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Pages 549-598

**JANUARY 1978** 

# AERONAUTICAL ENGINEERING

A SPECIAL BIBLIOGRAPHY

WITH INDEXES

Supplement 91

**JANUARY 1978** 

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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## AERONAUTICAL ENGINEERING

## A Special Bibliography

## **Supplement 91**

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 December 1977 in

- Scientific and Technical Aerospace Reports (STAR)
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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. Since that time, monthly supplements have been issued

This supplement to Aeronautical Engineering -- A Special Bibliography (NASA SP-7037) lists 359 reports, journal articles, and other documents originally announced in December 1977 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 lt 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

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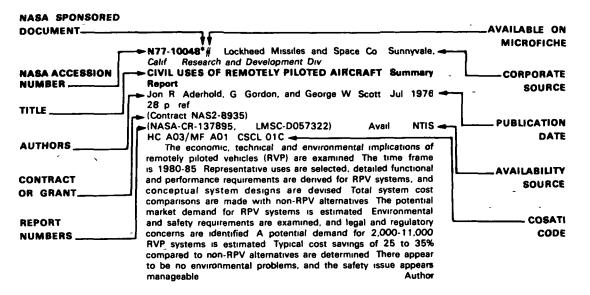
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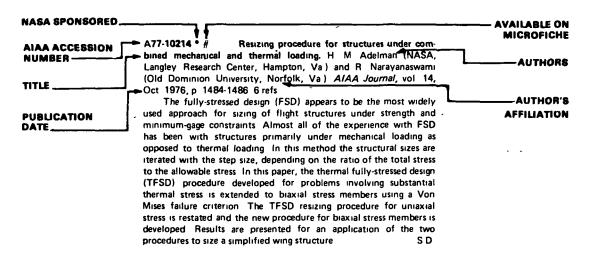
## **TABLE OF CONTENTS**

AA Entries	549
STAR Entries	577
Subject Index	A-1
Personal Author Index	B-1
Contract Number Index	C-1

## TYPICAL CITATION AND ABSTRACT FROM STAR



## TYPICAL CITATION AND ABSTRACT FROM IAA



## AERONAUTICAL ENGINEERING

A Special Bibliography (Suppl. 91)

### **JANUARY 1978**

## IAA ENTRIES

A77-47979 The new airport radar systems L Kroll (Bundesanstalt fur Flugsicherung, Frankfurt am Main, West Germany) Airport Forum, vol 7, Aug 1977, p 109, 110, 113 (9 ff) In English and German

The design of airport radar systems is discussed, and the characteristics of commercially available transmitters, antennae and receivers are assessed Features of automated aircraft detection and tracking systems, such as digital moving target indication, crystal-controlled frequency generation, frequency diversity operation, multiple stacking and dual beam antennae, are described Fully coherent radar systems giving very good subclutter visibility, as well as systems working with L and C-bands, are considered Advanced concepts of airport radar design under development, including antennae with adaptive controls, clutter-controlled signal processing techniques, multiple excitation antennae, and variable combination reception beams, are also mentioned JMB

A77-47980 Reducing walking distances at existing air ports J P Braaksma (Carleton University, Ottawa, Canada) *Airport Forum*, vol 7, Aug 1977 p 135 138, 141, 142 In English and German National Research Council of Canada Grant No A 8927

Appropriate gate allocation to shorten walking distances for passengers at airport terminals is proposed, with the emphasis on making the most effective use of existing facilities. An analysis of gate allocation procedures at a terminal of the Toronto, Canada International Airport over a period of several years was performed, various categories of passenger flow, such as arriving, departing, domestic, foreign and transferring were studied. It was found that the average walking distance for passengers could be reduced by as much as 57% through effective management of gate scheduling Maximum walking distances established by the reference manual of the International Air Transport Association are also discussed

JMB

A77-47999 Detail design aspects of a helicopter transmission system V A B Rogers In Detail design, Proceedings of the Conference, Keele, Staffs, England, April 3, 4, 1975

London and New York, Mechanical Engineering Publications, Ltd., Institution of Mechanical Engineers, 1976, p 55-57

The introduction outlines the various components that make up a helicopter transmission, tracing the path of power from the engines to main and tail rotors and describing briefly the task of each member A brief description is given of the dynamic issues that have to be considered leading to a summary of the major dynamic forces imposed on those members. The main text selects for detailed description, various mechanical components which, whilst not peculiar to helicopter design, are less common in other fields of mechanical engineering, (e.g., The Main Free-wheels, Shafts, Couplings and Tail Shaft Disconnect Coupling). The design parameters results from Development Tests (Problems encountered together with solutions are also given) Finally, in a more general manner, the steps taken to ensure maximum life and reliability of the components is outlined (Author)

A77 48000 Detail design in aircraft S J Swadling (British Aircraft Corp., Ltd., Filton, Bristol, England) In Detail design, Proceedings of the Conference, Keele, Staffs, England, April 3, 4, 1975 London and New York, Mechanical Engineering Publications, Ltd., Institution of Mechanical Engineers, 1976, p. 63 72

An examination is conducted of some of the problems encountered in the structural areas of design. The characteristics of the problems and the approaches adopted to solve them are illustrated with the aid of examples related to the design of the engine air intakes of Concorde Attention is given to design guides, ground rules, design loadings, design allowables and design factors, the forward sidewall assembly, the forward bottom corner, the frame corner problem, the joint between forward and aft structures, a typical frame, and the sidewall link assembly GR

A77-48001 Some detail design problems in aircraft gas turbines L Haworth In Detail design, Proceedings of the Con ference, Keele, Staffs, England, April 3, 4, 1975

London and New York, Mechanical Engineering Publications, Ltd , Institution of Mechanical Engineers, 1976, p 86-93

Approaches used in detail design procedures to improve the life of a component in aircraft gas turbines are illustrated with the aid of four examples. In the case of problems associated with thermal expansion, an oval bolt which permits free relative expansion of the flanges without loss of accuracy of location was employed. In another example difficulties in connection with an apparently simple stud were experienced and had to be overcome by various means Attention is also given to problems related to the introduction of the long root turbine blade and difficulties concerning a turbine shaft assembly.

A77-48054 ", Heat transfer at the critical point of a cylinder during intensive blowing (Teploobmen v kriticheskoi tochke tsilindra pri intensivnom vduve) B N Baskarev, V P Motulevich, and E D Sergievskii (Gosudarstvennyi Nauchno Issledovatel'skii Energeticheskii Institut, Moscow, USSR) Inzhenerno-Fizicheskii Zhurnal, vol 33, July 1977, p 5-10 8 refs In Russian

Heat transfer at the frontal critical point of a porous cylinder in transverse flow with intensive blowing of helium, nitrogen, and carbon dioxide gas was investigated Experiments were conducted in a subsonic wind tunnel with the application of thermoanemometric and interferometric methods in the following parameter range freestream velocity = 2 65 6 75 m/sec (Re = 3,007,500), tempera ture = 400 500 K, and blowing intensity F = 0.0 48 Agreement with calculated values of heat transfer was satisfactory in the moderate blowing range Under strong blowing of nitrogen and carbon dioxide there occurred loss of stability of laminar flow in the frontal region and some increase in heat transfer PTH

A77-48174 The effect of drop size on emissions from the primary zone of a gas turbine type combustor R W Anderson, P B Patil, J Chin, J A Nicholls, W Mirsky, and V Lyons (Michigan

University, Ann Arbor, Mich ) In Symposium on Combustion (International), 16th, Cambridge, Mass , August 15-20, 1976, Proceedings Pittsburgh, Pa , Combustion Institute, 1977, p 265-274, Comments, p 274, 275 8 refs US Environmental Protection Agency Grant No R-802925

An experimental gas turbine combustor designed to permit independent controlled variation of fuel droplet size, local equivalence ratio, inlet air temperature, combustor pressure, residence time and recirculation is used to study the processes of liquid fuel combustion and pollutant generation. The combustor is capable of producing a stable flame without a physical flame holder, allowing for a more accurate approximation of actual combustion processes A variety of mean fuel droplet diameters and primary zone equivalence ratios were employed in obtaining pollutant emission samples. In general, it is found that as droplet size increases, the level of unburned hydrocarbons and the mean value of NO concentrations decrease, while the CO level at the point of sampling increases An analysis of droplet sizes in the fuel atomization is also given. J M B

A77-48181 Aerodynamic and thermodynamic characteristics of kerosene-spray flames E E Khalil and J H Whitelaw (Imperial College of Science and Technology, London, England) In Symposium on Combustion (International), 16th, Cambridge, Mass, August 15-20, 1976, Proceedings Pittsburgh, Pa, Combustion Institute, 1977, p 569-575, Comments, p 576 17 refs Research supported by the Atomic Energy Research Establishment

Experiments measuring velocity, turbulence, mean and fluctu ating temperatures and droplet concentration in vertical kerosene spray flames burning in the atmosphere were conducted with the aim of testing numerical methods that employ models for droplet combustion to describe gaseous flames. Velocity, turbulence intensity and droplet concentration readings were obtained with a laser anemometer operating in forward scatter, mean and fluctuating temperatures were obtained with platinum rhodium thermocouple wires. Results suggest that a significant shortening of the flame length occurs as the droplet size is decreased from a Sauter mean diameter of 100 microns to 45 microns. The calculated values for the length of a gaseous flame do not appear to provide good approximations for this behavior.

A77-48240 \* Direct-connect tests of hydrogen-fueled super sonic combustors P J Waltrup, G L Dugger, F S Billig, and R C Orth (Johns Hopkins University, Laurel, Md) In Symposium on Combustion (International), 16th, Cambridge, Mass, August 15-20, 1976, Proceedings Pittsburgh, Pa, Combustion Institute, 1977, p 1619-1629 8 refs NASA-supported research

Direct-connect tests of hydrogen-fueled supersonic combustors were performed using arc-heated air at combustor inlet Mach numbers of 2.9 to 3.2 Various axisymmetric combustor geometries of 5.89 and 6.96 cm (inner diameter) inlet were investigated, the fuel was injected from the wall either from a ring of equally spaced holes normal to the air stream, or from a circumferential slot oriented 45 deg downstream. The hole-type injectors consistently gave better results. The effects of various parameters are examined, and the performance comparison procedure is described. A theoretical model of the supersonic combustion process which includes a pre combustion shock-compression is used to explain the character of the observed pressure distributions and to assess the effects of the measured heat transfer rates, deduced wall shear, and combustor geometry on performance. ML

A77-48241 Combustion considerations for future jet fuels W S Blazowski (USAF, Aero Propulsion Laboratory, Wright-Patterson AFB, Ohio) In Symposium on Combustion (Inter national), 16th, Cambridge, Mass, August 15-20, 1976, Proceedings Pittsburgh, Pa, Combustion Institute, 1977, p 1631-1638, Comments, p 1638, 1639 14 refs

The effects of fuel hydrogen and nitrogen content have been studied using a T56 combustor rig Increases of combustor liner temperature with decreased fuel hydrogen content were found to be substantial A new nondimensional temperature parameter which provides a means of correlating results for combustors having rich primary zones designs is presented Limited data for new low-smoke lean designs indicate much less sensitivity of combustor liner temperature to fuel hydrogen content. Although smoke emission increased with decreased hydrogen content, gaseous exhaust emissions were unchanged. The conversion of fuel bound nitrogen to NOx under practical aircraft combustion conditions is described, and recommendations for alternate jet fuel combustion efforts are summarized. ML

A77-48252 New air traffic control communications and data systems (Neue FS-Kommunikations- und Datensysteme) G D Priewe (Luft- und Raumfahrttechnik, Berlin, West Germany) Nachrichten Elektronik, vol 31, Aug 1977, p 222-224 In German

Suitable display units for air traffic control operations are examined, taking into account a device developed by a German company for air traffic-control applications in the 1980s. The modular display unit considered has the capability to collect, process, and display synthetic radar image data. Attention is given to the general requirements which have to be satisfied by a display unit employed in air traffic control operations, the configuration and function of the display system, the control section as central unit of the display device, the characteristics of the employed mini-computer, and the properties of suitable devices for a display in color.

A77-48289 # Non-equilibrium flow of an inviscid gas past a thin profile D Homentcovschi (Bucuresti, Institutul Politehnic, Bucharest, Rumania) Zeitschrift für angewandte Mathematik und Mechanik, vol 57, Aug 1977, p 461-469 7 refs

This paper considers the steady and linearized motion of a non-equilibrium inviscid gas past a thin profile. The form in distributions of the equations of the aerodynamics is used. For the symmetrical profile the problem is completely solved. For the case of the profile without thickness the problem calls for a separate consideration of the completely subsonic, intermediate and completely supersonic regimes respectively. In the first two cases the determination of the function n(x) reduces to the resolution of a Fredholm type regular integral equation of the second species. The paper gives the asymptotic solution of the problem for high values of relaxation time. For the case of the completely supersonic regime the problem is solved to the end. The motion of a fluid over a wall is also analysed.

A77-48290 # The role of the boundary layer in supersonic pressure perturbations along a weak wavy wall (Das Druckstorungsfeld im Uberschall langs einer schwach welligen Wand unter Berucksichtigung der Grenzschicht) H. W Stock (Dornier GmbH, Friedrichshafen, West Germany) Zeitschrift für angewandte Mathematik und Mechanik, vol 57, Aug 1977, p 471-476 10 refs In German

Pressure perturbations, generated by a wavy wall in supersonic flow, are calculated by the linearized small perturbation theory including boundary layer effects. The boundary layer is divided in an inviscid, rotational outer layer and a viscous sublayer. Laminar and turbulent boundary layers are investigated. The pressure perturbations, i.e., their amplitude and phase position, are related to those evaluated by the inviscid theory. It is shown that the influence of the boundary layer can be neglected, if the wavelength of the wavy wall is much larger than the boundary layer thickness. For smaller wavelengths the boundary layer has a damping effect on the outer flow, i.e., the amplitudes of the pressure perturbations are smaller than those for the inviscid case. Especially for laminar boundary layers and smaller wavelengths of the wavy wall the pressure perturbations close to the wall exhibit a subsonic character, although the outer flow is supersonic (Author)

A77-48362 # L-band antenna for aircraft-to-satellite communications E Hormann, D Lovis, and R Reitzig (Siemens AG, Munich, West Germany) In European Microwave Conference, 6th, Rome, Italy, September 14-17, 1976, Proceedings

Sevenoaks, Kent, England, Microwave Exhibitions and Publishers, Ltd., 1976, p. 288 291

An L-band aircraft transmit/receive antenna for the future Aerosat system is proposed. It consists of two identical phasescanned four-spiral antenna arrays mounted laterally on either side of the upper area of the aircraft body. The fan-beam is pointed in 10 different angular directions such as to satisfy the 4 dBi minimum gain coverage in the field-of-view 10 deg above horizon. The antenna mounts flush with the skin cutout between two stringers and frames in aircraft with transoceanic capability. The coverage performance of the antenna is demonstrated theoretically and experimentally.

(Author)

A77-48377 # Surface roughness measurements by using lowresolution FM-CW radar altimeters S R J Axelsson (Saab-Scania AB, Linkoping, Sweden) In European Microwave Conference, 6th, Rome, Italy, September 14-17, 1976, Proceedings

Sevenoaks, Kent, England, Microwave Exhibitions and Publishers, Ltd., 1976, p. 389-393 6 refs. Research supported by the Svenska Rymdaktiebolaget

When a radar altimeter is used over a rough ground surface, a noise component is added to the output signal. The mean deviation of the noise mainly depends on the range spread of the reflectors located within the antenna beam. The close relationship between noise and range spread can be used to estimate the height of surface roughnesses by low-resolution radar altimetry. Experimental results compare favorably with theoretical predictions. (Author)

A77-48378 # A method to reduce the need for large antennas in Microwave Landing Systems /MLS/ B Forssell (ELAB, Trondheim, Norway) In European Microwave Conference, 6th, Rome, Italy, September 14 17, 1976, Proceedings

Sevenoaks, Kent, England, Microwave Exhibitions and Publishers, Ltd , 1976, p. 394-398

The replacement of the present Instrument Landing System (ILS) by the new Microwave Landing System (MLS) which is supposed to begin about 1980 is caused by increasing requirements for capacity, accuracy and coverage which ILS cannot meet A method to obtain good performance with relatively small antennas is to utilize a larger bandwidth for the transfer of signals as space and frequency are interrelated quantities. The transmitted signals are then modulated with a frequency much higher than the information bandwidth and demodulated in the receiver. In this way, a compressed pulse (for pulsed signals) or an efficient delay discrimination (for continuous signals) can be obtained by means of a correlating receiver. By exploiting the whole frequency band allocated for MLS use at C-band, the angle measurement accuracy can be improved as much as 20-80 times.

A77-48411 Civil and military air traffic in France Management and compatibility J R Bauchet (EUROCONTROL, Nord Regional Centre, Bretigny-sur-Orge, Essonne, France) Eurocontrol, Mar 1977, p 3-9 Translation

The French system of air traffic classification is described with regard to general air traffic (such as public transportation) and operational air traffic (such as military aircraft), and the co ordination between the respective controllers Attention is given to dialogue procedures between civil and military controllers via a computer system known as STRIDA-CAUTRA, handling flight particular for the purpose of determining control clearances SCS

A77-48412 The transfer of the German North MATRAC to the EUROCONTROL Centre of Maastricht M A Woods (EUROCONTROL, Computers, Programming and Processing Div, Brussels, Belgium) Eurocontrol, Mar 1977, p 10-19

The German North Military Air Traffic Radar Control Centre (MATRAC) was transferred to the Maastricht Centre in 1975 in order to increase the capacity and flexibility of air traffic services The operational concept is outlined with regard to the area of rcsponsibility, aiispace structure, and method of control and sectorization Principal components of MATRAC procedures, hard ware, and software are described including radio telephone inter communication systems, the main computer complex, the peripheral computer complex, operator input and display subsystem, processing systems, and civil-military coordination SCCS

A77 48413 EUROCONTROL and radar E Morgan (EUROCONTROL Radar and Data Handling Div, Brussels, Bel gium) Eurocontrol, Mar 1977 p 20 28 14 refs

EUROCONTROL has implemented radar systems for automated air traffic control in Maastricht, Netherlands, Shannon, Ireland, and Karlsruhe Federal Republic of Germany The primary elements of the radar chains are described including (1) radar data display, such as the operator input device and display system, (2) the radar data processing system consisting of reception, processing, and transmission and (3) the data acquisition system, with primary and secondary surveillance radar heads, and digital extractor and data transplission systems. Equipment and procedules are being devised for the evaluation of the radar chain in terms of continuity of radar positional information, information accuracy monitoring, and control of unwanted and/or confusing information Studies for the future development of radar technology include the implementation of radar automatic failure and alignment detectors, and the ap plication of color to the display system SCS

A77 48414 Aircraft trajectories from radar extrapolations to long term prediction A Benoit, S Swierstra (EUROCONTROL, Navigation Systems Div, Biussels, Belgium), and J Storey (EURO CONTROL, Programming and Analysis Div, Bietigny sur Orge, Essonne, France) Eurocontrol, Mar 1977, p. 29 41

Methods are proposed for predicting aircraft trajectory using radar extrapolations and making the results available to the control function. The primary stages are: (1) utilization of available control. cente data and radar information, (2) introduction of additional data without the need for additional on line communications, and (3) generation and/or collection of data not available to the control for transfer to the computer trajectory module, forming a long term trajectory prediction system for the purpose of traffic management An accuracy analysis has been conducted on a test sample of thirteen commonly used aircraft to determine degree of prediction error, to compare the three methods proposed, and to evaluate the limitation of radar extrapolation. Applications have been made to a series of actual flights for trajectory prediction, techniques for prediction a third constoring and updating have been derived, and areas for finule research have been identified SCS

A77 48415 Air traffic control and the initial operation of superscinic transport aircraft. A review of preparatory measures H Schmid (EUROCONTROL, Operational and Requirements Div, Brussels, Belgium). *Eurocontrol*, Mar 1977, p. 42 45

A77-48416 Austria's role in international civil aviation M Halbmayer (Ministry of Transport, Vienna, Austria) *Eurocontrol*, Mar 1977, p. 46-53 Translation

The history of the Austrian civil aviation industry is discussed with reference to (1) the development of the industry both before and after the First World War, (2) air transport, including the establishment of the Osterreichische Luftverkehrs AG, (3) airports and air traffic control prior to 1938, (4) the beginning of the Austrian Airlines, and (5) current studies for partial restructuring and automation of air traffic control, and the development of a modern airspace surveillance system SCS

A77-48474 Rationalization of the European air net S Gordon (Simat, Helliesen and Eichner, Inc., Newton Centre, Mass.) and R de Neufville (MIT, Cambridge, Mass.) *Transportation Research*, vol 11, Aug 1977, p 235 244 30 refs Research supported by the University of California and Massachusetts Institute of Technology, U.S. Department of Transportation Grant No OS-5023947

This paper investigates the question of whether it might be possible to rationalize, that is to increase the quality of service for a given cost, the airline network within Europe Various policy analysts have suggested that significant benefits might be achieved along these lines if the Common Market were to reduce the bilateral restrictions on European airlines. Our conclusion is that this is not the case A main interest of this paper should be the approaches we propose for analyzing transport nets. First, we argue that, when one considers the multidimensional output of scheduled service, we should recognize that economies of scale do exist even for transport modes which are ordinarily not thought to have this characteristic This provides an important motivation for concentration of services, as does in fact exist. Second, we propose a measure of network connectivity which takes into account the intensity of connections between the nodes. This measure permits a much more precise discussion of the nature of any transportation network (Author)

A77-48480 Space-based solar power study near completion B M Elson Aviation Week and Space Technology, vol 107, Sept 19, 1977, p 58, 59, 62-65, 68, 69

The concept of solar power systems is discussed with regard to potential energy conversion schemes Two such systems have been found to be equally effective for the project (1) photovoltaic devices (solar cells) which would convert sunlight directly into electricity by means of solar cell arrays scaled at about 100 sq km for a 10 GW output at the busbars on the ground, and (2) thermal engines (two versions of which are feasible at the present time, the closed Brayton cycle using helium as the working fluid, and the potassium vapor Rankine cycle) which would convert sunlight into electricity via turbomachinery rather than solar cells Satellite construction techniques, cost evaluation, and flight experimentation are reviewed SCS

A77-48513 # The aerodynamic noise of gliders (Issledovanie aerodinamicheskogo shuma planerov) E V Vlasov and V F Samokhin Akusticheskii Zhurnal, vol 23, July-Aug 1977, p 550-556 8 refs In Russian

The noise caused by air flowing around KAI-12 or L 13 sport gliders was studied with attention to the intensity, spectral composition, and directional pattern. The dependence of aerodynamic flow noise on the flight regime and the positions of the flaps and wing interceptors was investigated. The basic causes of the noise were examined. M L

A77-48515 # Aerodynamic effects during supersonic flow past a laser beam (Aerodinamicheskie iavleniia pri sverkhzvukovom obtekanii lazernogo lucha) V A Belokon', O V Rudenko, and R V Khokhlov (Moskovskii Gosudarstvennyi Universitet, Moscow, USSR) Akusticheskii Zhurnal, vol 23, July-Aug 1977, p 632-634 In Russian

Supersonic flow past a laser beam is studied. In an analogous situation, modulated light causes acoustic perturbations in a resting absorbing medium. In the case of flow past a laser, effects occur without modulation since variability is obtained at the time of heating as a consequence of displacements in the medium. The paper is concerned with a one-dimensional gas flow passing through an immobile heated region which has the form of a normal cylinder extending infinitely. The reduction of light intensity is assumed to be small in the heated region. A mathematical analysis of this system is provided.

A77-48632 # Investigation of the state of dynamic stress and the influence of service time on the fatigue strength of turbine rotor blades of aircraft gas-turbine engines (Issledovanie dinamicheskoi napriazhennosti i vlinania ekspluatatsionnoi narabotki na ustalostnuju prochnost' rabochikh lopatok turbin AGTD) lu S Nalimov (Akademiia Nauk Ukrainskoi SSR, Institut Problem Proch nosti, Kiev, Ukrainian SSR) Problemy Prochnosti, Aug 1977, p 34-37 6 refs In Russian A77-48686 Simulation of traffic loading for approach and landing systems with statistical interrogation (Simulation der Ver kehrsbelastung bei Anflug- und Landesystemen mit statistischer Abfrage) W Skupin and R Ullrich (Braunschweig, Technische Universität, Braunschweig, West Germany) *Frequenz*, vol 31, Aug 1977, p. 246-253. In German

In evaluating an approach and landing system with statistical interlogation the total air traffic that influences the reply probability and impassment accuracy of the system must be taken into account. On the basis of a traffic model in which the possibility of interference between the replies in different channels of a given frequency is taken into account, the traffic loading is modeled by statistical generators that simulate interference due to same channel interrogation (pulse overlapping, blocking of the ground station), foreign channel interrogation, and foreign channel reply. A complete simulation facility is defined. Some preliminary results on using this taulity on a model of the distance measuring equipment based landing system for the case of single-channel operation are presented.

A77-48689 Avionics first principles II - Airborne radars M Hirst Flight International, vol. 112, Sept. 3, 1977, p. 695-699

A review is presented of the major advances in airborne radar technology including (1) development of microwave-emitting radars made possible by the discovery of the magnetron, (2) planar-array and cassegrain antennas which supersede the traditional dish antenna in many applications, (3) the travelling-wave tube, (4) developments in receiver electronics technology, and (5) electronic display technology. Several areas of current research are identified, such as electronic countermeasure resistance, antenna component miniaturization, and various types of reconnaissance radar systems. S C S

A77-48693 Design of nonlinear automatic flight control systems W L Garrard (Minnesota, University, Minneapolis, Minn ) and J M Jordan (US Army, Missile Command, Redstone Arsenal, Ala) *Automatica*, vol 13, Sept 1977, p 497 505 16 refs

A method for the synthesis of nonlinear automatic flight control systems is developed, and the performance of a control system synthesized by use of this method is compared to the performance of control system designed by use of linear quadratic optimal control theory Comparisons are made on the basis of aircraft dynamic response at high angles of attack. It is found that the nonlinear controller reduces the altitude loss during stall and increases the magnitude of the angle of attack for which the aircraft can recover from stall (Author)

A77-48698 # New lidar concept for measuring the slant range transmission in aircraft landing approaches R H Kohl (Tennessee, University, Tullahoma, Tenn) American Meteorological Society, Optical Society of America, and NASA Langley Research Center, International Laser Radar Conference on Laser Atmospheric Studies, 8th, Drexel University, Philadelphia, Pa, June 6-9, 1977, Paper 11 p

The single-scatter, single-wavelength, scalar-backscatter lidar equation is investigated to determine the transmission along a line from a point on the ground to what is known as the decision point on the 3 degree aircraft glide slope. It may be applied in aircraft landing approaches for measuring the slant range transmission. S C S

A77-48709 Alternate fuels for future aircraft G D Brewer (Lockheed-California Co., Burbank, Calif.) In Intersociety Energy Conversion Engineering Conference, 12th, Washington, D.C., August 28-September 2, 1977, Proceedings Volume 1

La Grange Park, III, American Nuclear Society, Inc., 1977, p. 62-68. 10 refs

The paper mentions some results of comparisons of the applicability of liquid hydrogen-fueled aircraft of the future and equivalent aircraft fueled with Jet A Liquid hydrogen-fueled aircraft show clear superiority stemming from better lift to-drag ratio in cruise and the specific fuel consumption realized during cruise. These advantages are retained when supersonic transport aircraft are

considered as well. At the moment, studies indicate that it would cost more to build and operate a hydrogen-fueled fleet than a fleet fueled with synthetic Jet A, but if one takes into account projected improvements in the production process for liquid hydrogen (hydrogen gasification) and for synthetic Jet A, the LH2-fueled aircraft comes out ahead PTH

A77-48819 \* The liquid hydrogen option for the subsonic transport - A status report P F Korycinski (NASA, Langley Research Center, Hampton, Va) In Intersociety Energy Conversion Engineering Conference, 12th, Washington, D C, August 28-September 2, 1977, Proceedings Volume 1 La Grange Park, III, American Nuclear Society, Inc, 1977, p 964-972 22 refs

Studies dealing with the use of liquid hydrogen for fuel in subsonic air transport systems are reviewed. Topics of the studies include the possibility for economical production of hydrogen, the problems associated with the efficient liquefaction of the gas, the development of insulation materials and materials for long-lasting liquid hydrogen fuel tanks, the difficulties related to fueling processes and the installation of liquid hydrogen fuel stations at major air terminals, an assessment of the hazards connected with liquid hydrogen fuels, and the engineering and design problems involved in incorporating liquid hydrogen fuel systems into large subsonic passenger aircraft.

<u>A77-48898</u> \* Experimental data and theoretical analysis of an operating 100 kW wind turbine B S Linscott, J Glasgow (NASA, Lewis Research Center, Cleveland, Ohio), W D Anderson, and R E Donham (Lockheed California Co, Burbank, Calif) In Intersociety Energy Conversion Engineering Conference, 12th, Washington, D C, August 28-September 2, 1977, Proceedings. Volume 2 La Grange Park, III, American Nuclear Society,

Inc , 1977, p 1633-1650 8 refs Contract No NAS3-20036

Part of the cooperative effort between NASA and ERDA has been the design and the erection of an experimental wind turbine by the NASA-Lewis Research Center This 100 kW turbine, designated the Mod-O, is located at the NASA Plum Brook site near Sandusky, Ohio Experimental test data have been correlated with analyses of turbine loads and complete system behavior of the 100 kW Mod-O wind turbine generator over a broad range of steady state conditions, as well as during transient conditions. The deficit in the ambient wind field due to the upwind tower turbine support structure was found to be very significant in exciting higher harmonic loads associated with the flapping response of the blade in bending

#### (Author)

A77-48899 Fluid dynamics of diffuser augmented wind turbines B L Gilbert, R A Oman, and K M Foreman (Grumman Aerospace Fluid Dynamics Laboratory, Bethpage, N Y ) In Intersociety Energy Conversion Engineering Conference, 12th, Washington, D C, August 28-September 2, 1977, Proceedings Volume 2 La Grange Park, III, American Nuclear Society, Inc., 1977, p. 1651-1659 6 refs Contract No E(11-1)- 2616

The Diffuser Augmented Wind Turbine (DAWT) is one of the advanced concepts being investigated to improve the economics of wind energy conversion systems (WECS) Application of modern boundary layer control techniques has reduced the surface area requirements of an efficient diffuser by an order of magnitude. Many parameters that effect the performance of the diffuser system have been examined in small scale wind tunnel tests with a family of compact diffusers, using screens and centerbodies to simulate the presence of a turbine Flow field surveys, overall performance, the effect of ground proximity, and the prospects for further improve ment are described. The baseline configuration is a conical, 60 deg included angle diffuser with an area ratio of 2 78 controlled by two tangential injection slots. This first generation DAWT can provide about twice the power of a conventional WECS with the same turbine diameter and wind Economic estimates show that this DAWT can be as much as 50% cheaper than conventional WECS for the same rated power (Author)

A77-49180 \* Aeroelastic stability of complete rotors with application to a teetering rotor in forward flight J Shamie and P Friedmann (California, University, Los Angeles, Calif) Journal of Sound and Vibration, vol 53, Aug 22, 1977, p 559-584 23 refs Grant No NGR-05-007-414

The derivation of a set of non-linear coupled flap-lag-torsion equations of motion for moderately large deflections of an elastic; two-bladed teetering helicopter rotor in forward flight is concisely outlined The following degrees of freedom are included in the mathematical model rigid body flapping, rigid body lead-lag, elastic bending in flap and lead-lag, blade root torsion, and shaft torsion Quasi-steady aerodynamic loads are considered and the effects of reversed flow are included The aeroelastic stability of the complete rotor is investigated by using a linearized system of equations of motion The equilibrium position about which the equations are linearized is obtained by considering the trim state of the helicopter, in true or simulated forward flight conditions. The sensitivity of the aeroelastic stability boundaries to interblade structural and mechanical coupling is illustrated by comparing the complete rotor stability boundaries with those obtained from a single blade analysis for a number of hover and forward flight cases (Author)

A77-49224 A new high-brightness, all-weather, ASDE /Airport Surface Detection Equipment/ A G L M Weijts (Hollandse Signaalapparaten, Hengelo, Netherlands) The Controller, vol 16, Aug 1977, p 27-29

The Airport Surface Detection Equipment (ASDE) is described including a list of system requirements and operational considerations. The system's main technological components include an antenna system with a turning speed of 60 rpm, transmitter/ receivers, digital scan converters, and bright displays Discussed in greater detail is the digital scan converter memory which consists of 896 x 896 memory cells subdivided into 49 blocks, and four special controls which may be used to (1) freeze the displayed picture, (2) invert the displayed picture, (3) test the operability of the display system, and (4) control the luminance of the display The ASDE radar frequency has been selected as the optimum compromise between parameters necessary for adverse weather conditions and antenna size necessary for high resolution SCS

A77-49225 Convex 76 - Aircraft noise and air traffic control T S Johnston (Guild of Air Traffic Control Officers, London, England) The Controller, vol 16, Aug 1977, p 29-31

It is suggested that most noise abatement programs impair the efficient use of aircraft, decrease flexibility of operation, and require aircraft to operate below optimum performance. Operational restrictions are listed, including minimum noise routings, use of reduced thrust on take-off, and power cutback on climb-outs. Minimum noise routes are described with regard to problems incurred in take-off and landing stages, and proposals by the National Air Traffic Services, the Civil Aviation Authority, and the Guild of Air Traffic Control Officers are reviewed.

A77-49244 # Unsteady Oseen flow around a flat-plate airfoil S Murata, Y Miyake, and Y Tsujimoto (Osaka University, Suita, Japan) JSME, Bulletin, vol 20, July 1977, p 819-826 10 refs

The viscous flow around a flat plate making small unsteady motion in a uniform flow is analized on the basis of Oseen's equation. The exact elementary solutions of the basic equations in the cases that concentrated force acts at the origin parallel and perpendicular to the uniform flow are presented at first. These solutions yield the fundamental structure of each case. The solutions are applied to the problems of plunging motion of a flat plate and of oscillation parallel to itself. Substantial understanding was obtained from the interpretation of the calculated results concerning the effects of viscosity of the fluid on the unsteady forces of a flat plate (Author).

A77-49340 # Stability of the pilot aircraft system in maneuvering flight J R Broussard and R F Stengel (Analytic Sciences

Corp , Reading, Mass ) (Annual Conference on Manual Control, 12th, Urbana, III , May 25-27, 1976 ) Journal of Aircraft, vol 14, Oct 1977, p 959-965 9 refs Contract No N00014-75-C-9432

A control-theoretic pilot model is incorporated in the analysis of pilot-aircraft motions during maneuvers. The pilot model is found to be of value for the definition of maneuvering flight stability boundaries, and it simulates pilot control actions during a representative task with reasonable fidelity. The model also is used to demonstrate the consequences of improperly adapted pilot response strategy. It is concluded that the pilot model presented here provides important capabilities for evaluation of flying qualities and for identifying proper piloting procedures during difficult maneuvers

(Author)

A77-49341 # Computer simulation of light aircraft crash R J Melosh (MARC Analysis Research Corp., Palo Alto, Calif.) and M P Kamat (Virginia Polytechnic Institute and State University, Blacksburg, Va.) Journal of Aircraft, vol. 14, Oct. 1977, p 1009-1014 7 refs

A skeletal aircraft model capable of reflecting material yielding and large geometry changes is used in a computer prediction of the post impact response of a general aviation aircraft. The threedimensional stiffness-equivalent truss model is monitored from the time of first runway contact through structural translation, rotation, bending and ovalation. Results indicate that post-impact response may be divided into three stages, of which the rebound phase is the most severe in terms of passenger trauma, peak acceleration, and structural plastic work dissipation. Furthermore, it appears that the primary energy-dissipation mechanism is friction between the air plane and the runway, plastic work consumes less than 3% of the touchdown kinetic energy. J M B

A77-49342 # Documentation of the feasibility research on a destructible parachute W B Pepper and R J Buxton (Sandia Laboratories, Albuquerque, N Mex.) Journal of Aircraft, vol 14, Oct 1977, p 1015-1017 ERDA-supported research

A flammable impregnating mixture which was developed to promote disintegration of a nylon parachute after the deceleration phase of a drop is described. It was specified that the parachute be capable of decelerating a 37 2-1b terradynamic penetration store from maximum release speeds of 550 knots at an altitude of approximately 250 ft above the terrain Mixture proportions for the impregnating agent, which contained the elastomer Viton A, magnesium particles and TNT, are given Drop tests of the 4 ft diameter ribbon parachute are also reported. J M B

A77-49343 \* # Vortex lattice prediction of subsonic aerodynamics of hypersonic vehicle concepts J L Pittman and J L Dillon (NASA, Langley Research Center, High-Speed Aerodynamics Div, Hampton, Va) *Journal of Aircraft*, vol 14, Oct 1977, p 1017, 1018 5 refs

The vortex lattice method introduced by Lamar and Gloss (1975) was applied to the prediction of subsonic aerodynamic characteristics of hypersonic body wing configurations. The reliability of the method was assessed through comparison of the calculated and observed aerodynamic performances of two National Hypersonic Flight Research Facility craft at Mach 0.2. The in vestigation indicated that a vortex lattice model involving 120 or more panel elements can give good results for the lift and induced drag coefficients of the craft, as well as for the pitching moment at angles of attack below 10 to 15 deg. Automated processes for calculating the local slopes of mean-camber surfaces may also render the method suitable for use in preliminary design phases. J M B

A77-49344 # Performance of plain-type spoilers applied to the GA/W/-1 wing D H Neuhart (Douglas Aircraft Co, Long Beach, Calif) and R B Oetting (Missouri Rolla, University, Rolla, Mo) Journal of Aircraft, vol 14, Oct 1977, p 1019, 1020 6 refs

Plain-type solid spoilers were mounted on a finite aspect ratio GA/W/-1 wing in an experiment assessing the usefulness of spoilers as replacements for ailerons in flight path (direct lift) control Wind-tunnel tests of basic flap and wing performance at three flap settings

showed that high lift coefficients could be obtained by the spoiler-wing configuration. In addition, studies of the effect of spoiler deflection on pitching moment performance indicated that the device may be a useful aid to the pilot in the approach-to-landing phase. It is concluded that a 15%-chord spoiler with the hingeline located at the 85% chord position could provide good results in terms of lift, drag and pitching moment performance. J M B

A77-49345 # Calculation of vortex breakdown locations for flow over delta wings J D Wilson (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio) *Journal of Aircraft*, vol 14, Oct 1977, p 1020 1022 13 refs

Quasi-cylindrical approximations of the Navier-Stokes equations are employed to predict the location of breakdowns in strong vortices formed when leading-edge separation occurs on highly swept delta wings. It is assumed that the viscous rotational vortex core is confined to a narrow region and thus has negligible influence on the location and shape of the spiral vortex sheet arising from the wing leading edge. A potential flow model is used to supply the outer boundary conditions for the vortex core. Initial boundary conditions on the velocity profiles (or swirl parameter) are treated through correlation with solutions to the core model for a range of initial conditions. The results of the theoretical calculations are confirmed by previously reported experimental observations of vortex break down locations. J M B

A77-49346 # Lightning-hazard assessment - A first-pass probabilistic model L McKague (General Dynamics Corp., Fort Worth, Tex.) Journal of Aircraft, vol 14, Oct 1977, p 1022-1024 9 refs

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A model for analyzing and predicting aircraft lightning hazards is described. The model takes into account three basic factors in calculating the frequency with which a given type of aircraft will be struck by lightning a geometric factor, termed the effective receptor area, an environmental factor, which may be considered a measure of lightning flash density, and a service-related factor, which defines the probability of encountering lightning under a specified set of operating conditions. The relative probabilities associated with lightning strikes to various parts of an airplane (radome, wingtip, fuselage, etc.) are also given. The model yields results that compare well with existing data on lightning strike frequency, suggesting that it could be a useful design tool. J M B

A77-49374 # Some regularities of the wearing of fuel pump plunger spheres (Nekotorye zakonomernosti protsessov iznosa sfer plunzherov toplivnykh nasosov) I G Nosovskii and V M Levchenko (Vysshee Inzhenerno-Aviatsionnoe Voennoe Uchilishche VVS, Kiev, Ukrainian SSR) Akademiia Nauk Uzbekskoi SSR, Doklady, no 6, 1977, p 23-25 5 refs In Russian,

An experimental procedure for determining the slippage rate between the working surfaces of a plunger sphere and an inclined washer in fuel pumps is explained. Slippage rates were determined for various washer inclination angles and rotor speeds at a constant exit pressure. The damage to sphere surface resulting from pitting by metal particles or from plastic deformation is described.

A77-49473 # The need for improved aircraft crashworthiness design R C Tennyson (Toronto, University, Toronto, Canada) and J W Bird (Department of National Defence, Ottawa, Canada) (Canadian Aeronautics and Space Institute, Canadian Symposium on Recreational and New Generation Light Aircraft, 2nd, Toronto, Canada, Sept 13-15, 1976 ) Canadian Aeronautics and Space Journal, vol 23, Sept-Oct 1977, p 269 278

Canadian aircraft accident statistics for the period 1970-1974 are surveyed, with emphasis given to cases in which fuselage and cabin damage occurred Separation of aircraft into specific weight categories and division of accidents into several types allow for determination of the prevalent conditions and extent of damage incurred during various kinos of crashes. In particular, categories involving aircraft weights greater than 12,500 lb, less than 6,000 lb, or between 6 000 and 12,500 lb are used in the survey. Speed of the aircraft at impact is also assessed. Recommendations are made for improving crashworthiness design, especially in the lighter weight categories. J M B

A77-49564 The initial region of subsonic coaxial jets II A S H Kwan and N W M Ko (University of Hong Kong, Hong Kong) Journal of Fluid Mechanics, vol 82, Sept 7, 1977, p 273-287 16 refs Research supported by the University of Hong Kong

The phase relationships between the fluctuating pressure and the axial and radial velocity fluctuations in the initial region of coaxial jets were obtained from single- and two-point correlations. The phase relationships were measured on the core side and the entrainment side of the vortices and in the mixing region. The phase relationships obtained in the coaxial jets agree with experimental results for single jets, indicating that the coherent structures in coaxial jets and in single jets are physically similar.

A77-49645 Acquisition of test compatible avionics - An updated approach J K Scully (Litton Systems, Inc., Woodland Hills, Calif ) In AUTOTESTCON '76, Proceedings of the Symposium, Arlington, Tex., November 10-12, 1976

New York, Institute of Electrical and Electronics Engineers, Inc., 1976, p. 143-150

Automated test technology forms an integral part of complex avionic systems, although many problems exist with regard to the system relationship between test compatibility (constraints, procedures, and equipment that will result in cost-effective maintenance of avionic systems) and airborne performance requirements. Three propositions are suggested to treat these problems (1) integration of test compatibility and airborne performance requirements within an incentive structure, (2) assignment of vertical design authority to the avionics unit design team, and (3) standardization of test systems to develop compatibility between avionics design, factory acceptance, and support levels SCS

#### A77-49651 # Some aspects of the development of air traffic of the Socialist States II (Einige Aspekte der Entwicklung des Luftverkehrs der sozialistischen Staaten II) A Kramer *Technisch*okonomische Information der zivilen Luftfahrt, vol 13, no 3, 1977, p 129-133 20 refs. In German

The increase in the volume of passenger traffic for the Socialist States in comparison to world air traffic levels during the considered period is related to various factors, including the development of the political relations between the involved states, their economic interrelation, and the technical advances in aircraft construction made, in particular, in the Soviet Union Tables are presented with data concerning the air traffic volume for different years and the various individual countries. The role of charter air transportation within the general air traffic is also examined, taking into account differences regarding the conditions in socialist and capitalist countries.

A77-49653 # Jakowlew Jak-42 - Uncomplicated, reliable, economical (Jakowlew Jak-42 - Unkompliziert, zuverlassig, wirtschaftlich) S lakovlev (O Konstruktorskoe Biuro lakovlev, USSR) (Grazhdanskaia Aviatsiia, no. 1, 1977.) Technisch-okonomische Information der zivilen Luftfahrt, vol 13, no 3, 1977, p. 146-150 In German, (Translation)

The Jak-42, which was designed for an employment on short-haul local routes in the Soviet Union, is to replace the Tu-134, IL-18, and An-24. The new airliner provides accommodations for 100 to 120 passengers Freight and mail can be carried in addition to the passengers and their baggage. The Jak 42 can carry a normal commercial payload of 10.5 tons over a distance of 1850 km at a speed of 820 km/hr. Attention is given to the takeoff and landing characteristics of the aircraft, aspects of wing design leading to a lowering of production costs, advances in the design of lift producing devices, aspects of aircraft control, problems of occkpit design, and

various approaches used to obtain a high level of reliability and a long operational life for the aircraft  $${\rm G}$\,{\rm R}$$ 

A77-49654 # The determination of the center-of-gravity position with the aid of dimensionless values (Ermittlung der Schwerpunktlage mit Hilfe dimensionsloser Werte) P Korreil (Gesellschaft für inteinationalen Flugverkehr mbH, Beilin, East Germany) Technisch-okonomische Information der zivilen Luftfahrt, vol 13, no 3, 1977, p 151 154 In German

The preservation of the given center-of gravity position is an essential condition for the stability and the control of an aircraft. The approaches used for the determination of the center of-gravity position are related to a use of balance cliarts, analytical studies, and investigations utilizing electronic computers. All procedures of center-of-gravity determination involve the summation of the individual moments with respect to a reference point and the determination of the lever arm with the aid of the known total weight. A description is presented of a computational procedure based on the IATA airport handling manual. The procedure avoids a use of negative moments. The center of gravity position in the procedure is determined from the dimensionless parameters. The adaptation of the considered procedure for applications involving interflug aircraft is discussed.

A77-49655 # The technical conception of the IL-62M Aerodynamic features (Die technische Konzeption der IL-62M -Aerodynamische Besonderheiten) G Muravev and V Egorov (O Konstruktorskoe Biuro Iliushin, USSR) (Grazhdanskaia Aviatsiia, no 10, 1976) Technisch-okonomische Information der zivilen Luftfahrt, vol 13, no 3, 1977, p 155-158 In German (Translation)

The aircraft IL-62M has, in comparison to the IL-62, a greater operational range and better takeoff and landing characteristics. The improvements are related to an employment of the D-30KU engine Differences of the new engine from the NK-8-4 engine of the IL-62 include lower fuel consumption rates, higher thrust values, and reduced noise levels at takeoff and landing operations. Additional flaps are used for the improvement of the lateral aircraft control in the low speed range. The general aerodynamic characteristics of the new aircraft are the same as those of the IL-62 Attention is given to the wing design, the installation of the engines, the aircraft control system, and aspects of flight safety.

A77-49656 # Noise emission of the agricultural aircraft Z-37 I - Sound intensity level measurements at the agricultural aircraft Z-37 II - Sound intensity level measurements at an agricultural airport (Larmemission des Agrarflugzeugs Z-37 I -Schallpegelmessungen am Agrarflugzeug Z-37 von Waltraud Krause II - Schallpegelmessungen an einem Agrarflugplatz) W Krause (Gesellschaft für internationalen Flugverkehr mbH, Berlin, East Germany) and H Findeis (Potsdam, Bezirkshygieneinspektion und institut, Potsdam, East Germany) Technisch-okonomische Information der zivilen Luftfahrt, vol 13, no 3, 1977, p 159-170 6 refs In German

The agricultural aircraft considered is a low-wing monoplane Maximum energy components of the acoustic emission spectrum lie in the range from 63 to 250 Hz. The characteristics of the frequency spectrum of the acoustic emission during takeoff are presented in a graph, taking into account distances of 50 m, 100 m, 200 m, and 400 m at various positional angles. Attention is given to maximum sound intensity levels as a function of distance, sound emission during braking, the shielding effects of buildings on noise propagation, noise intensity levels during various types of flight operations, acoustic measurements in the aircraft ouring the flight, details regarding the operations at an agricultural airport, and sound intensity levels at the airport measured under operational conditions. G R

A77-49657 # The helicopter Ka-26 in the Special Purpose Flights Sector of Interflug II (Der Hubschrauber Ka-26 im Bereich Spezialflug der Interflug. II) G Kronert (Gesellschaft für internationalen Flügverkehr mbH, Berlin, East Germany) Technischokonomische Information der zivilen Luftfahrt, vol 13, no 3, 1977, p. 171-175 In German

The employment of helicopter for obtaining aerial photographs and for making films increases in spite of the higher expenses per helicopter flying hour in comparison to the costs involved in the case of conventional aircraft. The reasons for this development are related to the special effects which can only be obtained by utilizing the particular flight characteristics of helicopters. The use of the Ka-26 for the considered applications is discussed. Other described applications of the Ka-26 helicopter are related to an employment as an ambulance aircraft, a use in rescue operations, and a utilization as a flying crane.

A77-49658 # Electroenergy supply for airports IV (Elektroenergieversorgung von Flughafen IV) H Krause (Gesellschaft fur internationalen Flugverkehr mbH, Berlin, East Germany) Technischokonomische Information der zivilen Luftfahrt, vol 13, no 3, 1977, p 176-179 In German

Approaches are discussed for the determination of limiting values of general validity concerning the continuing supply with electric power taking into account the available solutions for the existing supply problems Parallel systems containing storage bat teries can assure a supply of electric power without interruption Power supply interruption periods in the case of other solutions are 1 sec, 8 sec, 30 sec, and 3 min. The technical equipment required for various solutions is considered.

A77-49731 # Rain erosion resistant fluoroelastomer radome and antenna coatings J F Moraveck (CAAP Co, Inc, Huntington, Conn) In Symposium on Electromagnetic Windows, 13th, Atlanta, Ga, September 21-23, 1976, Proceedings

Atlanta, Ga, Georgia Institute of Technology, 1977, p 29-36 6 refs USAF-supported research

Sprayable and room temperature curable fluoroelastomer coating compositions having superior rain erosion resistance, thermal and thermal flash resistance have been developed for radome and antenna applications. Rotating arm performance of these coatings as a function of free film rheology, adhesion and coating composition is discussed. Flight testing of white and black pigmented coatings confirm the rotating arm evaluation. Thermal and thermal flash testing have been performed and electrical properties consistent with radome and antenna applications have been achieved. This development work has led to commercially available coating compositions which are currently under qualification testing. (Author)

A77-49734 # The protection of aircraft radomes against lightning strike R H J Cary (Ministry of Defence, London England) and D A Conti (British Aircraft Coip, Ltd, Guided Weapons Div, Stevenage, Herts, England) In Symposium on Electromagnetic Windows, 13th, Atlanta, Ga, September 21 23, 1976, Proceedings Atlanta, Ga, Georgia Institute of Technology, 1977, p 67-71 6 refs

The high voltage aspects of lightning protection systems for radomes are considered with emphasis on the basic requirement that the radome should not be punctured. Attention is given to maximum conductor separation, puncture factors, surface flashover factors, and external metal distribution. Lightning protection is also discussed in reference to the microwave performance and current performance of radomes.

A77-49743 # B-1 forward radome microwave test range J M Carter (Carco Electronics, Menlo Park, Calif) In Symposium on Electromagnetic Windows, 13th, Atlanta, Ga, September 21 23, 1976, Proceedings Atlanta, Ga, Georgia Institute of Technology, 1977, p 123-128

A radome microwave test range for use in qualifying the radome boresight error measuring system of the US Air Force B 1 is described Factors influencing radar performance, such as radome beam deflections and reflections, transmission efficiency, depolarization and antenna pattern distortion, were monitored at the test range A five-antenna null seeking servo system was employed in tracking horizontal and vertical boresight errors and simultaneously plotting radome transmission loss. Test data indicated that the servo tracking null seeker could be calibrated to an accuracy of better than 0.1 milliradians for a variety of antenna configurations and polarization modes. J M B

A77-49745 # Georgia Tech high temperature solar test facility J D Walton, Jr (Georgia Institute of Technology, Atlanta, Ga) In Symposium on Electromagnetic Windows, 13th, Atlanta, Ga, September 21-23, 1976, Proceedings Atlanta, Ga, Georgia Institute of Technology, 1977, p 133-138 8 refs ERDA sponsored research

The Georgia Institute of Technology Solar Thermal Test Facility, which involves a 400 kW solar furnace suitable for simulat ing aerodynamic heating of radomes, is described Plans for the facility, scheduled to begin preliminary operation in 1977, call for an initial array of 550 circular mirrors made of low-iron window glass Mechanical drive mounts for directing the concentrated solar energy to various test areas are also included in the planning Calculations indicate that with maximum heat flux and concentration ratios, the solar furnace could provide a test area in which at least 175 kW of radiant thermal energy is available Additional documentation of the facility is also mentioned. J M B

A77-49747 # Design and test results of very broadband radomes for ECM applications W Eckl (Messerschmitt-Bolkow-Blohm GmbH, Munich, West Germany) In Symposium on Electromagnetic Windows, 13th, Atlanta, Ga, September 21-23, 1976, Proceedings Atlanta, Ga, Georgia Institute of Technology, 1977, p. 143-148

The mechanical layout and electromagnetic properties of very broadband radomes for subsonic aircraft ECM applications are presented Constructions for the nose, tail, and under-fuselage radomes are described along with discussions of the electromagnetic properties and transmittivity, reflection coefficient, and boresight errors SCS

A77-49787 Model for the effect of electric fields on satellite-earth microwave radio propagation D P Haworth, P A Watson, and N J McEwan (Bradford, University, Bradford, Yorks, England) *Electronics Letters*, vol 13, Sept 15, 1977, p 562-564 15 refs

A model for cross polarization on satellite-earth radio paths is proposed in which particles lying in the horizontal plane under ærodynamic-gravitational forces are aligned by electric fields. This model explains the abrupt cross polarization magnitude changes and abrupt 180-deg phase changes recently observed on satellite-earth paths at microwave frequencies. (Author)

A77-49847 Theory of the lifting surface in unsteady motion in an inviscid fluid D. Homentcovschi (Bucuresti, Institutul Politechnic, Bucharest, Rumania) Acta Mechanica, vol. 27, no. 1.4, 1977, p. 205-216.7 refs

A lifting surface S in unsteady motion in a barotropic inviscid fluid which fills the whole space is considered. The surface S can be an aircraft wing, a tail surface, or a propeller. The determination of the velocity field and the pressure field is considered and a fundamental relation is derived. The solution of the direct problem is reduced to the solution of a singular integral equation. However, a solution of the obtained equation is difficult, even when numerical approaches are used. For the sake of simplicity, it is assumed that the lifting surface S moves over an (abstract) fixed surface. Attention is given to the case in which it is a helicoid with a directrix plane. G R

A77-49873 An operational video tape recording system utilizing IRIG standard 129-73 segmented helical scan recording format S S Damron, G L Schoettmer, and A E Strahm (Echo Science Corp, Mountain View, Calif) In International Telemetering Conference, Los Angeles, Calif, September 28-30, 1976, Proceedings Pittsburgh, Pa, Instrument Society of America, 1976, p 215-228 7 refs Contract No F33657-74-C-0562

The Operational Video Tape Recording (OVTR) system includes an airborne video recorder and remote control unit, designed to produce high band video recordings in the environments encountered on deployment in fighter aircraft The companion ground system consists of a video recorder/reproducer for playback of mission tapes and a video Discassette recorder/reproducer with a slow motion/stop action capability for complete analysis of the recorded data. The system incorporates multi-line rate flexibility to provide record capability of video signals from many electro-optical sensors. The OVTR system is easily expanded in capability to enable the recording of any type of instrumentation data that fits within a 0.5 MHz bandwidth, such as an 8 mB/s serial digital stream, spread spectrum or other down converted communications data. B J

A77-49908 ATS-6 European L-band aeronautical experiments D L Brown, Y Guerin, G Melchior, and F Absolonne (ESA, European Space Research and Technology Centre, Noordwijk, Netherlands) In International Telemetering Conference, Los Angeles, Calif, September 28-30, 1976, Proceedings

Pittsburgh, Pa , Instrument Society of America, 1976, p 642-654 13 refs

An ESA program is described in which the ATS-6 satellite was employed to conduct communication and navigation tests over the North Atlantic in an effort to define modulation techniques to be used with the Aerosat system. The experiments, performed on a Comet IV aircraft equipped with a slot dipole antenna, consisted of voice tests comparing delta-PSK with adaptive NBFM, an investigation of multipath noise effects on the PSK data transmission system, and ranging measurements B J

A77-49926 Survival and Flight Equipment Association, Annual Symposium, 14th, San Diego, Calif, September 13-16, 1976, Proceedings Canoga Park, Calif, Survival and Flight Equipment Association, 1976 193 p \$10.00

Techniques and hardware for aiding escape, survival, and recovery in aerospace emergencies are discussed in the contributed papers Escape and recovery systems for outer space (Space Shuttle and untrained passengers in particular) and from oil platforms and tankers in sudden emergencies are also dealt with Articles deal with masks, hoods, goggles, pilots' helmets and helmet information displays, oxygen supply and masks, ejection seat and ejection pods, and antiexposure suits for water immersion and severe cold Other articles address automatic ripcord release, survival kits, testing of life support equipment, a pulsating seat cushion to counteract fatigue in prolonged sitting, fluidic controls, and cabin safety design and delethalization of structures and objects within the head strike envelope R D V

A77-49932 SENDS /Safe Ejection Envelope Display System/ C Woodward (U S Naval Material Command, Naval Air Development Center, Warminster, Pa ) In Survival and Flight Equipment Association, Annual Symposium, 14th, San Diego, Calif, September 13-16, 1976, Proceedings Canoga Park, Calif, Survival and Flight Equipment Association, 1976, p 27-30

Simulation testing of a system designed to warn the pilot and aircrew on the time remaining within the safety envelope for safe ejection, the rate at which the craft in hazard is using up the envelope, and of flying conditions outside the safety envelope, is reported The SENDS system monitors aircraft dynamics by means of onboard sensors, furnishing data to an onboard computer which computes escape capability and displays current status in terms of time remaining for initiating an ejection within the safe recovery envelope of the escape system Human reaction time and total ejection event time can be predicted, but SENDS aids the human to eject  $R\,D\,V$ 

A77-49933 Fluidic thrust vector control systems for ejection seats R B Beale In Survival and Flight Equipment Association, Annual Symposium, 14th, San Diego, Calif, September 13-16, 1976, Proceedings Canoga Park, Calif, Survival and Flight Equipment Association, 1976, p. 31-34

A two-axis, hydrofluidic thrust vector control (TVC) system was designed to improve the trajectory of an ejection seat under adverse conditions from 0 to 600 knots air speed. Center of gravity misalignment and large aerodynamic oscillations are virtually eliminated by this method A vortex rate sensor, fluidic lag-lead compensation and a hydrofluidic servo actuator using hot gas pressurized oil were chosen to drive a hydrostatic ball and socket nozzle with 20 deg of thrust deflection of a 5000 lb rocket. This system controls seat attitude and rotational rates in the pitch and yaw axes By stabilizing the escape system at its aerodynamic trim condition with the drogue chute deployed during the rocket burn phase, the remainder of the flight remains stable, according to the 6 DOF seat simulation. Since this control system has only 1 moving part, no pressurized gas or initiators, it will have an MTBF exceeding 50,000 hrs and a maintenance requirement of zero (Author)

A77-49934 Fluidic event sequencing subsystem for AAES J W Morris (U S Navy, Naval Ordnance Station, Indian Head, Md), R K Brodersen (Martin Marietta Aerospace, Orlando, Fla), and V P Marchese (EMX Engineering, Inc, Cedar Grove, NJ) In Survival and Flight Equipment Association, Annual Symposium, 14th, San Diego, Calif, September 13-16, 1976, Proceedings

Canoga Park, Calif, Survival and Flight Equipment Association, 1976, p 38-41

The feasibility of employing fluidics to achieve event sequencing in aircrew automated escape systems (AAES) is explored. Two fluidic subsystems developed, fabricated, and tested were a fluidic sequencer (FS) breadboard and a flueric cartridge initiator (FCI). An oscillator feeding pulses into frequency dividers arranged to form a counter comprises the FS breadboard. Time delays for sequencing are generated as the fluidic logic circuits analyze counter outputs (and simulated altitude and velocity sensor inputs in the test). A gas-driven initiator with no moving parts heats an endwall to effect cartridge ignition within msec in the FCI. Interfacing of FS and FCI is sketched. R D V

A77-49935 Emergency escape from shuttle vehicles R T Kendall In Survival and Flight Equipment Association, Annual Symposium, 14th, San Diego, Calif, September 13-16, 1976, Proceedings – Canoga Park, Calif, Survival and Flight Equipment Association, 1976, p. 42-47, 17 refs

The Paracone emergency escape system for Space Shuttie passengers and its development are described Ejection seat and ejection pod concepts are compared Mission requirements dictate a versatile escape system for untrained passengers and personnel from a shirtsleeve situation at any point in the Shuttle mission on pad, pre-launch, during lift off, in trajectory, in orbit, or during the return trip The Paracone is an expandable gas-inflated structure enclosing the protected person and acting as aerodynamic decelerator in reentry Activation of the system in various mission phases is described and illustrated Paracone (large three-dimensional actuation devices, and auxiliary functions (large three-dimensional trackable target, flotation for a water landing or impact attenuation for a hard landing) are described R D V

A77-49936 Proposed helicopter safety system for catastrophic failures R T Kendall In Survival and Flight Equipment Association, Annual Symposium, 14th, San Diego, Calif, September 13-16, 1976, Proceedings Canoga Park, Calif, Survival and Flight Equipment Association, 1976, p 66-70 17 refs

Helicopters are subject to several types of catastrophic failures any one of which renders the helicopter unsafe and subjects the occupants to possible injury or death. There has been proposed a Kendall Paracone decelerator system that is attached and stowed at the top of the helicopter, around the main motor shaft. When a catastrophic failure occurs, the main rotor blades are jettisoned via pyrotechnics and at the same time the gas generators in the Paracone are ignited. The gas generators inflate the Paracone upward and outward forming the decelerator in one-half to one second (as required). This Paracone decelerator holds the helicopter descent rate to an impact velocity of 25 to 50 fps (as required). All of the required technology, materials and techniques are in-being today. The weight penalty as proposed would be approximately two percent of the gross weight of the helicopter (Author).

A77-49945 Performance and design of a vertical seeking seat steering system W J Stone (U S Naval Weapons Center, China Lake, Calif) In Survival and Flight Equipment Association, Annual Symposium, 14th, San Diego, Calif, September 13-16, 1976, Proceedings, Canoga Park, Calif, Survival and Flight Equipment Association, 1976, p 110-113

The estimated performance and the design of a seat steering and control system that will select a vertical-up trajectory irrespective of aircraft attitude at the point of ejection is described. Trajectory simulation studies indicate that a recovery can be accomplished as low as 50 ft above ground level during an ejection from a fully inverted aircraft. The increase in total impulse required to achieve maximum inverted performance also greatly enhances wing level and sink rate capability. The design that will be implemented for a series of feasibility demonstration tests consists of a three-axis strap-down rate gyro sensor system, microcomputer, gimbaled underseat rocket motor, hydraulic actuators, servo valves, hydraulic power supply, and electrical power supply. The system also has the potential for development into a fully independent vertical-seeking control system. (Author)

A77-49946 Evolution of automatic opening lap belts in high performance aircraft C S Goodman, Jr (USAF, San Antonio Air Logistics Center, Kelley AFB, Tex.) In Survival and Flight Equipment Association, Annual Symposium, 14th, San Diego, Calif, September 13-16, 1976, Proceedings Canoga Park, Calif, Survival and Flight Equipment Association, 1976, p 114-119 5 refs

In connection with an employment of the ejection seats used for an ejection from an aircraft in the case of an emergency during the period from 1949 to 1956 the crewman had to manually release his lap belt, kick away from the seat, and then deploy his parachute Many fatalities occurred because the whole procedure was taking too much time. The ejection seat was, therefore, made fully automatic with the incorporation of an automatic parachute and an automatic lap belt release. The automatic features reduced the operation time of the escape capability. The chronological evolution of automatic opening lap belts is discussed, giving attention to the E-1 automatic lap belt release, the first automatic lap belt, the HBU-series lap belt, and considerations concerning a new design of lap belt. G R

A77-49947 The development of new designs of emergency escape parachutes for ejection seats S B Jackson (Irvin Great Britain, Ltd, Letchworth, Herts, England) In Survival and Flight Equipment Association, Annual Symposium, 14th, San Diego, Calif, September 13-16, 1976, Proceedings Canoga Park, Calif, Survival and Flight Equipment Association, 1976, p 120-125

The initial investigation into two designs of Irvin G B emergency escape parachutes to the latest British specification for use on Martin-Baker MK 10 ejection seats is described. The specification requires parachutes with better stability and descent rate than given by the I 24 flat parachute. Trials are described up to medium high speed using ejection seats. The programme which is intended to include a 650 knot trial on the Pendine rocket sled has not yet been completed because of delays in testing, not because of parachute performance. (Author)

A77-49948 Teaching the practical techniques of establishing egress system performance in an accident environment R E Duran (USAF, San Antonio Air Logistics Center, Kelley AFB, Tex ) In Survival and Flight Equipment Association, Annual Symposium, 14th, San Diego, Calif, September 13-16, 1976, Proceedings Canoga Park, Calif, Survival and Flight Equipment Association, 1976, p 126-128

Six training categories are considered, taking into account an introductory definition of the weapon system and type of escape system, aspects of ejection statistics, questions of escape system capability, canopy/airframe/ejection seat ballistic schematics, service-able and ejected seats as training aids, and an analysis of past investigations. In the final segment extracts from previous on-site investigation reports are used as training aids. The concepts and procedures involved are illustrated with the aid of an extract from the T-37 aircraft accident investigation (egress systems) training pamphlet.

A77-49949 USAF experience in aircraft accident survivability W D Tuttle (USAF, Inspection and Safety Center, Norton AFB, Calif) In Survival and Flight Equipment Association, Annual Symposium, 14th, San Diego, Calif, September 13-16, 1976, Proceedings Canoga Park, Calif, Survival and Flight Equipment Association, 1976, p 132-136 11 refs

After crash landing of transport-type arcraft, passenger survival depends upon the crashworthy design of that aircraft. This study reviews the United States Air Force experience in crash landings and ditchings of aircraft when passengers were involved. It is limited to passenger-type Air Force aircraft accidents which occurred between 1967 and 1974. The study relates to the primary cause of death and injury of those passengers involved in survival accidents and discusses crashworthy features which would have improved their survival potential or reduced their injuries. It compares the crashworthiness of all Air Force transport aircraft and those Air Force aircraft performing missions similar to that proposed for the Advanced Medium Short Takeoff and Landing (STOL) Transport (AMST).

(Author)

A77-49950 Aircrew escape and survival - Problems and solutions G R Drew In Survival and Flight Equipment Association, Annual Symposium, 14th, San Diego, Calif, September 13-16, 1976, Proceedings Canoga Park, Calif, Survival and Flight Equipment Association, 1976, p. 137-140 5 refs

This paper reviews operational ejection seat systems and cites reasons why ejection systems currently in service are considered obsolete or 'old technology' Ejection seat system problems with respect to performance, survival rates, reliability, maintenance, weight, cost, and complexity, are reviewed Advanced system concepts are presented as a means of stimulating overall solutions for current aircrew ejection seat system problems (Author)

A77-49951 Evaluation of inflatable /'air bag'/ occupant restraint systems for aircraft application R G Snyder (Michigan, University, Ann Arbor, Mich ) In Survival and Flight Equipment Association, Annual Symposium, 14th, San Diego, Calif, September 13-16, 1976, Proceedings Canoga Park, Calif, Survival and Flight Equipment Association, 1976, p 147-150

The state-of-the-art of 'air bag' technology was assessed for potential applications to aircraft. The design development is outlined, the subsystems assessed, and effectiveness discussed. Problems ranging from toxicity to maintenance and reliability remain unresolved. Since most aircraft crash deceleration environments differ significantly from that of the automotive vehicle, it is uncertain how effective this system will work in aircraft without further extensive testing. No system of crash sensor known is capable of reliably sensing an impending crash, as distinguished from a hard landing or turbulence. While future use of 'air bags' in aircraft is promising, these systems do not now offer as effective protection as other available systems. (Author)

A77-50440 # Measurement of nondiagonal generalized damping ratios during ground vibration tests (Mesure des amortissements géneralés non diagonaux d'une structure lors d'un essai au sol de vibration) G Coupry (ONERA, Châtillon sous Bagneux, Hautsde-Seine, France) (Congres Canadien de Mécanique Appliquée, 6th, Vancouver, Canada, May 30-June 3, 1977) La Recherche Aero spatiale, July-Aug 1977, p 239-244 In French

Problems in measuring the nondiagonal damping ratios of a structure during ground vibration tests are discussed, in particular, a theoretical difficulty arising in the analysis of nondiagonal damping ratios due to dissipative coupling between the modes of the structure Errors in the classical determination of vibratory effects through isolation of the excitations of the various modes are assessed, the use of generalized masses, deformations and damping ratios, instead of adapted values based on the concept of equiphase response, is suggested to eliminate the faulty analysis A sample problem involving the nondiagonal damping ratios of a small twin-engined piane is also given.

A77-50441 # The measurement of aircraft overflight noise -Errors due to its nonstationary character (Metrologie des bruits de survols d'avions - Erreurs dues au caractère non stationnaire) M Ernoult *La Recherche Aerospatiale*, July-Aug 1977, p 245-254 9 refs In French

Techniques for measuring noise during aircraft overflights are described, with emphasis on the correction of errors due to the nonstationary nature of the received acoustic signals Acoustic noise received by a fixed ground microphone is modeled as a Gaussian, nonstationary random process, the estimation bias, variance and mean square error are calculated for a stationary process modulated by an exponential Optimal integration times for minimizing the mean square error are given. The results of the analysis, presented in graphical form, may be of use in interpreting spectral analyses of the acoustic noise, and in choosing the most appropriate parameters for the analysis.

A77-50456 Reliability, availability, maintainability/ logistics /RAM/LOG/ L L Bishop, T A Cronogue, R Hoffman, D Reside, G Donald, and R Flynn (US Army, Aviation Systems Command, St Louis, Mo) In Annual Reliability and Maintain ability Symposium, Philadelphia, Pa, January 18 20, 1977, Proceedings Piscataway, N J, Institute of Electrical and Electronics Engineers, Inc., 1977, p 49 68

The paper covers various aspects of the reliability, availability, maintainability/logistics (RAM/LOG) methodology of the US Army Aviation for development aircraft RAM/LOG data acquisition, processing and computation, and assessment are described PTH

A77-50462 The life cycle cost impacts of unsafe designs R L Weber (USAF, Inspection and Safety Center, Norton AFB, Calif ) In Annual Reliability and Maintainability Symposium, Philadelphia, Pa, January 18-20, 1977, Proceedings

Piscataway, N J , Institute of Electrical and Electronics Engineers, Inc , 1977, p 120-123

The paper outlines how accident costs can be incorporated into life cycle cost estimates. The problem of analyzing costs due to accidents and combining them with operating and servicing costs is discussed. PTH

A77-50463 Launch risk analysis J B Baeker, J D Collins, and J M Haber (J H Wiggins Co, Redondo Beach, Calif) In Annual Reliability and Maintainability Symposium, Philadelphia, Pa, January 18 20, 1977, Proceedings Piscata way, N J, Institute of Electrical and Electronics Engineers, Inc., 1977, p 124-129 5 refs USAF-supported research

An analysis procedure is developed for assessing the risk associated with the launch of a missile or space booster. The method considers the various hazardous vehicle failure modes and employs a statistical characterization of the vehicle state vector following a failure, the flight termination process and the effects of the atmosphere on the fragments resulting from vehicle breakup Based on these statistics, the impact distributions for all impacting vehicle debris are computed and used to define the impact probability and casualty expectation for locations hazarded by the launch. An incremental technique is used in these risk computations whereby fragment impact distributions are computed for discrete vehicle flight times. This allows for a considerably more accurate handling of the various sources of impact uncertainty. (Author)

A77-50466 \* Flight inspection data and crack initiation times W S Johnson (General Dynamics Corp., Fort Worth, Tex.), R. A Heller (Virginia Polytechnic Institute and State University, Blacksburg, Va.), and J N Yang (George Washington University, Washington, D.C.) In Annual Reliability and Maintainability Symposium, Philadelphia, Pa., January 18-20, 1977, Proceedings Piscataway, N.J., Institute of Electrical and

Electronics Engineers Inc 1977 o 148-154 23 refs Grant No NsG-1099

Lockheed C-130 service-flight inspection data is reduced by means of fracture mechanics and statistical analysis into a form from which the probability of time to crack initiation and the distribution of initial flaw sizes for various locations on the aircraft can be determined Crack sizes are normalized by extrapolating a growing crack backwards from its first recorded size to 03 inches (crack initiation size) yielding the time to crack initiation. In a similar fashion, the crack is grown backwards to a time equal to zero to yield an initial flaw size. In order to perform the discussed computations, crack growth constants were computed for each individual location and were analyzed statistically. Statistical distributions were fitted to times to crack initiation and to initial flaw sizes in order to describe their expected behavior. Weibull and Johnson distributions have been found to fit the data reasonably well but for a better fit convolution integrals of Poisson load distributions and Weibull strength distributions are needed (Author)

A77-50467 Wear reliability of aircraft splines D Kececio glu and A Koharcheck (Arizona, University, Tucson, Ariz) In Annual Reliability and Maintainability Symposium, Philadelphia, Pa, January 18 20, 1977, Proceedings Piscataway, N J, Institute of Electrical and Electronics Engineers, Inc., 1977, p 155-163 11 refs Contract No N00156-75 C-0944

Empirical mathematical models are developed, based on experimental research conducted with aircraft splines, which provide equations for predicting their reliability when spline tooth wear is the failure mode under consideration. The methodology for obtaining the needed distributions of wear for specified operating times and of time for specified amounts of spline-tooth wear is presented. Six applications are given which show how this distributional data can be used to predict the reliability of aircraft splines. The need to generate realistic distributional aircraft spline wear-life data is pointed out. (Author)

A77 50477 Reliability improvement warranty techniques and applications C A Hardy and R J Allen (General Dynamics Corp., Fort Worth, Tex.) In Annual Reliability and Maintainability Symposium, Philadelphia, Pa., January 18-20, 1977, Proceedings Piscataway, N J, Institute of Electrical and Electronics Engineers, Inc., 1977, p. 222-228

Incentives provided by the Air Force to contractors of new systems to design and produce electronic equipment with low failure rates and low repair costs in operational use are included in the procurement contracts as Reliability Improvement Warranty (RIW) provisions. These provisions obligate the contractor to accomplish repair and replacement of failed equipment at a fixed price during operational use of the equipment by the Air Force, and to guarantee the MTBF of the equipment during the warranty period. This paper defines the RIW concept and discusses it in reference to F-16 development.

A77-50483 RIW experience at ECOM R A Minarchik (U.S. Army, Systems Analysis Office, Fort Monmouth, N J.) In Annual Reliability and Maintainability Symposium, Philadelphia, Pa, January 18-20, 1977, Proceedings Piscataway, N J, Institute of Electrical and Electronics Engineers, Inc., 1977, p 257-260 The paper reviews the RIW (Reliability Improvement Warranty) experience at the Army Electronic Command (ECOM) with two RIW programs - CONUS NAV and the Absolute Altimeter The RIW requirements for the two programs are examined with emphasis on warranty period, exclusions, operating-time adjustments and MTBF guarantee BJ

A77-50488 Effectiveness of reliability system testing on quality and reliability J B Hovis (Westinghouse Electric Corp, Baltimore, Md) In Annual Reliability and Maintainability Symposium, Philadelphia, Pa, January 18-20, 1977, Proceedings

Piscataway, N J , Institute of Electrical and Electronics Engineers, Inc , 1977, p 281-285

This paper presents a reliability approach to a program for a high reliability airborne search and track combat radar which was based on three successful approaches evolved at Westinghouse Defense and Electronic Systems Center The reliability program plan implemented for this radar equipment was designed to produce a system which would perform in a flyoff test better than a predetermined mean-time-between-failure (MTBF) The basis of this approach was basically that used in the successful Electro-Optical system known as the B-52 Steerable TV (AN/AVQ-22) which achieved a field MTBF approximately equal to the predicted value and demonstrated in a Mil-Std-781 test a greater MTBF than the required value. It is felt that the principles described herein could be applied to any program to achieve the desired results in field usage (Author)

A77-50494 AFSATCOM terminal segment reliability test program R P Hassett (Mitre Corp., Bedford, Mass.) and E C Jonson (USAF, Electronic Systems Div., Bedford, Mass.) In Annual Reliability and Maintanability Symposium, Philadelphia, Pa, January 18-20, 1977, Proceedings Piscataway, N J, Institute of Electrical and Electronics Engineers, Inc., 1977, p 372-377 6 refs

The development program for the AFSATCOM terminal equipment and the next generation of high reliability airborne UHF radios included an extensive reliability test effort consisting of nine separate MIL-STD-781 tests Achievement of satisfactory reliability growth was a primary objective of the test program This paper describes the significant reliability requirements and features of the equipment and of the reliability program and presents an analysis of the results of the testing to date (Author)

A77-50497 Effects of temperature on avionics reliability J J Duhig, Jr and T E Weaver (Lockheed-Georgia Co, Marietta, Ga) In Annual Reliability and Maintainability Symposium, Philadelphia, Pa, January 18-20, 1977, Proceedings

Piscataway, N J, Institute of Electrical and Electronics Engineers, Inc, 1977, p 409-413

The effects of temperature on avionics reliability at the line replaceable unit level are determined. Field failure rates for 42 avionics boxes flying on the USAF C-141 jet transport fleet are analyzed along with operating temperatures obtained in a comprehensive thermal survey. A strong correlation between reliability and equipment price is shown where price is used as a measure of complexity. Using multiple regression analysis techniques, it is shown that the reliability of more complex equipment using flow-through forced convection cooling is very sensitive to increases in temperature. The reliability of less complex equipment cooled by free convection is not as sensitive to increases in temperature. (Author)

A77-50501 Failure analysis of digital systems using simulation L Bertolino (Aeritalia S p A, Settore Avionica, Turin, Italy) and L E Grefsrud (Boeing Co, Seattle, Wash) In Annual Reliability and Maintainability Symposium, Philadelphia, Pa, January 18-20, 1977, Proceedings Piscataway, N J, Institute of Electrical and Electronics Engineers, Inc, 1977, p 432-441

The paper describes a failure analysis method developed as part of the Boeing/Aeritalia 7X7 flight control system electronics

development program A model of the complete digital system is developed and subsequently modified into a functionally identical fault model which has the additional capability of detailed gate level fault simulation. The fault model combined with the self test program in a fault simulation run enables a quantitative evaluation of the self-test effectiveness by inserting faults one at a time and running the self-test for each one BJ

A77-50504 Combined Environment Reliability Test /CERT/ A H Burkhard (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio) In Annual Reliability and Main tainability Symposium, Philadelphia, Pa, January 18-20, 1977, Proceedings Piscataway, N J, Institute of Elec trical and Electronics Engineers, Inc, 1977, p. 460, 461

The Air Force Combined Environment Reliability Test (CERT) is applied to avionics systems and takes account of the dynamic and synergetic nature of the field environment along with its tempera ture, humidity, random vibration and altitude changes. This paper discusses the basic philosophy and assumptions that have been used to formulate the environmental conditions used for initial testing. Two general conclusions have been drawn (1) the test approach using mission profiles for one aircraft appears to have the most promise for obtaining consistent reliability statistics, and (2) a composite mission profile that includes qualification test levels does not seem suitable for obtaining consistent reliability statistics. B J

A77-50510 Logistics planning simulation model for USAF spare engine management H J Benet (Texas A & M University, College Station, Tex.) and C H Shipman (USAF, Wright-Patterson AFB, Ohio) In Annual Reliability and Maintainability Symposium, Philadelphia, Pa, January 18-20, 1977, Proceedings

Piscataway, N J , Institute of Electrical and Electronics Engineers, Inc , 1977, p 500-505 13 refs

The simulation model described herein is designed to assist Air Force Logistics Planners in predicting future aircraft engine removals and evaluating the adequacy of spare engine supplies. Written in FORTRAN, the model will give quarterly predictions of both the mean and variance of removals and stockouts so that confidence limits may be set on the ability of the logistics system to support programmed flying requirements (Author)

A77-50623 # Solid state light emitting displays. E S Eccles Aviation Review, Aug 1977, p 4, 5

Solid-state light-emitting displays are being developed for aviation indicators Based on an examination of various display elements, yellow light-emitting diodes were chosen for the display, with a typical strip using up to 900 individual diodes. It has been suggested that two standard forms of linear display, two sizes of circular display, and a four-digit 7-bar numeric readout would be sufficient for standard instrument replacement requirements. Scale illumination and a wide range of light-emitting diode intensity modulation would be utilized along with a digital computing system using microprocessors. Cost effectiveness may be enhanced by using the digital computer system for functions not applicable to conventional instruments.

A77-50624 # HUD and the retrofit market J R Caldow Aviation Review, Aug 1977, p 12-15

It has been suggested that aircraft with electro-mechanical gyro gunsight may be retrofit with modern Head-up Display (HUD) equipment on a cost-effective oasis Among the advantages of the HUD system are (1) the ability to be integrated with a navigation system, (2) the display of position information, assisting in target search, and for the comparison of predicted position with visual sighting, (3) the ability to interface a HUD system with fire control radar operating in the air-to-air mode, and (4) continuous indication of predicted bomb impact regardless of delivery maneuver it is concluded that the numerous benefits offered by the HUD system compensate for the cost of a HUD retrofit program SCS A77-50625 # Gas turbine temperature techniques. K G McAinsh Aviation Review, Aug 1977, p 16-18

The swaging of mineral insulated cable has been applied to thermocouple design, allowing for the production of exposed and submerged-junction thermocouples, butt-swaged harpin elements, and several mineral insulated thermocouple harness assemblies. Thermocouple assembly techniques include vacuum brazing, induction brazing and an electron-beam welding technique, with high reliabilities achieved by standard design techniques. Areas for future research are identified including technological relevance to the nuclear power industry, the development of high turbine entry temperatures, the formation of thermocouple junctions on refractory substrates, and the development of alternative temperature measuring systems.

A77-50662 The need for a workable collision avoidance system - Now C L Smith (Western Air Lines, Inc., Los Angeles, Calif.) Safe Journal, vol. 7, Fall 1977, p. 32, 33

The need to move ahead on achieving a workable collision avoidance system (CAS) for aircraft is argued. The Beacon CAS (BCAS) is recommended as 'earliest possible installation milestone', and as capable of identifying an imminent collision 30 sec prior to impact. Criteria on CAS acceptance recommended by the Air Line Pilots Assoc as 'of primary importance' are presented. Data are presented on total system errors and midair near-misses for the years 1972 through 1975. R D V

A77-50676 # Airport electrical and lighting equipment (Elektricheskoe i svetovoe oborudovanie aeroportov) V V Zhukov, B A Vol'pert, and V A Voevodzinskii Moscow, Izdatel'stvo Transport, 1976 288 p In Russian

A comprehensive text on airport runway and taxiway lighting hardware and associated electrical power equipment. Homing beacons, runway localizers, stopway lights, barrier lights, lead-in and lead-out lights, runway and taxiway lighting patterns and various types of luminaires are described. Power supplies, transformer substations, brightness regulators, emergency standby power supplies, and automatic control and switching equipment for runwayside airport lighting systems are covered. R D V

A77-50678 # Aircraft electric machines with intensive cooling systems (Aviatsionnye elektricheskie mashiny s intensivnym okhlazhdeniem) V I Naumenko and O G Klochkov Moscow, Izdatel'stvo Mashinostroenie, 1977 128 p 45 refs In Russian

The basic approach to the design of cooling systems for aircraft electric machines is presented along with a comparative evaluation of several cooling systems such as air cooling, systems using special cooling agents (e.g., motor oils), convective liquid cooling, evaporation cooling, and hybrid systems using air and evaporation systems in conjunction. Specific construction requirements for the systems are identified, and various heat transfer processes, using intensive free-cooling or forced-cooling modes are described, noting engineering methods for heat calculation. Examples of structural solutions for basic subassemblies are discussed, including schematic drawings of system construction.

A77-50682 # Appliances for assembling aircraft and helicopter subsystems and elements (Prisposobleniia dlia sborki uzlov i agregatov samoletov i vertoletov) V P Grigor'ev and Sh F Ganikhanov Moscow, Izdatel'stvo Mashinostroenie, 1977–139 p. 25 refs. In Russian

The textbook deals with some basic principles of developing the various technological processes involved in the construction of aircraft and helicopter airframes. The design characteristics of various stands, jigs, devices, and appliances used for assembly purposes are examined. A large number of complete arrangements developed for specific purposes are illustrated and discussed. Means of mechanizing assembly processes are studied.

A77-50684 # Construction and design principles of aircraft gas-turbine engines (Konstruktsila i osnovy proektirovanila aviatsionnykh GTD) S I Lovinskii, G I Linko, and G P Anuchkin Moscow, Izdateľstvo Mashinostroenie, 1977 319 p 28 refs In Russian

The textbook deals essentially with the design characteristics of aircraft gas-turbine engines and their assemblies, subsystems, and elements. Attention is centered on methods of designing the principal engine assemblies and methods of suppressing vibrations and increasing reliability and service life. The discussion includes lubrication, starting, fuel-supply, and automatic control systems. Some typical compressor and turbine designs are examined. V P

A77-50687 # The determination of ship location by means of navigation satellites (Opredelenie mesta sudna s pomoshch'iu navigatsionnykh sputnikov) lu K Baranov Moscow, Izdatel'stvo Transport, 1976 84 p 14 refs In Russian

The geometric bases of satellite movement are reviewed, and several methods of determining ship location by means of earth satellites are examined Techniques considered include a goniometer method, a rangefinder method, a radial velocity method, a differential distance method, and the isoline gradient during the measurement of distance differences by satellite. The determination of ship location by means of the Transit navigation satellite system is discussed, and data used to locate ships by means of Transit are analyzed.

A77-50693 # Practical aerodynamics of maneuvering aircraft /A manual for flight personnel/ (Prakticheskaia aerodinamika manevrennykh samoletov /Uchebnik dia letnogo sostava/) V A Altukhov, V G Braga, G F Butenko, N M Lysenko, A A Manucharov, S A Mikoian, Iu N Nechaev, M I Radchenko, and G F Sivkov Moscow, Voenizdat, 1977 440 p 19 refs In Russian

The book gives descriptions of the main flight characteristics of modern maneuvering aircraft. The central aspects to which attention is given are the main types of aerodynamic configurations and power plants of modern aircraft, the stability and control of the aircraft, and the behavior of the aircraft during various flight stages. Much of the information is given in the form of graphs illustrating, for example, the matching of air intake conditions with engine conditions, altitude-speed characteristics of the engine, regions of limits on jet engine operating regimes, effect of angle of attack on wing load distribution, onset of pitch and rolling moments, the trends of parameters of motion in aeroinertial rotation, methods of leading an aircraft out of spin, forces acting on aircraft during various flight phases, and landing schemes.

A77-50709 # Some mathematical aspects of the correlation theory of aircraft precision and reliability (O nekotorykh matematicheskikh aspektakh korreliatsionnoi teorii tochnosti i nadezhnosti letatel'nykh apparatov) V V Pozniakov *Kosmicheskie Issledovanija* na Ukraine, no 7, 1975, p 26-32 18 refs In Russian

Nonovershoot of a multidimensional random process with dependent components is treated, as a problem to which many aircraft precision and reliability problems are reducible. The validity of the normal distribution hypothesis for such a process, and the possibility of solving precision and reliability problems at the level of random functions correlation theory, are demonstrated. Techniques for computing multidimensional normal integrals and nonovershoot probabilities of random processes are reviewed. The solutions now available are acknowledged as a powerful tool for operations based on the correlation theory of precision and reliability. R D V

A77-50917 # The importance of monotonicity of finite difference schemes in straight-through calculation methods (O znachenii monotonnosti konechno-raznostnykh skhem v metodakh skvoznogo scheta) A N Minailos Zhurnal Vychislitel'noi Matematiki i Matematicheskoi Fiziki, vol 17, July-Aug 1977, p 1058-1063 14 refs In Russian Monotone finite difference schemes of high order of approximation have several advantages over nonmonotone schemes and first order schemes for the description of discontinuous solutions of supersonic flow problems. Some of the problems associated with nonmonotone schemes and low order schemes, such as smearing of shocks and growth of the entropy function, are illustrated by some results taken from the literature. A modification of a method based on the concept of donor cells is proposed as a means of eliminating artificial entropy layers. The main idea is that, instead of projecting the equation of motion onto the X-axis in regions of flow expansion, one introduces an isentropic flow equation.

A77-50938 # Numerical analysis of the axisymmetric flow past a pervious shell with a hole at the vertex (Chisel'ne doslidzhennia osesimetrichnogo obtikannia proniknikh obolonok z poliusnim otvorom) M K Tsiganov (Akademia Nauk Ukrains'koi RSR, Institut Gidromekhaniki, Kiev, Ukrainian SSR) Akademiia Nauk Ukrains'koi RSR, Dopovidi, Seria A - Fiziko-Matematichni ta Tekhnichni Nauki, July 1977, p 634-636 In Ukrainian

The potential inviscid incompressible flow through an open spherical shell (the flow enters through the open base of the shell and exits through a circular hole at the vertex) is examined. A numerical solution to the flow problem is obtained, by Belotserkovskii's (1965) method of discrete vortices, for circulatory and noncirculatory flow A pronounced influence of the dimensions of the vertex hole on the hydrodynamic characteristics and apparent mass of the shell is demonstrated V.P

A77-50983 A navigation device to help helicopters to land on ocean platforms (Dispositif de navigation et d'aide à l'apontage des hélicoptères sur plates-formes en mer) M Staron, J P Eglizeaud, and D Vasseur (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France) (Association Technique Maritime et Aéronautique, Session, Paris, France, May 2-6, 1977) ONERA, TP no 1977-71, 1977 27 p 8 refs In French

The paper describes the Astrolabe device which provides data facilitating all-weather helicopter approaches and landings Several features of the device, including its basic organization, the numerical processing of the signal, simulation and experimental results, and intended uses, are discussed. The construction of the device is also explained, the device relies on a synthetic antenna and an airborne data processor for analyzing signals emitted from beacons located on the ocean platform.

A77-50987 # Review of optical techniques with respect to aero-engine applications C Véret (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France) (NATO, AGARD, Lecture Series on Laser Optical Measurement Methods for Aero Engine Research and Development, 90th, Trenton, N J, London, England, Urbino, Italy, Aug 25-Sept 6, 1977) ONERA, TP no 1977-80, 1977 18 p 17 refs

Optical methods in aerodynamic research are used for flow visualization and for measurements of density and temperature distribution Optical methods are employed in the study of the flow characteristics of aero-engines by making use of experimental set-ups which include optical windows interferometry provides the basic optical method permitting visualization and density measurements in a flow field. The principles of interferometric studies are demonstrated for a Michelson-type interferometer which is easier to use in aero-engine research than other interferometer types. The employment of holographic interferometry is also considered Attention is given to applications involving the use of the optical methods in aero-engine studies and in the investigation of flames.

A77-50988 # New computation method of turbine blades film cooling efficiency (Méthode nouvelle de calcul de l'efficacité de refroidissement des aubes de turbine par film d'air) E Le Grives and J J Nicolas (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France) (NATO, AGARD, Symposium on High Temperature Problems in Gas Turbine Engines, Ankara, Turkey, Sept 19-23, 1977) ONERA, TP no 1977-85, 1977 13 p 14 refs In French Research supported by the Direction de Recherches et Moyens d'Essais

A new analytical technique is presented for the computation of film cooling effectiveness of gas turbine blades. It is based on a mathematical description of the counter rotating vortex structure associated with the injection of coolant through discrete holes. The transport of mass induced by these vortices plays the major part in the mixing process of hot gas with the individual jets, which defines the adiabatic effectiveness of the resulting film. When merging of the jets and entrainment by turbulent diffusion effects are also taken into account, data from various experiments performed on flat plates are found to be in good agreement with predictions following this approach. Simple rules for computing film effectiveness with injection through several rows of holes allow an extension of this analysis to a large variety of injection patterns. Curvature effects not accounted for in this presentation are left for further investigations (Author)

A77-50989 # Coherent structures in the mixing zone of a subsonic hot free jet C Dahan, G Elias, J Maulard (ONERA, Châtillon-sous-Bagneux, Hauts de-Seine, France), and M Perulli (ONERA, Châtillon-sous-Bagneux, Hauts-de Seine, Compiegne, Universite de Technologie, Compiegne, France) (Symposium sur la Turbulence, Technische Universitat Berlin, Berlin, West Germany, Aug 1-5, 1977 ) ONERA, TP no 1977-88, 1977 9 p

The existence of a large scale structure of turbulence in a free hot jet is emphasized by measurements carried out on the initial assumption of a fine scale structure. Second order analysis allows one to split the signals picked up in the jet and in the acoustic field into coherent and noncoherent components. The validity of this decomposition with regard to the physical picture of the phenomenon, i.e., vortices convected in the mixing zone, is tested by means of conditional sampling analysis, applied for several diagnostics.

(Author)

A77-50991 # Protection of cooled blades of complex internal structure (Protection d'aubes refroidies à structure interne complexe) P Galmiche (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France) (NATO, AGARD, Symposium on High Temperature Problems in Gas Turbine Engines, Ankara, Turkey, Sept 19-23, 1977) ONERA, TP no 1977-90, 1977 10 p 12 refs In French

The SF technique for protection of cooled blades of complex internal structure permits protection of both external and internal surfaces, as well as those of the orifices of cooling air, of whatever diameter, in a single operation. The SF method is most often a pack process, at controlled or high activity, its use can be envisaged for previously uncoated parts, but also for pieces already coated by a thermochemical, chemical or PVD method. The respective thickness of external and internal coatings may be precisely predetermined, no parasitic particle being liable to remain inside the parts after application of the PONERA-SF method are illustrated in the paper by the presentation and examination of quite various parts of advanced turbomachines, followed by operational tests by engine manufacturers or airlines.

A77-50996 # Influence of the noise level in a transonic wind tunnel on the aerodynamic characteristics of models (Influence du niveau de bruit des souffleries transsoniques sur les caractéristiques aérodynamiques des maquettes) X Vaucheret (ONERA, Châtillonsous-Bagneux, Hauts-de-Seine, France) (NATO, AGARD, Symposium on Unsteady Aerodynamics, Ottawa, Canada, Sept 26-28, 1977) ONERA, TP no 1977-110, 1977 16 p 29 refs in French

For the purpose of studying the influence of noise in transonic wind tunnels, the perforated walls of the ONERA S2 Modane wind tunnel were covered with a gauze so that the noise level is reduced to that specified in the LEHRT project Standard models were used in this study Except for a shift of the pitch moments, the noise does not affect the overall steady characteristics. The shock locations are strongly modified by the noise, but only when the separation occurs at the shock foot Without separation, the edge tones were easily perceived, especially as the lift decreased With separation and suppression of wall noise, the pressure transducers reveal wing vibrations in their natural modes. Without noise suppression this response is completely marked, which may falsify the conclusions concerning aerodynamics-structure coupling. With strong separation, the noise effect disappears. For fixed transition, the edge tone effect is damped in the absence of separation, but amplified by its presence (Author)

A77-50998 # Aerodynamic problems of helicopter blade tips B Monnerie and J-J Philippe (ONERA Châtillon sous-Bagneux, Hauts de-Seine, France) (Forum Européen sur les Aérodynes a Voilure Tournante et a Sustentation Propulsive, 3rd, Aix-en-Provence, France, Sept 7-9, 1977) ONERA, TP no 1977-112 1977 20 p 13 refs Research sponsored by the Direction Technique des Constructions Aéronautiques

Wind tunnel studies of wall mounted half wings and rotor models are reported Results for blades with straight or 30 deg-swept tips are presented with particular attention to the three-dimensional and unsteady aspects of the flows over these blade tips in zero lift configuration at high speed Available and planned computer programs for predicting these types of flows are described Results from an experimental investigation of phenomena related to vortex interaction are also considered MLL

A77-51002 # Techniques and facilities used at ONERA /Modane Center/ for icing tests (Techniques et moyens d'essais de givrage utilises à l'ONERA /Centre de Modane/) C Armand, F Charpin, G Fasso, and G Leclere (NATO, AGARD, Round Table on Icing in Aircraft, Ottawa, Canada, Sept 29, 1977) ONERA, TP no 1977-123, 1977 33 p 19 refs In French

Since 1962, the large S1 wind tunnel at Modane has been used to perform rcing tests on full-scale aircraft parts such as the wings, tail surfaces, and radome During recent years, experimental studies have promoted a technique for conducting tests on reduced-scale fixed wings Equations are provided which define the conditions for which the amount of ice formed is about the same as the amount of trapped water Lately this reduced-scale icing test technique has been extended to rotary wings The evolution of aerodynamic coefficients for rotors in icing conditions and the area distribution of ice on the blades are very similar to these observed in true flight (Author)

A77-51004 # Evolution of aircraft design through the concept of the control configured vehicle (Evolution de la conception des avions grace aux commandes automatiques genéralisees) P Poisson Quinton and J C Wanner (ONERA, Châtillon-sous-Bagneux, Hauts de-Seine, France) (Societé des Electriciens, des Electroniciens et des Radioélectriciens, Congres Annuel, Grenoble, France, Sept 20-24, 1977) ONERA, TP no 1977-129, 1977 31 p 35 refs In French

The paper examines some of the future aircraft design possibilities opened up by the concept of the control configured vehicle. Some of the new design goals discussed include artificial stability, direct control of forces by means of two additional degrees of freedom (direct lift and direct lateral force), load limitation during maneuvering, antiturbulence capability for greater comfort of pas sengers and crew, pushing back the flutter limit, and the integration of systems PTH

A77-51006 \* # Producibility aspects of advanced composites for an L-1011 Aileron J Van Hamersveld and L D Fogg (Lockheed California Co, Burbank, Calif ) *Society of Manufacturing Engineers*, *Paper EMR76-04*, 1976 48 p Contract No NAS1-12939

The design of advanced composite aileron suitable for long-term service on transport aircraft includes Kevlar 49 fabric skins on honeycomb sandwich covers, hybrid graphite/Kevlar 49 ribs and spars, and graphite/epoxy fittings Weight and cost savings of 28 and 20 percent, respectively, are predicted by comparison with the production metallic aileron. The structural integrity of the design has been substantiated by analysis and static tests of subcomponents. The producibility considerations played a key role in the selection of design concepts with potential for low-cost production. Simplicity in fabrication is a major factor in achieving low cost using advanced.

tooling and manufacturing methods such as net molding to size, draping, forming broadgoods, and cocuring components A broadgoods dispensing machine capable of handling unidirectional and bidirectional prepreg materials in widths ranging from 12 to 42 inches is used for rapid layup of component kits and covers Existing large autoclaves, platen presses, and shop facilities are fully exploited (Author)

A77-51007 Deburring - Requirements of the aircraft W I Satler (Douglas Aircraft Co, Long Beach, Calif) Society of Manufacturing Engineers, Paper MR76-124, 1976 11 p

The major problem of the deburring process for sheet metal and machined parts, as it relates to aerospace manufacturing, is identified as the volume of parts which must be hand burred Suggestions to alleviate this problem, within the defined requirements and limitations, are presented, including the development of a universal deburring machine, the creation of a portable deburring facility, and organization of a centralized deburring facility SCS

A77-51009 \* Trapped rubber processing for advanced composites P J Marra (Douglas Aircraft Co, Long Beach, Calif) Society of Manufacturing Engineers, Paper EM76-172, 1976 17 p 6 refs NASA-supported research

Trapped rubber processing is a molding technique for composites in which precast silicone rubber is placed within a closed cavity where it thermally expands against the composite's surface supported by the vessel walls. The method has been applied by the Douglas Aircraft Company, under contract to NASA-Langley, to the design and fabrication of 10 DC-10 graphite/epoxy upper aft rudder assemblies. A three-bay development tool form mold die has been designed and manufactured, and tooling parameters have been established Fabrication procedures include graphite layup, assembly of details in the tool, and a cure cycle. The technique has made it possible for the cocured fabrication of complex primary box structures otherwise impracticable via standard composite material processes. SCS

A77-51010 Design, fabrication and test of an F-14 composite overwing fairing H Forsch (Grumman Aerospace Corp, Bethpage, N Y) Society of Manufacturing Engineers, Paper EM76-175, 1976 17 p Navy-supported research

The objectives of the program described in this report were to fully demonstrate the cost and weight savings and the performance improvement made possible by utilization of hybrid composite materials for aircraft primary structures. In the present case, this was demonstrated by defining, developing, and testing the design for an F-14 overwing fairing made of hybrid fiberglass/graphite/epoxy material Design allowables were first analytically established for the hybrid laminate and then confirmed in a series of 72 coupon tests at room temperature and 300 F. A total of 28 element tests at 300 F completed the confirmation of the design concepts.

A77-51015 Rohrbond M M Schwartz (Rohr Industries, Inc, Chula Vista, Calif) Society of Manufacturing Engineers, Paper AD76-280, 1976 10 p

Advanced engineering techniques have been developed for high-strength titanium alloy structures used in thrust engines and airframe and space-oriented structures. One such technique is a diffusion welding system used as a joining process for nonhoneycomb applications. Another process is a joining system combining brazing and diffusion welding for honeycomb sandwich structures. Selected materials are applied to the faying surfaces in small amounts and when exposed to heat they react with the substrate and form a eutectic melt which creates a bridge between the components Diffusion is used to dilute subsequent thermal treatment, which results in a diffusion weld. Several test programs have been conducted by NASA-Langley and Lockheed Aircraft Corporation for evaluation of the methods for titanium and advanced composite materials, and other applications of the technique have been suggested. SCS

A77-51016 Deburring - Some of the problems and requirements of the aircraft industry J F Cochran (General Dynamics Corp., St Louis, Mo.) Society of Manufacturing Engineers, Paper MR76-547, 1976 11 p

The necessity, dictated by cost considerations, of carrying out more deburring operations on aircraft components and structures by machines rather than manually is underscored. Some examples of potential cost reductions by machine deburring are cited. Items for possible consideration include automatic abrasive brush machines and computer controlled robots.

A77-51028 \* # Theoretical jet exhaust noise model for the duct burning turbofan R S Larson (United Technologies Corp, Pratt and Whitney Aircraft Group, East Hartford, Conn) American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 4th, Atlanta, Ga, Oct 3-5, 1977, Paper 77-1264 13 p 22 refs Contract No NAS3-17866

A model was developed to predict the acoustic power spectrum for a Duct Burning Turbofan (DBTF) whose cycle results in a high velocity, high temperature fan stream and a lower velocity, lower temperature primary stream Model tests have demonstrated that a DBTF may produce substantially less noise than a conventional turbojet with the same thrust and weight flow Predictions from the model agreed well with measured data from the model tests. The characteristics of the DBTF acoustic power spectrum were shown to be related to the rapid mixing of the fan and primary streams. The effects of fan to primary velocity ratio, temperature ratio, area ratio, and the effect of nozzle geometry on DBTF jet noise were determined. (Author)

A77-51032 # Airframe noise - A status report, 1977 R L Chapkis and A H Marsh (DyTec Engineering, Inc, Huntington Beach, Calif) American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 4th, Atlanta, Ga, Oct 3-5, 1977, Paper 77-1268 8 p 35 refs

Numerous studies of airframe generated noise have now been conducted As a result, nonpropulsive noise sources are now routinely considered in evaluating landing noise levels of future airplanes All of the present methods for predicting airframe noise are largely empirical Uncertainty still exists as to the proper fluid mechanical and acoustical models to employ to describe airframe noise Further development of scaling laws and noise prediction models requires knowledge of Reynolds number and componentinteraction effects Progress since 1975 has included development of new experimental techniques for noise source identification and acquisition of high-quality flyover noise data (Author)

A77-51033 # Are wheel-well related aeroacoustic sources of any significance in airframe noise W M Dobrzynski and H H Heller (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Abteilung technische Akustik, Braunschweig, West Germany) American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 4th, Atlanta, Ga, Oct 3-5, 1977, Paper 77-1270 9 p 7 refs

An experimental program was initiated to determine the relative importance of wheel-well related aeroacoustic sources in the farfield airframe noise spectrum. Both model tests (employing geometric replicas of nose and main landing gear/wheel-well configurations) and full-scale tests (using a DC-10 series 30 aircraft) were conducted to study the aeroacoustic behavior of wheel-wells under flow-(respectively flight-) conditions corresponding to a landing approach situation Both model and full-scale tests indicate that aircraft wheel-wells respond primarily in their volume modes, however, levels of discrete frequency pressure modes within a wheel-well were found to be relatively low - on the order of 115 dB - for a typical approach condition and not very pronounced with respect to the neighboring random noise Prediction of farfield signatures due to wheel-well internal pressure resonances from model and full-scale data, and comparison-with--total aircraft-airframe-noise signatures-strongly suggest that wheel-well related aeroacoustic sources are rather unimportant in relation to other airframe noise contributors, such as landing-gears and wings (Author)

A77-51034 # Noise component method for airframe noise M R Fink (United Technologies Research Center, East Hartford, Conn) American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 4th, Atlanta, Ga, Oct 3-5, 1977, Paper 77-1271 11 p 18 refs US Department of Transportation Contract No FA76WA-3821

A method was developed for predicting aerodynamic noise radiated by an airframe Separate contributions are calculated for the clean wing, horizontal tail, vertical tail, landing gear, leading edge slats and flaps, and trailing edge flaps. Each noise component is predicted using scaling laws appropriate to that component, with amplitudes matched to available data Spectra calculated by this method, the NASA ANOPP total aircraft method, and the drag element method are compared with flyover noise data for a sailplane, a twin-propeller lightplane, a business jet, and a jumbo jet (Author)

A77-51035 \* # Auframe noise of the DC-9 A B Bauer and A G Munson (Douglas Aircraft Co, Inc, Long Beach, Calif) American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 4th, Atlanta, Ga, Oct 3-5, 1977, Paper 77-1272 8 p 11 refs Research supported by the Douglas Aircraft Independent Research and Development Program, Contract No NAS1-14696 (DOUGLAS-6658)

Airframe noise measurements are reported for the DC-9 31 aircraft flown at several speeds and with a number of flap, landing gear, and slat extension configurations. The data are corrected for atmospheric attenuation and spherical divergence, and are presented for an overhead position normalized to a 1-meter height. The sound pressure levels are found to vary approximately as the fifth power of flight velocity. Both lift and drag dipoles exist as a significant part of the airframe noise. The data are compared with airframe noise predictions using the drag element and the data analysis methods. Although some of the predictions are very good, further work is needed to refine these methods, particularly for the gear-down and flaps-down configurations.

A77-51036 \* # Experimental and analytical separation of hydrodynamic, entropy and combustion noise in a gas turbine combustor M Muthukrishnan, W C Strahle, and D H Neale (Georgia Institute of Technology, Atlanta, Ga) American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 4th, Atlanta, Ga, Oct 3-5, 1977, Paper 77 1275 11 p 12 refs Grant No NsG 3015

This paper deals with noise sources which are central to the problem of core engine noise in turbopropulsion systems. The sources dealt with are entropy noise and direct combustion noise, as well as a non-propagating psuedosound which is hydrodynamic noise. It is shown analytically and experimentally that a transition can occur from a combustion noise dominant situation to an entropy noise dominant case if the contraction of a terminating nozzle to the combustor is high enough. In the combustor tested, entropy noise is the dominant source for propagational noise if the combustor is choked at the exit. Analysis techniques include spectral, cross spectral, cross correlation, and ordinary and partial coherence analysis. Measurements include exterior and interior fluctuating and mean pressures and temperatures.

A77-51037 # Gas turbine engine core noise source isolation by internal-to-far field correlations B N Shivashankara (Boeing Commercial Airplane Co, Sesttle, Wash) American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 4th, Atlanta, Ga, Oct 3-5, 1977, Paper 77-1276 6 p

An auxiliary power unit (APU) was tested for exhaust noise in an anechoic chamber Six internal and numerous near- and far-field microphones were employed Extensive cross-correlation and coherence function analysis was performed. The combustor was found to be one of the dominant sources of exhaust noise in the far field below 400. Hz Additional\_noise generation around 375 and\_600 Hz was apparent between the combustor exit and the turbine exit which may be entropy noise or flow noise generated in the turbine inlet torus. The mixing process between the cooling air and the exhaust flow (which takes place a short distance upstream of the nozzle exit) was also identified as an important source of low frequency noise (Author)

A77-51038 \* # Measurement of far field combustion noise from a turbofan engine using coherence functions A M Karchmer, M Reshotko, and F J Montegani (NASA, Lewis Research Center, Cleveland, Ohio) American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 4th, Atlanta, Ga, Oct 3-5, 1977, Paper 77-1277 33 p 14 refs

Coherence measurements between fluctuating pressure in the combustor of a YF-102 turbofan engine and far-field acoustic pressure were made The results indicated that a coherent relationship between the combustor pressure and far-field existed only at frequencies below 250 Hz, with the peak occurring near 125 Hz. The coherence functions and the far-field spectra were used to compute the combustor-associated far field noise in terms of spectra, directivity, and acoustic power, over a range of engine operating conditions. The acoustic results so measured were compared with results obtained by conventional methods, as well as with as with as semiempirical predictions schemes. Examination of the directivity patterns indicated a peak in the combustion noise near 120 deg (relative to the inlet axis).

A77-51047 # New scaling laws for hot and cold jet mixing noise based on a geometric acoustics model C L Morfey, V M Szewczyk (Southampton, University, Southampton, England), and B J Tester (Lockheed-Georgia Co, Marietta, Ga) American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 4th, Atlanta, Ga, Oct 3-5, 1977, Paper 77 1287 26 p 29 refs Research supported by the Ministry of Defence (Procurement Executive), Contract No F33615-76-C 2021

New scaling laws are presented for hot turbulent jet mixing noise outside the cone of silence. These account for mean flow field effects on sound radiation via an analytical high-frequency approximate solution to Lilley's equation. Numerical calculations for sound radiation from sources in a cylindrical shear flow are used to test the validity of the approximation. The proposed scaling laws yield an excellent collapse of jet noise measurements over a wide range of conditions. The resulting information has been incorporated into a jet mixing noise prediction scheme which, with appropriate modifications to the analytical high-frequency approximation, can be applied both inside and outside the cone of silence. (Author)

A77-51048 = Shielding aspects of heated twin jet noise R A Kantola (GE Research and Development Center, Schenectady, NY) American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 4th, Atlanta, Ga, Oct 3-5, 1977, Paper 77 1288 15 p 9 refs US Department of Transportation Contract No QS-30034

A thorough experimental study of the noise characteristics of twin jets is presented in this paper. Both twin round and twin rectangular jets are investigated at typical jet engine conditions, that is with heated high velocity flow. By varying the nozzle to nozzle spacing, it is possible to discriminate between the effects of turbulent mixing and acoustic shielding. As a result of this investigation, it was established that the turbulent mixing effects (both interaction noise generation and mixing suppression) occur for closely spaced nozzles and while acoustic shielding occurs at all nozzle spacing, it plays the dominant role at wide nozzle spacings. The levels of this acoustic shielding afforded by an adjacent jet can be sufficient to cause a nearly complete masking of the noise of the shielded jet A significant discovery of this investigation was the importance of the layer of cooler slower moving ambient air that exists between the twin jet plumes. This interjet layer causes refraction and reflection of acoustic waves and as the nozzle separation increases, the layer extends further downstream, thereby shielding more of the jet noise (Author) sources

A77-51049 \* - An experimental investigation of the trailing edge noise mechanism J C Yu (NASA, Langley Research Center,

George Washington University, Joint Institute for Advancement of Flight Sciences, Hampton, Va) and C K W Tam (Florida State University, Tallahassee, Fla) American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 4th, Atlanta, Ga, Oct 3-5, 1977, Paper 77-1291 14 p 27 refs

An experimental investigation has been conducted to understand the physical mechanism of noise generation from a turbulent wall jet discharging over a flat plate and interacting with its sharp trailing edge An aspect ratio 10 rectangular nozzle was used to provide the wall jet Measurements made consist of farfield noise, surface pressure fluctuations, turbulent velocity fluctuations, and two-point space-time cross-correlations among these quantities Results are presented which suggest strongly that the generation mechanism is the interaction of the convecting large scale quasi orderly disturbance in the upper free shear layer of the wall jet with the trailing edge The interaction also excites large scale strong vortical motion in the trailing edge wake The dominant part of the sound field is highly coherent and in phase opposition across the trailing edge (Author)

A77-51052 # Unsteady surface pressure characteristics on aircraft components and farfield radiated airframe noise H H Heller and W M Dobrzynski (Deutsche Forschungs- und Versuchsanstalt fur Luft- und Raumfahrt, Abteilung technische Akustik, Braunschweig, West Germany) American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 4th, Atlanta, Ga, Oct 3-5, 1977, Paper 77-1295 11 p 12 refs

Aircraft wings and landing gears have been identified as primary contributors to airframe noise. An experimental and analytical research program was conducted to determine the relationship of aeroacoustic source mechanisms at the origin and the resulting farfield acoustic radiation for these particular aircraft components Employing an aerodynamically very clean glider both as test vehicle and test bed, fluctuating surface pressure characteristics were determined in regions that were suspected to be prime source areas. viz the wing flap trailing edges, and regions of highly turbulent flow impingement, or flow separation on fairly large models of 4-wheel main landing gears. Source characteristics in terms of surface pressure spectra and longitudinal and lateral pressure correlation lengths were ultimately used to predict farfield acoustic radiation, the results of this prediction procedure compared favorably with measured data. In review of this program, one may conclude that high-performance gliders offer themselves as excellent experimental tools in airframe noise research, providing near ideal test conditions, specifically inherent absence of disturbing (tunnel or engine) noise and flow turbulence, close to full-scale Reynolds-numbers and realistic relative motion of source and observer (Author)

A77-51057 \* ≓ A finite element algorithm for sound propagation in axisymmetric ducts containing compressible mean flow A L Abrahamson (Wyle Laboratories, Inc, Hampton, Va) American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 4th, Atlanta, Ga, Oct 3-5, 1977, Paper 77-1301 12 p 26 refs NASA-supported research

The described investigation is concerned with he development of a finite element scheme which can be used in a study of the acoustics of aircraft engine ducts. In the absence of suitable variational principles for acoustic fluctuations within an aircraft fan engine, an acoustic analysis must proceed directly from the differential equa tions which describe compressible flow. The derived equations cannot be solved algebraically. The numerical technique used for solving them makes use of a linear rectangular element of a type considered by Zienkiewicz (1971). Attention is given to aspects of element derivation, the global matrix assembly, the solution of the matrix equation, questions of acoustic attenuation, and illustrations of the potential of the current model in duct optimization.

A77-51060 # Source location by shielding with application to a large turbofan engine J A Beasley, E G Broadbent, and S M Damms (Royal Aircraft Establishment, Farnborough, Hants, England) American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 4th, Atlanta, Ga., Oct. 3-5, 1977, Paper 77-1304 13 p 12 refs

To investigate the distribution and directivity of the noise radiation from a large turbofan engine, it was mounted on a static test bed, and a movable screen was located successively at a number of positions partially shielding a microphone array. The results are analyzed by assuming that the acoustic source distribution can be represented by a number of discrete point sources spaced out along the axis of the engine and the jet. The directional strength of each point source is prescribed by a truncated Fourier series, whose coefficients are then evaluated by a least-squares fit to the measurements. (Author)

A77-51069 \* # Forward flight effects on EBF noise M R Fink (United Technologies Research Center, East Hartford, Conn) American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 4th, Atlanta, Ga, Oct 3-5, 1977, Paper 77-1314 12 p 16 refs Contract No NAS3 17863

Forward flight effects on local mean velocity and turbulence velocity profiles, surface pressure spectra, and far field acoustic pressure spectra were measured for a simple externally blown flap (EBF) Both upper-surface-blowing and under the wing configurations were tested Ratio of acoustic wind tunnel velocity to nozzle exhaust velocity was varied from 0 to 3/8 in steps of 1/8 A method was determined for predicting forward flight effects on surface-radiated noise. This noise is decreased in amplitude and shifted to higher frequency relative to data obtained at zero flight speed. Predictions are validated by comparisons with published NASA, Boeing, and Lockheed data. (Author)

A77-51070 \* # Forward speed effects on blown flap noise A P Pennock (Lockheed-Georgia Co, Marietta, Ga) American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 4th, Atlanta, Ga, Oct 3-5, 1977, Paper 77-1315 9 p 9 refs NASA-supported research

The effects of forward speed on the noise of under the-wing (externally blown flaps, EBF) and over-the-wing (upper surface blown, USB) blown flap configurations were measured in wind tunnel model tests with cold jets. The results are presented without correction for the effects (e.g., signal convection, shear layer refraction) associated with flight simulation in a wind tunnel or free jet facility. Noise decreases were generally observed at microphones forward of the wing. The reductions were larger at the low frequencies (below peak SPL) than at the high (above peak SPL). Noise increases of 10 dB or more were observed at the aft microphones, especially in the high frequency range.

A77-51071 \* # Numerical prediction of aeroacoustic jet-flap flows A J Baker (Tennessee, University, Knoxville, Tenn) and P D Manhardti (Computational Mechanics Consultants, Inc, Knoxville, Tenn) American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 4th, Atlanta, Ga, Oct 3-5, 1977, Paper 77-1316 11 p 26 refs Contract No NAS1-14282

Turbulent boundary layer flows departing an aerodynamic surface are experimentally verified to be strong sources of noise Analysis of the source tensor of the Lighthill equation identifies important gradients of mean and fluctuating velocity components Transition distributions of mean flow and select fluctuating velocity correlations, within the region immediately downstream of a sharp edged flap terminus are established by finite element solution of a parabolized form of the time-averaged steady flow Navier-Stokes equations closed with a turbulence kinetic energy model Numerical solutions are presented which quantize the localized large mean flow accelerations and resultant peaks in the distribution of turbulence kinetic energy in the near wake region Results are verified by comparison to experiment (Author)

A77-51072 \* # Interim noise correlation for some OTW configurations using external jet-flow deflectors U von Glahn and D Groesbeck (NASA, Lewis Research Center, Cleveland, Ohio) American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 4th, Atlanta, Ga, Oct 3-5, 1977, Paper 77-1317 27 p 5 refs

Jet/flap interaction acoustic data obtained statically from a model-scale study of STOL-OTW configurations with a conical nozzle mounted above the wing and using various external deflectors to provide jet-flow attachment are correlated. The acoustic data are correlated in terms that consider the jet/flap interaction noise contributions associated primarily with fluctuating lift, trailing edge, and configuration wake noise sources. Variables considered include deflector geometry, flap setting and wing size. Finally, the configuration overall noise levels are related to static lift and thrust measurements in order to provide insight into possible acoustic/ aerodynamic performance trade-off benefits.

A77-51073 \* # Over-the-wing model thrust reverser noise tests J Goodykoontz and O Gutierrez (NASA, Lewis Research Center, V/STOL and Noise Div, Cleveland, Ohio) American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 4th, Atlanta, Ga, Oct 3-5, 1977, Paper 77-1318 20 p 10 refs

Experimental results are presented for static acoustic tests of a 1/12 scale model over-the-wing target type thrust reverser. The model configuration simulates a design that is applicable to the over-the-wing short-haul advanced technology engine. Aerodynamic screening tests of a variety of reverser designs identified configurations that satisfied a reverse thrust requirement of 35 percent of forward thrust at a nozzle pressure ratio of 1.29. The variations in the reverser configuration included, blocker door angle, blocker door lip angle and shape, and side skirt shape. Acoustic data are presented and compared for the various configurations. The model data scaled to a single full size engine show that peak free field perceived noise levels at a 152.4 meter sideline distance range from 98 to 104 PNdB (Author)

A77-51074 \* # Summary of forward velocity effects on fan noise C E Feiler and J F Groeneweg (NASA, Lewis Research Center, Cleveland, Ohio) American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 4th, Atlanta, Ga, Oct. 3-5, 1977, Paper 77-1319 11 p 31 refs

The available experimental data comparing the in-flight and static behavior of fan noise are reviewed. These results are then compared with recent data obtained for a fan stage tested with forward velocity in the NASA Lewis 9x15 low speed wind tunnel. Tentative conclusions are presented, based on the author's judgments, about the significance and nature of the changes in noise observed when a forward velocity is imposed. Finally, the implications of the emerging picture of in-flight fan source noise for suppressor design are discussed. (Author)

A77-51075 # Investigation of subsonic fan noise sources by fluctuating pressure measurements on rotating blades P Raffy (SNECMA, Paris, France), S Lewy, J Lambourion, and M Chatanier (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France) American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 4th, Atlanta, Ga, Oct 3-5, 1977, Paper 77-1321 14 p 18 refs

Discrete frequency noise generated by a subsonic fan is studied through different experiments involving current aerodynamic and acoustic characterization, space structure measurement of in-duct propagating waves, and blade pressure measurements. These last tests were conducted on a six blades, low speed axial flow fan using electret miniature pressure transducers and on a scaled 0.47 meter diameter, high pressure ratio, subsonic fan using original thin film 50 micron thick - pressure transducers on blades. Relationships between inflow distortion, blade pressure signature and in-duct modal structure are highlighted and differences in the results obtained with the two fans analyzed Finally, starting from inflow distortion data as an input to theoretical calculations, blade pressure spectra, modal power distribution, radiated noise are derived and compared to experimental results

A77-51079 # Flight noise studies on a turbojet engine using microphones mounted on a 450 ft tower J R Brooks (Rolls-Royce

/1971/, Ltd , Bristol, England) American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 4th, Atlanta, Ga, Oct 3-5, 1977, Paper 77-1325 12 p 8 refs

The reported investigation had the objective to obtain definitive noise data from a small turbojet engine, statically and in flight Tests were designed for studying flight effects on the exhaust noise of a turbojet engine by making measurements at a number of jet velocities and forward speeds. It was attempted to obtain flight data for which ground effects were reduced to a minimum Corresponding static noise measurements included tests with the bare engine and tests in which the engine was installed in the aircraft. It was found that a use of tower-mounted microphones provided flight noise data of unusually good quality and tree from ground effects. Noise increases which occur in the forward arc, particularly in going from static to flight conditions, can only be explained by a mechanism which amplifies the noise as measured during a flyover.

A77-51080 \* # Acoustic scattering of point sources by a moving prolate spheroid S L Padula and C H Liu (NASA, Langley Research Center, Hampton, Va) American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 4th, Atlanta, Ga, Oct 3-5, 1977, Paper 77-1326 10 p

The theories of geometrical optics and diffraction are used to investigate the scattering of sound generated by a distribution of point sources in the neighborhood of a prolate spheroid Source positions, source frequencies, and spheroid sizes which correspond to source distributions and fuselage sizes in jet aircraft are selected. The alteration of the scattered field due to the simultaneous forward motion of the body and sources is illustrated. It is observed that the sound levels produced by rapidly moving point sources are sig nificantly higher than those produced by the moving source and body system. The results suggest that scattering of acoustic sources should be considered in any theoretical or experimental study of aircraft flyover noise. (Author)

A77-51081 # The noise from unheated supersonic jets in simulated flight W D Bryce and R A Pinker (National Gas Turbine Establishment, Farnborough, Hants, England) American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 4th, Atlanta, Ga, Oct 3-5, 1977, Paper 77-1327 13 p 18 refs

In an attempt to define the effect of flight on supersonic jet noise using controlled model scale experiments, a circular convergent nozzle passing an unheated airflow has been tested in an anechoic chamber with the addition of a co-flowing airstream to simulate flight. The results show that while the frequency of the shockassociated noise changes little in flight, the amplitude is modified both by changes in the source strength as measured at 90 deg to the jet axis and by a convective term which can be specified. The jet mixing noise reduces in flight by an amount consistent with that expected for a subsonic jet at the same velocity. (Author)

A77-51082 \* - Effect of flight on jet noise from supersonic underexpanded flows V Sarohia (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif) American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 4th, Atlanta, Ga, Oct 3-5, 1977, Paper 77 1328 9 p 20 refs Contract No NAS7 100

Experiments on underexpanded cold jet flows from a convergent nozzle under simulated flight conditions have shown that a large periodic spinning motion of the jet can occur with greatly enhanced broadband noise production. Shadowgraph pictures indicate that this oscillatory jet motion accompanies the generation of random weak shock waves at the source. These waves appear to be generated at the point downstream of the nozzle exit where the shock cells in the jet begin to disappear. The weak shock waves propagate upstream and have been identified to be the cause of enhanced broadband jet noise production in flight. In addition, the results show that the boundary layer flow conditions over the outside of the primary nozzle (simulating engine cowl flow in flight) have a key role in the production of these random weak shock waves (Author).

A77-51083 \* -' Effect of simulated forward speed on the jet noise of inverted velocity profile coannular nozzles A B Packman K W Ng (United Technologies Corp., Pratt and Whitney Aircraft Group, East Hartford, Conn.), and C Y Chen (United Technologies Research Center, East Hartford, Conn.) American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 4th, Atlanta, Ga., Oct. 3-5, 1977, Paper 77-1329. 12 p. 15 refs Contract No NAS3-17866

Tests were conducted of inverted velocity profile coannular nozzles and a conical nozzle in an acoustic wind tunnel facility to simulate flight effects on jet noise generation. Coannular model nozzles were tested at fan to core nozzle exit area ratios of 75 and 1.2 Fan stream jet velocity ranged up to 2000 fps at a variety of fan exhaust pressure ratios and temperatures for a core stream of 1000 fps. The wind tunnel airflow was varied from static to 425 fps. The acoustic results indicated that the noise level differences seen previously under static conditions are retained in the flight environ ment. (Author)

A77-51084 \*  $\neq$  Effects of forward motion on jet and core noise J K C Low (Douglas Aircraft Co, Inc., Long Beach, Calif.) American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 4th, Atlanta, Ga, Oct. 3-5, 1977, Paper 77-1330 15 p 20 refs Contract No NAS3 20031 (DOUGLAS-6616)

A study was conducted to investigate the effects of forward motion on both jet and core noise. Measured low-frequency noise from static-engine and from flyover tests with a DC-9-30 powered by JT8D 109 turbofan engines and with a DC-10-40 powered by JT9D 59A turbofan engines was separated into jet and core noise components Comparisons of the static and the corresponding in flight jet- and core-noise components are presented. The results indicate that for the DC 9 airplane at low power settings, where core noise is predominant, the effect of convective amplification on core-noise levels is responsible for the higher in-flight low-frequency noise levels in the inlet quadrant. Similarly, it was found that for the DC-10 airplane with engines mounted under the wings and flaps and flap deflection greater than 30 degrees, the contribution from jet flap-interaction noise is as much as 5 dB in the inlet quadrant and is responsible for higher in-flight low-frequency noise levels during approach conditions. Those results indicate that to properly investigate flight effects, it is important to consider the noise contributions from other low-frequency sources, such as the core and the jet-flap interaction (Author)

A77-51087 \* # Acoustic performance of inlet multiple-puretone suppressors installed on NASA Quiet Engine 'C' H E Bloomer, J W Schaefer, E J Rice, and C E Feiler (NASA, Lewis Research Center, Cleveland, Ohio) American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 4th, Atlanta, Ga, Oct 3-5, 1977, Paper 77-1333 10 p 11 refs

The purpose of the experimental program reported herein was to define the length of multiple pure tone (MPT) treatment required to reasonably suppress the MPT's produced by a supersonic tip speed fan and also determine what other suppression, broadband, and blade passing frequency (BPF), might be accomplished The experimental results are presented in terms of both far-field and duct acoustic data Front quadrant sound power level reduction in the far field is shown to agree with duct measurements over the range of treatment lengths Detailed one-third octave and narrow band spectra at the maximum forward noise angle are presented Some detailed analyses of one-third-octave band amplitudes are shown as a function of far-field angle. An approximate spinning mode duct propagation analysis is then introduced which predicts the acoustic suppression by the treatment on the multiple pure tones.

A77-51088 \* = Effects of simulated flight on fan noise suppression M F Heidmann and D A Dietrich (NASA, Lewis Research Center, Cleveland, Ohio) American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 4th, Atlanta, Ga, Oct 3-5, 1977, Paper 77-1334 22 p 17 refs

Attenuation properties of three treated fan inlets were evaluated in the NASA-Lewis Anechoic Wind Tunnel using a subsonic tip speed, 50.8 cm-diameter fan Tunnel flow simulated the inflow clean-up effect on source noise observed in flight and allowed observation of the blade passage frequency tone cut-off phenomenon Acoustic data consisted of isolated inlet noise measured in the far field at two positions and with traverses at four frequencies Averaged attenuation properties showed relative agreement of the inlets with their design intent, however, tunnel flow significantly affected the attenuation spectra. With no tunnel flow the strong blade passage tone was more highly attenuated than the adjacent broadband noise. With tunnel flow, when cut-off was observed, the attenuation at the tone frequency was comparable to that for broadband noise Tunnel flow increased by several dB the maximum attenuation occurring at midfrequencies of the attenuation spectra The combined effect of tunnel flow on attenuation and source noise resulted in suppressed fan noise levels throughout the spectra. Tunnel flow caused some substantial directivity variations that are interpreted as acoustic mode changes, with tunnel flow generally reducing the proportion of modes near cut-off (Author)

A77-51091 # Helicopter rotor aerodynamic and aeroacoustic environments C R Cox (Bell Helicopter Textron, Fort Worth, Tex) American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 4th, Atlanta, Ga, Oct 3-5, 1977, Paper 77-1338 11 p 11 refs

Results of flight tests are presented in which a helicopter rotor's blade surface pressure, leading edge stagnation point, surface flow magnitude and direction, and external noise were measured simultaneously Aerodynamic instrumentation installed at five radial blade stations is described and unsteady aerodynamic phenomena observed on the blades are identified Measured and theoretical normal force coefficients and angle of attack are compared General agreement is found for the azimuthal variation of each parameter Regions where theory and test disagree are identified and their importance to rotor performance design is discussed Airload fluctuations and acoustic signals are used to locate and define the origin of rotor noise during high speed flight and in operating regimes of strong wake interaction (Author)

A77-51092 \* # An experimental investigation of helicopter rotor high frequency broadband noise A Lee, K S Aravamudan, P Bauer, and W L Harris (MIT, Cambridge, Mass) American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 4th, Atlanta, Ga, Oct 3-5, 1977, Paper 77-1339 11 p 16 refs Grants No DAAG29-C 027, No NsG 2095

The paper describes experiments involving a 4 17 foot diameter model rotor operating in a 5 times 7 5 ft open jet wind tunnel enclosed in an anechoic chamber. The effects of rotor thrust, advance ratio, and the number of blades on the intensity and spectrum of high frequency broadband noise (HFBN) have been investigated. The effects of each parameter were determined by keeping the other two constant. The directivities of the two- and three-bladed rotors were measured in a direction perpendicular to the plane of the rotor disk. The effects of heading edge, pressure side, and suction side serrations on HFBN were measured under several operating conditions, and the effects of the serrations on the mean thrust generated by the rotor were studied A scaling law is proposed to determine the location of the peak frequency and intensity of HFBN (Author)

A77-51093 \* # Some results of the testing of a full-scale Ogee tip helicopter rotor, acoustics, loads, and performance W R Mantay (US Army, Air Mobility Research and Development Laboratory, Hampton, Va), P A Shidler, and R L Campbell (NASA, Langley Research Center, Hampton, Va) American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, <u>4</u>th, <u>Atlanta</u>, <u>Ga</u>, <u>Oct</u>\_ 3-5, 1977, Paper 77-1340 10 p 8 refs

Full-scale tests were utilized to investigate the effect of the Ogee tip on helicopter rotor acoustics, performance, and loads Two facilities were used for this study the Langley whirl tower and a UH-1H helicopter The test matrix for hover on the whirl tower involved thrust values from 0 to 44,480 N (10,000 lbs) at several tip Mach numbers for both standard and Ogee rotors The full scale testing on the UH-1H encompassed the major portion of the flight envelope for that aircraft Both near-field acoustic measurements as well as far-field flyover data were obtained for both the Ogee and standard rotors Data analysis of the whirl-tower test shows that the Ogee tip does significantly diffuse the tip vortex while providing some improvement in hover performance Flight testing of both rotors indicates that the strong impulsive noise signature of the standard rotor can be reduced with the Ogee rotor Forward flight performance was significantly improved with the Ogee configuration for a large number of flight conditions Further, rotor control loads and vibrations were reduced through use of this advanced tip rotor (Author)

A77-51094 \* # Some measured and calculated effects of a tip vortex modification device on impulsive noise R J Pegg (NASA, Langley Research Center, Hampton, Va) and R P White, Jr (Systems Research Laboratories, Inc, Newport News, Va) American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 4th, Atlanta, Ga, Oct 3 5, 1977, Paper 77-1341 8 p 23 refs

The results of a recent wind tunnel test program to evaluate the effectiveness of the Tip Air Mass Injection (TAMI) system in modifying the blade tip vortex occurring during helicopter flight is described with attention to the effect of this modification on the impulsive noise. The measurement program is explained, and the correlation between experimental and predicted results is discussed. Topics considered include the effect of descent rate on noise pressure time histories, the effect of air mass injection on noise, and the analysis based on a dB(A) weighted approach. Impulsive noise generated by the interaction of a helicopter rotor blade and the concentrated tip vortex during forward flight descent is a primary contributor to acoustic annoyance as it draws early attention to the presence of the helicopter.

A77-51095 \* # Interaction of rotor tip flow irregularities with stator vanes as a noise source J H Dittmar (NASA, Lewis Research Center, Cleveland, Ohio) American Institute\_of Aeronautics and Astronautics, Aeroacoustics Conference, 4th, Atlanta, Ga, Oct 3-5, 1977, Paper 77-1342 10 p 27 refs

The role of the interaction of rotor tip flow irregularities (vortices and velocity defects) with downstream stator vanes is discussed as a possible fan noise mechanism. This is accomplished by indicating some of the methods of formation of these flow irregularities, observing how they would behave with respect to known noise behavior and, attempting to compare the strength of the rotor tip flow irregularity mechanism with the strength of the more common rotor wake stator mechanism. The rotor tip flow irregularity-stator interaction is indicated as being a probable inflight noise source. (Author)

A77-51099 # Effect of forward motion on turbomachinery noise G L Blankenship (Douglas Aircraft Co, Inc, Long Beach, Calif) American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 4th, Atlanta, Ga, Oct 3-5, 1977, Paper 77-1346 17 p 27 refs (DOUGLAS-6619)

A study was conducted to determine a procedure for correcting static-engine data for the effects of forward motion Data were analyzed from airplane flyover and static-engine tests with a JT8D-109 low-bypass-ratio turbofan engine installed on a DC-9-30, with a CF6-6D high-bypass ratio turbofan engine installed on a DC-10-10, and with a JT8D-59A high-bypass-ratio turbofan engine installed on a DC-10-40 The observed differences between the static and the flyover data bases are discussed in terms of noise generation, convective amplification, atmospheric propagation, and engine instal lation. The results indicate that each noise source must be adjusted separately for forward-motion and installation effects and then projected to flight conditions as a function of source-path angle, directivity angle, and acoustic range relative to the microphones on

the ground High-frequency noise measured on the static-test stand and projected to flight must be adjusted for an additional source of atmospheric absorption, excess attenuation. The level and the directivity of the fan tone at blade passing frequency generated under static conditions must be corrected for the reduced level of turbulence in flight and for the change in the modal constituents of the source. At frequencies equal to and greater than the fanblade-passing frequency, the increased flight levels of turbine noise must be considered. (Author)

A77 51102 # Simultaneous characterization of jet noise sources and acoustic field by a new application of conditional sampling L Avezard, C Dahan, G Elias A Lelarge, J Maulard (ÜNERA, Châtillon-sous-Bagneux, Hauts de-Seine, France), and M Perulli (Complegne, Universite de Technologie, Complègne, France) American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 4th, Atlanta, Ga, Oct 3-5, 1977, Paper 77 1349 9 p 7 refs

A new method of signal processing involving conditional sampling permits the calculation of conditional coherence between an information representative of wave packets within an emitting medium and the acoustic field. This method is applied to jet noise emission, with different diagnostics within the jet (hot wire, laser velocimetry, infrared radiometry) and leads to the characterization of the acoustic field associated with the wave packets isolated, even in a poor acoustic environment. Furthermore, conditional schlieren photography triggered by the same conditioning criteria (on micro phone or jet probing signals) permits the visualization of these wave packets. (Author)

A77:51103 \* # Experimental results of large-scale structures in jet flows and their, relation to jet noise production V Sarohia and P F Massier (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif ) American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 4th, Atlanta, Ga, Oct 3-5, 1977, Paper 77-1350 7 p 16 refs Contract No NAS7-100

Experiments have been performed to determine the role of large-scale turbulent structures in the production of jet noise Axisymmetric turbulent jet flows at ambient stagnation temperature have been observed with the aid of flow visualization techniques Jet Mach numbers at the nozzle exit ranged between 01 and 09, and the Reynolds number, based on nozzle exit diameter, was approximately 10 to the 6th Large organized turbulent structures existed as far downstream of the nozzle exit as 7 diameters. High speed schlieren motion pictures synchronized with near field pressure measurements of an excited jet indicated that strong instantaneous peaks in the pressure signal occurred whenever a merging process between two large-scale organized structures occurred. This pressure julse propagated at a speed which was somewhat larger than the velocity of the jet at the nozzle exit.

A77-51107 \* # Aeroacoustic performance of a scoop inlet J M Abbott (NASA, Lewis Research Center, Cleveland, Ohio) American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 4th, Atlanta, Ga, Oct 3-5, 1977, Paper 77-1354 10 p 10 refs

Results of a low speed wind tunnel test program are presented which demonstrate the aerodynamic and acoustic performance of a scoop inlet Engine noise that would normally propagate toward the ground is directed upward by the extended lower lip of the scoop inlet In addition, more of the scoop airflow comes in from above the inlet than below, leading to relatively higher surface velocities on the upper lip and lower surface velocities on the lower lip. These lower velocities on the lower lip result in a higher attanable angle of attack before internal flow separation occurs (Author)

A77-51108 \* # The influence of the inlet duct contour on forward radiated fan noise D Sloan, B W Farquhar, and C Rayl (Boeing Commercial Airplane Co, Seattle, Wash) American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 4th, Atlanta, Ga, Oct 3-5, 1977, Paper 77 1355 11 p 10 refs Contract No NASI-14673 Measurements have been obtained to determine the extent to which the shape of the inlet duct affects the directivity pattern of forward radiated noise from aircraft gas turbine engines. The test program was conducted using a model fan to which were attached any of three inlet ducts with each designed to cause a particular noise directivity pattern. Existing information on the effects of wave refraction in inlet-type flow fields was used to design the duct contours. Results indicated that the shape of the inlet duct strongly influenced the radiated noise field but that wave refraction was not the dominant factor in controlling the noise directivity pattern.

(Author)

A77-51109 # A novel concept for suppressing internally generated aircraft engine noise S L Sarin and D A Cornelisse (Fokker-VFW, Schiphol Airport, Netherlands) American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 4th, Atlanta, Ga, Oct 3-5, 1977, Paper 77-1356 6 p

A method for suppressing aircraft engine noise through injection of hot air over the duct surface was investigated. The observed noise suppression capacity of an anti-icing system which injects hot air over the acoustical liners of engine intakes motivated static and in flight tests of the resultant noise levels. Findings indicated an appreciable lowering of forward radiated pure tone over RPM ranges at which noise is increasing with RPM. The phenomenon was also observed when untreated intakes were tested. Further study to determine the physical mechanism involved and the applicability of the technique to a variety of aircraft is proposed. J M B

A77-51115 \* # Acoustic loads on upper-surface-blown powered-lift systems C M Willis, J A Schoenster, and J S Mixson (NASA, Langley Research Center, Hampton, Va) American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 4th, Atlanta, Ga, Oct 3-5, 1977, Paper 77-1363 8 p 12 refs

Powered lift concepts are utilized in aircraft currently under development for STOL application. One of the concepts, upper surface blowing, places the jet exit just above the upper surface of the wing to produce powered lift from the jet exhaust blowing over the deflected flap. New data are presented to show the effects of airspeed, angle of attack, and angle of jet impingement. Scaling relationships are investigated concerning their applicability for extrapolating data to a different model size. The effects of a number of test parameters are examined and full scale spectra are predicted from model data. It is concluded that scale models are an effective means for obtaining fluctuating pressure spectra for use in aircraft design. The prediction of full-scale loads from model data will require geometrically accurate models and closely spaced measurement locations.

A77-51117 # Cabin noise behavior of a USB STOL transport L M Butzel, L D Jacobs, J V O'Keefe, and M B Sussman (Boeing Commercial Airplane Co, Seattle, Wash) American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 4th, Atlanta, Ga, Oct 3-5, 1977, Paper 77-1365 10 p

Exterior fuselage fluctuating pressures and cabin noise were measured for a 100 ton, twin engine, upper surface blowing (USB) propulsive lift aircraft Measurements were accomplished in conjunction with the developmental flight tests of the US Air Force YC-14 Advanced Medium STOL transport for various ground, low speed and cruise conditions Results from preliminary analysis of the data show orderly and intuitively reasonable trends. Interior and exterior levels are found to generally correlate with engine mixed exhaust relative jet velocity. Modest changes in interior noise are associated with USB flap and vortex generator deployment. The resultant data base should support further detailed analysis. (Author)

A77-51118 # An analytical model for entropy noise of subsonic nozzle flow H Y Lu (Boeing Commercial Airplane Co, Seattle, Wash) American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 4th, Atlanta, Ga, Oct 3-5, 1977, Paper 77-1366 7 p

An analytical model was developed for the evaluation of entropy noise generated in a low Mach number nozzle flow The acoustic intensity radiated from the nozzle exit was obtained in closed form Correlations among upstream temperature, pressure, and velocity fluctuations are required for calculation of radiated noise The mean flow and the flow inhomogeneities were assumed to be quasi one-dimensional, and an exponential nozzle was selected to simplify the analysis Results show that the upstream fluctuation of temperature is an important source of nozzle entropy noise and the noise intensity is roughly proportional to the nozzle contraction rate (Author)

A77-51178 Position Location and Navigation Symposium, San Diego, Calif, November 1-3, 1976, Proceedings Symposium sponsored by the Institute of Electrical and Electronics Engineers New York, Institute of Electrical and Electronics Engineers, Inc, 1976 243 p Members, \$15, nonmembers, \$20

Position location and navigation systems are discussed, with attention given to Doppler navigation concepts, inertial navigation systems, techniques involving distance measurement equipment (DME), hyperbolic range difference monitoring, the Navstar Global Positioning System and tactical radio frequency systems Topics of the papers include accuracy assessment of augmented multilateration tracking systems, a tracking system covering 100 test participants over a wide range, Doppler positioning for search and rescue missions, development of a range measurement system for tracking aircraft, optimal orthonormalization of strap-down inertial guidance systems, precise positioning of sonobuoys using DME techniques, low-altitude aircraft overflight monitoring, marine navigation systems, and the Joint Tactical Information Distribution System J M B

A77-51179 Position location systems technology N Lawhead (General Dynamics Corp, Electronics Div, San Diego, Calif) in Position Location and Navigation Symposium, San Diego, Calif, November 1-3, 1976, Proceedings New York, Institute of Electrical and Electronics Engineers, Inc, 1976, p 1-12

Inertial navigation and electromagnetic position location systems are discussed. The advantages of inertial systems, including high short-term accuracy, resistance to jamming and capability of accommodating an unlimited number of users without performance degradation, are reviewed, disadvantages, such as poor long-term accuracy due to gyro drifts and unwieldy size, are also cited Electromagnetic systems, which have high long-term accuracy and can be reduced to convenient size, are suggested as complements to the inertial devices Range measurement techniques employed by position location systems are reviewed, and the correction of range measurement errors is also considered. Several position location system configurations, including those that rely on range, azimuth and elevation readings, range and two direction angles, spherical range-only assessments, or hyperbolic range difference monitoring, are described JMB

A77-51180 Precision location, navigation and guidance using DME techniques J T Raney and K D Rehm (IBM Corp, Federal Systems Div, Owego, N Y) In Position Location and Navigation Symposium, San Diego, Calif, November 1-3, 1976, Proceedings New York, Institute of Electrical and Electronics Engineers, Inc., 1976, p 13-21 Grant No DAAD07-75-C-0108

A Distance Measurement Equipment (DME) approach for a precision location, navigation and control system which has multimission applications is presented Specifically, a description is given of the Drone Formation Control System (DFCS) which is intended to provide simultaneous location, navigation, guidance, control and telemetry functions of up to six Remotely Piloted Vehicles (RPVs) from takeoff to 'landing plus precision location and navigation of four additional vehicles Features discussed include automatic rendezvous, collision avoidance, manual/automatic control, and formation flying. The control and navigational concepts leading to accuracies of 23 feet in absolute position and 19 feet in relative position are discussed. The application of DME systems to other range instrumentation tasks, such as MSR (Mobile Sea Range), ATC (Air Traffic Control), RPV mission guidance and control, and weapon guidance applications is also considered. (Author)

A77-51181 A multipurpose position accuracy verification system H I Brock and G Bonfanti (Martin Marietta Aerospace, Orlando, Fla) In Position Location and Navigation Symposium, San Diego, Calif, November 1-3, 1976, Proceedings

New York, Institute of Electrical and Electronics Engineers, Inc, 1976, p 22-26 7 refs

A method for accurately estimating the position and velocity of aircraft during test flights at low altitudes is described. The position-fixing technique involves distance measuring equipment (DME), including an interrogator, installed on board the test aircraft, and a grid of five ground stations. The software developed for the interrogator is capable of compensating for hardware biases and atmospheric refraction errors, while producing real-time accuracy analyses, DME ground stations can be located on existing surveyed sites, eliminating the need for expensive resurveying. Position estimates accurate to less than 20 ft may be obtainable with the method. J M B

A77-51182 Accuracy evaluation of augmented multilateration tracking systems P H Lisman and J W Prausa (Stanford Research Institute, Menlo Park, Calif) In Position Location and Navigation Symposium, San Diego, Calif, November 1-3, 1976, Proceedings New York, Institute of Electrical and Electronics Engineers, Inc, 1976, p 27-32

Performance tests for high-accuracy aircraft tracking systems that combine multilateration position determination with inertial sensor attitude determination are discussed. The tracking systems, also known as state vector tracking systems, are typically capable of accuracies within 5 to 50 feet in position and 0.2 to 3 deg in attitude. The design of tests using independent reference instrumentation to verify that equipment will function within specified tolerance limits, or to measure the essential parameters of a particular cause-effect relationship in the system, is considered Reference instrumentation, which may include theodolites, laser trackers, photogrammetry, ballistic cameras and high-precision inertial systems, is described Data analysis schemes applicable to accuracy or precision tests are also mentioned. J M B

A77-51183 Applications of augmented multilateration tracking systems L E Davies (Stanford Research Institute, Menio Park, Calif) In Position Location and Navigation Symposium, San Diego, Calif, November 1-3, 1976, Proceedings

New York, Institute of Electrical and Electronics Engineers, Inc , 1976, p. 33-38  $\,$ 

Basically, multilateration tracking involves the measurement of the distances between the test/training PIP (participant instrumentation package) and three or more remote stations, and the use of these data in a computer to track the PIP. In the case of an augmented system other measurements that contribute to the tracking process are made at the participant vehicle. Representative augmented multilateration tracking systems include the RMS (range measuring system), the ACMR (air combat maneuvering range), and the EATS (extended area test system) The characteristics that determine potential applications are examined, taking into account advantages which also apply to a conventional radar, advantages which are related to the absence of angle measurements, and the types of augmentation. Present and potential applications are related to basic and primary flight training, air to surface weapon delivery, electronic warfare training, ground forces training, and fleet exercises G R

A77-51184 Technical objectives and approaches to the tracking subsystem of the Extended Area Test System /EATS/ J F Cline (Stanford Research Institute, Menlo Park, Calif) In Position Location and Navigation Symposium, San Diego, Calif, November

-3, 1976, Proceedings New York, Institute		te of	
Electrical and Electronics	Engineers,	Inc , 1976, p 39-46 Cont	racts
No N00019-70-C-039	1, No	N00019-71-C-0451,	No
N00019-73-C-0537,	No	N00123-74 C-0900,	No
N00123-75-C-0715			

The tracking apparatus developed for the Extended Area Test System of the Pacific Missile Test Center is described. The tracking subsystem is designed to perform multifateration tracking of up to 100 test participants (ships, aircraft, missiles and targets) within a 250-nautical mile range from an island station, the subsystem is also required to relay certain communication and instrumentation signals. Problems addressed in feasibility studies, including altitude reporting by test participants, transponcer peak power requirements, accuracy specifications, the analysis of radio frequency link failures and the use of airborne instrumentation stations, are reviewed Methods of increasing the capacity of the tracking apparatus, such as decreasing the interrogation rates of certain participants, are also mentioned J M B

A77-51185 Application of UHF adaptive array to navigation/tracking systems W K Masenten and W R Jones (Hughes Aircraft Co, Fullerton, Calif.) In Position Location and Navigation Symposium, San Diego, Calif., November 1-3, 1976, Proceedings New York, Institute of Electrical and Electronics

Engineers, Inc, 1976, p 47-52 8 refs. Contract No N00014-75-C-1198

The UHF Adaptive Array Processor was originally developed to suppress jammers and interference on UHF communication channels It can also effectively provide direction finding which uses signal sources, beacons, and interference/jammers. This feature allows a UHF antenna system to be utilized as a navigation aid and provides both absolute and relative directional data in the presence of jamming/interference environments The UHF Adaptive Array Processor forms beams and nulls in the direction of the desired signal and interference, respectively. Since a programmable computer implements the adaptation algorithms, a variety of array weighting algorithms can be used. These algorithms include the angle estimation technique recently proposed by Davis, Brennan, and Reed (1976), this technique forms the equivalent of the monopulse sum/difference patterns to estimate the signal source location. The ability of the UHF Adaptive Array Processor to implement this and other direction finding algorithms is discussed, and the function design and hardware implementation of the adaptive array processor are reviewed (Author)

A77-51186 \* Single pass Doppler positioning for Search and Rescue satellite missions P E Schmid, F O Vonbun (NASA, Goddard Space Flight Center, Greenbelt, Md ), and J J Lynn (Old Dominion Systems, Inc, Gaithersburg, Md ) In Position Location and Navigation Symposium, San Diego, Calif, November 1-3, 1976, Proceedings New York, Institute of Electrical and Electronics Engineers, Inc, 1976, p 58-67 6 refs

This paper describes the implementation of beacon location experiments involving the NASA Nimbus-6 and the Amateur Satellite Corporation (AMSAT) Oscar-6 and Oscar-7 spacecraft. The purpose of these experiments is to demonstrate the feasibility of determining the geographical location of a low power VHF 'distress beacon' via satellite Doppler data collected during satellite passes is reduced in a mini-computer by means of a simple algorithm resulting in the simultaneous recovery of the unknown receiver coordinates and the unknown Doppler bias frequency. Results indicate point positioning to within a few kilometers - which is within the required accuraces for the positioning of downed aircraft for Search/Rescue missions (Author)

A77-51187 Development of the RMS-2 System of ODDR&E/T&E/ R Gehrke (System Planning Corp., Arlington, Va.) In Position Location and Navigation Symposium, San Diego, Calif, November 1-3, 1976, Proceedings New York, Institute of Electrical and Electronics Engineers, Inc., 1976, p 68-72 The original Range Measurement System (RMS) was the result of a program conducted to obtain a multiple object tracking system There is now a family of such systems Each system utilizes the same basic concept and hardware to attain a multiple player tracking capability tailored to meet the needs of a particular test range. The development of the first RMS is described and investigations which led to the construction of the RMS-2 are examined. The first configuration of the RMS-2 is considered and the evolution of the early RMS-2 to its present RMS/SCORE configuration is discussed. The RMS/SCORE is flexible and adaptable by the choice of software control. It has tracked aircraft, helicopters, troops, and tanks. G R

A77-51188 History and development of the SCORE pod P F Hughes (System Planning Corp., Arlington, Va.) In Position Location and Navigation Symposium, San Diego, Calif, November 1-3, 1976, Proceedings New York, Institute of Electrical and Electronics Engineers, Inc., 1976, p. 77-80

The Simulated Combat Operations Range Equipment (SCORE) whose development was sponsored by the Deputy Director of Defense Research and Engineering for Test and Evaluation, ODDR&E(T&E), uses an inertial navigation system to provide accurate tracking of high-performance aircraft. The system operates as an adjunct to the multilateration tracking system, RMS-2 A flight test in November 1973 demonstrated the potential capability of the SCORE system A test in December 1974 indicated that the accuracy of the RMS/SCORE system approached predictions, but further development of the system was needed A field acceptance test of three SCORE pods, conducted in June-July 1976, showed that tracks of pairs of pods on an aircraft differed by 10 to 15 ft in position, 5 to 10 ft/sec in velocity and 1 to 2 deg in attitude. The RMS/SCORE Accuracy Test, initiated in the Summer of 1976, is designed to measure the accuracy of this system as a function of the vehicleto-system geometry, hardware and software configuration, and the physical environment (Author)

A77-51189 Navigation checkpointing with forward-sensed, fixed-range terrain profiles G E Carlson, G L Bair, and C M Benoit (Missouri-Rolla, University, Rolla, Mo.) In Position Location and Navigation Symposium, San Diego, Calif, November 1-3, 1976, Proceedings New York, Institute of Electrical and Electronics Engineers, Inc., 1976, p 81-88 Navy-supported research

A method for automatic identification of navigation checkpoints is presented. It uses terrain elevation profiles sensed at a fixed range with a forward-looking, azimuth-scanning radar. These profiles are compared with stored reference profiles to identify the aircraft position. The comparison concept and system implementation are discussed. The results of system analysis performed by digital simulation are shown. These results establish the theoretical feasibility of the system and indicate system parameter selections, limits on allowable profile errors, and the effect of aircraft altitude errors Results are presented for a range of terrain roughnesses to indicate the effect of this parameter. (Author)

A77-51190 Advanced terrain correlation techniques P R Hinrichs (E-Systems, Inc., Dallas, Tex.) In Position Location and Navigation Symposium, San Diego, Calif., November 1-3, 1976, Proceedings New York, Institute of Electrical and Electronics Engineers, Inc., 1976, p. 89-96

The requirements for an ideal positioning system are enumerated and compared with terrain correlation systems Models for terrain and performance characteristics are introduced Properly implemented, a terrain correlation system can be very accurate and tolerate large navigational uncertainties prior to the update Error estimates are made for state-of-the-art components and reference source data, and predictions using the performance models and these error characteristics indicate that accuracies rivaling optical systems can be achieved (Author)

A77-51192 Tactical and long-range navigation in the AN/ARN-101/V/ T E Perfitt and F E Pickel (Lear Siegler, Inc.,

Grand Rapids, Mich ) In Position Location and Navigation Symposium, San Diego, Calif , November 1-3, 1976, Proceedings

New York, Institute of Electrical and Electronics Engineers, Inc., 1976, p. 116-121 USAF-supported research

The AN/ARN-101 provides a navigation subsystem with a high degree of accuracy, flexibility, and expansion capability which, in turn, is the basis for accurate reconnaissance and weapon delivery operation in the RF-4C and F-4E aircraft. The navigation, position locating, and position updating capability utilizes a digital inertial measurement unit, Loran, fire-control radar, Pave Tack, TISEO, and optical sight interfaces A multisensor implementation of offset target location and coordinate computation is utilized to update the navigation position, and to provide information to the tactical problem The prime navigation mode is an integrated Loran-inertial implementation utilizing an 8-state Kalman filter and a secondary phase correction algorithm to minimize navigation errors associated with Loran Outputs are provided in latitude/longitude, Universal Transverse Mercator (UTM), and Loran Time Difference (TD) coordinates The computation subsystem was designed with spare memory and execution time to handle additional sensors as they are applied to the ARN-101 (Author)

A77-51195 Air Combat Maneuvering Range/Instrumentation 'ACMR/I' G W Eaton (Cubic Corp., San Diego, Calif.) In Position Location and Navigation Symposium, San Diego, Calif., November 1-3, 1976, Proceedings New York, Institute of Electrical and Electronics Engineers, Inc., 1976, p 141-148

The instrumentation system described provides real-time attitude and position data on eight high-dynamic fighter aircraft and position data on 12 additional cooperative targets. Position data is derived from multilateration range measurements using FM-CW phase-comparison techniques Attitude and acceleration data is obtained from a strap-down inertial system initialized by the ranging system Digital data is transmitted to and from the target by frequency shift keying of the ranging carrier A multiprocessor ground computer using Kalman filter techniques provides a total state vector for each participant at a rate of 10 per second. The multiprocessor also provides real-time missile simulation for performance scoring The Display and Debriefing Subsystem provides real-time computer-drawn pseudo three-dimensional display of the aircraft, total replay capability, and control of the entire system from the operator's console (Author)

A77-51196 Precise positioning of sonobuoys using AME and DME techniques R W H Keller (Cubic Corp., San Diego, Calif.) In Position Location and Navigation Symposium, San Diego, Calif., November 1-3, 1976, Proceedings New York, Institute of Electrical and Electronics Engineers, Inc., 1976, p 149-156

The Sonobuoy Reference System (SRS) described is a new technique in antisubmarine warfare. This system, flown by the Navy in S-3A and P-3C aircraft, allows precise electronic location of enemy submarines. Sonobuoys are dropped in the area of a suspected submarine, and SRS allows display of its location relative to the sonobuoys. Based on phase-comparison techniques, the system determines the angles between aircraft and sonobuoys by measuring the phase difference between a signal arriving at two antennas. Slant range is determined by measuring the phase delay of a signal transmitted from the aircraft Self-calibration, data processing (including Kalman filtering), and other system applications are also described. (Author)

A77-51197 Aircraft Space Position Measurement System -An application of precision DME E Herzberg (Cubic Corp., San Diego, Calif.) In Position Location and Navigation Symposium, San Diego, Calif., November 1 3, 1976, Proceedings

New York, Institute of Electrical and Electronics Engineers, Inc., 1976, p. 157-163

The Aircraft Space Position Measurement System (ASPMS) is a USAF omnidirectional tracking system designed and produced for

the 4950th Test Wing at Wright Patterson AFB, Ohio This system consists of two airborne interrogators, five transponders, a master site, and a ground relay station Rectangular and spherical coordinates of the aircraft are computed from multiple slant-range data furnished by distance-measuring equipment and a barometric altitude transducer Coordinates are provided in near real-time to the aircraft and to a laser tracking system for use in acquisition ASPMS has a range of 100 miles and a position-fixing accuracy of plus or minus 25 ft in the x- and y-directions, and plus or minus 50 ft in the z-direction (Author)

A77-51198 An application of Omega as a sensor R Brown and G Brohaugh (Northrop Corp., Electronics Div., Palos Verdes Peninsula, Calif.) In Position Location and Navigation Symposium, San Diego, Calif., November 1-3, 1976, Proceedings New York, Institute of Electrical and Electronics

Engineers, Inc., 1976, p. 169-176

A hybrid navigation system, for use on the USAF E-3A Airborne Warning and Control System, is described. The system consists of dual inertial navigation systems aided by both Doppler radar and Omega navigation equipment. The primary objective is to provide attitude, heading, velocity, and position information with a very high probability of mission success. Both bounded position accuracy (a one-mile standard deviation) and inflight alignment of the inertial navigators make Omega a logical choice as one of the prime sensor subsystems. The system that resulted from this effort provides both ground and inflight alignment of both inertial navigation systems. Inflight alignment has been achieved using Doppler radar and Omega together, Doppler radar alone, and Omega alone This paper discusses design and performance features of the system, addresses system-level considerations, and provides flight-test data (Author)

A77-51199 An integrated marine navigation system J M Nash (Orincon Corp., La Jolla, Calif.) In Position Location and Navigation Symposium, San Diego, Calif., November 1-3, 1976, Proceedings New York, Institute of Electrical and Electronics Engineers, Inc., 1976, p. 177-183. 6 refs

Optimal integration of four marine navigation sensor subsystems is achieved using a seven-state, extended Kalman filter. A surface ship's gyrocompass, electromagnetic speed (EM) log, Omega radio navigation receiver, and a Navy Navigation Satellite System (NNSS) receiver are used to obtain position and velocity measurements for input to a seagoing navigation system. Linearized error models are developed for each sensor subsystem and used in a covariance analysis of the integrated system Maneuvers, failure modes, and potential computational simplifications are modeled and analyzed Error budget sensitivity analyses are performed to ascertain the time-varying effects of various error sources on system accuracy. The result of the error modeling, covariance analyses and experiments with computational modifications is a best, suboptimal, filter design which is recommended for onboard multisensor integration of navigation sensors (Author)

A77-51200 Loran-C data acquisition and handling for improved accuracy D J Granato (Defense Mapping Agency, Hydrographic Center, Washington, D C ) and B J Uttam (Analytic Sciences Corp, Reading, Mass ) In Position Location and Navigation Symposium, San Diego, Calif, November 1-3, 1976, Proceedings New York, Institute of Electrical and Electronics Engineers, Inc, 1976, p 184-188 7 refs

The design of a Loran-C data handling system for navigation is presented, noting the force-fit algorithm, which has the potential to improve accuracy (dependent on wave propagation time) by reducing errors between theoretical and empirically-derived additional secondary phase (ASF) factors The primary elements of the Loran-C data acquisition system are described along with procedures for data handling, processing, and storage at a centralized facility The techniques are designed to generate improved ASF corrections, and thus improve general system accuracy SCS

A77-51201 Clarinet Pilgrim - Communications using Loran-C W N Dean (Magnavox Government and Industrial Electronics Co, Fort Wayne, Ind.) In Position Location and Navigation Symposium, San Diego, Calif, November 1-3, 1976, Proceedings New York, Institute of Electrical and Electronics

Engineers, Inc., 1976, p. 190-195

The Clarinet Pilgrim system, presently operational in the Northwest Pacific Loran-C chain, is used to transmit communications using pulse position modulation of some of the pulses from each Loran station. The position shifts are randomized to prevent timing errors. A theoretical analysis predicts that the effects on navigation receivers, both linear and hard-limiting, should be negligible. A series of controlled tests was made to determine the effects of modulation on hard-limiting receivers. The results show the effects to be truly negligible. (Author)

A77-51202 The GPS Control Segment and its service to the GPS User M J Hurley, D D Thornburg (General Dynamics Corp, Electronics Div, San Diego, Calif), and J L Kramer (General Dynamics Western Data Service Center, San Diego, Calif) in Position Location and Navigation Symposium, San Diego, Calif, November 1-3, 1976, Proceedings New York, Institute of Electrical and Electronics Engineers, Inc, 1976, p 196-202 DOD-sponsored research

Phase I of the GPS navigation satellite effort is to evaluate the performance of User receiving equipment Phase I is composed of six satellites, a ground Control Segment, and User equipment The purpose of this paper is to describe how the Control Segment supports the User equipment testing effort. The Control Segment generates the data required by the User to obtain a navigation solution, uploads this data into the satellite processor for transmission to the User, and collects the satellite ranging data required to determine the satellite ephemeris and clock performance parameters. The Control Segment software mechanization to perform these functions is a file-based, multi tasked architecture. This architecture and its legacy to future phases of GPS are also described.

A77-51203 The Inverted Range GPS User test facility R L Harrington and J T Dolloff (General Dynamics Corp., Electronics Div, San Diego, Calif) In Position Location and Navigation Symposium, San Diego, Calif, November 1-3, 1976, Proceedings New York, Institute of Electrical and Electronics Engineers, Inc., 1976, p. 204-211

The Inverted Range will supply four ground-based simulated GPS satellite signals at Yuma Proving Ground for testing of GPS receivers. The ground transmitters can operate independently or in synchronization with the satellites as they become available. The four ground transmitters are remotely controlled by the Inverted Range Control Center, which is equipped with a GPS receiver for monitoring both ground transmitter and satellite signals. The simulated satellite signals use four of the available 36 PRN codes to be used by GPS but differ from the satellites in that only the L1 signal is supplied. The navigation message contents are necessarily different, although the word/subframe/frame lengths and parity scheme are the same Both code phase and frequency of the ground transmitter signals are controlled. The code phase is controlled with a resolution of about 1.5 nanoseconds, and the ground transmitter signals are predicted to have an accuracy of a few nanoseconds. The signals will be radiated with hemispherical coverage at a power level selectable between -30 and +30 dBm (Author)

A77-51204 JTIDS - An overview of the system design and implementation R Dell-Imagine (Hughes Aircraft Co, Ground Systems Group, Fullerton, Calif) In Position Location and Navigation Symposium, San Diego, Calif, November 1-3, 1976, Proceedings New York, Institute of Electrical and Electronics Engineers, Inc., 1976, p 212 215

The Joint Tactical Information Distribution System (JTIDS) is a time-division multiple access communications system designed to operate in the 960-1215 MHz band of the Tactical Air Navigation System (TACAN) and provide a secure antijam data link to operate

in the tactical environment of the 1980's This paper summarizes the operation of JTIDS and the design of JTIDS terminals by Hughes Ground Systems under subcontract to Boeing for its E-3A program The network architecture, waveform characteristics, coding, and network synchronization methods are examined A summary of TACAN compatibility analyses and tests is given Finally, the partitioning of the E-3A hardware is described (Author).

A77-51205 Principles, simulation results and interoperability of JTIDS relative navigation W R Fried (Hughes Aircraft Co, Fullerton, Calif) In Position Location and Navigation Symposium, San Diego, Calif, November 1-3, 1976, Proceedings New York, Institute of Electrical and Electronics Engineers, Inc., 1976, p. 216-222

The time-synchronous operation and high accuracy time-ofarrival measurement capability of JTIDS terminals makes possible a high performance relative navigation (RELNAV) capability through addition of only a software module to the JTIDS communication terminal computer program Each member of a JTIDS community determines his own position, velocity and time bias through sequential passive time-of-arrival measurements on the signals received from the other members in the net, using appropriate source selection criteria, a recursive (e.g., Kalman) filter mechanization and extrapolation with dead reckoning data. Infrequent active roundtrip-timing is used by some units to maintain very high time quality The derived navigational information is either with respect to a relative grid, whose origin and direction are arbitrarily established by one member, or with respect to absolute, geographic coordinates Computer simulation results have demonstrated the high accuracy performance capability of the RELNAV concept for a variety of mission scenarios (Author)

A77-51261 \* Proving the correctness of a flight-director program for an airborne minicomputer W D Maurer (George Washington University, Washington, D C) (Association for Computing Machinery, Interface Meeting on Programming Systems in the Small Processor Environment, New Orleans, La, Mar 4-6, 1976) ACM SIGPLAN Notices, vol 11, Apr 1, 1976, p 103-108 NSF Grant No DCR 73-03431-A01, Grant No NsG 1170

Program verification procedures are described and used to determine the correctness of a program written for an airborne computer. The basic method relies on the inductive assertion method of Floyd (1967), modified and extended for application to a machine-language situation. Correctness considerations in the flight director program include self-modification, system correctness, executable instructions, overflow, approximate calculations with fractional quantities, and fixed point scaling. An example proof of correctness, which proceeds by proving the correctness of a certain subroutine, is provided.

A77-51276 # Electronic systems for air traffic control (Radiotekhnicheskie sredstva upravlenila vozdushnym dvizheniem) V A Boldin *Itogi Nauki i Tekhniki, Serila Radiotekhnika,* vol 10, no 1, 1976, p 5-103 36 refs in Russian

Various methods, employing electronic systems for air traffic control, are described, including Tacan, Loran, DF, VOR, ILS, MLS, and DABS Onboard systems for collision avoidance are presented (noting the criteria used for their design and testing) such as EROS II, AVOIDS, and SECANT Landing systems are discussed including those using amplitude scanning of antenna radiation patterns, systems employing the Doppler effect, and a comparison of systems using the Doppler effect, amplitude scanning, and a method of active interferometry SCS

A77-51277 # Radar systems with phased-array antennas (Radiolokatsionnye sistemy s fazirovannymi antennymi reshetkami) N T Vasilenko Itogi Nauki i Tekhniki, Seriia Radiotekhnika, vol 10, no 1, 1976, p 104-223 59 refs In Russian

Design principles for radar systems with phased-array antennas are described, including electronic beam control A classification

table of types of phased-array antennas is presented, noting the advantages and deficiencies of each. Noise immunity of radar systems with phased-array antennas is discussed along with the criteria for its evaluation. Techniques for sidelobe reduction are outlined, and descriptions of adaptive radar stations and radar stations using matched systems are included Suggestions are given for using radar systems with phased-array antennas for ground-based, shipboard, and airborne functions SCS

#### A77-51351 Automatic systems check-out Aviation Engineering and Maintenance, vol 1, Sept 1977, p 22-24, 39, 40

Components of the USAF Central Integrated Test (CITS) automatic built-in testing system are described in detail The CITS control and display panel is reproduced, and test display modes are listed, with identification codes CITS software options are enumerated in brief Descriptions are provided of the data bus, plug-in interface unit, data acquisition units (strategically located through the aircraft), computer-controlled airborne strip printer (furnishing hard copy on failures and fault isolation data to aid maintenance), and maintenance recorder (writing logistics information and ground analysis of difficult failures onto magnetic tape) The CITS system was designed for a B-1 prototype R D V

#### A77-51352 CF6 engine designed for maintenance Aviation Engineering and Maintenance, vol 1, Sept 1977, p 25-27, 48

Redesign of the CF6 bypass turbofan engine family and engine components for maintainability is described Improved maintainability is manifested in three areas enhanced inspection accessibility, easy rapid removal and replacement of engine parts, and modular construction of basic components Data on shop visit rates, inflight shutdown rates, and unscheduled removal rates for the CF6 and comparable engines are provided Fan, high-pressure compressor, low-pressure turbine, combustor/high-pressure turbine, and geabox are individually replaceable modules Transportability of the entire engine assembly and of modular parts is described Inspection ports for borescopes and their use are discussed R D V

#### A77-51353 Aurframe composite materials B Walsh Aviation Engineering and Maintenance, vol 1, Sept 1977, p 37, 38<sup>-</sup>

Advantages of composite materials for airframe parts fabrication, types of composites and their salient properties, composites development and applications programs sponsored by USAF, US Navy, and NASA, and barriers to acceptance of composites in the industry are discussed briefly. To date, use of composites has become common only in secondary structures (spoilers, fairing panels, control surfaces) and some medium primary structures (horizontal tail in B-737, vertical fin in DC-10 and L-1011). Weight savings and fuel savings with no loss in strength or service life, and lower costs with increasing acceptance and production and rising overall materials costs, are cited. R D V

#### A77-51354 Eight-channel resolver simplifies digital flight controls J Munn (Micro Networks Corp., Worcester, Mass.) Aviation Engineering and Maintenance, vol 1, Sept 1977, p 41-43, 63

A77-51460 A mathematical model of transcontinental balloon C D La Padula and C F Polcaro (CNR, Laboratorio di

Astrofisica Spaziale, Frascati, Italy) International Astronautical Federation, International Astronautical Congress, 28th, Prague, Czechoslovakia, Sept 25-Oct 1, 1977, Paper 77-167 22 p 6 refs

The general features of a mathematical model of intercontinental stratospheric balloon flight that takes into consideration the sunrise-sunset effect, outgassing, and balloon pressurization, are described. The computer program is based on both adiabatic formulas and step-by-step temperature variations. A ballast release logic optimized for best possible altitude stabilization and minimum ballast consumption was verified on model runs.

A77-51600 Computer studies of swirl flows in Carnot diffusors (Rechnerische Untersuchungen von Drallstromungen in Carnotdiffusoren) M Acriviellis (Karlsruhe, Universitat, Karlsruhe, West Germany) Forschung im Ingenieurwesen, vol 43, no 5, 1977, p 159-163 5 refs. In German

The calculation of the static pressure rise and the stagnation pressure drop for single-stage Carnot diffusors with swirl flow is carried out with the aid of a computational modes based on measurement results, and calculated values are compared with experiment The computed velocity trend and static pressure trend are in agreement with the experimentally determined ones, but the measured stagnation pressure is well below the calculated one. The reason for this is seen mainly in the appearance of vortex instabilities in the boundary layer of the swirl flow.

A77-51608 # Conditions of physical validity in the linear aerodynamics of supersonic jets (Conditii de validitate fizica in aerodinamica liniara a jeturilor supersonice) C lacob (Bucuresti, Universitatea, Bucharest, Rumania) Studii si Cercetari Matematice, vol 29, Sept-Oct 1977, p 507-519 5 refs in Rumanian

The theory of plane supersonic jets expanding in the atmosphere has been recently studied (Jacob, 1975) and an extension of the Prandtl formula has been obtained The formulae connect the length of the first wave to the mean diameter of the jet function of the pressure at the nozzle. In the present paper the physical validity conditions of these formulae have been analyzed and numerical results are presented.

A77-51610 # Queues with delayed, probabilistic feedback as a model of air traffic control communications W W Bundy and W C Giffin (Ohio State University, Columbus, Ohio) Operations Research Society of America and Institute of Management Sciences, Joint National Meeting, Miami, Fla, Nov 3-5, 1976, Paper 23 p 8 refs

The availability of aids to navigation and air traffic control facilities is one of the factors which determine the ultimate capacity of an airfield An investigation is conducted of the air traffic controller availability to pilots who need to engage in voice communications with the controller. The investigation makes use of a model for the description of the communication network and the measurement of its performance. The feedback model employed is examined. The model utilizes the numerical techniques for solving finite systems of linear differential equations with constant coefficients first proposed by Koopman (1972). Attention is given to approaches for modeling the probability of feedback, the definition of the probability state vector, the queue statistics calculated from the numerically determined time-varying probability distribution, and the results of a statistical analysis of voice communications.

GΠ

A77-51613 # Estimation of helicopter performance by an extended energy method improved by flight tests K Sanders (Deutsche Forschungs- und Versuchsanstalt fur Luft- und Raumfahrt, Institut fur Flugmechanik, Braunschweig, West Germany) Deutsche Gesellschaft fur Luft- und Raumfahrt, European Rotorcraft and Powered Lift Aurcraft Forum, 2nd, Buckeburg, West Germany, Sept 20-22, 1976, Paper 13 p. 8 refs

This paper presents a useful method for obtaining hecliopter performance data Only minimal flight test data is required and the method does not require excessive computer time. The estimation of helicopter performance by the energy method yields good results for medium forward speeds. The energy-method has been extended to also include hovering, low speed, and high speed flight. It was found that only a small number of flight test data points are needed to obtain the required correction factors. These factors cover effects which are not considered in the simple downwash model, take into account ground effect influences, and correct for power losses caused by compressibility effects. Results computed using the expanded method were compared with flight test data for five different helicopters. Calculated results agreed closely with experimental results when flight test data of sufficient accuracy was used (Author)

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### STAR ENTRIES

N77-32079\*# National Aeronautics and Space Administration Ames Research Center Moffett Field Calif

#### DETERMINING THE LIFT AND DRAG DISTRIBUTIONS ON A THREE-DIMENSIONAL AIRFOIL FROM FLOW-FIELD VELOCITY SURVEYS

Kenneth L Orloff May 1977 75 p

(NASA-TM-73247 A-7062) Avail NTIS HC A04/MF A01 CSCL 01A

The application of the incompressible momentum integral equation to a three-dimensional airfoil was reviewed to interpret the resulting equations in a way that suggests a reasonable experimental technique for determining the spanwise distributions of lift and drag. Consideration was given to constraints that must be placed on the character of the vortex wake structure shed by the wing to provide the familiar relationship between lift and bound vorticity. It is shown that the induced drag distribution is not directly measurable, but can be obtained via the lift distribution approximately for a deflected wake and exactly for a planar wake. Moreover it is shown that it is only necessary to survey a short distance above and below the wing trailing edge Examples are presented for several typical loading distributions and the results of a numerical simulation of the suggested experiment are discussed Author

N77-32080\*# National Aeronautics and Space Administration Hugh L Dryden Flight Research Center, Edwards Calif

### BUFFET CHARACTERISTICS OF THE F-8 SUPERCRITICAL WING AIRPLANE

V Michael DeAngelis and Richard C Monaghan Sep 1977 30 p refs

(NASA-TM-56049 H-945) Avail NTIS HC A03/MF A01 CSCL 01A

The buffet characteristics of the F-8 supercritical wing airplane were investigated. Wing structural response was used to determine the buffet characteristics of the wing and these characteristics are compared with wind tunnel model data and the wing flow characteristics at transonic speeds. The wingtip accelerometer was used to determine the buffet onset boundary and to measure the buffet intensity characteristics of the airplane. The effects of moderate trailing edge flap deflections on the buffet onset boundary are presented. The supercritical wing flow characteristics were determined from wind tunnel and flight static pressure measurements and from a dynamic pressure sensor mounted on the flight test airplane in the vicinity of the shock wave that formed on the upper surface of the wing at transonic speeds. The comparison of the airplane's structural response data to the supercritical flow characteristics includes the effects of a leading edge vortex generator Author

N77-32081\*# National Aeronautics and Space Administration Langley Research Center, Langley Station Va

#### AERODYNAMIC CHARACTERISTICS AT MACH NUMBERS FROM 0.6 TO 2.16 OF A SUPERSONIC CRUISE FIGHTER CONFIGURATION WITH A DESIGN MACH NUMBER OF 1.8

Barrett L Shrout Washington Sep 1977 79 p refs (NASA-TM-X-3559 L-11604) Avail NTIS HC A05/MF A01 CSCL 01A

An investigation was made in the Langley 8-foot transonic tunnel and the Langley Unitary Plan wind tunnel over a Mach

number range of 0.6 to 2.16 to determine the static longitudinal and lateral aerodynamic characteristics of a model of a supersoniccruise fighter. The configuration which is designed for efficient cruise at Mach number 1.8 is a twin-engine tailless arrow-wing concept with a single rectangular inlet beneath the fuselage and outboard vertical tails and ventral fins. It had untrimmed values of lift-drage ratio ranging from 10 at subsonic speeds to 6.4 at the design Mach number. The configuration was statically stable both longitudinally and laterally.

N77-32082\*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio

#### COLD-AIR PERFORMANCE OF A 12 766-CENTIMETER-TIP-DIAMETER AXIAL-FLOW COOLED TURBINE 3 EFFECT OF ROTOR TIP CLEARANCE ON OVERALL PERFORMANCE OF A SOLID BLADE CONFIGURATION

Jeffrey Haas (Army Air Mobility Research and Development Lab Cleveland Ohio) and Milton G Kofskey Sep 1977 24 p refs (NASA-TP-1032 E-9181) Avail NTIS HC A02/MF A01 CSCL 01A

Two tip clearance configurations one with a recess in the casing and the other with a reduced rotor blade height were investigated at design equivalent speed over a range of tip clearance from about 2.0 to 5.0 percent of the stator blade height. The optimum configuration with a recess in the casing was the one where the rotor tip diameter was equal to the stator tip diameter (zero blade extension). For this configuration there was an approximate 1.5 percent decrease in total efficiency for an increase in tip clearance of 1 percent of stator blade height. For the reduced blade height configurations there was an approximate 2.0 percent decrease in total efficiency for an increase in tip clearance of 1 percent of stator blade height configurations there was an approximate 2.0 percent decrease in total efficiency for an increase in tip clearance of 1 percent of stator blade height configurations there was an approximate 2.0 percent decrease in total efficiency for an increase in tip clearance of 1 percent of stator blade height configurations there was an approximate 2.0 percent decrease in total efficiency for an increase in tip clearance of 1 percent of stator blade height configurations there was an approximate 2.0 percent decrease in total efficiency for an increase in tip clearance of 1 percent of stator blade height configurations there was an increase in tip clearance of 1 percent of stator blade height configurations there was an increase in tip clearance of 1 percent of stator blade height configurations there was an increase in tip clearance of 1 percent of stator blade height configurations there was an increase in tip clearance of 1 percent of stator blade height configurations there was an increase in tip clearance of 1 percent of stator blade height configurations there was an increase in tip clearance of 1 percent of stator blade height configurations there was an increase in tip clearance of 1 percent of stator blade height configurations there was an increase in tip clearance of 1 percent of stator

Author

N77-32083\*# National Aeronautics and Space Administration Langley Research Center Langley Station Va EFFECT OF ROTOR WAKE ON AERODYNAMIC CHARAC-

SYSTEMS RESEARCH AIRCRAFT

Raymond E Mineck (US Army Air Mobility Research and Development Lab Langley Va ) Washington Sep 1977 120 p refs

(DA Proj 1L1-61102-AH-45)

(NASA-TM-X-3548 L-11515) Avail NTIS HC A06/MF A01 CSCL 01A

Tests were conducted in the Langley V/STOL tunnel to determine the effect of the main-rotor wake on the aerodynamic characteristics of the rotor systems research aircraft A 1/6-scale model with a 4-blade articulated rotor was used to determine the effect of the rotor wake for the compound configuration Data were obtained over a range of angles of attack, angles of sideslip, auxiliary engine thrusts rotor collective pitch angles and rotor tip-path plane angles for several main-rotor advance ratios Separate results are presented for the forces and moments on the airframe the wing and the tail An analysis of the test data indicates significant changes in the aerodynamic characteristics. The rotor wake increases the longitudinal static stability the effective dihedral, and the lateral static stability of the airframe. The rotor induces a downwash on the wing. This downwash decreases the wing lift and increases the drag. The asymmetrical rotor wake induces a differential lift across the wing and a subsequent rolling moment. These rotor induced effects on the wing become smaller with increasing forward speed Author

#### N77-32084# Navai Postgraduate School Monterey Calif DATA REDUCTION FOR THE UNSTEADY AERODYNAMICS ON A CIRCULATION CONTROL AIRFOIL M S Thesis Mar 1977 63 p. refs

(AD-A041153) Avail NTIS HC A04/MF A01 CSCL 20/4 Calculating the lift drag and pitching moment coefficients for an airfoil from the static pressure distribution obtained from wind tunnel tests is a routine task when steady flow is considered but it is much more complicated when the airfoil is operating in an unsteady flow field, similar to that experienced by a helicopter rotor blade, produced by an oscillating wind tunnel. A data reduction routine capable of condensing the large numbers of data associated with the unsteady investigation, as well as a numerical integration algorithm for the unsteady aerodynamic coefficients, were developed, however, no unsteady data were collected due to hardware failures. The ability of the program was demonstrated on previously obtained steady and quasi-steady data and sample results were presented Author (GRA)

N77-32085# Armament Development and Test Center, Eglin AFB, Fla

#### TRANSONIC PRESSURE DISTRIBUTION ON AN AIRCRAFT DURING WING MODEL ROCKET SLED RUNS **Final Report** Hans Rasmussen Mar 1977 73 p refs

(AD-A041633, ADTC-TR-77-34) NTIS Avail HC A04/MF A01 CSCL 20/4

Hardware and techniques are described which were used in a series of rocket sled runs aimed at measuring aerodynamic data in the transonic speed regime during rocket sled runs. During these tests surface pressure distribution was measured on an aircraft wing model mounted in vertical position on a rocket sled at Mach numbers between zero and Mach 0.95 and at Reynolds numbers (based on cord length) up to 23 millions The data were collected while sweeping the entire Mach number range both during acceleration and during deceleration. Selected data obtained in this test series are presented and compared with wind tunnel and flight test results. The influence of time delay in the pressure tubing is discussed and methods for compensating for this effect are presented Author (GRA)

#### N77-32090# Bolt, Beranek and Newman, Inc., Cambridge Mass A GUIDE FOR ESTIMATION OF AEROACOUSTIC LOADS ON FLIGHT VEHICLE SURFACES, VOLUME 1 Final Report, Jan 1975 - Jul 1976

Eric E Ungar John F Wilby, Donald B Bliss B Pinkel and A Galaitsis Wright-Patterson AFB, Ohio AFFDL Feb 1977 207 p refs

(Contract F33615-75-C-3017)

(AD-A041198 BBN-3215-Vol-1, AFFDL-TR 76-01-Vol-1) Avail NTIS HC A10/MF A01 CSCL 20/1

A compilation is presented of the best available methods for estimating the magnitudes, spectra and correlations of pressures that act on the surfaces of flight vehicles due to propulsion and powered lift systems, surface flows and arma-Author (GRA) ment

N77-32091# Advisory Group for Aerospace Research and Development Paris (France)

SPECIAL COURSE ON CONCEPTS FOR DRAG REDUC-TION

Jun 1977 294 p Presented at an AGARD Special Course at the von Karman Inst Rhode-St-Genese, Belgium, 28 Mar 1 Apr 1977

(AGARD-R-654 ISBN-92-835-1247-2) Avail NTIS HC A13/MF A01

The results of aerodynamic research and development in aircraft design to reduce drag, boundary layer control, and optimization of gas turbine intake system are evaluated in relation with fuel consumption

N77-32092\*# National Aeronautics and Space Administration Langley Research Center Langley Station Va AN OVERVIEW OF CONCEPTS FOR AIRCRAFT DRAG

### REDUCTIONS

Jerry N Hefner and Dennis M Bushnell In AGARD Spec Course on Concepts for Drag Reduction Jun 1977 30 p refs

Avail NTIS HC A13/MF A01 CSCL 01A

A current overview of aerodynamic drag reduction concepts which have potential for reducing aircraft fuel consumption is presented. The discussion shows where the greatest percentages. of aircraft fuel is burned and what areas have the greatest potential for fuel conservation. The paper deals with aerodynamic improvements and touches only briefly on structural and propulsion improvements. Concepts for reducing pressure drag (i.e. roughness wave interference and separation drag) drag due to lift/induced drag and skin-friction drag at subsonic and supersonic speeds are emphasized Author

#### N77-32093\*# National Aeronautics and Space Administration Langley Research Center Langley Station Va

#### METHODS FOR REDUCING SUBSONIC DRAG DUE TO LIFT

R T Whitcomb /n AGARD Spec Course on Concepts for Drag Reduction Jun 1977 17 p refs

#### Avail NTIS HC A13/MF A01 CSCL 01A

The results of repeat experimental research on methods for reducing subsonic drag due to lift are discussed The NASA supercritical airfoils and their application to structurally practical wings with increased aspect radio are described. A design approach and experimental results for wing-tip-mounted winglets are presented Several methods for utilizing the thrust of let engines to provide reductions in the drag due to lift are also discussed Author

N77-32101# DOD Aircraft Ground Fire Suppression and Rescue Office, Wright-Patterson AFB, Ohio

DESIGN OF A CASCADE FIRE APPARATUS FOR TESTING COUNTERMEASURE EFFECTIVENESS Final Report, Jan -Jun. 1976

S Wiersma R S Alger, R G McKee, and W H Johnson Jun 1976 51 p refs

(AD-A043176, DOD-AGFSRS-76-7) NTIS Avail HC A04/MF A01 CSCL 13/12

A cascade fire apparatus was designed to be used in the evaluation of agent effectiveness and application techniques in suppressing accidental aircraft ground fires involving fuels which are cascading, spraying, or pouring. The apparatus provides for (1) a controllable burning rate (2) a reproducible fire, (3) a flame geometry that minimizes wind effects, and (4) an adjustable size by virtue of its modular nature. One of the two fuel supply nozzling options yields a smokeless fire, however the other option has better fire characteristics for evaluating some of the countermeasures Suppression tests were conducted using PKP and Monnex dry chemical agents and gaseous Halon 1211 It was not possible to compare the effectiveness of Halon 1211 and the powder agents because of the different application rates and capacities of the extinguishers tested and therefore the different required fire size. The apparatus appeared to be well suited for evaluation of agent effectiveness against the kinematic fires and also for training firemen in fighting these fires

Author (GRA)

N77-32102# National Transportation Safety Board Washington, D C Bureau of Technology

### BRIEFS OF ACCIDENTS INVOLVING AIR TAXI OPERA-TIONS, US GENERAL AVIATION, 1975 1975 130 p

10/0 100 p			
(PB-267653/4,	NTSB-AMM-77-10)	Avail	NTIS
HC A07/MF A01	CSCL 01B		

Forty-three commuter air carrier and 157 on-demand air taxi accident briefs are reviewed. The brief format presents the facts, conditions, circumstances and probable cause(s) for each accident. Additional statistical information on all air taxi accidents is tabulated by type of accident phase of operation, injury index aircraft damage, pilot certificate, injuries and causal/factor(s)

GRA

### N77-32103 Texas Univ , Austin GLOBAL POSITIONING SYSTEM NAVIGATION ALGO-RITHMS Ph D. Thesis

Leonard Richard Kruczynski 1976 327 p

Avail Univ Microfilms Order No 77-11544

The passive-ranging concept of the system and the various hardware software and environmental factors which determine system accuracy were examined The simulation of an aircraft flight with satellite range and range-rate measurements and with barometric altimeter measurements is used to numerically evaluate navigation algorithms. The results show that accuracy is strongly dependent on user-satellite geometry. An exponentially correlated random acceleration filter model for the aircraft, combined with measurement bias models, was incorporated into an extended Kalman filter. Numerical results show that, for the basic filter model, filters which maintain good accuracy during the maneuvering phases of flight have poor performance during cruising flight and conversely, filters which perform well during cruise, have degraded accuracy during maneuvers.

N77-32104\*# National Aeronautics and Space Administration Ames Research Center, Moffett Field, Calif

#### MULTIPLE CURVED DESCENDING APPROACHES AND THE AIR TRAFFIC CONTROL PROBLEM

Sandra G Hart (San Jose State Univ, Calif), Duncan McPherson (San Jose State Univ, Calif), John Kreifeldt (Tufts Univ Medford, Mass), and Thomas E Wemple Aug 1977 20 p refs (Grant NGL-05-046-002)

(NASA-TM-78430, A-7151) Avail NTIS HC A02/MF A01 CSCL 17G

A terminal area air traffic control simulation was designed to study ways of accommodating increased air traffic density The concepts that were investigated assumed the availability of the microwave landing system and data link and included (1) multiple curved descending final approaches, (2) parallel runways certified for independent and simultaneous operation under IFR conditions, (3) closer spacing between successive aircraft, and (4) a distributed management system between the air and ground Three groups each consisting of three pilots and two air traffic controllers flew a combined total of 350 approaches Piloted simulators were supplied with computer generated traffic situation displays and flight instruments. The controllers were supplied with a terminal area map and digital status information. Pilots and controllers also reported that the distributed management procedure was somewhat more safe and orderly than the centralized management procedure. Flying precision increased as the amount of turn required to intersect the outer mark decreased Pilots reported that they preferred the alternative of multiple curved descending approaches with wider spacing between aircraft to closer spacing on single, straight in finals while controllers preferred the latter option. Both pilots and controllers felt that parallel runways are an acceptable way to accommodate increased traffic density safely and expeditiously Author

N77-32105# Technische Universitaet, Brunswick (West Germany) Sonderforschungsbereich 58 Flugfrehrung

#### CONTRIBUTIONS TO THE EVALUATION OF THE GERMAN PROPOSAL DLS FOR A NEW MICROWAVE LANDING SYSTEM, PART 1 [BEITRAEGE ZUR ERPROBUNG DES DEUTSCHEN VORSCHLAGES DLS FUER EIN NEUES MIKROWELLEN-LANDESYSTEM, 1 TEIL]

Sep 1976 91 p refs Partly in GERMAN and ENGLISH 2 Vol

(TUBS/SFB58/M1-Pt-1) Avail NTIS HC A05/MF A01

Research projects in connection with the development and evaluation of the German proposal DLS (Distance measuring equipment-based Landing System) are presented Topics include multipath propagation, systems capacity, and anthropotechnical aspects

N77-32106# Technische Universitaet, Brunswick (West Germany) Sonderforschungsbereich 58 Flugfuehrung SIMULATION OF THE MULTIPATH PROPAGATION OF DLS [SIMULATION DER MEHRWEGEAUSBREITUNG BEIM

#### DLS) H Ecklundt *In its* Contrib to the Evaluation of the Ger Proposal

DLS for a New Microwave Landing System, Pt 1 Sep 1976 p 6-12 refs in GERMAN

Avail NTIS HC A05/MF A01

Multipath propagation aspects of the German proposal for DLS (Distance measuring equipment-based Landing System), i.e., ground reflection building reflection aircraft reflection, diffuse reflection, and hump deviation were simulated As a basis for comparison, the MIT Lincoln Laboratory multipath simulation computer program was used. The development of the program s multipath driver with MIT subroutines and model driver with model subroutines is described.

N77-32107# Technische Universitaet Brunswick (West Germany) Sonderforschungsbereich 58 Flugfuehrung

MEASUREMENT OF THE MULTIPATH PROPAGATION AT THE BRUNSWICK TEST AIRPORT [MESSUNGEN DER MEHRWEGEAUSBREITUNG AUF DEM TESTFLUGHAFEN BRAUNSCHWEIG]

Peter Form and Springer *In its* Contrib to the Evaluation of the Ger Proposal DLS for a New Microwave Landing System, Pt 1 Sep 1976 p 13-27 in GERMAN

#### Avail NTIS HC A05/MF A01

A multipath instrument landing system was tested at Brunswick airport, Germany The Doppler shift between direct signal and reflected (building) system was used to separate the signals. The tests were performed with a Plaggio aircraft flying at 10 m altitude. The Doppler shifts of the direct and reflected signal (1011 MHz) were calculated Evaluation of the test data shows the technique to be promising.

#### N77-32108# Technische Universitaet, Brunswick (West Germany) Sonderforschungsbereich 58 Flugfuehrung THE BRUNSWICK DLS TEST AIRPORT AREA - A NON CLEAN ENVIRONMENT

Peter Form Springer, and H Ecklundt *In its* Contrib to the Evaluation of the Ger Proposal DLS for a New Microwave Landing System, Pt 1 Sep 1976 p 28-37 Presented at the 6th AWOP Working Group A Meeting, The Hague 5-16 Jul 1976

#### Avail NTIS HC A05/MF A01

DLS-independent multipath measurements and multipath environment simulation of the Brunswick test airport were made The results show the rather strong multipath propagation conditions under which the DLS microwave landing system is being tested ESA

N77-32110 Technische Universitaet Brunswick (West Germany) Sonderforschungsbereich 58 Flugfuehrung

#### INFLUENCE OF THE MULTIPATH PROPAGATION ON THE DISTANCE MEASURING PART OF DLS [EINFLUSS DER MEHRWEGEAUSBREITUNG AUF DEN ENTFERNUNG-SMESSTEIL DES DLS]

Busch In its Contrib to the Evaluation of the Ger Proposal DLS for a New Microwave Landing System Pt 1 Sep 1976 p 77-80 In GERMAN

#### Avail NTIS HC A05/MF A01

The influence of the multipath propagation on the distance measuring component of DLS was investigated by computer simulation. The simulation program consisted of three phases calculation of the demodulated signal calculation of the time failures and reconstruction of the evaluation algorithm of the DLS distance measuring component Results of the simulation programs show that for a disturbed demodulated signal (DME-impulse) the signal curve remains Gaussian ESA

N77-32111# Technische Universitaet, Brunswick (West Germany) Sonderforschungsbereich 58 Flugfuehrung PRESENTATION OF DLS INFORMATION

R Beyer In its Contrib to the Evaluation of the Ger Proposal DLS for a New Microwave Landing System, Pt 1 Sep 1976 p 81-84

Avail NTIS HC A05/MF A01

Displays of DLS information are discussed taking the advantages of DLS more flexible approach profiles new piloting

techniques and as a consequence advanced cockpit instrumentation into account. It is concluded that the conventional cockpit instruments generally are adequate for the conventional approach with DLS and that DLS simplifies the design of flight dependent circuits (e.g. gain programmers) needed to process relative position information by providing absolute position information ESA

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N77-32112# Technische Universitaet Brunswick (West Germany) Sonderforschungsbereich 58 Flugfuehrung CONTRIBUTIONS TO THE EVALUATION OF THE GERMAN PROPOSAL DLS FOR A NEW MICROWAVE LANDING

SYSTEM, PART 2 [BEITRAEGE ZUR ERPROBUNG DES DEUTSCHEN VORSCHLAGES DLS FUER EIN NEUES MIKROWELLENLANDESYSTEM, 2 TEIL] Mar 1977 79 p refs Partly in GERMAN and partly in ENGLISH

2 Vol

(TUBS/SFB58/M2-Pt-2) Avail NTIS HC A05/MF A01

Research projects in connection with the development and evaluation of the German proposal DLS (Distance measuring equipment-based Landing System) are presented Topics include multipath propagation simulation, adjustable null-steering in elevation measurement improvements to the DLS system multipath immunity in mountainous sites and Salzburg scenario for multipath simulation tests

#### N77-32116# Technische Universitaet Brunswick (West Germany) Sonderforschungsbereich 58 Flugfuehrung MULTIPATH IMMUNITY OF MLS IN MOUNTAINOUS SITES

Peter Form *In its* Contrib to the Evaluation of the Ger Proposal DLS for a New Microwave Landing System Pt 2 Mar 1977 p 55-66 refs Presented at the 7th AWOP Group A Meeting, London, Nov 1976

#### Avail NTIS HC A05/MF A01

The usability of microwave landing systems in mountainous regions is discussed. Some examples of operational sites partly surrounded by mountains requiring curved approach or missed approach procedures are given. Salzburg Airport and Hong Kong International Airport. The immunity of DLS (Distance measuring equipment-based Landing System) in such environments a result of the pulse transmission, is described. In addition to narrow angle focusing antennas, the used pulse technique generates elliptical characteristics in space which limits the space for transmission and eliminates multipath sources.

#### N77-32118# Technische Universitaet Brunswick (West Germany) Sonderforschungsbereich 58 Flugfuehrung CIVIL TRANSPORT AIRCRAFT SHORT RANGE ALL-WEATHER FLIGHT [ALLWETTERFLUG ZIVILER TRANS-PORTFLUGZEUGE IM NAHBEREICH]

Sep 1976 82 p refs in GERMAN

(TUBS/SFB58/FB1976) Avail NTIS HC A05/MF A01

Topics dealt with include flight path and aircraft position control, navigation and security systems instrumentation and human factors engineering

N77-32119# Technische Liniversitaet Brunswick (West Germany) Sonderforschungsbereich 58 Flugfuehrung

#### INTEGRATED PATH GUIDANCE SYSTEM FOR UNCONVEN-TIONAL APPROACH PROCEDURES [INTEGRIERTES BAHNFUEHRUNGSSYSTEM FUER UNKONVENTIONELLE ANFLUGVERFAHREN]

K H Doetsch and R Brockhaus *In its* Civil Transport Aircraft Short Range All-Weather Flight Sep 1976 p 7-28 refs In GERMAN

Avail NTIS HC A05/MF A01

Topics discussed include the hybrid computer system the simulation program, simulator extensions test evaluation, simulator tests, optimization of the multiparameter system, and application of characteristic frequency drift curves for the investigation of the breakdown security of flight control systems ESA

N77-32121# Technische Universitaet Brunswick (West Germany) Sonderforschungsbereich 58 Flugfuehrung FLIGHT MECHANICAL PROBLEMS IN CONNECTION WITH THE INTERCEPTION PROCESS [FLUGMECHANISCHE PROBLEME BEIM ABFANGVORGANG]

K Wilhelm In its Civil Transport Aircraft Short Range All-Weather Flight Sep 1976 p 33-35 in GERMAN

#### Avail NTIS HC A05/MF A01

The influence of wind shearing on the flight path of an aircraft was investigated using hybrid computer EAI Pacer 600 simulation on the one hand and mathematical modeling on the other hand. A program to optimize the interception and overshooting process by means of a digital computer program was initiated.

N77-32123# Technische Universitaet Brunswick (West Germany) Sonderforschungsbereich 58 Flugfuehrung RECOGNITION AND ELIMINATION OF INTERFERENCE DISTURBANCES BY MODIFICATION OF THE RADIO FIELD OF LANDING SYSTEMS WITH SPATIAL MODULATION DEGREE DIAGRAMS [ERKENNUNG UND BESEITIGUNG VON INTERFERENZSTOERUNGEN DURCH MODIFIKA-TIONEN DES FUNKFELDES VON LANDESYSTEMEN MIT RAEUMLICHEN MODULATIONSGRADDIAGRAMMEN] Westphai In Its Civil Transport Aircraft Short Range All-Weather

Westphal In its Civil Transport Aircraft Short Range All-Weather Flight Sep 1976 p 50-54 In GERMAN

#### Avail NTIS HC A05/MF A01

The influence of interference disturbed guidance signals on the behavior of a generalized airplane model in the approach phase was studied. By means of a small tabletop calculator EAI-TR 10 with a capacity of 20 summing amplifiers 20 coefficient potentiometers. 12 integrating networks and a multiplier the approach of a Boeing 707-312 without autopilot was simulated It is shown that the simulation system has similar accuracies in the flight dynamics as the real approach system. ESA

N77-32129# Martin Marietta Aerospace Denver Colo Denver Div

#### MICRON RELIABILITY ANALYSES Final Technical Report, Apr 1974 - Apr 1977

Richard W Burrows and Ray A Holtz Jun 1977 168 p (Contract F33615-74-C-1107)

(AD-A042987 MCR-74-164 AFAL-TR-77-62) Avail NTIS HC A08/MF A01 CSCL 17/7

The purpose of the MICRON Reliability Analysis Program was for Martin Marietta Corporation (MMC) to assist the Air Force Avionics Laboratory to achieve a MICRON Inertial Navigation System that would exhibit a high reliability and provide a significantly reduced cost-of-ownership. The approach used by MMC to help attain the specified program goals included, but was not limited to preparing a reliability program plan and reliability test plan, performing independent reliability analyses and assessments, preparing design guidelines, performing trade off studies developing reliability models supplying data, and monitoring testing GRA

N77-32131\*# National Aeronautics and Space Administration Langley Research Center Langley Station Va VARIATION OF PITCHING MOMENT WITH ENGINE

#### VARIATION OF PITCHING MOMENT WITH ENGINE THRUST FOR A TWIN-ENGINE COMMERCIAL JET AIRCRAFT

Robert E Shanks Washington Sep 1977 15 p refs (NASA-TM-X-3569 L-10984) Avail NTIS HC A02/MF A01 CSCL 01C

Flight tests were made to determine the effect of engine net thrust on airplane pitching moment for a twin-engine commercial jet transport in the approach climbout and descent and cruise configurations. The results indicate that for all the conditions analyzed, the pitching moment due to thrust is somewhat higher than that estimated from the product of net thrust and its moment arm (perpendicular distance from thrust axis to the airplane center of gravity). The differences are attributed to additional moments produced by nacelle normal force, jet-induced downwash and interaction between wing flow and engine nacelle flow Author

#### N77-32132# Coast Guard Washington D C WIDE AREA ILLUMINATOR DEVELOPMENT FOR US COAST GUARD HH-3F HELICOPTER Final Report, Jul 1975 - Jan 1977

James E Perry, Thomas Cassidy, Clifton S Fox and Gertrude H Kornfeld Feb 1977 81 p Prepared by Army Night Vision Lab Fort Belvoir Va

(AD-A041425 USCG-D-30-77) NTIS Avail HC A05/MF A01 CSCL 13/1

A program to define and design a wide area illuminator to be used on the United States Coast Guard HH-3F search and rescue helicopters is described. An explanation of the Night Vision Laboratory Computer search model and how it was used to select the optimum light source for the application is given Finally the completed purchase description and the test plan for use in evaluating the hardware when developed is presented It is anticipated that the first of the illuminators will be available for testing on aircraft during 1978 Author (GRA)

#### N77-32138# Kaman Aerospace Corp., Bloomfield, Conn HELICOPTER TRANSMISSION VIBRATION AND NOISE **REDUCTION PROGRAM** Final Report, May 1974 - Feb 1977

Michael A Bowes Nicholas Glansante, Robert B Bossler, Jr and Alex Berman Jun 1977 156 p refs (Contract DAAJ02-74-C-0039 DA Proj 1G2-62207-AH-89)

(AD-A042457 R-1495, USAAMRDL-TR-77-14) Avail NTIS HC A08/MF A01 CSCL 01/3

A combined analytical and test program has been performed to develop a method for analytically determining the vibration and noise characteristics of a helicopter transmission. This effort included formulation of the necessary analytical method, validation of this method through direct comparison with test data, and use of the method to predict the effects of various transmission design changes. The analytical method formulated in this program makes use of available techniques for predicting gear-meshinduced excitations. These techniques have been expanded to include a more rigorous treatment of spiral bevel and helical gear induced mesh excitations. Response of the dynamic system is predicted using a coupled torsion and bending analysis of the gearshafts, and includes the effects of bearing and case dynamics Predicted case surface response is used directly to calculate radiated sound power GRA

N77-32140# California Univ Los Angeles Dept of Mechanics and Structures

AN OPTIMALITY CRITERIA APPROACH TO THE MINIMUM WEIGHT DESIGN OF AIRCRAFT STRUCTURES term Report, 1 Mar 1976 - 1 Mar 1977 M W Dobbs and R B Nelson Mar 1977 96 p refs in-

(Grant AF-AFOSR-2640-74)

(AD-A042759, UCLA-ENG-7731 AFOSR-77-0844TR) Avail NTIS HC A05/MF A01 CSCL 01/3

The research presented in this report is both a continuation and an extension of the optimality criteria approach to structural optimization reported in AFOSR-TR-75-1431. In the present study the optimality criteria method is extended to provide a capability for the automated minimum weight design of elastic redundant structures composed of one- and two-dimensional structural elements and subjected to multiple independent static loading conditions The design variables are taken to be the thicknesses of the structural elements. These variables are constrained to be between specified maximum and minimum values as are the internal stresses in each element and the nodal displacements of the structure Results are presented to indicate both the excellent performance of the optimality criteria method and the wide range of structures which can be designed using the algorithm Finally, the algorithm is extended to include the new

(to automated design) and very important requirement that structural integrity under the applied loads be maintained given the presence of existing structural fatigue cracks. This requirement, which is cast in an energy format and incorporated in the design algorithm as an inequality constraint is shown to have a dominant effect in the design of safe minimum weight aircraft structures Author (GRA)

N77-32141# Defense Systems Management School, Fort Belvoir,

#### LIFE CYCLE COST REDUCTION TECHNIQUES ASSOCI-ATED WITH ADVANCED MEDIUM STOL TRANSPORT (AMST)

David R Forville May 1977 35 p refs

(AD-A042880) Avail NTIS HC A03/MF A01 CSCL 01/3 The report considers what factors have to be conceived developed, and evaluated in designing a transport aircraft system for introduction in the 1980's. The basic considerations are cost and the attempts made to reduce cost throughout the life cycle of the system AMST currently in the validation phase of its life cycle, is evaluated. The parameters considered for cost reduction are range/payload cargo compartment size, operational field length, engine availability and crew size. These tradeoffs are considered in arriving at a DTC goal. The LCC reduction possibilities are considered separately. The new concept of design to life cycle cost (DTLCC) is evaluated as a combination of DTC goals and LCC goals The Cost Analysis Cost Estimating (CACE) model is used as the evaluator of operating and support costs for the DTCC plan The results proved to be an overview of concepts versus hard facts because of the sensitive nature resulting from the upcoming source selection Author (GRA)

N77-32143# Bell Helicopter Co Fort Worth, Tex

ROTORCRAFT FLIGHT SIMULATION WITH COUPLED AEROELASTIC STABILITY ROTOR ANALYSIS VOLUME 3 PROGRAMMER'S MANUAL Final Technical Report

P Y Hsieh May 1977 84 p

(Contract DAAJ02-75-C-0025 DA Proj 1F2-62209-AH-76)

(AD-A042907 FTR699-099-022-Vol-3

USAAMRDL-TR-76-41C) Avail NTIS HC A05/MF A01 CSCL 09/2

This report consists of three volumes and documents the current version in the C81 family of rotorcraft flight simulation programs developed by Bell Helicopter Textron This current version of the digital computer program is referred to as AGAJ76 The accompanying program for calculating fully-coupled rotor blade mode shapes is called DN9100 Volume III, the Programmers Manual includes a catalog of subroutines and a discussion of programming considerations GRA

N77-32145# Texas Instruments Inc Dallas Equipment Group

#### SYSTEM AVIONIC ARCHITECTURES FOR RPVs Final Technical Report, 2 Feb - 2 Aug 1976

R Allen, L Chamberlin J Early J Graham, W Grimes E Karintis A Minnick and T Shipchandler Wright-Patterson AFB Ohio AFAL Apr 1977 203 p refs

(Contract F33615-76-C-1215)

(AD-A041502,	AFAL-TR-76-245)	Avail	NTIS
HC A10/MF A01	CSCL 01/3		

Results are presented from a 6-month study to design an avionic digital processing system for the multi-mission Advanced Remotely Piloted Vehicle (ARPV) application The recommended approach is a microprocessor-based design consisting of a distributed processing network with modular processor/memory elements (PEs) interconnected via a MIL-STD-1553A data bus The objective was to design a digital processing system providing not only adequate performance for the anticipated ARPV missions but also the lowest possible life cycle cost (LCC) Three different processing systems were designed to meet performance requirements for specific postulated ARPV missions. The total LCC for each candidate system was then estimated using a postulated 10-year life-cycle scenario. The optimum design was selected on the basis of minimum LCC. In addition to the minimum

LCC the recommended system also provides the best performance in terms of flight-critical reliability. The extensive use of standard modules throughout the distributed network provides flexible system performance by allowing throughput capacity and/or memory capacity to be increased readily as processing requirements demand. The use of standard modules is also important in achieving a low LCC. Results from this study in particular the modular design of the basic PE are applicable not only to the ARPV problem but other Air Force avionic processing applications as well. Author (GRA)

#### N77-32146# RAND Corp., Santa Monica Calif AVIONICS DATA FOR COST ESTIMATING

Bruce E Armstrong Mar 1977 20 p Presented at the 1976 DoD Cost Analysis Symp Airlie, Va 14-17 Nov 1976 (AD-A043265, P-5745-1) Avail NTIS HC A02/MF A01 CSCL 01/3

Avionics cost has been a continuing problem to the defense cost analyst. The various services and the Office of the Secretary of Defense (OSD) have sponsored numerous avionics data collection efforts as well as funding various companies to develop cost models and cost estimating relationships. To mention a few both the Air Force and the Navy and research firms such as General Research Corporation (GRC), Research Management Corporation (RMC), and Institute for Defense Analyses (IDA) have all been involved at one time or another with efforts to develop the avionics cost estimation methods and a supporting data bank The reason for this level of effort is that the costs of avionics account for nearly 30 percent of the total costs of fighter aircraft and a significant amount in most other aircraft types. Yet because of rapid technological change typically small production runs and poor historical cost information reliable prediction of avionics costs has been impeded. This paper discusses a recent Rand study sponsored by OSD/Director of Planning and Evaluation (DP and E) which had the objective of creating an avionics data base for tactical aircraft GRA

N77-32147# Illinois Univ Urbana-Champaign Coordinated Science Lab

ON THE IMPORTANCE OF PROGRAM INTELLIGENCE TO ADVANCED AUTOMATION IN FLIGHT OPERATIONS Final Report, 23 Jul 1973 - 22 May 1976

Robert T Chien Wright-Patterson AFB Ohio Apr 1977 51 p refs

(Contract F33615-73-C-1238)

(AD-A042915 AFAL-TR-77-20) Avail NTIS HC A04/MF A01 CSCL 01/4

In today's sophisticated aircraft much emphasis has been placed on the acquiring of and the displaying to the pilot an ever increasing amount of information obtained during flight missions This has resulted in increased workloads for the pilot which force him to evaluate highly complex sets of input data to decide upon courses of action and then to implement those actions in minimal times. Such a situation is seen as undesirable because it increases the pilot's chances for making errors which consequently lowers the probability of mission success. In order to continuously provide low workloads and hence more safety for the pilot his crew and the aircraft itself, the Coordinated Science Laboratory has developed a system which relieves the pilot of having to deal with many situations which would detract from his overall mission goals. This intelligent computer-aided decision making system (CADM) works cooperatively with the pilot in order to ensure the safety of the aircraft and its crew thereby allowing the accomplishment of successful missions

GRA

N77-32148\* National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio

### PLATFORM FOR A SWING ROOT TURBOMACHINERY BLADE Patent

Richard Ravenhall inventor (to NASA) (GE Cincinnati) Issued 30 Aug 1977 5 p Filed 3 Feb 1976 Sponsored by NASA (NASA-Case-LEW-12312-1 --US-Patent-4 045 149 US-Patent-Appl-SN-654787 US-Patent-Class-416-135 US-Patent-Class-416-190 US-Patent-Class-416-193A US-Patent Class 416-241A) Avail US Patent Office CSCL 21E A rotor apparatus comprising a biace having a root adapted to swing laterally within a supporting spindle under impact loading is provided with a flow path defining platform. The platform comprises an inner shroud extending generally laterally of the blade airfoil portion and adapted to swing laterally. In one embodiment wherein the blade primarily comprises a laminate of composite filament plies, the inner shroud is bonded to the laminate. An outer shroud fixed with respect to the supporting spindle, forms a lateral extension of the inner shroud with the blade in its normal operating position. The inner and outer shrouds are provided with a pair of complementary adjacent surfaces contoured to pass in relatively close-fitting relationships to each other when the blade swings under impact loadings

Official Gazette of the U.S. Patent Office

N77-32154\*# National Aeronautics and Space Administration Lewis Research Center, Cleveland Ohio

EFFECT OF SLOTTED CASING TREATMENT WITH CHANGE IN REYNOLDS NUMBER INDEX ON PERFORMANCE OF A JET ENGINE

John E Moss Jr and Willis M Braithwaite Sep 1977 19 p refs

(NASA-TP-1058 E-9185) Avail NTIS HC A02/MF A01 CSCL 21E

A tip-treated J85-13 engine was tested at Reynolds number indices (RNI) of 0.3 and 0.7 with a clean inlet for 80 and 100-percent corrected engine speeds. This engine was equipped with a compressor case which allowed changes to the case wall over the rotor tips of six of its eight stages. For all tests the principal effects were (1) with tip treatment a stall pressure ratio loss of 6 percent at 100 percent corrected engine speeds for both the 0.3 and 0.7 RNI and (2) with and without tip treatment decreasing the RNI from 0.7 to 0.3 decreased the stall pressure ratio 3.8 percent for 100 percent corrected engine speeds and 2.8 percent for 100 percent corrected engine

speed and 2.8 percent for 80-percent corrected engine speed Author

N77-32156\*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio

### INTERACTION OF ROTOR TIP FLOW IRREGULARITIES WITH STATOR VANES AS A NOISE SOURCE

James H Dittmar Oct 1977 14 p refs Presented at the 4th Aeroacoustics Conf Atlanta 3-5 Oct 1977 sponsored by AIAA

(NASA-TM-73706) Avail NTIS HC A02/MF A01 CSCL 21E The role of the interaction of rotor tip flow irregularities (vortices and velocity defects) with downstream stator vanes is discussed as a possible fan noise mechanism. This is accomplished by (1) indicating some of the methods of formation of these flow irregularities (2) observing how they would behave with respect to known noise behavior and (3) attempting to compare the strength of the rotor tip flow irregularity mechanism with the strength of the more common rotor wake stator mechanism. The rotor tip flow irregularity-stator interaction is indicated as being a probable inflight noise source.

#### N77-32157\*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio EFFECTS OF SIMULATED FLIGHT ON FAN NOISE SUP-PRESSION

Marcus F Heidmann and Donald A Dietrich Oct 1977 34 p refs Presented at 4th Aeroacoustics Conf Atlanta 3-5 Oct 1977 sponsored by AIAA

(NASA-TM 73708 E-9247) Avail NTIS HC A03/MF A01 CSCL 21E

Attenuation properties of three treated fan inlets were evaluated Tunnel flow simulated the inflow clean up effect on source noise observed in flight and allowed observation of the blade passage frequency tone cut-off phenomenon. Accustic data consisted of isolated inlet noise measured in the far ineld at two fixed positions and with traverses at four frequencies. Attenuation and source noise properties with and without flight simulation are compared and discussed. Averaged atrenuation properties showed relative agreement of the inlets with their design intent however tunnel flow significantly affected the attenuation spectra Author

N77-32158\*# National Aeronautics and Space Administration Lewis Research Center Cleveland, Ohio

#### ACOUSTIC PERFORMANCE OF INLET MULTIPLE-PURE-TONE SUPPRESSORS INSTALLED ON NASA QUIET ENGINE C

Harry E Bloomer John W Schaefer Edward J Rice and Charles E Feiler Oct 1977 16 p refs Presented at 4th Aeroacoustics Conf Atlanta 3-5 Oct 1977 sponsored by AIAA

(NASA-TM-73713) Avail NTIS HC A02/MF A01 CSCL 21E The length of multiple-pure-tone (MPT) treatment required to reasonably suppress the MPT's produced by a supersonic tip speed fan was defined. Other suppression broadband and blade passing frequency which might be accomplished were also determined The experimental results are presented in terms of both far-field and duct acoustic data Author

N77-32159\*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio

#### SUMMARY OF FORWARD VELOCITY EFFECTS ON FAN NOISE

Charles E Feiler and John F Groeneweg Oct 1977 16 D refs Presented at 4th Aeroacoustics Conf Atlanta, 3-5 Oct 1977 sponsored by AIAA

(NASA-TM-73722 E-9209) Avail NTIS HC A02/MF A01 CSCL 20A

Available experimental data comparing the in-flight and static behavior of fan noise are reviewed. These results are then compared with recent data obtained for a fan stage tested with forward velocity in a low speed wind tunnel. Tentative conclusions are presented about the significance and nature of the changes in noise observed when a forward velocity is imposed Finally the implications of the emerging picture of in-flight fan source noise for suppressor design are discussed Author

#### N77-32162# Avco Lycoming Engine Group Stratford Conn INVESTIGATION OF FACTORS CONTROLLING ENGINE SCHEDULED OVERHAUL 153/155 Paul A King and Robert L Givens May 1977 182 p refs

(Contract DAAJ02-75-C-0018)

(AD-A042190 LYC-76-42 USAAMRDL-TR-77-9) Avail NTIS HC AU9/MF A01 CSCL 05/1

This report presents an analysis of the factors responsible for the return of helicopter turbine engines to depot. Engine component causes are detailed from the larger set of total system caused returns. The derived data are used to identify significant parameters which can allow the design of high initial time between-overhauls with an optimum growth rate. Models and examples of the design approach are presented with emphasis on reliability and maintainability support. The report is concluded with a qualitative analysis of advanced component system concepts and their probable effect on TBO interval and safety/ mission reliability Author (GRA)

N77-32163# Air Force Aero Propulsion Lab Wright-Patterson AF8 Ohio

A REVIEW OF TURBOPROPULSION COMBUSTION PART 1 FUNDAMENTALS OF COMBUSTION PART 2 TURBOPROPULSION COMBUSTION TECHNOLOGY Summary Report, Mar 1975 - Dec 1976

William S Blazowski and Robert E Henderson Jun 1977 60 p refs

(AD-A043C22 AFAPL-TR-77-41) Avail NTIS HC A04/MF A01 CSCL 21/2

This report constitutes a reprint of two chapters on turbopropulsion combustion expressly prepared as part of a Propulsion Text Book entitled A Comprehensive Study of Aircraft Gas Turbine Engines, edited by G C Oates A variety of subjects are reviewed ranging from fundamental chemistry thermodynamics and gas dynamics of combustion to jet engine combustor design factors performance characteristics and engineering/analysis tools. In

addition the impact of environmental controls and regulations is discussed and the effects alternate and/or non-spec fuels may have on combustion system performance are examined. Each chapter includes an extensive reference list of related topics many of which expand further on key points discussed ĠRA

N77-32164# Politecnico di Torino (Italy) Ist di Macchine e Motori per Äeromobili

PRELIMINARY INVESTIGATIONS OF THE UNSTEADY FLOW IN TURBOJET ENGINES DURING TRANSIENTS

Maurizio Pandolfi and Luca Zannetti Mar 1976 23 p refs (Contract CNR-75-00353 07-115 6799) (Publ-PP-174) Avail NTIS HC A02/MF A01

The problem of predicting the performance of turbojet engines during transients is discussed. Some results of computations about typical fast transients, which may take place in turbojet engines are presented. The methodology is based on advanced numerical techniques successfully developed for unsteady gasdynamics problems, regarding the computational point of view and on classical concepts widely used in turbomachine studies regarging the modelling of the actual machine. The main limitations are related to the modelling of transonic or supersonic flow at the bladings which accrues at larger rotational speed FSΔ

N77-32173# Human Engineering Labs Aberdeen Proving Ground Md

#### COMPUTER-GENERATED DISPLAYS ADDED TO HEL HELICOPTER OPERATIONAL TRAINER Final Report

Gordon L. Herald May 1977 28 p (AD A043267 HEL-TM-18-77) NTIS Avail HC A03/MF A01 CSCL 05/9

A Singer-Link Helicopter Operational Trainer has been interfaced with the U.S. Army Human Engineering Laboratory's Command Control Simulator computer to provide the helicopter trainer with real-time computer generated cathode ray-tube imaging displays. This report discusses the equipment configuration data collection displays and the hardware and software problems associated with this development Author (GRA)

N77-32240# Rocket Propulsion Establishment, Westcott (England)

#### THE EFFECT OF SIMULATED AERODYNAMIC HEATING ON THE STRENGTH OF THREE ROCKET MOTOR CASE STEELS

G R Ramsden and D A R Herrick Jun 1976 24 p refs (RPE-TR-45, BR55715) Avail NTIS HC A02/MF A01

The effect of simulated aerodynamic heating on the strength of three high strength steels used in rocket motor cases was investigated Low alloy steel RS 131 (1 % Cr-Mo) and 18 % Ni maraging steels DTD 5212 and RPE 1090 (G 125) were tested at temperatures up to 700 C attained in 5 sec. The results show that the reduction in short term strength of these metals at elevated temperatures is not so great as to preclude their use in Mach 3 missiles and in some types of Mach 4 missiles Author (ESA)

N77-32280\* National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio

NICKEL BASE ALLOY Patent

John C Freche and William J Waters inventors (to NASA) Issued 6 Sep 1977 3 p Filed 30 Dec 1975 Supersedes N76-14247 (14 - 05 p 0557)

(NASA Case-LEW-12270 1 US-Patent-4 046 560

US-Patent-Appl-SN-645507 US-Patent-Class-75-170 US-Patent-Class-148-32 5} Avail US Patent Office US Patent Office CSCL 11F

A nickel base superalloy for use at temperatures of 2000 F (1095 C) to 2200 F (1205 C) was developed for use as stator vane material in advanced gas turbine engines. The alloy has a nominal composition in weight percent of 16 tungsten 7 aluminum 1 molybdenum 2 columbium 0.3 zirconium 0.2 carbon and the balance nickel

Official Gazette of the U.S. Patent Office

N77-32474# Royal Aircraft Establishment Farnborough (England)

#### A PRECISION VOLTAGE REFERENCE UNIT FOR CALIBRA-TING AIRBORNE DATA ACQUISITION SYSTEMS D Thomas Dec 1976 31 p refs

(RAE-TR-76164 BR560669) Avail NTIS HC A03/MF A01 A precision voltage reference unit is described which enables

the accuracy and precision of flight data acquisition systems to be measured under operational conditions. Two versions were designed having outputs of 8 mV and 4 V which simulate 80% of the full scale output respectively of low level (10 mV) and high level (5 V) transducer outputs and a range of source impedances is also simulated. The voltage stability of the units is better than 0.01% for the high level version and 0.1% for the low level version over the temperature range -40 to  $\pm$  80 C. The design is such that the magnitude of a number of error sources (e.g. common mode voltages system input impedances and offset voltages and currents) can be determined.

Author (ESA)

N77-32524# Scope Electronics Inc. Reston Va VOICE CONTROL SYSTEMS FOR AIRBORNE ENVIRON-MENTS Final Technical Report, 5 Jan 1976 - 4 Jan 1977 Hill Montague Griffiss AFB N Y RADC Jun 1977 93 p (Contract F30602-76-C-0127)

(AD-A043252 Rept-6205-0377 RADC-TR-77-189) Avail NTIS HC A05/MF A01 CSCL 01/3

The effects of g-force stress on human voice patterns were investigated with the objective of finding means for making isolated word recognition word devices work in the fighter aircraft cockpit environment. Data were taken in a human centrifuge with SCOPE Electronics Incis Voice Data Entry System (VDETS) used to prompt and pace the subjects. Data were subsequently digitized and stored for analysis and recognition experiments using the VDETS algorithm with a number of variations. Recognition performance on the centrifuge data was initially poor Means were found for improving it substantially through mudifications to the VDETS algorithm and through preprocessing techniques VDETS modifications included increased coding resolution improved segmentation techniques and provision for multimode training Breathing noise elimination and inverse filtering preprocessing routines were effective. Variations in spectral characteristics with g-force stress were found but no consistent pattern was discerned. The effectiveness of the inverse filtering led to the conclusion that the major problem was the race mask worn by the subjects, causing a variable element in the acoustic transmission path Additional work will be required to eliminate Author (GRA) face mask effects

N77-32573# Defense Systems Management School Fort Belvoir Va

## A NEW LOOK IN RELIABILITY F-18 OPERATIONAL MISSION ENVIRONMENT

Douglas P Dunbar Jr May 1977 40 p refs

(AD-A042781) Avail NTIS HC A03/MF A01 CSCL 17/8 This study project examines the F-18 program s development of an expected operational mission environment (OME) of the airplane to tailor existing specifications for design and test requirements of systems and equipment. Based on F-18 contractor studies and reports plus interviews of contractor and Navy Project Management Office personnel discussion is presented treating establishment of mission profiles/environments expected reliability improvements and life cycle cost savings. Study results indicate that use of the OME concept will significantly increase F-18 operational reliability as compared to existing carrier-based aircraft Analysis also indicates that a 'front end investment cost of approximately three million dollars for OME design and test of selected mission critical equipment will result in a savings-of over-100 million-dollars in-operating and support costs through manpower spares and rework reductions Recommendations include establishment of a requirement for and standard methodology of developing mission profiles early in the acquisition cycle of future systems. The expected operational envisionment derived from these profiles should then form the baseline for design and test requirements of system and equipment Author (GRA)

N77-32850# National Gas Turbine Establishment Pyestock (England)

## THE EFFECT OF FLIGHT ON THE NOISE OF SUBSONIC JETS

B J Cocking Oct 1976 37 p refs Presented at the 3d Aero-Acoust Specialists Conf Paio Alto Calif Jul 1976 (NGTE-R-343 BR55165) Avail NTIS HC A03/MF A01

The noise of a single-stream circular jet and a coaxial jet with coplanar nozzles of 2.5 area ratio has been measured under simulated flight conditions in the RAE 24 ft wind tunnel. The majority of tests were conducted with the single-stream jet and primary section of the coaxial jet at a nominal temperature of 880 K. The data were used to quantify the effect of jet temperature and were combined with measurements from an earlier test series to establish a prediction method for the effect of flight on the noise of single-stream subsorie jets. This method is based on jet noise theory modified by experimentally derived constants For coaxial jets it is concluded t' at the noise reductions which are independent of the secondary stream velocity are predicted to an acceptable degree by the method suggested for unheated single-stream jets. The prediction methods are suitable for both OASPLs and spectra Author (ESA)

N77-32871# Naval Air Development Center Warminster Pa Crew Systems Dept

#### PREDICTION OF AIRBORNE TARGET DETECTION

Gloria Twine Chisum 3 Jun 1977 27 p refs (AD-A041428, NADC-77102-40) Avail NTIS HC A03/MF A01 CSCL 17/8

The visibility of a uniformly luminous object depends on the apparent contrast between the object and its background the angular subtense of the object the contrast threshold of the observer at the level of luminance to which the eyes are adapted, the conditions and technique of observing and the shape of the object Techniques for combining the influence of the various factors have been applied to the problem of predicting airborne target detectability are made Author (GRA)

N77-33040\*# Academy of Sciences (USSR) Moscow National Committee for the History of Science and Technology ON THE WORKS OF S S NEZHDANOVSKY IN THE FIELD OF FLIGHT BASED ON REACTIVE PRINCIPLES, 1880 -

1895 c12 V N Sokolsky /n NASA Washington Essays on the History of Rocketry and Astronautics Vol 1 Sep 1977 p 125-139 refs

Avail NTIS MF A01 SOD HC CSCL 22A

The work of a Soviet scientist and inventor of the 19th century S S Nezhdanovsky is discussed Investigations in the field of aircraft science and technology are emphasized in relation to Nezhdanovsky s studies of using the jet principle in solving the problem of human flight Nezhdanovsky dealt with calculations of the speed at which combustion products flow and considered such problems as fuel feeding into the combustion chamber by means of pumps and the use of one of the fuel components for cooling the walls of the combustion chamber BLP

#### N77-33100<sup>5</sup># Aerophysics Research Corp., Bellevue, Wash NSEG A SEGMENTED MISSION ANALYSIS PROGRAM FOR LOW AND HIGH SPEED AIRCRAFT VOLUME 2: PROGRAM USERS MANUAL

D S Hague and H L Rozendaal Washington NASA Sep 1977 - 175 p

(Contract NAS1-13599)

(NASA-CR-2808) Avail NTIS HC A08/MF A01 CSCL 098 A rapid mission analysis code based on the use of approximate flight path equations of motion is described Equation form varies with the segment type, for example accelerations, climbs, cruises, descents, and decelerations. Realistic and detailed vehicle characteristics are specified in tabular form. In addition to its mission performance calculation capabilities, the code also contains extensive flight envelop performance mapping capabilities Approximate take off and landing analyses can be performed At high speeds centrifugal lift effects are taken into account Extensive turbolet and ramlet engine scaling procedures are incorporated in the code Author

#### N77-33101# Boeing Vertol Co., Philadelphia, Pa PRODUCT IMPROVEMENT PROGRAM EVALUATION Final Report, 17 May 1976 - 17 Feb 1977

Stephen J Blewitt Jun 1977 118 p refs

(DA Proj 1F2-62209-AH-76)

(AD-A042134 D210-11146-2 USAAMRDL-TR-77-17) Avail NTIS HC A06/MF A01 CSCL 01/3

This report presents the results of a study to davelop an analysis technique for evaluating the cost and operational effectiveness of potential aircraft modifications that affect reliability and maintainability Author (GRA)

N77-33102\*# Virginia Polytechnic Inst and State Univ.

### Blacksburg Dept of Engineering Science and Mechanics THREE DIMENSIONAL STEADY AND UNSTEADY ASYM-METRIC FLOW-PAST WINGS OF ARBITRARY PLAN-FORMS

O A Kandil E H Atta and A H Nayfeh Sep 1977 33 p refs

(Grant NGR-47-004-090)

(NASA-CR-145235) Avail NTIS HC A03/MF A01 CSCL 01A

The nonlinear discrete vortex method was extended to treat the problem of asymmetric flows past a wing with leading-edge separation including steady and unsteady flows. The problem was formulated in terms of a body-fixed frame of reference. and the nonlinear discrete vortex method was modified accordingly Only examples of flows past delta wings are presented Comparison of these results with experimental results for a delta wing undergoing a steady rolling motion at zero angle of attack demonstrates the superiority of the present method in obtaining highly accurate loads. Numerical results for yawed wings at large angles of attack are also presented. In all cases, total load coefficients, pressure distributions and shapes of the free-vortex sheets are shown Author

N77-33103\*# National Aeronautics and Space Administration Langley Research Center, Langley Station, Va

#### PRESSURE DISTRIBUTIONS ON A 1- BY 3-METER SEMISPAN WING WITH A NONSTREAMWISE TIP IN SUBSONIC FLOW

Long P Yip and Gary L. Shubert (Joint Inst for Advan of Flight Sci, Hampton, Va) Aug 1977 205 p refs

(NASA-TM-72755) Avail NTIS HC A10/MF A01 CSCL 01A Pressure distributions on a 1- by 3-meter semispan wing with a tip that is streamwise at 0 deg sweep are presented The tip becomes nonstreamwise as the wing is swept. At 0 deg sweep angle, the semispan wing has a taper ratio of 10 and NACA 0012 airfoil section contours. The test was conducted in the Langley V/STOL tunnel at a freestream dynamic pressure of 2 46 kPa. Pressure distributions are presented for sweep angles of 10, 20, 30, and 40 with an angle of attack range from -6 deg to 20 deg The data are presented without analysis or discussion Author

#### N77-33104\*# Kansas Univ, Lawrence FLIGHT EVALUATION OF AN ADVANCED TECHNOLOGY LIGHT TWIN-ENGINE AIRPLANE (ATLIT)

Bruce J Holmes Washington NASA Jul 1977 286 p refs (Grant NGR-17-002-072)

(NASA-CR-2832) Avail NTIS HC A13/MF A01 CSCL 01A Project organization and execution, airplane description and performance predictions, and the results of the flight evaluation of an advanced technology light twin engine airplane (ATLIT) are presented. The ATUT is a Piper PA-34-200 Seneca I modified

by the installation of new wings incorporating the GA(W)-1 (Whitcomb) airfoil, reduced wing area, roll control spoilers, and full span Fowler flaps The conclusions for the ATLIT evaluation are based on complete stall and roll flight test results and partial. performance test results The Stalling and rolling characteristics met design expectations. Climb performance was penalized by extensive flow separation in the region of the wing body juncture Cruise performance was found to be penalized by a large value of zero lift drag. Calculations showed that, with proper attention to construction details, the improvements in span efficiency and zero lift drag would permit the realization of the predicted increases in cruising and maximum rate of climb Author performance

N77-33105\*# Aeronautical Research Associates of Princeton, Inc, N J

#### VORTEX INTERACTIONS AND DECAY IN AIRCRAFT WAKES - Final Report

Alan J Bilanin Milton E Teske, Coleman DuPDonaldson and Guy G Williamson Washington NASA Sep 1977 121 p refs

(Contract NAS1-13939)

(NASA-CR-2870) Avail NTIS HC A06/MF A01 CSCL 20D The dynamic interaction of aircraft wake vortices was investigated using both inviscid and viscous models. For the viscous model, a computer code was developed using a second-order closure model of turbulent transport. The phenomenon of vortex merging which results in the rapid aging of a vortex wake was examined in detail. It was shown that the redistribution of vorticity during merging results from both convective and diffusive mechanisms Author

N77-33107\*# National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio

### NONLINEAR AEROELASTIC EQUATIONS FOR COMBINED FLAPWISE BENDING, CHORDWISE BENDING, TORSION, AND EXTENSION OF TWISTED NONUNIFORM ROTOR BLADES IN FORWARD FLIGHT

Krishna Rao V Kaza and Raymond G Kvaternik (NASA Langley Res Center) Aug 1977 111 p refs

(NASA-TM-74059) Avail NTIS HC A06/MF A01 CSCL 01A Second-degree nonlinear aeroelastic equations were developed using Hamilton's principle. The implications of the slender beam approximation as applied to the derivation of the seconddegree nonlinear equations of motion are discussed and a mathematical ordering scheme which is compatible with the assumption of a slender beam is introduced. The blade aerodynamic loading was obtained from strip theory based on a guasi-steady approximation of two dimensional, incompressible unsteady airfoil theory The equations were compared with several of those existing in the literature and the results are discussed Author

N77-33108\*# National Aeronautics and Space Administration Langley Research Center, Langley Station, Va

#### SUBSONIC LONGITUDINAL AERODYNAMIC CHARACTER-ISTICS AND ENGINE PRESSURE DISTRIBUTIONS FOR AN AIRCRAFT WITH AN INTEGRATED SCRAMJET DESIGNED FOR MACH 6 CRUISE

Jarrett K Huffman, Charles H Fox, Jr, and Patrick J Johnston Aug 1977 400 p refs

(NASA-TM-X-73911) Avail NTIS HC A17/MF A01 CSCL 01A

A 1/10-scale model of a proposed hypersonic aircraft with an integrated scramjet was tested. The investigation took place over a Mach number range from 02 to 07 and an angle of attack range from 2 deg to approximately 17 deg at a sideslip angle of 0 deg. The primary configuration variables studied were engine location, internal engine geometry and external engine geometry. The results are presented without analysis. Author

N77-33112\*# National Aeronautics and Space Administration Langley Research Center Langley Station Va THEORETICAL PARAMETRIC STUDY OF THE RELATIVE

ADVANTAGES OF WINGLETS AND WING-TIP EXTEN-SIONS

Harry H. huyson, Gregory D. Riebe and Cynthia L. Fulton. Sep. 1977 75 p refs

(NASA-TP-1020 L 11679) Avail NTIS HC A04/MF A01 CSCL 01A

It was found that for identical increases in bending moment a winglet provides a greater gain in induced efficiency than a tip extension. Winglet toe in angle allows design trades between efficiency and root moment. A winglet showed the greatest benefit when the wing loads were heavy near the tip Washout diminished the benefit of either tip modification and the gain m induced efficiency became a function of lift coefficient heavy wing loadings obtained the greatest benefit from a winglet, and low speed performance was enhanced even more than cruise performance. Both induced efficiency and bending moment increased with winglet length and outward cant. The benefit of a winglet relative to a tip extension was greatest for a nearly vertical winglet. Root bending moment was proportional to the minimum weight of bending material required in the wing it is a valid index of the impact of tip modifications on a new wing desian Author

N77-33114\*# Douglas Aircraft Co Inc. Long Beach, Calif WIND TUNNEL AND ANALYTICAL INVESTIGATION OF OVER-THE WING PROPULSION/AIR FRAME INTERFER ENCES FOR A SHORT-HAUL AIRCHAFT AT MACH NUMBERS FROM 06 TO 078 Final Raport

O D Wells M L Lopez H R Welge P A Henne, and A E Sewell Washington NASA Sep 1977 244 p rers (Contract NAS3-18284)

(NASA-CR-2905, MDC-J7601) Avail NTIS HC A11/MF A01 CSCL 01A

Results of analytical calculations and wind tunnel tests at cruise speeds of a representative four engine short haul aircraft employing upper surface blowing (USB) with a supercritical wing are discussed. Wind tunnel tests covered a range of Mach number M from 0.6 to 0.78. Tests explored the use of three USB nozzle configurations. Results are shown for the isolated wing body and for each of the three nozzle types installed Experimental results indicate that a low angle nacelle and streamline contoured nacelle yielded the same interference drag at the design Mach number A high angle powered lift riacelle had higher interference drag primarily because of nacelie boattail low pressures and flow separation. Results of varying the spacing between the nacelles and the use of trailing edge flap deflections. wing upper surface contouring and a convergent-divergent nozzle to reduce potential adverse jet effects were also discussed Analytical comparisons with experimental data made for selected cases indicate favorable agreement Author

N77-33115\*# National Aeronautics and Space Administration Langley Research Center Langley Station Va

THANSONIC WIND-TUNNEL INVESTIGATION OF THE MANEUVER POTENTIAL OF THE WASA SUPERCRITICAL WING CONCEPT, PHASE 1

James B. Hallissy and Triecdore G. Ayers. Washington Sep. 1977 295 p refs

(NASA-TM-X-3534 L 11064) Avail MTIS HC A13/MF AUT CSCL 01A

An investigation was conducted in the MASA Langley 8-foot transonic pressure tunnel at Mach numbers from 0.60 to 0.375 with a variable-wing sweep airplane model in order to evaluate a series of wings designed to demonstrate the maneuver potential of the supercritical airfoil concept. Both conventional and supercritical wing designs for several planform configurations were investigated with wing sweep angles from 16.0 deg to 72.5 drg depending on Mach number and wing configuration. The supercritical wing configuration showed significant improvements over the conventional configurations in drag-divergence Mach number and in drag level at transprise maneuver conditions.

Actor

N77-33116\*# National Aeronautics and Space Administration Langley Research Center Langley Station Va

TRANSONIC AERODYNAMIC CHARACTERISTICS OF A SUPERCRITICAL-WING TRANSPORT MODEL WITH TRAILING EDGE CONTROLS

Michael J. Mann and Richard A. Langhans. Washington: Oct. 1977 336 p refs

(NASA-TM-X-3431 L-10871) Avail NTIS HC A15/MF A01 CSCL 01A

The effects of wing trailing-edge control surfaces on the static transonic aerodynamic characteristics of a transport configuration with a supercritical wing were studied. The configuration was tested with both an area-ruled fuselage and a cylindrical fuselage. The Mach number range was from 0.80 to 096 and the angle of attack range was from -1 deg to 12 deg. The Reynolds number was 1 580 000 based on the mean aerodynamic chord. Tabular data are presented Author

N77-33117\*# National Aeronautics and Space Administration Langley Research Center Langley Station, Va

TRANSONIC AERODYNAMIC CHARACTERISTICS OF A SUPERCRITICAL-WING TRANSPORT MODEL WITH TRAILING-EDGE CONTROLS, SUPPLEMENT, PART 1

Michael J. Marin and Richard A. Langhans. Washington: Oct. 1977 493 p

(NASA-TM-X-3431-Pt-1) Avail NTIS HC A21/MF A01 CSCI 01A

For abstract see N77-33116

N77-33118 \*# National Aeronautics and Space Administration Langley Research Center Langley Station Va TRANSONIC AERODYNAMIC CHARACTERISTICS OF A

SUPERCRITICAL WING TRANSPORT MODEL WITH TRAILING-EDGE CONTROLS

Michael J. Mann and Richard A. Langhans. Vranhington: Out 1977 480 p

(NASA-TM-X-3431-Pt-2) Aval NTIS HC A21/MF A01 CSCL 01A

For abstract see N77 33116

N77-33119\*# National Aeronautics and Space Administration Langley Research Center, Langley Station Va TRANSONIC AERODYNAMIC CHARACTERISTICS OF 4

SUPERCRITICAL-WING TRANSPORT MODEL WITH TRAILING EDGE CONTROLS

Michael J. Mann and Richard A. Langhans. Washington: Oct. 1977 498 p

(NASA-TM-X-3431-Pt-3) Avail NTIS HC A21/MF A01 CSCL 01A

For abstract, see N77-33116

N77-33120\*# National Aeronautics and Space Administration Langley Research Center Langley Station, Va

TRANSONIC AERODYNAMIC CHARACTERISTICS OF A SUPERCRITICAL-WING TRANSPORT MODEL WITH TRAILING-EDGE CONTROLS

Michael J. Mann and Richard A. Langhans. Washington: Oct. 1977 476 p

(NASA-TM-X-3431-Pt-4) Avail NTIS HC A21/MF A01 CSCL 01A

For abstract see N77-33116

N77-33121\*# Textron Bell Aerospace Co Buffalo N Y Niagara Frontier Operations

UNSTEADY SUPERSONIC AERODYNAMIC THEORY FOR INTERFERING SURFACES BY THE METHOD OF POTEN-TIAL GRADIENT Final Report

William P Jones (Tex A&M Univ College Station) and Kari Arppa Washington NASA Oct 1977 38 p refs (Contract NAS1-13986)

(NASA-CR-2898) Avail NTIS HC A03/MF A01 CSCL 01A A generalized solution of the hyperbolic wave equation was further developed to relate the velocity components at a field point to the potential gradient distribution in the dependence domain. Singular integrals were evaluated in closed form, with numerical integration methods for more complex but analytic functions Idealization of the lifting surfaces by trapezoidal elements with two sides parallel to the streamlines is computationally efficient. Streamwise integrals were performed analytically and spanwise integrals were neccessary only on element leading and trailing sides All integrands vanish on the Mach cone Pressure distribution on a double delta wing and generalized aerodynamic coefficients for three AGARD planforms were calculated and compared with available results Author

#### N77-33122# Naval Postgraduate School Monterey Calif INITIAL UNSTEADY AERODYNAMIC MEASUREMENTS OF A CIRCULATION CONTROLLED AIRFOIL AND AN OSCIL-LATING FLOW WIND TUNNEL M S Thesis Emmett John Lancaster Jun 1977 74 p refs (AD-A042102) Avail NTIS HC A03/MF A01 CSCL 20/4

Steady state results of lift developed by varying the momentum blowing coefficient C sub mu upon a refurbished Circulation Control Rotor (CCR) airfoil section were favorable. This thesis was an experimental investigation to quantitatively evaluate whether the steady state results could be applied by a quasisteady assumption when a harmonic perturbation of C sub mu was superimposed upon the steady value Results suggested an attenuation in the dynamic transfer function of dC sub P/d C sub mu as the oscillating blowing frequency was increased initial measurements indicated that the RMS C sub P perturbation was an order of magnitude greater than the normalized RMS velocity perturbation. To further clarify this situation investigations were conducted to establish a dynamic frequency response calibration of the wind tunnel Results confirmed the order of magnitude difference between the RMS C sub P and normalized RMS velocity perturbations, indicating that the tunnel flow environment was governed by Euler's equation in its complete form rather than with the simplifications which lead to the quasi-steady small perturbation theory GRA

#### N77-33124# Naval Postgraduate School, Monterey, Calif AN ANALYSIS OF PERSONNEL PARACHUTES FOR USE BY MARINE CORPS FORCE RECONNAISSANCE UNITS M 8 Thesis

Robert Joseph McLaughlin Mar 1977 125 p refs

(AD-A041151) Avail NTIS HC A06/MF A01 CSCL 01/3 There is an opportunity for the Manne Corps to adopt a free-fall parachute, especially for Force Reconnaissance units, where the emphasis is on achieving an assigned mission for the Force Commander The subject of this thesis is to explore the field of free-fall and high-glide parachutes currently in use within the military establishment and the civilian community and to develop a model for selecting the most cost-effective free-fall parachute for use in the Marine Corps Author (GRA)

N77-33128\*# Scientific Translation Service Santa Barbara, Calif ANALYSIS OF AIR ACCIDENTS INVOLVING AIRPLANES OR HELICOPTERS OF VARIOUS TYPES OF APPLICATION T Kostia Washington NASA Aug 1977 21 p refs Transl into ENGLISH of Polish conf paper Presented at Ergonomics in Aviat 1st Natl Sci Technol Conf, Warsaw, 17-19 May 1975 p 266-282 Original language document was announced as A76-28551

(Contract NASw-2791)

(NASA-TT-F-17443) Avail NTIS HC A02/MF A01 CSCL 01C

The results are presented of a statistical analysis of air accidents involving two- and four-engine communications aircraft and general aviation aircraft up to 5.7 tons with emphasis on agricultural aircraft based on the whole on accident statistics published by the Civil Aeronautics Board. The occurrence rate of various kinds of accidents involving fatalities or not was calculated the causes of the accidents are classified and some conclusions are drawn from the results regarding possible directions for future safer designs for general aviation aircraft Author

N77-33129<sup>9</sup># Scientific Translation Service Santa Barbara Calit NOTES ON THE POLLUTION OF AIRPLANES AND HELI-COPTERS BY CHEMICALS DURING AGRICULTURAL JOBS Bernard Straszewski Washington NASA Aug 1977 5 p Transl into ENGLISH of Polish conf paper Presented at Ergonomics in Aviat 1st Natl Sci Technol Conf, Warsaw 17-19 Mar 1975 p 326-328

(Contract NASw-2791)

(NASA-TT-F-17444) Avail NTIS HC A02/MF A01 CSCL 01C

Contamination of the fuselage the pilot's cabin the engine, and the onboard compressed air installations while spraying agricultural fields is briefly discussed. Corrosion, service life and exposure of the pilot and service personnel to toxic chemicals are among the factors considered J M S

N77-33130<sup>•</sup># National Aeronautics and Space Administration Ames Research Center Moffett Field Calif

A FLIGHT INVESTIGATION OF THE WAKE TURBULENCE ALLEVIATION RESULTING FROM A FLAP CONFIGURA-TION CHANGE ON A B-747 AIRCRAFT

Robert A Jacobsen and Barbara J Short Jul 1977 45 p refs

(NASA-TM-73263, A-7116) Avail NTIS HC A03/MF A01 CSCL 01C

A flight test investigation was conducted to evaluate the effects of a flap configuration change on the vortex wake characteristics of a Boeing 747 (B-747) aircraft as measured by differences in upset response resulting from deliberate vortex encounters by a following Learjet aircraft and by direct measurement of the velocities in the wake. The flaps of the B-747 have a predominant effect on the wake. The normal landing flap configuration produces a strong vortex that is attenuated when the outboard flap segments are raised, however extension of the landing gear at that point increases the vortex induced upsets. These effects are in general agreement with existing wind tunnel and flight data for the modified flap configuration.

N77-33131# National Aeronautical Lab Bangalore (India) Information Centre for Aeronautics

BIRD STRIKE HAZARDS A BIBLIOGRAPHY, 1971 -1976

H S S Murthy, comp Jun 1977 22 p

(NAL-Bibl-Ser-77) Avail NTIS HC A02/MF A01

A comprehensive collection of literature on aircraft bird strike hazards is presented. The entries are arranged into six groups (1) literature survey (2) bird ingestion (3) environmental control (4) laser techniques, (5) radar techniques and (6) structural design. An author index is provided.

N77-33132# ARA Inc., West Covina Calif

INVESTIGATION OF AN ALUMINUM ROLLING HELIX CRASH ENERGY ABSORBER Final Report, Feb - Dec 1975

Bernard Mazelsky May 1977 36 p

(Contract DAAJ02-75-C-0015)

(AD-A042084 ARA-176 USAAMRDL-TR-77-8) Avail NTIS HC A03/MF A01 CSCL 01/3

This report covers an investigation of various aluminum alloy wires suitable for a rolling helix energy absorber strut (TOR-SHOK) for use in crashworthy troop seats. Several aluminum alloy wire types were investigated to determine the linear stroking distance that the device could endure prior to the breaking of the helical wires and to ascertain compatibility with the 6061-T6 aluminum tubes that are used as the struts to transmit the impact forces into the energy-absorbing helical wires. Once the wire was selected several struts were fabricated and tested In addition, two units were subjected to environmental tests in accordance with Military Standard 810B and were statically tested after the environmental tests. This study indicated that the most compatible aluminum wire to be used with the 6061-T6 aluminum tubing is the 5056-H38 series aluminum wire. The devices after being subjected to the environmental tests performed the same as those devices that were not subjected to the environmental tests. This was primarily a result of properly GRA anodizing and sealing the aluminum tubing

N77-33135# Calspan Corp Buffalo, N Y

MULTIPATH AND PERFORMANCE TESTS OF TRSB RECEIVERS Interim Report, 1974 - Mar 1977

J Beneke C W Wightman C B Vallone, and A M Offt Mar 1977 210 p refs

(Contract DOT-FA74WA-3445)

(AD-A041891 FAA-RD-77-66, CALSPAN-AG-5580-E-1) Avail NTIS HC A10/MF A01 CSCL 17/7

A landing system simulation program has been carried out in support of the Microwave Landing System (MLS) program of the Federal Aviation Administration Both scanning beam and doppler scan techniques were simulated and several angle processors were tested with each technique. This report contains the results of extensive simulation evaluations on the time reference scanning beam (TRSB) system. The results of the doppler simulation tests are published in the Calspan Technical notes referenced in this report. A representative set of multipath parameters was selected and used to explore the dynamic characteristics of the TRSB technique. Tests were run to determine the multipath error magnitude as a function of separation angle amplitude scalloping frequency and different processor parameters These tests were conducted on a TRSB simulator that uses a computer to control the multipath parameters for each scan Typical multipath scenarios were programed that represented the signals an aircraft would receive when flying through a multipath interference region. Some of the multipath scenarios used in the ICAO AWOP evaluations were simulated. The receivers used in the ICAO flight test program were evaluated in the simulator A breadboard processor was developed that operates as a dwell gate processor similar to the flight test receivers, or as a single edge processor (SEP) to evaluate the flare system A closed loop simulation, including aircraft and autopilot characteristics MLS signals with dynamic multipath characteristics and the MLS processor, was used to determine the aircraft perturbations resulting from hangar multipath reflections GRA

#### N77-33136# Boeing Commercial Airplane Co., Seattle Wash AIR TRAFFIC CONTROL EXPERIMENTATION AND EVAL-UATION TEST

S G Wilson C V Paulson, and I R Reese Sep 1976 157 p refs

(Contract DOT-TSC-707-6)

(AD-A041971 D6-44051, FAA RD-75-173-6, FAA-76-22-6) Avail NTIS HC A08/MF A01 CSCL 17/7

Results of performance evaluation of voice, digital data and ranging modems in the aeronautical satellite environment are given Approximately 80 hours of modem performance data were acquired on board an FAA KC-135 jet aircraft operating over the North Atlantic L-band test signals received at the aircraft were generated by ATS-6 satellite relay of transmissions from a NASA ground station The modern evaluation tests were conducted between September 1974 and April 1975 as part of the U.S. Department of Transportation (DOT) aeronautical technology test program The U.S. DOT tests were a component of the International ATS-6 L-Band Experiment coordinated by the NASA/Goddard Space Flight Center Measured modern performance includes the word intelligibility achieved by four distinct speech transmission modems, the average bit-error probability and error patterns associated with five phase-shiftkeyed 1200-bps data modems and the rms ranging accuracy achieved with two ranging modems. In each case the performance was evaluated as a function of carrier-to-noise density ratio (C/No) and direct-signal-to-multipath-signal ratio (S/I) Testing was performed with representative operational-class aircraft antennas as well as with special antennas, allowing the variation of the relative multipath level GRA

#### N77-33137# Transportation Systems Center, Cambridge, Mass REQUIREMENTS FOR FLIGHT TESTING AUTOMATED TERMINAL SERVICE Interim Report Joseph S Dumas May 1977 39 p ref

(AD-A041975 TSC-FAA-77-3 FAA-AEM-77-6) Avail NTIS HC A03/MF A01 CSCL 17/7

This report describes requirements for the flight tests of the baseline Automated Terminals Service (ATS) system The overall

objective of the flight test program is to evaluate the feasibility of the ATS concept. Within this objective there are two categories of specific ATS flight test objectives (1) the objectives concerned with verifying the basic advisory capabilities of ATS and (2) the objectives concerned with evaluating pilots responses to ATS messages. The flight testing is broken down into three parts Part I will consist of system checkout flights Part II will consist of validation and some pilot evaluation tests and will be conducted at NAFEC Part III will consist primarily of normal airport operations at a selected general aviation airport. The requirements for the Part II and III evaluations of each of the ATS services to pilots are presented. For each service, there is a listing of the major issues involved in the evaluation and a discussion of the methods to be used in the evaluation. The description of the test methods for each service presents the type of missions that will be required along with a table showing the measures to be taken and the sources of data where these Author (GRA) measures can be most easily obtained

N77-33140# Technische Universitaet Brunswick (West Sonderforschungsbereich 58 Flugfuehrung Germany)

MEASUREMENTS OF THE INFLUENCE OF STATIC AND DYNAMIC INTERFERENCE ON AN ILS-RECEIVER AND MEASUREMENT OF THE CAPTURE EFFECT WITH THE DOUBLE FREQUENCY PROCEDURE [MESSUNGEN DES EINFLUSSES STATISCHER UND DYNAMISCHER INT-ERFERENZ AUF EINEM ILS-EMPFAENGER UND MESSUNG DES CAPTURE-EFFEKTES BEI ZWEIFREQUENZVERFAH-REN]

P Form R Springer, and U Stoldt Sep 1976 25 p In GERMAN

(TUBS/SFB58/50) Avail NTIS HC A02/MF A01

Static and dynamic interference of an onboard instrument landing system were investigated. The static interference tests show that the phase difference between effective and disturbance signal is the most important factor. Dynamic interference, caused by Doppler shift resulting from the moving aircraft leads to an interchange of side bands and therefore of the information content Measurement of the capture effect of the double frequency procedure showed that the disturbed signal can probably be suppressed to a large extent ESA

N77-33142# European Space Agency, Paris (France) MONTE CARLO SIMULATION OF VOR/DME HOLDING PROCEDURES BASIC NOTIONS AND APPLICATIONS Holger Schnuerer Sep 1977 29 p refs Transl into ENGLISH of 'Grundlagen u Anwend der Simulation von VOR/DME Warteverfahren mit der Monte-Carlo-Tech DFVLR, Brunswick Report DLR-FB-77-08, 17 Mar 1977 Original report in GERMAN previously announced as N77-30105 Original German report available from DFVLR Cologne DM 1370

(ESA-TT-419 DLR-FB-77-08) Avail NTIS HC A03/MF A01 Using DME in addition to VOR allows a better use of the airspace for holding procedures in civil aviation. As yet there are no procedures agreed on by the international authorities for the construction of the airspace to be reserved for a safe execution of these holding procedures. A method for the construction of holding areas of different probabilities is described in which the simulation of flight paths in a computer using the Monte Carlo technique has special importance. The simulation allows the application of an extensive and detailed error model. In addition the locally different physical conditions may be taken into consideration. Both factors are most important for safe and economical use of airspace Author (ESA)

#### N77-33143# Sikorsky Aircraft, Stratford, Conn PERFORMANCE FLIGHT TESTS OF THE RH-53D DESIGN **GROWTH CONFIGURATION**

J McCauley 4 Nov 1976 215 p refs (Contract N00019-74-C-0183)

(SER-651316) Avail NTIS HC A10/MF A01

Performance of the RH-53D design growth configuration (DGC) helicopter was evaluated during hover level flight forward climb, and dynamic tow. Test results demonstrate significant improvements in aircraft performance when compared with the standard RH-53D The RH-53D (DGC) achieved out of ground effect hover at a gross weight of 50,000 pounds Level flight tests showed an improved capability during heavy weight level flight and indicated the ability of the RH-53D (DGC) to maintain level flight at 50 000 pounds with one engine inoperative. Dynamic tow tests demonstrated the ability of the helicopter to safely accomplish the tow mission with a significant margin of available power remaining.

#### N77-33144# Sikorsky Aircraft Stratford, Conn HANDLING QUALITIES OF THE RH-53D IN THE DESIGN GROWTH CONFIGURATION

L. Bajorinas and P. Griswold 11 Oct 1976 226 p. refs. (Contract N00019-74-C-0183)

(SER-651317) Avail NTIS HC A11/MF A01

A flying qualities flight test program was conducted on the RH-53D in the Design Growth Configuration which included use of improved rotor blades, T64-Ge-415 engine ratings, and increased drive train input horsepower (8660) Sideward flight characteristics, control power and control margins dynamic stability, maneuver stability and response equivalent to external disturbance were investigated as well as engine-out characteristics in static tow, at altitude, and near the surface. Tests were made at 42,000 lbs and the design alternate gross weight of 50,000 lbs No significant differences between the handling qualities of a production RH-53D and one in the Design Growth Configuration were found, and no flight control rigging or AFCS gain changes were required The maximum flyaway gross weight following a single engine power loss during tow was increased The height-velocity characteristics at 50,000 lbs GW were improved over those at 42 000 lbs in production RH-53D configuration Author

N77-33146<sup>\*</sup># National Aeronautics and Space Administration Langley Research Center Langley Station, Va AN ELEMENTARY ANALYSIS OF THE EFFECT OF SWEEP,

AN ELEMENTARY ANALYSIS OF THE EFFECT OF SWEEP, MACH NUMBER, AND LIFT COEFFICIENT ON WING-STRUCTURE WEIGHT

Albert C Kyser Sep 1977 31 p ref

(NASA-TM-74072) Avail NTIS HC A03/MF A01 CSCL 01C Results are presented from an elementary analysis of the effect of sweep angle on the idealized structural weight of swept wings with cruise Mach number M and lift coefficient C sub L as parameters. The analysis indicates that sweep is unnecessary for cruise Mach numbers below about 0.80, whereas for the higher subsonic speeds, a well defined minimum-weight condition exists at a sweep angle in the neighborhood of 35 deg or 40 deg. depending on M and C sub L. The results further indicate that wing structure weight increases sharply with Mach number in the high subsonic range with Mach 0.85 wings weighing half again as much as Mach 0.75 wings. Weight is also shown to increase with cruise lift coefficient but the effect is not strong for the usual range of design lift coefficients. Minimum wingstructure weight is found to occur at a ratio of thickness to normal chord of about 18 percent, but it is concluded that the thickness ratio for optimum wing design would probably lie in the range of 12 to 15 percent Author

N77-33147\*# Boeing Commercial Airplane Co., Seattle Wash Preliminary Design Dept

#### TECHNICAL AND ECONOMIC ASSESSMENT OF SWEPT-WING SPAN-DISTRIBUTED LOAD CONCEPTS FOR CIVIL AND MILITARY AIR CARGO TRANSPORTS Oct 1977 152 p refs (Contract NAS1-14667)

(VASA-CR-145229 D6-45159) Avail NTIS HC A08/MF A01 CSCL 01C

The feasibility of large freighter aircraft was assessed including the impact of military requirements on the performance, economics, and fuel consumption characteristics. Only configurations having net payloads of 272 155 to 544 311 kilograms contained within swept wings of constant chord were studied. These configurations were of advanced composite construction with controllable winglets and full-span digitally-controlled. trailing-edge surfaces Civil, military and joint civil/military production programs were considered Author

N77-33148\*# Virginia Univ Charlottesville Dept of Engineering Science and Systems

THE DEVELOPMENT OF A MODEL FOR PREDICTING PASSENGER ACCEPTANCE OF SHORT-HAUL AIR TRANSPORTATION SYSTEMS

A Robert Kuhithau and Ira D Jacobson Sep 1977 59 p (Grant NGR-47-005-181)

(NASA-CR-145250, UVA/528060/ESS77/111) Avail NTIS HC A04/MF A01 CSCL 01C

Meaningful criteria and methodology for assessing, particularly in the area of ride quality the potential acceptability to the traveling public of present and future transportation systems were investigated. Ride quality was found to be one of the important variables affecting the decision of users of air transportation, and to be influenced by several environmental factors especially motion, noise pressure temperature and seating Models were developed to quantify the relationship of subjective comfort to all of these parameters and then were exercised for a variety of situations Passenger satisfaction was found to be strongly related to ride quality and was so modeled. A computer program was developed to assess the comfort and satisfaction levels of passengers on aircraft subjected to arbitrary flight profiles over arbitrary terrain A model was deduced of the manner in which passengers integrate isolated segments of a flight to obtain an overall trip comfort rating A method was established for assessing the influence of other links (e.g., access, terminal conditions) in the overall passenger trip Author

N77-33149\*# Douglas Aircraft Co, Inc. Long Beach Calif MODELING AND PARAMETER UNCERTAINTIES FOR AIRCRAFT FLIGHT CONTROL SYSTEM DESIGN Final Report

J D McDonnell, R A Berg, R M Heimbaugh and C A Felton Washington NASA Sep 1977 132 p refs

(Contract NAS1-14151)

(NASA-CR-2887 MDC-J4555) Avail NTIS HC A07/MF A01 CSCL 01C

Values of plant dynamic uncertainties for some recent aircraft design and development programs are given. Histories of pertinent aerodynamic, inertial and structural parameter variations are given for a period of time from program initiation to aircraft certification. These data can be used as typical of future vehicles so that control system design concepts are evaluated with due consideration to their sensitivity to uncertainties in plant dynamics Author

N77-33150\*# National Aeronautics and Space Administration Langley Research Center Langley Station, Va

BEHAVIOR OF AIRCRAFT ANTISKID BREAKING SYSTEMS ON DRY AND WET RUNWAY SURFACES A SLIP-RATIO-CONTROLLED SYSTEM WITH GROUND SPEED REFER-ENCE FROM UNBRAKED NOSE WHEEL

John A Tanner and Sandy M Stubbs Washington Oct 1977 167 p refs

(NASA-TN-D-8455 L-11292) Avail NTIS HC A08/MF A01 CSCL 01C

An experimental investigation was conducted at the Langley aircraft landing loads and traction facility to study the braking and cornering response of a slip ratio controlled aircraft antiskid braking system with ground speed reference derived from an unbraked nose wheel The investigation, conducted on dry and wet runway surfaces, utilized one main gear wheel, brake and tire assembly of a DC-9 series 10 airplane. During maximum braking, the average ratio of the drag force friction coefficient developed by the antiskid system to the maximum drag force friction coefficient available was higher on the dry surface than on damp and flooded surfaces, and was reduced with lighter vertical loads, higher yaw angles, and when new tire treads were replaced by worn treads. Similarly, the average ratio of side force friction coefficient developed by the tire under antiskid control to the maximum side force friction coefficient available to a freely rolling yawed tire decreased with increasing yaw angle, generally increased with ground speed, and decreased when tires with new treads were replaced by those with worn Treads Author

N77-33151°# National Aeronautics and Space Administration Ames Research Center, Moffett Field, Calif

Longitudinal Mandung Qualities During Approacm and Landing of a powered lift stol aircraft

James A Franklin and Robert C Innis Mar 1972 68 p refs (NASA-TM-X-62144) Avail NTIS HC A04/MF A01 CSCL 01C

Longitudinal handling qualities evaluations were conducted on the Ames Research Center Flight Simulator for Advanced Aircraft (FSAA) for the approach and landing tasks of a powered lift STOL research aircraft The test vehicle was a C-8A aircraft modified with a new wing incorporating internal blowing over an augmentor flap. The investigation included (1) use of various flight path and airspeed control techniques for the basic vehicle, (2) assessment of stability and command augmentation schemes for pitch attitude and airspeed control, (3) determination of the influence of longitudinal and vertical force coupling for the power control (4) determination of the influence of pitch axis coupling with the thrust vector control and (5) evaluations of the contribution of stability and command augmentation to recovery from a single engine failure. Results are presented in the form of pilot ratings and commentary substantiated by landing Author approach time histories

N77-33152# Rockwell International Corp., Columbus, Ohio Columbus Aircraft Div

EVALUATION OF COMPOSITE WING FOR XFY-12A

AIRPLANE Final Report, 29 Jun 1974 - 31 Aug. 1976 D N Ulry R W Gehring, and K I Clayton Dec 1976 320 D

(Contract N62269-74-C-0577)

(AD-A041208, NR76H-135 NADC-77183-30) Avail NTIS HC A14/MF A01 CSCL 11/4

A prior study conducted for the Naval Air Systems Command for application of advanced composites in the XFV-12A aircraft indicated the wing torque box to be the component of airframe structure having the greatest potential for significant weight asvings through composite material application A Phase II design/development program was undertaken to develop detail design concepts for a XFV-12A composite wing box and fabricate a representative section of this wing box for development test and evaluation to provide a base for subsequent Phase III full scale verification testing GRA

N77-33153# Naval Postgraduate School, Monterey, Calif MUMAN FACTORS ENGINEERING CONSIDERATIONS IN DESIGNING NAVAL AIRCRAFT FOR MAINTAINABILITY William Edward Baumgartner Jun 1977 109 p refs (AD-A041156) Avail NTIS HC A06/MF A01 CSCL 01/3

Rising maintenance costs and the necessity for increased availability have resulted in a new emphasis on maintainability as a design parameter in the acquisition of Naval air systems Human factors engineering, traditionally considered a means of improving operator performance, is also a designer's tool for improving aircraft maintainability Department of Defense directives mandating that all systems be designed according to specific human factors engineering and maintainability criteria confirm the necessity for including the human engineer in the designing of aircraft for maintainability Appendix A 'The Checklist for Human Factors Engineering of Maintainability in Naval Air Systems Design,' has been developed as a tool for aircraft designers and Navy design monitors to ensure human factoring criteria have been incorporated in the maintainability of the major aircraft subsystems Author (GRA)

N77-3316-3/ RAND Corp., Santa Monica, Calif

an evaluation of very large airplanes and Alternative fuels: Executive summary intovim Ropert

W T Mitolowsky Dec 1976 41 p refs

(Contract F49620-77-C-0023)

(AD-A042112, R-1889/1-AF) Avail NTIS HC A03/MF A01 CSCL 21/4

Candidate applications of very large airplanes include strategic airlifter, tanker, missile launcher tactical battle platform,

mantime air cruiser, and C3 platform This report summanzes AD-A040532 which explored the military utility of very large airplanes (ovor 1 million pounds gross weight) and exemined several alternative fuels that could be used by such airplanes GRA

N77-3316647 Army Air Mobility Research and Development Lab., Fort Eustie, Va Research and Development Lab AM ASSESSMENT OF THE MOVER PERFORMANCE OF THE

MELICOPTED

Donald N Arents May 1977 19 p refs

(DA Proj 1L2-8311-D-157)

(AD-A042033, USBAMRDL-TN-25) Avail NTIS HC A02/MF A01 CSCL 01/3

This report documents a study of the hovering characteristics the XH-59A helicopter, which was built to demonstrate the feasibility of the Advancing Blade Concept (ABC) The study examined in- and out-of-ground hover characteristics, aircraft and rotor figures of merit, and hover performance at 10- and 20-foot wheel heights The XH-59A's performance is also compared to the performances of other Army helicopters. This indicates that the XH-59A performs better than other helicopters, largely because it lacks a tail rotor GRA

N77-331664# Cessna Aircraft Co., Wichita, Kans Wallace Div

A-376 FATIGUE SENSOR EVALUATION PROGRAM · FULL SCALE TEST AND FIELD AIRCRAFT INSTRUMENTATION Final Report, Jul. 1971 - Jan 1976 Robert W Walker and John Y Kaufman Mar 1977 123 p

Robert W Walker and John Y Kaufman Mar 1977 123 p refs

(Contract F33657-71-C-0163)

(AD-A042114, ASD-TR-77-4) Avail NTIS HC A06/MF A01 CSCL 01/3

Micró Measurements FM Fatigue Sensors were installed on A-37 aircraft at three CONUS bases to determine the longevity and suitability of this device for field installation. A similar installation on an A-378 full scale fatigue test provided base line data for relative severity comparisons of accumulated fatigue The sensor is shown to be practical for field installation and this report recommends field installations designed for more advanced data analysis methods.

N77-33157°# National Aeronautics and Space Administration Langley Research Center, Langley Station, Va A SUGPENDED ANEMOMETER SYSTEM FOR MEASURING TRUE AIRSPEED ON LOW-SPEED AIRPLANES David D Kershner Oct 1977 30 p refs

(NASA-TN-D-8523, L-11269) Avail NTIS HC A02/MF A01 CSCL 01D

A suspended anemometer system for calibrating pitot-static systems on low speed research airplanes is described. The anemometer measures true airspeed when suspended beneath the airplane on a long cable in regions of undisturbed air. The electrical output of the propeller driven tachometer is a sine wave, the frequency of which is proportional to true airspeed. The anemometer measures true airspeed over a range from 20 to 60 m/sec at altitudes to 3000 m, with an accuracy of + or - 0.5 percent of full scale range. This accuracy is exclusive of errors in the recording system. The stability of the suspended system was investigated and was found adequate in the airspeed range. For the purpose of determining the location of the anemometer relative to the airplane, a method is given for calculating the shape assumed by the deployed cable.

 N77-33160// Grumman Aerospace Corp., Bethpage, N.Y.
 Power

 Optics and Displays Dept
 MASTER MONITOR DISPLAY APPLICATION STUDY FOR

 F-10. Fincil Roscatt
 Joseph Austin 25 Mar 1977 157 p

 (Contract N62269-76-C-0199)
 (AD-A041570, NADC-77076-30)
 Avail

 HC A08/MF A01
 CSCL 09/5

This Report summarizes the results of a study to replace the existing Caution Advisory indicator in the F-14 with a Master Monitor Display (MMD) An MMD is described which uses the existing F-14 fault sensors with a few additions, and with several minor modifications to the aircraft interface. The MMD design features management by exception, and provides automatic display of fault and course of action information on a cathode ray tube readout for all detected faults. It also provides for manual display of total systems status, system fault, and fault history information on a call up basis. Author (GRA)

N77-33160°# National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio

PROGRESS IN ADVANCED MIGH TEMPERATURE TURDINE MATERIALS, COATINGS, AND TECHNOLOGY

John C Freche and G Mervin Ault 23 Sep 1977 44 p refs Presented at the 50th Panel on Propulsion and Energetics, Ankara, 19-23 Sep 1977, sponsored by AGARD

(NASA-TM-X-73628) Avail NTIS HC A03/MF A01 CSCL 21E

Material categories as well as coatings and recent turbine cooling developments are reviewed Current state of the art is identified, and as assessment, when appropriate, of progress, problems, and future directions is provided Author

 $\$77\text{-}33160^\circ\#$  National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio

STEADY-STATE UNBALANCE RESPONSE OF A THREE-DISK FLEXIBLE ROTOR ON FLEXIBLE, DAMPED SUP-PORTS

Robert E Cunningham 29 Sep 1977 42 p refs Presented at the Vibrations Conf, Chicago, 26-29 Sep 1977, sponsored by ASME

(NASA-TM-X-73866 E-9091-1) Avail NTIS HC A03/MF A01 CSCL 21E

Experimental data are presented for the unbalance response of a flexible, ball bearing supported rotor to speeds above the third lateral bending critical Values of squeeze film damping coefficients obtained from measured data are compared to theoretical values obtained from short bearing approximation over a frequency range from 5000 to 31000 cycles/min Experimental response for an undamped rotor is compared to that of one having oil squeeze film dampers at the bearings Unbalance applied varied from 0.62 to 15.1 gm-cm

N77-33161°# National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio OVER-TME-WING MODEL THRUST REVERSER NOISE

TESTS J Goodykoontz and O Gutierrez 5 Oct 1977 20 p refs

Presented at the 4th Aeroacoustics Conf Atlanta, 3-5 Oct 1977. sponsored by AIAA

(NASA-TM-73495, E-9328) Avail NTIS HC A02/MF A01 CSCL 20A

Static acoustic tests were conducted on a 1/12 scale model over-the-wing target type thrust reverser. The model configuration simulates a design that is applicable to the over-the-wing short-haul advanced technology engine. Aerodynamic screening tests of a variety of reverser designs identified configurations that satisfied a reverse thrust requirement of 35 percent of forward thrust at a nozzle pressure ratio of 1.29. The variations in the reverser configuration included, blocker door angle, blocker door lip angle and shape, and side skirt shape. Acoustic data are presented and compared for the various configurations. The model data scaled to a single full size engine show that peak free field perceived noise (PN) levels at a 152.4 meter sideline distance range from 98 to 104. PNdb

N77-33102°# National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio

IDENTIFICATION AND MEASUREMENT OF COMBUSTION NOISE FROM A TURBOFAN ENGINE USING CORRELA-TION AND COMERENCE TECHNIQUES Ph D Thomas Allen Martin Karchmer Sep 1977 156 p refs (NASA-TM-73747, E-9319) Avail NTIS HC A08/MF A01 CSCL 20A

Fluctuating pressure measurements within the combustor and tailpipe of a turbofan engine are made simultaneously with for field acoustic measurements. The pressure measurements within the engine are accomplished with cooled semi-infinite waveguido probes utilizing conventional condenser microphones as the transducers. The measurements are taken over a broad range of engine operating conditions and for 16 far field microphone positions between 10 deg and 160 deg relative to the engine inlet exis Correlation and coherence techniques are used to determine the relative phase and amplitude relationships between the internal pressures and far field acoustic pressures. The results indicate that the combustor is a low frequency source region for acoustic propagation through the tailpipe and out to the far field Specifically, it is found that the relation between source pressure and the resulting sound pressure involves o 180 deg phase shift The latter result is obtained by Fourior transforming the cross correlation function between the source pressure and acoustic pressure after removing the propagation delay time. Further, it is found that the transfer function between the source pressure and acoustic pressure has a magnitude approximately proportional to frequency squared. These results are shown to be consistent with a model using a modified source term in Lighthill's turbulence stress tensor, wherein the fluctuating Reynolds stresses are replaced with the pressure fluctuations due to fluctuating entropy Author

N77-33103°# National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio

FROM A TURBOFAN ENGINE USING COMERENCE

A M Kerchmer, M Reshotko, and F J Montegani 5 Oct 1977 33 p refs Presented at 4th Aeroacoustics Conf. Atlanta, 3-5 Oct 1977, sponsored by AIAA

(NASA-TM-73748, E-9320, AIAA-Paper-77-1277) Avail NTIS HC A03/MF A01 CSCL 21E

Coherence measurements between fluctuating pressure in the combustor of a YF-102 turbofan engine and far-field acoustic pressure were made. The results indicated that a coherent relationship between the combustor pressure and far-field existed only at frequencies below 250 Hz, with the peak occurring near 125 Hz. The coherence functions and the far-field spectra were used to compute the combustor-associated far-field noise in terms of spectra, directivity, and acoustic power, over a range of engine operating conditions. The acoustic results so measured were compared with results obtained by conventional methods, as well as with various semiempirical predictions schemes Examination of the directivity patterns indicated a peak in the combustion noise near 120 deg (relative to the inlet axis).

R77-33166°# National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio

OUTPUT FEEDBACK REGULATOR DESIGN FOR JET ENGINE CONTROL SYSTEMS

Walter Merrill 1977 14 p refs Presented at Intern Forum on Alternatives for Linear Multivariable Control, Chicago, 13-14 Oct 1977, sponsored by Nati Elec Conf

(NASA-TM-73776) Avail NTIS HC A02/MF A01 CSCL 21E A multivariable control design procedure based on the output feedback regulator formulation is described and applied to turbofan engine model Full order model dynamics, were incorporated in the example design The effect of actuator dynamics on closed loop performance was investigaged Also the importance of turbine inlet temperature as an element of the dynamic feedback was studied Step responses were given to indicate the improvement in system performance with this control Calculation times for all experiments are given in CPU seconds for comparison purposes Author

N77-33166°# National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio STATE-OF-THE-ART OF TURBOFAN ENGINE NOISE CONTROL W L Jones and J F Groeneweg Oct 1977 22 p refs Presented at NOISE-CON 77 Hampton, Va 17-19 Oct 1977 cosponsored by Inst of Noise Control Eng (NASA-TM-73734 E-9254) Avail NTIS HC A02/MF A01

CSCL 21E The technology of turbofan engine noise reduction is surveyed

(2) fan and core noise suppression (3) turbomachinery noise, sources and (4) a new program for improving static noise testing of fans and engines

N77-33167\*# National Aeronautics and Space Administration Lewis Research Center Cleveland, Ohio

#### MINIMUM TIME ACCELERATION OF AIRCRAFT TUR-BOFAN ENGINES BY USING AN ALGORITHM BASED ON NONLINEAR PROGRAMMING

Fred Teren Jul 1977 182 p refs

(NASA-TM-73741) Avail NTIS HC A09/MF A01 CSCL 21E Minimum time accelerations of aircraft turbofan engines are presented. The calculation of these accelerations was made by using a piecewise linear engine model and an algorithm based on nonlinear programming. Use of this model and algorithm allows such trajectories to be readily calculated on a digital computer with a minimal expenditure of computer time. Author

#### N77-33188\*# AIResearch Mfg Co., Phoenix Ariz POLLUTION REDUCTION TECHNOLOGY PROGRAM FOR SMALL JET AIRCRAFT ENGINES, PHASE 1 Final Report, Nov 1974 - Jun 1976

T W Bruce F G Davis, T E Kuhn, and H C Mongia Sep 1977 177 p refs

(Contract NAS3-18560)

(NASA-CR-135214 ArResearch-21-2498) Avail NTIS HC A09/MF A01 CSCL 21E

A series of combustor pressure rig screening tests was conducted on three combustor concepts applied to the TFE731-2 turbofan engine combustion system for the purpose of evaluating their relative emissions reduction potential consistent with prescribed performance, durability, and envelope contraints. The three concepts and their modifications represented increasing potential for reducing emission levels with the penalty of increased hardware complexity and operational risk. Concept 1 entailed advanced modifications to the present production TFE731-2 combustion system. Concept 2 was based on the incorporation of an axial air-assisted airblast fuel injection system. Concept 3 was a staged premix/prevaporizing combustion system. Significant emissions reductions were achieved in all three concepts, consistent with acceptable combustion system performance Concepts 2 and 3 were identified as having the greatest achievable emissions reduction potential and were selected to undergo refinement to prepare for ultimate incorporation within an Author enaine

N77-33169\*# National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio

#### F100 MULTIVARIABLE CONTROL SYNTHESIS PROGRAM EVALUATION OF A MULTIVARIABLE CONTROL USING A REAL-TIME ENGINE SIMULATION

John R Szuch, James F Soeder Kurt Seldner and David S Cwynar Oct 1977 103 p refs

(NASA-TP-1056 E-9170) Avail NTIS HC A06/MF A01 CSCL 21E

The design, evaluation and testing of a practical multivariable linear quadratic regulator control for the F100 turbofan engine were accomplished NASA evaluation of the multivariable control logic and implementation are covered. The evaluation utilized a real time hybrid computer simulation of the engine Results of the evaluation are presented, and recommendations concerning future engine testing of the control are made. Results indicated that the engine testing of the control should be conducted as planned. Author N77-33171# AIResearch Mfg Co Torrance Calif SUBSYSTEM DESIGN ANALYSIS LIGHT WEIGHT ALTER-NATOR (MODEL TEST PROGRAM) ADDENDUM 2 Final Report

C H Lee, D Berker G Tatro and P Walia Mar 1977 105 p

(Contract F29601-74-C-0055)

(AD-A041257, AFWL-TR-75-66-Add-2) Avail NTIS HC A06/MF A01 CSCL 10/2

This report discusses the test and computer simulation activities conducted on a modified-design small-rating aircraft alternator. These activities were intended to provide additional verifications of the alternator analytical approach utilized in designing two specialized large-rating lightweight alternators. The latter designs have been previously detailed in Air Force technical reports AFWL-TR-75-66 Subsystem Design Analysis Report for Lightweight Alternator (AC Load Case) and AFWL-TR-75-66 Addendum 1, Subsystem Design Analysis Report for Lightweight Alternator (GRA) Author (GRA)

N77-33172# Aeronautical Research Council London (England) THE CURRENT STATE OF RESEARCH AND DESIGN IN HIGH PRESSURE RATIO CENTRIFUGAL COMPRESSORS P M Came Jul 1976 75 p refs Supersedes NGTE-NT-1029

(AD-A041011 ARC-CP-1363 NGTE-NT-1029) Avail NTIS HC A04/MF A01 CSCL 21/5

A review of the achievements of research effort in centrifugal compressors is presented and its effect on current design methods is discussed. The paper concludes with recommendations for future research. Author (GRA)

N77-33175# General Electric Co Cincinnati Ohio Aircraft Engine Group

#### HIGH VELOCITY JET NOISE SOURCE LOCATION AND REDUCTION TASK 4 DEVELOPMENT/EVALUATION OF TECHNIQUES FOR INFLIGHT INVESTIGATION Final Report

W S Clapper and E J Stringas 22 Feb 1977 569 p refs (Contract DOT-OST-30034)

(AD-A041849 Rept-R77AEG189 FAA-RD-76-79-4) Avail NTIS HC A24/MF A01 CSCL 20/1

This report presents the results of Task 4 as conducted under the subject program over a period of 30 months. Task 4 was formulated to identify and evaluate several inflight simulation techniques select the most promising technique for demonstration and validation and employ that technique in testing under Task 5 of the program Techniques evaluated include closed-circuit wind tunnels free jets rocket sleds and high speed trains Pertinent results from the evaluation phase and rationale which led to selection of the free jet simulation technique are discussed including advantages and disadvantages. The results of a theoretical study aimed at relating the noise signature obtained in a free jet facility for simulation of forward flight effects on jet noise with the noise signature in true flight are presented Transformation is carried out by extracting 'static directivity' of the noise after correcting for refraction turbulent scattering and absorption effects and then employing a suitable multipole source decomposition to evaluate the proper dynamic effect A flowchart describing the details of the transformation procedure and a listing of the computer program are included. Acoustic results from the Learjet and NASA-Lewis F-106 Aircraft Flyovers and the French Aerotrain Tests taken with a baseline 8-lobe and 104-tube nozzle were used to formulate a data base for verification of the free jet simulation technique. Detailed directivity and spectra comparisons between aerotrain data and transformed free jet data are presented for three primary jet velocities and two flight velocities for the three nozzle types GRA

N77-33176# National Gas Turbine Establishment, Farnborough (England)

### THE EFFECT OF FLIGHT ON THE NOISE OF SUBSONIC JETS

B J Cocking Oct 1976 30 p refs

(AD-A041730 NGTE-R-343 DRIC-BR-556165) Avail NTIS HC A03/MF A01 CSCL 20/4

The noise of a single-stream circular jet and a coaxial let with coplanar nozzles of 2.5 area ratio has been measured under simulated flight conditions. The majority of tests were conducted with the single-stream jet and primary section of the coaxial jet at a nominal temperature of 880 K. The data have been used to quantify the effect of jet temperature and were combined with measurements from an earlier test series to establish a prediction method for the effect of flight on the noise of single-stream subsonic jets. This method is based on jet noise theory modified by experimentally derived constants. For coaxial jets it is concluded that the noise reductions, which are independent of the secondary stream velocity, are predicted to an acceptable degree by the method suggested for unheated single-stream lets GRA

N77-33177# General Electric Co., Cincinnati, Ohio Aircraft Engine Groun

SUPERSONIC JET EXHAUST NOISE INVESTIGATION ACOUSTIC FAR-FIELD/NEAR-FIELD DATA VOLUME 4 REPORT Final Technical Report, 1 Dec 1972 - 23 Sep. 1976

Paul R Knott and John F Brausch Wright-Patterson AFB, Ohio AFAPL Jul 1976 510 p Sponsored in part by DOT (Contract F33615-73-C-2031)

(AD-A041819, R74AEG452-Vol-4, AFAPL-TR-76-68-Vol-4) Avail NTIS HC A22/MF A01 CSCL 20/1

This report is an acoustic data report presenting a series of parametric acoustic far-field and near-field results for subsonic and supersonic heated flow conditions for a simple conical nozzle (thin lip and thick lip) and a convergent-divergent nozzle at design and off-design conditions Author (GRA)

#### N77-33179# Tennessee Univ Space Inst Tullahoma

INVESTIGATION OF FEASIBLE NOZZLE CONFIGURATIONS FOR NOISE REDUCTION IN TURBOFAN AND TURBOJET VOLUME 3 SHROUDED SLOT NOZZLE AIRCRAFT CONFIGURATIONS Final Report, Aug 1975 - Mar 1977 B H Gosthert J R Maus William A Dunnill, M C Joshi and V Veerasamý Mar 1977 127 p refs (Contract DOT-FA72WA-3053)

FAA-RD-75-162-3) (AD-A041782 NTIS Avail HC A07/MF A01 CSCL 21/5

This report presents the results of a study of the acoustic and fluid dynamic characteristics of a shrouded slot nozzle Experiments were carried out on a slot nozzle of aspect ratio 27 with an ejector shroud having a cross sectional area of four times the primary nozzle area. Parameters varied during the tests were, shroud length shroud divergence ratio and acoustical impedance of the shroud wall. Tests were conducted for primary flow Mach numbers from 0.5 to choking and stagnation temperatures from ambient to 1200 R. The results of the study show that both the thrust and the noise attenuation characteristics of the ejector shroud improve with increasing length. Thrust increases of near 40% were obtained for the longest shroud tested A noise reduction of 13 dB was obtained for the lined shroud with a near choked, high temperature primary jet. The corresponding thrust augmentation was approximately 20%

Author (GRA)

N77-33180# Association Aeronautique et Astronautique de France Paris

#### TURBULENT EFFECTS IN AXIAL COMPRESSORS [EFFETS INSTATIONNAIRES DANS LES COMPRESSEURS AXIAUX]

M Sagnes 1977 63 p refs In FRENCH Presented at the 13th Collog d'Aerodyn Appl Lyon, 8-10 Nov 1976 (Contract DRME-74/607)

(AAAF-NT-77-20, ISBN-2-7170-0437-8) Avail NTIS HC A04/MF A01, CEDOCAR Paris FF 25 (France and EEC) FF 29 (others)

An attempt to improve the lift and reduce the drag in turbocompressors by provoked turbulence is presented. The experimental setup is detailed and the results are discussed establishing unequivocally the possibility of inducing the required effects by sinusoidal orientation of the blades FSA

N77-33181# Advisory Group for Aeronautical Research and Development Paris (France)

#### POWER PLANT RELIABILITY

Aug 1977 222 p refs in ENGLISH and FRENCH Presented at the 49th Meeting of the AGARD Propulsion and Energetics Panel The Hague 31 Mar - 1 Apr 1977

(AGARD-CP-215 ISBN-92-835-0198-5) Avail NTIS HC A10/MF A01

The reliability of current civil and military engines is discussed Plans to improve engine reliability and the role of engine diagnostics and monitoring is explored

N77-33182# Aeronautical Systems Div Wright-Patterson AFB Ohio

#### ENGINE STRUCTURAL INTEGRITY PROGRAM (ENSIP)

Eric E Abell and Edward G Koepnick In AGARD Power Plant Reliability Aug 1977 4 p

#### Avail NTIS HC A10/MF A01

A new military standard for turbine engines for use by the Air Force is discussed. The standard is aimed at providing overail policy and requirements for turbine engine structural development during the entire system life cycle. A first review of the tasks involved in the standard are outlined. Specific items such as duty cycle and tests concerned with fatigue considerations are noted Author

#### N77-33183# Ministero della Difesa Aeronautica Rome (Italy) MILITARY ENGINE DETERIORATION IN SERVICE CON-NECTED WITH LIFE CYCLE COSTS

G Facca and L Giorgieri In AGARD Power Plant Reliability Aug 1977 18 p refs

#### Avail NIIS HC A10/MF A01

Problems responsible for military jet engine deterioration are identified and cost structure for these problems is analyzed. Since a large amount of labor, skill and costs are involved in maintaining engines in service at an adequate standard of efficiency and safety several standards must be met. Overall maintenance and repair life cycle costs must be comparable to the new engine cost Design must pay proper attention to reliability and maintainability concepts from the beginning and trade-offs should be performed in order to optimize the engine overall life cycle costs Author

N77-33184# Direction Centrale du Materiel de l'Armee de l'Air, Paris (France)

MAINTENANCE METHODS FOR IMPROVING PROPULSION SYSTEM RELIABILITY [METHODES DE MAINTENANCE POUR AMELIORER LA FIABILITE DES PROPULSEURS] Claude Sprung // AGARD Power Plant Reliability Aug 1977 9 p In FRENCH

Avail NTIS HC A10/MF A01

Preventive measures used by the French Air Force in systematic aircraft engine maintenance procedures are described Topics discussed include spectrometry of oils analysis of metal particles engine vibration, and the use of endoscopy, ultrason-Transl by ARH ics and gammagraphy

N77-33185# Civil Aviation Authority Redhill (England) Airworthiness Div

#### CIVIL AIRWORTHINESS REQUIREMENTS FOR POWER-PLANT RELIABILITY

John Slatford In AGARD Power Plant Reliability Aug 1977 6 p

Avail NTIS HC A10/MF A01

Several aspects of aircraft reliability are discussed. These considerations relating to the safety of the aircraft and its occupants are summarized into three objectives. Any failure of an engine that could hazard the aircraft must be kept to an absolute minimum. Loss of thrust in flight must not reduce the total thrust available to the aircraft to such an extent that the flight cannot be completed safely. A normally operating engine

must provide the thrust necessary for the aircraft to meet its scheduled performance and respond quickly and accurately to the demands of the pilot Author

#### N77-33186# KLM Royal Dutch Airlines, Amsterdam (Netherlands)

### RELIABILITY VERSUS COST IN OPERATING WIDE BODY JET ENGINES

S K W J Demarteau /n AGARD Power Plant Reliability Aug 1977 7 p

Avail NTIS HC A10/MF A01

The high degree of reliability from aircraft and engines required by scheduled international airline operational and maintenance characteristics is discussed Standards must be met in order to offer a safe but also commercially and economically justified product A specific cost/reliability level was investigated for the General Electric CF6 engine Reliability was found to be influenced by inherent design deficiencies, operation environment and maintenance policy Cost consequences were dependent on airline operation, the way an airline is organized, the scale of operation and airline standards Author

#### N77-33187# Service des Etudes de Propulsion, Paris (France) RISKS AFFECTING THE STRUCTURAL RESISTANCE AND INTEGRITY OF MODERN PROPULSION SYSTEMS [LES RISQUES AFFECTANT LA RESISTANCE STRUCTURALE ET LA SECURITE DES PROPULSEURS MODERNES]

Jean A Aguer In AGARD Power Plant Reliability Aug 1977 14 p refs in FRENCH

#### Avail NTIS HC A10/MF A01

The performance of modern engines already in service or those which will be in use in the 1980's and thereafter depends on higher temperature levels greater thermal and kinetic stress and constraints, and new materials technologies for improved efficiency. To maintain the structural integrity of these engines, the effects of thermal and kinetic energies to be used in the future must be determined. Precise examples are given to demonstrate what procautions must be taken. The most important priorities should be given to the use of trainium engine ingestion turbine blades fuels and lubricants and the thrust/weight ratio Transi by A.R.H.

N77-33188# Ministry of Detence London (England) Directorate of Engine Development

### DEVELOPMENT PROCEDURES TO PROMOTE RELIABIL-

R Holl /n AGARD Power Plant Reliability Aug 1977 14 p refs

#### Avail NTIS HC A10/MF A01

Reliability attainment so far as the military aircraft gas turbine is concerned was studied. Civil engine development and operational reliability were considered in order to emphasize that the aircraft gas turbine particularly in a basically non-complete form provided a step change in reliability when compared with its predecessor the high powered piston propeller engine Conclusions indicate that recent concentration on the achievement of performance goals has resulted in increasingly complex and very costly engines as well as a near total lack of attention to design reliability.

N77-33189# Societe Nationale d Etudes et de Construction de Moteurs d Aviation, Moissy-Cramayel (France)

#### CFM56 TURBOFAN MAINTAINABILITY AND RELIABILITY-ORIENTED DEVELOPMENT

Jean-Pierre Marechal In AGARD Power Plant Reliability Aug 1977 19 p In ENGLISH and FRENCH

#### Avail NTIS HC A10/MF A01

Reliability and maintainability criteria introduced in the CFM 55 turbufan engine are described. A 7500 operating program will provide methodical accumulation of data so that maintenance costs may be minimized through high repairability accessibility, modularity, and interchangeable features. N77-33190# General Electric Co., Cincinnati, Ohio Aircraft Engine Group

## AIRCRAFT ENGINE DESIGN AND DEVELOPMENT THROUGH LESSONS LEARNED

Bernard L Koff In AGARD Power Plant Reliability Aug 1977 11 p

Avait NTIS HC A10/MF A01

Aircraft engine design was examined in terms of performance and reliability Durability, maintenance, weight, initial cost and timing were also considered. It is stated that design and development are derivatives of a lessons learned approach Since materials, modern analytical and experimental techniques have progressed so has our ability to design and develop modern aircraft Author

## N77-33192# Air Force Aero Propulsion Lab Wright-Patterson AFB, Ohio

#### A PROCEDURE FOR PREDICTING THE LIFE OF TURBINE ENGINE COMPONENTS

R J Hill In AGARD Power Plant Reliability Aug 1977 9 p refs

Avail NTIS HC A10/MF A01

A procedural method is presented for the creation of a life estimate of aircraft gas turbine engine components. The method consists of three segments -- the calculation of a modulus, the determination of a critical material property and a comparison of the modulus to the material property with a resulting judgment Each segment is discussed in qualitative terms and related to required validation and acceptance testing Author

N77-33193# Direction du Materiel Etudes de Propulsion Paris (France)

THE EVOLUTION AND CONTROL OF DIFFERENT PER-FORMANCE DEGRADATION PROCESSES IN MODERN PROPULSION SYSTEMS [EVOLUTION ET CONTROLE DES DIFFERENTS PROCESSUS DE DEGRADATION DE PERFOR-MANCE SUR LES PROPULSEURS MODERNES]

P Chetail In AGARD Power Plant Reliability Aug 1977 17 p refs in FRENCH

#### Avail NTIS HC A10/MF A01

The development of policies for jet angine maintenance and the basic principles for applying monitoring methods are discussed Processes involved in the degradation of thermodynamic and mechanical performance are examined. A computer program is described for evaluating the efficacy of the monitoring methods from a technical and economic point of view. Transl by A R H

#### N77-33194# Pisa Univ (Italy) TESTING SIMULATION OF DAMAGES OCCURRED IN SERVICE

D Dini and L Giorgieri (Ministero della Difesa Aeronautica) In AGARD Power Plant Reliability Aug 1977 22 p refs

#### Avail NTIS HC A10/MF A01

A basic framework is presented from which further simulation of increased complexity and sophistication can be easily implemented regarding engine failures by an in-flight foreign object, large overpressure signature inlet flow distortion and icing environment. A general basic engine reliability program is provided, capable of simulating a running turbojet-engine and its air supplying environment as an integrated system. The specific subroutines for the possible damages are to be supplied by the user Recent advances on testing simulation of flight-incurred power plant damages promise to reduce accidents due to engine operation at low altitudes and in rugged confined terrain State-of-the-art design techniques are discussed to improve engine reliability including an analysis of three particular experimental simulations to determine damage causes and effects. Recommendations are put forth that will eliminate or reduce the causes of aviation accidents Author

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N77-33195# Societe Nationale d'Etudes et de Construction de Moteurs d'Aviation, Moissy-Cramayel (France)

#### PROGRESS IN DETERMINING SERVICE LIFE BY ENDUR-ANCE TESTS [PROGRES DE LA DETERMINATION DE LA VIE EN SERVICE PAR LES ESSAIS D'ENDURANCE]

B Devoge In AGARD Power Plant Reliability Aug 1977 6 p In FRENCH

Avail NTIS HC A10/MF A01

For numerous reasons, aircraft engine builders conduct long endurance tests which are notably distinguished from the usual development and certification tests Formulas for accelerated cyclic tests were adapted for the Olympus MK 610-14-28 engine used on the Concorde Topics discussed include a description of the cycle test compared to the flight cycle, the installation of the test equipment, and the precautions that were taken to assure a faithful representation of operational conditions When commercial Concorde service began, the accumulated cycles represented several years of usage \_\_\_\_\_\_ Transl by A R H

N77-33198# Pratt and Whitney Aircraft, West Palm Beach Fla Government Products Div

### ACCELERATED MISSION TEST: A VITAL RELIABILITY TOOL

B J McDonnell In AGARD Power Plant Reliability Aug 1977 6 p

Avail NTIS HC A10/MF A01

The Accelerated Mission Test (AMT) has been successfully used in the F100 engine program to anticipate potential future problems Early identification of service oriented problems has provided the lead time, necessary to take corrective action before the problems occur in operation which decreases engine 'down' time thereby improving life cycle cost. The AMT is a supplemental testing procedure and must be used in conjunction with all of the advanced structural analysis techniques. Plans are now being developed to conduct accelerated mission tests on engines that have completed the overhaul or depot cycle. The purpose of the testing will be to identify potential problem areas associated with engine parts that have been repaired in accordance with the overhaul procedures.

N77-33197# Technische Hochschule, Aachen (West Germany) Inst fuer Strahlantriebe und Turboarbeitsmaschinen

EXPERIMENTAL INVESTIGATION ON THE INFLUENCE OF COMPONENT FAULTS ON TURBOJET ENGINE PERFORM-ANCE

H Toenskoetter /n AGARD Power Plant Reliability Aug 1977 12 p refs

Avail NTIS HC A10/MF A01

Some results of experimental investigations on the effect of implanted local faults, e.g. turbine guide vane damage, plugged fuel nozzles, and turbine rotor blade damage, on the performance of a single spool turbojet engine are presented. The formation of flow non-uniformities downstream from the faults is especially described. In one-dimensional gas path analysis systems circumferential-averaged thermodynamic parameters are used for fault detection. The effect of the implanted faults on some of these averaged parameters will be shown in companison with the local parameter changes in the disturbed sector. The possibilities of using the analysis of flow non-uniformities for the isolation of local faults in the hot section of turbojet engines are discussed and questions of probe position for this diagnostic technique are ventilated.

N77-33196# Vereinigte Flugtechnische Werke-Fokker G m b H Bremen (West Germany)

#### METHODS OF IMPROVING THE PERFORMANCE RELI-ABILITY OF ADVANCED MILITARY POWER PLANT SYSTEMS

Richard Smyth In AGARD Power Plant Reliability Aug 1977 23 p refs

Avail NTIS HC A10/MF A01

Advanced military propulsion systems will be equipped with multi-parameter control systems based around an electronic

computer making use of digital technology Such control systems have a high degree of flexibility and can be used for a wide range of applications. This offers new possibilities of efficient and accurate monitoring of engine performance in the aircraft and by the flight support organization responsible for reliability and safety of the propulsion system. The possibilities are discussed based on the experience gained with a multi-parameter electronic engine controller of a V/STOL fighter aircraft. Special consideration is given to practical aspects such as handling procedures Author.

N77-33199 Air Force Logistics Command, Wright-Patterson AFB, Ohio

#### PRELIMINARY RESULTS OF USAF EXPERIENCE WITH ENGINE MONITORING AND DIAGNOSTICS

A Bruce Richter and Kenneth E Eickmann /n AGARD Power Plant Reliability Aug 1977 6 p

#### Avail NTIS HC A10/MF A01

A formal flight test evaluation of an engine health monitoring system being used on tan T-36 supersonic aircraft is described. The system consists of engine sensors, an airframe mounted Data Processing Unit (DPU), and a ground based diagnostic display unit. The sensors continuously monitor some 24 parameters including an EGT, RPM, fuel flow, and EPR, however, data is only recorded if the pilot wishes or if a gate in the DPU is tnggered.

N77-33200<sup>\*</sup># Virginia Polytechnic Inst and State Univ, Blacksburg

DIGITAL FLIGHT CONTROL SYSTEMS

Alper K Caglayan and Hugh F VanLandingham Sep 1977 51 p refs

(Grant NGR-47-004-116)

(NASA-CR-145248) Avail NTIS HC A04/MF A01 CSCL 01C

The design of stable feedback control laws for sampled-data systems with variable rate sampling was investigated. These types of sampled-data systems arise naturally in digital flight control systems which use digital actuators where it is desirable to decrease the number of control computer output commands in order to save wear and tear of the associated equipment. The design of aircraft control systems which are optimally tolerant of sensor and actuator failures was also studied. Detection of the failed sensor or actuator must be resolved and if the estimate of the state is used in the control law, then it is also desirable to have an estimator which will give the optimal state estimate even under the failed conditions.

#### N77-33201\*# Rockweil International Corp., Los Angeles, Calif DESIGN AND DEVELOPMENT OF A STRUCTURAL MODE CONTROL SYSTEM

Oct 1977 184 p refs (Contract NAS4-2347)

(NASA-CR-143846, NA-77-296) Avail NTIS HC A09/MF A01 CSCL 01C

A program was conducted to compile and document some of the existing information about the conceptual design, development, and tests of the B-1 structural mode control system (SMCS) and its impact on ride quality. This report covers the following topics (1) Rationale of selection of SMCS to meet ride quality criteria versus basic aircraft stiffening (2) Key considerations in designing an SMCS, including vane geometry rate and deflection requirements, power required, compensation network design, and fail-safe requirements (3) Summary of key results of SMCS vane wind tunnel tests (4) SMCS performance (5) SMCS design details, including materials, bearings, and actuators (6) Results of qualification testing of SMCS on the 'Iron Bird' flight control simulator, and lab qualification testing of the actuators (7) Impact of SMCS vanes on engine inlet characteristics from wind tunnel tests Author N77-33202\*# Honeywell, Inc., Minneapolis, Minn Systems and Research Center

F-8C ADAPTIVE FLIGHT CONTROL LAWS Final Report G L Hartmann C A Harvey G Stein, D N Carlson and R C Hendrick Washington NASA Sep 1977 334 p refs (Contract NAS1-13383)

(NASA-CR-2880 HONEYWELL-76SRC/16) Avail NTIS HC A15/MF A01 CSCL 01C

Three candidate digital adaptive control laws were designed for NASA's F-8C digital flyby wire aircraft Each design used the same control laws but adjusted the gains with a different adaptative algorithm. The three adaptive concepts were high-gain limit cycle, Liapunov-stable model tracking and maximum likelihood estimation. Sensors were restricted to conventional inertial instruments (rate gyros and accelerometers) without use of air-data measurements Performance growth potential and computer requirements were used as criteria for selecting the most promising of these candidates for further refinement. The maximum likelihood concept was selected primarily because it offers the greatest potential for identifying several aircraft parameters and hence for improved control performance in future aircraft application. In terms of identification and gain adjustment accuracy the MLE design is slightly superior to the other two but this has no significant effects on the control performance achievable with the F-BC aircraft. The maximum likelihood design is recommended for flight test, and several refinements to that design are proposed Author

N77-33203\*# Honeywell Inc Minneapolis Minn Systems and Research Center

ADAPTIVE F-8C FLIGHT CONTROL EXTENSIONS **Final Report** 

Gunter Stein and Gary L Hartmann Washington NASA Sep 1977 143 p refs

(Contract NAS1-13383)

(NASA-CR-2881 HONEYWELL-76SRC/16) Avail NTIS HC A07/MF A01 CSCL 01C

An adaptive concept which combines gain-scheduled control laws with explicit maximum likelihood estimation (MLE) identification to provide the scheduling values is described. The MLE algorithm was improved by incorporating attitude data estimating gust statistics for setting filter gains and improving parameter tracking during changing flight conditions. A - teral MLE algorithm was designed to improve true air speed id angle of attack estimates during lateral maneuvers. Relationships between the pitch axis sensors inherent in the MLE design were examined and used for sensor failure detection. Design details and simulation performance are presented for each of the three areas investigated Author

#### N77-33204# Naval Postgraduate School, Monterey Calif WING ROCK AS A LATERAL-DIRECTIONAL AIRCRAFT LIMIT CYCLE OSCILLATION INDUCED BY NONLINEAR AERODYNAMICS OCCURRING AT HIGH ANGLE OF ATTACK MS Thesis

Paul David Young Jun 1977 69 p refs (AD-A042104) Avail NTIS HC A04/MF A01 CSCL 01/3 Wing rock at high angle of attack is an oscillatory lateraldirectional motion phenomenon known to exist in some of today's high performance tactical aircraft. The motion has been consistently characterized as a lightly damped Dutch-Roll oscillation attributable to asymmetric wing stall. However, evidence gathered from wind tunnel simulations and at least one British study indicate that aerodynamic nonlinearities may be the source of wing rock Regardless of the actual cause of the phenomenon, a study of wing rock has positive ramifications with respect to gaining a clear r understanding of the aerodynamics associated with high angle of attack flight. This report presents the results of an investigation of wing rock which centered on the premise that two distinct nonlinear aerodynamic mechanisms (aerodynamic hysteresis and a cubic nonlinearity in yawing moment) not only can cause wing rock but may drive it to a limit cycle oscillation as well Author (GRA)

N77-33206# Missouri Univ Columbia Dept of Electrical Engineering

#### ANALYSIS OF INHERENT ERRORS IN ASYNCHRONOUS DIGITAL FLIGHT CONTROLS Interim Report, 1 Feb 1976 - 31 Jan 1977

Charles Slivinsky 31 Jan 1977 17 p refs (Grant AF-AFOSR-2968-76)

NTIS (AD-A041813 AFOSR-77-0728TR) Avail HC A02/MF A01 CSCL 01/4

Progress has been achieved in the study of inherent errors in asynchronous digital flight controls. The research involves model development, software development and parametric analysis of representative flight control systems Author (GRA)

#### N77-33207# Bell Helicopter Co Fort Worth Tex ROTORCRAFT FLIGHT SIMULATION WITH COUPLED ROTOR AEROELASTIC STABILITY **ANALYSIS** VOLUME 1 ENGINEER'S MANUAL Final Technical Report, May 1975 - May 1976

Tyce T McLarty May 1977 347 p refs

(Contract DAAJ02-75-C-0025 DA Proj 1F2-62209-AH-76)

(AD-A042462, USAAMRDL-TR-76-41A Rept-699-099-022) Avail NTIS HC A15/MF A01 CSCL 20/4

This report consists of three volumes and documents the current version in the C81 family of rotorcraft flight simulation programs developed by Bell Helicopter Textron This current version of the digital computer program is referred to as AGAJ76 The accompanying program for calculating fully-coupled rotor blade mode shapes is called DN9100. The first volume the Engineer's Manual presents an overview of the computer program capabilities plus discussions for the background and development of the principle mathematical models in the program. The models discussed include all those currently in the program

GRA

N77-33208# Advisory Group for Aeronautical Research and Development, Paris (France)

#### STRUCTURAL ASPECTS OF ACTIVE CONTROLS

Aug 1977 102 p refs Partly in ENGLISH and FRENCH Proc of 44th Meeting of AGARD Struct and Mater Panel, Lisbon, 21 Apr 1977

(AGARD-CP-228, NTIS ISBN-92-835-0200-00) Avail HC A06/MF A01

Design and implementation factors regarding flight control systems are reviewed. Flutter suppression system testing is discussed including wind tunnel tests, as well as actual flight tests Also considered is the impact flight command stability systems have on aircraft dynamic response

N77-33209# British Aircraft Corp Filton (England) Commercial Aircraft Div

#### A PRACTICAL OPTIMUM SELECTION PROCEDURE FOR A MOTIVATOR IN ACTIVE FLUTTER SUPPRESSION SYSTEM DESIGN ON AN AIRCRAFT WITH UNDERWING STORES

M R Turner and C G Lodge In AGARD Structural Aspects of Active Controls Aug 1977 19 p

#### Avail NTIS HC A06/MF A01

Theoretical active flutter control of a variable sweep wing with external stores with four combinations of store configuration/ wing sweep/Mach number was studied. Electrically modified outputs of a structure-mounted transducer were used to drive an auxiliary control surface on the wing or store. The best transducer/force positions on the wing and stores were found using Nyquist plots, representing the control surface loads by point forces. The object was to see if a common active flutter control system using a control surface on the wing could be found for a range of stores, Mach numbers and wing sweep angles Difficulties were due to two instabilities with close frequencies in two of the configurations and very low dampings in some of the stable modes Author N77-33210# Vereinigte Flugtechnische Werke-Fokker G m b H , Bremen (West Germany)

#### IMPACT OF A COMMAND AND STABILITY AUGMENTA-TION SYSTEM ON GUST RESPONSE OF A COMBAT AIRCRAFT

K D Colimann and O Sensburg (Messerschmitt-Boelkow-Blohm GmbH Munich) In AGARD Structural Aspects of Active Controls Aug 1977 17 p refs

#### Avail NTIS HC A06/MF A01

To get reasonable results for just response calculations it is necessary to introduce the elastic aircraft behaviour as well as the Command and Stability Augmentation System (CSAS) into the mathematical model. It is demonstrated how calculation results are influenced by using aerodynamic interference air forces the influence of the CSAS is then presented. It is shown that the influence of the CSAS on the dynamic response is of prime interest and often far exceeds the influence of the elastic structure The unsteady aerodynamic forces should be determined with three-dimensional theories including interference, and corrections to match the steady derivatives measured in the wind tunnel should be included. The impedance function control loop transfer functions are highly nonlinear due to the nonlinearities of the hydraulic actuators. All these functions must be determined experimentally and introduced into the elastic aircraft equation Response plots of the total system should be calculated and compared with results of so-called structural mode coupling tests' If correlation is good, a major part for the investigation of structural response of the aircraft due to various input functions is verified Author

N77-33211# British Aircraft Corp Filton (England) Unternehmensbereich Flugzeuge

### ACTIVE FLUTTER SUPPRESSION OF AN AIRPLANE WITH WING MOUNTED EXTERNAL STORES

H Hoenlinger /n AGARD Structural Aspects of Active Controls Aug 1977 15 p refs

#### Avail NTIS HC A06/MF A01

A wing store flutter suppression system with store mounted vanes was designed. The system was proved effective when implemented and flight-tested on a Fiat G 91/T3 aircraft. The relatively small vanes used were very effective in controlling flutter and their use did not alter aircraft flight mechanical characteristics.

#### N77-33212# Boeing Co., Wichita Kans AIRPLANE MATH MODELING METHODS FOR ACTIVE CONTROL DESIGN

Kenneth L Roger In AGARD Structural aspects of active controls Aug 1977 11 p refs

#### Avail NTIS HC A06/MF A01

Selected analytical methods are described which are useful and practical in math modeling for airplane active control system design A technique for writing state equations is presented which is suitable for incorporating lifting surface aerodynamic solutions An economical method of computing unsteady aerodynamic influence matrices is presented for line doublets and plate doublets, the latter usable at any Mach number An economical way to analyze three-dimensional turbulence and a convenient way of using design criteria in n-dimensions are presented to aid in designing for statistical performance Recommendations include the use of a single airplane math model for analysis of multiple performance parameters and the use of control hardware math modeling during preliminary design Author

N77-33213# Air Force Flight Dynamics Lab , Wright-Patterson AFB, Ohio Flight Control Div

## CONSISTENCY IN AIRCRAFT STRUCTURAL AND FLIGHT CONTROL ANALYSIS

Robert C Schwanz In AGARD Structural Aspects of Active Controls Aug 1977 18 p refs

Avail NTIS HC A06/MF A01

Military Specifications (MILSPECS) are often employed by the USAF procuring authority as guidelines for design development, acceptance testing and mission application of military aircraft The MILSPECS must usually be satisfied by formulations of the aerodynamic and dynamic analyses that are consistent or equivalent if not identical When control configured vehicle considerations are involved however, inconsistencies resulting from analysis expediency or previous engineering convention may occur in this paper YF-16, C-5A, B-52E and large transport aircraft design studies and flight tests provide data for a discussion and numerical illustration of these inconsistencies. It is concluded that they may be minimized or avoided altogether if flight control specialists become more familiar with restrictions of present-day unsteady aerodynamic theory, and structural specialists increase their knowledge of modern dynamics and control theory Author

#### N77-33214# Boeing Aerospace Co Seattle Wash YC-14 CONTROL SYSTEM REDUNDANCY

William T Hamilton In AGARD Structural Aspects of Active Controls Aug 1977 7 p refs

#### Avail NTIS HC A06/MF A01

The YC-14 is the Boeing entry in the USAF Advanced Medium STOL Transport program The task of operating a large jet aircraft into and out of a semi-prepared, 2 000 feet long airstrip with a 27,000 pound payload presents an unusual flight control challenge The YC-14 answers this challenge using an advanced flight control system that includes digital computers Excellent STOL flying qualities have been achieved through control wheel steering and speed hold modes. Fail operational-fail safe performance is provided by a triplex flight control system. Aircraft dynamics following an engine failure are docile and do not require immediate pilot attention or unusual skill. The superior capability of digital computers to perform logic functions enables a comprehensive, semi-automated preflight test Failures are detected and identified to the Line Replaceable Unit. The YC-14 s use of redundant digital computers in the flight control role is a first for an aircraft designed to demonstrate operational use

Author

#### N77-33215# Office National d'Etudes et de Recherches Aerospatiales, Paris (France) Div de Recherche WIND TUNNEL STUDY OF AN ACTIVE FLUTTER SUPPRES-SION SYSTEM

Roger Destuynder In AGARD Structural Aspects of Active Controls Aug 1977 9 p refs In FRENCH ENGLISH summary

#### Avail NTIS HC A06/MF A01

Active flutter control was tested in a wind tunnel on a model of wing carrying an external tank. The aerodynamic forces of the control system were generated by a classical aileron piloted by a miniaturized servo-control from a signal issued by an accelerometer detecting the wing movement A single control law was used in the whole velocity range A gain of more than 15% was obtained on the flutter critical velocity Author

N77-33216# Air Force Human Resources Lab Brooks AFB Tex Flying Training Div

INVESTIGATION OF DIAGNOSTIC, ERROR DETECTOR AND SELF-TAUGHT INSTRUCTIONAL STRATEGIES FOR FLIGHT SIMULATOR PROGRAMS Final Report, Apr 1975 - May 1978

Dolores Tyler, Robert W McFadden, Edward E Eddowes, and Robert R Fuller Oct 1976 211 p refs

(AD-A035682 AFHRL-TR-76-65) Avail NTIS HC A10/MF A01 CSCL 05/9

This study investigated the use of three instructional strategies in the training of basic instrument flight maneuvers in a T-40 simulator under standard conditions and two levels of increased task loading. The three strategies investigated were (a) diagnostic (b) error detector and (c) self-taught. Diagnostic instructors used immediate feedback through error analysis the error detector instructor used limited feedback and the self-taught group was instructed without the aid of any feedback from the instructor pilot. The three levels of loading were (a) no task loading (b) a change in the center of gravity from normal to full forward and (c) a change in air turbulence from zero to maximum Twenty-seven Air Force officers awaiting entry into undergraduate pilot training were randomly assigned to one of the three instructional strategy groups. The results indicate that there were no significant differences between the three instructional strategies ie, the students of any one strategy performed equally as well as the students of the other two strategies. The results indicated that there were significant differences among task load conditions. A general decrement in performance was noted when the students flew the maneuvers with the center of gravity change and an even greater decrement when they flew with maximum turbulence GRA

#### N77-33230\*# Systems Technology, Inc., Mountain View, Calif RESEARCHER'S GUIDE TO THE NASA AMES FLIGHT SIMULATOR FOR ADVANCED AIRCRAFT (F8AA)

John B. Sinacon, Robert L. Stapleford, Wayne F. Jewell, and John M Lehman Washington NASA Aug 1977 276 p refs

(Contract NAS2-9024)

(NASA-CR-2875 STI-TR-1074-1) Avail NTIS HC A13/MF A01 CSCL 14B

Performance, limitations supporting software, and current checkout and operating procedures are presented for the flight simulator, in terms useful to the researcher who intends to use it Suggestions to help the researcher prepare the experimental plan are also given The FSAA's central computer cockpit and visual and motion systems are addressed individually but their interaction is considered as well. Data required available options, user responsibilities, and occupancy procedures are given in a form that facilitates the initial communication required with the NASA operations group Author

#### N77-33252\*# National Aeronautics and Space Administration Lyndon B Johnson Space Center, Houston, Tex SPACE SHUTTLE PROGRAM: LIGHTNING PROTECTION

CRITERIA DOCUMENT

4 Nov 1975 79 p refs Revised

(NASA-TM-74974. JSC-07636-Rev-A) NTIS Avail HC A05/MF A01 CSCL 22B

The lightning environment for space shuttle design is defined and requirements that the design must satisfy to insure protection of the vehicle system from direct and indirect effects of lightning are imposed Specifications, criteria, and guidelines included provide a practical and logical approach to protection problems Author

N77-33480# Weapons Research Establishment, Adelaide (Australia)

#### AN ACCURATE ANGULAR POSITION AND ANGULAR VELOCITY INSTRUMENT BASED ON AN OPTICAL INCREMENTAL ENCODER

B Humski Dec 1976 35 p refs

(WRE-TN-1730(WR/D)) Avail NTIS HC A03/MF A01

An instrument designed to measure the instantaneous angular position and angular velocity of a freely rotating wind tunnel model is described. The transducer based on a photo-optical incremental encoder, is insensitive to vibrations. Although primarily intended for studying the roll behaviour of a wind tunnel model its high resolution instantaneous response to roll reversal, freedom from accummulated errors and error detection capabilities make it suitable for general purpose usage in a wide range of applications Author

N77-33685# Bolt, Beranek, and Newman Inc., Canoga Park, Calif

#### AIRCRAFT SIDELINE NOISE A TECHNICAL REVIEW AND ANALYSIS OF COMTEMPORARY DATA

David Q Walker Apr 1977 47 p refs (Contract F33615-76-C-0507) (AD-A042076, BBN-3291 AMRL-TR-76-115) Avail NTIS HC A03/MF A01 CSCL 20/1

This report presents a review and analysis of recent aircraft flyover data where the aircraft is at a low angle of elevation relative to the observer Excess attenuation factors (attenuation in addition to normal spherical divergence and atmospheric absorption losses), evaluated for a range of aircraft types were found to vary between aircraft and could be generally characterized as a function of aircraft angle of elevation only Fuselage shellding or installation effects could not be positively identified although their presence is suggested by the differing excess attenuation characteristics of each aircraft type. Lack of detail in the data available for review precluded the identification of any propagation losses due to turbulent scattering of sound in the atmosphere The results of the study suggest that currently applied predictive models for sideline noise tend to overestimate noise levels particularly for 3 and 4 engine aircraft An alternative approach to sideline noise prediction is suggested and recommendations are made to encourage technical development in this uncertain Author (GRA) area of aircraft noise prediction

N77-33686# Bolt, Beranek and Newman, Inc. Canoga Park, Calif

FURTHER SENSITIVITY STUDIES OF COMMUNITY-AIRCRAFT NOISE EXPOSURE (NOISEMAP) PREDICTION **PROCEDURES** Final Report

Dwight E Bishop, Thomas C Dunderdale, Richard D Horonjeff, and John F Mills Apr 1977 88 p refs (Contract F33615-76-C-0507 AF Proj 7231)

(AD-A041781, BBN-3295) Avail NT/S HC A05/MF A01 CSCL 20/1

This report describes the results of studies of the sensitivity of the noise exposure contours to various model parameters and assumptions presently in the NOISEMAP procedure. The areas within Day/Night Level (LDN) contours for ten Air Force airbases increased by 11 to 40 percent when the noise measure was adjusted for the presence of pure tones. The contour areas for typical mixed fighter, bomber/tanker, and training airbases were reduced by 3 to 11 percent by substitution of the SAE algorithms for ground-to-ground propagation and transition models, whereas adding the fuselage shielding algorithm reduced the contour areas by 13 to 22 percent. Since there is little firm evidence showing one set of algorithms more accurate than the other, the present NOISEMAP models will be retained until further technical analyses or new data show a clear basis GRA for alteration

N77-33696# Technical Univ of Norway, Trendheim Akustisk Lab

#### AIRPLANE NOISE: DIMENSIONS AND MEANS OF NOISE REDUCTION

M Ringheim Oct 1976 13 p refs in NORWEGIAN, ENGLISH summary

(ELAB-STF44-A75080 ISBN-82-595-696-3) Avail NTIS HC A02/MF A01, Tech Univ of Norway, Trondheim Nor Kr 20

An estimate was made of the number of people exposed to noise from military and civil aircraft in Norway. Possibilities for the reduction of noise exposure are reviewed and costs are estimated for various alternatives ESA

N77-33959\*# Kansas Univ Center for Research, Inc Lawrence A RESEARCH PROGRAM TO REDUCE INTERIOR NOISE IN GENERAL AVIATION AIRPLANES Progress Report

Jan Roskam, Vincent U Muirhead Howard W Smith, Tonnis D Peschier, Don Durenberger, Kees Vandam and Tzy-Chuan Shu Oct 1977 76 p refs (Grant NsG-1301)

(NASA-CR-155154, KU-FRL-317-5) NTIS Avail HC A05/MF A01 CSCL 20A

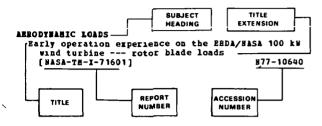
Analytical and semi-empirical methods for determining the transmission of sound through isolated panels and predicting panel transmission loss are described. Test results presented include the influence of plate stiffness and mass and the effects of pressurization and vibration damping materials on sound transmission characteristics. Measured and predicted results are presented in tables and graphs Author

# SUBJECT INDEX

#### AERONAUTICAL ENGINEERING / A Special Bibliography (Suppl 91)

#### **JANUARY 1978**

#### **Typical Subject Index Listing**



The title is used to provide a description of the subject matter. When the title is insufficiently descriptive of the document content a title extension is added separated from the title by three hyphens. The NASA or AIAA accession number is included in each entry to assist the user in locating the abstract in the abstract section of this supplement. If applicable, a report number is also included as an aid in identifying the document.

### A

A-37 AIRCRAFT	
A-37B fatique sensor evaluation program;	Full
scale test and field aircraft instrument	ation
[AD-A042114]	N77-33156
AC GENERATORS	
Subsystem design analysis light weight alt	ernator
(model test program). Addendum 2	
[AD-A0412571	N77-33171
ACCELERATED LIFE TESTS	
Accelerated mission test: A vital reliabi	lity tool
·····	N77-33196
ACOUSTIC ATTENUATION	
Shielding aspects of heated twin jet noise	
[AIAA PAPER 77-1288]	A77-51048
A research program to reduce interior nois	e 1n
general aviation airplanes test meth	
results	
[NASA-CR-155154]	N77-33959
ACOUSTIC DUCTS	
A finite element algorithm for sound propa	gation
in axisymmetric ducts containing compres	
mean flow	
FAIAA PAPER 77-13011	A77-51057
ACOUSTIC SCATTERING	
Acoustic scattering of point sources by a	moving
/ prolate spheroid jet fuselage	,
[ AIAA PAPER 77-1326]	A77-51080
ADAPTIVE CONTROL	
Application of UHF adaptive array to	
navigaticn/tracking systems	
	A77-51185
F-8C adaptive flight control laws	
[NASA-CR-2880]	N77-33202
P-SC adaptive flight control extensions	- for
maximum likelihood estimation	
[NASA-CR-2881]	N77-33203
ABRIAL PHOTOGRAPHY	
The helicopter Ka-26 in the Special Purpos	e
Flights Sector of Interflug. II	
	477-49657
AERIAL RECONNAISSANCE	
An analysis of personnel parachutes for us	e bv
Marine Corps Force Reconnaissance Units	,
[AD-A041151]	N77-33124
ABRIAL RUDDERS	
Trapped rubber processing for advanced com	posites
[SNE PAPER EN76-172]	A77-51009
ABBOACOUSTICS	
Coherent structures in the mixing zone of	a
subsonic hot free jet	-
[ONERA, TP NO. 1977-88]	177-50989
i on and i at the task wet	

burning turbofan [AIAA PAPEZ 77-1264] A77-51028 Are wheel-well related aeroacoustic sources of any significance in airframe noise [AIAA PAPEZ 77-1271] A77-51033 Noise component method for airframe noise [AIAA PAPEZ 77-1271] A77-51034 New scaling laws for hot and cold jet mixing noise based on a geometric accoustics model [AIAA PAPEZ 77-1287] A77-51037 Unsteady surface pressure characteristics on aircraft components and farfield radiated airframe noise [AIAA PAPEZ 77-1295] A77-51052 Forward filique effects on EBF noise Externally Blown Flaps [AIAA PAPEZ 77-1314] A77-51069 Numerical prediction of aeroacoustic jet-flap flows [AIAA PAPEZ 77-1316] A77-51071 Interim noise correlation for some OTW configurations using external jet-flow deflectors enjine Over The Wing [AIAA PAPEZ 77-1317] A77-51072 Summary of forward velocity effects on fan noise [AIAA PAPEZ 77-1319] A77-51074 Investigation of subsonic fan noise sources by fluctuating pressure measurements on rotating blades [AIAA PAPEZ 77-1321] A77-51080 Effect of filigat on jet noise from supersonic undererpanded flows [AIAA PAPEZ 77-1326] A77-51080 Effects of forward motion on jet and core noise [AIAA PAPEZ 77-1330] A77-51084 Acoustic performance of inlet multiple-pure-tone suppressors installed on NASA Quiet Engine 'C' [AIAA PAPEZ 77-1334] A77-51087 Effects of forward motion on jet and core noise [AIAA PAPEZ 77-1334] A77-51087 Effects of simulated flight on fan noise suppressors [AIAA PAPEZ 77-1334] A77-51093 Effects of simulated flight on fan noise suppressors [AIAA PAPEZ 77-1340] A77-51093 Effects of forvard motion on turbomachinery noise [AIAA PAPEZ 77-1340] A77-51093 Effects of simulated flight on fan noise supression [AIAA PAPEZ 77-1340] A77-51093 Effects of simulated flight on fan noise supression [AIAA PAPEZ 77-1340] A77-51093 Effects of simulated flight on fan noise supression [AIAA PAPEZ 77-1340] A77-51093 Effects of simulated flight on fan noise production [AIAA PAPEZ 77-1354] A77-51093 Effect	Theoretical jet exhaust noise model for the duct
significance in airframe noise [ATAA PAPER 77-1270] A77-51033 Noise component method for airframe noise [ATAA PAPER 77-1271] A77-51034 New scaling laws for hot and cold jet mixing noise based on a geometric acoustics model [ATAA PAPER 77-1287] A77-51007 Unsteady surface pressure characteristics on aircraft components and farfield radiated airframe noise [ATAA PAPER 77-1287] A77-51052 Porward fliqut effects on EBP noise Externally Blown Plaps [ATAA PAPER 77-1314] A77-51069 Numerical prediction of aeroacoustic jet-flap flows [ATAA PAPER 77-1316] A77-51071 Interim noise correlation for some OTW configurations using external jet-flow deflectors engine Over The Wing [ATAA PAPER 77-1317] A77-51072 Summary of forward velocity effects on fan noise [ATAA PAPER 77-1319] A77-51073 Investigation of subsonic far noise sources by fluctuating pressure measurements on rotating blades [ATAA PAPER 77-1320] A77-51076 Constic scattering of point sources by a moving prolate spheroid yet fuselage [ATAA PAPER 77-1320] A77-51080 Effects of forward motion on jet and core noise [ATAA PAPER 77-1330] A77-51087 Effects of simulated flight on fan noise suppression underesponded flows [ATAA PAPER 77-1330] A77-51087 Effects of simulated flight on fan noise suppression [ATAA PAPER 77-1334] A77-51087 Effects of simulated flight on fan noise suppression [ATAA PAPER 77-1334] A77-51087 Effects of simulated flight on fan noise suppression [ATAA PAPER 77-1334] A77-51093 Effects of simulated flight on fan noise suppression [ATAA PAPER 77-1340] A77-51093 Effects of simulated flight on fan noise suppression [ATAA PAPER 77-1340] A77-51093 Effect of orvard motion on turbomachinery noise [ATAA PAPER 77-1340] A77-51093 Effect of sorvard motion on turbomachinery noise [ATAA PAPER 77-1340] A77-51093 Effect of sorvard motion on turbomachinery noise [ATAA PAPER 77-1340] A77-51093 Effect of sorvard motion on turbomachinery noise [ATAA PAPER 77-1340] A77-51102 Effect of sorvard motion on turbomachin	[AIAA PAPER 77-1264] A77-51028
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FATAA PAPE2 77-1326]A77-51080Effect of rligat on jet noise from supersonicundererpanded flowsFATAA PAPE2 77-1326]A77-51082Effects of forward motion on jet and core noise[ATIA PAPE2 77-1330]AT7-51084A77-51084Acoustic performance of inlet multiple-pure-tonesuppressors installed on NASA Quiet Engine 'C'[ATAA PAPE2 77-1333]A77-51087Effects of simulated flight on fan noise suppressionA77-51087Effects of simulated flight on fan noise suppressionA77-51091Some results of the testing of a full-scale OgeeParformance[ATAA PAP2E 77-1340]A77-51093Interaction of rotor tip flow irregularities withstator wanes as a noise sourceA77-51095Effect of forward motion on turbomachinery noise[ATAA PAP2E 77-1340]A77-51095Simultaneous characterization of jet noise sourcesand acoustic field by a new application ofconditional samplingA77-51102Arperimental results of large-scale structures injet flows and their relation to jet noiseproductionA77-51103Ar7-51102Ar7-51102Arostic p	
undererpanded flows [AIAA PAPE& 77-1326] A77-51082 Effects of forward motion on jet and core noise [AIAA PAPE& 77-1330] A77-51084 Acoustic performance of inlet multiple-pure-tone suppressors installed on NASA Quiet Engine 'C' [AIAA PAPE& 77-1333] A77-51087 Effects of simulated flight on fan noise suppression [AIAA PAPE& 77-1334] A77-51088 Helicopter rotor aerodynamic and aeroacoustic environments [AIAA PAPE& 77-1338] A77-51091 Some results of the testing of a full-scale Ogee tip helicopter rotor; acoustics, loads, and performance [AIAA PAPE& 77-1380] A77-51093 Interaction of rotor tip flow irregularities with stator vanes as a noise source [AIAA PAPE& 77-1342] A77-51095 Effect of forward motion on turbomachinery noise [AIAA PAPE& 77-1346] A77-51095 Effect of forward motion on turbomachinery noise [AIAA PAPE& 77-1346] A77-51095 Effect of forward motion of jet noise sources and acoustic field by a new application of conditional sampling [AIAA PAPE& 77-1350] A77-51102 Experimental results of large-scale structures in jet flows and their relation to jet noise production [AIAA PAPE& 77-1354] A77-51107 Ar7-51107 The influence of the inlet duct contour on forward radiated fan noise [AIAA PAPE& 77-1355] A77-51108 Acoustic loads on upper-surface-blown powered-lift systems [AIAA PAPE& 77-1363] Caroner of a TSB STOL transport	FAIAA PAPER 77-13261 A77-51080
Effects of forward motion on jet and core noise [ATAA PAP2B 77-1330] A77-51084 Acoustic performance of inlet multiple-pure-tone suppressors installed on NASA Quiet Engine 'C' [ATAA PAP2B 77-1333] Effects of simulated flight on fan noise suppression [ATAA PAP2B 77-1334] Helicopter rotor aerodynamic and aeroacoustic environments [ATAA PAP2B 77-1336] Some results of the testing of a full-scale Ogee tip helicopter rotor; acoustics, loads, and performance [ATAA PAP2B 77-1340] A77-51093 Interaction of rotor tip flow irregularities with stator vanes as a noise source [ATAA PAP2B 77-1346] A77-51095 Effect of forward motion on turbomachinery noise [ATAA PAP2B 77-1346] A77-51099 Simultaneous characterization of jet noise sources and accoustic field by a new application of conditional sampling [ATAA PAP2B 77-1349] A77-51102 Experimental results of large-scale structures in jet flows and their relation to jet noise production [ATAA PAP2B 77-1350] A77-51107 The influence of the inlet duct contour on forward radiated fan noise [ATAA PAP2B 77-1355] A77-51108 Acoustic Loads on upper-surface-blown powered-lift systems [ATAA PAP2B 77-1363] A77-51115 Cabin noise production of a 158 STOL transport	underexpanded flows
Acoustic performance of inlet multiple-pure-tone suppressors installed on NASA Quiet Engine 'C' [ATAA PAPER 77-1333] A77-51087 Effects of simulated flight on fan noise suppression [ATAA PAPER 77-1334] A77-51088 Helicopter rotor aerodynamic and aeroacoustic environments [ATAA PAPER 77-1336] A77-51091 Some results of the testing of a full-scale Ogee tip helicopter rotor; acoustics, loads, and performance [ATAA PAPER 77-1340] A77-51093 Interaction of rotor tip flow irregularities with stator vanes as a noise source [ATAA PAPER 77-1342] A77-51095 Effect of forward motion on turbomachinery noise [ATAA PAPER 77-1346] A77-51095 Simultaneous cnaracterization of jet noise sources and acoustic field by a new application of conditional sampling [ATAA PAPER 77-1363] A77-51102 Erperimental results of large-scale structures in jet flows and their relation to jet noise production [ATAA PAPER 77-1354] A77-51102 Ar7-51107 The influence of the inlet duct contour on forward radiated fan noise [ATAA PAPER 77-1355] A77-51108 Acoustic loads on upper-surface-blown powered-lift systems [ATAA PAPER 77-1363] A77-51115 Cabin poise performance of a SSOUL transport	[AIAA PAPER 77-1328] A77-51082 Effects of forward motion on jet and core noise
suppressors installed on NASA Quiet Engine 'C' [AIAA PAPER 77-1333] A77-51087 Effects of simulated flight on fan noise suppression [AIAA PAPER 77-1334] A77-51088 Helicopter rotor aerodynamic and aeroacoustic environments [AIAA PAPER 77-1338] A77-51091 Some results of the testing of a full-scale Ogee tip helicopter rotor; acoustics, loads, and performance [AIAA PAPER 77-1340] A77-51093 Interaction of rotor tip flow irregularities with stator vanes as a noise source [AIAA PAPER 77-1342] A77-51095 Effect of forward motion on turbomachinery noise [AIAA PAPER 77-1346] A77-51099 Simultaneous characterization of jet noise sources and accustic field by a new application of conditional sampling [AIAA PAPER 77-1349] A77-51102 Experimental results of large-scale structures in jet flows and their relation to jet noise production [AIAA PAPER 77-1350] A77-51107 The influence of the inlet duct contour on forward radiated fan noise [AIAA PAPER 77-1355] A77-51108 Accoustic loads on upper-surface-blown powered-lift systems [AIAA PAPER 77-1363] A77-51105	[AIAA PAPER 77-1330] A77-51084
Effects of simulated flight on fan noise suppression [AIAA PAPER 77-1334]A77-51088Helicopter rotor aerodynamic and aeroacoustic environmentsA77-51091Some results of the testing of a full-scale Ogee tip helicopter rotor; acoustics, loads, and performance [AIAA PAPER 77-1340]A77-51093Interaction of rotor tip flow irregularities with stator wanes as a noise source [AIAA PAPER 77-1342]A77-51093Effect of forward motion on turbomachinery noise [AIAA PAPER 77-1346]A77-51095Simultaneous cnaracterization of jet noise sources and acoustic field by a new application of conditional sampling [AIAA PAPER 77-1363]A77-51102Experimental results of large-scale structures in jet flows and their relation to jet noise production [AIAA PAPER 77-1354]A77-51102Arresting (AIAA PAPER 77-1355]A77-51102Arresting (AIAA PAPER 77-1355]A77-51102Arresting (AIAA PAPER 77-1355]A77-51107Areing (AIAA PAPER 77-1355]A77-51108Acoustic loads on upper-surface-blown powered-lift systems (AIAA PAPER 77-1363]A77-51115Cabin noise (AIAA PAPER 77-1363]A77-51115Cabin noise (AIAA PAPER 77	suppressors installed on NASA Quiet Engine 'C'
Helicopter rotor aerodynamic and aeroacoustic environments [ATAA PAP2E 77-1338]A77-51091Some results of the testing of a full-scale Ogee tip helicopter rotor; acoustics, loads, and performance [ATAA PAP2E 77-1340]A77-51093Interaction of rotor tip flow irregularities with stator wanes as a noise source [ATAA PAP2E 77-1342]A77-51095Effect of forward motion on turbomachinery noise [ATAA PAP2E 77-1346]A77-51095Simultaneous cnaracterization of jet noise sources and acoustic field by a new application of conditional sampling [ATAA PAP2E 77-1349]A77-51102Erperimental results of large-scale structures in jet flows and their relation to jet noise production [ATAA PAP2E 77-1350]A77-51103Arcocoustic performance of a scoop inlet [ATAA PAP2E 77-1355]A77-51107The influence of the inlet duct contour on forward radiated fan noise [ATAA PAP2E 77-1355]A77-51108Acoustic loads on upper-surface-blown powered-lift systems [ATAA PAP2E 77-1363]A77-51105	[AIAA PAPER 77-1333] A/7-51087 Effects of simulated flight on fan noise suppression
environments [AIAA PAP2E 77-1338] A77-51091 Some results of the testing of a full-scale Ogee tip helicopter rotor; acoustics, loads, and performance [AIAA PAP2E 77-1340] A77-51093 Interaction of rotor tip flow irregularities with stator vanes as a noise source [AIAA PAP2E 77-1342] A77-51095 Effect of forward motion on turbomachinery noise [AIAA PAP2E 77-1346] A77-51095 Simultaneous cnaracterization of jet noise sources and acoustic field by a new application of conditional sampling [AIAA PAP2E 77-1349] A77-51102 Experimental results of large-scale structures in jet flows and their relation to jet noise production [AIAA PAP2E 77-1354] A77-51102 Arro-51107 The influence of the inlet duct contour on forward radiated fan noise [AIAA PAP2E 77-1355] A77-51108 Acoustic loads on upper-surface-blown powered-lift systems [AIAA PAP2E 77-1363] A77-51115 Cabin poise peravious of a ISB STOL transport	[AIAA PAPER 77-1334] A77-51088 Helicopter rotor aerodynamic and aeroacoustic
<pre>Some results of the testing of a full-scale Ogee tip helicopter rotor; acoustics, loads, and performance [AIAA PAPEE 77-1340] A77-51093 Interaction of rotor tip flow irregularities with stator vanes as a noise source [AIAA PAPEE 77-1346] A77-51095 Effect of forward motion on turbomachinery noise [AIAA PAPEE 77-1346] A77-51099 Simultaneous caaracterization of jet noise sources and acoustic field by a new application of conditional sampling [AIAA PAPEE 77-1349] A77-51102 Experimental results of large-scale structures in jet flows and their relation to jet noise production [AIAA PAPEE 77-1350] A77-51107 Aeroacoustic performance of a scoop inlet [AIAA PAPEE 77-1355] A77-51107 The influence of the inlet duct contour on forward radiated fan noise [AIAA PAPEE 77-1355] A77-51108 Acoustic loads on upper-surface-blown powered-lift systems [AIAA PAPEE 77-1363] CAT-51115 Cabin noise of a ISB STOL transport</pre>	environments
performance [AIAA PAPER 77-1340]A77-51093Interaction of rotor tip flow irregularities with stator vanes as a noise source [AIAA PAPER 77-1342]A77-51095Effect of forward motion on turbomachinery noise [AIAA PAPER 77-1346]A77-51099Simultaneous caaracterization of jet noise sources and acoustic field by a new application of conditional sampling [AIAA PAPER 77-1349]A77-51102Experimental results of large-scale structures in jet flows and their relation to jet noise production [AIAA PAPER 77-1350]A77-51102Aeroacoustic performance of a scoop inlet [AIAA PAPER 77-1354]A77-51107The influence of the inlet duct contour on forward radiated fan noise [AIAA PAPER 77-1355]A77-51108Acoustic loads on upper-surface-blown powered-lift systems [AIAA PAPER 77-1363]A77-51115Cabun poise pedayior of a USB STOL transport 	Some results of the testing of a full-scale Ogee
[AIAA PAPER 77-1340]A77-51093Interaction of rotor tip flow irregularities with stator vanes as a noise source [AIAA PAPER 77-1342]A77-51095Effect of forward motion on turbomachinery noise [AIAA PAPER 77-1346]A77-51095Simultaneous caaracterization of jet noise sources and acoustic field by a new application of conditional sampling [AIAA PAPER 77-1349]A77-51102Experimental results of large-scale structures in jet flows and their relation to jet noise production [AIAA PAPER 77-1350]A77-51102Arrosoustic performance of a scoop inlet [AIAA PAPER 77-1354]A77-51107The influence of the inlet duct contour on forward radiated fan noise [AIAA PAPER 77-1355]A77-51108Acoustic loads on upper-surface-blown powered-lift systems [AIAA PAPER 77-1363]A77-51105Ar7-51105A77-511063	
stator vanes as a noise source[AIAA PAPEd 77-1342]A77-51095Bffect of forward motion on turbomachinery noise[AIAA PAPEd 77-1346][AIAA PAPEd 77-1346]A77-51099Simultaneous characterization of jet noise sourcesand acoustic field by a new application ofconditional samplingA77-51102[AIAA PAPEd 77-1349]A77-51102Experimental results of large-scale structures injet flows and their relation to jet noiseproductionA77-51102[AIAA PAPEd 77-1350]A77-51102Aeroacoustic performance of a scoop inlet[AIAA PAPEd 77-1354][AIAA PAPEd 77-1355]A77-51107The influence of the inlet duct contour on forwardradiated fan noise[AIAA PAPEd 77-1355]A77-51108Acoustic loads on upper-surface-blown powered-liftsystems[AIAA PAPEd 77-1363]A77-51115Cabin poise pedaylor of a USB STOL transport	[AIAA PAPER 77-1340] A77-51093
Effect of forward motion on turbomachinery noise [AIAA PAP2B 77-1346]       A77-51099         Simultaneous characterization of jet noise sources and acoustic field by a new application of conditional sampling [AIAA PAP2B 77-1399]       A77-51102         Experimental results of large-scale structures in jet flows and their relation to jet noise production [AIAA PAP2B 77-1350]       A77-51102         Aeroacoustic performance of a scoop inlet [AIAA PAP2B 77-1354]       A77-51107         The influence of the inlet duct contour on forward radiated fan noise [AIAA PAP2B 77-1355]       A77-51108         Acoustic loads on upper-surface-blown powered-lift systems [AIAA PAP2B 77-1363]       A77-51115	stator vanes as a noise source
[AIAA PAP2& 77-1346] A77-51099 Simultaneous characterization of jet noise sources and acoustic field by a new application of conditional sampling A77-51102 Experimental results of large-scale structures in jet flows and their relation to jet noise production A77-51107 Aeroacoustic performance of a scoop inlet [AIAA PAP2& 77-1350] A77-51107 The influence of the inlet duct contour on forward radiated fan noise [AIAA PAP2& 77-1355] A77-51108 Acoustic loads on upper-surface-blown powered-lift systems [AIAA PAP2& 77-1363] A77-51115	
and acoustic field by a new application of conditional sampling [ATAN PAPSE 77-1349] A77-51102 Experimental results of large-scale structures in jet flows and their relation to jet noise production [AIAA PAPSE 77-1350] A77-51102 Aeroacoustic performance of a scoop inlet [AIAA PAPSE 77-1354] A77-51107 The influence of the inlet duct contour on forward radiated fan noise [AIAA PAPSE 77-1355] A77-51108 Acoustic loads on upper-surface-blown powered-lift systems [AIAA PAPSE 77-1363] A77-51115	[AIAA PAPER 77-1346] A77-51099
[AIAA PAP2B 77-1349]       A77-51102         Experimental results of large-scale structures in jet flows and their relation to jet noise production       A77-51102         [AIAA PAP2B 77-1350]       A77-51103         Aeroacoustic performance of a scoop inlet [AIAA PAP2B 77-1354]       A77-51107         The influence of the inlet duct contour on forward radiated fan noise [AIAA PAP2B 77-1355]       A77-51108         Acoustic loads on upper-surface-blown powered-lift systems [AIAA PAP2B 77-1363]       A77-51115         Cabin poise perhavior of a TSB STOL transport	and acoustic field by a new application of
Experimental results of large-scale structures in jet flows and their relation to jet noise production [AIAA PAPEE 77-1350] A77-51103 Aeroacoustic performance of a scoop inlet [AIAA PAPEE 77-1354] A77-51107 The influence of the inlet duct contour on forward radiated fan noise [AIAA PAPEE 77-1355] A77-51108 Acoustic loads on upper-surface-blown powered-lift systems [AIAA PAPEE 77-1363] A77-51115 [AIAA PAPEE 77-1363] A77-51115	Conditional sampling [AIAA PAPER 77-1349] A77-51102
production [AIAA PAPEE 77-1350] A77-51103 Aeroacoustic performance of a scoop inlet [AIAA PAPER 77-1354] A77-51107 The influence of the inlet duct contour on forward radiated fan noise [AIAA PAPER 77-1355] A77-51108 Acoustic loads on upper-surface-blown powered-lift systems [AIAA PAPER 77-1363] A77-51115 Cabin poise pehavior of a USB STOL transport	Experimental results of large-scale structures in
Aeroacoustic performance of a scoop inlet [AIAA PAP2R 77-1354] A77-51107 The influence of the inlet duct contour on forward radiated fan noise [AIAA PAP2R 77-1355] A77-51108 Acoustic loads on upper-surface-blown powered-lift systems [AIAA PAP2R 77-1363] A77-51115 Cabin poise pehavior of a ISB STOL transport	production
[AIAA PAP2R 77-1354] A77-51107 The influence of the inlet duct contour on forward radiated fan noise [AIAA PAP2R 77-1355] A77-51108 Acoustic loads on upper-surface-blown powered-lift systems [AIAA PAP2R 77-1363] A77-51115 Cabin noise pehavior of a ISB STOL transport	[AIAA PAPER 77-1350] A77-51103 Aeroacoustic performance of a scoop inlet
radiated fan noise [AIAA PAPER 77-1355] A77-51108 Acoustic Loads on upper-surface-blown powered-lift systems [AIAA PAPER 77-1363] A77-51115 [Cabin noise pehavior of a ISB STOL transport	[AIAA PAPER 77-1354] A77-51107
Acoustic loads on upper-surface-blown powered-lift systems [AIAA PAPER 77-1363] A77-51115 Cabin poise penavior of a ISB STOL transport	radiated fan noise
SYSTEMS [AIAA PAPER 77-1363] A77-51115 Cabin polse pehavior of a ISB STOL transport	
Cabin noise pehavior of a TSB STOL transport	systems
upper surface blowing YC-14 aircraft [AIAA PAPER 77-1365] A77-51117	Cabin noise pehavior of a TSB STOL transport
•	(AIAA PAPER 77-1365) A77-51117

An analytical model for entropy noise of subsonic nozzle flow FAIAA PAPER 77-13661 AERODYNAMIC CHARACTERISTICS A77-51118 Aerodynamic and thermodynamic characteristics of kerosene-spray flames A77-48181 'erodynamic effects during supersonic flow past a laser beam A77-48515 Experimental data and theoretical analysis of an operating 100 kW wind turbine 177-48898 Fluid dynamics of diffuser augmented wind turbines 177-48899 Vortex lattice prediction of subsonic aerodynamics of hypersonic vehicle concepts A77-49343 The technical conception of the IL-62M -Aerodynamic features A77-49655 Influence of the noise level in a transonic wind tunnel on the aerodynamic characteristics of models [ONERA, TP NC. 1977-110] A77-50996 Conditions of physical validity in the linear aerodynamics of supersonic jets A77-51608 Aerodynamic characteristics at Mach numbers from 0.6 to 2.16 of a supersonic cruise fighter configuration with a design Mach number of 1.8 [NASA-TM-X-3559] N77-32081 Effect of rotor wake on aerodynamic characteristics of a 1/6 scale model of the rotor systems research aircraft --- in the Langley V/STOL tunnel [NASA-TM-X-3548] N77-32083 Subsonic longitudinal aerodynamic characteristics and engine pressure distributions for an aircraft with an integrated scramjet designed for Mach 6 cruise --- conducted in Langley 7 by 10 foot high speed tunnel [NASA-"M-X-73911] N77-33108 Theoretical parametric study of the relative advantages of winglets and wing-tip extensions [NASA-TP-1020] N77-3. N77-33112 The effect of flight on the noise of subsonic jets [AD-A041730]
 [AD-A041730]
 Wing rock as a lateral-directional aircraft limit cycle oscillation induced by nonlinear aerodynamics occurring at high angle of attack N77-33176 FAD-A0421041 N77-33204 AERODYNABIC COEFFICIENTS Data reduction for the unsteady aerodynamics on a circulation control airfoil --- wind tunnel test data FAD-A0411531 N77-32084 ABRODINABIC CONFIGURATIONS Practical aerodynamics of maneuvering aircraft /A manual for flight personnel/ --- Russian book 477-50693 Over-the-wing model thrust reverser noise tests [NASA-TM-734951 N77-33161 Consistency in aircraft structural and flight control analysis N77-33213 AERODYNAMIC DRAG Determining the lift and drag distributions on a three-dimensional airfoil from flow-field velocity surveys [NASA-TM-73247] ABEODYNAMIC FORCES Unsteady supersonic aerodynamic theory for N77-32079 interfering surfaces by the method of potential gradient [NASA-CR-2898] N77-33121 Airplane math modeling methods for active control design N77-33212 AERODYNAHIC BEATING The effect of simulated aerodynamic heating on the strength of three rocket motor case steels N77-32240 [RPE-TR-451 AEBODYNAMIC INTERFERENCE Variation of pitching moment with engine thrust for a twin-engine commercial jet aircraft [NASA-IM-X-3569] N77-32131 SUBJECT INDEX

AERODYNAMIC LOADS A guide for estimation of aeroacoustic loads on flight vehicle surfaces, volume 1 N77-32090 [AD-A041198] AERODYNAMIC NOISE The aerodynamic noise of gliders A77-48513 Influence of the noise level in a transonic wind tunnel on the aerodynamic characteristics of models [ONERA, PP NO. 1977-110] Noise component method for airframe noise [AIAA PAP2R 77-1271] A77-50996 177-51034 Forward flight effects on EBF noise --- Externally Blown Plaps [AIAA PAPES 77-1314] A77-51069 Summary of forward velocity effects on fan noise [AIAA PAPER 77-1319] 177-51074 The noise from unheated supersonic jets in simulated flight [AIAA PAPER 77-1327] A77-51081 Effects of forward motion on jet and core noise [AIAA PAPBE 77-1330] A77-A77-51084 Helicopter rotor aerodynamic and aeroacoustic environments [AIAA PAP&R 77-1338] Interaction of rotor tip flow irregularities with stator wanes as a noise source A77-51091 [AIAA PAPER 77-1342] A77-51095 31multaneous cnaracterization of jet noise sources and acoustic field by a new application of Conditional sampling [AIAA PAPER 77-1349] A77-51102 There are a solution of large-scale structures in yet flows and their relation to yet noise production [AIAA PAPER 77-1350] A77-51103 An analytical model for entropy noise of subsonic nozzle flow [AIAA PAPER 77-1366] A77-51118 Interaction of rotor tip flow irregularities with stator vanes as a noise source [NASA-TM-73706] N77-32156 AERODYNAMIC STABILITY Stability of the pilot-aircraft system in maneuvering flight A77-49340 Rotorcraft flight simulation with coupled rotor aeroelastic stability analysis. Volume 3. Programmer's manual [AD-A042307] N77-32143 Rotorcraft flight simulation with coupled rotor aeroelastic stability analysis. Volume 1: Engineer's manual [AD-A042462] N77-33207 AERO DYNAMICS Initial unsteady aerodynamic measurements of a circulation controlled airfoil and an oscillating flow wind tunnel [AD-A042102] N77-33122 AEROELASTICITY Aeroelastic stability of complete rotors with application to a teetering rotor in forward flight A77-49180 Rotorcraft flight simulation with coupled rotor aeroelastic stability analysis. Volume 3: Programmer's manual [AD-A0429J7] N77-32143 Nonlinear agroglastic equations for combined flapwise benling, chordwise bending, torsion, and extension of twisted nonuniform rotor blades in forward flight [NASA-TM-74059] N77-33107 Rotorcraft flight simulation with coupled rotor aeroelastic stability analysis. Volume 1: Engineer's manual [AD-A042462] N77-33207 AEROSAT SATELLITES L-band antenna for aircraft-to-satellite communications --- for Aerosat system A77-48362 AEROSPACE ENVIRONMENTS Voice control systems for airborne environments [AD-A043252] N77-N77-32524 AEROSPACE TECHNOLOGY TRANSFER Evolution of aircraft design through the concept of the control configured vehicle [ONERA, TP NO. 1977-129] A77-51004

A BROTHER SODY NAMICS An analytical model for entropy noise of subsonic nozzle flow [AIAA PAPER 77-1366] 177-51118 AGRICULTURE Noise emission of the agricultural aircraft 2-37. I - Sound intensity level measurements at the agricultural aircraft 2-37. II - Sound intensity level measurements at an agricultural airport 177-49656 Notes on the pollution of airplanes and helicopters by chemicals during agricultural jobs [NASA-TT-F-17444] N77-33129 AILEBONS Producibility aspects of advanced composites for an L-1011 Aileron ISME PAPER EMR76-041 177-51006 AIR BAG RESTRAINT DEVICES Evaluation of inflatable /'air bag'/ occupant restraint systems for aircraft application A77-49951 AIR CARGO Technical and economic assessment of swept-wing span-distributed load concepts for civil and military air cargo transports [NASA-CR-145229] N77-33147 ATR COOLING New computation method of turbine blades film cooling efficiency [ONERA, TP NO. 1977-85] A77-Protection of cooled blades of complex internal A77-50988 structure [ONERA, TP NO. 1977-90] A77-50991 AIR INTAKES Detail design in aircraft A77-48000 AIR NAVIGATION ATS-6 European L-band aeronautical experiments A77-49908 Position Location and Navigation Symposium, San Diego, Calif., November 1-3, 1976, Proceedings A77-51178 Position location systems technology A77-51179 Precision location, navigation and guidance using DME techniques A77-51180 Applications of augmented multilateration tracking systems --- for military targets 177-51183 Navigation checkpointing with forward-sensed, fixed-range terrain profiles 177-51189 Advanced terrain correlation techniques --position locating system in war environments 177-51190 Tactical and long-range navigation in the AN/ARN-101/V/ A77-51192 Aircraft Space Position Measurement System - An application of precision DME 177-51197 An application of Omega as a sensor --- in E-3A Airborne Warning and Control hybrid navigation system 177-51198 The Inverted Range - GPS User test facility ---Global Fositioning System A77-51203 Principles, simulation results and interoperability of JTIDS relative navigation
--- Joint Tactical Information Distribution System A77-51205 AIR POLLUTION The effect of drop size on emissions from the primary zone of a gas turbine type combustor A77-48174 Notes on the pollution of airplanes and helicopters by chemicals during agricultural jobs [NASA-TT-F-17444] N77-33129 AIR TRAFFIC Some aspects of the development of air traffic of the Socialist States. II A77-49651 AIE TRAPPIC CONTBOL The new airport radar systems 477-47979

design

New air traffic control communications and data systems A77-48252 Civil and military air traffic in France -Management and compatibility 177-48411 The transfer or the German North MATRAC to the EUROCONTAOL Centre of Maastricht --- Military Air Traffic Radar Control A77-48412 EUROCONTROL ani radar --- automated air traffic control radar system implementation A77-48413 Air traffic control and the initial operation of supersonic transport aircraft - A review of preparatory measures A77-48415 Austria's cole in international civil aviation A77-48416 Simulation of traffic loading for approach and landing systems with statistical interrogation A77-48686 A new high-orightness, all-weather, ASDE /Airport Surface Derection Equipment/ A77-49224 Convex 76 - Aircraft noise and air traffic control A77-49225 Electronic systems for air traffic control A77-51276 Queues with delayed, probabilistic feedback as a model of air traffic control communications A77-51610 Bultiple curved descending approaches and the air traffic control problem [NASA-TM-78430] N77-32104 Air traffic control experimentation and evaluation test [AD-A041971] N77-33136 Requirements for flight testing automated terminal service [ AD-A0419751 N77-33137 Monte Carlo simulation of VOR/DHE holding procedures. Basic notions and applications [ESA-TT-419] N77-33142 AIE TRANSPORTATION Rationalization of the European air net 177-48474 Some aspects of the development of air traffic of the Socialist States. II A77-49651 The development of a model for predicting passenger acceptance of short-haul air transportation systems [NASA-CR-145250] N77-33148 AIBBORNE EQUIPMENT An operational video tape recording system utilizing IRIG standard 129-73 segmented helical scan recording format A77-49873 History and development of the SCORE pod ---Simulated Combat Operations Range Equipment A77-51188 Measurements of the influence of static and dynamic interference on an ILS-receiver and measurement of the capture effect with the double frequency procedure [TUBS/SPB58/50] AIRBORNE SURVEILLANCE RADAR N77-33140 Avionics first principles. II - Airborne radars 177-48689 AIRBORNE/SPACEBORNE COMPUTERS Proving the correctness of a flight-director program for an airborne minicomputer A77-51261 Eight-channel resolver simplifies digital flight controls A77-51354 AIRCRAFT ACCIDENT INVESTIGATION Teaching the practical techniques of establishing egress system performance in an accident environment 177-49948 ATRCRAPT ACCIDENTS. Computer simulation of light aircraft crash A77-49741 The need for improved aircraft crashworthiness

A77-49473

Proposed helicopter safety system for catastrophic failures 177-49936 Evolution of automatic opening lap belts in high performance aircraft A77-49946 The development of new designs of emergency escape parachutes for ejection seats 177-49947 USAF experience in aircraft accident survivability A77-49949 Aircrew escape and survival - Problems and solutions 177-49950 "he life cycle cost impacts of unsafe designs --aircraft accident effects A77-50462 Single pass Dorpler positioning for Search and Rescue satellite missions A77-51186 Briefs of accidents involving air taxi operations, US general aviation, 1975 [PB-267653/4] N77-32102 Analysis of air accidents involving airplanes or helicopters of various types of Application [NASA-TT-F-17443] N7 N77-33128 Testing simulation of damages occurred in service N77-33194 ATRCRAFT ANTENNAS Rain erosion resistant fluoroelastomer radome and antenna coatings A77-49731 B-1 forward radome microwave test range A77-49743 AIRCRAFT COMMUNICATION L-band antenna for aircraft-to-satellite communications --- for Aerosat system A77-48362 New lidar concept for measuring the slant range transmission in aircraft landing approaches 177-48698 ATS-6 European L-band aeronautical experiments A77-49908 AFSATCOM terminal segment reliability test program 177-50494 Principles, simulation results and interoperability of JTIDS relative navigation --- Joint Tactical Information Distribution System A77-51205 AIRCRAFT COMPARTMENTS Cabin noise behavior of a USB STOL transport ---upper surface blowing YC-14 aircraft [AINA PAPER 77-1365] 477-51117 A research program to reduce interior noise in general aviation airplanes --- test methods and results [NASA-CR-155154] 177-33959 AIRCBAPT CONFIGURATIONS The aerodynamic noise of gliders 477-48513 AIRCRAFT CONSTRUCTION MATERIALS Producibility aspects of advanced composites for an L-1011 Aileron SME PAPER EMR76-041 A77-51006 Trapped rubber processing for advanced composites [SME PAPER EN76-172] A77-51009 Design, fabrication and test of an F-14 composite overwing fairing ISNE PAPER EN76-1751 A77-51010 Airframe composite materials A77-51353 AIRCRAFT CONTROL Design of nonlinear automatic flight control A77-48693 The determination of the center-of-gravity position with the aid of dimensionless values --- for aircraft control and stability 177-49654 Practical aerodynamics of maneuvering aircraft /A manual for flight personnel/ --- Russian book 177-50693 Evolution of aircraft design through the concept of the control configured vehicle [ONERA, TP NO. 1977-129] A77-51004 Precision location, navigation and guidance using DME techniques 177-51180 Eight-channel resolver simplifies digital flight controls.

SUBJECT INDEX

Digital flight control systems N77-33200 [NASA-CR-145246] F-8C adaptive flight control laws [NASA-CR-2880] N77-33202 F-8C adaptive flight control extensions --- for maximum likelihood estimation [NASA-CR-2881] N77-33203 Structural Aspects of Active Controls [ AGARD-C2-228 ] N77-33208 A practical optimum selection procedure for a motivator in active flutter suppression system design on an aircraft with underwing stores N77-33209 Impact of a command and stability augmentation system on gust response of a combat aircraft N77-33210 Airplane mata modeling methods for active control design N77-33212 Consistency in aircraft structural and flight control analysis N77-33213 YC-14 control system redundancy N77-33214 ATRCRAPT DESTGN Detail design in aircraft A77-48000 Performance of plain-type spoilers applied to the GA/W/-1 WING A77-49344 The need for improved aircraft crashworthiness design A77-49473 Jakowlew Jak-42 - Uncomplicated, reliable, economical A77-49653 The technical conception of the IL-62M -Aerodynamic features A77-49655 Design and test results of very broadband radomes for ECM applications A77-49747 The life cycle cost impacts of unsafe designs ----aircraft accident effects A77-50462 Evolution of aircraft design through the concept of the control configured vehicle [ONERA, TP NO. 1977-129] A77-5 Producibility aspects of advanced composites for A77-51004 an L-1011 Aileron [SME PAPER Edg76-04] 177-51006 Design, fabrication and test of an F-14 composite overwing fairing SME PAPER EN 76-1751 A77-51010 Special course on concepts for drag reduction [AGARD-R-654] N77-32091 An overview of concepts for aircraft drag reductions N77-32092 Modeling and parameter uncertainties for aircraft flight control system design [NASA-CR-2887] N77-33149 Human factors engineering considerations in designing Naval aircraft for maintainability [AD-A041156] N77-33153 AIRCRAFT DETECTION The new airport radar systems 177-47979 Accuracy evaluation of augmented multilateration tracking systems --- for aircraft detection A77-51182 Applications of augmented multilateration tracking systems --- for military targets 177-51183 Development of the RMS-2 System of ODDR&E/T&E/ -Range Measurement System for tank and aircraft tracking 177-51187 Prediction of airborne target detection [AD-A041428] N77-32871 AIRCRAFT ENGINES Some detail design problems in aircraft gas turbines A77-48001 Investigation of the state of dynamic stress and the influence of service time on the fatigue strength of turbine rotor blades of aircraft gas-turbine engines A77-48632

177-51354

AIRCRAFT NOISE

Scme regularities of the wearing of fuel pump plunger spheres for aircraft engines
A77-49374
Logistics planning simulation model for USAF spare engine management
Gas turbine temperature techniques
A77-50625 Construction and design principles of aircraft
gas-turbine engines Bussian book
A77-50684
Review of optical techniques with respect to aero-engine applications
[ONERA, TP BO. 1977-80] A77-50987
A finite element algorithm for sound propagation in axisymmetric ducts containing compressible
sean flow
[AIAA PAPER 77-1301] A77-51057 The influence of the inlet duct contour on forward
radiated fan noise
[AIAA PAPER 77-1355] A77-51108
A novel concept for suppressing internally generated aircraft engine noise
[AIAA PAPER 77-1356] A77-51109
CP6 engine designed for maintenance A77-51352
Power plant reliability
[AGARD-CP-215] N77-33181
Civil airworthiness requirements for powerplant reliability
N77-33185
Risks affecting the structural resistance and integrity of modern propulsion systems
N77-33187
Aircraft engine design and development through lessons learned
N77-33190
Progress in determining service life by endurance
tests Concorde aırcraft N77-33195
Methods of improving the performance reliability
of advanced military power plant systems N77-33198
Preliminary results of USAF experience with engine
monitoring and diagnostics x77-33199
AIRCRAFT EQUIPMENT
Reliability, availability,
maintainability/logistics /RAM/LOG/ A77-50456
Aircraft electric machines with intensive cooling
systems Russian book A77-50678
Master monitor display application study for P-14
[AD-A041570] N77-33158 AIRCRAFT FUBLS
Alternate fuels for future aircraft
A77-48709
The liquid hydrogen option for the subsonic transport - A status report
A77-48819
AIRCRAFT GUIDANCE Precision location, navigation and guidance using
DNE techniques
A77-51180 Global positioning system navigation algorithms
for application to navigation satellites
used for aircraft guidance N77-32103
N//-32103 Integrated path guidance system for unconventional
approach procedures
N77-32119 Recognition and elimination of interference
disturbances by modification of the radio field
of landing systems with spatial modulation degree diagrams
N77-32123
AIRCRAFT BAZARDS
Design of a cascade fire apparatus for testing counterneasure effectiveness
[AD-A043176] N77-32101
AIBCEAFT INDUSTRY Austria's role in international civil aviation
A77-48416
AIBCRAFT INSTEOMENTS Solid state light emitting displays
A77-50623

-

.

A multipurpose position accuracy verificat:	on system
airborne DME	A77-51181
Air Combat Maneuvering Range/Instrumentatio	
Presentation of DLS information	A77-51195
AIRC BAPT LANDING	N77-32111
New lidar concept for measuring the slant i transmission in aircraft landing approact	hes
A navigation device to help helicopters to ocean platforms	A77-48698 land on
[ONERA, TP NO. 1977-71] Electronic systems for air traffic control	A77-50983
Hultiple curved descending approaches and 4	A77-51276 the air
traffic control problem [NASA-TM-78430]	₩77-32104
Longitudinal handling gualities during app and landing of a powered lift STOL aircra fulling we could be	coach aft N77-33151
[NASA-TH-X-62144] AIRC BAFT LIGHTS	
Wide area illuminator development for US Co Guard HH-3P nelicopter [AD-A041425]	N77-32132
LAD-ROY 1425 J AIRC RAFT HAINTENANCE Wear reliability of aircraft splines	N77-32132
Reliability improvement warranty technique:	A77-50467 s and
applications to P-16 aircraft Logistics planning simulation model for US	A77-50477 AF spare
engine management	A77-50510
Automatic systems check-out	A77-51351
CP6 engine designed for maintenance Investigation of factors controlling engine	A77-51352
scheduled overhaul: T53/T55 (AD-A042190)	N77-32162
[AD-A042134] [AD-A042134]	N77-33101
Human factors engineering considerations in designing Naval aircraft for maintainabi	n
[AD-A041156] Maintenance methods for improving propulsion	₩77-33153
system reliability	N77-33184
AIRC RAFT MANEDVERS Stability of tae pilot-aircraft system in maneuvering flight	
Practical aerodynamics of maneuvering airc manual for flight personnel/ Russian	
Air Combat Maneuvering Range/Instrumentation	A77-50693
'ACME/I'	A77-51195
Transonic wind-tunnel investigation of the maneuver potential of the NASA supercrit:	ıcal
wing concept, phase 1 [NASA-TH-4-3534]	N77-33115
AIRCRAFT MODELS Transonic pressure distribution on an aircu	raft
<pre>wing model during rocket sled runs [AD-A041633]</pre>	N77-32085
AIRC RAFT MOISE Convex 76 - Aircraft noise and air traffic	A77-49225
Noise emission of the agricultural aircraf I - Sound intensity level measurements a	t the
agrıcultural aırcrâft Z-37. II - Sound i level measursments at an agricultural aı	ntensity cport A77-49656
The measurement of aircraft overflight noi: Brrors due to its nonstationary character	se - c
Are wheel-well related aeroacoustic sources	A77-50441 s of any
SIGNIFICANCE IN AIFFRAME NOISE [AIAA PAPER 77-1270] Noise component method for airframe noise	A77-51033
(AIAA PAPER 77-1271) Airframe noise of the DC-9	A77-51034
[AIAA PAPER 77-1272]	A77-51035

A-5

SUBJECT INDEX

Interim neise correlation for some OTW configurations using external jet-flow deflectors --- engine Over The Wing [AIAA PAPER 77-1317] A77-51072 Plight noise studies on a turbojet engine using microphones mounted on a 450 ft. tower [~IA& PAPER 77-1325] A77-5 177-51079 <sup>2</sup> n experimental investigation of helicopter rotor high frequency broadband noise [AIAA PAPEE 77-1339] A7 Some measured and calculated effects of a tip A77-51092 vortex modification device on impulsive noise --- for helicopter rotors [AIAA PAPER 77-1341] A77-51094 Effect of forward motion on turbomachinery noise FAIAA PAPER 77-13461 A77-51099 A guide for estimation of aeroacoustic loads on flight vehicle surfaces, volume 1 FAD-A0411981 N77-32090 Aircraft sideline noise: A technical review and analysis of contemporary data [ AD-A042076 ] N77-33685 Further sensitivity studies of community-aircraft noise exposure (NOISEMAP) prediction procedures [ AD-A041781 ] N77-33686 Airplane noise: Dimensions and means of noise reduction --- in Norway [ELAB-STF44-A75080] N77-33696 ATECRAFT PARTS Wear reliability of aircraft splines 477-50467 Techniques and facilities used at ONERA /Modane Center/ for icing tests [ONERA, TP NO. 1977-123] Deburring - Reguirements of the aircraft A77-51002 [SME PAPER MR76-124] A77-51007 Investigation of an aluminum rolling helix crash energy absorter [AD-A042084] N77-33132 AIRCRAFT PERFORMANCE Some mathematical aspects of the correlation theory of aircraft precision and reliability A77-50709 Flight evaluation of an advanced technology light twin-engine airplane (ATLIT) [NASA-CR-2832] N77-33104 AIRCRAFT PRODUCTION <sup>3</sup> ppliances for assembling aircraft and helicopter subsystems and elements --- Russian textbook A77-50682 Deburring - Some of the problems and requirements of the aircraft industry [SME PAPER MR76-547] 177-51016 AIBCRAFT RELIABILITY Detail design aspects of a helicopter transmission system A77-47999 The protection of aircraft radomes against lightning strike A77-49734 Reliability, availability, maintainability/logistics /RAM/LOG/ A77-50456 Flight inspection data and crack initiation times A77-50466 Reliability improvement warranty techniques and applications --- to F-16 aircraft A77-50477 Failure analysis of digital systems using simulation A77-50501 Some mathematical aspects of the correlation theory of aircraft precision and reliability A77-50709 A new look in reliability: F-18 operational mission environment [AD-A042781] N77-32573 Power plant reliability [AGARD-CP-2151 N77-33181 Maintenance methods for improving propulsion system reliability N77-33184 Civil airworthiness requirements for powerplant reliability N77-33185 Reliability versus cost in operating wide body jet engines N77-33186

Risks affecting the structural resistance and integrity of modern propulsion systems N77-33187 Development procedures to promote reliability N77-33188 CFM56 turbofan maintainability and reliability-oriented development N77-33189 Aircraft engine design and development through lessons learned N77-33190 The evolution and control of different performance degradation processes in modern propulsion systems --- monitoring jet engines N77-33193 AIRCRAFT SAFRTY Lightning-mazard assessment - A first-pass probabilistic model --- for aircraft A77-49346 Survival and Flight Equipment Association, Annual Symposium, 14th, San Diego, Calif., September 13-16, 1976, Proceedings A77-49926 SENDS /Safe Ejection Envelope Display System/ a77-49932 Fluidic thrust vector control systems for ejection seats A77-49933 Fluidic event sequencing subsystem for AAES ---Aircrew Automated Escape Systems A77-49934 Proposed helicopter safety system for catastrophic failures 177-49936 Evaluation of inflatable /'air bag'/ occupant restraint systems for aircraft application A77-49951 The need for a workable collision avoidance system Now --- in civil aviation A77-50662 Bird strike hazards: A bibliography, 1971 - 1976 N77-33131 [NAL-BIBL-SER-77] AIRCRAFT SPECIFICATIONS Consistency in aircraft structural and flight control analysis N77-33213 AIRCRAFT STABILITY The determination of the center-of-gravity position with the aid of dimensionless values --- for aircraft control and stability 177-49654 ATRCRAFT STRUCTURES Design and test results of very broadband radomes for ECM applications 177-49747 AIRCRAFT TIRES Behavior of aircraft antiskid breaking systems on dry and wet runway surfaces: A Slip-ratio-controlled system with ground speed reference from unbraked nose wheel [NASA-TN-D-8455] N77-33150 AIRCBAFT WAKES Vortex interactions and decay in aircraft wakes [NASA-CR-2870] N77-N77-33105 AIRFIELD SURPACE MOVEMENTS A new high-brightness, all-weather, ASDE /Airport Surface Detection Equipment/ A77-49224 AIRPOIL PROFILES Unsteady Osean flow around a flat-plate airfoil A77-49244 AIRFOILS Theory of the lifting surface in unsteady motion in an inviscid fluid A77-49847 Determining the lift and drag distributions on a three-dimensional airfoil from flow-field velocity surveys [NASA-TM-73247] N77-32079 Data reduction for the unsteady aerodynamics on a circulation control airfoil --- wind tunnel test data [AD-A041153] N77-32084 Flight evaluation of an advanced technology light twin-engine airplane (ATLIT) [ NA SA-CR-2832 ] N77-33104

~

~

	,	
Initial unsteady aerodynamic measureme		AIRS PEED
circulation controlled airfoil and a oscillating flow wind tunnel	n	Porwar Blow
	N77-33122	[AIA
AIBPBANE MATERIALS	017 55122	Summar
Rohrbond high strength Ti alloy jo	ining method	<b>L</b> AIA
for thrust engines, airframe and spa		Sumpar
[SNE PAPER AD76-280] AIRFRAMES	A77-51015	(NAS
Detail design in aircraft		A susp airs
Securi design in diretare	A77-48000	( NAS
Appliances for assembling aircraft and	helicopter	ALGOBITEM
subsystems and elements Russian		G loba l
$h_{1}$	A77-50682	
Airframe noise - A status report, 1977 [AIAA PAPER 77-1268]	A77-51032	used
Are wheel-well related aeroacoustic so		Minimu
significance in airframe noise		engi
FAIAA PAPER 77-12701	A77-51033	prog
Noise component method for airframe no		[NAS
[AIAA PAPER 77-1271] Airframe noise of the DC-9	A77-51034	ALL-WEATH A new
FAIAA PAPER 77-1272]	A77-51035	Surf
Unsteady surface pressure characterist	lcs on	
aircraft components and farfield rad	lated	Civil
airframe noise		flig
[AIAA PAPER 77-1295] Airframe composite materials	A77-51052	(TUB ALL-WEATH
Alliame composite materials	A77-51353	Civil
An optimality criteria approach to the		flig
weight design of aircraft structures		[ TUB
[AD-A042759]	N77-32140	Integr
Wind tunnel and analytical investigati		appr
over-the-wing propulsion/air frame i for a short-haul aircraft at Mach nu		Flight
0.6 to 0.78 conducted in the Lew		inte
foot tunnel	, -	
[NASA-CR-2905]	N77-33114	Recogn
AIRLINE OPERATIONS		dist
Reducing walking distances at existing	Alrports A77-47980	of 1 degr
Austria's role in international civil		degi
	177-48416	ALONINUM
Rationalization of the European air ne		Invest
Some accords of the desclosure of en-	A77-48474	ener
Some aspects of the development of air the Socialist States. II	trainic or	ANECHOIC
the Socialist States. II	A77-49651	Gas tu
The determination of the center-of-gra	vity	inte
position with the aid of dimensionle	ss values	[AIA]
for aircraft control and stabili		ABBROUETB
Briefs of accidents involving air taxi	A77-49654	A susp airs
OS general aviation, 1975	operations,	[NAS
[PB-267653/4]	N77-32102	ABGLE OF
AIRPLANE PRODUCTION COSTS		Wing r
Producibility aspects of advanced comp	osites for	cycl
an L-1011 Aileron [SME PAPER EMR76-04]	A77-51006	aero [AD-
AIRPORT LIGHTS	R77-51000	ANGULAR V
Airport electrical and lighting equipm	ent	An acc
Russian book	_	inst
	A77-50676	(WBE
AIRPORT PLANNING Reducing walking distances at existing	arnorte	ANNULAR N Effect
actually variably distances at existing	A77-47980	of i
A new high-brightness, all-weather, AS		[AIA
Surface Detection Equipment/		ANTENNA A
	A77-49224	A pplic
Convex 76 - Aircraft hoise and air tra	A77-49225	navı
Electroenergy supply for airports. IV	A//-49225	ANTENNA D
	A77-49658	L-band
AIRPORT SURFACE DETECTION EQUIPMENT		COBB
The new airport radar systems		
AIRPORTS	A77-47979	A meth
Austria's role in international civil	aviation	Micr
	A77-48416	Rađar
The Brunswick DLS test airport area -		
environment		A STH ROPOL
	N77-32108	C1V11
A-37B fatigue sensor evaluation progra scale test and field aircraft instru		flıg [TOB
[AD-A042114]	N77-33156	[100
Aircraft sideline noise: A technical		
analysis of comtemporary data		
[AD-A042C76]	N77-33685	

AIRS PBED
Porward flight effects on EBP noise Externally
Blown Plaps
[AIAA PAPER 77-1314] A77-51069
Summary of forward velocity effects on fan noise
[AIAA PAPER 77-1319] A77-51074
Summary of forward velocity effects on fan noise
[NASA-TU-73722] N77-32159
A suspended anemometer system for measuring true
airspeed on low-speed airplanes
[NASA-TN-D-8523] N77-33157
ALGOBITEES
Global positioning system navigation algorithms
for application to navigation satellites
used for aircraft guidance
N77-32103
Minimum time acceleration of aircraft turbofan
engines by using an algorithm based on nonlinear
programming
[NASA-TM-73741] N77-33167
ALL-WEATHER AIR NAVIGATION
A new high-brightness, all-weather, ASDE /Airport
Surface Detection Equipment/
A77-49224
Civil transport aircraft short range all-weather
flight
[TUBS/SFB58/FB1976] N77-32118
ALL-WEATHER LANDING SYSTEMS
Civil transport aircraft short range all-weather
flight
[TUBS/SPB58/PB1976] N77-32118
Integrated path guidance system for unconventional
approach procedures
N77-32119
Flight mechanical problems in connection with the
interception process
N77-32121
Recognition and elimination of interference
disturbances by modification of the radio field
of landing systems with spatial modulation
degree diagrams
N77-32123
ALUMINUM ALLOYS
ALUMINUM ALLOYS Investigation of an aluminum rolling helix crash
ALUMINUM ALLOYS Investigation of an aluminum rolling helix crash energy absorber
ALUMINUM ALLOYS Investigation of an aluminum rolling helix crash energy absorber [AD-A042084] N77-33132
ALUMINUM ALLOYS           Investigation of an aluminum rolling helix crash           energy absorber           [AD-A042084]           NT7-33132           ANECHOIC CHAMBERS
ALUMINUM ALLOYS         Investigation of an aluminum rolling helix crash         energy absorber         [AD-A042084]         NECHOIC CHAMBRES         Gas turbine engine core noise source isolation by
ALUMINUM ALLOYS         Investigation of an aluminum rolling helix crash energy absorber [AD-A042084]         NNCCHOIC CHAMBERS         Gas turbine engine core noise source isolation by internal-to-far field correlations
ALUMINUM ALLOYS         Investigation of an aluminum rolling helix crash energy absorber         [AD-A042084]         NECHOIC CHAMBERS         Gas turbine engine core noise source isolation by internal-to-far field correlations         [AIA PAPER 77-1276]
ALUMINUM ALLOYS         Investigation of an aluminum rolling helix crash energy absorber         [AD-A042084]         NECHOIC CHAMBERS         Gas turbine engine core noise source isolation by internal-to-far field correlations         [ATAA PAPER 77-1276]         A77-51037
ALUMINUM ALLOYS         Investigation of an aluminum rolling helix crash energy absorber [AD-A042084]         NT7-33132         NECCHOIC CHAMBERS         Gas turbine engine core noise source isolation by internal-to-far field correlations [AIAA PAPER 77-1276]         AFECOMETERS         A suspended anemometer system for measuring true
ALUMINUM ALLOYS         Investigation of an aluminum rolling helix crash energy absorber         [AD-A042084]         NECHOIC CHAMBERS         Gas turbine engine core noise source isolation by internal-to-far field correlations [AIAA PAPER 77-1276]         AVEKOMETERS         A suspended anemometer system for measuring true airspeed on low-speed airplanes
ALUMINUM ALLOYS         Investigation of an aluminum rolling helix crash energy absorber [AD-A042084]         NECHOIC CHAMBRES         Gas turbine engine core noise source isolation by internal-to-far field correlations [AIAA PAPER 77-1276]         AVECOMETRES         A suspended anemometer system for measuring true airspeed on low-speed airplanes [NASA-TN-D-8523]
ALUMINUM ALLOYS         Investigation of an aluminum rolling helix crash energy absorber [AD-A042084]         NFECHOIC CHAMBERS         Gas turbine engine core noise source isolation by internal-to-far field correlations [AIAA PAPER 77-1276]         AFROMETERS         A suspended anemometer system for measuring true airspeed on low-speed airplanes [NASA-TN-D-8523]         AFGLE OF ATTACK
ALUMINUM ALLOYS         Investigation of an aluminum rolling helix crash energy absorber [AD-A042084]         NFC HOIC CHAMBERS         Gas turbine engine core noise source isolation by internal-to-far field correlations [AIAA PAPER 77-1276]         AFROMETERS         A suspended anemometer system for measuring true airspeed on low-speed airplanes [NASA-TN-D-8523]         NFGLE OF ATTACK         Wing rock as a lateral-directional aircraft limit
ALUMINUM ALLOYS         Investigation of an aluminum rolling helix crash energy absorber [AD-A042084]         NFC HOIC CHAMBERS         Gas turbine engine core noise source isolation by internal-to-far field correlations [AIAA PAPER 77-1276]         AVEC BOIC CHAMBERS         A suspended anemometer system for measuring true airspeed on low-speed airplanes [NSA-TN-D-8523]         NGLE OF ATTACK         Wing rock as a lateral-directional aircraft limit cycle oscillation induced by nonlinear
ALUMINUM ALLOYS         Investigation of an aluminum rolling helix crash energy absorber [AD-A042084]         NFCCHOIC CHAMBERS         Gas turbine engine core noise source isolation by internal-to-far field correlations [AIAA PAPER 77-1276]         AFROMETERS         A suspended anemometer system for measuring true airspeed on low-speed airplanes [NSA-TN-D-8523]         NFGLE OF ATTACK         Wing rock as a lateral-directional aircraft limit cycle oscillation induced by nonlinear aerodynamics occurring at high angle of attack
ALUMINUM ALLOYS         Investigation of an aluminum rolling helix crash energy absorber [AD-A042084]         NT7-33132         ANECHOIC CHAMBERS         Gas turbine engine core noise source isolation by internal-to-far field correlations [AIAA PAPER 77-1276]         ANEMONETERS         A suspended anemometer system for measuring true airspeed on low-speed airplanes [NASA-TN-D-8523]         NFIG CF ATTACK         Wing rock as a lateral-directional aircraft limit cycle oscillation induced by nonlinear aerodynamics occurring at high angle of attack [AD-A042104]
ALUMINUM ALLOYS         Investigation of an aluminum rolling helix crash energy absorber [AD-A042084]         NEC BOIC CHAMBERS         Gas turbine engine core noise source isolation by internal-to-far field correlations [AIAA PAPER 77-1276]         ATT-51037         ANBCMETRES         A suspended anemometer system for measuring true airspeed on low-speed airplanes [NASA-TN-D-8523]         NASA-TN-D-8523]         NT7-33157         NGLB OF ATTACK         Wing rock as a lateral-directional aircraft limit cycle oscillation induced by nonlinear aerodynamics occurring at high angle of attack [AD-A042104]         NT7-33204
ALUMINUM ALLOYS         Investigation of an aluminum rolling helix crash energy absorber [AD-A042084]         NT7-33132         ANEC HOIC CHAMBERS         Gas turbine engine core noise source isolation by internal-to-far field correlations [AIAA PAPER 77-1276]         ANENOMETRES         A suspended anemometer system for measuring true airspeed on low-speed airplanes [NAA-TN-D-8523]         NFGLE OF ATTACK         Wing rock as a lateral-directional aircraft limit cycle oscillation induced by nonlinear aerodynamics occurring at high angle of attack [AD-A042104]         ANGULAR VELOCITY An accurate angular position and angular velocity
ALUMINUM ALLOYS         Investigation of an aluminum rolling helix crash energy absorber [AD-A042084]         NT7-33132         ANECHOIC CHAMBERS         Gas turbine engine core noise source isolation by internal-to-far field correlations [AIAA PAPER 77-1276]         ANEMOMETERS         A suspended anemometer system for measuring true airspeed on low-speed airplanes [NASA-TN-D-8523]         NIG FOR ATTACK         Wing rock as a lateral-directional aircraft limit cycle oscillation induced by nonlinear aerodynamics occurring at high angle of attack [AD-A042104]         ANGULAR VELOCITY An accurate angular position and angular velocity instrument based on an optical incremental encoder
ALUMINUM ALLOYS         Investigation of an aluminum rolling helix crash energy absorber [AD-A042084]         NFC HOIC CHAMBERS         Gas turbine engine core noise source isolation by internal-to-far field correlations [AIAA PAPER 77-1276]         ANEC HOIC CHAMBERS         A suspended anemometer system for measuring true airspeed on low-speed airplanes [NSA-TN-D-8523]         NIGLE OF ATTACK         Wing rock as a lateral-directional aircraft limit cycle oscillation induced by nonlinear aerodynamics occurring at high angle of attack [AD-A042104]         ANGULAR VELOCITY         An accurate angular position and angular velocity instrument based on an optical incremental encoder [WEP-TN-1730(WE/D)]
ALUMINUM ALLOYS         Investigation of an aluminum rolling helix crash energy absorber [AD-A042084]         NFRCHOIC CHAMBERS         Gas turbine engine core noise source isolation by internal-to-far field correlations [AIAA PAPER 77-1276]         AFROMETERS         A suspended anemometer system for measuring true airspeed on low-speed airplanes [NAA-TN-D-8523]         NFGLE OF ATTACK         Wing rock as a lateral-directional aircraft limit cycle oscillation induced by nonlinear aerodynamics occurring at high angle of attack [AD-A042104]         ANGULAR VELOCITY         An accurate angular position and angular velocity instrument based on an optical incremental encoder [WRE-TN-1730(WR/D)]         ANHULAR WOZZLES
ALUMINUM ALLOYS         Investigation of an aluminum rolling helix crash energy absorber [AD-A042084]         NEC BOIC CHAMBERS         Gas turbine engine core noise source isolation by internal-to-far field correlations [AIAA PAPER 77-1276]         AT7-51037         AWBCRETRES         A suspended anemometer system for measuring true airspeed on low-speed airplanes [NASA-TN-D-8523]         NT7-33157         AWGLE OF ATTACK         Wing rock as a lateral-directional aircraft limit cycle oscillation induced by nonlinear aerodynamics occurring at high angle of attack [AD-A042104]         ANGULAR VELOCITY         An accurate angular position and angular velocity instrument based on an optical incremental encoder [WEE-TN-1730(WE/D)]         N77-33480         ANULAR WOZZIES         Effect of subulated forward speed on the fet noise
ALUMINUM ALLOYS         Investigation of an aluminum rolling helix crash energy absorber [AD-A042084]         NFCCHOIC CHAMBERS         Gas turbine engine core noise source isolation by internal-to-far field correlations [AIAA PAPER 77-1276]         ATT-51037         ANBCHETRES         A suspended anemometer system for measuring true airspeed on low-speed airplanes [NSA-TN-D-8523]         NING: Cock as a lateral-directional aircraft limit cycle oscillation induced by nonlinear aerodynamics occurring at high angle of attack [AD-A042104]         NHGUIRAR VELOCITY         An accurate angular position and angular velocity instrument based on an optical incremental encoder [WET-TN-1730(WE/D)]         NHULAR WOZZLES         Biffect of simulated forward speed on the jet noise of inverted velocity profile coannular nozzles
ALUMINUM ALLOYS         Investigation of an aluminum rolling helix crash energy absorber [AD-A042084]         NT7-33132         ANEC HOIC CHAMBERS         Gas turbine engine core noise source isolation by internal-to-far field correlations [AIAA PAPER 77-1276]         ATT-51037         ANENOMETRES         A suspended anemometer system for measuring true airspeed on low-speed airplanes [NASA-TN-D-8523]         NASLE OF ATTACK         Wing rock as a lateral-directional aircraft limit cycle oscillation induced by nonlinear aerodynamics occurring at high angle of attack [AD-A042104]         ANGULAR VELOCITY         An accurate angular position and angular velocity instrument based on an optical incremental encoder [WEE-TN-1730(WE/D)]         ANHULAR MOZZERS         Effect of simulated forward speed on the jet noise of inverted velocity profile coannular nozzles [AIAA PAPER 77-1329]
ALUMINUM ALLOYS         Investigation of an aluminum rolling helix crash energy absorber [AD-A042084]         N77-33132         AWECHOIC CHAMBERS         Gas turbine engine core noise source isolation by internal-to-far field correlations [AIAA PAPER 77-1276]         AT7-51037         AWEMOMETERS         A suspended anemometer system for measuring true airspeed on low-speed airplanes [NASA-TN-D-8523]         NT7-33157         HGLE OF ATTACK         Wing rock as a lateral-directional aircraft limit cycle oscillation induced by nonlinear aerodynamics occurring at high angle of attack [AD-A042104]         NT7-33204         AHGULAR VELOCITY         An accurate angular position and angular velocity instrument based on an optical incremental encoder [WRE-TN-1730(WR/D)]         NT7-33480         AHHULAR HOZZLARS         Effect of simulated forward speed on the jet noise of inverted velocity profile coannular nozzles [AIAA PAPAR 77-1329]         AT7-51083
ALUMINUM ALLOYS         Investigation of an aluminum rolling helix crash energy absorber [AD-A042084]         NFC HOIC CHAMBERS         Gas turbine engine core noise source isolation by internal-to-far field correlations [AIAA PAPER 77-1276]         ATT-51037         AWBC BOIC CHAMBERS         A suspended anemometer system for measuring true airspeed on low-speed airplanes [NSA-TN-D-8523]         NING FOCK as a lateral-directional aircraft limit cycle oscillation induced by nonlinear aerodynamics occurring at high angle of attack [AD-A042104]         NHGUILAR VELOCITY         An accurate angular position and angular velocity instrument based on an optical incremental encoder [WEP-TN-1730(WE/D)]         NT7-33480         AWBUILAR PAPAR 77-1329]         ATT-51083         AFTENA PAPAR 77-1329]         ATT-51083         ANEL PAPAR 77-51083
ALUMINUM ALLOYS         Investigation of an aluminum rolling helix crash energy absorber [AD-A042084]         NFRCHOIC CHAMBERS         Gas turbine engine core noise source isolation by internal-to-far field correlations [AIAA PAPER 77-1276]         AFROMETRES         A suspended anemometer system for measuring true airspeed on low-speed airplanes [NASA-TN-D-8523]         NFGLE OF ATTACK         Wing rock as a lateral-directional aircraft limit cycle oscillation induced by nonlinear aerodynamics occurring at high angle of attack [AD-A042104]         ANGULAR VELOCITY         An accurate angular position and angular velocity instrument based on an optical incremental encoder [WEP-TN-1730(WE/D)]         Biffect of simulated forward speed on the jet noise of inverted velocity profile coannular nozzles [AIAA PAPER 77-1329]         APTIENN ARRAYS Application of UHP adaptive array to navigation/tracking systems
ALUMINUM ALLOYS         Investigation of an aluminum rolling helix crash energy absorber [AD-A042084]         N77-33132         AWEC HOIC CHAMBERS         Gas turbine engine core noise source isolation by internal-to-far field correlations [AIAA PAPER 77-1276]         AT7-51037         AWENOMETERS         A suspended anemometer system for measuring true airspeed on low-speed airplanes [NASA-TN-D-8523]         NT7-33157         HGLE OF ATTACK         Wing rock as a lateral-directional aircraft limit cycle oscillation induced by nonlinear aerodynamics occurring at high angle of attack [AD-A042104]         NT7-33204         ANGULAR VELOCITY         An accurate angular position and angular velocity instrument based on an optical incremental encoder [WRE-TN-1730(WR/D)]         NT7-33480         ANHULAR WOZZERS         Effect of simulated forward speed on the jet noise of inverted velocity profile coannular nozzles [AIAA PAPER 77-1329]         AT7-51083         ANTEBNA ARRAYS         Application of UBF adaptive array to navigation/tracking systems
ALUMINUM ALLOYS         Investigation of an aluminum rolling helix crash energy absorber [AD-A042084]         NFC HOIC CHAMBERS         Gas turbine engine core noise source isolation by internal-to-far field correlations [AIAA PAPER 77-1276]         ATT-51037         ANBC HOIC CHAMBERS         A suspended anemometer system for measuring true airspeed on low-speed airplanes [NASA-TN-D-8523]         NING FOCK as a lateral-directional aircraft limit cycle oscillation induced by nonlinear aerodynamics occurring at high angle of attack [AD-A042104]         NHGUILAR VELOCITY         An accurate angular position and angular velocity instrument based on an optical incremental encoder [WET-TN-1730(WE/D)]         NHULIAR VOZILES         Effect of simulated forward speed on the jet noise of inverted velocity profile coannular nozzles [AIAA PAPAE 77-1329]         ATT-51083         ANTENNA ARAYS         APPLCATION of UEF adaptive array to navigation/tracking systems         ATT-51185
ALUMINUM ALLOYS         Investigation of an aluminum rolling helix crash energy absorber [AD-A042084]         NFRCHOIC CHAMBERS         Gas turbine engine core noise source isolation by internal-to-far field correlations [AIAA PAPER 77-1276]         AFROMETRES         A suspended anemometer system for measuring true airspeed on low-speed airplanes [NASA-TN-D-8523]         NBGLE OF ATTACK         Wing rock as a lateral-directional aircraft limit cycle oscillation induced by nonlinear aerodynamics occurring at high angle of attack [AD-A042104]         ANGULAR VELOCITY         An accurate angular position and angular velocity instrument based on an optical incremental encoder [WEP-TN-1730(WE/D)]         NTMOULER WOZZLES         Effect of simulated forward speed on the jet noise of inverted velocity profile coannular nozzles [AIAA PAPER 77-1329]         Application of UHF adaptive array to navigation/tracking systems         AT7-51185         ANTE WA DESIGN         L-band antenna for aircraft-to-satellite
ALUMINUM ALLOYS         Investigation of an aluminum rolling helix crash energy absorber [AD-A042084]         NFC HOIC CHAMBERS         Gas turbine engine core noise source isolation by internal-to-far field correlations [AIAA PAPER 77-1276]         ATT-51037         ANBC HOIC CHAMBERS         A suspended anemometer system for measuring true airspeed on low-speed airplanes [NASA-TN-D-8523]         NING FOCK as a lateral-directional aircraft limit cycle oscillation induced by nonlinear aerodynamics occurring at high angle of attack [AD-A042104]         NHGUILAR VELOCITY         An accurate angular position and angular velocity instrument based on an optical incremental encoder [WET-TN-1730(WE/D)]         NHULIAR VOZILES         Effect of simulated forward speed on the jet noise of inverted velocity profile coannular nozzles [AIAA PAPAE 77-1329]         ATT-51083         ANTENNA ARAYS         APPLCATION of UEF adaptive array to navigation/tracking systems         ATT-51185
ALUMINUM ALLOYS         Investigation of an aluminum rolling helix crash energy absorber [AD-A042084]         NFC HOIC CHAMBERS         Gas turbine engine core noise source isolation by internal-to-far field correlations [AIAA PAPER 77-1276]         ATT-51037         AWBC HOIC CHAMBERS         A suspended anemometer system for measuring true airspeed on low-speed airplanes [NASA-TN-D-8523]         NING FOCK as a lateral-directional aircraft limit cycle oscillation induced by nonlinear aerodynamics occurring at high angle of attack [AD-A042104]         NHGUILAR VELOCITY         An accurate angular position and angular velocity instrument based on an optical incremental encoder [WET-TN-1730(WE/D)]         ANHULAR VOZILES         Biffect of simulated forward speed on the jet noise of inverted velocity profile coannular nozzles [AIAA PAPAR 77-1329]         ANTEBNA MERAYS         APPLICATION of UHF adaptive array to navigation/tracking systems         APT-51185         AFTENNA DESIGN         L-band antenna for aircraft-to-satellite communications for Aerosat system
ALUMINUM ALLOYS         Investigation of an aluminum rolling helix crash energy absorber [AD-A042084]         NFCEGOIC CHAMBERS         Gas turbine engine core noise source isolation by internal-to-far field correlations [AIAA PAPER 77-1276]         AMBC HOIC CHAMBERS         A suspended anemometer system for measuring true airspeed on low-speed airplanes [NASA-TM-D-8523]         N MAST-TM-D-8523]         NIG rock as a lateral-directional aircraft limit cycle oscillation induced by nonlinear aerodynamics occurring at high angle of attack [AD-A042104]         NHGULAR VELOCITY         An accurate angular position and angular velocity instrument based on an optical incremental encoder [VET-TN-1730(VE/D)]         NHULAR WOZZLES         Effect of simulated forward speed on the jet noise of inverted velocity profile coannular nozzles [AIAA PAPER 77-1329]         Application of UHF adaptive array to navigation/tracking systems         APT-51185         ANTENNA DESIGN         L-band antenna for aircraft-to-satellite communications for Aerosat system         AT7-48362         A method to reduce the need for large antennas in
ALUMINUM ALLOYS         Investigation of an aluminum rolling helix crash energy absorber [AD-A042084]         NFC HOIC CHAMBERS         Gas turbine engine core noise source isolation by internal-to-far field correlations [AIAA PAPER 77-1276]         ATT-51037         AWBC HOIC CHAMBERS         A suspended anemometer system for measuring true airspeed on low-speed airplanes [NASA-TN-D-8523]         NING FOCK as a lateral-directional aircraft limit cycle oscillation induced by nonlinear aerodynamics occurring at high angle of attack [AD-A042104]         NHGUILAR VELOCITY         An accurate angular position and angular velocity instrument based on an optical incremental encoder [WET-TN-1730(WE/D)]         ANHULAR VOZILES         Biffect of simulated forward speed on the jet noise of inverted velocity profile coannular nozzles [AIAA PAPAR 77-1329]         ANTEBNA MERAYS         APPLICATION of UHF adaptive array to navigation/tracking systems         APT-51185         AFTENNA DESIGN         L-band antenna for aircraft-to-satellite communications for Aerosat system
ALUMINUM ALLOYS         Investigation of an aluminum rolling helix crash energy absorber [AD-A042084]         NFEC HOIC CHAMBERS         Gas turbine engine core noise source isolation by internal-to-far field correlations [AIAA PAPER 77-1276]         ATT-51037         AWBC HOIC CHAMBERS         A suspended anemometer system for measuring true airspeed on low-speed airplanes [NASA-TM-D-8523]         NING FOCK as a lateral-directional aircraft limit cycle oscillation induced by nonlinear aerodynamics occurring at high angle of attack [AD-A042104]         NHGUILAR VELOCITY         An accurate angular position and angular velocity instrument based on an optical incremental encoder [WET-TM-1730(WE/D)]         ANHUILAR POZZLES         Biffect of simulated forward speed on the jet noise of inverted velocity profile coannular nozzles [AIAA PAPAE 77-1329]         ATT-51185         AFTENMA DESIGN         L-band antenna for aircraft-to-satellite communications for Aerosat system         AT7-48362         A method to reduce the need for large antennas in Microwave Landing Systems /MLS/
ALUMINUM ALLOYS         Investigation of an aluminum rolling helix crash energy absorber [AD-A042084]       N77-33132         ANEC ROIC CHAMBERS       Source isolation by internal-to-far field correlations [AIAA PAPER 77-1276]       N77-51037         ANECROIC CHAMBERS       A77-51037         A suspended anemometer system for measuring true airspeed on low-speed airplanes [NASA-TN-D-8523]       N77-33157         ANGLE OF ATTACK       Wing rock as a lateral-directional aircraft limit cycle oscillation induced by nonlinear aerodynamics occurring at high angle of attack [AD-A042104]       N77-33204         ANGULAR VELOCITY       An accurate angular position and angular velocity instrument based on an optical incremental encoder [WEE-TN-1730(WR/D)]       N77-33480         ANULIAR WOZIES       Effect of simulated forward speed on the jet noise of inverted velocity profile coannular nozzles [AIAA PAPER 77-1329]       A77-51083         ANTENMA ARRAYS       Application of UHF adaptive array to navigation/tracking systems       A77-51185         ANTE NAD BSIGM       L-band antenna for aircraft-to-satellite communications for Aerosat system       A77-48362         A method to reduce the need for large antennas in Microwave Landing Systems /MLS/       A77-48362
ALUMINUM ALLOYS         Investigation of an aluminum rolling helix crash energy absorber [AD-A042084]         NFRCHOIC CHAMBERS         Gas turbine engine core noise source isolation by internal-to-far field correlations [AIAA PAPER 77-1276]         ANBC HOIC CHAMBERS         A suspended anemometer system for measuring true airspeed on low-speed airplanes [NASA-TM-D-8523]         N MASH-TM-D-8523]         NIG rock as a lateral-directional aircraft limit cycle oscillation induced by nonlinear aerodynamics occurring at high angle of attack [AD-A042104]         NHGULAR VELOCITY         An accurate angular position and angular velocity instrument based on an optical incremental encoder [WE-TN-1730(WE/D)]         NHULAR WOZZLES         Effect of simulated forward speed on the jet noise of inverted velocity profile coannular nozzles [AIAA PAPER 77-1329]         AT7-51185         ANTENNA DESIGN         L-band antenna for aircraft-to-satellite communications for Aerosat system         AT7-48362         A method to reduce the need for large antennas in Microwave Landing Systems /MLS/ A77-48378
ALUMINUM ALLOYS         Investigation of an aluminum rolling helix crash energy absorber [AD-A042084]         NFEC HOIC CHAMBERS         Gas turbine engine core noise source isolation by internal-to-far field correlations [AIAA PAPER 77-1276]         ATT-51037         AWBC HOIC CHAMBERS         A suspended anemometer system for measuring true airspeed on low-speed airplanes [NASA-TM-0-8523]         N SA-TM-0-8523]         NT7-33157         NGLE OF ATTACK         Wing rock as a lateral-directional aircraft limit cycle oscillation induced by nonlinear aerodynamics occurring at high angle of attack [AD-A042104]         NT7-33204         HNGUIAR VELOCITY         An accurate angular position and angular velocity instrument based on an optical incremental encoder [WE-TN-1730(WE/D)]         NTMULAR VOZILES         Bffect of simulated forward speed on the jet noise of inverted velocity profile coannular nozzles [AIAA PAPAE 77-1329]         AT7-51083         ANTEBNA ABRAYS         Application of UBF adaptive array to navigation/tracking systems         Ar7-48362         A method to reduce the need for large antennas in Microwave Landing Systems /MLS/ Radar systems with phased-array antennas         AT7-48378         Radar systems with phased-array antennas
ALUMINUM ALLOYS         Investigation of an aluminum rolling helix crash energy absorber [AD-A042084]       N77-33132         ANEC ROIC CHAMBERS       Source isolation by internal-to-far field correlations [ATAA PAPER 77-1276]       A77-51037         ANECROIC CHAMBERS       A77-51037         ANEC ROIC CHAMBERS       A77-51037         A suspended anemometer system for measuring true airspeed on low-speed airplanes [NASA-TN-D-8523]       N77-33157         ANGLE OF ATTACK       Wing rock as a lateral-directional aircraft limit cycle oscillation induced by nonlinear aerodynamics occurring at high angle of attack [AD-A042104]       N77-33204         ANGULAR VELOCITY       An accurate angular position and angular velocity instrument based on an optical incremental encoder [WRE-TN-1730(WR/D)]       N77-33480         ANULAR WOZZLES       Effect of simulated forward speed on the jet noise of inverted velocity profile coannular nozzles [AIAA PAPER 77-1329]       A77-51083         ANTENMA ARANYS       Application of UHF adaptive array to navigation/tracking systems       A77-51185         ANTE NAD BSIGM       L-band antenna for aircraft-to-satellite communications for Aerosat system       A77-48362         A method to reduce the need for large antennas in Microwave Landing Systems /MLS/ Radar systems with phased-array antennas       A77-48378
ALUMINUM ALLOYS         Investigation of an aluminum rolling helix crash energy absorber [AD-A042084]         NECHOIC CHAMBERS         Gas turbine engine core noise source isolation by internal-to-far field correlations [AIAA PAPER 77-1276]         ANEC HOIC CHAMBERS         Gas turbine engine core noise source isolation by internal-to-far field correlations [AIAA PAPER 77-1276]         ANEMOMETRES         A suspended anemometer system for measuring true airspeed on low-speed airplanes [NASA-TM-D-8523]         NIGLE OF ATTACK         Wing rock as a lateral-directional aircraft limit cycle oscillation induced by nonlinear aerodynamics occurring at high angle of attack [AD-A042104]         NGULAR VELOCITY         An accurate angular position and angular velocity instrument based on an optical incremental encoder [WE-TN-1730(WE/D)]         NHULAR WOZZLES         Effect of simulated forward speed on the jet noise of inverted velocity profile coannular nozzles [AIAA PAPAE 77-1329]         APPLCATION of UBF adaptive array to navigation/tracking systems         AP7-51185         ANTENNA DESIGN         L-band antenna for aircraft-to-satellite communications for Aerosat system         Ar7-48362         A method to reduce the need for large antennas in Microwave Landing Systems /MLS/ Radar systems with phased-array antennas         Ar7-48378         Radar systems with phased-array antennas         Ar7-51277
ALUMINUM ALLOYS         Investigation of an aluminum rolling helix crash energy absorber [AD-A042084]       N77-33132         ANEC ROIC CHAMBERS       Source isolation by internal-to-far field correlations [ATAA PAPER 77-1276]       N77-51037         ANECROIC CHAMBERS       A77-51037         A suspended anemometer system for measuring true airspeed on low-speed airplanes [NASA-TN-D-8523]       N77-33157         A GLE OF ATTACK       Wing rock as a lateral-directional aircraft limit cycle oscillation induced by nonlinear aerodynamics occurring at high angle of attack [AD-A042104]       N77-33204         ANGULAR VELOCITY       An accurate angular position and angular velocity instrument based on an optical incremental encoder [WE-TN-1730(WR/D)]       N77-33480         ANULAR WOZIES       Effect of simulated forward speed on the jet noise of inverted velocity profile coannular nozzles [AIAA PAPER 77-1329]       A77-51083         ANTENMA DESIGS       L-band antenna for aircraft-to-satellite communications for Aerosat system       A77-48362         A method to reduce the need for large antennas in Microwave Landing Systems /MLS/ Radar systems with phased-array antennas       A77-51277         ANTE HROPOLOGY       Civil transport aircraft short range all-weather flight       A77-51277

**∆**-7

#### ANTISKID DEVICES

ANTISKID DEVICES Behavior of aircraft antiskid breaking systems on dry and wet runway surfaces: A slip-ratio-controlled system with ground speed reference from unbraked nose wheel [NASA-TN-D-8455] N77-33150 ANTISTRWARTNE WARPARE Precise positioning of sonobuoys using AME and DME techniques --- Angle Measuring and Distance Measuring Equipment in antisubmarine warfare 177-51196 APPROACH CONTEOL Nultiple curved descending approaches and the air traffic control problem [NASA-TM-78430] N77-32104 Longitudinal handling qualities during approach and landing of a powered lift STOL aircraft [ NASA-TM-X-62144 ] N77-33151 ARCHITECTURE (COMPUTERS) System avionic architectures for RPVs FAD-A0415021 N77-32145 AREA NAVIGATION Civil and military air traffic in France -Management and compatibility A77-48411 The transfer of the German North MATRAC to the FUROCONTFOL Centre of Maastricht --- Military Air Traffic Radar Control A77-48412 EUROCCNTROL and radar --- automated air traffic control radar system implementation 177-48413 ASSEMBLTHC. Appliances for assembling aircraft and helicopter subsystems and elements --- Russian textbook A77-50682 ATLTT PROJECT Flight evaluation of an advanced technology light twin-engine airplane (ATLIT) [NASA-CR-2832] N77-33104 ATS 6 ATS-6 European L-band aeronautical experiments A77-49908 AUSTRIA Fustria's role in international civil aviation A77-48416 AUTOMATIC CONTROL Evolution of automatic opening lap belts in high performance aircraft 177-49946 Requirements for flight testing automated terminal service [AD-A041975] N77-33137 AUTOMATIC FLIGHT CONTROL EUROCONTROL and radar --- automated air traffic --control radar system implementation A77-48413 Design of nonlinear automatic flight control systems A77-48693 Failure analysis of digital systems using simulation A77-50501 Evolution of aircraft design through the concept of the control configured vehicle [ONERA, TP NO. 1977-129] A77-5100 Integrated path guidance system for unconventional A77-51004 approach procedures N77-32119 Structural Aspects of Active Controls AGARD-CP-228] N77-33208 YC-14 control system redundancy N77-33214 AUTOMATIC TEST EQUIPMENT Acquisition of test compatible avionics - An updated approach 177-49645 Automatic systems check-out A77-51351 AUXILIARY POWER SOURCES Electroenergy supply for airports. IV A77-49658 Subsystem design analysis light weight alternator (model test program). Addendum 2 [AD-A041257] N77-33171 AVAILABILITY Reliability, availability. maintainability/logistics /RAM/LOG/ A77-50456

#### SUBJECT INDEX

AVIONICS Acquisition of test compatible avionics - An updated approach A77-49645 Reliability improvement warranty techniques and applications --- to F-16 aircraft A77-50477 Effects of temperature on avionics reliability A77-50497 Failure analysis of digital systems using simulation A77-50501 Combined Environment Reliability Test /CERT/ --for avionics 177-50504 System avionic architectures for RPVs N77-32145 [AD-A041502] Avionics data for cost estimating [ AD-A043265 ] N77-32146 AXIAL FLOW TURBINES Cold-air performance of a 12.766-centimeter-tip-diameter axial-flow cooled turbine. 3: Effect of rotor tip clearance on overall performance of a solid blade configuration N77-32082 [NASA-TP-1032] AXISYMMETRIC PLOW Numerical analysis of the axisymmetric flow\_past a pervious shell with a hole at the vertex 177-50938

### B

B-1 AIRCRAFT
B-1 forward radome microwave test range
A77-49743
Design and development of a structural mode
control system [NASA-CR-143846] N77-33201
BALL BEARINGS
Steady-state unbalance response of a three-disk
flexible rotor on flexible, damped supports
[NASA-TM-X-73666] N77-33160
BALLOON FLIGHT
A mathematical model of transcontinental balloon [TAF PAPER 77-167] A77-51460
[IAF PAPER 77-167] A77-51460 BIBLIOGRAPHIES
Bird strike hazards: A bibliography, 1971 - 1976
[NAL-BIBL-SER-77] N77-33131
BIRD-AIRCRAFT COLLISIONS
Bird strike hazards: A bibliography, 1971 - 1976
[NAL-BIBL-SER-77] N77-33131
BLADE TIPS
Aerodynamic problems of helicopter blade tips [ONERA, FP NO. 1977-112] A77-50998
Investigation of subsonic fan noise sources by
fluctuating pressure measurements on rotating
blades
[AIAA PAPER 77-1321] A77-51075
Cold-air performance of a
12.766-centimeter-tip-diameter axial-flow cooled
turbine. 3: Effect of rotor tip clearance on
overall performance of a solid blade configuration [NASA-TP-1032] N77-32082
Interaction of rotor tip flow irregularities with
stator vanes as a noise source
[NASA-TM-73706] N77-32156
BLOWING
Heat transfer at the critical point of a cylinder
during intensive blowing A77-48054
BODY-WING COMPIGURATIONS
Vortex lattice prediction of subsonic aerodynamics
of hypersonic vehicle concepts
A77-49343
BOUNDARY LAYER CONTROL
Data reduction for the unsteady aerodynamics on a
cırculatıon control aırfoil wind tunnel test data
[AD-A041153] N77-32084
Special course on concepts for drag reduction
[AGARD-R-054] N77-32091
BOUNDARY LAYER PLOW
Numerical prediction of aeroacoustic jet-flap flows
[AIAA PAPER 77-1316] A77-51071
BBAKES (FOR ABBESTING MOTION) Behavior of aircraft antiskid breaking systems on
dry and wet runway surfaces: A
slip-ratio-controlled system with ground speed
reference from unbraked nose wheel
[NASA-TN-D-8455] N77-33150

BROACBAND Design and test results of very broadband radomes for ECM applications A77-49747 BUPPETING Buffet characteristics of the P-8 supercritical wing airrlane [NASA-TB-56049] N77-32080 C C-130 AIRCEMPT Flight inspection data and crack initiation times A77-50466 C-135 ATRCRAFT Air traffic control experimentation and evaluation test [AD-A041971] C-141 AIRCRAFT N77-33136 Effects of temperature on avionics reliability A77-50497 CABIN ATHOSPHERES Notes on the pollution of airplanes and helicopters by chemicals during agricultural jobs [ NASA-TT-F-17444 ] N77-33129 CALTERATING precision voltage reference unit for calibrating airborne data acquisition systems [RAE-TR-76164] N77-32474 CARNOT CYCLE Computer studies of swirl flows in Carnot diffusors A77-51600 CASCADE PLOW Design of a cascade fire apparatus for testing countermeasure effectiveness FAD-A0431761 N77-32101 CENTER OF GRAVITY The determination of the center-of-gravity position with the aid of dimensionless values --- for aircraft control and stability 177-49654 CENTRIFUGAL COMPRESSORS The current state of research and design in high pressure ratio centrifugal compressors --- for gas turbine engines [AD-A041011] N77-33172 CHANNEL CAPACITY Queues with delayed, probabilistic feedback as a model of air traffic control communications A77-51610 CIRCUIT RELIABILITY COIT RELIABILITI Effects of temperature on avionics reliability A77-50497 CIVIL AVIATION Austria's role in international civil aviation A77-48416 Rationalization of the European air net 177-48474 Some aspects of the development of air traffic of the Socialist States. II 177-49651 The need for a workable collision avoidance system - Now --- in civil aviation A77-50662 CLEARANCES Cold-air performance of a 12.766-centimeter-tip-diameter axial-flow cooled turbine. 3. Effect of rotor tip clearance on overall performance of a solid blade configuration [NASA-TP-1032] N77-32082 COAXIAL PLOW The initial region of subsonic coarial jets. A77-49564 CORERENCE COEFFICIENT Identification and measurement of combustion noise from a turbofan engine using correlation and coherence techniques [NASA-TM-73747] N77-33162 NASA-TH-/3/4/ N//-3: Measurement of far field combustion noise from a turbofan engine using coherence functions [NASA-TH-73748] COLLISION AVOIDANCE N77-33163 The need for a workable collision avoidance system - Now --- in civil aviation A77-50662 Electronic systems for air traffic control A77-51276

Air Combat Maneuvering Range/Instrumentation 'ACMR/I A77-51195 COMBUSTION CHAMBERS Direct-connect tests of hydrogen-fueled supersonic combustors A77-48240 Experimental and analytical separation of hydrodynamic, entropy and combustion noise in a gas turbine combustor [AIAA PAPEs 77-1275] A77-51036 A review of turbopropulsion combustion. Part 1: Pundamentals of combustion. Part 2: Turbopropulsion combustion technology [ AD-A043022 ] N77-32163 Identification and measurement of combustion noise from a turpofan engine using correlation and coherence techniques [NASA-TM-73747] N77-33162 COMBUSTION EPPICIENCY Pollution reduction technology program for small yet aircraft engines, phase 1 [NASA-CR-135214] N77-3: N77-33168 COMBUSTION STABILITY Measurement of far field combustion noise from a turbofan engine using coherence functions [NASA-TM-73748] N77-33163 CONET 4 AIRCRAFT ATS-6 European L-band aeronautical experiments 177-49908 COMMERCIAL AIRCRAFT Variation of pitching moment with engine thrust for a twin-engine commercial jet aircraft [NASA-TM-4-3569] N77-. N77-32131 COMMUNICATION NETWORKS JTIDS - An overview of the system design and implementation --- Joint Tactical Information Distribution System A77-5120ª Queues with delayed, probabilistic feedback as a model of air traffic control communications A77-51610 COMMUNICATION SATELLITES ATS-6 European L-band aeronautical experiments A77-49908 AFSATCON terminal segment reliability test program A77-50494 Single pass Doppler positioning for Search and Rescue satellite missions 177-51186 COMMUNITIES Further sensitivity studies of community-aircraft noise exposure (NOISENAP) prediction procedures [AD-A041781] N7-33 N77-33686 COMPORENT RELIABILITY Detail design aspects of a helicopter transmission system 177-47999 Some detail design problems in aircraft gas turbines A77-48001 Wear reliability of aircraft splines A77-50467 CFM56 turbofan maintainability and reliability-oriented development N77-33189 COMPOSITE MATERIALS Producibility aspects of advanced composites for an L-1011 Aileron SHE PAPER ENR76-041 A77-51006 Design, fabrication and test of an F-14 composite overwing fairing [SME PAPER EN 76-175] A77-51010 Alfframe composite materials A77-51353 COSPOSITE STRUCTURES Rohrbond --- high strength Ti alloy joining method for thrust engines, airframe and space structures [SME PAPER AD76-280] A77-5101 A77-51015 Evaluation of composite wing for XFV-12A airplane [ AD-A041208 ] COMPOUND HELICOPTERS N77-33152 Effect of rotor wake on aerodynamic characteristics of a 1/6 scale model of the rotor systems research aircraft --- in the Langley V/STOL tunnel [NASA-TM-4-3548] N N77-32083

CONBAT

#### COMPRESSIBLE FLOW

SUBJECT INDEX

CONTINUOUS WAVE RADAR

COMPRESSIBLE FLOW A finite element algorithm for sound propagation in axisymmetric ducts containing compressible mean flow [AIAA PAPER 77-1301] A77-51057 COMPRESSOR BFFICIENCY Cold-air performance of a 12.766-centimeter-tip-diameter axial-flow cooled turbine. 3: Effect of rotor tip clearance on overall performance of a solid blade configuration [NASA-TP-1032] N77-32082 COMPUTER GRAPHICS Computer-generated displays added to HEL helicopter operational trainer [AD-A043267] N77-32173 COMPUTER PROGRAMS Proving the correctness of a flight-director program for an airborne minicomputer A77-51261 A mathematical model of transcontinental balloon (IAF PAPER 77-167) A77-5 A77-51460 NSEG: A segmented mission analysis program for low and high speed aircraft. Volume 2: Program users manual [NASA-CE-2808] N77-33100 COMPUTER SYSTEMS DESIGN Acquisition of test compatible avionics - An updated apprcach 177-19645 COMPUTER TECHNIQUES On the importance of program intelligence to advanced automation in flight operations N77-32147 CONPUTERIZED DESIGN Estimation of belicopter performance by an extended energy method improved by flight tests 177-51613 P-8C adaptive flight control extensions --- for maximum likelihood estimation [NASA-CR-2881] X77-33203 COMPUTERIZED SINULATION Simulation of traffic loading for approach and landing systems with statistical interrogation A77-48686 Computer simulation of light aircraft crash A77-49341 Pailure analysis of digital systems using simulation A77-50501 Logistics planning simulation model for USAF spare engine management A77-50510 Principles, simulation results and interoperability of JTIDS relative navigation --- Joint Tactical Information Distribution System A77-51205 Computer studies of swirl flows in Carnot diffusors A77-51600 Simulation of the multipath propagation of DLS N77-32106 Influence of the multipath propagation on the distance measuring part of DLS N77-32110 F100 multivariable control synthesis program: Evaluation of a multivariable control using a real-time engine simulation [NASA-TP-1056] CONCOBDE AIRCBAFT N77-33169 Air traffic control and the initial operation of supersonic transport aircraft - A review of preparatory measures A77-48415 Progress in determining service life by endurance tests --- Concorde aircraft N77-33195 CONFERENCES Survival and Flight Equipment Association, Annual Symposium, 14th, San Diego, Calif., September 13~16, 1976, Proceedings A77-49926 Position Location and Navigation Symposium, San Diego, Calif., November 1-3, 1976, Proceedings A77-51178 Power plant reliability [AGARD-CP-215] N77-33181 CONTAMINATION Notes on the pollution of airplanes and helicopters by chemicals during agricultural jobs [NASA-TT-F-17444] N77-33129

Surface roughness measurements by using low-resolution FM-CW radar altimeters A77-48377 CONTROL CONFIGURED VEHICLES Evolution of aircraft design through the concept of the control configured vehicle [ONERA, TP NO. 1977-129] A77-51004 Initial unsteady aerodynamic measurements of a circulation controlled airfoil and an oscillating flow wind tunnel [AD-A042102] N77-33122 CONTROL SIMULATION Simulation of traffic loading for approach and landing systems with statistical interrogation . 177-48686 CONTROL SURFACES Transonic aerodynamic characteristics of a supercritical-wing transport model with trailing-edge controls N77-33116 [NASA-TH-X-3431] Transonic aerodynamic characteristics of a supercritical-wing transport model with supercritical-wing transport model with trailing-edge controls, supplement, part 1 [NASA-TM-X-3431-PT-1] N Transonic aerodynamic characteristics of a supercritical-wing transport model with trailing-edge controls [NASA-TM-X-3431-PT-2] N Transonic aerodynamic characteristics of a N77-33117 N77-33118 supercritical-wing transport model with trailing edge controls [NASA-TM-4-3431-PT-31 N77-33119 Transonic aerodynamic characteristics of a supercritical-wing transport model with trailing-dge controls [NASA-TH-X-3431-PT-4] N77-33120 CONTROL THEORY F-8C adaptive flight control laws [ NA SA-CR-2880 ] CONVERGENT NOZZLES N77-33202 The noise from unheated supersonic jets in simulated flight [AIAA PAPER 77-1327] A77-51081 Effect of flight on jet noise from supersonic underexpanded flows (AIAA PAPER 77-1328) COOLING SYSTEMS A77-51082 Aircraft electric machines with intensive cooling systems --- Russian book A77-50678 CORROSION PREVENTION Protection of cooled blades of complex internal structure [ONERA, IP NO. 1977-90] COST ANALYSIS A77-50991 Reliability versus cost in operating wide body jet engines N77-33186 COST EFFECTIVENESS The life cycle cost impacts of unsafe designs ---aircraft accident effects A77-50462 Product improvement program evaluation [AD-A042134] N77-33101 COST ESTIBATES The life cycle cost impacts of unsafe designs --aircraft accident effects A77-50462 Avionics data for cost estimating [AD-A043265] N77-32146 COST REDUCTION Life cycle cost reduction techniques associated with Advanced Medium STOL Transport (AMST) , N77-32141 [AD-A042830] CRACK INITIATION Flight inspection data and crack initiation times A77-50466 CRASH INJURIES USAF experience in aircraft accident survivability 177-49949 CRASH LANDING Bvaluation of inflatable /'air bag'/ occupant restraint systems for aircraft application A77-49951 CRITICAL POINT Heat transfer at the critical point of a cylinder during intensive blowing A77-48054

,

•

CROSS COBBELATION	
Identification and measurement of combustic	on noise
from a turbofan engine using correlation	anđ
coherence techniques	
[NASA-TH-73747]	N77-33162
CROSS POLARIZATION	
Model for the effect of electric fields on	
satellite-earth microwave radio propagat:	LOD
	177-49787
CYLIEDRICAL BODIES	
Heat transfer at the critical point of a c	ylinder
during intensive blowing	
-	177 00000

### D

A77-48054

D	
DAMPERS (VALVES)	
Steady-state unbalance response of a three	
flexible rotor on flexible, damped suppo [NASA-TM-X-73666]	N77-33160
DATA ACQUISITION	
Loran-C data acquisition and handling for : accuracy	improved
Automatic systems check-out	A77-51200
	A77-51351
Avionics data for cost estimating [AD-A043265]	N77-32146
An accurate angular position and angular v	elocity
instrument based on an optical increment: [WRE-IN-1730(WR/D)]	N77-33480
DATA BASES	117 33400
Reliability, availability,	
maintainability/logistics /RAM/LOG/	A77-50456
DATA CONVERTERS	
Eight-channel resolver simplifies digital : controls	flight
51.01 BDACTCCTHA	A77-51354
DATA PROCESSING Loran-C data acquisition and handling for :	1mproved
accuracy	A77-51200
DATA REDUCTION	
Data reduction for the unsteady aerodynamic circulation control airfoil wind tun	cs on a nel test
data [AD-A041153]	N77-32084
DATA SAMPLING Simultaneous characterization of jet noise	
and acoustic field by a new application (	
conditional sampling (AIAA PAPER 77-1349] DATA SYSTEBS	A77-51102
New air traffic control communications and	data
systems	A77-48252
DATA TRANSMISSION ATS-6 European L-band aeronautical experime	
DC 9 AIRCRAFT	A77-49908
Airframe poise of the DC-9 [AIAA PAPER 77-1272]	177-51035
Behavior of aircraft antiskid breaking sys	tems on
dry and wet runway surfaces: A slip-ratio-controlled system with ground	sneed
reference fich unbraked nose wheel	Specu
[NASA-TN-D-8485]	N77-33150
DBAD RECKOFING An integrated marine navigation system	
	A77-51199
DECISION BARING On the importance of program intelligence	to
advanced autchation in flight operations	
[AD-A042915]	N77-32147
DBLTA WINGS Calculation of vortex breakdown locations	for flow
over delta wings	
Three dimensional steady and unsteady asym	A77-49345
flow past wings of arbitrary planforms	actric .
[NASA-CR-145235]	N77-33102
DESIGN ANALYSIS Technical and economic assessment of swept	- W1 D/J
span-distributed load concepts for civil	and
Bilitary air cargo transports	N77_27407
[NASA-CR-145229]	N77-33147

DIFPUSERS Pluid dynamics of diffuser augmented wind turbines A77-48899
Computer studies of swirl flows in Carnot diffusors A77-51600
DIGITAL DATA Air traffic coatrol experimentation and evaluation
test [AD-A041971] N77-33136
DIGITAL BADAR SYSTEMS The new airport radar systems A77-47979
New air traffic control communications and data systems
A77-48252 EUROCONTROL and radar automated air traffic control radar system implementation
A77-48413 Applications of augmented multilateration tracking systems for military targets
A77-51183 Development of the RMS-2 System of ODDR6E/T6E/
Range Measurement System for tank and aırcraft trackıng A77-51187
DIGITAL SINULATION Preliminary investigations of the unsteady flow in
turbojet engines during transients [PUBL-PP-174] N77-32164
DIGITAL SYSTEMS Pailure analysis of digital systems using simulation
A77-50501 Bight-channel resolver simplifies digital flight
controls A77-51354
Digital flight control systems [NASA-CB-145246] N77-33200
Analysis of inherent errors in asynchronous digital flight controls
[AD-A041813] N77-33206 DISPLAY DEVICES
New air traffic control communications and data systems
A77-48252 A new high-brightness, all-weather, ASDE /Airport Surface Detection Equipment/
A77-49224 SENDS /Safe Ejection Envelope Display System/
Solid state light emitting displays
Automatic systems check-out A77-50623
A77-51351 Presentation of DLS information
N77-32111 Master monitor display application study for P-14
[AD-A041570] N77-33158 DISTANCE MEASURING BQUIPMENT
Precision location, navigation and guidance using DME techniques
A77-51180 A multipurpose position accuracy verification system airborne DME
A77-51181 Applications of augmented multilateration tracking
systems for military targets A77-51183
Precise positioning of sonobuoys using AME and DME techniques —— Angle Measuring and Distance
Reasuring Equipment in antisubmarine warfare
Aircraft Space Position Measurement System - An application of precision DME
A77-51197 Contributions to the evaluation of the German proposal DLS for a new microwave landing system,
part 1 [TUBS/SPB58/M1-PT-1] N77-32105
Simulation of the multipath propagation of DLS N77-32106
Influence of the multipath propagation on the distance measuring part of DLS
Presentation of DLS information
N77-32111 Contributions to the evaluation of the German proposal DLS for a New Microwave Landing System,
proposal DLS for a New Microwave Landing System, Part 2

#### DIURNAL VABIATIONS

Multipath immunity of MLS in mountainous sites N77-32116 Nonte Carlo simulation of VOR/DME holding procedures. Basic notions and applications [ESA-TT-419] N7 N77-33142 DIURNAL VARIATIONS A mathematical model of transcontinental balloon **FIAF PAPER 77-1671** 177-51460 DOPPLER EFFECT Single pass Doppler positioning for Search and Rescue satellite missions A77-51186 Measurement of the multipath propagation at the Brunswick test airport --- multipath instrument landing system N77-32107 DRAG REDUCTION An overview of concepts for aircraft drag reductions N77-32092 Methods for reducing subsonic drag due to lift N77-32093 DROP SIZE The effect of drop size on emissions from the primary zone of a gas turbine type combustor 177-48174 DROP TESTS Documentation of the feasibility research on a destructible parachute 177-49342 DUCTED FANS Investigation of subscnic fan noise sources by fluctuating pressure measurements on rotating blades **SAIAA PAPER 77-13211** A77-51075 DUCTED PLON A finite element algorithm for sound propagation in axisymmetric ducts containing compressible mean flow [AIAA PAPER 77-1301] 177-51057 DUCTS The influence of the inlet duct contour on forward radiated fan noise FAIAA PAPER 77-1355] 177-51108 DYNAMIC CONTEOL Design of nonlinear automatic flight control systems 177-48693 DYNAMIC LOADS Investigation of the state of dynamic stress and the influence of service time on the fatigue strength of turbine rotor blades of aircraft gas-turbine engines A77-48632 Acoustic loads on upper-surface-blown powered-lift systems

[AIAA PAPER 77-1363] A77-51115 DYNAMIC RESPONSE Measurement of nondiagonal generalized damping ratios during ground vibration tests A77-50440 Structural Aspects of Active Controls rAGARE-CE-228] 477-33208 Impact of a command and stability augmentation system on gust response of a combat aircraft

N77-33210 DYNAMIC STABILITY Handling qualities of the RH-53D in the design growth configuration [SER-651317] N77-33144

### Ε

Emergency escape from shuttle vehicles A77-49935

#### SUBJECT INDEX

Performance and design of a vertical seeking seat steering system A77-49945 Evolution of automatic opening lap belts in high performance aircraft A77-49946 The development of new designs of emergency escape parachutes for ejection seats A77-49947 Teaching the practical techniques of establishing egress system performance in an accident environment A77-49948 Aircrew escape and survival - Problems and solutions 177-49950 BLASTIC DAMPING Aeroelastic stability of complete rotors with application to a teetering rotor in forward flight A77-49180 RLASTIC DEPORMATION Nonlinear aeroelastic equations for combined and extension of twisted nonuniform rotor blades in forward flight [NASA-TM-74059] N77-33107 ELASTONERS Rain erosion resistant fluoroelastomer radome and antenna coatings A77-49731 ELECTRIC FIELDS Nodel for the effect of electric fields on satellite-earth microwawe radio propagation A77-49787 BLECTRIC MOTORS Aircraft electric machines with intensive cooling systems --- Russian book A77-50678 ELECTRIC POWER SUPPLIES Electroenergy supply for airports. IV A77-49658 Airport electrical and lighting equipment ---Russian book A77-50676 ELECTRODIC COUNTERNEASURES Design and test results of very broadband radomes for ECM applications A77-49747 BLECTBONIC BOUIPHENT TESTS BIW experience at ECON --- Reliability Improvement Warranty reguirements for Army A77-50483 AFSATCOM terminal segment reliability test program 177-50494 Effects of temperature on avionics reliability A77-50497 Combined Environment Reliability Test /CERT/ --for avionics A77-50504 EMERGENCY LIFE SUSTAINING SYSTEMS Emergency escape from shuttle vehicles A77-49935 The development of new designs of emergency escape parachutes for ejection seats 177-49947 ENERGY CONSERVATION An overview of concepts for aircraft drag reductions N77-32092 ENERGY DISSIPATION Vortex interactions and decay in aircraft wakes [NASA-CR-2870] N77-33105 ENERGY METHODS Estimation of helicopter performance by an extended energy method improved by flight tests A77-51613 ENERGY TECHNOLOGY Experimental data and theoretical analysis of an operating 100 kW wind turbine A77-48898 RNGINE ANALYZERS Preliminary results of USAF experience with engine monitoring and diagnostics N77-33199 ENGT-NE CONTROL Output feedback regulator design for jet engine control systems f NASA-TM-737761 N77-33165

P100 multivariable control synthesis program:
Evaluation of a multivariable control using a real-time engine simulation
[NASA-TP-1056] N77-33169
Nethods of improving the performance reliability of advanced military power plant systems
N77-33198
BUGINE COOLANTS
Aircraft electric machines with intensive cooling systems Russian book
A77-50678
ENGINE DESIGN Some detail design problems in aircraft gas turbines
A 77-48001
Construction and design principles of aircraft gas-turbine engines Russian book
gas-tulbine engines Russian book A77-50684
CP6 engine designed for maintenance
A77-51352 Power plant reliability
[AGARD-CP-215] N77-33181
CFM56 turbofan maintainability and reliability~oriented development
N77-33189
Aircraft engine design and development through lessons learned
N77-33190
ENGINE PAILUBE
Civil airworthiness requirements for powerplant reliability
N77-33185
Development procedures to promote reliability N77-33188
Testing simulation of damages occurred in service
N77-33194
Experimental investigation on the influence of component faults on turbojet engine performance
N77-33197
ENGINE INLETS Detail design in aircraft
A77-48000
ENGINE MONITOBING INSTRUMENTS
Naintenance methods for improving propulsion system reliability
N77-33184
The evolution and control of different performance degradation processes in modern propulsion systems
monitoring jet engines
N77-33193 Methods of improving the performance reliability
of advanced military power plant systems
N77-33198 Preliminary results of USAF experience with engine
monitoring and diagnostics N77-33199
monitoring and diagnostics N77-33199 ENGINE NOISE
monitoring and diagnostics N77-33199 EMGINE NOISE Experimental and analytical separation of hydrodynamic, entropy and combustion noise in a
monitoring and diagnostics N77-33199 EMGINE NOISE Experimental and analytical separation of hydrodynamic, entropy and combustion noise in a
monitoring and diagnostics N77-33199 EMGINE NOISE Experimental and analytical separation of hydrodynamic, entropy and combustion noise in a qas turbine combustor [AIA] PAPER 77-1275] Gas turbine engine core noise source isolation by
monitoring and diagnostics N77-33199 EMGINE NOISE Experimental and analytical separation of hydrodynamic, entropy and combustion noise in a qas turbine combustor [AIAA PAPER 77-1275] Gas turbine engine core noise source isolation by internal-to-far field correlations
monitoring and diagnostics N77-33199 EMGINE NOISE Experimental and analytical separation of hydrodynamic, entropy and combustion noise in a qas turbine combustor [AIA] PAPER 77-1275] Gas turbine engine core noise source isolation by
<pre>monitoring and diagnostics N77-33199 EMGINE NOISE Experimental and analytical separation of hydrodynamic, entropy and combustion noise in a qas turbine combustor [AIAA PAPER 77-1275] A77-51036 Gas turbine engine core noise source isolation by internal-to~far field correlations [AIAA PAPER 77-1276] A77-51037 Measurement of far field combustion noise from a turbofan engine using coherence functions</pre>
monitoring and diagnostics N77-33199 EMGINE NOISE Experimental and analytical separation of hydrodynamic, entropy and combustion noise in a gas turbine combustor [AIAA PAPER 77-1275] Gas turbine engine core noise source isolation by internal-to-far field correlations [AIAA PAPER 77-1276] A77-51037 Measurement of far field combustion noise from a
BONITOTING and diagnostics       N77-33199         EMGINE NOISE       Experimental and analytical separation of hydrodynamic, entropy and combustion noise in a qas turbine combustor         [AIAA PAPER 77-1275]       A77-51036         Gas turbine engine core noise source isolation by internal-to-far field correlations       A77-51037         Measurement of far field combustion noise from a turbofan engine using coherence functions       A77-51038         Shielding aspects of heated twin jet noise for a far field combustion for set for a far field coherence functions       A77-51048
BONITORING and diagnostics N77-33199 ENGINE NOISE Experimental and analytical separation of hydrodynamic, entropy and combustion noise in a qas turbine combustor [AIAA PAPER 77-1275] A77-51036 Gas turbine engine core noise source isolation by internal-to-far field correlations [AIAA PAPER 77-1276] A77-51037 Measurement of far field combustion noise from a turbofan engine using coherence functions [AIAA PAPER 77-1277] A77-51038 Shielding aspects of heated twin jet noise [AIAA PAPER 77-1288] A77-51048 Source location by shielding with application to a
BONITORING and diagnostics N77-33199 EMGINE NOISE Experimental and analytical separation of hydrodynamic, entropy and combustion noise in a qas turbine combustor [AIAA PAPER 77-1275] A77-51036 Gas turbine engine core noise source isolation by internal-to-far field correlations [AIAA PAPER 77-1276] A77-51037 Measurement of far field combustion noise from a turbofan engine using coherence functions [AIAA PAPER 77-1277] A77-51038 Shielding aspects of heated twin jet noise [AIAA PAPER 77-1288] A77-51048 Source location by shielding with application to a large turbofan engine for aircraft noise reduction
BONITORING and diagnostics N77-33199 ENGINE NOISE Experimental and analytical separation of hydrodynamic, entropy and combustion noise in a qas turbine combustor [AIAA PAPER 77-1275] A77-51036 Gas turbine engine core noise source isolation by internal-to-far field correlations [AIAA PAPER 77-1276] A77-51037 Measurement of far field combustion noise from a turbofan engine using coherence functions [AIAA PAPER 77-1277] A77-51038 Shielding aspects of heated twin jet noise [AIAA PAPER 77-1280] A77-51048 Source location by shielding with application to a large turbofan engine for aircraft noise [AIAA PAPER 77-1308] A77-51060
BONITOTING and diagnostics N77-33199 EMGINE NOISE Experimental and analytical separation of hydrodynamic, entropy and combustion noise in a qas turbine combustor [AIAA PAPER 77-1275] A77-51036 Gas turbine engine core noise source isolation by internal-to-far field correlations [AIAA PAPER 77-1276] A77-51037 Measurement of far field combustion noise from a turbofan engine using coherence functions [AIAA PAPER 77-1277] A77-51038 Shielding aspects of heated twin jet noise [AIAA PAPER 77-1288] A77-51048 Source location by shielding with application to a large turbofan engine for aircraft noise reduction [AIAA PAPER 77-1304] A77-51060 Plight noise studies on a turbojet engine using microphones mounted on a 450 ft. tower
BONITORING and diagnostics N77-33199 ENGINE NOISE Experimental and analytical separation of hydrodynamic, entropy and combustion noise in a qas turbine combustor [AIAA PAPER 77-1275] A77-51036 Gas turbine engine core noise source isolation by internal-to-far field correlations [AIAA PAPER 77-1276] A77-51037 Measurement of far field combustion noise from a turbofan engine using coherence functions [AIAA PAPER 77-1277] A77-51038 Shielding aspects of heated twin jet noise [AIAA PAPER 77-1288] A77-51048 Source location by shielding with application to a large turbofan engine for aircraft noise reduction [AIAA PAPER 77-1304] A77-51060 Plight noise studies on a turbojet engine using microphones mounted on a 450 ft. tower [AIAA PAPER 77-1325] A77-51079
BONITOTING and diagnostics N77-33199 EMGINE NOISE Experimental and analytical separation of hydrodynamic, entropy and combustion noise in a qas turbine combustor [AIAA PAPER 77-1275] A77-51036 Gas turbine engine core noise source isolation by internal-to-far field correlations [AIAA PAPER 77-1276] A77-51037 Measurement of far field combustion noise from a turbofan engine using coherence functions [AIAA PAPER 77-1277] A77-51038 Shielding aspects of heated twin jet noise [AIAA PAPER 77-1288] A77-51048 Source location by shielding with application to a large turbofan engine for aircraft noise reduction [AIAA PAPER 77-1304] A77-51060 Plight noise studies on a turbojet engine using microphones mounted on a 450 ft. tower [AIAA PAPER 77-1325] A77-51079 Effects of forward motion on jet and core noise [AIAA PAPER 77-1330] A77-51084
BONITORING and diagnostics N77-33199 EMGINE NOISE Experimental and analytical separation of hydrodynamic, entropy and combustion noise in a qas turbine combustor [AIAA PAPER 77-1275] A77-51036 Gas turbine engine core noise source isolation by internal-to-far field correlations [AIAA PAPER 77-1276] A77-51037 Measurement of far field combustion noise from a turbofan engine using coherence functions [AIAA PAPER 77-1277] A77-51038 Shielding aspects of heated twin jet noise [AIAA PAPER 77-1288] A77-51048 Source location by shielding with application to a large turbofan engine for aircraft noise reduction [AIAA PAPER 77-1304] A77-51060 Flight noise studies on a turbojet engine using microphones mounted on a 450 ft. tower [AIAA PAPER 77-1325] A77-51079 Effects of forward motion on jet and core noise [AIAA PAPER 77-1301] A77-51084 Acoustic performance of inlet multiple-pure-tone
BONITOTING and diagnostics N77-33199 EMGINE NOISE Experimental and analytical separation of hydrodynamic, entropy and combustion noise in a qas turbine combustor [AIAA PAPER 77-1275] A77-51036 Gas turbine engine core noise source isolation by internal-to-far field correlaticns [AIAA PAPER 77-1276] A77-51037 Measurement of far field combustion noise from a turbofan engine using coherence functions [AIAA PAPER 77-1277] A77-51038 Shielding asfects of heated twin jet noise [AIAA PAPER 77-1288] A77-51048 Source location by shielding with application to a large turbofan engine for aircraft noise reduction [AIAA PAPER 77-1304] A77-51060 Flight noise studies on a turbojet engine using microphones mounted on a 450 ft. tower [AIAA PAPER 77-1325] A77-51079 Effects of forward motion on jet and core noise [AIAA PAPER 77-1330] A77-51084 Acoustic performance of inlet multiple-pure-tone supressors installed on NASA Quiet Eggine 'C'
BONITORING and diagnostics N77-33199 EMGINE NOISE Experimental and analytical separation of hydrodynamic, entropy and combustion noise in a qas turbine combustor [AIAA PAPER 77-1275] A77-51036 Gas turbine engine core noise source isolation by internal-to-far field correlations [AIAA PAPER 77-1276] A77-51037 Measurement of far field combustion noise from a turbofan engine using coherence functions [AIAA PAPER 77-1277] A77-51038 Shielding aspects of heated twin jet noise [AIAA PAPER 77-1283] A77-51048 Source location by shielding with application to a large turbofan engine for aircraft noise reduction [AIAA PAPER 77-1304] A77-51060 Flight noise studies on a turbojet engine using microphones mounted on a 450 ft. tower [AIAA PAPER 77-1325] A77-51079 Effects of forward motion on jet and core noise [AIAA PAPER 77-1301] A77-51084 Acoustic performance of inlet multiple-pure-tone suppressors installed on NASA Quiet Engine 'C' [AIAA PAPER 77-133] A77-51087
BONITOTING and diagnostics N77-33199 EMGINE NOISE Experimental and analytical separation of hydrodynamic, entropy and combustion noise in a qas turbine combustor [AIAA PAPER 77-1275] A77-51036 Gas turbine engine core noise source isolation by internal-to-far field correlaticns [AIAA PAPER 77-1276] A77-51037 Measurement of far field combustion noise from a turbofan engine using coherence functions [AIAA PAPER 77-1277] A77-51038 Shielding asfects of heated twin jet noise [AIAA PAPER 77-1288] A77-51048 Source location by shielding with application to a large turbofan engine for aircraft noise reduction [AIAA PAPER 77-1304] A77-51060 Plight noise studies on a turbojet engine using microphones mounted on a 450 ft. tower [AIAA PAPER 77-1325] A77-51079 Effects of forward motion on jet and core noise [AIAA PAPER 77-1330] A77-51084 Acoustic performance of inlet multiple-pure-tone suppressors installed on NASA Quiet Engine 'C' [AIAA PAPER 77-1333] A77-51087 Interaction of rotor tip flow irregularities with stator wanes as a noise source
BONITOTING and diagnostics N77-33199 ENGINE NOISE Experimental and analytical separation of hydrodynamic, entropy and combustion noise in a qas turbine combustor [AIAA PAPER 77-1275] A77-51036 Gas turbine engine core noise source isolation by internal-to-far field correlations [AIAA PAPER 77-1276] A77-51037 Measurement of far field combustion noise from a turbofan engine using coherence functions [AIAA PAPER 77-1277] A77-51038 Shielding aspects of heated twin jet noise [AIAA PAPER 77-1288] A77-51048 Source location by shielding with application to a large turbofan engine for aircraft noise reduction [AIAA PAPER 77-1304] A77-51060 Plight noise studies on a turbojet engine using microphones mounted on a 450 ft. tower [AIAA PAPER 77-1325] A77-51079 Effects of forward motion on jet and core noise [AIAA PAPER 77-1330] A77-51084 Acoustic performance of inlet multiple-pure-tone suppressors installed on NASA Quiet Engine 'C' [AIAA PAPER 77-133] A77-51087 Interaction of rotor tip flow irregularities with stator vanes as a noise source [AIAA PAPER 77-1342] A77-51095 Effect of forward motion on turbomachinery noise
BONITOTING and diagnostics N77-33199 EMGINE NOISE Experimental and analytical separation of hydrodynamic, entropy and combustion noise in a qas turbine combustor [AIAA PAPER 77-1275] A77-51036 Gas turbine engine core noise source isolation by internal-to-far field correlaticns [AIAA PAPER 77-1276] A77-51037 Measurement of far field combustion noise from a turbofan engine using coherence functions [AIAA PAPER 77-1277] A77-51038 Shielding asfects of heated twin jet noise [AIAA PAPER 77-1288] A77-51048 Source location by shielding with application to a large turbofan engine for aircraft noise reduction [AIAA PAPER 77-1304] A77-51060 Plight noise studies on a turbojet engine using microphones mounted on a 450 ft. tower [AIAA PAPER 77-1325] A77-51079 Effects of forward motion on jet and core noise [AIAA PAPER 77-1330] A77-51084 Acoustic performance of inlet multiple-pure-tone suppressors installed on NASA Quiet Engine 'C' [AIAA PAPER 77-1333] A77-51087 Interaction of rotor tip flow irregularities with stator wanes as a noise source [AIAA PAPER 77-1342] A77-51095 Effect of forward motion on turbomachinery noise [AIAA PAPER 77-1346] A77-51099
BONITOTING and diagnostics N77-33199 ENGINE NOISE Experimental and analytical separation of hydrodynamic, entropy and combustion noise in a qas turbine combustor [AIAA PAPER 77-1275] A77-51036 Gas turbine engine core noise source isolation by internal-to-far field correlations [AIAA PAPER 77-1276] A77-51037 Measurement of far field combustion noise from a turbofan engine using coherence functions [AIAA PAPER 77-1277] A77-51038 Shielding aspects of heated twin jet noise [AIAA PAPER 77-1288] A77-51048 Source location by shielding with application to a large turbofan engine for aircraft noise reduction [AIAA PAPER 77-1304] A77-51060 Plight noise studies on a turbojet engine using microphones mounted on a 450 ft. tower [AIAA PAPER 77-1325] A77-51079 Effects of forward motion on jet and core noise [AIAA PAPER 77-1330] A77-51084 Acoustic performance of inlet multiple-pure-tone suppressors installed on NASA Quiet Engine 'C' [AIAA PAPER 77-133] A77-51087 Interaction of rotor tip flow irregularities with stator vanes as a noise source [AIAA PAPER 77-1342] A77-51095 Effect of forward motion on turbomachinery noise
BONITOTING and diagnostics N77-33199 EMGINE NOISE Experimental and analytical separation of hydrodynamic, entropy and combustion noise in a qas turbine combustor [AIAA PAPER 77-1275] A77-51036 Gas turbine engine core noise source isolation by internal-to-far field correlations [AIAA PAPER 77-1276] A77-51037 Measurement of far field combustion noise from a turbofan engine using coherence functions [AIAA PAPER 77-1277] A77-51038 Shielding aspects of heated twin jet noise [AIAA PAPER 77-1288] A77-51048 Source location by shielding with application to a large turbofan engine for aircraft noise reduction [AIAA PAPER 77-1304] A77-51060 Plight noise studies on a turbojet engine using microphones wounted on a 450 ft. tower [AIAA PAPER 77-1325] A77-51084 Acoustic performance of inlet multiple-pure-tone suppressors installed on NASA Quiet Engine 'C' [AIAA PAPER 77-1333] A77-51087 Interaction of rotor tip flow irregularities with stator vanes as a noise source [AIAA PAPER 77-1342] A77-51087 Effect of forward motion on turbomachinery noise [AIAA PAPER 77-1342] A77-51095 Effect of forward motion on turbomachinery noise [AIAA PAPER 77-1342] A77-51095 Effect of forward motion on turbomachinery noise [AIAA PAPER 77-1342] A77-51095 Effect of forward motion on turbomachinery noise [AIAA PAPER 77-1342] A77-51099 A novel concept for suppressing internally

Acoustic performance of inlet multiple-pure-tone suppressors installed on NASA quiet engine C [NASA-IM-73713] 877-32158 Summary of forward velocity effects on fan noise [NASA-TM-73742] N77-3 N77-32159 State-of-the-art of turbofan engine noise control [NASA-TH-73734] N77-33166 High velocity jet noise source location and reduction. Fask 4: Development/evaluation of techniques for inflight investigation [ AD-A041849 ] N77-33175 Supersonic jet exhaust noise investigation. Volume 4: Acoustic far-field/near-field data report [AD-A041819] N77-33177 Investigation of feasible nozzle configurations for noise reduction in turbofan and turbojet aircraft. Volume 3: Shrouded slot nozzle configurations [AD-A041782] N77-33179 EBGINE PARTS Some detail design problems in aircraft gas turbines A77-48001 CF6 engine designed for maintenance A77-51352 Investigation of factors controlling engine scheduled overhaul: T53/T55 [AD-A042190] N77-32162 ENGINE TESTS CF6 engine designed for maintenance A77-51352 Effect of slotted casing treatment with change in Reynolds number index on performance of a jet engine [NÁSA-TP-1058] N77-32154 CFM56 turbofan maintainability and reliability-oriented development N77-33189 Progress in determining service life by endurance tests --- Concorde aircraft N77-33195 Accelerated mission test: A vital reliability tool N77-33196 Experimental investigation on the influence of component faults on turbojet engine performance N77-33197 ENTROPY Experimental and analytical separation of hydrodynamic, entropy and combustion of ise in a gas turbine combustor [AIAA PAP2R 77-1275] A77-510 A77-51036 ENVIRONMENT PROTECTION Convex 76 - Alcoraft noise and air traffic control 177-49225 ENVIRONMENTAL TESTS Combined Environment Reliability Test /CERT/ --for avionics A77-50504 ERROR ANALYSIS Analysis of inderent errors in asynchronous digital flight controls ₩77-33206 FAD-A0418131 BREOR CORRECTING CODES The measurement of aircraft overflight noise -Errors due to its nonstationary character 177-50441 ESCAPE CAPSULES Emergency escape from shuttle vehicles 177-49935 ESCAPE SYSTEMS Survival and Plight Equipment Association, Annual Symposium, 14th, San Diego, Calif., September 13-16, 1976, Proceedings 177-49926 Fluidic event sequencing subsystem for AAES --Aircrew Automated Escape Systems 177-49934 The development of new designs of emergency escape parachutes for ejection seats 177-19917 Teaching the practical techniques of establishing egress system performance in an accident environment 177-49948 Aircrew escape and survival - Problems and solutions A77-49950 EURO PR Rationalization of the European air net A77-48474

## EXHAUST GASES

-

-

- --

Gas turbine engine core noise source isolation by internal-to-far field correlations [AIA PAFER 77-1276] A77-51037 Pollution reduction technology program for small jet aircraft engines, phase 1 [NASA-CR-135214] N77-33168
[AIAA PAPER 77-1276] A77-51037 Pollution reduction technology program for small jet aircraft engines, phase 1
Pollution reduction technology program for small jet aircraft engines, phase 1
jet aircraft engines, phase 1
[NASA-CR-135214] N77-33168
EXHAUST NOZZLES
Theoretical jet exhaust noise model for the duct
burning turbofan
[AIAA PAPER 77-1264] A77-51028
EXTEBSIONS
Theoretical parametric study of the relative
advantages of winglets and wing-tip extensions
[NASA-TE-1020] N77-33112
EXTEBNAL STORES
Active flutter suppression of an airplane with
wing mounted external stores
N77-33211
EXTEBNALLY BLOWN FLAPS
Forward flight effects on EBF noise Externally
Blown Flaps
FAIAA PAPER 77-13141 A77-51069
Interim noise correlation for some OTW
configurations using external jet-flow deflectors
engine Over The Wing
[AIAA PAPER 77-1317] A77-51072

## F

r	
F-8 AIRCRAFT	
Design of nonlinear automatic flight control	1 systems A77-48693
Buffet characteristics of the F-8 supercrit	
wing airrlane	
[ NASA-TM-56049 ]	N77-32080
F-8C adaptive flight control laws	
[NASA-CR-2880]	<b>N77-33202</b>
F-8C adaptive flight control extensions	for
maximum likelihood estimation	
[NASA-CB-2881]	N77-33203
P-14 AIRCRAFT	
Human factors engineering considerations in	
designing Naval aircraft for maintainabil	
[AD-A041156]	N77-33153
F-16 AIRCRAFT Reliability improvement warranty techniques	
applications to F-16 aircraft	
applications to f-10 allelate	A77-50477
MICRON reliability analyses	A//- 304//
[AD-A042987]	N77-32129
F-106 AIRCRAFT	arr SEIES
High velocity jet noise source location and	1
reduction. Task 4: Development/evaluati	
techniques for inflight investigation	
[AD-A041849]	N77-33175
PAILURE ABALYSIS	
Failure analysis of digital systems using s	
	A77-50501
PAILURE MODES	
Testing simulation of damages occurred in s	
	N77-33194
Experimental investigation on the influence component faults on turbojet engine perfo	
component radies on thrub let endine berte	N77-33197
PAIRINGS	111-33131
Design, fabrication and test of an F-14 con	posite
overwing fairing	
SME PAPER EN76-1751	A77-51010
FAR FIELDS	
Measurement of far field combustion noise f	Гов а
turbofan engine using coherence functions	5
[AIAA PAPER 77-1277]	A77-51038
Unsteady surface pressure characteristics of	
aircraft components and farfield radiated	1
airframe noise	
[AIAA PAPER 77-1295]	A77-51052
Measurement of far field combustion noise f	
turbofan engine using coherence functions [NASA-TH-73748]	
Supersonic jet exhaust noise investigation.	N77-33163
Volume 4: Acoustic far-field/near-field	da+ =
report	uata
[AD-A041819]	N77-33177
PATIGUE (MATEBIALS)	111 55 -111
Engine structural integrity program (ENSIP)	
	N77-33182

## SUBJECT INDEX

PATIGUE TESTS A-37B fatique sensor evaluation program: Pull scale test and field aircraft instrumentation [AD-A042114] N77-33156 PEASIBILITY AMALYSIS	I
Space-based solar power study near completion A77-48480	I
Documentation of the feasibility research on a destructible parachute A77-49342	ļ
FEED BACK CONTROL Output feedback regulator design for jet engine	
control systems [NASA-TM-73776] N77-33165 FIGHTER AIECRAFT	I
HUD and the retrofit market A77-50624 Air Combat Maneuvering Range/Instrumentation	
'ACHB/I' A77-51195	
Aerodynamic characteristics at Mach numbers from 0.6 to 2.16 of a supersonic cruise fighter configuration with a design Mach number of 1.8 [NASA-TH-X-3559] N77-32081	
A new look in reliability: P-18 operational mission environment	
[AD-A042731] N77-32573 FILE COOLING New computation method of turbine blades film	
cooling efficiency [ONERA, TP NO. 1977-85] A77-50988	I
<b>FINITE DIFFERENCE THEORY</b> The importance of monotonicity of finite difference schemes in straight-through	
calculation methods of supersonic flow problems	
PINITE ELEMENT METHOD	
A finite element algorithm for sound propagation in arisymmetric ducts containing compressible mean flow	
[AIAA PAPER 77-1301] A77-51057 Numerical prediction of aeroacoustic jet-flap flows [AIAA PAPER 77-1316] A77-51071 FIRE EITINGUISERES	
Design of a cascade fire apparatus for testing	
countermeasure effectiveness	
Countermeasure effectiveness [AD-A043176] N77-32101 FIRE PREVENTION	
[AD-A043176] N77-32101 FIRE PREVENTION Design of a cascade fire apparatus for testing countermeasure effectiveness	
[AD-A043176] N77-32101 FIRE PREVENTION Design of a cascade fire apparatus for testing countermeasure effectiveness [AD-A043176] N77-32101 FLANE PROPAGATION	
[AD-A043176] N77-32101 FIRE PREVENTION Design of a cascade fire apparatus for testing countermeasure effectiveness [AD-A043176] N77-32101	
[AD-A043176]       N77-32101         FIRE PREVENTION       Design of a cascade fire apparatus for testing countermeasure effectiveness         [AD-A043176]       N77-32101         FLAME PROPAGATION       N77-32101         A erodynamic and thermodynamic characteristics of kerosene-spray flames       N77-48181         FLAPS (CONTROL SUBFACES)       A flight investigation of the wake turbulence	
<pre>[AD-A043176] N77-32101 PIRE PREVENTION Design of a cascade fire apparatus for testing countermeasure effectiveness [AD-A043176] N77-32101 PLANE PROPAGATION Aerodynamic and thermodynamic characteristics of kerosene-spray flames A77-48181 PLAPS (CONTROL SUBPACES) A flight investigation of the wake turbulence alleviation resulting from a flap configuration change on a B-747 aircraft</pre>	
<pre>[AD-A043176] N77-32101 FIRE PREVENTION Design of a cascade fire apparatus for testing countermeasure effectiveness [AD-A043176] N77-32101 FLANE PROPAGATION Aerodynamic and thermodynamic characteristics of kerosene-spray flames A77-48181 FLAPS (CONTROL SURPACES) A flight investigation of the wake turbulence alleviation resulting from a flap configuration change on a B-747 aircraft [NASA-TM-73263] N77-33130 FLAT FLATES</pre>	
<pre>[AD-A043176] N77-32101 FIRE PREVENTION Design of a cascade fire apparatus for testing countermeasure effectiveness [AD-A043176] N77-32101 FLANE PROPAGATION Aerodynamic and thermodynamic characteristics of kerosene-spray flames A77-48181 FLAPS (COWTROL SURPACES) A flight investigation of the wake turbulence alleviation resulting from a flap configuration change on a B-747 aircraft [NASA-TM-73263] N77-33130 FLAT FLATES Unsteady Oseen flow around a flat-plate airfoil A77-49244 FLIGHT CHARACTERISTICS</pre>	ł
<pre>[AD-A043176] N77-32101 FIRE PREVENTION Design of a cascade fire apparatus for testing     countermeasure effectiveness     [AD-A043176] N77-32101 FIAME PROPAGATION     Aerodynamic and thermodynamic characteristics of     kerosene-spray flames</pre>	P
<pre>[AD-A043176] N77-32101 FIRE PREVENTION Design of a cascade fire apparatus for testing countermeasure effectiveness [AD-A043176] N77-32101 FLANE ROPAGATION Aerodynamic and thermodynamic characteristics of kerosene-spray flames A77-48181 FLAPS (COWTBOL SURPACES) A flight investigation of the wake turbulence alleviation resulting from a flap configuration change on a B-747 aircraft [NASA-TM-73263] N77-33130 FLAT FLATES Unsteady Oseen flow around a flat-plate airfoil A77-49244 FLIGHT CHARACTERISTICS The aerodynamic noise of gliders Practical aerodynamics of maneuvering aircraft /A manual for flight personnel/ Russian book A77-56693 Effect of flight on jet noise from supersonic</pre>	P
<pre>[AD-A043176] N77-32101 FIRE PREVENTION Design of a cascade fire apparatus for testing countermeasure effectiveness [AD-A043176] N77-32101 FLANE PROPAGATION Aerodynamic and thermodynamic characteristics of kerosene-spray flames A77-48181 FLAPS (COWTBOL SURPACES) A flight investigation of the wake turbulence alleviation resulting from a flap configuration change on a B-747 aircraft [NASA-TM-73263] N77-33130 FLAT FLATES Unsteady Oseen flow around a flat-plate airfoil A77-49244 FLIGHT CHARACTERISTICS The aerodynamic noise of gliders Practical aerodynamics of maneuvering aircraft /A manual for flight personnel/ Russian book A77-51082 Effect of flight on jet noise from supersonic underexpanded flows [AIA PAPER 77-1328] A77-51082 Handling qualities of the RH-53D in the design</pre>	•
<pre>[AD-A043176] N77-32101 FIRE PREVENTION Design of a cascade fire apparatus for testing countermeasure effectiveness [AD-A043176] N77-32101 FLAME BROPAGATION Aerodynamic and thermodynamic characteristics of kerosene-spray flames Ar77-48181 FLAPS (CONTROL SUBPACES) A flight investigation of the wake turbulence alleviation resulting from a flap configuration change on a B-747 aircraft [NASA-TM-73263] N77-33130 FLAT FLATES Unsteady Oseen flow around a flat-plate airfoil NT7-49244 FLIGHT CHARACTERISTICS The aerodynamic noise of gliders Ar77-48513 Practical aerodynamics of maneuvering aircraft /A manual for flight personnel/ Russian book Ar77-50693 Effect of fligat on jet noise from supersonic underexpanded flows [AIAN PAPER 77-1328] A77-51082</pre>	• •
<pre>[AD-A043176] N77-32101 FIRE PREVENTION Design of a cascade fire apparatus for testing countermeasure effectiveness [AD-A043176] N77-32101 FLAME PROPAGATION Aerodynamic and thermodynamic characteristics of kerosene-spray flames A77-48181 FLAPS (COWTBOL SURPACES) A flight investigation of the wake turbulence alleviation resulting from a flap configuration change on a B-747 aircraft [NASA-TM-73263] N77-33130 FLAT FLATES Unsteady Oseen flow around a flat-plate airfoil A77-49244 FLIGHT CHARACTERISTICS The aerodynamic noise of gliders A77-48513 Practical aerodynamics of maneuvering aircraft /A manual for flight personnel/ Russian book [AT7-450693] Effect of flignt on jet noise from supersonic underexpanded flows [ATA PAPER 77-1328] A77-51082 Handling qualities of the RH-53D in the design growth configuration [SER-651317] N77-33144 FLIGHT COMTROL The transfer or the German North MATRAC to the EUROCONTROL Centre of Mastricht Hilitary Air Traffic Radar Control</pre>	* •
<pre>[AD-A043176] N77-32101 FIRE PREVENTION Design of a cascade fire apparatus for testing countermeasure effectiveness [AD-A043176] N77-32101 FLAME ROPAGATION Aerodynamic and thermodynamic characteristics of kerosene-spray flames A77-48181 FLAPS (COWTBOL SURPACES) A flight investigation of the wake turbulence alleviation resulting from a flap configuration change on a B-747 aircraft [NASA-TM-73263] N77-33130 FLAT FLATES Unsteady Oseen flow around a flat-plate airfoil A77-49244 FLIGHT CHARACTERISTICS The aerodynamic noise of gliders A77-48513 Practical aerodynamics of maneuvering aircraft /A manual for flight personnel/ Russian book (AIA PAPER 77-1328] A77-51082 Handling qualities of the RH-53D in the design growth configuration [SER-651317] N77-33144 FLIGHT COMTROL The transfer or the German North MATRAC to the EUROCONTROL Centre of Mastricht Hilitary Air Traffic Radar Control A77-48412 Aircraft trajectories from radar extrapolations to long tera prediction</pre>	• • •
[AD-A043176]       N77-32101         FIRE PREVENTION       Design of a cascade fire apparatus for testing countermeasure effectiveness [AD-A043176]       N77-32101         FLAME ROPAGATION       Aerodynamic and thermodynamic characteristics of kerosene-spray flames       N77-48181         FLAPS (CONTROL SUBFACES)       A flight investigation of the wake turbulence alleviation resulting from a flap configuration change on a B-747 aircraft [NASA-TM-73263]       N77-33130         FLAT FLATES       Unsteady Oseen flow around a flat-plate airfoil Ar7-49244       N77-48513         Practical aerodynamics of maneuvering aircraft /A manual for flight personnel/ Russian book Ar75-50693       N77-51082         Effect of flight on jet noise from supersonic undererpanded flows [AIAA PAPER 77-1328]       N77-33144         FLAGHT CONTROL       Configuration [SER-651317]       N77-33144         FLIGHT CONTROL       Centre of Maastricht Military Air Traffic Radar Control       N77-48412	• • •

	rcraft
flight control system design [NASA-CR-2887]	N77-33149
Digital flight control systems	
[NASA-CR-145246] F-8C adaptive flight control laws	N77-33200
[NASA-CE-2880] P-9C adaptive flight control extensions maximum likelihood estimation	N77-33202 for
[NASA-CB-2881] Analysis of inherent errors in asynchronous digital flight controls	N77-33203
[AD-A041813] Structural Aspects of Active Controls	N77-33206
[AGARD-CP-228]	N77-33208
A practical optimum selection procedure for motivator in active flutter suppression s design on an aircraft with underwing stor	ystem
YC-14 control system redundancy	N77-33209
PLIGHT CREWS	N77-33214
Aircrew escape and survival - Problems and	solutions A77-49950
PLIGET HAZARDS Lightning-bazard assessment - A first-pass	
probabilistic model for aircraft	A77-49346
Launch risk analysis	A77-50463
FLIGHT INSTRUMENTS On the importance of program intelligence t	
advanced automation in flight operations	.0
[AD-A042915]	N77-32147
A-37B fatique sensor evaluation program: F scale test and field aircraft instrumenta	'ull tion
FAD-A042114]	N77-33156
FLIGHT OPTIMIZATION Flight mechanical problems in connection way	th the
interception process	
PLIGHT PATHS	N77-32121
Civil and military air traffic in France -	
Management and compatibility	A77-48411
Aırcraft trajectories from radar extrapolat long term prediction	
	N77_4981#
Integrated path guidance system for unconve approach procedures	
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approach procedures Flight mechanical problems in connection wi interception process FLIGHT BULES Civil and military air traffic in France - Management and compatibility FLIGHT SAPETY The need for a workable collision avoidance - Now in civil aviation	entional N77-32119 th the N77-32121 A77-48411 e system A77-50662 on of
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approach procedures Flight mechanical problems in connection winterception process FLIGHT RULES Civil and military air traffic in France - Management and compatibility FLIGHT SAPETY The need for a workable collision avoidance - Now in civil aviation FLIGHT SINULATION Air traffic control and the initial operation supersonic transport aircraft - & review preparatory measures The noise from unheated supersonic jets in	entional N77-32119 th the N77-32121 A77-48411 e system A77-50662 on of
approach procedures Flight mechanical problems in connection wire interception process FLIGHT RULES Civil and military air traffic in France - Management and compatibility FLIGHT SAPETY The need for a workable collision avoidance - Now in civil aviation FLIGHT SINULATION Air traffic control and the initial operation supersonic transport aircraft - A review preparatory measures The noise from unheated supersonic jets in simulated flight (AIAA PAPER 77-1227]	entional N77-32119 th the N77-32121 A77-48411 e system A77-50662 on of of A77-48415 A77-51081
<pre>approach procedures Flight mechanical problems in connection wide interception process FLIGHT RULES Civil and military air traffic in France - Management and compatibility FLIGHT SAPETI The need for a workable collision avoidance - Now in civil aviation FLIGHT SINULATION Air traffic control and the initial operation FLIGHT supersonic transport aircraft - A review preparatory measures The noise from unheated supersonic jets in simulated flight [AIAA PAPER 77-1327] Effect of simulated forward speed on the jet </pre>	entional N77-32119 Lth the N77-32121 A77-48411 e system A77-50662 on of of A77-48415 A77-51081 t noise
approach procedures Flight mechanical problems in connection wire interception process FLIGHT RULES Civil and military air traffic in France - Management and compatibility FLIGHT SAPETY The need for a workable collision avoidance - Now in civil aviation FLIGHT SINULATION Air traffic control and the initial operation supersonic transport aircraft - A review preparatory measures The noise from unheated supersonic jets in simulated flight (AIAA PAPER 77-1327) Effect of simulated forward speed on the jet of inverted velocity profile coannular no (AIAA PAPER 77-1329)	entional N77-32119 th the N77-32121 A77-48411 e system A77-50662 on of of A77-48415 A77-51081 th noise pzzles A77-51083
<pre>approach procedures Flight mechanical problems in connection wide interception process FLIGHT RULES Civil and military air traffic in France - Management and compatibility FLIGHT SAPETI The need for a workable collision avoidance - Now in civil aviation FLIGHT SINULATION Air traffic control and the initial operation Supersonic transport aircraft - A review preparatory measures The noise from unheated supersonic jets in simulated flight [AIAA PAPER 77-1327] Effect of simulated forward speed on the je of inverted velocity profile coannular no [AIAA PAPER 77-1329] Effects of simulated flight on fan noise supersonic fight on fan noise form </pre>	entional N77-32119 th the N77-32121 A77-48411 e system A77-50662 on of of A77-48415 A77-51081 et noise pzzles A77-51083 pppression
approach procedures Flight mechanical problems in connection with interception process FLIGHT RULES Civil and military air traffic in France - Management and compatibility FLIGHT SAPETY The need for a workable collision avoidance - Now in civil aviation FLIGHT SINULATION Air traffic control and the initial operation supersonic transport aircraft - A review preparatory measures The noise from unheated supersonic jets in simulated flight (AIAA PAPER 77-1327) Effect of simulated forward speed on the jet of inverted velocity profile coannular no (AIAA PAPEB 77-1329) Effects of simulated flight on fan noise su (AIAA PAPEB 77-1334) Rotorcraft flight simulation with coupled re	entional N77-32119 th the N77-32121 A77-48411 e system A77-50662 on of of A77-51081 th toise ozzles A77-51083 ippression A77-51088
<pre>approach procedures Flight mechanical problems in connection wide interception process FLIGHT RULES Civil and military air traffic in France - Management and compatibility FLIGHT SAPETY The need for a workable collision avoidance - Now in civil aviation FLIGHT SINULATION Air traffic control and the initial operation supersonic transport aircraft - A review preparatory measures The noise from unheated supersonic jets in simulated flight (AIAA PAPEB 77-1329) Effect of simulated forward speed on the je of inverted velocity profile coannular no (AIAA PAPEB 77-1329) Effects of simulated flight on fan noise su (AIAA PAPEB 77-1334) Rotorcraft flight simulation with coupled r aeroelastic stability analysis. Volume 3 </pre>	entional N77-32119 th the N77-32121 A77-48411 e system A77-50662 on of of A77-51081 th toise ozzles A77-51083 ippression A77-51088
<pre>approach procedures Flight mechanical problems in connection wide interception process FLIGHT RULES Civil and military air traffic in France - Management and compatibility FLIGHT SAPETY The need for a workable collision avoidance - Now in civil aviation FLIGHT SINULATION Air traffic control and the initial operation Supersonic transport aircraft - &amp; review preparatory measures The noise from unheated supersonic jets in simulated flight (AIAA PAPER 77-1327) Effect of simulated forward speed on the je of inverted velocity profile coannular no (AIAA PAPER 77-1329) Effects of simulated flight on fan noise su (AIAA PAPER 77-134) Rotorcraft flight simulation with coupled r aeroelastic stability analysis. Volume 3 Programmer's manual (AD-A042907]</pre>	entional N77-32119 th the N77-32121 A77-48411 e system A77-50662 on of of A77-51081 th toise pzzles A77-51083 uppression A77-51088 otor E: N77-32143
<pre>approach procedures Flight mechanical problems in connection wide interception process FLIGHT RULES Civil and military air traffic in France - Management and compatibility FLIGHT SAPETY The need for a workable collision avoidance - Now in civil aviation FLIGHT SINULATION Air traffic control and the initial operation supersonic transport aircraft - A review preparatory measures The noise from unheated supersonic jets in simulated flight (AIA) PAPER 77-1329] Effect of simulated forward speed on the je of inverted velocity profile coannular no (AIAA PAPER 77-1329] Effects of simulated flight on fan noise su (AIAA PAPER 77-1339] Rotorcraft flight simulation with coupled r aeroelastic stability analysis. Volume 3 Programmer's manual [AD-A042907] Effects of simulated flight on fan noise su </pre>	entional N77-32119 th the N77-32121 A77-48411 e system A77-50662 on of of A77-48415 A77-51081 et noise N77-51083 appression A77-51088 cotor : N77-32143 appression
approach procedures Flight mechanical problems in connection with interception process FLIGHT RULES Civil and military air traffic in France - Management and compatibility FLIGHT SAPERY The need for a workable collision avoidance - Now in civil aviation FLIGHT SINULATION Air traffic control and the initial operation supersonic transport aircraft - A review preparatory measures The noise from unheated supersonic jets in simulated flight (AIAA PAPER 77-1327) Effect of simulated forward speed on the jet of inverted velocity profile coannular no (AIAA PAPER 77-1329) Effects of simulated flight on fan noise st (AIAA PAPER 77-1334) Rotorcraft flight simulation with coupled r aeroelastic stability analysis. Volume 3 Programmer's manual (ND-A042907) Effects of simulated flight on fan noise st (NASA-TM-73708) The effect of flight on the noise of subson	entional N77-32119 th the N77-32121 A77-48411 e system A77-50662 on of of A77-51081 to noise ozzles A77-51083 ppression A77-51088 otor : N77-32143 ppression N77-32157 ic gets
<pre>approach procedures Flight mechanical problems in connection wide interception process FLIGHT RULES Civil and military air traffic in France - Management and compatibility FLIGHT SAPETI The need for a workable collision avoidance - Now in civil aviation FLIGHT SINULATION Air traffic control and the initial operation supersonic transport aircraft - A review preparatory measures The noise from unheated supersonic jets in simulated flight [AIAA PAPER 77-1329] Effect of simulated forward speed on the je of inverted velocity profile coannular no [AIAA PAPER 77-1329] Effects of simulated flight on fan noise su [AIAA PAPER 77-1329] Effects of simulated flight on fan noise su [AIAA PAPER 77-1330] Rotorcraft flight simulation with coupled r aeroelastic stability analysis. Volume 3 Programmer's manual [AD-A042907] Effects of flight on fan noise su [NASA-TH-73708] The effect of flight on the noise of subsor [NGTE-R-393]</pre>	entional N77-32119 th the N77-32121 A77-48411 e system A77-50662 on of of A77-48415 A77-51081 th toose ozzles A77-51081 th toose ozzles N77-32143 N77-32157 N77-32157 N77-32850
approach procedures Flight mechanical problems in connection with interception process FLIGHT RULES Civil and military air traffic in France - Management and compatibility FLIGHT SAPERY The need for a workable collision avoidance - Now in civil aviation FLIGHT SINULATION Air traffic control and the initial operation supersonic transport aircraft - A review preparatory measures The noise from unheated supersonic jets in simulated flight (AIAA PAPER 77-1327) Effect of simulated forward speed on the jet of inverted velocity profile coannular no (AIAA PAPER 77-1329) Effects of simulated flight on fan noise st (AIAA PAPER 77-1334) Rotorcraft flight simulation with coupled r aeroelastic stability analysis. Volume 3 Programmer's manual (ND-A042907) Effects of simulated flight on fan noise st (NASA-TM-73708) The effect of flight on the noise of subson	entional N77-32119 th the N77-32121 A77-48411 e system A77-50662 on of of A77-48415 A77-51081 et noise orzeles A77-51083 a77-51083 a77-51088 otor : N77-32143 ippression N77-32157 inc jets N77-32850

Rotorcraft flight simulation with coupled rotor aeroelastic stability analysis. Volume 1: Engineer's manual [AD-A042462] N77-33207 Researcher's guide to the NASA Ames Plight Simulator for Advanced Aircraft (PSAA) [ NASA-CE-2875 ] N77-33230 PLIGHT SIMULATORS Investigation of diagnostic, error detector and self-taught instructional strategies for flight simulator programs [AD-A035682] N77-33216 Researcher's guide to the NASA Ames Plight Simulator for Advanced Aircraft (PSAA) [NASA-CR-2875] N77-33230 FLIGHT STABILITY TESTS Performance flight tests of the RH-53D design growth configuration [SER-651316] N77-33143 PLIGHT TEST INSTRUMENTS A precision voltage reference unit for calibrating airborne data acquisition systems [RAE-TR-76164] N77-32474 PLIGHT TESTS Are wheel-well related aeroacoustic sources of any Significance in airframe noise [AIAA PAPER 77-1270] Estimation of helicopter performance by an A77-51033 extended energy method improved by flight tests A77-51613 Plight evaluation of an advanced technology light twin-engine airplane (ATLIT) [NASA-CR-2832] N77-33 N77-33104 A flight investigation of the wake turbulence alleviation resulting from a flap configuration change on a B-747 aircraft [NASA-TM-73263] N77-33130 Requirements for flight testing automated terminal service [ AD-A041975 ] N77-33137 a assessment of the hover performance of the XH-59A advancing blade concept demonstration helicopter [AD-A042063] N77-33155 FLIGHT TRAINING Investigation of diagnostic, error detector and self-taught instructional strategies for flight simulator programs N77-33216 [AD-A035632] PLOW DISTRIBUTION Numerical prediction of aeroacoustic jet-flap flows [AIAA PAP22 77-1316] A77-5 Determining the lift and drag distributions on a three-dimensional airfoil from flow-field A77-51071 velocity surveys [NASA-IM-73247] N77-32079 FLOW BOUATIONS Unsteady Oseen flow around a flat-plate airfoil 177-49244 PLOW GROMPTRY Three dimensional steady and unsteady asymmetric flow past wings of arbitrary planforms [NASA-CR-145235] N77-33102 FLOW MEASUREMENT Review of optical techniques with respect to aero-engine applications [ONERA, PP NO. 1977-80] PLOW VISUALIZATION A77-50997 Review of optical techniques with respect to aero-engine applications [OMERA, IP NO. 1977-80] A77-50 Experimental results of large-scale structures in A77-50987 yet flows and their relation to jet noise production **FAIAA PAPER 77-13501** A77-51103 PLUIDIC CIRCUITS Pluidic thrust vector control systems for ejection seats A77-49933 Fluidic event sequencing subsystem for AAES ---Aircrew Automated Escape Systems A77-49934 FLUORO COMPOUNDS Rain erosion resistant fluoroelastomer radome and antenna coatings A77-49731

FLUTTER

PLUTTER A practical optimum selection procedure for a design on an alreaft with underwing stores N77-33209 Active flutter suppression of an airplane with wing mounted external stores N77-33211 wind tunnel study of an active flutter suppression system N77-33215 FLY BY WIRE CONTROL F-8C adaptive flight control laws [NASA-CR-2880] N77-33202 PRACIURE MECHANICS Flight inspection data and crack initiation times A77-50466 FRANCE Civil and military air traffic in France -Management and compatibulity 177-48411 FREE JETS Coherent structures in the mixing zone of a subsonic hot free jet [ONERA, TP NC. 1977-88] A77-50989 FUEL CONBUSTION The effect of drop size on emissions from the primary zone of a gas turbine type combustor A77-48174 Combustion considerations for future jet fuels A77-48241 FUEL CONSUMPTION An overview of concepts for aircraft drag reductions N77-32092 FILET. PUMPS Scme regularities of the wearing of fuel pump plunger spheres --- for aircraft engines A77-49374 FILEL SPRAYS Aerodynamic and thermodynamic characteristics of kerosene-spray flames A77-48181 FULL SCALE TESTS Some results of the testing of a full-scale Ogee tip helicopter rotor; acoustics, loads, and performance FAIAA PAPER 77-13401 A77-51093 FUSELAGES Acoustic scattering of point sources by a moving prolate spheroid --- Jet fuselage FAIAA PAPER 77-13261 A77-51080 Notes on the pollution of airplanes and helicopters by chemicals during agricultural jobs FNASA-TT-F-17444 ] N77-33129

## G

GAS INJECTION Heat transfer at the critical point of a cylinder during intensive blowing A77-48054 A novel concept for suppressing internally generated aircraft engine noise FAIAA PAPER 77-13561 177-51109 GAS TURBINE ENGINES Some detail design problems in aircraft gas turbines A77-48001 The effect of drop size on emissions from the primary zone of a gas turbine type combustor A77-48174 Gas turbine temperature techniques A77-50625 Construction and design principles of aircraft gas-turbine engines --- Russian book A77-50684 Experimental and analytical separation of hydrodynamic, entropy and combustion noise in a gas turbine combustor [AIAA PAPER 77-1275] A77-51036 Gas turbine engine core noise source isolation by internal-to-far field correlations [AIAA PAPER 77-1276] A77-510 A77-51037 Nickel base alloy --- for gas turbine engine stator vanes [NASA-CASE-LEW-12270-1] N77-32280 The current state of research and design in high pressure ratio centrifugal compressors --- for gas turbine engines [AD-A041011] N77-33172

Development procedures to promote reliability N77-33188 A procedure for predicting the life of turbine engine components N77-33192 GAS TURBINES Experimental data and theoretical analysis of an operating 100 kW wind turbine A77-48898 Fluid dynamics of diffuser augmented wind turbines 177-48899 New computation method of turbine blades film COOLING efficiency [ONERA, IP NO. 1977-85] GENERAL AVIATION AIRCEAFT A77-50988 Computer simulation of light aircraft crash A77-49341 Analysis of air accidents involving airplanes or helicopters of various types of application [NASA-TT-P-17443] N77-33 A research program to reduce interior noise in general aviation airplanes --- test methods and N77-33128 results [ NASA-CR-155154 ] N77-33959 GERMANY The transfer of the German North MATRAC to the EUROCONTROL Centre of Maastricht --- Military Air Traffic Radar Control A77-48412 Contributions to the evaluation of the German proposal DLS for a new microwave landing system, part 1 [TUBS/SFB58/M1-PT-1] N77-32105 Contributions to the evaluation of the German proposal DLS for a New Microwave Landing System, Part 2 [TUBS/SFB58/M2-PT-2] N77-32112 Civil transport aircraft short range all-weather flight [TUBS/SFB58/FB1976] N77-32118 GLIDE PATHS New lidar concept for measuring the slant range transmission in aircraft landing approaches A77-48698 GLID BRS The aerodynamic noise of gliders A77-48513 GLOBAL POSITIONING SYSTEM The GPS Control Segment and its service to the GPS User --- Global Positioning System navigation satellite A77-51202 The Inverted Range - GPS User test facility -Global Positioning System A77-51203 Slobal positioning system navigation algorithms --- for application to navigation satellites used for aircraft guidance N77-32103 GRAPHITE-EPOXY COMPOSITE MATEBIALS Trapped rubber processing for advanced composites [SME PAPER EN76-172] A77-51 A77-51009 GROUND SPBED Behavior of aircraft antiskid breaking systems on dry and wet runway surfaces: A slip-ratio-controlled system with ground speed reference from unbraked nose wheel [NASA-TN-D-8455] N77-33150 GROUND TESTS The Inverted Bange - GPS User test facility ---Global Positioning System 177-51203 GROUND-AIR-GROUND COMMUNICATIONS History and development of the SCORE pod ---Simulated Combat Operations Range Equipment 177-51188 GUST LOADS Impact of a command and stability augmentation system on gust response of a combat aircraft N77-33210 H H-53 HELICOPTER Performance flight tests of the RH-53D design

growth configuration

f SER-651316 1

N77-33143

Handling gualities of the RE-53D in the design growth configuration [SBR-651317] N77-N77-33144 HANDROOKS Researcher's guide to the NASA Ames Flight Simulator for Advanced Aircraft (FSAA) [NASA-CE-2875] N77-33230 BEAD-UP DISPLAYS HUD and the retrofit market A77-50624 HEAT RESISTANT ALLOYS Nickel base alloy --- for gas turbine engine stator vanes [NASA-CASE-LEW-12270-1] N77-32280 HEAT TRANSFER Heat transfer at the critical point of a cylinder during intensive blowing 177-48054 RELICAL RENDINGS. Investigation of an aluminum rolling helix crash energy absorber [AD-A042084] N77-33132 HELICOPTER DESIGN Detail design aspects of a helicopter transmission system 177-47999 HELICOPTER PERFORMANCE The helicopter Ka-26 in the Special Purpose Flights Sector of Interflug. II A77-49657 Helicopter rotor aerodynamic and aeroacoustic environments [AIAA PAPER 77-1338] 177-51091 Some results of the testing of a full-scale Ogee tip helicopter rotor; acoustics, loads, and performance TAIAA PAPER 77-13401 A77-51093 Estimation of helicopter performance by an extended energy method improved by flight tests 177-51613 Performance flight tests of the RH-53D design growth configuration [SER-651316] 77-33143 Handling gualities of the RH-53D in the design growth configuration [SER-651317] N77 N77-33144 An assessment of the hover performance of the XH-59A advancing blade concept demonstration helicop;er [ AD-A04 2063 ] N77-33155 BELICOPTER WARES Helicopter rotor aerodynamic and aeroacoustic environments [AIAA PAPER 77-1338] A77-51091 Effect of rotor wake on aerodynamic characteristics of a 1/6 scale model of the rotor systems research aircraft --- in the Langley V/STOL tunnel [NASA-TM-X-3548] N77-32083 HELICOPTERS. Proposed helicopter safety system for catastrophic failures A77-49936 Appliances for assembling aircraft and helicopter subsystems and elements --- Russian tertbook A77-50682 A navigation device to help helicopters to land on ocean platforms [ONERA, TP NO. 1977-71] A77-50983 An experimental investigation of helicopter rotor high frequency broadband noise [AIAA PAPER 77-1339] A77-Wide area illuminator development for US Coast A77-51092 Guard BH-3P helicopter [AD-A041425] N77-32132 Helicopter transmission vibration and noise reduction program [AD-A042457] N77-32136 Investigation of factors controlling engine scheduled overhaul: T53/T55 [AD-A042190] N77-32162 Computer-generated displays added to HEL helicopter operational trainer [AD-A003267] N77-32173 HIGH PRESSURE The current state of research and design in high pressure ratio centrifugal compressors --- for gas turbine engines FAD-A0410111 N77-33172

HIGH STRENGTH ALLOIS Rohrbond —- high strength Ti alloy joining method for thrust engines, airframe and space structures [SME PAPER AD76-280] A77-5101 A77-51015 HIGH STRENGTH STRELS The effect of simulated aerodynamic heating on the strength of three rocket motor case steels [ RPE-TR-451 N77-32240 HIGH TEMPERATURE Progress in advanced high temperature turbine materials, coatings, and technology [NASA-TM-X-73628] N77-33159 HIGH TEMPERATURE AIR novel concept for suppressing internally qenerated aircraft engine noise [AIAA PAPER 77-1356] HIGH TEMPERATURE GASES A77-51109 Coherent structures in the mixing zone of a subsonic not free jet [ONERA, FP NO. 1977-88] A77-50989 HIGH TEMPERATURE TESTS Georgia Feca high temperature solar test facility 177-49745 HOVEBING An assessment of the hover performance of the XH-59A advancing blade concept demonstration helicopter [AD-A042063] N77-33155 HUNAN PACTORS BRGINEBRING Ruman factors engineering considerations in designing Naval aircraft for maintainability [AD-A041156] N77 N77-33153 HYBRID NAVIGATION SYSTEMS An application of Omega as a sensor --- in E-3A Airborne Jarning and Control hybrid navigation system A77-51198 HYDRODYNAMICS Experimental and analytical separation of hydrodynamic, entropy and combustion oise in a gas turbine combustor [AIAA PAPER 77-1275] A77-51 A77-51036 HYDROGEN FUELS Alternate fuels for future aircraft A77-48709 The liquid hydrogen option for the subsonic transport - A status report 177-48819 HYDROGEN-BASED ENERGY Direct-connect tests of hydrogen-fueled supersonic combustors A77-48240 HYPERBOLIC DIFFERENTIAL EQUATIONS The importance of monotonicity of finite difference schemes in straight-through calculation methods --- of supersonic flow problems A77-50917 HYPERSONIC AIRCRAFT Vortex lattice prediction of subsonic aerodynamics of hypersonic vehicle concepts A77-49343 NSEG: A segmented mission analysis program for low and migh speed aircraft. Volume 2: Program users manual [NASA-CR-2808] N77-33100 Subsonic longitudinal aerodynamic characteristics and engine pressure distributions for an aircraft with an integrated scramjet designed for Mach 6 cruise --- conducted in Langley 7 by 10 foot high speed tunnel [NASA-FM-1-73911] N77-33108 ICE FORMATION Techniques and facilities used at ONERA /Modane

Center/ for loing tests [ONERA, PP NO. 1977-123] A77-51002 IL-62 AIRCRAFT The technical conception of the IL-62M -Aerodynamic features A77-49655 IMPACT Launch risk analysis

A77-50463

#### IN-FLIGHT BONITOBING

IN-FLIGHT NONITOBING Methods of improving the performance reliak of advanced military power plant systems	
Preliminary results of USAP experience with monitoring and diagnostics	-
INERTIAL NAVIGATION	N77-33199
Position location systems technology An application of Omega as a sensor in Airborne Warning and Control hybrid navig	A77-51179 E-3A jation
system	A77-51198
MICRON reliability analyses [AD-A042987]	N77-32129
INFORMATION SYSTEMS Principles, simulation results and interoperability of JTIDS relative naviga Joint Tactical Information Distributi	tion Ion System A77-51205
INLET HOZZLES Veroacoustic performance of a scoop inlet [AIAA PAPER 77-1354] The influence of the inlet duct contour on radiated fan noise [AIAA PAPER 77-1355]	A77-51107 forward A77-51108
INSPECTION Flight inspection data and crack initiation	
INSTBUMENT APPROACH	177-50466
Integrated path guidance system for unconve approach procedures	
INSTRUMENT LANDING SYSTEMS	N77-32119
Contributions to the evaluation of the Germ proposal DLS for a new microwawe landing part 1	system,
fTUBS/SFB58/M1-PT-1] Simulation of the multipath propagation of	N77-32105 DLS N77-32106
Measurement of the multipath propagation at Brunswick test airport multipath inst landing system	the rument
The Brunswick DLS test airport area - a non environment	N77-32107 clean
Presentation of DLS information	N77-32108
Measurements of the influence of static and dynamic interference on an ILS-receiver a measurement of the capture effect with th	l Ind
double frequency procedure fTUBS/SFB58/50] INTAKE SYSTEMS	N77-33140
Effects of simulated flight on fan noise su (NASA-TH-73708) INTEREPTION	ppression N77-32157
Flight mechanical problems in connection wi interception process	th the
	N77-32121
Non-equilibrium flow of an inviscid gas pas thin profile	st a
The role of the boundary layer in supersoni pressure perturbations along a weak wavy	A77-48289 C wall A77-48290
Theory of the lifting surface in unsteady m in an inviscid fluid	A77-49847
IONOSPHERIC PROPAGATION Model for the effect of electric fields on satellite-earth microwawe radio propagati	
ISEBTROPIC PROCESSES The importance of monotonicity of finite difference schemes in straight-through calculation methods of supersonic flo problems	
J	A77-50917

JET AIRCRAFT Variation of pitching moment with engine thrust for a twin-engine commercial jet aircraft [NASA-TM-X-3569] N77-32131

#### SUBJECT INDER

A new look in reliability: P-18 operational mission environment [AD-A042781] N77-325 On the works of S. S. Wezhdanovsky in the field of N77-32573 flight based on reactive principles, 1880 - 1895 N77-33040 JET AIRCRAFT NOISE Coherent structures in the mixing zone of a subsonic hot free jet [ONERA, TP NO. 1977-88] N77-50 Theoretical jet exhaust noise model for the duct N77-50989 burning turbofan [ATAA PAPER 77-1264] Airframe noise - A status report, 1977 [ATAA PAPER 77-1268] 177-51028 A77-51032 New scaling laws for hot and cold jet mixing noise based on a geometric acoustics model A77-51047 [AIAA PAPER 77-1287] Shielding aspects of heated twin jet noise [AIAA PAPER 77-1288] 177-51048 An experimental investigation of the trailing edge noise mechanism [AIAA PAPER 77-1291] A77-51049 Summary of forward velocity effects on fan noise [AIAA PAPER 77-1319] A77 Investigation of subsonic fan noise sources by A77-51074 fluctuating pressure measurements on rotating blades A77-51075 FAIAA PAPER 77-1321] Acoustic scattering of point sources by a moving prolate spheroid --- jet fuselage AIAA PAPER 77-1326] 177-51080 Effect of flight on jet noise from supersonic underexpanded flows [AIAA PAPER 77-1328] 177-51082 Effect of simulated forward speed on the jet noise of inverted velocity profile coannular nozzles [AIAA PAPER 77-1329] A77-5 A77-51083 Effects of forward motion on jet and core noise [AIAA PAPSE 77-1330] A77-A77-51084 Acoustic performance of inlet multiple-pure-tone suppressors installed on NASA Quiet Engine 'C' [AIAA PAPER 77-1333] A77-51087 Effects of simulated flight on fan noise suppression [AIAA PAPER 77-1334] 177-51088 Interaction of rotor tip flow irregularities with stator wanes as a noise source [AIAA PAPBE 77-1342] A77-51095 Simultaneous characterization of jet noise sources and acoustic field by a new application of conditional sampling [AIAA PAPER 77-1349] A77-51102 Experimental results of large-scale structures in jet flows and their relation to jet noise production [AIAA PAPER 77-1350] A77-51103 Aeroacoustic performance of a scoop inlet [AINA PAPSE 77-1354] \$77-51107 The influence of the inlet duct contour on forward radiated fan noise [AIAA PAPER 77-1355] A77-51108 Cabin noise behavior of a USB STOL transport ----upper surface blowing YC-14 aircraft FAIAA PAPER 77-13651 N77-51117 The effect of flight on the noise of subsonic jets rucmy\_o\_lal N77-32850 [NGTE-R-343] N77-3 Heasurement of far field combustion noise from a turbofan engine using coherence functions [NASA-TH-73748] N77-33163 High velocity jet noise source location and reduction. Task 4: Development/evaluation of techniques for inflight investigation [AD-A041849] The effect of flight on the noise of subsonic jets N77-33176 JET ENGINE FORLS Combustion considerations for future jet fuels A77-48241 Alternate fuels for future aircraft A77-48709 Design of a cascade fire apparatus for testing countermeasure effectiveness [ AD-A043176 ] N77-32101 An evaluation of very large airplanes and alternative fuels: Executive summary [AD-A042112] N77-33154

JET REGINES Effect of slotted casing treatment with change in Beynolds number index on performance of a jet enqine [NASA-TP-1058] N77-32154 On the works of S. S. Nezhdanovsky in the field of flight based on reactive principles, 1880 - 1995 N77-33040 Supersonic jet exhaust noise investigation. Volume 4: Acoustic far-field/near-field data report [AD-A041819] N77-33 177 Military engine deterioration in service connected with life cycle costs N77-33183 Reliability versus cost in operating wide body jet engines N77-33186 JET EXHAUST Theoretical jet exhaust noise model for the duct burning turbofan FAIAA PAPEB 77-1264j 177-51028 Pollution reduction technology program for small jet aircraft engines, phase 1 [NASA-CE-135214] N77-3: N77-33168 JET PLAPS Numerical prediction of aeroacoustic jet-flap flows [AIAA PAPER 77-1316] A77-51071 JET FLON Interim neise correlation for some OTW Configurations using external jet-flow deflectors --- engine Over The Wing [AIAA PAPER 77-1317] A77-5107 177-51072 Effect of flight on jet noise from supersonic underexpanded flows FAIAA PAPER 77-1328) JET HIXING PLON A77-51082 The initial region of subsonic coaxial jets. II A77-49564 Coherent structures in the mixing zone of a subsonic hot free jet [ONERA, TP NO. 1977-88] A77-5090 New scaling laws for hot and cold jet mixing noise A77-50989 based on a geometric acoustics model [AIAA PAPER 77-1287] x77-51047 JET PROPULSION flight works of S. S. Nezhdanovsky in the field of flight based on reactive principles, 1880 - 1895 N77-33040 JET TERUST Variation of pitching moment with engine thrust for a twin-engine commercial jet aircraft [NASA-TM-X-3569] N77-์ท77-32131 K KALMAN PILTERS An integrated marine havigation system A77-51199 KEEOSENB

Aerodynamic and thermodynamic characteristics of kerosene-spray flames A77-48181

## L

L-1011 AIBCRAFT	
Producibility aspects of advanced composit	es for
an L-1011 Aileron	
[SHE PAPER EMR76-04]	A77-51006
LANINAR FLOW	
Special course on concepts for drag reduct	100
[AGARD-B-654]	N77-32091
LANDING AIDS	
A method to reduce the need for large ante	
A method to reduce the need for large ante	
Microwave Landing Systems /MLS/	
	A77-48378
Simulation of traffic loading for approach	and
landing systems with statistical interro	gation
•	A77-48686
Multiple curved descending approaches and	the air
traffic control problem	
[NASA-TH-78430]	877-32104
LANDING GEAR	
Are wheel-well related aeroacoustic source	s of any
significance in alfframe noise	5 01 41,
FAIAA PAPEE 77-1270]	A77-51033

Unsteady surface pressure characteristics of	
aircraft components and farfield radiated	
airframe noise [AIAA PAPE& 77-12951	<b>۸77−51052</b>
LASER OUTPUTS	K77-51052
Aerodynamic effects during supersonic flow laser peam	past a
	A77-48515
LAUNCH VEHICLES Launch risk analysis	
	A77-50463
LIFE (DUBABILITY) A procedure for predicting the life of turk	1 60
engine components	
LIFT	N77-33192
Determining the lift and drag distributions	
three-dimensional airfoil from flow-field velocity surveys	l
[ NASA-IM-73247]	N77-32079
Methods for reducing subsonic drag due to 1	.1ft N77-32093
An elementary analysis of the effect of swe	
Mach number, and lift coefficient on wing-structure weight	
[NASA-TH-74072]	N77-33146
LIFTING BODIES Theory of the lifting surface in unsteady m	otion
in an inviscid fluid	
Unsteady supersonic aerodynamic theory for	<b>▶77-49847</b>
interfering surfaces by the method of pot	ential
gradient [NASA-CR-2898]	N77-33121
LIGHT AIRCRAFT	
Computer simulation of light aircraft crash	A77-49341
Flight noise studies on a turbojet engine w microphones mounted on a 450 ft. tower	ISING
FAIAA PAPER 77-1325]	A77-51079
LIGHT BEAMS Aerodynamic effects during supersonic flow	nact a
laser beam	-
LIGHT BAITTING DIODBS	A77-48515
Solid state light emitting displays	
LIGHTHILL MBTHOD	A77-50623
Numerical prediction of aeroacoustic jet-fl [AIAA PAPER 77-1316]	ap flows A77-51071
LIGHTING BOUIPABAR	K77-51071
Airport electrical and lighting equipment - Russian book	
	<b>A77-50676</b>
LIGHTHING Lightning-hazard assessment - A first-pass	
probabilistic model for aircraft	A77-49346
The protection of aircraft radomes against	A77-43340
lightning strike	A77-49734
Space shuttle program: Lightning protection	
criteria document [NASA-TH-74974]	N77-33252
LIQUID HYDROGEN	
The liquid mydrogen option for the subsonic transport - A status report	:
LOGISTICS	A77-48819
Reliability, availability,	
maintainability/logistics /RAM/LOG/	A77-50456
LOGISTICS MANAGEMENT	
RIW experience at ECOM Reliability Impr Warranty reguirements for Army	ovement
	A77-50483
Logistics planning simulation model for US engine management	r spare
	A77-50510
LONG TERM EFFECTS CFM56 turboian maintainability and	`
reliability-oriented development	N77-33189
Progress in determining service life by end	
tests Concorde aircraft	N77-33195

#### LONGITUDINAL CONTROL

LONGITUDINAL CONTROL Longitudinal handling qualities during approach and landing of a powered lift STOL aircraft [NASA-TM-X-62144] N7 N77-33151 LONGITUDINAL STABILITY Longitudinal handling qualities during approach and landing cf a powered lift STOL aircraft [NASA-TM-X-62144] N7 N77-33151 LORAN Tactical and long-range navigation in the AN/ARN-101/V/ 177-51192 LORAN C Loran-C data acquisition and handling for improved ACCUTACY 177-51200 Clarinet Pilgrim - Communications using Loran-C

## М

transmitted by pulse position mcdulation

177-51201

MACH NUMBER An elementary analysis of the effect of sweep, Mach number, and lift coefficient on wing-structure weight INASA-TN-740721 N77-33146 MACHINING Deburring - Requirements of the aircraft [SME PAPER ME76-124] HAINTAINABILITY A77-51007 Reliability, availability, maintainability/logistics /RAM/LOG/ 177-50456 BAINTENANCE \*ilitary engine deterioration in service connected with life cycle costs N77-33183 MAN BACHINE SYSTEMS Stability of the pilot-aircraft system in maneuvering flight A77-49340 SENDS /Safe Ejection Envelope Display System/ h77-49932 BANAGEMENT PLANNING Logistics planning simulation model for USAF spare engine management A77-50510 \* new look in reliability: F-18 operational mission environment [AD-A042781] N77-32573 MANEUVERABILITY Transonic wind-tunnel investigation of the maneuver potential of the NASA supercritical wing concept, phase 1 [NASA-TM-X-3534] N77-33115 NANUALS Practical aerodynamics of maneuvering aircraft /A manual for flight personnel/ --- Russian book A77-50693 Rotorcraft flight simulation with coupled rotor aeroelastic stability analysis. Volume 1: Engineer's manual [AD-A042462] N77-33207 MATERIALS HANDLING The determination of the center-of-gravity position with the aid of dimensionless values --- for aircraft control and stability A77-49654 NATERBATICAL HODELS lightning-hazard assessment - A first-pass probabilistic model --- for aircraft 177-49346 Alfframe ncise - A status report, 1977 [AIAA PAPER 77-1268] A77-51032 A mathematical model of transcontinental balloon A77-51460 FIAF PAPER 77-167] Airplane math modeling methods for active control desıan N77-33212 MAXIBUE LIEBLIBOOD ESTIMATES F-8C adaptive flight control extensions --- for maximum likelihood estimation [NASA-CR-2881] - N77-33203 MEASURING INSTRUMENTS An accurate angular position and angular velocity instrument based on an optical incremental encoder N77-33480 [WRE-IN-1730(WR/D)]

#### SUBJECT INDEX

MECHANICAL DEVICES Appliances for assembling aircraft and helicopter subsystems and elements --- Russian textbook 177-50682 NECHANIZATION Deburring - Some of the problems and requirements of the aircraft industry [SME PAPdd MR76-547] A77-51016 METAL FATIGUE Investigation of the state of dynamic stress and the influence of service time on the fatigue strength of turbine rotor blades of aircraft gas-turpine engines A77-48632 BRTAL PINISHING Deburring - Some of the problems and requirements of the aircraft industry [SME PAPER ME76-547] A77-510 A77-51016 METAL GRINDING Soleving - Some of the problems and requirements of the aircraft industry [SME PAPER Mu76-547] A77-510 177-51016 METAL SURFACES Deburring - Requirements of the aircraft SME PAPER MR76-1241 A77-51007 **MICROPROCESSORS** Bight-channel resolver simplifies digital flight controls A77-51354 System avionic architectures for RPVs [AD-A041502] N77-32145 BICROWAVE ANTENNAS L-band antenna for aircraft-to-satellite communications --- for Aerosat system A77-48362 A method to reduce the need for large antennas in Microwave Landing Systems /MLS/ 477-48378 B-1 forward radome microwave test range A77-49743 Application of UHF adaptive array to navigation/tracking systems A77-51185 HICROWAVE LANDING SYSTEMS A method to rejuce the need for large antennas in Nicrowave Landing Systems /MLS/ A77-48378 Simulation of traffic loading for approach and landing systems with statistical interrogation A77-48686 Multiple curved descending approaches and the air traffic control problem [NASA-TM-78430] N77-32104 Contributions to the evaluation of the German proposal DLS for a new microwave landing system, part 1 [TJBS/SFB58/M1-PT-1] N77-32105 The Brunswick DLS test airport area - a non clean environment N77-32108 Influence of the multipath propagation on the distance measuring part of DLS N77-32110 Contributions to the evaluation of the German proposal DLS for a New Microwave Landing System, Part 2 [TUBS/SF358/d2-PT-2] Nultipath immunity of MLS in mountainous sites N77-N77-32112 N77-32116 MICROWAVE SCANNING BEAM LANDING SYSTEM Hultipata and performance tests of TRSB receivers [AD-A041891] N77-33 ₩77-33135 MICROWAVE TRANSMISSION Nodel for the effect of electric fields on satellite-earth microwave radio propagation 177-49787 MIDAIR COLLISIONS The need for a workable collision avoidance system Now --- in civil aviation A77-50662 MILITARY AIR PACILITIES The transfer of the German Worth MATRAC to the EUROCONTROL Centre of Maastricht --- Military Air Traffic Radar Control \_ A77-48412 MILITARY AIRCRAFT USAF experience in aircraft accident survivability 177-49949

BOISE INTENSITY

NILITARY AVIATION
<pre>Beliability, availability, maintainability/logistics /BAM/LOG/</pre>
NILITARY TECHNOLOGY
Documentation of the feasibility research on a destructible parachute
A77-49342 Pluidic event sequencing subsystem for AAES Aircrew Automated Escape Systems
A77-49934 HUD and the retrofit market
A77-50624 Applications of augmented multilateration tracking systems for military targets
A77-51183 Development of the RMS-2 System of ODDR&E/T&E/ Range Measurement System for tank and aircraft tracking A77-51187
History and development of the SCORE pod Simulated Combat Operations Range Equipment A77-51188
Tactical and long-range navigation in the AN/ARN-101/V/ A77-51192
JTIDS - An overview of the system design and implementation Joint Tactical Information Distribution System
MINICORPUTERS A77-51204
Proving the correctness of a flight-director program for an airborne minicomputer
HIRROBS -
Georgia Tech high temperature solar test facility A77-49745
MISSILE TRACKING Technical objectives and approaches to the
tracking subsystem of the Extended Area Test System /FATS/
hISSILES A77-51184
The effect of simulated aerodynamic heating on the strength of three rocket motor case steels
[RPE-TR-45] N77-32240 HISSIOB PLANNING
NSEG: A seqmented mission analysis program for low and high speed aircraft. Volume 2: Program
USERS MANUAL [NASA-CR-2808] N77-33100
HODERS Air traffic control experimentation and evaluation
test [AD-A041971] N77-33136
MONITORS
Master monitor display application study for P-14 , [AD-A041570] N77-33158 BONDPLABES
Noise emission of the agricultural aircraft Z-37.
I - Sound intensity level measurements at the agricultural aircraft 2-37. II - Sound intensity
level measurements at an agricultural airport A77-49656
HONOTONE FUNCTIONS The importance of monotonicity of finite
difference schemes in straight-through calculation methods of supersonic flow
problems A77-50917
NONTE CARLO HETHOD Nonte Carlo simulation of VOR/DME holding procedures. Basic notions and applications
[ESA-TT-419] N77-33142
Nultipath immunity of MLS in mountainous sites N77-32116
HTBP Reliability improvement warranty techniques and applications to P-16 aircraft
Effectiveness of reliability system testing on
quality and reliability system testing on A77-50488
All-50488 BULTIPATH TEANSHISSION Simulation of the multipath propagation of DLS
Simulation of the multipath propagation of DLS 977-32106

Measurement of the multipath propagation at the Brunswick test airport --- multipath instrument landing system N77-32107 The Brunswick DLS test airport area - a non clean environment N77-32108 Influence of the multipath propagation on the distance measuring part of DLS N77-32110 BULTIVARIATE STATISTICAL ANALYSIS Output feedback regulator design for jet engine control systems [NASA-TH-73776] N77-33165 N NATIONAL AIRSPACE UTILIZATION SYSTEM Civil and military air traffic in France -Management and compatibility A77-48411 NAVIER-STOKES EQUATION Calculation of vortex breakdown locations for flow over delta wings A77-49345 NAVIGATION AIDS A navigation device to help helicopters to land on ocean platforms [ONERA, TP NO. 1977-71] A77-50983 Position Location and Navigation Symposium, San Diego, Calif., November 1-3, 1976, Proceedings A77-51178 Application of UHF adaptive array to navigation/tracking systems A77-51185 Tactical and long-range navigation in the AN/ARN-101/V/ 177-51192 Loran-C data acquisition and handling for improved accuracy A77-51200 NAVIGATION SATELLITES. The determination of ship location by means of navigation satellites --- Russian book 177-50687 The GPS Control Segment and its service to the GPS User --- Global Positioning System navigation satellite A77-51202 Global positioning system navigation algorithms --- for application to navigation satellites used for aircraft guidance N77-32103 NEAR FIELDS Supersonic jet exhaust noise investigation. Volume 4: Acoustic far-field/near-field data report [ AD-A041819 ] N77-33177 NETWORK SYNTHESIS Fluidic event sequencing subsystem for AAES ---Aircrew Automated Escape Systems A77-49934 NICKEL ALLOYS Nickel base alloy --- for gas turbine engine stator vanes [NASA-CASE-LEW-12270-1] N77-32280 NOISE GENERATORS Airframe noise - A status report, 1977 [AIAA PAPER 77-1268] A77-51032 Noise component method for airframe noise [AIAA PAPSE 77-1271] A77-51034 Gas turbine enque core noise source isolation by internal-to-far field correlations [AIAA PAPER 77-1276] A77-51 A77-51037 An experimental investigation of the trailing edge noise mechanism [AIAA PAPER 77-1291] A7 Some measured and calculated effects of a tip A77-51049 vortex modification device on impulsive noise --- for helicopter rotors [AIAA PAPAR 77-1341] 177-51094 NOISE INTENSITY Influence of the noise level in a transonic wind tunnel on the aerodynamic characteristics of models A77-50996

Effect of forward motion on turbomachinery noise [AIAA PAPER 77-1346] NOISE MEASUREMENT A77-51099 Noise emission of the agricultural aircraft Z-37. I = Sound intensity level measurements at the agricultural aircraft 2-37. II = Sound intensitylevel measurements at an agricultural airport A77-49656 The measurement of aircraft overflight noise -Errors due to its nonstationary character A77-50441 Airframe ncise of the DC-9 [AIAA PAPER 77-1272] A77-51035 Reasurement of far field combustion noise from a turbofan engine using coherence functions (AIAA PAPER 77-1277) A77-51038 Shielding aspects of heated twin jet noise ATTA PAPER 77-1288 1 A77-510 An experimental investigation of the trailing edge A77-51048 noise mechanism [AIAA PAPER 77-1291] A77-51049 Interim neise correlation for some OTW configurations using external jet-flow deflectors --- engine Over The Wing [AIAA PAPER 77-1317] 477-51072 177-51072 Over-the-wing model thrust reverser noise tests [ATAA PAPER 77-1318] A77-**X77-51073** Investigation of subsonic fan noise sources by fluctuating pressure measurements on rotating blades [AIAA PAPER 77-1321] A77-51075 Flight noise studies on a turbojet engine using microphones mounted on a 450 ft. tower [AIAA PAFER 77-1325] A77-51079 Effects of forward motion on jet and core noise [AIAA PAPER 77-1330] A77-51084 Helicopter rotor aerodynamic and aeroacoustic environments [AIAA PAPER 77-1338] A77-51091 Some measured and calculated effects of a tip vortex modification device on impulsive noise --- for helicopter rotors [AIAA PAPER 77-1341] A77-51094 Simultaneous characterization of jet noise sources and acoustic field by a new application of conditional sampling [AIAA PAPER 77-1349] A77-51102 Cabin noise behavior of a USB STOL transport --upper surface blowing YC-14 aircraft [AIAA PAPER 77-1365] A77-51117 Over-the-wing mcdel thrust reverser noise tests [NSA-TM-73495] N77-3310 Identification and measurement of combustion noise N77-33161 from a turbofan engine using correlation and coherence techniques [NASA-TM-73747] N77-33162 Measurement of far field combustion noise from a turbofan engine using coherence functions [NASA-TM-73748] N77-33163 NOISE POLLUTION Further sensitivity studies of community-aircraft noise exposure (NOISEMAP) prediction procedures [ AD-A041781] N77-33686 NOISE PROPAGATION Unsteady surface pressure characteristics on aircraft components and farfield radiated airframe noise [AIAA PAPER 77-1295] A77-51052 Effect of simulated forward speed on the jet noise of inverted velocity profile coannular nozzles [AIAA PAPER 77-1329] A77-5 177-51083 NOISE REDUCTION Convex 76 - Aircraft noise and air traffic control A77-49225 Theoretical jet exhaust noise model for the duct burning turbofan FAIAA PAPER 77-12641 A77-51028 Shielding aspects of heated twin jet noise [AIAA PAFER 77-1288] A77-51048 Source location by shielding with application to a large turbofan engine --- for aircraft noise reduction **FAIAA PAPER 77-13041** A77-51060 Summary of forward velocity effects on fan noise (AIAA PAPER 77-1319] A77-5 X77-51074 A//-5 A coustic performance of inlet multiple-pure-tone suppressors installed on NASA Quiet Engine 'C' [AIAA FAPER 77-1333] A77-5

## A77-51087

#### SUBJECT INDEX

Effects of simulated flight on fan noise suppression [AIAA PAPER 77-1334] A77-51088 Aeroacoustic performance of a scoop inlet [AINA PAPER 77-1354] A77-51107 A novel concept for suppressing internally generated aircraft engine noise A77-51109 [AIAA PAPER 77-1356] Helicopter transmission vibration and noise reduction program [AD-A042457] N77-32136 Effects of simulated flight on fan noise suppression [NASA-TM-73708] N77-32157 Acoustic performance of inlet multiple-pure-tone suppressors installed on NASA quiet engine C [NASA-TM-73713] N77 N77-32158 State-of-the-art of turbofan engine noise control [NASA-TM-73734] N77-33166 High velocity jet noise source location and reduction. Task 4: Development/evaluation of techniques for inflight investigation [AD-A041849] N77-33175 Investigation of feasible nozzle configurations for noise reduction in turbofan and turbojet aircraft. Volume 3: Shrouded slot nozzle configurations [AD-A041782] N77-33179 Airplane noise: Dimensions and means of noise reduction --- in Norway [ELAB-STP44-A 75080] N77-33696 A research program to reduce interior noise in general aviation airplanes --- test methods and results [NASA-CR-155154] N77-33959 NOISE SPECTRA Are wheel-well related aeroacoustic sources of any significance in airframe noise [AIAA PAPER 77-1270] A77-51033 Experimental and analytical separation of hydrodynamic, entropy and combustion noise in a gas turbine combustor [AIAA PAPER 77-1275] A77-51036 An experimental investigation of helicopter rotor high frequency broadband noise [AIAA PAPER 77-1339] A77-51 A77-51092 NONE QUILIBRIUM FLOW Non-equilibrium flow of an inviscid gas past a thin profile A77-48289 NONLINEAR EQUATIONS Nonlinear aeroelastic equations for combined flapwise bending, chordwise bending, torsion, and extension of twisted nonuniform rotor blades in forward flight [NASA-TM-74059] N77-33107 NONLINEAR PREDBACK Design of nonlinear automatic flight control systems 177-48693 NONLINEAR PROGRAMMING Ninimum time acceleration of aircraft turbofan engines by using an algorithm based on nonlinear programming [NASA-TM-73741] N77-33167 NORMAL DENSITY PUNCTIONS Some mathematical aspects of the correlation theory of aircraft precision and reliability A77-50709 NORWAY Airplane noise: Dimensions and means of noise reduction --- in Norway [ELAB-STF44-A75080] N77-33696 NOZZLE FLOW An analytical model for entropy noise of subsonic nozzle flow [AIAA PAP38 77-1366] 177-51118 NUCLEAR PROPULSION An evaluation of very large airplanes and alternative fuels: Executive summary [AD-A042112] N77-33154 NUMBRICAL ANALYSIS Numerical analysis of the axisymmetric flow past a pervious shell with a hole at the vertex A77-50938 0

OFFSI	SORE PLATFO	a ms						
A	navigation	device	to	help	helicopters	to	land	on
	ocean plati	forms						
	[ONERA, PP	NO. 197	77-	711			A77-5	50983

OGEE SHAPE	
Some results of the testing of a full-scale	
tip helicopter rotor; acoustics, loads, a	nd
performance	
FAIAA PAPER 77-1340]	A77-51093
OREGA HAVIGATION SYSTEM	
An application of Omega as a sensor in	E-3A
Airborne Warning and Control hybrid navig	
system	•
-,	177-51198
ONBOARD BOUIFBENT	
A multipurpose position accuracy verificati	on system
airbcrue DBE	
	A77-51181
OPTICAL MEASUBING INSTRUMENTS	
Review of optical techniques with respect t	. n
aero-enging applications	
[ONERA, TP NO. 1977-80]	A77-50987
OPTICAL RADAR	
New lidar concept for measuring the slant r	ange
transmission in aircraft landing approach	
	A77-48698
OPTICAL SCANNERS	
An operational video tape recording system	
utilizing [BIG standard 129-73 segmented	helical
scan recording format	
boun recording roraci	N77-49873
OPTINAL CONTROL	
Design of nonlinear automatic flight contro	1 systems
beside of monitour deconders fridat solers	A77-48693
OPTIMIZATION	
Turbulent effects in axial compressors	
f AAAF-NT-77-201	N77-33180
OSCILLATING PLOW	117 33100
The initial region of subsonic coaxial jets	
the initial region of subscure coartar jets	A77-49564
Turbulent effects in axial compressors	A/7=43504
TARBUTENT EFfects in artai complessors	N77-33180
OSBEN APPROXIMATION	177-33 100
Unsteady Oseen flow around a flat-plate air	for1
unsteady useen 110# around a fiat-plate all	A77-49244

## P

PANELS	
A research program to reduce interior noise	2 <b>1</b> n
general aviation airplanes test metho	ds and
results	
[NASA-CR-155154]	N77-33959
PARACHUTE DESCENT	
The development of new designs of emergency	escane
parachutes for ejection seats	cocabe
parachuces for ejection seats	177-49947
An analysis of personnel parachutes for use	
Marine Corps Force Reconnaissance Units	
[AD-A041151]	N77-33124
PARACHUTE PARTICS	017-33124
Documentation of the feasibility research of	u a
destructible parachute	A77-49342
	A//-49342
PARACHUTES	
Proposed helicopter safety system for catas	trophic
failures	
	A77-49936
An analysis of personnel parachutes for use	b <b>y</b>
Marine Corps Force Reconnaissance Units	
[AD-A041151]	N77-33124
PASSENGER AIECRAFT	
Jakowlew Jak-42 - Uncomplicated, reliable,	
economical	
	A77-49653
PASSENGERS	
Reducing walking distances at existing airp	
	A77-47980
Briefs of accidents involving air taxi oper	ations,
OS general aviation, 1975	
[PB-267653/4]	N77-32102
PAYLOADS	
Technical and economic assessment of swept-	WING
span-distributed load concepts for civil	
military air cargo transports	
[ NASA-CR-145229]	N77-33147
PERFORATED SEELLS	
Numerical analysis of the arisymmetric flow	past a
pervious shell with a hole at the verter	w
Forting Shore then a more at the terter	A77-50938
	•

-

PERPORNANCE PREDICTION
Estimation of helicopter performance by an
extended energy method improved by flight tests A77-51613
A review of turbopropulsion combustion. Part 1: Fundamentals of combustion. Part 2:
Turbopropulsion combustion technology [AD-A043022] N77-32163
Preliminary investigations of the unsteady flow in
turbojet engines during transients [PUBL-PP-174] N77-32164
A procedure for predicting the life of turbine
engine components N77-33192
PERFORMANCE TESTS Performance and design of a vertical seeking seat
steering system
A77-49945 Multipath and performance tests of TRSB receivers
[AD-A041891] N77-33135
Air traffic control experimentation and evaluation test
[AD-A041971] N77-33136
PHASED ARRAYS Radar systems with phased-array antennas
A77-51277
<b>PILOT PERFORMANCS</b> Stability of the pilot-aircraft system in maneuvering flight
A77-49340
On the importance of program intelligence to advanced automation in flight operations
[AD-A042915] N77-32147
Requirements for flight testing automated terminal service
[AD-A041975] N77-33137
PILOT TRAINING Teaching the practical techniques of establishing
egress system performance in an accident environment
PITCHING MOMBHTS
Variation of pitching moment with engine thrust
for a twin-engine commercial jet aircraft [NASA-TM-4-3569] N77-32131
PLASTIC AIRCRAFT STRUCTURES
Trapped runber processing for advanced composites [SNE PAPER EN76-172] A77-51009
PLUMGERS Some regularities of the wearing of fuel pump
plunger spheres for aircraft engines
POINT SOURCES
Source location by shielding with application to a
large turbofan engine for aircraft noise reduction
[AIAA PAPER 77-1304] A77-51060
Acoustic scattering of point sources by a moving prolate spheroid jet fuselage
[AIAA PAPER 77-1326] A77-51080
POLLUTION CONTROL Convex 76 - Algoraft noise and air traffic control
A77-49225
Pollution reduction technology program for small jet aircraft engines, phase 1
[NASA-CR-135214] N77-33168 POROUS WALLS
Numerical analysis of the axisymmetric flow past a
pervious shell with a hole at the vertex A77-50938
POSITION (LOCATION)
The determination of ship location by means of navigation satellites Russian book
A77-50687
Source location by shielding with application to a large turbofan engine for aircraft noise
reduction
Position Location and Navigation Symposium, San
Diego, Calif., November 1-3, 1976, Proceedings A77-51178
Position location systems technology
A77-51179 Precision location, navigation and guidance using
DHE techniques
A77-51180 Navigation checkpointing with forward-sensed,
fixed-range terrain profiles
A77-51189

- -

Aircraft Space Position Measurement System - An application of precision DME 177-51197 POSITION ERRORS A multipurpose position accuracy verification system --- airborne DME 177-51181 POSITION INDICATORS A multipurpose position accuracy verification system --- airborne EME A77-51181 Couracy evaluation of augmented multilateration tracking systems --- for aircraft detection A77-51182 POSITIONING Single pass Doppler positioning for Search and Rescue satellite missions A77-51186 Advanced terrain correlation techniques --position locating system in war environments A77-51190 Precise positioning of sonobuoys using AME and DME techniques --- Angle Measuring and Distance Measuring Equipment in antisubmarine warfare A77-51196 POTENTIAL GRADIENTS Unsteady supersonic aerodynamic theory for interfering surfaces by the method of potential gradient [NASA-CR-28981 N77-33121 POWER TRANSMISSION Detail design aspects of a helicopter transmission system A77-47999 POWERED LIFT AIRCRAFT <sup>1</sup> coustic loads on upper-surface-blown powered-lift systems [AIAA PAPER 77-1363] PREDICTION ANALYSIS TECHNIQUES 177-51115 Wear reliability of aircraft splines 177-50467 Logistics planning simulation model for USAP spare engine management A77-50510 Airframe noise - A status report, 1977 [AIAA PAPER 77-1268] A77-51032 PREDICTIONS Prediction of airborne target detection FAD-A0414281 N77-32871 PREFLIGHT ANALYSIS Air traffic control and the initial operation of supersonic transport aircraft - A review of preparatory measures A77-48415 PRESSURE DISTRIBUTION Transonic pressure distribution on an aircraft wing model during rocket sled runs [AD-1041633] ¥77-32085 A guide for estimation of aeroacoustic loads on flight vehicle surfaces, volume 1 [AD-A041198] N77-32090 Pressure distributions on a 1- by 3-meter semispan wing with a nonstreamwise tip in subsonic flow [NASA-TH-72755] N77-3 N77-33103 PRESSURE MEASUREMENTS Measurement of far field combustion noise from a turbofan engine using coherence functions [AIAA PAPER 77-1277] PRESSURE OSCILLATIONS A77-51038 The role of the boundary layer in supersonic pressure perturbations along a weak wavy wall A77-48290 PROBABILITY TEEOBY Lightning-hazard assessment - A first-pass probabilistic model --- for aircraft A77-49346 1 Queues with delayed, probabilistic feedback as a model of air traffic control communications 177-51610 PRODUCTION MANAGEBENT Product improvement program evaluation [AD-A042134] N77-33101 PROLATE SPHEBOIDS Acoustic scattering of point sources by a moving prolate spheroid --jet fuselage **FAIAA PAPER 77-13261** A77-51080 PROPAGATION HODES Simulation of the multipath propagation of DLS N77-32106

Measurement of the multipath propagation at the Brunswick test airport --- multipath instrument landing system N77-32107 Influence of the multipath propagation on the distance measuring part of DLS N77-32110 PROPAGATION VELOCITY Effect of simulated forward speed on the jet noise of inverted velocity profile coannular nozzles [AIAA PAP2E 77-1329] A77-5 PROPELLANT COMBUSTION A77-51083 A review of turbopropulsion combustion. Part 1: Fundamentals of combustion. Part 2: Turbopropulsion combustion technology N77-32163 [AD-A043022] PROPULSION Wind tunnel and analytical investigation of over-the-wing propulsion/air frame interferences for a short-maul aircraft at Mach numbers from 0.6 to 0.78 --- conducted in the Lewis 8 by 6 foot tunnel ENASA-CR-2905 1 N77-33114 PROPULSION SYSTEM CONFIGURATIONS Over-the-wing model thrust reverser noise tests [AIAA PAPER 77-1318] A77-PROPULSION SYSTEM PERFORMANCE A77-51073 A review of turbopropulsion combustion. Part 1: Fundamentals of combustion. Part 2: Turbopropulsion combustion technology [AD-A043022] N77-32163 The evolution and control of different performance degradation processes in modern propulsion systems --- monitoring jet engines N77-33193 Methods of improving the performance reliability of advanced military power plant systems N77-33198 PROPULSIVE EFFICIENCY Maintenance methods for improving propulsion system reliability N77-33184 Risks affecting the structural resistance and integrity of modern propulsion systems N77-33187 PROTECTIVE COATINGS Rain erosion resistant fluoroelastomer radome and antenna coatings 177-49731 Protection of cooled blades of complex internal structure [ONERA, TP NO. 1977-90] A77-50991 Progress in advanced high temperature turbine materials, coatings, and technology [NASA-TH-X-73628] N7 N77-33159 PULSE COMBUNICATION Clarinet Pilgrim - Communications using Loran-C --- transmitted by pulse position modulation 177-51201 PULSE POSITION MODULATION Clarinet Pilgrim - Communications using Loran-C --- transmitted by pulse position modulation A77-51201

## Q

QUALITY CONTROL RIW experience at ECON --- Reliability Improvement Warranty requirements for Army A77-50483 Effectiveness of reliability system testing on quality and reliability A77-50488 OUBURING THRORY Queues with delayed, probabilistic feedback as a model of air traffic control communications A77-51610 QUIET ENGINE PROGRAM Acoustic performance of inlet multiple-pure-tone suppressors installed on NASA Quiet Engine 'C' (AIAA PAP&R 77-1333) A77-5 A77-51087 R BADAR ANTENNAS B-1 forward radome microwave test range 177-49743

Radar systems with phased-array antennas A77-51277

BETHOLDS NUMBER

RADAR DATA EUROCONTROL and radar automated air tr	affic
control radar system implementation	A77-48413
BADAR DETECTION	
A new high-brightness, all-weather, ASDE / Surface Detection Equipment/	Alcport
	A77-49224
RADAB BQUIPHENT The new airport radar systems	
RADAR SCANNING	A77-47979
Navigation checkpointing with forward-sens	ed,
fixed-range terrain profiles	177-51189
BADAB TRACKING	177 51105
The new airport radar systems	177-47979
Aircraft trajectories from radar extrapola	
long term prediction	A77-48414
Applications of augmented multilateration	tracking
systems for military targets	A77-51183
Application of UHP adaptive array to navigation/tracking systems	
,	A77-51185
Development of the RMS-2 System of ODDR&E/ Range Measurement System for tank and an	
tracking	
RADIO ALTIMETEES	A77-51187
Surface roughness measurements by using	
low-resolution FM-CW radar altimeters	A77-48377
RADIO COMMUNICATION AFSATCOM terminal segment reliability test	
AFSATCOM terminal sequent rellability test	A77-50494
RADIO FREQUENCY INTERFERENCE Recognition and elimination of interference	•
Recognition and elimination of interference disturbances by modification of the radi	o field
of landing systems with spatial modulati degree diagrams	on
	N77-32123
Measurements of the influence of static an dynamic interference on an ILS-receiver	and
measurement of the capture effect with t	he
double freguency procedure [TUBS/SFB58/50]	N77-33140
RADIO TRACKING Technical objectives and approaches to the	
tracking subsystem of the Extended Area	
System /BATS/	A77-51184
RADOME MATERIALS Rain erosion resistant fluoroelastomer rad	ana and
antenna coatings	ome and
The protection of aircraft radomes against	177-49731
lightning strike	
RADOBES	A77-49734
B-1 forward radome microwave test range	177 40712
Design and test results of very broadband	A77-49743 radomes
for ECM applications	A77-49747
RAIN BROSION	R//-45/4/
Rain erosion resistant fluoroelastomer rad antenna coatings	ome and
	A77-49731
RAMAN SPECTROSCOPY Review of optical techniques with respect	to
aero-engine applications	
[ONERA, TP NO. 1977-80] RANDOM PROCESSES	A77-50987
Some mathematical aspects of the correlati	
theory of aircraft precision and reliabi	A77-50709
<b>BANGEFINDING</b> Position location systems technology	
	A77-51179
Development of the RMS-2 System of ODDR&E/ Bange Measurement System for tank and an	
tracking	
Air Combat Maneuvering Bange/Instrumentati	A77-51187 .on
'ACMB/I'	
-	A77-51195

Global positioning system navigation algor:	
for application to navigation satell: used for aircraft guidance	ites
-	N77-32103
REFRACTORY MATERIALS Progress in advanced high temperature turb:	IDe
materials, coatings, and technology	
[NASA-TM-X-73628]	N77-33159
REPRACTORY METAL ALLOYS Protection of cooled blades of complex inte	ernal
structure	
[ONERA, TP NO. 1977-90] Reliability analysis	A77-50991
RIW experience at ECOM Reliability Imp	covement
Warranty regulrements for Army	A77-50483
Effectiveness of reliability system testing	
quality and reliability	
APSATCOM terminal segment reliability test	A77-50488 program
-	A77-50494
Effects of temperature on avionics reliabi	11ty A77-50497
Combined Environment Reliability Test /CER	
for avionics	
MICRON reliability analyses	A77-50504
[AD-A042987]	N77-32129
Accelerated mission test: A vital reliabi	lity tool N77-33196
RELIABILITY ENGINEERING	N//-35150
Some detail design problems in aircraft ga	
The need for improved aircraft crashworthin	A77-48001
design	1000
The protection of supersft radomon against	A77-49473
The protection of aircraft radomes against lightning strike	
	A77-49734
REMOTE CONTROL An operational video tape recording system	
utilizing IRIG standard 129-73 segmented	helical
scan recording format	A77-49873
REMOTELY PILOTED VEHICLES	A//-490/3
Precision location, navigation and guidance	e using
DME techniques	A77-51180
System avionic architectures for RPVs	
[AD-A041502] Reproduction (Copying)	N77-32145
An operational video tape recording system	
utilizing IRIG standard 129-73 segmented	helical
scan recording format	A77-49873
RESCUE OPERATIONS	
The helicopter Ka-26 in the Special Purpos Plights Sector of Interflug. II	e
-	A77-49657
Single pass Doppler positioning for Search	and
Rescue satellite missions	A77-51186
Wide area illuminator development for US C	
Guard HH-3P nelicopter [AD-A041425]	N77-32132
RESEARCH AIRCRAFT	
Effect of rotor wake on aerodynamic characteristics of a 1/6 scale model of	t ha
rotor systems research aircraft in t	he
Langley V/STOL tunnel	
(NASA-IM-X-3548) RESIDENTIAL ARBAS	N77-32083
Airplane poise: Dimensions and means of n	01Se
reduction in Norway [ELAB-STF44-A75080]	N77-33696
RETROFITTING	
HOD and the retrofit market	
	177 64/00
REVIEWING	A77-50624
	reductions
REVIEWING An overview of concepts for aircraft drag :	
rbai rairg	reductions N77-32092
BEVIEWING An overview of concepts for aircraft drag : BETHOLDS NUMBER Effect of slotted casing treatment with ch Reynolds number index on performance of a	reductions N77-32092 ange in
REVIEWING An overview of concepts for aircraft drag : RETHOLDS NUMBER Effect of slotted casing treatment with ch Reynolds number index on performance of ; engine	reductions N77-32092 ange in
BEVIEWING An overview of concepts for aircraft drag : BETHOLDS NUMBER Effect of slotted casing treatment with ch Reynolds number index on performance of a	reductions N77-32092 ange in a jet

#### RIBBON PARACHUTES

RIBBON PARACEUTES Documentation of the feasibility research on a destructible parachute 177-49342 PIDING OUALITY The development of a model for predicting passenger acceptance of short-haul air transportation systems [NASA-CR-145250] N77-33148 Design and development of a structural mode control system [NASA-CR-1438461 N77-33201 RTSK Launch risk analysis A77-50463 ROCKET ENGINE CASES Rohrbond --- high strength Ti alloy joining method for thrust engines, airframe and space structures [SHE PAPER AD76-280] A77-5101 The effect of simulated aerodynamic heating on the strength of three rocket motor case steels A77-51015 N77-32240 [RPE-TR-45] ROCKET LAUNCHING Launch risk analysis A77-50463 ROCKET PROPELLED SLEDS Transonic pressure distribution on an aircraft wing model during rocket sled runs FAD-A0416331 N77-32085 ROTARY WING AIRCRAFT Rotorcraft flight simulation with coupled rotor aeroelastic stability analysis. Volume 3: Programmer's manual [AD-A0429071 N77-32143 Potorcraft flight simulation with coupled rotor aeroelastic stability analysis. Volume 1: Engineer's manual [AD-A042462] N77-33207 BOTABY WINGS Aeroelastic stability of complete rotors with application to a teetering rotor in forward flight 177-49180 Aerodynamic problems of helicopter blade tips [ONERA, TP NC. 1977-112] A77-1 Techniques and facilities used at ONERA /Modane À77-50998 Center/ for icing tests [ONERA, TP NO. 1977-123] A77-51002 experimental investigation of helicopter rotor Αn high frequency broadband noise [AIAA PAPER 77-1339] A77-51092 Some measured and calculated effects of a tip vortex modification device on impulsive noise --- for helicopter rotors [AIAA PAPER 77-1341] A77-A77-51094 Nonlinear aeroelastic equations for combined flapwise bending, chordwise bending, torsion, and extension of twisted nonuniform rotor blades in forward flight [NASA-TM-74059] ROTOR ABRODYNAMICS N77-33107 Aerodynamic problems of helicopter blade tips [ONERA, TP NO. 1977-112] A7 Helicopter rotor aerodynamic and aeroacoustic A77-50998 environments [AIAA PAFEB 77-1338] A77-51091 Some results of the testing of a full-scale Ogee tip helicopter rotor; acoustics, loads, and performance FAIAA PAPER 77-13401 A77-51093 Interaction of rotor tip flow irregularities with stator vanes as a noise source [AIAA PAPER 77-1342] A77-51095 Effect of rotor wake on aerodynamic characteristics of a 1/6 scale model of the rotor systems research aircraft --- in the Langley V/STOL tunnel [NASA-TM-X-3548] N77-32083 Nonlinear aeroelastic equations for combined flapwise bending, chordwise bending, torsion, and extension of twisted nonuniform rotor blades in forward flight [NASA-TM-74059] N77-33107 ROTOE BLADES (TURBONACHINERY) Experimental data and theoretical analysis of an operating 100 kW wind turbine A77-48898 Platform for a swing root turbomachinery blade N77-32148 [NASA-CASE-LEW-12312-1]

#### SUBJECT INDEX

ROTORS Steady-state unbalance response of a three-disk flexible rotor on flexible, damped supports [NASA-TM-X-73666] RUHWAY LIGHTS Airport electrical and lighting equipment ---Russian pook

A77-50676

A77-51060

## S

SAFETY MANAGEMENT The life cycle cost impacts of unsafe designs --aircraft accident effects 177-50462 SATELLITE SOLAR ENERGY CONVERSION Space-based solar power study near completion A77-48480 SATELLITE SOLAR POWER STATIONS Space-based solar power study near completion A77-48480 SATELLITE TRANSMISSION Model for the effect of electric fields on satellite-earth microwave radio propagation 177-49787 SCALE MODELS Bffect of rotor wake on aerodynamic characteristics of a 1/6 scale model of the rotor systems research aircraft --- in the Langley V/STOL tunnel [NASA-TM-X-3548] N N77-32083 Over-the-wing model thrust reverser noise tests [NASA-TM-73495] N77-1 N77-33161 SCALING LAWS New scaling laws for hot and cold jet mixing noise based on a geometric acoustics model [AIAA PAPER 77-1287] 177-51047 SCIENTISTS On the works of S. S. Nezhdanovsky in the field of h the works of S. S. Neznamovsky in the instance of flight based on reactive principles, 1880 - 1895 N77-33040 SCOD PS Aeroacoustic performance of a scoop inlet [AIAA PAPSE 77-1354] A77-51107 SBARCH RADAR Effectiveness of reliability system testing on quality and reliability A77-50488 SEARCHLIGHTS Wide area illuminator development for US Coast Guard HH-3F helicopter FAD-A0414251 N77-32132 SEAT BELTS Evolution of automatic opening lap belts in high performance alrcraft A77-49946 SENISPAN MODELS Pressure distributions on a 1- by 3-meter semispan wing with a honstreamwise tip in subsonic flor [NASA-TH-72755] N77-N77-33103 SENSORS A-37B fatigue sensor evaluation program: Full scale test and field aircraft instrumentation [AD-A042114] N77-N77-33156 SEPARATED PLOW Calculation of wortex breakdown locations for flow over delta wings 177-49345 SERVICE LIPE Reliability improvement warranty techniques and applications --- to P-16 aircraft A77-50477 Airframe composite materials A77-51353 Life cycle cost reduction techniques associated with Advanced Medium STOL Transport (AMST) FAD-A042880 ) B77-32141 [AD-A042880] B77-3211 Military engine deterioration in service connected with life cycle costs N77-33183 Progress in determining service life by endurance tests --- Concorde aircraft N77-33195 SHIELDING Source location by shielding with application to a large turpofan engine --- for aircraft noise reduction

[AIAA PAPER 77-1304]

STATOR BLADES

```
SHIPS
   The determination of ship location by means of
      navigation satellites --- Bussian book
                                                         177-50687
SHOCK ABSORBERS
   Investigation of an aluminum rolling helix crash
      energy absorter
      [AD-A042084]
                                                          N77-33132
SHORT HAUL AIRCHAFT
   Jakowlew Jak-42 - Uncomplicated, reliable,
      economical
                                                         A77-49653
   The development of a model for predicting
      passenger acceptance of short-haul air transportation systems
      [ NASA-CR-145250 ]
                                                         N77-33148
SHORT TAKEOFF AIRCBAFT
   Interim noise correlation for some OTW
   configurations using external jet-flow deflectors

--- enqine Over The Wing

[AIAA PAPER 77-1317]

Over-the-wing model thrust reverser noise tests

[AIAA PAPER 77-1318]

A77-51073
                                                         A77-51072
                                                         A77-51073
   Life cycle cost reduction techniques associated
with Advanced Medium STOL Transport (AMST)
[AD-A042880] N77-
                                                         N77+32141
    Wind tunnel and analytical investigation of
      over-the-wing propulsion/air frame interferences
      for a short-haul aircraft at Mach numbers from
0.6 to 0.78 --- conducted in the Lewis 8 by 6
      foot tunnel
   [NASA-CB-2905] N77-:
Longitudinal handling qualities during approach
and landing of a powered lift STOL aircraft
[NASA-TM-X-62144] N77-:
                                                         N77-33114
                                                          N77-33151
   Evaluation of composite wing for XFV-12A airplane
      [ AD-A0412081
                                                         N77-33152
   YC-14 control system redundancy
                                                         N77-33214
SHROUDED NOZZLES
   Investigation of feasible nozzle configurations
      for noise reduction in turbofan and turbojet
      aircraft. Volume 3: Shrouded slot nozzle
      configurations
      [AD-A041782]
                                                         N77-33179
SIGNAL TO NOISE BATIOS
   Surface roughness measurements by using
low-resclution FM-CW radar altimeters
                                                          A77-48377
SILICONE RUBBER
   Trapped rubber processing for advanced composites
[SNE PAPER EM76-172] A77-51
                                                         A77-51009
SMALL PERTURBATION PLOW
   The role of the boundary layer in supersonic
pressure perturbations along a weak wavy wall
                                                         A77-48290
SOLAR COLLECTORS
   Georgia Tech high temperature solar test facility
                                                         177-49745
SOLAR FURNACES
   Georgia Tech high temperature solar test facility
                                                         177-49745
SOLID STATE DEVICES
   Solid state light emitting displays
                                                         177-50623
SONOBUOYS
   Precise positioning of sonobuoys using AME and DHE
      techniques --- Angle Measuring and Distance
Measuring Equipment in antisubmarine warfare
                                                         A77-51196
SOUND FIELDS
   Simultaneous characterization of jet noise sources
      and acoustic field by a new application of
      conditional sampling
[AIAA PAPEE 77-1349]
                                                         177-51102
SOURD PRESSORE
   Measurement of far field combustion noise from a
      [AIAA PAPER 77-1277]
                                                         A77-51038
   Acoustic loads on upper-surface-blown powered-lift
      systems
      [AIAA PAPER 77-1363]
                                                         A77-51115
SOUND PROPAGATION
   A finite element algorithm for sound propagation
      in axisymmetric ducts containing compressible
      nean flow
      [AIAA PAPER 77-1301]
                                                         A77-51057
```

SPACE BISSIONS Single pass Doppler positioning for Searc	h and
Rescue satellite missions	
SPACE SHUTTLES	A77-51186
Emergency escape from shuttle vehicles	
Space shuttle program: Lightning protect	A77-49935 10B
criteria locument [NASA-TM-74974]	N77-33252
SPACECRAFT COMMUNICATION	
L-band anteana for aircraft-to-satellite communications for Aerosat system	
	A77-48362
SPACECRAFT CONSTRUCTION MATERIALS Rohrbond high strength Ti alloy joini	ng method
for thrust engines, airframe and space	
[SHE PAPER AD76-280]	A77-51015
SPAC BCBAPT LAUBCHING Launch fisk analysis	
•	A77-50463
SPACECRAPT SHIRLDING	
Space shuttle program: Lightning protect criteria document	101
[ NASA-TM-74974 ]	N77-33252
SPECTRUM ANALYSIS The measurement of aircraft overflight no	150 -
Errors due to its nonstationary charact	
	A77-50441
SPRECH RECOGNITION Voice control systems for airborne enviro	nmonts
[AD-A043252]	N77-32524
SPHERICAL SHELLS	
Numerical analysis of the axisymmetric fl pervious shell with a hole at the verte	
-	
SPIRAL ANTENNAS	
L-band antenna for aircraft-to-satellite communications for Aerosat system	
	A77-48362
SPLINES Wear reliapility of aircraft splines	
wear remainer or arrelate springs	A77-50467
SPOILERS	
Performance of plain-type spoilers applie GA/W/-1 wing	d to the
	A77-49344
SPEAYING Notes on the pollution of airplanes and	
helicopters by chemicals during agricul	tural jobs
[ NASA-TT-P-17444 ]	N77-33129
STABILIZED PLATFORMS Accuracy evaluation of augmented multilat	eration
tracking systems for aircraft detec	tion
STANDARDS	A77-51182
A precision voltage reference unit for ca	librating
airborne data acquisition systems	
[RAE-TR-76164] STATE VECTORS	N77-32474
Accuracy evaluation of augmented multilat tracking systems for aircraft detec	eration
tracking systems for aircraft detec	110n A77-51182
STATIC TESTS	A77-31102
Over-the-wing model thrust reverser noise	tests
(AIAA PAPER 77-1318) STATISTICAL ANALYSIS	A77-51073
Analysis of air accidents involving airpl	
helicopters of various types of applica	N77-33128
[NASA-TT-2-17443] STATISTICAL CORRELATION	R//-33128
Some mathematical aspects of the correlat	
theory of aircraft precision and reliab	A77-50709
Advanced terrain correlation techniques -	
position locating system in war environ	ments A77-51190
STATISTICAL DISTRIBUTIONS	K//-51190
Plight inspection data and crack initiati	
STATISTICAL TESTS	A77-50466
Combined Environment Reliability Test /CE	
for avionics	RT/
STATOR BLADES	A77-50504
STATOR BLADES Interaction of rotor tip flow irregularit	A77-50504
STATOR BLADES	A77-50504

STATOBS

- --

STATOBS Nickel base allow --- for gas turbine engine stator vanes [NASA-CASE-LEW-12270-1] N77-32280 STEADY FLOW Three dimensional steady and unsteady asymmetric flow past wings of arbitrary planforms [NASA-CR-145235] N77-33102 STEADY STATE Steady-state unbalance response of a three-disk flexible rotor on flexible, damped supports [NASA-TM-X-73666] N7 N77-33160 STEERING Performance and design of a vertical seeking seat steering system 177-49945 STRUCTURAL DESIGN Detail design in aircraft A77-48000 Design, fabrication and test of an F-14 composite overwing fairing [SME PAPER EM76-175] STRUCTURAL DESIGN CRITERIA 177-51010 An optimality criteria approach to the minimum weight design of aircraft structures [ ND- A0427591 N77-32140 STRUCTURAL ENGINEERING Engine structural integrity program (ENSIP) ₩77-33182 Military engine deterioration in service connected with life cycle costs N77-33183 STRUCTURAL RELIABILITY The need for improved aircraft crashworthiness design A77-49473 The protection of aircraft radomes against lightning strike 177-49734 Airframe composite materials A77-51353 STRUCTURAL STABILITY Aeroelastic stability of complete rotors with application to a teetering rotor in forward flight A77-49180 STRUCTURAL VIBRATION Measurement of nondiagonal generalized damping ratios during ground vibration tests 177-50440 Modeling and parameter uncertainties for aircraft flight control system design ENASA-CR-28871 N77-33149 Design and development of a structural mode control system [NASA-CR-143846] N77-33201 Find tunnel study of an active flutter suppression svstem N77-33215 STRUCTURAL BRIGHT An elementary analysis of the effect of sweep, Mach number, and lift coefficient on wing-structure weight [NASA-TM-74072] N77-33146 STRUTS Investigation of an aluminum rolling helix crash energy abscrier [AD-A042084] N77-33132 SUBSONIC AIRCRAFT NSEG: A segmented mission analysis program for low and high speed aircraft. Volume 2: Program users manual [NASA-CE-2808] N77-33100 suspended anemometer system for measuring true airspeed on low-speed airplanes [NASA-TN-D-8523] N77-33157 SUBSONIC FLOW Non-equilibrium flow of an inviscid gas past a thin profile A77-48289 Vortex lattice prediction of subsonic aerodynamics of hypersonic vehicle concepts 177-49343 The initial region of subsonic coaxial jets. II A77-49564 An analytical model for entropy noise of subsonic nozzle flow [AIAA PAPER 77-1366] A77-51118

Pressure distributions on a 1- by 3-meter semispan [NASA-TM-72755] N77-3 N77-33103 [NASA-TM-72755] The effect of flight on the noise of subsonic jets N77-33176 Supersonic jet exhaust noise investigation. Volume 4: Acoustic far-field/near-field data report [AD-A041819] N77-33177 SUBSONIC SPEED Investigation of subsonic fan noise sources by fluctuating pressure measurements on rotating blades [AIAA PAPER 77-1321] 177-51075 Methods for reducing subsonic drag due to lift N77-32093 SUBSONIC WIND TUNNELS Heat transfer at the critical point of a cylinder during intensive blowing A77-48054 Wind tunnel and analytical investigation of over-the-wing propulsion/air frame interferences for a short-haul aircraft at Mach numbers from 0.6 to 0.78 --- conducted in the Lewis 8 by 6 foot tunnel [NASA-CR-2905] SUPERCRITICAL WINGS N77-33114 Buffet characteristics of the P-8 supercritical wing airplane [ NASA-TM-56049] N77-32080 Transonic wind-tunnel investigation of the maneuver potential of the NASA supercritical wing concept, phase 1 [NASA-TM-4-3534] N77-33115 Transonic aerodynamic characteristics of a supercritical-wing transport model with trailing-edge controls [NASA-TM-X-3431] N77-33116 Transonic aerodynamic characteristics of a supercritical-wing transport model with trailing-edge controls, supplement, part 1 [NASA-TM-X-3431-PT-1] N N77+33117 Transonic aerodynamic characteristics of a supercritical-wing transport model with trailing-edge controls [NASA-TM-4-3431-PT-2] N77-33118 Transonic aerodynamic characteristics of a supercritical-wing transport model with trailing edge controls [NASA-TM-X-3431-PT-3] N77-33119 Transonic aerodynamic characteristics of a supercritical-wing transport model with trailing-edge controls [NA SA-TM-4-3431-PT-4] N77-33120 SUPERSONIC AIRCRAFT Aerodynamic characteristics at Mach numbers from 0.6 to 2.16 of a supersonic cruise fighter configuration with a design Mach number of 1.8 [NASA-IM-X-3559] SUPERSONIC BOUNDARY LAYERS N77-32081 The role of the boundary layer in supersonic pressure perturbations along a weak wavy wall 177-48290 SUPERSONIC COMBUSTION Direct-connect tests of hydrogen-fueled supersonic combustors A77-48240 SUPERSONIC COMBUSTION RAMJET ENGINES Subsonic longitudinal aerodynamic characteristics and engine pressure distributions for an allcraft with an integrated scramjet designed for Mach 6 cruise --- conducted in Langley 7 by 10 foot migh speed tunnel [NASA-TM-X-73911] SUPERSONIC PLOW N77-33108 Non-equilibrium flow of an inviscid gas past a thin profile 177-48289 Aerodynamic effects during supersonic flow past a laser beam A77-48515 The importance of monotonicity of finite difference schemes in straight-through calculation methods --- of supersonic flow problems A77-50917

Supergence det e-bauet pelce investigation	
Supersonic jet exhaust noise investigation Volume 4: Acoustic far-field/near-field	
report	
[AD-A041819]	N77-33177
SUPERSONIC JET FLOW The noise from unheated supersonic jets in	
simulated flight	
(AIAA PAPER 77-1327]	A77-51081
Conditions of physical validity in the lin	ear
aerodynamics of supersonic jets	A77-51608
SUPERSONIC TURBINES	
Progress in determining service life by en	durance
tests Concorde aircraft	N77-33195
SUPERSONICS	A// 33133
Unsteady supersonic aerodynamic theory for	
interfering surfaces by the method of po	tential
gradient [NASA-CR-2898]	N77-33121
SUBPACE PINISHING	
Deburring - Requirements of the aircraft	
[SNE PAFER MR76-124] SUBFACE HAVIGATION	A77-51007
The determination of ship location by mean	s of
navigation satellites Russian book	
An integrated marine pavigation system	A77-50687
An integrated warrie pavigation System	A77-51199
SURFACE ROUGENESS	
Navigation checkpointing with forward-sens fixed-range terrain profiles	ed,
liked funge terfain profiles	A77-51189
SURFACE ROUGHNESS EFFECTS	
Surface roughness measurements by using low-resclution PM-CW radar altimeters	
IOW-resclution FM-CW labor altimeters	A77-48377
SURVEILLANCE BADAR	
The transfer of the German North MATRAC to	
EUROCONTROL Centre of Maastricht Mil Air Traffic Badar Control	itary
	A77-48412
EUROCONTROL and radar automated air tr	affic
EUROCONTROL and radar automated air tr control radar system implementation	
	affic A77-48413
control radar system implementation	A77-48413 vability
control radar system implementation SURVIVAL USAF experience in aircraft accident survi	A77-48413
control radar system implementation SURVIVAL	A77-48413 Vability A77-49949 Solutions
control radar system implementation SURVIVAL DSAF experience in aircraft accident survi SURVIVAL EQUIPMENT Aircrew escape and survival - Problems and	A77-48413 Vability A77-49949
control radar system implementation SURVIVAL USAF experience in aircraft accident survi SURVIVAL EQUIPMENT Aircrew escape and survival - Problems and SWEEP ANGLE	A77-48413 vability A77-49949 solutions A77-49950
control radar system implementation SURVIVAL DSAF experience in aircraft accident survi SURVIVAL EQUIPMENT Aircrew escape and survival - Problems and	A77-48413 vability A77-49949 solutions A77-49950
control radar system implementation SURVIVAL USAF experience in aircraft accident survi SURVIVAL EQUIPMENT Aircrew escape and survival - Problems and SWEEP ANGLE An elementary analysis of the effect of sw Mach number, and lift coefficient on wing-structure weight	A77-48413 vability A77-49949 solutions A77-49950 eep,
control radar system implementation SURVIVAL USAF experience in aircraft accident survi SURVIVAL EQUIPMENT Aircrew escape and survival - Problems and SWEEP ANGLE An elementary analysis of the effect of sw Mach number, and lift coefficient on wing-structure weight [NASA-TM-74072]	A77-48413 vability A77-49949 solutions A77-49950
control radar system implementation SURVIVAL USAF experience in airCraft accident survi SURVIVAL EQUIPMENT Aircrew escape and survival - Problems and SWEBP ANGLE An elementary analysis of the effect of sw Mach number, and lift coefficient on wing-structure weight [NASA-TM-74072] SWEPT WINGS	A77-48413 vability A77-49949 solutions A77-49950 eep, N77-33146
control radar system implementation SURVIVAL USAF experience in aircraft accident survi SURVIVAL EQUIPMENT Aircrew escape and survival - Problems and SWEEP ANGLE An elementary analysis of the effect of sw Mach number, and lift coefficient on wing-structure weight [NASA-TM-74072] SWEPT WINGS Pressure distributions on a 1- by 3-meter wing with a nonstreamwise tip in subsoni	A77-48413 vability A77-49949 solutions A77-49950 eep, N77-33146 semispan c flow
<pre>control radar system implementation SURVIVAL USAF experience in arcraft accident survi SURVIVAL EQUIPMENT Aircrew escape and survival - Problems and SWEEP ANGLE An elementary analysis of the effect of sw Mach number, and lift coefficient on wind-structure weight [NASA-TM-74072] SWEPT WINGS Pressure distributions on a 1- by 3-meter wind with a nonstreamwise tip in subsoni [NASA-TM-72755]</pre>	A77-48413 vability A77-49949 solutions A77-49950 eep, N77-33146 semispan c flow N77-33103
<pre>control radar system implementation SURVIVAL USAF experience in aircraft accident survi SURVIVAL EQUIPMENT Aircrew escape and survival - Problems and SWEEP ANGLE An elementary analysis of the effect of sw Mach number, and lift coefficient on wing-structure weight [NASA-TM-74072] SWEPT WINGS Pressure distributions on a 1- by 3-meter ving with a nonstreamvise tip in subsoni [NASA-TM-72755] An elementary analysis of the effect of sw </pre>	A77-48413 vability A77-49949 solutions A77-49950 eep, N77-33146 semispan c flow N77-33103
<pre>control radar system implementation SURVIVAL USAF experience in arcraft accident survi SURVIVAL EQUIPMENT Aircrew escape and survival - Problems and SWEEP ANGLE An elementary analysis of the effect of sw Mach number, and lift coefficient on winq-structure weight (NASA-TM-74072] SWEPT WINGS Pressure distributions on a 1- by 3-meter winq with a nonstreamwise tip in subsoni (NASA-TM-72755] An elementary analysis of the effect of sw Mach number, and lift coefficient on winq-structure weight</pre>	A77-48413 vability A77-49949 solutions A77-49950 eep, N77-33146 semispan c flow N77-33103 eep,
<pre>control radar system implementation SURVIVAL USAF experience in aircraft accident survi SURVIVAL EQUIPMENT Aircrew escape and survival - Problems and SWEEP ANGLE An elementary analysis of the effect of sw Hach number, and lift coefficient on wing-structure weight [NASA-TM-74072] SWEPT WINGS Pressure distributions on a 1- by 3-meter wing with a nonstreamvise tip in subsoni [NASA-TM-72755] An elementary analysis of the effect of sw Mach number, and lift coefficient on wing-structure weight [NASA-TM-74072]</pre>	A77-48413 vability A77-499949 solutions A77-49950 eep, N77-33146 semispan c flow N77-33103 eep, N77-33146
<pre>control radar system implementation SURVIVAL USAF experience in aircraft accident survi SURVIVAL EQUIPMENT Aircrew escape and survival - Problems and SWEEP ANGLE An elementary analysis of the effect of sw Hach number, and lift coefficient on wing-structure weight [NASA-TM-74072] Nach number, and lift coefficient on [NASA-TM-72755] An elementary analysis of the effect of sw Mach number, and lift coefficient on wing-structure weight [NASA-TM-74072] Technical and economic assessment of swept</pre>	A77-48413 vability A77-49949 solutions A77-49950 eep, N77-33146 semispan c flow N77-33103 eep, N77-33146 -wing
<pre>control radar system implementation SURVIVAL USAF experience in aircraft accident survi SURVIVAL EQUIPMENT Aircrew escape and survival - Problems and SWEEP ANGLE An elementary analysis of the effect of sw Mach number, and lift coefficient on wing-structure weight [NASA-TM-74072] SwEPT WINGS Pressure distributions on a 1- by 3-meter wing with a nonstreamvise tip in subsoni [NASA-TM-72755] An elementary analysis of the effect of sw Mach number, and lift coefficient on wing-structure weight [NASA-TM-74072] Technical and economic assessment of swept span-distributed load concepts for civil miltary air cargo transports</pre>	A77-48413 vability A77-49949 solutions A77-49950 eep, N77-33146 semispan c flow N77-33103 eep, N77-33146 -wing and
<pre>control radar system implementation SURVIVAL USAF experience in aircraft accident survi SURVIVAL EQUIPMENT Aircrew escape and survival - Problems and SWEEP ANGLE An elementary analysis of the effect of sw Mach number, and lift coefficient on wing-structure weight [NASA-TM-74072] SWEPT WINGS Pressure distributions on a 1- by 3-meter wing with a nonstreamwise tip in subsoni [NASA-TM-72755] An elementary analysis of the effect of sw Mach number, and lift coefficient on wing-structure weight [NASA-TM-74072] Technical and economic assessment of swept span-distributed load concepts for civil military air cargo transports [NASA-CR-145229]</pre>	A77-48413 vability A77-49949 solutions A77-49950 eep, N77-33146 semispan c flow N77-33103 eep, N77-33146 -wing
<pre>control radar system implementation SURVIVAL USAF experience in aircraft accident survi SURVIVAL EQUIPMENT Aircrew escape and survival - Problems and SWEBP ANGLE An elementary analysis of the effect of sw Mach number, and lift coefficient on wing-structure weight [NASA-TM-74072] SWEPF WINGS Pressure distributions on a 1- by 3-meter wing with a nonstreamuse tip in subsoni [NASA-TM-72755] An elementary analysis of the effect of sw Mach number, and lift coefficient on wing-structure weight [NASA-TM-74072] Technical and economic assessment of swept span-distributed load concepts for civil military air cargo transports [NASA-CR-145229] SYNTHEMES </pre>	A77-48413 vability A77-49949 solutions A77-49950 eep, N77-33146 semispan c flow N77-33103 eep, N77-33146 -wing and
<pre>control radar system implementation SURVIVAL USAF experience in aircraft accident survi SURVIVAL EQUIPMENT Aircrew escape and survival - Problems and SWEEP ANGLE An elementary analysis of the effect of sw Mach number, and lift coefficient on wing-structure weight [NASA-TM-74072] SWEPT WINGS Pressure distributions on a 1- by 3-meter wing with a nonstreamvise tip in subsoni [NASA-TM-72755] An elementary analysis of the effect of sw Mach number, and lift coefficient on wing-structure weight [NASA-TM-74072] Technical and economic assessment of swept span-distributed load concepts for civil military air cargo transports [NASA-CM-745229] SINTHETIC FUELS Plenate fuels for future aircraft</pre>	A77-48413 vability A77-49949 solutions A77-49950 eep, N77-33146 semispan c flow N77-33103 eep, N77-33146 -wing and
<pre>control radar system implementation SURVIVAL USAF experience in aircraft accident survi SURVIVAL EQUIPMENT Aircrew escape and survival - Problems and SWEBP ANGLE An elementary analysis of the effect of sw Mach number, and lift coefficient on wing-structure weight [NASA-TM-74072] SWEPF WINGS Pressure distributions on a 1- by 3-meter wing with a nonstreamuse tip in subsoni [NASA-TM-72755] An elementary analysis of the effect of sw Mach number, and lift coefficient on wing-structure weight [NASA-TM-74072] Technical and economic assessment of swept span-distributed load concepts for civil military air cargo transports [NASA-CR-145229] SUNTETIC PUELS Alternate fuels for future aircraft SUSTEM EFFECTIVENESS</pre>	A77-48413 vability A77-49949 solutions A77-49950 eep, N77-33146 semispan c flow N77-33103 eep, N77-33146 -winq and N77-33147 A77-48709
<pre>control radar system implementation SURVIVAL USAF experience in aircraft accident survi SURVIVAL EQUIPMENT Aircrew escape and survival - Problems and SWEEP ANGLE An elementary analysis of the effect of sw Mach number, and lift coefficient on wing-structure weight (NASA-TM-74072] SWEPT WINGS Pressure distributions on a 1- by 3-meter wing with a nonstreamvise tip in subsoni (NASA-TM-72755] An elementary analysis of the effect of sw Mach number, and lift coefficient on wing-structure weight (NASA-TM-74072] Technical and economic assessment of swept span-distributed load concepts for civil military air cargo transports (NASA-CR-145229] SYNTHETIC PUBLS Alternate fuels for future aircraft SYSTEM EFFECTIVENESS Proving the correctness of a flight-direct</pre>	A77-48413 vability A77-49949 solutions A77-49950 eep, N77-33146 semispan c flow N77-33103 eep, N77-33146 -winq and N77-33147 A77-48709
<pre>control radar system implementation SURVIVAL USAF experience in aircraft accident survi SURVIVAL EQUIPMENT Aircrew escape and survival - Problems and SWEBP ANGLE An elementary analysis of the effect of sw Mach number, and lift coefficient on wing-structure weight [NASA-TM-74072] SWEPF WINGS Pressure distributions on a 1- by 3-meter wing with a nonstreamuse tip in subsoni [NASA-TM-72755] An elementary analysis of the effect of sw Mach number, and lift coefficient on wing-structure weight [NASA-TM-74072] Technical and economic assessment of swept span-distributed load concepts for civil military air cargo transports [NASA-CR-145229] STNTMETIC PUEIS Alternate fuels for future aircraft STSTEM EFFECTIVENESS Proving the correctness of a flight-direct program for an airborne minicomputer</pre>	A77-48413 vability A77-49949 solutions A77-49950 eep, N77-33146 semispan c flow N77-33103 eep, N77-33146 -winq and N77-33147 A77-48709
<pre>control radar system implementation SURVIVAL USAF experience in aircraft accident survi SURVIVAL EQUIPMENT Aircrew escape and survival - Problems and SWEEP ANGLE An elementary analysis of the effect of sw Mach number, and lift coefficient on wing-structure weight (NASA-TM-74072] SWEPT WINGS Pressure distributions on a 1- by 3-meter wing with a nonstreamvise tip in subsoni (NASA-TM-72755] An elementary analysis of the effect of sw Mach number, and lift coefficient on wing-structure weight (NASA-TM-74072] Technical and economic assessment of swept span-distributed load concepts for civil military air cargo transports (NASA-CR-145229] SYNTHETIC PUBLS Alternate fuels for future aircraft SYSTEM EFFECTIVENESS Proving the correctness of a flight-direct program for an airborne minicomputer SYSTEM FAILURES</pre>	A77-48413 vability A77-49949 solutions A77-49950 eep, N77-33146 semispan c flow N77-33103 eep, N77-33146 -wing and N77-33147 A77-48709 or A77-51261
<pre>control radar system implementation SURVIVAL USAF experience in aircraft accident survi SURVIVAL EQUIPMENT Aircrew escape and survival - Problems and SWEBP ANGLE An elementary analysis of the effect of sw Mach number, and lift coefficient on wing-structure weight [NASA-TM-74072] SWEPF WINGS Pressure distributions on a 1- by 3-meter wing with a nonstreamuse tip in subsoni [NASA-TM-72755] An elementary analysis of the effect of sw Mach number, and lift coefficient on wing-structure weight [NASA-TM-74072] Technical and economic assessment of swept span-distributed load concepts for civil military air cargo transports [NASA-CR-145229] STNTMETIC PUEIS Alternate fuels for future aircraft STSTEM EFFECTIVENESS Proving the correctness of a flight-direct program for an airborne minicomputer</pre>	A77-48413 vability A77-49949 solutions A77-49950 eep, N77-33146 semispan c flow N77-33103 eep, N77-33146 -wing and N77-33147 A77-48709 or A77-51261
<pre>control radar system implementation SURVIVAL USAF experience in aircraft accident survi SURVIVAL EQUIPMENT Aircrew escape and survival - Problems and SWEEP ANGLE An elementary analysis of the effect of sw Mach number, and lift coefficient on wing-structure weight (NASA-TM-74072] SWEPT WINGS Pressure distributions on a 1- by 3-meter wing with a nonstreamwise tip in subsoni (NASA-TM-72755] An elementary analysis of the effect of sw Mach number, and lift coefficient on wing-structure weight (NASA-TM-74072] Technical and economic assessment of swept span-distributed load concepts for civil military air cargo transports (NASA-CR-145229] SYNTHETIC PUBLS Alternate fuels for future aircraft SYSTEM EFFECTIVENESS Proving the correctness of a flight-direct program for an airborne minicomputer SISTEM FAILURES Effectiveness of reliability system testin quality and reliability</pre>	A77-48413 vability A77-49949 solutions A77-49950 eep, N77-33146 semispan c flow N77-33103 eep, N77-33146 -wing and N77-33147 A77-48709 or A77-51261
<pre>control radar system implementation SURVIVAL USAF experience in aircraft accident survi SURVIVAL EQUIPMENT Aircrew escape and survival - Problems and SWEEP ANGLE An elementary analysis of the effect of sw Mach number, and lift coefficient on wing-structure weight (NASA-TM-74072) SWEPT WINGS Pressure distributions on a 1- by 3-meter wing with a nonstreamwise tip in subsoni (NASA-TM-72755] An elementary analysis of the effect of sw Mach number, and lift coefficient on wing-structure weight (NASA-TM-74072] Technical and economic assessment of swept span-distributed load concepts for civil military air cargo transports (NASA-CR-145229) SINTHETIC FUELS Alternate fuels for future aircraft SISTEM EFFECTIVENESS Proving the correctness of a flight-direct program for an airborne minicomputer SISTEM PAILURES Effectiveness of reliability system testin quality and reliability SISTEMS ANALYSIS</pre>	A77-48413 vability A77-49949 solutions A77-49950 eep, N77-33146 semispan c flow N77-33103 eep, N77-33146 -wing and N77-33147 A77-48709 or A77-51261 g on
<pre>control radar system implementation SURVIVAL USAF experience in aircraft accident survi SURVIVAL EQUIPMENT Aircrew escape and survival - Problems and SWEEP ANGLE An elementary analysis of the effect of sw Mach number, and lift coefficient on wing-structure weight (NASA-TM-74072] SWEPT WINGS Pressure distributions on a 1- by 3-meter wing with a nonstreamwise tip in subsoni (NASA-TM-72755] An elementary analysis of the effect of sw Mach number, and lift coefficient on wing-structure weight (NASA-TM-74072] Technical and economic assessment of swept span-distributed load concepts for civil military air cargo transports (NASA-CR-145229] SYNTHETIC PUBLS Alternate fuels for future aircraft SYSTEM EFFECTIVENESS Proving the correctness of a flight-direct program for an airborne minicomputer SISTEM FAILURES Effectiveness of reliability system testin quality and reliability</pre>	A77-48413 vability A77-49949 solutions A77-49950 eep, N77-33146 semispan c flow N77-33103 eep, N77-33146 -wing and N77-33147 A77-48709 or A77-51261 g on
<pre>control radar system implementation SURVIVAL USAF experience in aircraft accident survi SURVIVAL EQUIPMENT Aircrew escape and survival - Problems and SWEEP ANGLE An elementary analysis of the effect of sw Mach number, and lift coefficient on wing-structure weight (NASA-TM-74072) WiNGS Pressure distributions on a 1- by 3-meter wing with a nonstreamwise tip in subsoni (NASA-TM-72755) An elementary analysis of the effect of sw Mach number, and lift coefficient on wing-structure weight (NASA-TM-74072) Technical and economic assessment of swept span-distributed load concepts for civil military air cargo transports (NASA-CR-145229) SINTHETIC FUELS Alternate fuels for future aircraft SISTEM EFFECTIVENESS Proving the correctness of a flight-direct program for an airborne minicomputer SISTEM FAILURES Effectiveness of reliability system testin quality and reliability SISTEMS ANALYSIS An integrated marine pavigation system Principles, simulation results and</pre>	A77-48413 vability A77-49949 solutions A77-49950 eep, N77-33146 semispan c flow N77-33103 eep, N77-33146 -wing and N77-33147 A77-48709 or A77-51261 g on A77-50488 A77-51199
<pre>control radar system implementation SURVIVAL USAF experience in aircraft accident survi SURVIVAL EQUIPMENT Aircrew escape and survival - Problems and SWEBF ANGLE An elementary analysis of the effect of sw Mach number, and lift coefficient on ving-structure weight (NASA-TM-74072] SWEPT WINGS Pressure distributions on a 1- by 3-meter ving with a nonstreamvise tip in subsoni (NASA-TM-72755) An elementary analysis of the effect of sw Mach number, and lift coefficient on ving-structure weight (NASA-TM-74072] Technical and economic assessment of swept span-distributed load concepts for civil military air cargo transports (NASA-CR-145229) SINTHETIC PDEIS Alternate fuels for future aircraft SISTEM EFFECTIVENESS Proving the correctness of a flight-direct program for an airborne minicomputer SISTEM PAILUBES Effectiveness of reliability system testin quality and reliability SISTEMS ANALYSIS An integrated marine pavigation system Principles, simulation results and interoperability of JTIDS relative navig </pre>	A77-48413 vability A77-49949 solutions A77-49950 eep, N77-33146 semispan c flow N77-33103 eep, N77-33146 -wing and N77-33147 A77-48709 or A77-51261 q on A77-50488 A77-51199 ation
<pre>control radar system implementation SURVIVAL USAF experience in aircraft accident survi SURVIVAL EQUIPMENT Aircrew escape and survival - Problems and SWEEP ANGLE An elementary analysis of the effect of sw Mach number, and lift coefficient on wing-structure weight (NASA-TM-74072) WiNGS Pressure distributions on a 1- by 3-meter wing with a nonstreamwise tip in subsoni (NASA-TM-72755) An elementary analysis of the effect of sw Mach number, and lift coefficient on wing-structure weight (NASA-TM-74072) Technical and economic assessment of swept span-distributed load concepts for civil military air cargo transports (NASA-CR-145229) SINTHETIC FUELS Alternate fuels for future aircraft SISTEM EFFECTIVENESS Proving the correctness of a flight-direct program for an airborne minicomputer SISTEM FAILURES Effectiveness of reliability system testin quality and reliability SISTEMS ANALYSIS An integrated marine pavigation system Principles, simulation results and</pre>	A77-48413 vability A77-49949 solutions A77-49950 eep, N77-33146 semispan c flow N77-33103 eep, N77-33146 -wing and N77-33147 A77-48709 or A77-51261 q on A77-50488 A77-51199 ation

## T

TACAN

Tactical and long-range navigation in the AN/ARN-101/V/ A77-51192 JTIDS - An overview of the system design and implementation --- Joint Tactical Information Distribution System A77-51204 TAIL ROTORS Detail design aspects of a helicopter transmission system A77-47999 TAPE RECORDERS An operational wideo tape recording system utilizing IRIG standard 129-73 segmented belical scan recording format A77-49973 TARGET DRONE AIRCRAFT Prediction of airborne target detection N77-32871 f AD-A0414231 TARGET RECOGNITION Prediction or airborne target detection N77-32871 [AD-A041428] TECHNOLOGY ASSESSMENT Space-based solar power study near completion A77-48480 Avionics first principles. II - Airborne radars A77-48689 Position location systems technology A77-51179 An assessment of the hover performance of the XH-59A advancing blade concept demonstration helicopter [AD-A042063] TECHNOLOGY UTILIZATION N77-33155 Progress in advanced high temperature turbine materials, coatings, and technology [NASA-TM-4-73628] N77-33159 TEET ERING Aeroelastic stability of complete rotors with application to a testering rotor in forward flight 177-49180 TEMPERATURE EFFECTS PERATORE EFFECTS Effects of temperature on avionics reliability A77-50497 TEMPERATURE MEASUREMENT Gas turbine temperature techniques A77-50625 TERNINAL PACILITIES. Reducing walking distances at existing airports A77-47980 AFSATCOM terminal segment reliability test program A77-50494 TERRAIN AMALYSIS Navigation checkpointing with forward-sensed, fixed-range terrain profiles A77-51189 Advanced terrain correlation techniques --position locating system in war environments 177-51190 TEST FACILITIES Acquisition of test compatible avionics - An updated approach Georgia Teca high temperature solar test facility A77-49745 The Inverted Range - GPS Oser test facility ---Global Positioning System A77-51203 TEXT BOOKS Appliances for assembling aircraft and helicopter subsystems and elements --- Russian textbook A77-50682 THERMAL DEGRADATION The evolution and control of different performance degradation processes in modern propulsion systems monitoring jet engines N77-33193 THERMAL RESISTANCE Risks affecting the structural resistance and integrity of modern propulsion systems N77-33187 THER SOCOUPLES. Gas turbine temperature techniques A77-50625

#### THERMODYNAMIC EFFICIENCY

THER SODY NAMES REPTICIENCY. New computation method of turbine blades film cooling efficiency [OVERA, TP NO. 1977-85] A77-50988 The evolution and control of different performance degradation processes in modern propulsion systems monitoring jet engines N77-33193 THERMODYNAMIC PROPERTIES Aerodynamic and thermodynamic characteristics of kerosene-spray flames A77-48181 Risks affecting the structural resistance and integrity of modern propulsion systems N77-33187 THIN BODIES Non-equilibrium flow of an inviscid das past a thin profile A77-48289 THREE DIMENSIONAL FLOW Three dimensional steady and unsteady asymmetric flow past wings of arbitrary planforms [NASA-CR-145235] N77-33102 THRUST REVERSAL Over-the-wing model thrust reverser noise tests [AIAA PAPER 77-1318] A77-A77-51073 Over-the-wing model thrust reverser noise tests [NASA-TM-73495] THRUST VECTOR CONTROL N77-33161 Fluidic thrust vector control systems for ejection seats 177-49933 TIME DIVISION MULTIPLE ACCESS JTIDS - An overview of the system design and implementation --- Joint Tactical Information Distribution System A77-51204 TIME SIGNALS Multipath and performance tests of TRSB receivers FAD-A0418911 N77-33135 TIP SPEED Some results of the testing of a full-scale Ogee tip helicopter rotor; acoustics, loads, and performance FAIAA PAPER 77-13401 A77-51093 TITANIUM ALLOYS Rohrbond --- high strength Ti alloy joining method for thrust engines, airframe and space structures [SME PAPER AD76-280] A77-5101 A77-51015 TRACKING (POSITION) Position Location and Navigation Symposium, San Diego, Calif., November 1-3, 1976, Proceedings A77-51178 Accuracy evaluation of augmented multilateration tracking systems --- for aircraft detection A77-51182 # pplications of augmented multilateration tracking systems --- for military targets 177-51183 Development of the RMS-2 System of ODDR&E/T&E/ -Range Measurement System for tank and aircraft tracking A77-51187 History and development of the SCORE pod --Simulated Combat Operations Range Equipment A77-51188 Aircraft Space Position Measurement System - An application of precision DME A77-51197 TRAILING EDGES an experimental investigation of the trailing edge noise mechanism [AIAA PAPER 77-1291] A77-51049 Transonic aerodynamic characteristics of a supercritical-wing transport model with trailing-edge controls FNASA-TM-X-34311 N77-33116 Transonic aerodynamic characteristics of a supercritical-wing transport model with
trailing-edge controls, supplement, part 1
[NASA-TM-X-3431-PT-1] N N77-33117 Transonic aerodynamic characteristics of a supercritical-wing-transport model with trailing-edge controls - -[ NA SA-TM-X-3431-PT-2] N77-33118 Transonic aerodynamic characteristics of a supercritical-wing transport model with trailing edge controls [NASA-TM-X-3431-PT-3] N77-33119

- -

#### SUBJECT INDEX

Fransonic aerodynamic characteristics of a supercritical-wing transport model with trailing-edge controls [NASA-IM-4-3431-PT-4] N77-33120 TRAILING-EDGE FLAPS Unsteady surface pressure characteristics on aircraft components and farfield radiated airframe noise A77-51052 **FAIAA PAPER 77-12951** TRAINING DEVICES Computer-generated displays added to HEL helicopter operational trainer [AD-A043267] N77-32173 Investigation of diagnostic, error detector and self-taugat instructional strategies for flight simulator programs SIBULATOR PROG [AD-A035082] TRAINING SIMULATORS N77-33216 Air traffic control and the initial operation of supersonic transport aircraft - A review of preparatory measures A77-48415 TRAJECTORY ANALYSIS Aircraft trajectories from radar extrapolations to long term prediction A77-48414 TRAJECTORY CONTROL Performance and design of a vertical seeking seat steering system A77-49945 TRANSCONTINENTAL SYSTEMS A mathematical model of transcontinental balloon [IAP PAPER 77-167] A77-5 A77-51460 TRAN SDUCERS An accurate angular position and angular velocity instrument based on an optical incremental encoder [WRE-TN-1730(WR/D)] N77-33480 TRANSPER FUNCTIONS Impact of a command and stability augmentation system on gust response of a combat aircraft N77-33210 TRANSIENT PRESSURES Preliminary investigations of the unsteady flow in turbojet engines during transients [PUBL-PP-174] N77-3216 N77-32164 TRANSMISSIONS (MACHINE BLEMENTS) Helicopter transmission vibration and noise reduction program [AD-A042457] N77-32136 TRANSONIC FLOW Transonic pressure distribution on an aircraft wing model during rocket sled runs [AD-A041633] N77-32085 Transonic aerodynamic characteristics of a supercritical-wing transport model with trailing-edge controls [NASA-TM-K-3431] Transonic aerodynamic characteristics of a supercritical-wing transport model with N77-33116 trailing-edge controls, supplement, part 1 [NASA-TM-A-3431-PT-1] N77-33117 -Transonic aerodynamic characteristics of a supercritical-wing transport model with trailing-edq controls
[NASA-TM-4-3431-PT-2]
Transonic aerodynamic characteristics of a N77-33118 supercritical-wing transport model with trailing edge controls [ NASA-TM-X-3431-PT-3] N77-33119 Transonic aerodynamic characteristics of a supercritical-wing transport model with trailing-edge controls [NASA-TM-X-3431-PT-4] N77-33120 TRANSONIC WIND TOWNELS Influence of the noise level in a transonic wind tunnel on the aerodynamic characteristics of models [ONERA, IP NO. 1977-110] A77-50996 Transonic wind-tunnel investigation of the maneuver potential of the NASA supercritical wing concept, phase 1 [NASA-TH-X-3534] N77-33115 TRANSPORT AIRCRAFT The liquid aydrogen option for the subsonic transport - A status report A77-48819 Jakowlew Jak-42 - Uncomplicated, reliable, economical A77-49653

A77-51047

The determination of the center-of-gravity position with the aid of dimensionless values for aircraft control and stability A77-49654 Life cycle cost reduction techniques associated with Advanced Medium STOL Transport (AMST) [AD-A042880] N77-32141 Transonic aerodynamic characteristics of a supercritical-wing transport model with trailing-edge controls [ NASA-TH-X-3431 ] N77-33116 Transonic aerodynamic characteristics of a supercritical-wing transport model with trailing-edge controls, supplement, part 1 [NASA-TH-X-3431-PT-1] N77-33117 Transonic aerodynamic characteristics of a supercritical-wing transport model with trailing-edge controls [NASA-TM-X-3431-PT-2] N77-33118 Transonic aerodynamic characteristics of a supercritical-wing transport model with trailing edge contrcls [NASA-TH-X-3431-PT-3] ¥77-33119 Transonic aerodynamic characteristics of a supercritical-wing transport model with trailing-edge controls [NASA-TM-X-3431-PT-4] N77-33120 Technical and economic assessment of swept-wing span-distributed load concepts for civil and wilitary air cargo transports
[NASA-CR-145229] 177-33147 An evaluation of very large airplanes and alternative fuels: Executive summary [AD-A042112] N77-33154 TURBINE BLADES Fluid dynamics of diffuser augmented wind turbines -48899 New computation method of turbine blades film cooling efficiency [ONERA, TP NO. 1977-85] A77-50988 TURBINE ENGINES Investigation cf factors controlling engine scheduled overhaul: T53/T55 [ AD-A042190 ] N77-32162 Progress in advanced high temperature turbine materials, coatings, and technology [NASA-TM-X-73628] N7 N77-33159 Engine structural integrity program (ENSIP) N77-33182 Risks affecting the structural resistance and integrity of modern propulsion systems N77-33187 TURBOCOMPRESSORS Turbulent effects in axial compressors N77-33180 [ AAAF-NT-77-20 ] TURBOFAN ENGINES Theoretical jet exhaust noise model for the duct burning turbofan [ATAN PAPER 77-1264] A77-5 Measurement of far field combustion noise from a A77-51028 turbofan engine using coherence functions [AIAA PAPER 77-1277] A77-51038 Source location by shielding with application to a large turbofan engine --- for aircraft noise reduction FAIAA PAPER 77-1304] A77-51060 Summary of forward velocity effects on fan noise [AINA PAPER 77-1319] A77-5 A77-51074 ACOUSTIC performance of inlet multiple-pure-tone suppressors installed on NASA Quiet Engine 'C' (AIAA PAPER 77-13331 A77-5 A77-51087 Effects of simulated flight on fan noise suppression FAIAA PAPER 77-1334] A77-51088 Interaction of rotor tip flow irregularities with stator vanes as a noise source [AIAA PAPER 77-1342] 177-51095 Effect of forward motion on turbomachinery noise 177-51099 [AIAA PAPER 77-1346] The influence of the inlet duct contour on forward radiated fan noise [AIAA PAPER 77-1355] 377-51108 CF6 engine designed for maintenance 177-51352 Acoustic performance of inlet multiple-pure-tone constro performance or inter multiple part of the suppressors installed on NASA quiet enqine C N77-32158 [ NASA-TH-73713 ] Summary of forward velocity effects on fan noise [NASA-TM-73722] N77-3. N77-32159

Identification and measurement of combustion noise from a turboran engine using correlation and coherence techniques [NASA-TH-73747] N77-33162 Neasurement of far field combustion noise from a turbofan engine using coherence functions N77-33163 [NASA-TH-73748] Output feedback regulator design for jet engine control systems [NASA-TH-73776] N77-33165 State-of-taa-art of turbofan engine noise control [NASA-TH-73734] N77-33 N77-33166 Minimum time acceleration of aircraft turbofan engines by using an algorithm based on nonlinear programming NASA-TM-737411 N77-33167 Pollution reduction technology program for small pet aircraft engines, phase 1 [NASA-CR-135214] N77-33168 F100 multivariable control synthesis program: Evaluation of a multivariable control using a real-time engine simulation [ NASA-TP-1056 ] N77-33169 CFM56 turbofan maintainability and reliability-oriented development N77-33189 Accelerated mission test: A vital reliability tool N77-33196 TURBOJET ENGINES Flight noise studies on a turbojet engine using microphones mounted on a 450 ft. tower [AIAA PAPER 77-1325] 177-51079 Preliminary investigations of the unsteady flow in turbojet engines during transients [PUBL-PP-174] N77-32164 Investigation of feasible nozzle configurations for noise reduction in turbofan and turbojet aircraft. Volume 3: Shrouded slot nozzle configurations [AD-A041782] N77-33179 Testing simulation of damages occurred in service N77-33194 Experimental investigation on the influence of component faults on turbojet engine performance N77-33197 TURBONACHINE BLADES Investigation of the state of dynamic stress and the influence of service time on the fatigue strength of turbine rotor blades of aircraft gas-turbine engines 177-48632 Protection of cooled blades of complex internal structure [ONEBA, IP NO. 1977-90] A77-50991 Platform for a swing root turbomachinery blade [NASA-CAS2-LBW-12312-1] N77 N77-32148 TURBOPROP ENGINES A review of turbopropulsion combustion. Part 1: Fundamentals of combustion. Part 2: Turbopropulsion combustion technology [ AD-A043022 ] N77-32163 TURBULENT BOUNDARY LAYER Numerical prediction of aeroacoustic jet-flap flows [AINA PAPER 77-1316] A77-5107 A77-51071 TURBULENT FLOW Computer studies of swirl flows in Carnot diffusors 177-51600 Special course on concepts for drag reduction [AGARD-R-654] N77-32091 Interaction of rotor tip flow irregularities with stator vanes as a noise source [ NASA-TM-73706] N77-32156 Turbulent effects in axial compressors [AAAF-NT-77-20] N77-33180 TURBULENT JETS Coherent structures in the mixing zone of a subsonce not free jet [ONERA, TP NO. 1977-88] A77-509 An experimental investigation of the trailing edge A77-50989 noise mechanism [AIAA PAPER 77-1291] A77-51049 Experimental results of large-scale structures in jet flows and their relation to jet noise production [AIAA PAPER 77-1350] A77-51103 TURBULENT MIXING New scaling laws for hot and cold jet mixing noise based on a geometric acoustics model

[AIAA PAPER 77-1287]

#### TURBULENT WAKES

SUBJECT INDEX

Shielding aspects of heated twin jet noise	
FAIAA PAPER 77-12881	A77-51048
TURBOLENT WAKES	
A flight investigation of the wake turbule	nce
alleviation resulting from a flap config	uration
change on a E-747 aircraft	
[ NASP-TM-73263 ]	N77-33130
TWO DIMENSIONAL FLOW	
Conditions of physical validity in the line	ear
aerodynamics of supersonic jets	
-	A77-51608

## II

ULTRABIGE FRECUENCIES Application of UHF adaptive array to navigaticn/tracking systems A77-51185 UNSTEADY FLOW Unsteady Oseen flow around a flat-plate airfoil A77-49244 Theory of the lifting surface in unsteady motion in an inviscid fluid A77-49847 Data reduction for the unsteady aerodynamics on a circulation control airfoil --- wind tunnel test data N77-32084 [AD-A041153] Three dimensional steady and unsteady asymmetric flow past wings of arbitrary planforms [NASA-CR-145235] N77-33102 UPPER SURFACE BLOWN FLAPS Acoustic loads on upper-surface-blown powered-lift systems FAIAA PAPER 77-13631 A77-51115 UP TO THE TRANSPORT OF A USB STOL transport ----upper surface blowing YC-14 aircraft [AIAA PAPER 77-1365] A77-5 A77-51117 USER MANUALS (COMPUTER PROGRAMS) Rotorcraft flight simulation with coupled rotor aeroelastic stability analysis. Volume 3: Programmer's manual [AD-A042907] N77-32143 NSEG: A segmented mission analysis program for low and high speed aircraft. Volume 2: Program users manual [NASA-CR-28081 N77-33100 USER REQUIREMENTS RIW experience at ECOM --- Reliability Improvement Warranty requirements for Army A77-50483 The GPS Control Segment and its service to the GPS User --- Global Positioning System navigation satell1te 177-51202 UTILITY AIRCRAFT ILITY AIRCEAFT Noise emission of the agricultural aircraft Z-37. I - Scund intensity level measurements at the agricultural aircraft Z-37. II - Sound intensity level measurements at an agricultural airport - X77-496 A77-49656 The helicopter Ka-26 in the Special Purpose Flights Sector of Interflug, II

#### A77-49657

### V

VELOCITY DISTBIBUTION	
Effect of simulated forward speed on the j	et noise
of inverted velocity profile coannular n	ozzles
[AIAA PAPER 77-1329]	A77-51083
VHF CHNIBANGE NAVIGATION	
Nonte Carlo simulation of VOR/DME holding	
procedures. Basic notions and application	
[ESA-TT-419]	N77-33142
VIBRATION DAMPING	
Measurement of nondiagonal generalized dam	ping
ratios during ground vibration tests	
_	A77-50440
Helicopter transmission witration and nois	e
reduction program	
[AD-A042457]	N77-32136
Design and development of a structural mod	e
control system	
[NASA-CR-143846]	N77-33201
Structural Aspects of Active Controls	
[AGARD-CP-228]	N77-33208

Active flutter suppression of an airplane with wing mounted external stores N77-33211 Wind tunnel study of an active flutter suppression system N77-33215 VIBRATION ISOLATORS Steady-state unbalance response of a three-disk flexible rotor on flexible, damped supports N77-33160 [NASA-TH-1-73666] VIBRATION MEASUREMENT Measurement of nondiagonal generalized damping ratios during ground vibration tests A77-50440 VIDEO EQUIPSENT An operational video tape recording system utilizing IRIG standard 129-73 segmented helical scan recording format A77-49873 VISCOUS FLOW The role of the boundary layer in supersonic pressure perturbations along a weak wavy wall A77-48290 VISUAL PERCEPTION Prediction of airborne target detection [AD-A041428] N77-32871 VOICE COMMUNICATION Voice control systems for airborne environments N77-32524 [ AD-A043252 ] Air traffic control experimentation and evaluation test FAD-A041971 N77-33136 VOLTAGE REGULATORS A precision voltage reference unit for calibrating airborne data acquisition systems FRAE-TE-76164 ] N77-32474 VORTEX BREAKDOWN Calculation of vortex breakdown locations for flow over delta wings A77-49345 VORTEX GENERATORS Interaction of rotor tip flow irregularities with stator wanes as a noise source N77-32156 [NASA-TN-73706] VORT ICRS Vortex lattice prediction of subsonic aerodynamics of hypersonic vehicle concepts ×77-49343 Vortex interactions and decay in aircraft wakes N77-33105 [NASA-CR-2870]

## W

WALL FLOW The role of the boundary layer in supersonic pressure perturbations along a weak wavy wall A77-48290 WALL JETS An experimental investigation of the trailing edge noise mechanism [AIAA PAPER 77-1291] A77-51049 WARNING SYSTEMS SENDS /Safe Ejection Envelope Display System/ A77-49932 WEAPON SYSTEM MANAGEMENT The life cycle cost impacts of unsafe designs ---aircraft accident effects A77-50462 WEAR Wear reliability of aircraft splines A77-50467 WEIGHT REDUCTION The need for improved aircraft crashworthiness design A77-49473 Design, fabrication and test of an F-14 composite overwing fairing [SME PAPER E176-175] A77-51010 An optimality criteria approach to the minimum weight design of aircraft structures [ AD-A042759 ] N77-32140 WELDED JOINTS Rohrbond --- high strength Ti alloy joining method for thrust engines, airframe and space structures [SME PAPER AD76-280] A77-5101 A77-51015 NIND EFFECTS Flight mechanical problems in connection with the interception process N77-32121

A-32

WIND TUNNEL MODELS Influence of the noise level in a transonic wind tunnel on the aerodynamic characteristics of models [ONPERA, TP NO. 1977-110] A77-50996 WIND TUBNEL TESTS Performance of plain-type spoilers applied to the GA/W/-1 wing A77-49344 Influence of the noise level in a transonic wind tunnel on the aerodynamic characteristics of models [ONEBA, TP NO. 1977-110] 177-50996 Aerodynamic problems of helicopter blade tips [ONEBA, TP NO. 1977-112] A7 177-50998 Techniques and facilities used at ONERA /Modane Center/ for icing tests [OMEBA, TP NC. 1977-123] Porward speed effects on blown flap noise [ATAA PAPEE 77-1315] A77-51002 A77-51070 Effects of simulated flight on fan noise suppression [AIAA PAPER 77-1334] A77-51088 Aeroacoustic performance of a scoop inlet [AIAA PAPER 77-1354] A77-51107 Characteristics of a 1/6 scale model of the rotor systems research aircraft --- in the Langley V/STOL tunnel [NASA-TM-X-3548] N77-32083 Data reduction for the unsteady aerodynamics on a circulation control airfoil --- wind tunnel test data [AD-A041153] N77-32084 The effect of flight on the noise of subsonic jets [NGTE-R-343] N77-32850 WINDPOWERED GENERATORS Experimental data and theoretical analysis of an operating 100 kW wind turbine A77-48898 Pluid dynamics of diffuser augmented wind turbines A77-48899 WING PLAPS Forward speed effects on blown flap noise FAIAA PAPER 77-13151 A77-51070 WING LOADING Wing rock as a lateral-directional aircraft limit cycle oscillation induced by nonlinear aerodynamics occurring at high angle of attack FAD-A0421041 N77-33204 WING OSCILLATIONS Wind tunnel study of an active flutter suppression system N77-33215 WING TANKS Active flutter suppression of an airplane with wing mounted external stores N77-33211 WING TIP VORTICES Some measured and calculated effects of a tip vortex modification device on impulsive noise --- for helicopter rotors [AIAA PAPER 77-1341] A77-A77-51094 WING TIPS Theoretical parametric study of the relative advantages of winglets and wing-tip extensions [ NASA-TP-1020 ] N77-33112 VINGLETS Theoretical parametric study of the relative advantages of winglets and wing-tip extensions [NASA-TP-1020] N77-33112 WINGS Performance of plain-type spoilers applied to the GA/W/-1 wing A77-49344 Transonic pressure distribution on an aircraft wing model during rocket sled runs [AD-A041633] 177-32085 Evaluation of composite wing for XFV-12A airplane [ AD-A041208] N77-33152

YC-14 AIRCRAFT	1
Cabin noise behavior of	a USB STOL transport
upper surface blowing	YC-14 aircraft
FAIAA PAPER 77-1365]	<b>۸77-51117</b>

Y

Z

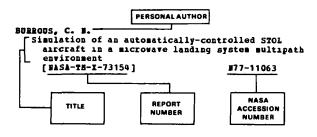
Z-37 AIRCRAFT Noise emission of the agricultural aircraft 2-37. I - Sound intensity level measurements at the agricultural aircraft 2-37. II - Sound intensity level measurements at an agricultural airport A77-49656

# **PERSONAL AUTHOR INDEX**

## AERONAUTICAL ENGINEERING / A Special Bibliography (Suppl 91)

## **JANUARY 1978**

## Typical Personal Author Index Listing



Listings in this index are arranged alphabetically by personal author. The title of the document provides the user with a brief description of the subject matter. The report number helps to indicate the type of document čited (e.g. NASA report translation NASA contractor report). The accession number is located beneath and to the right of the title e.g. N77 11063. Under any one authors name the accession numbers are arranged in sequence with the *IAA* accession numbers appearing first.

## A

ABBOTT, J. H.	
Aeroacoustic performance of a scoop inlet	
[AIAA PAPER 77-1354] A77-51107	7
ABBLL, E. B.	
Engine structural integrity program (ENSIP) N77-33182	?
ABRAHANSON, A. L.	
A finite element algorithm for sound propagation	
in axisymmetric ducts containing compressible mean flow	
[AIAA PAPER 77-1301] A77-51057	,
ABSOLONNE, F.	
ATS-6 European L-band aeronautical experiments	
A77-49908	3
ACRIVLELLIS, M.	
Computer studies of swirl flows in Carnot diffusors	
A77-51600	)
AGUER, J. A.	
Risks affecting the structural resistance and	
integrity of modern propulsion systems N77-33187	,
ALGER, R. S.	
Design of a cascade fire apparatus for testing	
countermeasure effectiveness	
[AD-A043176] 977-32101	
ALLEN. B.	
System avionic architectures for RPVs	
[AD-A041502] N77-32145	5
ALLEN, R. J.	
Reliability improvement warranty techniques and	
applications	
A77-50477	
ALTUKEOV, V. A. Practical aerodynamics of maneuvering aircraft /A	
Practical aerodynamics of maneuvering aircraft /A	
	1
Practical aerodynamics of maneuvering aircraft /4 manual for flight personnel/ ANDERSON, R. W.	I
Practical aerodynamics of maneuvering aircraft /4 manual for flight personnel/ A77-50693 ANDERSON, B. W. The effect of drop size on emissions from the	I
Practical aerodynamics of maneuvering aircraft /4 manual for flight personnel/ A77-50693 AEDERSON, B. W. The effect of drop size on emissions from the primary zone of a gas turbine type combustor	
Practical aerodynamics of maneuvering aircraft /4 manual for flight personnel/ A77-50693 ABDERSON, B. W. The effect of drop size on emissions from the primary zone of a gas turbine type ccmbustor A77-48174	
Practical aerodynamics of maneuvering aircraft /4 manual for flight personnel/ A77-50693 ANDERSON, B. W. The effect of drop size on emissions from the primary zone of a gas turbine type ccmbustor A77-48174 ANDERSON, W. D.	
Practical aerodynamics of maneuvering aircraft /4 manual for flight personnel/ A77-50693 ANDERSON, B. W. The effect of drop size on emissions from the primary zone of a gas turbine type ccmbustor A77-48174 Experimental data and theoretical analysis of an	
Practical aerodynamics of maneuvering aircraft /4 manual for flight personnel/ A77-50693 AHDERSON, B. W. The effect of drop size on emissions from the primary zone of a gas turbine type combustor A77-48174 Experimental data and theoretical analysis of an operating 100 kW wind turbine	ļ
Practical aerodynamics of maneuvering aircraft /4 manual for flight personnel/ A77-50693 ANDERSON, B. W. The effect of drop size on emissions from the primary zone of a gas turbine type cubustor A77-48174 ANDERSON, W. D. Experimental data and theoretical analysis of an operating 100 kW wind turbine A77-48898	ļ
Practical aerodynamics of maneuvering aircraft /4 manual for flight personnel/ A77-50693 ANDERSON, B. W. The effect of drop size on emissions from the primary zone of a gas turbine type ccmbustor ANDERSON, W. D. Experimental data and theoretical analysis of an operating 100 kW wind turbine A77-48898 ANUCEKIN, G. P.	•
Practical aerodynamics of maneuvering aircraft /4 manual for flight personnel/ A77-50693 ANDERSON, B. W. The effect of drop size on emissions from the primary zone of a gas turbine type cubustor A77-48174 ANDERSON, W. D. Experimental data and theoretical analysis of an operating 100 kW wind turbine A77-48898	ļ
Practical aerodynamics of maneuvering aircraft /A manual for flight personnel/ A77-50693 ANDERSON, B. W. The effect of drop size on emissions from the primary zone of a gas turbine type ccmbustor A77-48174 ANDERSON, W. D. Experimental data and theoretical analysis of an operating 100 kW wind turbine A77-48898 NUUCHKIN, G. P. Construction and design principles of aircraft	•
Practical aerodynamics of maneuvering aircraft /A manual for flight personnel/ A77-50693 ANDERSON, B. W. The effect of drop size on emissions from the primary zone of a gas turbine type cubustor A77-48174 ANDERSON, W. D. Experimental data and theoretical analysis of an operating 100 kW wind turbine A77-48898 ANUCHKIN, G. P. Construction and design principles of aircraft gas-turbine engines	•

ARAVABUDAH, K. S.	
An experimental investigation of helicopte	er rotor
high frequency broadband noise	
[AIAA PAPER 77-1339]	A77-51092
ARENTS, D. N. An assessment of the hover performance of	* • •
IH-59A advancing blade concept demonstra	
helicopter	11101
[AD-A042063]	₩77-33155
ARMAND, C.	
Techniques and facilities used at ONERA /I	Iodane
Center/ for icing tests	
[ONERA, IP NO. 1977-123]	A77-51002
ARMSTRONG, B. E.	
Avionics data for cost estimating	
[AD-A043265]	N77-32146
ARPPA, K.	-
Unsteady supersonic aerodynamic theory for interfering surfaces by the method of po	******
gradient	JCential
[NASA-CR-2898]	N77-33121
ATTA, B. H.	
Three dimensional steady and unsteady asy:	metric
flow past wings of arbitrary planforms	
[NASA-CR-145235]	N77-33102
AULT, G. H.	
Progress in advanced high temperature turk	bine
materials, coatings, and technology	
[NASA-TH-4-73628]	N77-33159
AUSTIN, J. Master monitor display application study i	For P-10
[AD-A041570]	N77-33158
[AD-A041570] AVEZARD, L.	111 33130
Simultaneous characterization of jet noise	sources
Simultaneous characterization of jet noise and acoustic field by a new application	of
conditional sampling [AIAA PAPSE 77-1349]	
[AIAA PAPER 77-1349]	A77-51102
AXELSSON, S. R. J.	
Surface roughness measurements by using	
low-resolution PM-CW radar altimeters	A77-48377
AVERS, T. G.	A//-405//
Transonic wind-tunnel investigation of the	•
maneuver potential of the NASA supercrit	
wing concept, phase 1	
[NA SA-TH- 4-3534]	N77-33115
_	
B	
BARKER, J. B.	
Launch risk analysis	<b>177-50463</b>
BAIR, G. L.	A77-30403
Navigation checkpointing with forward-sens	sed.
fixed-range terrain profiles	
	A77-51189
BAJORIWAS, L.	
Handling gualities of the RH-53D in the de	esign
growth configuration	
[SER-651317]	N77-33144
BAKER, A. J.	Flan flaws
Numerical prediction of aeroacoustic jet- [AIAA PAPER 77-1316]	A77-51071
BARA NOV, IU. K.	A//-JIV/I
The determination of ship location by mean	ns of
navigation satellites	
	A77-50687
BASKAREV, B. B.	-
Heat transfer at the critical point of a c	<b>ylinder</b>
during intensive blowing	
	A77-48054

,

BAUER, A. B. Airframe noise of the DC-9 [AIAA PAPER 77-1272] A77-51035 BAUER, P. An experimental investigation of helicopter rotor high frequency broadband noise [AIAA PAPER 77-1339] A77-51092 BAUNGARTNER, W. E. Human factors engineering considerations in designing Naval aircraft for maintainability [AD-A041156] N77 N77-33153 BEALE, R. B. Fluidic thrust vector control systems for ejection seats A77-49933 BEASLEY, J. A. Source location by shielding with application to a large turbofan engine [AIAA PAPER 77-1304] A77-51060 BELOKON, V. A. Aerodynamic effects during supersonic flow past a laser beam 177-48515 BENEKE. J. Multipath and performance tests of TRSB receivers N77-33135 [ AD-A0418911 BENET, E. J. Logistics planning simulation model for USAF spare engine management A77-50510 BENOIT. A. Aircraft trajectories from radar extrapolations to long term prediction A77-48414 BENOIT, C. M. Navigation checkpointing with forward-sensed, fixed-range terrain profiles A77-51189 BRRG. R. A. Modeling and parameter uncertainties for aircraft flight control system design [ VASA-CR-2887] N77-33149 BERKER, D. Subsystem design analysis light weight alternator (model test program). Addendum 2
[AD-A041257] N77-33171 BERNAN, A. Helicopter transmission vibration and noise reduction program [AD-A042457] N77-32136 BERTOLIEG, L. Failure analysis of digital systems using simulation A77-50501 BEYER, R. Presentation of DLS information N77-32111 BILANIN, A. J. Vortex interactions and decay in aircraft wakes [NASA-CR-28701 N77-33105 BILLIG, F. S. Direct-connect tests of hydrogen-fueled supersonic combustors A77-48240 BIRD, J. W. The need for improved aircraft crashworthiness design A77-49473 ' BISHOP, D. E. Purther sensitivity studies of community-aircraft noise exposure (NOISEMAP) prediction procedures [AD-A041781] N77-33686 BISHOP, L. L. Reliability, availability, maintainability/logistics /RAM/LOG/ A77-50456 BLANKENSHIP, G. L. Effect of forward motion on turbomachinery noise FAIAA PAPER 77-1346] A77-51099 BLAZOWSKI, W. S. Combustion considerations for future jet fuels 177-48241 A review of turbopropulsion combustion. Part 1: Fundamentals of combustion. Part 2: Turbopropulsion combustion technology FAD-A0430221 N77-32163 BLEWITT, S. J. Product improvement program evaluation [AD-A042134] N77-33101

#### PERSONAL AUTHOR INDEX

BLISS. D. B. A quide for estimation of aeroacoustic loads on flight venicle surfaces, volume 1 [AD-A041198] N77-32090 BLOOMER, H. E. Acoustic performance of inlet multiple-pure-tone ACOUSLIC PERFORMANCE OF INLET MULTIPLE-PURE-tone suppressors installed on NASA Quiet Engine 'C' [AIAA PAPER 77-1333] A77-5: Acoustic performance of inlet multiple-pure-tone suppressors installed on NASA guiet engine C [NASA-TH-73713] N77-32 A77-51087 N77-32158 BOLDIN, V. A. Electronic systems for air traffic control A77-51276 BONFANTI, G. A multipurpose position accuracy verification system A77-51181 BOSSLER, R. B., JR. Helicopter transmission vibration and noise reduction program [ AD-A042457 ] N77-32136 BOWES, M. A. Helicopter transmission vibration and noise reduction program [AD-A042457] N77-32136 RBARSMA, J. P. Reducing walking distances at existing airports 177-47980 BRAGA, V. G. Practical aerodynamics of maneuvering aircraft /4 manual for flight personnel/ A77-50693 BRAITHWAITE, W. M. Effect of slotted casing treatment with change in Reynolds number index on performance of a jet engine [ NASA-TP-1058 ] N77-32154 BRAUSCH, J. F. Supersonic jet exhaust noise investigation. Volume 4: Acoustic far-field/near-field data report [AD-A041819] N77-33177 BREWER, G. D. Alternate ruels for future aircraft 377-48709 BROADBENT, E. G. Source location by shielding with application to a large turbofan engine [AIAA PAPER 77-1304] A77-51060 BROCK, H. I. A multipurpose position accuracy verification system A77-51181 BROCKHAUS. R. Integrated path guidance system for unconventional approach procedures N77-32119 BRODERSEN, R. K. Fluidic event sequencing subsystem for AAES 177-49934 BROHAUGH, G. An application of Omega as a sensor A77-51198 BROOKS, J. R. Flight noise studies on a turbojet engine using microphones mounted on a 450 ft. tower [AIAA PAPE# 77-1325] A77-51079 BROUSSARD, J. H. Stability of the pilot-aircraft system in maneuvering flight 177-49340 BROWN, D. L. ATS-6 European L-band aeronautical experiments 177-49908 BROWN, R. An application of Omega as a sensor A77-51198 BRICE. T. W. Pollution reduction technology program for small jet aircraft engines, phase 1 [NASA-CR-135214] N77-33168 BRICE, W. D. The noise from unheated supersonic jets in simulated flight . [AIAA PAPER 77-1327] - -A77-51081 BUNDY, W. W. Queues with delayed, probabilistic feedback as a model of air traffic control communications A77-51610 DAVIES, L. E.

boundary, A. D.	
Combined Environment Reliability Test /Cl	
	A77-50504
BURROWS, R. W.	
MICRON reliability analyses	
[AD-A042987]	N77-32129
BUSCH	
Influence of the multipath propagation of	1 the
distance measuring part of DLS	

BUSENELL, D. H. An overview of concepts for aircraft drag reductions N77-32092

BUTENKO, G. P. Practical aerodynamics of maneuvering aircraft /A manual for flight personnel/ A77-50693 BUTZEL, L. H. Cabin noise behavior of a USB STOL transport

[AINA PAPER 77-1365] A77-51117 BUXTON, R. J. Documentation of the feasibility research on a

destructible parachute A77-49342

## C

CAGLAYAN, A. K.	
Digital flight control systems	
[ NASA-CE-145246]	N77-33200
CALDOW, J. R.	
HUD and the retrofit market	
	A77-50624
CAME, P. S.	
The current state of research and design in	high
pressure ratio centrifugal compressors	2
[AD-A041011]	¥77-33172
CAMPBELL, B. L.	
Some results of the testing of a full-scale	Ogee
tip helicopter rotor; acoustics, loads, a	nd
performance	
<pre>FAIAA PAPER 77-1340]</pre>	A77-51093
CARLSON, D. H.	
F-3C adaptive flight control laws	
[NASA-CR-2880]	₩77-33202
CARLSON, G. E.	•
Navigation checkpointing with forward-sense	α,
fixed-range terrain profiles	
C3D0000 7 M	177-51189
CARTER, J. H. B-1 forward radome microwave test range	
p-) forward ladome wicrowave test lande	A77-49743
CARY, R. H. J.	8/1-43143
The protection of aircraft radomes against	
lightning strike	
requesting series	A77-49734
CASSIDY, T.	ATT 43134
Wide area illuminator development for US Co	ast
Guard HH-3F helicopter	4.5 -
[AD-A041425]	N77-32132
CHAMBERLIN, L.	
System avionic architectures for BPVs	
[AD-A041502]	N77-32145
CHAPKIS, R. L.	
Aırframe noise - A status report, 1977	
[AIAA PAPEB 77-1268]	A77-51032
CHARPIN, P.	
CHARPIN, P. Techniques and facilities used at ONERA (Mc	
CHARPIN, P. Techniques and facilities used at ONERA /Mo Center/ for icing tests	dane
CHARPIN, P. Techniques and facilities used at ONERA /Mo Center/ for icing tests [ONERA, TP NO. 1977-123]	
CHARPIN, P. Techniques and facilities used at ONERA /Mo Center/ for icing tests [OMERA, TP NO. 1977-123] CHATANIER, M.	dane A77-51002
CHARPIN, P. Techniques and facilities used at ONERA /Mo Center/ for icing tests [ONERA, TP NO. 1977-123] CHATANIER, H. Investigation of subsonic fan noise sources	dane A77-51002 : by
CHARPIN, P. Techniques and facilities used at ONERA /Mo Center/ for icing tests [ONERA, TP NO. 1977-123] CHATANIER, M. Investigation of subsonic fan noise sources fluctuating fressure measurements on rota	dane A77-51002 : by
CHARPIN, P. Techniques and facilities used at ONERA /Mo Center/ for icing tests fOMERA, TP NO. 1977-123] CHATANIER, H. Investigation of subsonic fan noise sources fluctuating pressure measurements on rota blades	dane A77-51002 by ting
CHARPIN, P. Techniques and facilities used at ONERA /Mo Center/ for icing tests [ONERA, TP NO. 1977-123] CHATANIER, M. Investigation of subsonic fan noise sources fluctuating pressure measurements on rota blades [AIAA PAPEE 77-1321]	dane A77-51002 : by
CHARPIN, P. Techniques and facilities used at ONERA /Mo Center/ for icing tests [ONERA, TP NO. 1977-123] CHATANIER, M. Investigation of subsonic fan noise sources fluctuating pressure measurements on rota blades [AIAA PAPEE 77-1321] CHEN, C. Y.	dane A77-51002 by tlng A77-51075
CHARPIN, P. Techniques and facilities used at ONERA /Mo Center/ for icing tests [ONERA, TP NO. 1977-123] CHATANIER, M. Investigation of subsonic fan noise sources fluctuating pressure measurements on rota blades [AIAA PAPEE 77-1321] CHEN, C. I. Effect of simulated forward speed on the je	dane A77-51002 by ting A77-51075 t noise
CHARPIN, P. Techniques and facilities used at ONERA /Mc Center/ for icing tests [ONERA, TP NO. 1977-123] CHATANIER, M. Investigation of subsonic fan noise sources fluctuating fressure measurements on rota blades [AIIA PAPEB 77-1321] CHEM, C. Y. Effect of simulated forward speed on the je of inverted velocity profile coannular no	dane A77-51002 by ting A77-51075 t noise zzles
<ul> <li>CHARPIN, P. Techniques and facilities used at ONERA /Mo Center/ for icing tests [ONERA, TP NO. 1977-123]</li> <li>CHATANIER, H. Investigation of subsonic fan noise sources fluctuating pressure measurements on rota blades [AIAA PAPEE 77-1321]</li> <li>CHEN, C. Y. Effect of simulated forward speed on the je of inverted velocity profile coannular no [AIAA PAPEE 77-1329]</li> </ul>	dane A77-51002 by ting A77-51075 t noise
CHARPIN, P. Techniques and facilities used at ONERA /Mo Center/ for icing tests [ONERA, TP NO. 1977-123] CHATANIER, M. Investigation of subsonic fan noise sources fluctuating pressure measurements on rota blades [AIAA PAPEE 77-1321] CBPM, C. Y. Effect of simulated forward speed on the je of inverted velocity profile coannular no [AIAA PAPEE 77-1329] CHETAIL, P.	dane A77-51002 by ting A77-51075 t noise zzles A77-51083
<pre>CHARPIN, P. Techniques and facilities used at ONERA /Mc Center/ for icing tests [ONERA, TP NO. 1977-123] CHATANIER, M. Investigation of subsonic fan noise sources fluctuating pressure measurements on rota blades [AIAA PAPER 77-1321] CHER, C. Y. Effect of simulated forward speed on the je of inverted velocity profile coannular no [AIAA PAPER 77-1329] CHETAIL, P. The evolution and control of different performance.</pre>	dane A77-51002 by ting A77-51075 t noise zzles A77-51083 ormance
CHARPIN, P. Techniques and facilities used at ONERA /Mo Center/ for icing tests [ONERA, TP NO. 1977-123] CHATANIER, M. Investigation of subsonic fan noise sources fluctuating pressure measurements on rota blades [AIAA PAPEE 77-1321] CBPM, C. Y. Effect of simulated forward speed on the je of inverted velocity profile coannular no [AIAA PAPEE 77-1329] CHETAIL, P.	dane A77-51002 by ting A77-51075 t noise zzles A77-51083 ormance
<pre>CHARPIN, P. Techniques and facilities used at ONERA /Mc Center/ for icing tests [ONERA, TP NO. 1977-123] CHATANIER, M. Investigation of subsonic fan noise sources fluctuating pressure measurements on rota blades [AIAA PAPER 77-1321] CHER, C. Y. Effect of simulated forward speed on the je of inverted velocity profile coannular no [AIAA PAPER 77-1329] CHETAIL, P. The evolution and control of different performance.</pre>	dane A77-51002 by ting A77-51075 t noise zzles A77-51083 ormance n systems
<pre>CHARPIN, P. Techniques and facilities used at ONERA /Mc Center/ for icing tests [ONERA, TP NO. 1977-123] CHATANIER, M. Investigation of subsonic fan noise sources fluctuating pressure measurements on rota blades [AIAA PAPER 77-1321] CHER, C. Y. Effect of simulated forward speed on the je of inverted velocity profile coannular no [AIAA PAPER 77-1329] CHETAIL, P. The evolution and control of different perf degradation processes in modern propulsic CHIEN, R. T.</pre>	Adane A77-51002 by ting A77-51075 t noise zzles A77-51083 ormance n systems N77-33193
<ul> <li>CHARPIN, P. Techniques and facilities used at ONERA /Mo Center/ for icing tests [ONERA, TP NO. 1977-123]</li> <li>CHATANIER, M. Investigation of subsonic fan noise sources fluctuating pressure measurements on rota blades [AIAA PAPEE 77-1321]</li> <li>CHEN, C. Y. Effect of simulated forward speed on the je of inverted velocity profile coannular no [AIAA PAPEE 77-1329]</li> <li>CHETAIL, P. The evolution and control of different perf degradation processes in modern propulsion</li> </ul>	Adane A77-51002 by ting A77-51075 t noise zzles A77-51083 ormance n systems N77-33193

CHIN, J. The effect of grop size on emissions from the primary zone of a gas turbine type combustor 177-48174 CHISUM, G. T. Prediction of airborne target detection [AD-A041428] N77-32871 CLAPPER, W. S. High velocity jet noise source location and reduction. Task 4: Development/evaluation of techniques for inflight investigation [AD-A041849] N77-33175 CLAYTON, R. I. Evaluation or composite wing for XFV-12A airplane [AD-A041208] N77-33152 CLINE, J. P. Technical objectives and approaches to the tracking subsystem of the Extended Area Test System /BATS/ A77-51184 COCHBAN, J. P. Deburring - Some of the problems and requirements of the aircraft industry [SHE PAPEA Ma76-547] A77-51016 COCKING, B. J. The effect of flight on the noise of subsonic jets N77-32850 The effect of flight on the noise of subsonic jets [AD-A041730] N77-33176 [ AD-A041730 ] COLLINS. J. D. Launch risk analysis A77-50463 COLLMANN, K. D. Impact of a command and stability augmentation system on gust response of a combat aircraft N77-33210 CONTI, D. A. The protection of aircraft radomes against lightning strike 177-49734 CORNELISSE, D. A. A novel concept for suppressing internally generated aircraft engine noise **FAIAA PAPER 77-13561** A77-51109 COUPBY, G. Measurement of nondiagonal generalized damping ratios during ground vibration tests A77-50440 COX. C. R. Helicopter rotor aerodynamic and aeroacoustic environments [AIAA PAPER 77-1338] A77-51091 CRONOGUE, T. A. Reliability, availability, maintainability/logistics /RAM/LOG/ A77-50456 CUNNINGHAM, R. B. Steady-state unbalance response of a three-disk flexible rotor on flexible, damped supports [NASA-TM-X-73666] N7 N77-33160 CWINER, D. S. F100 multivariable control synthesis program: Evaluation of a multivariable control using a real-time engine simulation N77-33169 [NASA-TP-1056]

## D

DAHAN, C.	
Coherent structures in the mixing zone of a	<b>a</b>
subsonic not free jet	
[ONEBA, FP NO. 1977-88]	A77-50989
Simultaneous characterization of jet noise	sources
and acoustic field by a new application (	of
conditional sampling	
FAIAA PAPER 77-1349]	A77-51102
DAMMS, S. H.	
Source location by shielding with application	ion to a
large turbofan engine	
[AIAA PAPZR 77-1304]	A77-51060
DAMRON, S. S.	
An operational video tape recording system	
utilizing IRIG standard 129-73 segmented	helical
scan recording format	
	A77-49873
DAVIES, L. E.	
Applications of augmented multilateration t	tracking
systems	
	A77-51183

•

\_\_\_\_

DAVIS, P. G. Pollution reduction technology program for small jet aircraft engines, phase 1 [NASA-CR-135214] N77-33168 DE NEUFVILLE, R. Rationalization of the European air net A77-48474 DEAN, W. N. Clarinet Pilgrim - Communications using Loran-C A77-51201 DEANGELIS, V. M. Buffet characteristics of the F-8 supercritical wing airplane [NASA-TM-560491 N77-32080 DELL-INAGINE, R. JTIDS - An overview of the system design and 1mplementation A77-51204 DEMARTRAU, S. K. W. J. Reliability versus cost in operating wide body jet engines N77-33186 DESTUYNDER, R. Wind tunnel study of an active flutter suppression system N77-33215 DEVOGE. B. Progress in determining service life by endurance tests N77-33195 DIETRICH, D. A. Effects of simulated flight on fan noise suppression [AIAA PAPER 77-1334] A77-51088 Effects of simulated flight on fan noise suppression [NASA-TM-73708] N77-32157 DILLON, J. L. Vortex lattice prediction of subsonic aerodynamics of hypersonic vehicle concepts A77-49343 DINI. D. Testing simulation of damages occurred in service N77-33194 DITTEAR, J. H. Interaction of rotor tip flow irregularities with stator wanes as a noise source A77-51095 FAIAA PAPER 77-1342] Interaction of rotor tip flow irregularities with stator vanes as a noise source [NASA-TM-73706] N77-32156 DOBBS, N. W. An optimality criteria approach to the minimum weight design of aircraft structures [AD-A042759] N77-32140 DOBBZYNSKI, W. H. Are wheel-well related aeroacoustic sources of any significance in airframe noise [AIAA PAPER 77-1270] A77-51033 Unsteady surface pressure characteristics on aircraft components and farfield radiated airframe noise FAIAA PAPER 77-12951 A77-51052 DOETSCH, K. H. Integrated path guidance system for unconventional approach procedures N77-32119 DOLLOFF, J. T. The Inverted Range - GPS User test facility A77-51203 DONALD, G. Reliability, availability, maintainability/logistics /RAM/LOG/ 177-50456 DONHAN, R. E. Experimental data and theoretical analysis of an operating 100 kW wind turbine A77-48898 DREW, G. R. Aircrew escape and survival - Problems and solutions A77-49950 DUGGER, G. L. Direct-connect tests of hydrogen-fueled supersonic combustors A77-48240 DUHIG, J. J., JB. Effects of temperature on avionics reliability A77-50497

PERSONAL AUTHOR INDEX

DUMAS. J. S. Requirements for flight testing automated terminal SATUICA N77-33137 FAD-A0419751 DURBAR, D. P., JR. A new look in reliability: F-18 operational mission environment [AD-A042781] N77-32573 DUNDERDALE, T. C. Further sensitivity studies of community-aircraft noise exposure (NOISEMAP) prediction procedures [AD-A041781] N77-33686 DUNNILL W. A. Investigation of feasible nozzle configurations for noise reduction in turbofan and turbojet aircraft. Volume 3: Shrouded slot nozzle configurations N77-33179 [AD-A041782] DUPDOWALDSON, C. Vortex interactions and decay in aircraft wakes N77-33105 [NASA-CE-2870] DURAN, B. E. Teaching the practical techniques of establishing egress system performance in an accident environment 177-49948 DURENBERGER, D. A research program to reduce interior noise in general aviation airplanes [NASA-CR-155154] N77-33959 Ε BARLY. J. System avionic architectures for RPVs [ AD-A041502 ] N77-32145 BATON, G. W. Air Combat Maneuvering Range/Instrumentation 'ACMR/I' A77-51195 ECCLES, E. S. Solid state light emitting displays A77-50623 BCKL, W. Design and test results of very broadband radomes for ECM applications A77-49747 BCKLUNDT, H. Simulation of the multipath propagation of DLS N77-32106 The Brunswick DLS test airport area - a non clean environment N77-32108 EDDOWES, E. E. Investigation of diagnostic, error detector and self-taught instructional strategies for flight simulator programs [ AD-A035682 ] N77-33216 EGLIZEAUD, J. P. A navigation device to help helicopters to land on ocean platforms [ONERA, TP NO. 1977-71] 177-50983 EGOROV, V. The technical conception of the IL-62M -Aerodynamic features 177-49655 BICKNANN, K. B. Preliminary results of USAP experience with engine monitoring and diagnostics N77-33199 BLIAS. G. Coherent structures in the mixing zone of a Subsonic hot free jet [ONERA, TP NJ. 1977-88] A77-5098 Simultaneous characterization of jet noise sources A77-50989 and acoustic field by a new application of conditional sampling [AIAA PAPER 77-1349] A77-51102 ELSON, B. H. Space-based solar power study near completion A77-48480 BRNOULT. H.

The measurement of aircraft overflight noise -Errors due to its nonstationary character A77-50441

## F

PACCA, G.	
Ailitary engine deterioration in service co	onnected
with life cycle costs	
PARQUEAR, B. W.	N77-33183
The influence of the inlet duct contour on	forward
radiated fan noise FAIAA PAPER 77-1355]	A77-51108
PASSO, G.	A77-51108
Techniques and facilities used at ONERA /No	dane
Center/ for loing tests {ONERA, TP NO. 1977-123]	177-51002
FEILEB, C. E.	A77-51002
Summary of forward velocity effects on fam	noise
[AIAA PAPER 77-1319]	A77-51074
Acoustic_performance of inlet multiple-pure suppressors installed on NASA Quiet Engin	
[AIAA PAPER 77-1333]	A77-51087
Acoustic performance of inlet multiple-pure	
suppressors installed on NASA quiet engir [NASA-TM-73713]	N77-32158
Summary of forward velocity effects on fan	
f NASA-TH-73722]	N77-32159
FELTON, C. A. Nodeling and parameter uncertainties for as	rcraft
flight control system design	
[NASA-CR-2887]	N77-33149
FINDERS, B. Noise emission of the agricultural aircraft	2-37-
I - Sound intensity level measurements at	the
agricultural aircraft Z-37. II - Sound in	
level measurements at an agricultural air	A77-49656
FINK, M. R.	
Noise component method for airframe noise	177 54004
[AIAA PAPER 77-1271] Forward flight effects on EBF noise	477-51034
(AIAA PAPER 77-1314]	A77-51069
FLYNN, R.	
Reliability, availability, maintainability/logistics /RAM/LOG/	
Multurability, togistics / Akh/ 500/	A77-50456
FOGG, L. D.	
	- 6
Producibility aspects of advanced composite	es for
	es for A77-51006
Producibility aspects of advanced composite an L-1011 Alleron [SME PAPER BNR76-04] POREHAW, K. H.	A77-51006
Producibility aspects of advanced composite an L-1011 Aileron [SME PAPER BMR76-04]	<b>A77-51006</b> urbines
Producibility aspects of advanced composite an L-1011 Alleron (SME PAPER EMR76-04] FOREMAN, K. H. Fluid dynamics of diffuser augmented wind t FORM, P.	A77-51006 urbines A77-48899
Producibility aspects of advanced composite an L-1011 Aileron [SME PAPER BMR76-04] POBEMAW, K. H. Fluid dynamics of diffuser augmented wind t PORM, P. Measurement of the multipath propagation at	A77-51006 urbines A77-48899
Producibility aspects of advanced composite an L-1011 Alleron (SME PAPER EMR76-04] FOREMAN, K. H. Fluid dynamics of diffuser augmented wind t FORM, P.	A77-51006 urbines A77-48899 the
<ul> <li>Producibility aspects of advanced composite an L-1011 Alleron [SME PAPER EMR76-04]</li> <li>POBEHAW, K. H. Fluid dynamics of diffuser augmented wind t</li> <li>PORM, P. Measurement of the multipath propagation at Erunswick test airport</li> <li>The Brunswick DLS test airport area - a non</li> </ul>	A77-51006 urbines A77-48899 the N77-32107
<ul> <li>Producibility aspects of advanced composite an L-1011 Alleron (SME PAPER EMR76-04]</li> <li>POREMAN, K. H. Fluid dynamics of diffuser augmented wind t</li> <li>PORM, P. Measurement of the multipath propagation at Brunswick test airport</li> </ul>	A77-51006 urbines A77-48899 the N77-32107 tclean
<ul> <li>Producibility aspects of advanced composite an L-1011 Alleron (SME PAPER EMR76-04]</li> <li>POREMAN, K. H. Fluid dynamics of diffuser augmented wind t</li> <li>PORM, P. Measurement of the multipath propagation at Erunswick test airport</li> <li>The Brunswick DLS test airport area - a non environment</li> </ul>	A77-51006 urbines A77-48899 the N77-32107 clean N77-32108
<ul> <li>Producibility aspects of advanced composite an L-1011 Aileron (SME PAPER EMR76-04]</li> <li>POBEMAN, K. H. Fluid dynamics of diffuser augmented wind t</li> <li>PORM, P. Measurement of the multipath propagation at Brunswick test airport</li> <li>The Brunswick DLS test airport area - a non environment</li> <li>Hultipath immunity of MLS in mountainous so</li> </ul>	A77-51006 urbines A77-48899 the N77-32107 clean N77-32108 tes N77-32116
<ul> <li>Producibility aspects of advanced composite an L-1011 Alleron (SME PAPER EME76-04]</li> <li>POREMAN, K. H. Fluid dynamics of diffuser augmented wind t</li> <li>PORM, P. Measurement of the multipath propagation at Erunswick test airport</li> <li>The Brunswick DLS test airport area - a non environment</li> <li>Multipath immunity of MLS in mountainous so Measurements of the influence of static and</li> </ul>	A77-51006 urbines A77-48899 the N77-32107 clean N77-32108 tes N77-32116
<ul> <li>Producibility aspects of advanced composite an L-1011 Aileron (SME PAPER EMR76-04]</li> <li>POBEMAN, K. H. Fluid dynamics of diffuser augmented wind t</li> <li>PORM, P. Measurement of the multipath propagation at Brunswick test airport</li> <li>The Brunswick DLS test airport area - a non environment</li> <li>Hultipath immunity of MLS in mountainous so</li> </ul>	A77-51006 urbines A77-48899 the N77-32107 clean N77-32108 tes N77-32116 ind
Producibility aspects of advanced composite an L-1011 Alleron (SME PAPER BMR76-04] POREMAN, K. H. Fluid dynamics of diffuser augmented wind the PORM, P. Measurement of the multipath propagation at Brunswick test airport The Brunswick DLS test airport area - a non environment Multipath immunity of MLS in mountainous so Measurements of the influence of static and dynamic interference on an ILS-receiver a measurement of the capture effect with the double frequency procedure	A77-51006 urbines A77-48899 the N77-32107 clean N77-32108 tes N77-32116 ind
Producibility aspects of advanced composite an L-1011 Alleron (SME PAPER EME76-04] POREMAN, K. H. Fluid dynamics of diffuser augmented wind the PORM, P. Measurement of the multipath propagation at Brunswick test airport The Brunswick DLS test airport area - a non environment Hultipath immunity of MLS in mountainous si Measurements of the influence of static and dynamic interference on an ILS-receiver a measurement of the capture effect with the double frequency procedure [TUBS/SFE58/50]	A77-51006 urbines A77-48899 the N77-32107 clean N77-32108 tes N77-32116 ind
Producibility aspects of advanced composite an L-1011 Alleron (SME PAPER EMR76-04] POREMAN, K. H. Fluid dynamics of diffuser augmented wind the FORM, P. Measurement of the multipath propagation at Brunswick test airport The Brunswick DLS test airport area - a non environment Multipath immunity of MLS in mountainous so Measurements of the influence of static and dynamic interference on an ILS-receiver a measurement of the capture effect with the double frequency procedure [TUBS/SFB58/50] POBSCE, B.	A77-51006 urbines A77-48899 the N77-32107 clean N77-32108 tes N77-32116 Ind Ind N77-33140
Producibility aspects of advanced composite an L-1011 Alleron (SME PAPER EMR76-04] POREMAN, K. H. Fluid dynamics of diffuser augmented wind the PORM, P. Measurement of the multipath propagation at Erunswick test airport The Brunswick DLS test airport area - a non environment Multipath immunity of MLS in mountainous si Measurements of the influence of static and dynamic interference on an ILS-receiver a measurement of the capture effect with the double frequency procedure [TUBS/SFB58/50] POBSCH, B. Design, fabrication and test of an F-14 com overwing fairing	A77-51006 urbines A77-48899 the N77-32107 clean N77-32108 tes N77-32116 ind ie N77-33140 uposite
Producibility aspects of advanced composite an L-1011 Alleron (SME PAPER EMR76-04] POREMAN, K. H. Fluid dynamics of diffuser augmented wind the FORM, P. Measurement of the multipath propagation at Brunswick test airport The Brunswick DLS test airport area - a non environment Multipath immunity of MLS in mountainous su Measurements of the influence of static and dynamic interference on an ILS-receiver a measurement of the capture effect with the double frequency procedure [TUBS/SFB58/50] POBSCE, B. Design, fabrication and test of an P-14 com overwing fairing [SME PAPER EM76-175]	A77-51006 urbines A77-48899 the N77-32107 clean N77-32108 tes N77-32116 Ind Ind N77-33140
<pre>Producibility aspects of advanced composite an L-1011 Alleron (SME PAPER EMR76-04] FOREMAN, K. H. Fluid dynamics of diffuser augmented wind the FORM, P. Measurement of the multipath propagation at Erunswick test airport The Brunswick DLS test airport area - a non environment Multipath immunity of MLS in mountainous si Measurements of the influence of static and dynamic interference on an ILS-receiver a measurement of the capture effect with the double frequency procedure [TUBS/SFB58/50] FOBSCE, B. Design, fabrication and test of an P-14 com overwing fairing [SME PAPER EM76-175] FOBSSELL, B. A method to reduce the need for large anter</pre>	A77-51006 urbines A77-48899 the N77-32107 clean N77-32108 tes N77-32116 N77-33140 uposite A77-51010
Producibility aspects of advanced composite an L-1011 Alleron (SME PAPER EMR76-04] POREMAN, K. H. Fluid dynamics of diffuser augmented wind the PORM, P. Measurement of the multipath propagation at Erunswick test airport The Brunswick DLS test airport area - a non environment Multipath immunity of MLS in mountainous so Measurements of the influence of static and dynamic interference on an ILS-receiver a measurement of the capture effect with the double frequency procedure [TUBS/SFB58/50] PORSCE, H. Design, fabrication and test of an F-14 com overwing fairing [SME PAPER EM76-175] PORSSELL, B.	A77-51006 urbines A77-48899 the N77-32107 clean N77-32108 tes N77-32116 N77-33140 uposite A77-51010
<pre>Producibility aspects of advanced composite an L-1011 Alleron (SME PAPER BMR76-04] POREMAN, K. H. Fluid dynamics of diffuser augmented wind the PORM, P. Measurement of the multipath propagation at Erunswick test airport The Brunswick DLS test airport area - a non environment Multipath immunity of MLS in mountainous si Neasurements of the influence of static and dynamic interference on an ILS-receiver a measurement of the capture effect with the double frequency procedure [TUBS/SFB58/50] POBSCE, H. Design, fabrication and test of an P-14 com overwing fairing [SME PAPER EM76-175] POBSSELL, B. A method to reduce the need for large anter Microwave Landing Systems /MLS/ POBVILLE, D. R.</pre>	A77-51006 arbines A77-48899 the N77-32107 clean N77-32108 tes N77-32116 N77-33140 posite A77-51010 mas in A77-48378
Producibility aspects of advanced composite an L-1011 Alleron (SME PAPER EMR76-04] POREMAN, K. H. Fluid dynamics of diffuser augmented wind the FORM, P. Measurement of the multipath propagation at Erunswick test airport The Brunswick DLS test airport area - a non- environment Multipath immunity of MLS in mountainous so Neasurements of the influence of static and dynamic interference on an ILS-receiver a measurement of the capture effect with the double frequency procedure [TUBS/SFB58/50] PORSCE, B. Design, fabrication and test of an P-14 com overwing fairing [SME PAPER EM76-175] PORSSELL, B. 4 method to reduce the need for large anter Microwave Landing Systems /MLS/ PORVILLE, D. R. Life cycle cost reduction techniques associ	A77-51006 urbines A77-48899 the N77-32107 clean N77-32108 tes N77-32116 N77-32116 A77-33140 posite A77-51010 mas in A77-48378 ated
<ul> <li>Producibility aspects of advanced composite an L-1011 Alleron (SME PAPER EMR76-04]</li> <li>POREMAN, K. H. Fluid dynamics of diffuser augmented wind the PORM, P. Measurement of the multipath propagation at Brunswick test airport</li> <li>The Brunswick DLS test airport area - a non environment</li> <li>Multipath immunity of MLS in mountainous si Measurements of the influence of static and dynamic interference on an ILS-receiver a measurement of the capture effect with the double frequency procedure [TUBS/SFP58/50]</li> <li>PORSCH, H. Design, fabrication and test of an F-14 com overwing fairing [SME PAPER EM76-175]</li> <li>PORSSELL, B.</li> <li>A method to reduce the need for large anter Microwave Landing Systems /MLS/</li> <li>PORYILLE, D. R. Life cycle cost reduction techniques associ- with Advanced Medium STOL Transport (AMS)</li> </ul>	A77-51006 urbines A77-48899 the N77-32107 clean N77-32108 tes N77-32116 N77-32116 N77-33140 uposite A77-51010 unas in A77-48378 Lated
Producibility aspects of advanced composite an L-1011 Alleron (SME PAPER EMR76-04] POBEMAN, K. H. Fluid dynamics of diffuser augmented wind the PORM, P. Measurement of the multipath propagation at Erunswick test airport The Brunswick DLS test airport area - a non- environment Multipath immunity of MLS in mountainous so Neasurements of the influence of static and dynamic interference on an ILS-receiver a measurement of the capture effect with the double frequency procedure [TUBS/SFB58/50] POBSCE, B. Design, fabrication and test of an P-14 com overwing fairing [SME PAPER EM76-175] POBSELL, B. 4 method to reduce the need for large anter Microwave Landing Systems /MLS/ POBYLLE, D. R. Life cycle cost reduction techniques associ with Advanced Medium STOL Transport (AMSI [AD-A042880] POI, C. H., JE.	A77-51006 urbines A77-48899 the N77-32107 clean N77-32108 tes N77-32108 tes N77-32116 A77-33140 posite A77-51010 mas in A77-48378 ated N77-32141
Producibility aspects of advanced composite an L-1011 Alleron (SME PAPER EMR76-04] POREMAN, K. H. Fluid dynamics of diffuser augmented wind the PORM, P. Measurement of the multipath propagation at Brunswick test airport The Brunswick DLS test airport area - a non environment Hultipath immunity of MLS in mountainous si Measurements of the influence of static and dynamic interference on an ILS-receiver a measurement of the capture effect with the double frequency procedure [TUBS/SFP58/50] PORSCH, H. Design, fabrication and test of an F-14 com overwing fairing [SME PAPER EM76-175] PORSSELL, B. A method to reduce the need for large anter Microwave Landing Systems /MLS/ PORYILLE, D. R. Life cycle cost reduction techniques associ with Advanced Medium STOL Transport (AMSI [AD-A002880] POI, C. H., JR.	A77-51006 urbines A77-48899 the N77-32107 clean N77-32108 tes N77-32108 tes N77-32116 A77-33140 posite A77-51010 mas in A77-48378 ated N77-32141
Producibility aspects of advanced composite an L-1011 Aileron (SME PAPER ERR76-04] POREMAN, K. H. Fluid dynamics of diffuser augmented wind the Porter of the multipath propagation at Erronswick test airport The Brunswick DLS test airport area - a non- environment Multipath immunity of MLS in mountainous si Measurements of the influence of static and dynamic interference on an ILS-receiver a measurement of the capture effect with the double frequency procedure fTUBS/SFB58/50] POBSCE, B. Design, fabrication and test of an F-14 com overving fairing (SME PAPER EM76-175] POBSYLL, B. A method to reduce the need for large anter Microwave Landing Systems /MLS/ POBYILLE, D. B. Life cycle cost reduction techniques associ with Advanced Medium STOL Transport (AMS) [AD-A002880] POI, C. H., JR.	A77-51006 arbines A77-48899 the N77-32107 clean N77-32108 tes N77-32108 tes N77-32108 tes N77-33140 posite A77-51010 mas in A77-48378 ated N77-32141 Sistics
<ul> <li>Producibility aspects of advanced composite an L-1011 Alleron (SME PAPER EMER76-04]</li> <li>POREMAN, K. H. Fluid dynamics of diffuser augmented wind the PORM, P. Measurement of the multipath propagation at Brunswick test airport</li> <li>The Brunswick DLS test airport area - a non environment</li> <li>Multipath immunity of MLS in mountainous si Measurements of the influence of static and dynamic interference on an ILS-receiver a measurement of the capture effect with the double frequency procedure [TUBS/SPE58/50]</li> <li>POBSCE, B. Design, fabrication and test of an F-14 com overwing fairing [SME PAPER EM76-175]</li> <li>PORSSEL, B.</li> <li>A method to reduce the need for large anter Microwave Landing Systems /MLS/</li> <li>POBYILLE, D. B. Life cycle cost reduction techniques associ with Advanced Medium STOL Transport (AMSI [AD-A042880]</li> <li>POI, C. H., JR.</li> <li>Subsonic longitudinal aerodynamic character and engine pressure distributions for an aircraft with an integrated scranjet design for Mach 6 cruise</li> </ul>	A77-51006 urbines A77-48899 the N77-32107 clean N77-32108 tes N77-32116 N77-32116 N77-33140 uposite A77-51010 unas in A77-48378 Lated N77-32141 cistics upned
Producibility aspects of advanced composite an L-1011 Aileron (SME PAPER EMR76-04] POREMAN, K. H. Fluid dynamics of diffuser augmented wind the Porter and the multipath propagation at Erunswick test airport The Brunswick DLS test airport area - a non- environment Multipath immunity of MLS in mountainous si Measurements of the influence of static and dynamic interference on an ILS-receiver a measurement of the capture effect with the double frequency procedure fTUBS/SFB58/50] POBSCE, B. Design, fabrication and test of an F-14 com overving fairing (SME PAPER EM76-175] POBSYLL, B. A method to reduce the need for large anter Microwave Landing Systems /MLS/ POBYILLE, D. B. Life cycle cost reduction techniques associ with Advanced Medium STOL Transport (AMS) [AD-A002080] POI, C. H., JR. Subsonic longitudinal aerodynamic character and engine pressure distributions for an aircraft with an integrated scramjet design (MSA-TH-I-73911]	A77-51006 arbines A77-48899 the N77-32107 clean N77-32108 tes N77-32108 tes N77-32108 tes N77-33140 posite A77-51010 mas in A77-48378 ated N77-32141 Sistics
Producibility aspects of advanced composite an L-1011 Alleron (SME PAPER EMR76-04] POBEMAN, K. H. Fluid dynamics of diffuser augmented wind the PORM, P. Measurement of the multipath propagation at Erunswick test airport The Brunswick DLS test airport area - a non environment Multipath immunity of MLS in mountainous su Measurements of the influence of static and dynamic interference on an ILS-receiver a measurement of the capture effect with the double frequency procedure [TUBS/SFB58/50] POBSCE, B. Design, fabrication and test of an P-14 com overwing fairing [SME PAPER EM76-175] PORSELL, B. A method to reduce the need for large anter Microwave landing Systems /MLS/ PORYILE, D. R. Life cycle cost reduction techniques associ with Advanced Medium STOL Transport (AMSI [AD-A042880] POI, C. H., JE. Subsonic longitudinal aerodynamic character and engine pressure distributions for an aircraft with an integrated scramjet desi for Mach 6 cruise [NASA-TM-X-73911] POI, C. S.	A77-51006 urbines A77-48899 the N77-32107 clean N77-32108 tes N77-32108 tes N77-32108 A77-33140 posite A77-51010 mas in A77-48378 ated N77-32141 cistics gned N77-33108
Producibility aspects of advanced composite an L-1011 Aileron (SME PAPER EMR76-04] POREMAN, K. H. Fluid dynamics of diffuser augmented wind the Porter and the multipath propagation at Erunswick test airport The Brunswick DLS test airport area - a non- environment Multipath immunity of MLS in mountainous si Measurements of the influence of static and dynamic interference on an ILS-receiver a measurement of the capture effect with the double frequency procedure fTUBS/SFB58/50] POBSCE, B. Design, fabrication and test of an F-14 com overving fairing (SME PAPER EM76-175] POBSYLL, B. A method to reduce the need for large anter Microwave Landing Systems /MLS/ POBYILLE, D. B. Life cycle cost reduction techniques associ with Advanced Medium STOL Transport (AMS) [AD-A002080] POI, C. H., JR. Subsonic longitudinal aerodynamic character and engine pressure distributions for an aircraft with an integrated scramjet design (MSA-TH-I-73911]	A77-51006 urbines A77-48899 the N77-32107 clean N77-32108 tes N77-32108 tes N77-32108 A77-33140 posite A77-51010 mas in A77-48378 ated N77-32141 cistics gned N77-33108

,

FRANKLIN, J. A.	
Longitudinal handling qualities during appr	oach
and landing of a powered lift STOL aircra	ıft
[ NA SA-TM-X-62144 ]	N77-33151
PRECHE, J. C.	
Nickel base alloy	
[ NA SA-CASE-LEW-12270-1 ]	N77-32280
Progress in advanced high temperature turbi	Lne
materials, coatings, and technology	
[NASA-TM-X-73628]	N77-33159
PRIED, W. R.	
Principles, simulation results and	
interoperability of JTIDS relative naviga	tion
	A77-51205
PRIEDMANN, P.	
Aeroelastic stability of complete rotors wi	
application to a teetering rotor in forwa	
	A77-49180
PULLER, R. R.	
Investigation of diagnostic, error detector	
self-taught instructional strategies for	flight
simulator programs	
[AD-A035682]	N77-33216
PULTON, C. L.	
Theoretical parametric study of the relativ	
advantages or winglets and wing-tip exter	
[ NA SA-TP-1020 ]	N77-33112
Δ.	

## G

GALAITSIS, A. A guide for estimation of aeroacoustic loads on
flight vehicle surfaces, volume 1 [AD-A041198] N77-32090
GALMICHE, P. Protection of cooled blades of complex internal
structure [ONERA, TP NO. 1977-90] A77-50991
GANIKHANOV, SH. F. Appliances for assembling aircraft and helicopter
subsystems and elements A77-50682
GARRARD, W. L. Design of nonlinear automatic flight control systems
GEHRING, R. W.
Evaluation of composite wing for XFV-12A airplane [AD-A041208] N77-33152
GEHRKE, R. Development of the RMS-2 System of ODDR&E/T&F/
GIANSANTE, N.
Helicopter transmission vibration and noise
reduction program [AD-A042457] N77-32136
GIPFIN, W. C. Queues with delayed, probabilistic feedback as a
model of air traffic control communications A77-51610
GILBERT, B. L.
Pluid dynamics of diffuser augmented wind turbines A77-48899
GIORGIBRI, L. Military engine deterioration in service connected
with life cycle costs
N77-33183 Testing simulation of damages occurred in service
N77-33194
GIVENS, B. L. Investigation of factors controlling engine
scheduled overhaul: T53/T55
[AD-A042190] N77-32162 GLASGOW, J.
Experimental data and theoretical analysis of an operating 100 kW wind turbine
GOET HERT, B. H.
Investigation of feasible nozzle configurations
for noise reduction in turbofan and turbojet
aircraft. Volume 3: Shrouded slot nozzle
configurations [AD-A041782] N77-33179
GOOD BAN, C. S., JR.
Brolution of automatic opening lap belts in high performance aircraft
A77-49946
GOODYKOOHTZ, J. Over-the-wing model thrust reverser noise tests
(AIAA PAPER 77-1318] A77-51073

Over-the-wing model thrust reverser noise tests [NASA-TM-73495] N77-N77-33161 GORDON, S. Rationalization of the European air net A77-48474 GRAHAM. J. System avionic architectures for RPVs [AD-A041502] N77-32145 GRANATO, D. J. Loran-C data acquisition and handling for improved accuracy A77-51200 GREFSRUD, L. E. Failure analysis of digital systems using simulation A77-50501 GRIGOREV, V. P. Appliances for assembling aircraft and helicopter subsystems and elements A77-50682 GRIMES, W. System avionic architectures for RPVs [AD-A041502] N77-32145 GRISTOLD, P. Handling gualities of the RH-53D in the design growth configuration [SER-651317] N77-N77-33144 GROBNEWEG, J. P. Summary of forward velocity effects on fan noise [AIAA PAPER 77-1319] A77-5 Summary of forward velocity effects on fan noise 177-51074 [NASA-TM-73722] N77-32159 State-of-the-art of turbofan engine noise control [NASA-TM-73734] N77-33166 GROBSBECK, D. Interim noise correlation for some OTW configurations using external jet-flow deflectors [AIAA PAPER 77-1317] A77-5107 A77-51072 GUERIN, Y. ATS-6 European L-band aeronautical experiments 177-19908 GUTIERREZ, O. Over-the-wing model thrust reverser noise tests [AIAA PAPER 77-1318] Over-the-wing model thrust reverser poise tests [NASA-TM-73495] N77-1 A77-51073 N77-33161

## H

HAAS, J. E. Cold-air performance of a 12.766-centimeter-tip-diameter axial-flow cooled turbine. 3: Effect of rotor tip clearance on overall performance of a solid blade configuration [NASA-TP-1032] N77-32082 HABER, J. M. Launch risk analysis A77-50463 HAGUE, D. S. NSEG: A segmented mission analysis program for low and high speed aircraft. Volume 2: Program users manual [NASA-CR-2808] N77-33100 HALBMAYER, B. Austria's role in international civil aviation 177-48416 HALLISSY, J. B. Transonic wind-tunnel investigation of the maneuver potential of the NASA supercritical wing concept, phase 1 [NASA-TM-X-3534] N77-33115 HABILTON, W. T. YC-14 control system redundancy N77-33214 HARDY, C. A. Reliability improvement warranty techniques and applications A77-50477 HARRINGTON, B. L. The Inverted Range - GPS User test facility 177-51203 HARBIS, W. L. An experimental investigation of helicopter rotor high frequency broadband noise [AIAA PAPER 77-1339] A77-51092 HART, S. G. Multiple curved descending approaches and the air traffic control problem [NASA-TM-78430] N77-32104

#### PERSONAL AUTHOR INDEX

HARTMANN, G. L. F-8C adaptive flight control laws	
[NASA-CE-2880]	N77-33202
F-8C adaptive flight control extensions [NASA-CR-2881]	N77-33203
HARVEY, C. A.	177 35205
F-8C adaptive flight control laws	N77 33300
[NASA-CE-2880] HASSETT, R. P.	N77-33202
AFSATCOM terminal segment reliability test	
EAWORTH, D. P.	A77-50494
Model for the effect of electric fields of	n
satellite-earth microwave radio propagat	tion
HAWORTH, L.	A77-49797
Some detail design problems in aircraft ga	as turbines
	A77-48001
REFNER, J. N. · An overview of concepts for aircraft drag	reductions
	N77-32092
HEIDMANN, M. P. Effects of simulated flight on fam noise s	
[AIAA PAPER 77-1334]	A77-51088
Effects of simulated flight on fan noise s	
[NASA-TM-73708] HEIMBAUGH, R. M.	N77-32157
Modeling and parameter uncertainties for a	aircraft
flight control system design [NASA-CR-2887]	N77-33149
HELLER, H. H.	N// 00149
Are wheel-well related aeroacoustic source	es of any
significance in airframe noise [AIAA PAPE2 77-1270]	A77-51033
Unsteady surface pressure characteristics	
aircraft components and farfield radiate airframe noise	ed
[AIAA PAPER 77-1295]	A77-51052
HELLER, R. A. Flight inspection data and crack initiation	
right inspection data and crack initiation	A77-50466
HENDERSON, R. E.	
A review of turbopropulsion combustion. F Fundamentals of combustion. Part 2:	Part 1:
Turbopropulsion combustion technology	
[AD-A043022] HENDRICK- R- C-	N77-32163
HENDRICK, R. C. F-8C adaptive flight control laws	N77-32163
HENDBICK, R. C. P-8C adaptive flight control laws [NASA-CR-2880]	N77-32163 N77-33202
HEBDBICK, R. C. P-8C adaptive flight control laws [NASA-CE-2880] HENNE, P. A.	N77-33202
HENDRICK, R. C. P-8C adaptive flight control laws [NASA-CE-2880] HENNE, P. A. Wind tunnel and analytical investigation of over-the-wing propulsion/air frame inter	N77-33202 of ferences
HEBDBICK, R. C. P-8C adaptive flight control laws [NASA-CE-2880] HEBNBE, P. A. Wind tunnel and analytical investigation of over-the-wing propulsion/air frame inter for a short-haul aircraft at Mach number	N77-33202 of ferences
HENDRICK, R. C. P-8C adaptive flight control laws [NASA-CE-2880] HENNE, P. A. Wind tunnel and analytical investigation of over-the-wing propulsion/air frame inter	N77-33202 of ferences
HENDBICK, R. C. P-8C adaptive flight control laws [NASA-CR-2880] HENNE, P. A. Wind tunnel and analytical investigation of over-the-wing propulsion/air frame inter for a short-haul aircraft at Mach number 0.6 to 0.78 [NASA-CR-2905] HERALD, G. L.	N77-33202 of ferences rs from
HENDBICK, R. C. P-8C adaptive flight control laws [NASA-CR-2880] HENNE, P. A. Wind tunnel and analytical investigation of over-the-wing propulsion/air frame inter for a short-haul aircraft at Mach number 0.6 to 0.78 [NASA-CR-2905]	N77-33202 of ferences rs from
<ul> <li>HENDRICK, R. C.</li> <li>P-8C adaptive flight control laws <pre></pre></li></ul>	N77-33202 of ferences rs from
HEBD BICK, R. C. P-8C adaptive flight control laws [NASA-CR-2880] HENNE, P. A. Wind tunnel and analytical investigation of over-the-wing propulsion/air frame inter for a short-maul aircraft at Mach number 0.6 to 0.78 [NASA-CR-2905] HERALD, G. L. Computer-generated displays added to HEL helicopter operational trainer [AD-A043267] HERRICK, D. A. E.	N77-33202 of ferences from N77-33114 N77-32173
<ul> <li>HENDRICK, R. C.</li> <li>P-8C adaptive flight control laws <pre>[NASA-CE-2880]</pre></li> <li>HENNE, P. A. <pre>Wind tunnel and analytical investigation of over-the-wing propulsion/air frame inter for a short-haul aircraft at Mach number 0.6 to 0.78 <pre>[NASA-CE-2905]</pre></pre></li> <li>HERALD, G. L. <pre>Computer-generated displays added to HEL helicopter operational trainer [AD-A043267]</pre></li> <li>HERRICK, D. A. E. The effect of simulated aerodynamic heating strength of three rocket motor case steed</li></ul>	N77-33202 of ferences ts from N77-33114 N77-32173 ag on the els
<ul> <li>HEBD BICK, R. C.</li> <li>P-8C adaptive flight control laws <ul> <li>NASA-CR-28801</li> </ul> </li> <li>HENNE, P. A.</li> <li>Wind tunnel and analytical investigation of over-the-wing propulsion/air frame interfor a short-haul aircraft at Mach number 0.6 to 0.78 <ul> <li>NASA-CR-29051</li> </ul> </li> <li>HERAID, G. L.</li> <li>Computer-generated displays added to HEL helicopter operational trainer <ul> <li>[N-A0432671]</li> <li>HERRICK, D. A. R.</li> <li>The effect of simulated aerodynamic heating strength of three rocket motor case stee [RPE-TR-45]</li> </ul> </li> </ul>	N77-33202 of ferences cs from N77-33114 N77-32173 ag on the
<ul> <li>HENDBICK, R. C.</li> <li>P-8C adaptive flight control laws <ul> <li>NASA-CE-2880]</li> </ul> </li> <li>HENNE, P. A.</li> <li>Wind tunnel and analytical investigation of over-the-wing propulsion/air frame interfor a short-haul aircraft at Mach number 0.6 to 0.78 <ul> <li>NASA-CE-2905]</li> </ul> </li> <li>HERALD, G. L.</li> <li>Computer-generated displays added to HEL helicopter operational trainer <ul> <li>(AD-A043267]</li> </ul> </li> <li>HERRICK, D. A. E.</li> <li>The effect of simulated aerodynamic heatin strength of three rocket motor case stee [RPE-TE-45]</li> <li>HERZBERG, E.</li> <li>Aircraft Space Position Measurement System</li> </ul>	N77-33202 of ferences from N77-33114 N77-32173 ag on the els N77-32240
<ul> <li>HENDBICK, R. C.</li> <li>P-8C adaptive flight control laws <pre>[NASA-CE-2880]</pre></li> <li>HENNE, P. A. <pre>Wind tunnel and analytical investigation of over-the-wing propulsion/air frame inter for a short-naul aircraft at Mach number 0.6 to 0.78 <pre>[NASA-CE-2905]</pre></pre></li> <li>HERALD, G. L. <pre>Computer-generated displays added to HEL helicopter operational trainer <pre>[AD-A043267]</pre></pre></li> <li>HERRICK, D. A. B. <pre>The effect of simulated aerodynamic heatin strength of three rocket motor case stee <pre>[RPE-TR-45]</pre></pre></li> </ul>	N77-33202 of ferences from N77-33114 N77-32173 ng on the ls N77-32240 n - An
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<ul> <li>HEBD BICK, R. C.</li> <li>P-8C adaptive flight control laws [NASA-CR-2880]</li> <li>HENNE, P. A.</li> <li>Wind tunnel and analytical investigation of over-the-wing propulsion/air frame inter for a short-haul aircraft at Mach number 0.6 to 0.78 [NASA-CR-2905]</li> <li>HERALD, G. L.</li> <li>Computer-generated displays added to HEL helicopter operational trainer [AD-A043267]</li> <li>HERRICK, D. A. B.</li> <li>The effect of simulated aerodynamic heatin strength of three rocket motor case stee [RPE-TR-45]</li> <li>HERZBERG, B.</li> <li>Aircraft Space Position Measurement System application of precision DME</li> <li>HERSON, H. H.</li> <li>Theoretical parametric study of the relating the strength of the relating the strength of the relating the study of the relating the strength of the relating the study of the relating the strength of the relating the study of the relating the strength of the relating the study of the relating the study of the relating the study of the stud</li></ul>	N77-33202 of ferences s from N77-33114 N77-32173 ng on the s N77-32240 n - An A77-51197 twe
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<ul> <li>HENDBICK, R. C.</li> <li>P-8C adaptive flight control laws [NAA-CE-2880]</li> <li>HENNE, P. A.</li> <li>Wind tunnel and analytical investigation of over-the-wing propulsion/air frame inter for a short-haul aircraft at Mach number 0.6 to 0.78 [NASA-CE-2905]</li> <li>HERALD, G. L.</li> <li>Computer-generated displays added to HEL helicopter operational trainer [AD-A043267]</li> <li>HERRICK, D. A. R.</li> <li>The effect of simulated aerodynamic heatin strength of three rocket motor case stee [RPE-TR-45]</li> <li>HERZBENG, E.</li> <li>Aircraft Space Position Measurement System application of precision DME</li> <li>HEYSON, H. H.</li> <li>Theoretical parametric study of the relation advantages or winglets and wing-tip exter [NASA-TP-1020]</li> <li>HILL, R. J.</li> </ul>	N77-33202 of ferences rs from N77-33114 N77-32173 ng on the els N77-32240 m - An A77-51197 NVe PDSions N77-33112
<ul> <li>HENDBICK, R. C.</li> <li>P-8C adaptive flight control laws [NASA-CE-2880]</li> <li>HENNE, P. A.</li> <li>Wind tunnel and analytical investigation of over-the-wing propulsion/air frame inter for a short-haul aircraft at Mach number 0.6 to 0.78 [NASA-CE-2905]</li> <li>HERALD, G. L.</li> <li>Computer-generated displays added to HEL helicopter operational trainer [AD-A043267]</li> <li>HERRICK, D. A. B.</li> <li>The effect of simulated aerodynamic heatin strength of three rocket motor case stee [RPE-TR-45]</li> <li>HERBEG, E.</li> <li>Aircraft Space Position Measurement System application of precision DME</li> <li>HEMSON, H. H.</li> <li>Theoretical parametric study of the relatin advantages or winglets and wing-tip exter [NASA-TP-1020]</li> <li>HILL, R. J.</li> <li>A procedure for predicting the life of tur</li> </ul>	N77-33202 of ferences rs from N77-33114 N77-32173 ng on the els N77-32240 m - An A77-51197 NVe PDSions N77-33112
<ul> <li>HEBD BICK, R. C.</li> <li>P-8C adaptive flight control laws [NASA-CE-2880]</li> <li>HENNE, P. A.</li> <li>Wind tunnel and analytical investigation of over-the-wing propulsion/air frame inter for a short-haul aircraft at Mach number 0.6 to 0.78 [NASA-CR-2905]</li> <li>HERALD, G. L.</li> <li>Computer-generated displays added to HEL helicopter operational trainer [AD-A043267]</li> <li>HERRICK, D. A. R.</li> <li>The effect of simulated aerodynamic heatin strength of three rocket motor case stee [RPE-TR-45]</li> <li>HERZBERG, E.</li> <li>Aircraft Space Position Measurement System application of precision DMS</li> <li>HEMSON, H. H.</li> <li>Theoretical parametric study of the relatin advantages or winglets and wing-tip exten [NASA-TP-1020]</li> <li>HILL, R. J.</li> <li>A procedure for predicting the life of tur engine components</li> </ul>	N77-33202 of ferences rs from N77-33114 N77-32173 ng on the els N77-32240 m - An A77-51197 NVe PDSions N77-33112
<ul> <li>HENDBICK, R. C.</li> <li>P-8C adaptive flight control laws [NASA-CE-2880]</li> <li>HENNE, P. A.</li> <li>Wind tunnel and analytical investigation of over-the-wing propulsion/air frame inter for a short-naul aircraft at Mach number 0.6 to 0.78</li> <li>[NASA-CE-2905]</li> <li>HERALD, G. L.</li> <li>Computer-generated displays added to HEL helicopter operational trainer [AD-A043267]</li> <li>HERRICK, D. A. B.</li> <li>The effect of simulated aerodynamic heatin strength of three rocket motor case steed [RPE-TR-45]</li> <li>HERSBG, E.</li> <li>Aircraft Space Position Measurement System application of precision DME</li> <li>HERSON, H. H.</li> <li>Theoretical parametric study of the relatin advantages or winglets and wing-tip exter [NASA-TP-1020]</li> <li>HILL, R. J.</li> <li>A procedure for predicting the life of tur engine components</li> </ul>	N77-33202 of ferences from N77-33114 N77-32173 og on the els N77-32240 o - An A77-51197 two endstons N77-33112 cbune
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<ul> <li>HENDRICK, R. C.</li> <li>P-8C adaptive flight control laws [NASA-CR-2880]</li> <li>HENNE, P. A.</li> <li>Wind tunnel and analytical investigation of over-the-wing propulsion/air frame inter for a short-maul aircraft at Mach number 0.6 to 0.78 [NASA-CR-2905]</li> <li>HERALD, G. L.</li> <li>Computer-generated displays added to HEL helicopter operational trainer [AD-A043267]</li> <li>HERFICK, D. A. B.</li> <li>The effect of simulated aerodynamic heatin strength of three rocket motor case stee [RPE-TR-45]</li> <li>HERZBERG, E.</li> <li>Aircraft Space Position Measurement System application of precision DMS</li> <li>HENSON, H. H.</li> <li>Theoretical parametric study of the relatin advantages or winglets and wing-tip exten [NASA-TP-1020]</li> <li>HILL, R. J.</li> <li>A procedure for predicting the life of tur engine components</li> <li>HINRICHS, P. B.</li> <li>Advanced terrain correlation techniques</li> </ul>	N77-33202 of ferences from N77-33114 N77-32173 ag on the els N77-32240 a - An A77-51197 we ensions N77-33112 cbine N77-33192 A77-51190 cadars
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<ul> <li>HEBD BICK, R. C.</li> <li>P-8C adaptive flight control laws [NASA-CE-2880]</li> <li>HEBNBE, P. A.</li> <li>Wind tunnel and analytical investigation of over-the-wing propulsion/air frame inter for a short-haul aircraft at Mach number 0.6 to 0.78 [NASA-CE-2905]</li> <li>HEBALD, G. L.</li> <li>Computer-generated displays added to HEL helicopter operational trainer [AD-A043267]</li> <li>HERRICK, D. A. E.</li> <li>The effect of simulated aerodynamic heatin strength of three rocket motor case steed [RPE-TE-45]</li> <li>HERSBEG, R.</li> <li>Aircraft Space Position Measurement System application of precision DMS</li> <li>HEYSON, H. H.</li> <li>Theoretical parametric study of the relatin advantages or winglets and wing-tip extent [NASA-TP-1020]</li> <li>HILL, R. J.</li> <li>A procedure for predicting the life of tur engine components</li> <li>HINFICHS, P. R.</li> <li>Advanced terrain correlation techniques</li> <li>HIRST, M.</li> <li>Avionics first principles. II - Airborne re</li> </ul>	N77-33202 of ferences from N77-33114 N77-32173 ag on the els N77-32240 m - An A77-51197 eve N77-33112 cbine N77-33192 A77-51190 cadars A77-48689
<ul> <li>HENDRICK, R. C.</li> <li>P-8C adaptive flight control laws [NASA-CE-2880]</li> <li>HENNE, P. A.</li> <li>Wind tunnel and analytical investigation of over-the-wing propulsion/air frame inter for a short-haul aircraft at Mach number 0.6 to 0.78</li> <li>(NASA-CE-2905]</li> <li>HERALD, G. L.</li> <li>Computer-generated displays added to HEL helicopter operational trainer [AD-A043267]</li> <li>HERRICK, D. A. B.</li> <li>The effect of simulated aerodynamic heatin strength of three rocket motor case steed [RPE-TR-45]</li> <li>HERSEG, E.</li> <li>Aircraft Space Position Measurement System application of precision DME</li> <li>HEMSON, H. H.</li> <li>Theoretical parametric study of the relatin advantages or winglets and wing-tip exter [NASA-TP-1020]</li> <li>HILL, R. J.</li> <li>A procedure for predicting the life of tur engine components</li> <li>HINRICHS, P. B.</li> <li>Advanced terrain correlation techniques</li> <li>HIRST, M.</li> <li>Avionics first principles. II - Airborne I</li> </ul>	N77-33202 of ferences from N77-33114 N77-32173 ag on the els N77-32240 m - An A77-51197 eve N77-33112 cbine N77-33192 A77-51190 cadars A77-48689
<ul> <li>HEBD BICK, R. C.</li> <li>P-8C adaptive flight control laws [NASA-CE-2880]</li> <li>HEBNBE, P. A.</li> <li>Wind tunnel and analytical investigation of over-the-wing propulsion/air frame inter for a short-haul aircraft at Mach number 0.6 to 0.78 [NASA-CE-2905]</li> <li>HEBALD, G. L.</li> <li>Computer-generated displays added to HEL helicopter operational trainer [AD-A043267]</li> <li>HERRICK, D. A. E.</li> <li>The effect of simulated aerodynamic heatin strength of three rocket motor case steed [RPE-TE-45]</li> <li>HERSBEG, R.</li> <li>Aircraft Space Position Measurement System application of precision DMS</li> <li>HEYSON, H. H.</li> <li>Theoretical parametric study of the relatin advantages or winglets and wing-tip extent [NASA-TP-1020]</li> <li>HILL, R. J.</li> <li>A procedure for predicting the life of tur engine components</li> <li>HINFICHS, P. R.</li> <li>Advanced terrain correlation techniques</li> <li>HIRST, M.</li> <li>Avionics first principles. II - Airborne in Wing mounted external stores</li> <li>HOEBMANN, E.</li> </ul>	N77-33202 of ferences rs from N77-33114 N77-32173 ag on the els N77-32240 a - An A77-51197 type ensions N77-33192 A77-51190 radars A77-48689 with
<ul> <li>HEND BICK, R. C.</li> <li>P-8C adaptive flight control laws [NASA-CE-2880]</li> <li>HENNE, P. A.</li> <li>Wind tunnel and analytical investigation of over-the-wing propulsion/air frame inter for a short-naul aircraft at Mach number 0.6 to 0.78</li> <li>[NASA-CE-2905]</li> <li>HERALD, G. L.</li> <li>Computer-generated displays added to HEL helicopter operational trainer [AD-A043267]</li> <li>HERRICK, D. A. B.</li> <li>The effect of simulated aerodynamic heatin strength of three rocket motor case steed [RPE-TR-45]</li> <li>HERSBG, E.</li> <li>Aircraft Space Position Measurement System application of precision DME</li> <li>HEMSON, H. H.</li> <li>Theoretical parametric study of the relatin advantages or winglets and wing-tip exter [NASA-TP-1020]</li> <li>HILL, R. J.</li> <li>A procedure for predicting the life of tur engine components</li> <li>HINFICHS, P. B.</li> <li>Advanced terrain correlation techniques</li> <li>HIRST, M.</li> <li>Avionics first principles. II - Airborne in HOBBILINGER, H.</li> <li>Active flutter suppression of an airplane wing mounted external stores</li> </ul>	N77-33202 of ferences rs from N77-33114 N77-32173 ag on the els N77-32240 a - An A77-51197 type ensions N77-33192 A77-51190 radars A77-48689 with

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HOFFMAN, R.	
Reliability, availability,	
maintainability/logistics /RAM/LOG/	
	A77-50456
HOLL, R.	
Development procedures to promote reliabili	ty
	N77-33188
HOLMES, B. J.	
Flight evaluation of an advanced technology	/ light
twin-engine airplane (ATLIT)	
[ NASA-CE-2832 ]	N77-33104
HOLTZ, R. A.	
MICRON reliability analyses	
[AD-A042987]	N77-32129
HOMENTCOVSCHI, D.	
Von-equilibrium flow of an inviscid gas pas	st a
thin profile	
	A77-48289
Theory of the lifting surface in unsteady m	otion
in an inviscid fluid	
	A77-49847
HOROBJEFF, B. D.	
Further sensitivity studies of community-ai	
noise exposure (NOISENAP) prediction proc	
[AD-A041781]	N77-33686
HOVIS, J. B.	
Effectiveness of reliability system testing	non
quality and reliability	
	477-50488
HSIEH, P. Y.	
Rotorcraft flight simulation with coupled r	
aeroelastic stability analysis. Volume 3	:
?rogrammer's manual	
f AD-A0429071	N77-32143
HUFFHAN, J. K.	
Subsonic longitudinal aerodynamic character	istics
and engine pressure distributions for an	
aircraft with an integrated scramjet desi	gned
for Mach 6 cruise	
[ NASA-TM-X-73911 ]	N77-33108
HUGHES, P. F.	
History and development of the SCORE pod	
	A77-51188
HUMSKI, B.	
Ar accurate angular position and angular ve	
instrument based on an optical incrementa	
[WRE-TN-1730 (WR/D) ]	N77-33480

HURLEY, M. J. The GPS Control Segment and its service to the GPS User A77-51202

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TACOB. C

14002, 00	
Conditions of physical validity in the lin aerodynamics of supersonic jets	lear
derodynumics of supersonic jets	
	A77-51608
IAKOVLEV, S.	
Jakowlew Jak-42 - Uncomplicated, reliable,	
economical	
	A77-49653
INNIS, R. C.	
Longitudinal handling qualities during app	roach
and landing of a powered lift STOL aircr	aft
[NASA-TH-X-62144]	N77-33151

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JACKSON, S. B. The development of new designs of emergency parachutes for ejection seats	y escape
	177-49947
JACOBS, L. D.	
Cabin noise behavior of a USB STOL transpor	t
FAIAA PAPEB 77-13651	177-51117
JACOBSEN, B. A.	
A flight investigation of the wake turbuler	ice
alleviation resulting from a flap configu	iration
change on a E-747 aircraft	
[ NASA-TM-73263 ]	N77-33130
JACOBSON, I. D.	
The development of a model for predicting	
passenger acceptance of short-haul air	
transportation systems	
[NASA-CR-145250]	977-33148

JEWELL, W. P. Researcher's guide to the NASA Ames Flight Simulator for Advanced Aircraft (PSAA) [NASA-CR-2875] N77-33230 JOHNSON, W. H. Design of a cascade fire apparatus for testing countermeasure effectiveness [AD-A043176] N77-32101 JOHNSON, W. S. Plight inspection data and crack initiation times A77-50466 JOHNSTON, P. J. Subsonic longitudinal aerodynamic characteristics and engine pressure distributions for an aircraft with an integrated scramjet designed for Mach 6 cruise [NASA-TM-4-73911] N77-33108 JOBSSTON, T. S. Convex 76 - Alccraft noise and air traffic control A77-49225 JONES, W. L. State-of-the-act of turbofan engine noise control [NASA-TM-73734] N77-33166 JONES, W. P. Unsteady supersonic aerodynamic theory for interfering surfaces by the method of potential gradient [NASA-CR-2898] N77-33121 JONES, W. R. Application of UHP adaptive array to navigation/tracking systems A77-51185 JONSON, E. C. APSATCOM terminal segment reliability test program A77-50494 JORDAN, J. M. Design of nonlinear automatic flight control systems A77-48693 JOSHI, N. C. Investigation of feasible nozzle configurations for noise reduction in turbofan and turbojet aircraft. Volume 3: Shrouded slot nozzle configurations [AD-A041732] N77-33179

## K

KAMAT, M. P. Computer simulation of light aircraft crash A77-49341 KANDIL, O. A. Three dimensional steady and unsteady asymmetric flow past wings of arbitrary planforms [NASA-CR-145235] N77-33 N77-33102 KANTOLA, R. A. Shielding aspects of heated twin jet noise [AIAA PAPER 77-1288] A77-51048 KARCHMER, A. M. Heasurement of far field combustion noise from a turbofan engine using coherence functions [AIAA PAPER 77-1277] A77-5 A77-51038 Identification and measurement of combustion noise from a turboran engine using correlation and coherence techniques
[NASA-TM-73747] N77-33162 Measurement of far field combustion noise from a turbofan engine using coherence functions [NASA-TM-73748] N77-33163 [AD-A041502] N77-32145 KAOPMAN, J. Y. A-37B fatigue sensor evaluation program: Pull scale test and field aircraft instrumentation [AD-A042114] N77-N77-33156 KAZA, K. B. V. Nonlinear aeroelastic equations for combined flapwise bending, chordwise bending, torsion, and extension of twisted nonuniform rotor blades in forward flight [NASA-TM-74059] N77-33107 KECECIOGLU, D. Wear reliability of aircraft splines A77-50467 KELLER. R. W. H. Precise positioning of sonobuoys using AME and DME techniques A77-51196

KENDALL, R. T. Emergency escape from shuttle vehicles A77-49935 Proposed helicopter safety system for catastrophic failures 177-49936 RERSANRE D. D. A suspended anemometer system for measuring true airspeed on low-speed airplanes [ NASA-TN-D-85231 N77-33157 RHALL, B. B. Perodynamic and thermodynamic characteristics of kerosene-spray flames A77-48181 KHOKHLOV, B. V. Aerodynamic effects during supersonic flow past a laser beam 177-48515 KING. P. A. Investigation of factors controlling engine scheduled cverhaul: T53/T55 FAD-A0421901 N77-32162 KLOCHKOV, O. G. Aircraft electric machines with intensive cooling systems A77-50678 KNOTT, P. B. Supersonic det exhaust noise investigation. Volume 4: Acoustic far-field/near-field data report FAD-A041819] N77-33177 N. W. H. RO, The initial region of subsonic coaxial jets. II - -A77-49564 KOBPBICK, B. G. Engine structural integrity program (ENSIP) N77-33182 KOFF. B. L. Aircraft engine design and development through lessons learned N77-33190 KOPSKEY, M. G. Cold-air performance of a 12.766-centimeter-tip-diameter axial-flow cooled turbine. 3: Effect of rotor tip clearance on overall performance of a solid blade configuration [NASA-TP-1032] N77-32082 KOHARCHECK, A. Wear reliability of aircraft splines A77-50467 KOHL, R. H. New lidar concept for measuring the slant range transmission in aircraft landing approaches A77-48698 KOBBFELD, G. H. Wide area illuminator development for US Coast Guard HB-3F belicopter N77 [AD-A041425] N77-32132 KORRELL, P. The determination of the center-of-gravity position with the aid of dimensionless values A77-49654 KORYCINSKI, P. P. The liquid hydrogen option for the subsonic transport - A status report 177-48819 KOSTIA, T. Analysis of air accidents involving airplanes or helicopters of various types of application [NASA-TT-F-17443] N77-3: N77-33128 KRAMBR, A. Some aspects of the development of air traffic of the Socialist States. II 177-49651 KRAMER, J. L. The GPS Control Segment and its service to the GPS Oser A77-51202 KRAUSE, H. Electroenergy supply for airports. IV 477-49658 KRAUSE. W. Noise emission of the agricultural aircraft 2-37. I - Sound intensity level measurements at the agricultural aircraft 2-37. II - Sound intensity level measurements at an agricultural airport A77-49656

PERSONAL AUTHOR INDEX

KEBIFELDT, J.	
Multiple curved descending approaches and	the air
traffic control problem	
[NASA-TM-78430]	N77-32104
KROBLL, L.	
The new airport radar systems	A77-47979
KROBNERT, G.	R//-4/3/3
The helicopter Ka-26 in the Special Purpos	<u>م</u>
Flights Sector of Interflug. II	-
11-1-100 000001 01 1100111430 av	A77-49657
KRUCZYNSKI, L. R.	
Global positioning system navigation algor	ithms
······································	N77-32103
KUHLTHAU, A. R.	
The development of a model for predicting	
passenger acceptance of short-haul air	
transportation systems	
[ NASA-CR-145250 ]	N77-33148
KUHN, T. B.	
Pollution reduction technology program for	small
jet aircraft engines, phase 1	
[ NA SA-CR-135214 ]	N77-33168
KVATERNIK, R. G.	- <b>d</b>
Nonlinear aeroelastic equations for combin-	
flapwise bending, chordwise bending, tor and extension of twisted nonuniform roto	sion,
in forward flight	Diddes
[NASA-TM-74059]	N77-33107
KWAN, A. S. H.	
The initial region of subsonic coaxial jet:	s. II
,	177-49564
KYSEB, A. C.	
An elementary analysis of the effect of sw	eep,
Mach number, and lift coefficient on	
wing-structure weight	
[ NA SA-TM-74072]	N77-33146
-	
L	
LA PADULA, C. D.	
A mathematical model of transcontinental b	alloon
[INF PAPER 77-167]	A77-51460
LAMBOURION, J.	A77 31400
Investigation of subsonic fan noise sources	s bv
fluctuating pressure measurements on rota	
blades	2
[AIAA PAPER 77-1321]	A77-51075
LANCASTER, B. J.	
Initial unsteady aerodynamic measurements	ofa
circulation controlled airfoil and an	
oscillating flow wind tunnel	
[AD-A042102]	N77-33122
LANGHANS, R. A.	
Transonic aerodynamic characteristics of a	
supercritical-wing transport model with trailing-edge controls	
(NASA-TN-X-3431]	N77-33116
Transonic aerodynamic characteristics of a	011-33110
remover deronance characteristres of g	

Transonic aerodynamic characteristics of a supercritical-wing transport model with trailing-edge controls, supplement, part 1 [NASA-TH-K-3431-PT-1] Transonic aerodynamic characteristics of a

supercritical-wing transport model with trailing-edge controls [NASA-TH-X-3431-PT-2] N77-33118 Transonic aerodynamic characteristics of a

supercritical-wing transport model with trailing edge controls N77-33119 [NASA-TM-4-3431-PT-3] N77-33119 Transonic aerodynamic characteristics of a supercritical-wing transport model with trailing-adge controls [NASA-TM-4-3431-PT-4] N77-33120

LARSON, R. S. Theoretical jet exhaust noise model for the duct burning turbofan [AIAA PAPER 77-1264] LAWHERD, N. Position location systems technology LE GRIVES, B.

New computation method of turbine blades film cooling efficiency [ONERA, TP NO. 1977-85] h77-50988 LECLBRE, G. Techniques and facilities used at ONERA /Modane

Center/ for long tests [ONERA, IP NO. 1977-123] A77-51002

B-8

•

LEE, A.
An experimental investigation of helicopter rotor high frequency broadband noise
[AIAA PAPER 77-1339] A77-51092
LEE, C. H.
Subsystem design analysis light weight alternator
(model test program). Addendum 2 [AD-A041257]
LEHNAN, J. S.
Researcher's guide to the NASA Ames Flight
Simulator for Advanced Aircraft (PSAA)
[NASA-CR-2875] N77-33230 LELARGE, A.
Simultaneous characterization of jet noise sources
and acoustic field by a new application of
conditional sampling
[AIAA PAPER 77-1349] A77-51102 LEVCHENKO, V. H.
Some regularities of the wearing of fuel pump
plunger spheres
A77-49374
LEWY, S. Investigation of subsonic fan noise sources by
fluctuating pressure measurements on rotating
blades
[AIAA PAPEB 77-1321] A77-51075
LINKO, G. I. Construction and design principles of aircraft
qas-turbine engines
A77-50684
LINSCOTT, B. S.
Experimental data and theoretical analysis of an operating 100 kW wind turbine
LISMAN, P. H.
Accuracy evaluation of augmented multilateration
tracking systems A77-51182
LIU, C. H.
Coustic scattering of point sources by a moving /
prolate spheroid
[AIAA PAPER 77-1326] A77-51080
LODGE, C. G.
LODGE, C. G. <sup>1</sup> practical optimum selection procedure for a motivator in active flutter suppression system
LODGE, C. G. <sup>1</sup> practical optimum selection procedure for a motivator in active flutter suppression system design on an aircraft with underwing stores
LODGE, C. G. <sup>1</sup> practical optimum selection procedure for a motivator in active flutter suppression system design cn an aircraft with underwing stores N77-33209
LODGE, C. G. <sup>1</sup> practical optimum selection procedure for a motivator in active flutter suppression system design cn an aircraft with underwing stores N77-33209 LOPEZ, H. L.
LODGE, C. G. <sup>1</sup> practical optimum selection procedure for a motivator in active flutter suppression system design cn an aircraft with underwing stores N77-33209 LOPEZ, H. L. Wind tunnel and analytical investigation of over-the-wing propulsion/air frame interferences
LODGE, C. G. <sup>3</sup> practical optimum selection procedure for a motivator in active flutter suppression system design cn an aircraft with underwing stores N77-33209 LOPEZ, H. L. Wind tunnel and analytical investigation of over-the-wing propulsion/air frame interferences for a short-haul aircraft at Mach numbers from
LODGE, C. G. <sup>1</sup> practical optimum selection procedure for a motivator in active flutter suppression system design cn an aircraft with underwing stores N77-33209 LOPEZ, H. L. Wind tunnel and analytical investigation of over-the-wing propulsion/air frame interferences for a short-haul aircraft at Mach numbers from 0.6 to 0.78
LODGE, C. G. <sup>1</sup> practical optimum selection procedure for a motivator in active flutter suppression system design cn an aircraft with underwing stores N77-33209 LOPEZ, H. L. Wind tunnel and analytical investigation of over-the-wing propulsion/air frame interferences for a short-haul aircraft at Mach numbers from 0.6 to 0.78 [NASA-CR-2905] N77-33114
LODGE, C. G. <sup>1</sup> practical optimum selection procedure for a motivator in active flutter suppression system design cn an aircraft with underwing stores N77-33209 LOPEZ, H. L. Wind tunnel and analytical investigation of over-the-wing propulsion/air frame interferences for a short-haul aircraft at Mach numbers from 0.6 to 0.78 [NASA-CR-2905] N77-33114 LOVIDSKII, S. I. Construction and design principles of aircraft
LODGE, C. G. <sup>1</sup> practical optimum selection procedure for a motivator in active flutter suppression system design cn an aircraft with underwing stores N77-33209 LOPEZ, H. L. Wind tunnel and analytical investigation of over-the-wing propulsion/air frame interferences for a short-haul aircraft at Mach numbers from 0.6 to 0.78 [NASA-CR-2905] N77-33114 LOVIESKII, S. I. Construction and design principles of aircraft qas-turbine engines
LODGE, C. G. <sup>3</sup> practical optimum selection procedure for a motivator in active flutter suppression system design cn an aircraft with underwing stores N77-33209 LOPEZ, H. L. Wind tunnel and analytical investigation of over-the-wing propulsion/air frame interferences for a short-haul aircraft at Mach numbers from 0.6 to 0.78 [NASA-CR-2905] N77-33114 LOVIBSKII, S. I. Construction and design principles of aircraft gas-turbine engines A77-50684
LODGE, C. G. <sup>1</sup> practical optimum selection procedure for a motivator in active flutter suppression system design cn an aircraft with underwing stores N77-33209 LOPEZ, H. L. Wind tunnel and analytical investigation of over-the-wing propulsion/air frame interferences for a short-haul aircraft at Mach numbers from 0.6 to 0.78 [NASA-CR-2905] N77-33114 LOVIESKII, S. I. Construction and design principles of aircraft qas-turbine engines
LODGE, C. G. <sup>3</sup> practical optimum selection procedure for a motivator in active flutter suppression system design cn an aircraft with underwing stores N77-33209 LOPEZ, H. L. Wind tunnel and analytical investigation of over-the-wing propulsion/air frame interferences for a short-haul aircraft at Mach numbers from 0.6 to 0.78 [NASA-CR-2905] N77-33114 LOVIESKII, S. I. Construction and design principles of aircraft qas-turbine engines A77-50684 LOVIS, D. L-band antenna for aircraft-to-satellite communications
LODGE, C. G. <sup>1</sup> practical optimum selection procedure for a motivator in active flutter suppression system design cn an aircraft with underwing stores N77-33209 LOPEZ, H. L. Wind tunnel and analytical investigation of over-the-wing propulsion/air frame interferences for a short-haul aircraft at Mach numbers from 0.6 to 0.78 [NASA-CR-2905] N77-33114 LOVIBSKII, S. I. Construction and design principles of aircraft qas-turbine engines N77-50684 LOVIS, D. L-band antenna for aircraft-to-satellite communications N77-48362
LODGE, C. G. <sup>1</sup> practical optimum selection procedure for a motivator in active flutter suppression system design cn an aircraft with underwing stores N77-33209 LOPEZ, H. L. Wind tunnel and analytical investigation of over-the-wing propulsion/air frame interferences for a short-haul aircraft at Mach numbers from 0.6 to 0.78 [NASA-CR-2905] N77-33114 LOVIBSKII, S. I. Construction and design principles of aircraft qas-turbine engines A77-50684 LOVIS, D. L-band antenna for aircraft-to-satellite communications A77-48362 LOW, J. K. C.
LODGE, C. G. <sup>1</sup> practical optimum selection procedure for a motivator in active flutter suppression system design cn an aircraft with underwing stores N77-33209 LOPEZ, H. L. Wind tunnel and analytical investigation of over-the-wing propulsion/air frame interferences for a short-haul aircraft at Mach numbers from 0.6 to 0.78 [NASA-CR-2905] N77-33114 LOVIBSKII, S. I. Construction and design principles of aircraft qas-turbine engines N77-50684 LOVIS, D. L-band antenna for aircraft-to-satellite communications N77-48362
LODGE, C. G. <sup>1</sup> practical optimum selection procedure for a motivator in active flutter suppression system design cn an aircraft with underwing stores N77-33209 LOPEZ, H. L. Wind tunnel and analytical investigation of over-the-wing propulsion/air frame interferences for a short-haul aircraft at Mach numbers from 0.6 to 0.78 [NASA-CR-2905] N77-33114 LOVIBSKII, S. I. Construction and design principles of aircraft qas-turbine engines A77-50684 LOVIS, D. L-band antenna for aircraft-to-satellite communications A77-48362 LOW, J. K. C. Effects of forward motion on jet and core noise [AIAA PAPPER 77-1330] A77-51084 LU, H. Y.
LODGE, C. G. <sup>1</sup> practical optimum selection procedure for a motivator in active flutter suppression system design cn an aircraft with underwing stores N77-33209 LOPEZ, H. L. Wind tunnel and analytical investigation of over-the-wing propulsion/air frame interferences for a short-haul aircraft at Mach numbers from 0.6 to 0.78 [NASA-CR-2905] N77-33114 LOVIESKI, S. I. Construction and design principles of aircraft qas-turbine engines A77-50684 LOVIS, D. L-band antenna for aircraft-to-satellite communications A77-48362 LOW, J. K. C. Effects of forward motion on jet and core noise [AIAA PAPER 77-1330] LU, H. Y. An analytical model for entropy noise of subsonic
LODGE, C. G. <sup>1</sup> practical optimum selection procedure for a motivator in active flutter suppression system design cn an aircraft with underwing stores N77-33209 LOPEZ, H. L. Wind tunnel and analytical investigation of over-the-wing propulsion/air frame interferences for a short-haul aircraft at Mach numbers from 0.6 to 0.78 [NASA-CR-2905] N77-33114 LOVIBSAL, S. I. Construction and design principles of aircraft qas-turbine engines A77-50664 LOVIS, D. L-band antenna for aircraft-to-satellite communications A77-48362 LOW, J. K. C. Effects of forward motion on jet and core noise [AIAA PAPER 77-1330] A77-51084 LU, H. Y. An analytical model for entropy noise of subsonic nozzle flow
LODGE, C. G. <sup>1</sup> practical optimum selection procedure for a motivator in active flutter suppression system design cn an aircraft with underwing stores N77-33209 LOPEZ, H. L. Wind tunnel and analytical investigation of over-the-wing propulsion/air frame interferences for a short-haul aircraft at Mach numbers from 0.6 to 0.78 [NASA-CR-2905] N77-33114 LOVIESKI, S. I. Construction and design principles of aircraft qas-turbine engines A77-50684 LOVIS, D. L-band antenna for aircraft-to-satellite communications A77-48362 LOW, J. K. C. Effects of forward motion on jet and core noise [AIAA PAPER 77-1330] LU, H. Y. An analytical model for entropy noise of subsonic
LODGE, C. G. <sup>1</sup> practical optimum selection procedure for a motivator in active flutter suppression system design cn an aircraft with underwing stores N77-33209 LOPEZ, H. L. Wind tunnel and analytical investigation of over-the-wing propulsion/air frame interferences for a short-haul aircraft at Mach numbers from 0.6 to 0.78 [NASA-CR-2905] N77-33114 LOVIBSKII, S. I. Construction and design principles of aircraft qas-turbine engines A77-50684 LOVIS, D. L-band antenna for aircraft-to-satellite communications A77-48362 LOW, J. K. C. Effects of forward motion on jet and core noise [AIAA PAPER 77-1330] A77-51084 LU, H. Y. An analytical model for entropy noise of subsonic nozzle flow [AIAA PAPER 77-1366] A77-51118 LINN, J. J. Single pass Doppler positioning for Search and
LODGE, C. G. <sup>1</sup> practical optimum selection procedure for a motivator in active flutter suppression system design cn an aircraft with underwing stores N77-33209 LOPEZ, H. L. Wind tunnel and analytical investigation of over-the-wing propulsion/air frame interferences for a short-haul aircraft at Mach numbers from 0.6 to 0.78 [NASA-CR-2905] N77-33114 LOVIBSKII, S. I. Construction and design principles of aircraft qas-turbine engines A77-50684 LOVIS, D. L-band antenna for aircraft-to-satellite communications A77-48362 LOW, J. K. C. Effects of forward motion on jet and core noise [NAN PAPER 77-1330] LU, H. Y. An analytical model for entropy noise of subsonic nozzle flow [AIPA PAPER 77-1366] LYNN, J. J. Single pass Doppler positioning for Search and Rescue satellite missions
LODGE, C. G. <sup>1</sup> practical optimum selection procedure for a motivator in active flutter suppression system design cn an aircraft with underwing stores N77-33209 LOPEZ, H. L. Wind tunnel and analytical investigation of over-the-wing propulsion/air frame interferences for a short-haul aircraft at Mach numbers from 0.6 to 0.78 [NASA-CR-2905] N77-33114 LOVIESKI, S. I. Construction and design principles of aircraft qas-turbine engines A77-50684 LOVIS, D. L-band antenna for aircraft-to-satellite communications A77-48362 LOW, J. K. C. Effects of forward motion on jet and core noise [AIAA PAPER 77-1330] LU, H. Y. An analytical model for entropy noise of subsonic nozzle flow [AIFA PAPER 77-1366] LINN, J. J. Single pass Dorpler positioning for Search and Rescue satellite missions A77-51186
LODGE, C. G. <sup>1</sup> practical optimum selection procedure for a motivator in active flutter suppression system design cn an aircraft with underwing stores N77-33209 LOPEZ, H. L. Wind tunnel and analytical investigation of over-the-wing propulsion/air frame interferences for a short-haul aircraft at Mach numbers from 0.6 to 0.78 [NASA-CR-2905] N77-33114 LOVIBSKII, S. I. Construction and design principles of aircraft qas-turbine engines A77-50684 LOVIS, D. L-band antenna for aircraft-to-satellite communications A77-48362 LOW, J. K. C. Effects of forward motion on jet and core noise [AIAA PAPER 77-1330] A77-51084 LU, H. Y. An analytical model for entropy noise of subsonic nozzle flow [AIAA PAPER 77-1366] A77-51118 LINN, J. J. Single pass Doppler positioning for Search and Rescue satellite missions A77-51186 LYONS, V.
LODGE, C. G. <sup>1</sup> practical optimum selection procedure for a motivator in active flutter suppression system design cn an aircraft with underwing stores N77-33209 LOPEZ, H. L. Wind tunnel and analytical investigation of over-the-wing propulsion/air frame interferences for a short-haul aircraft at Mach numbers from 0.6 to 0.78 [NASA-CR-2905] N77-33114 LOVIESKI, S. I. Construction and design principles of aircraft qas-turbine engines A77-50684 LOVIS, D. L-band antenna for aircraft-to-satellite communications A77-48362 LOW, J. K. C. Effects of forward motion on jet and core noise [AIAA PAPER 77-1330] LU, H. Y. An analytical model for entropy noise of subsonic nozzle flow [AIAA PAPER 77-1366] LINN, J. J. Single pass Dorpler positioning for Search and Rescue satellite missions A77-51186 LYONS, V. The effect of drop size on emissions from the primary zone of a qas turbine type combustor
LODGE, C. G. <sup>1</sup> practical optimum selection procedure for a motivator in active flutter suppression system design cn an aircraft with underwing stores N77-33209 LOPEZ, H. L. Wind tunnel and analytical investigation of over-the-wing propulsion/air frame interferences for a short-haul aircraft at Mach numbers from 0.6 to 0.78 [NASA-CR-2905] N77-33114 LOVIBSK1-CS. I. Construction and design principles of aircraft qas-turbine engines A77-50664 LOVIS, D. L-band antenna for aircraft-to-satellite communications N77-48362 LOW, J. K. C. Effects of forward motion on jet and core noise [AIAA PAPER 77-1330] A77-51084 LU, H. Y. An analytical model for entropy noise of subsonic nozzle flow [AIAA PAPER 77-1366] A77-51118 LINN, J. J. Single pass Doppler positioning for Search and Rescue satellite missions A77-48174
LODGE, C. G. <sup>1</sup> practical optimum selection procedure for a motivator in active flutter suppression system design cn an aircraft with underwing stores N77-33209 LOPEZ, H. L. Wind tunnel and analytical investigation of over-the-wing propulsion/air frame interferences for a short-haul aircraft at Mach numbers from 0.6 to 0.78 [NASA-CR-2905] N77-33114 LOVIESKII, S. I. Construction and design principles of aircraft qas-turbine engines A77-50684 LOVIS, D. L-band antenna for aircraft-to-satellite communications [AIAA PAPER 77-1330] LU, H. Y. An analytical model for entropy noise of subsonic nozzle flow [AIAA PAPER 77-1366] LINN, J. J. Single pass Doppler positioning for Search and Rescue satellite missions A77-48174 LIONS, V. The effect of drop size on emissions from the primary zone of a gas turbine type combustor A77-48174 LISENKO, N. H.
LODGE, C. G. <sup>1</sup> practical optimum selection procedure for a motivator in active flutter suppression system design cn an aircraft with underwing stores N77-33209 LOPEZ, H. L. Wind tunnel and analytical investigation of over-the-wing propulsion/air frame interferences for a short-haul aircraft at Mach numbers from 0.6 to 0.78 [NASA-CR-2905] N77-33114 LOVIBSK1-CS. I. Construction and design principles of aircraft qas-turbine engines A77-50664 LOVIS, D. L-band antenna for aircraft-to-satellite communications N77-48362 LOW, J. K. C. Effects of forward motion on jet and core noise [AIAA PAPER 77-1330] A77-51084 LU, H. Y. An analytical model for entropy noise of subsonic nozzle flow [AIAA PAPER 77-1366] A77-51118 LINN, J. J. Single pass Doppler positioning for Search and Rescue satellite missions A77-48174

## М

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MANHABDT, P. D. Numerical prediction of aeroacoustic jet-flap flows (AIAA PAPEB 77-1316) A77-51071

MARN, M. J.	
Transonic aerodynamic characteristics of a	
<pre>supercritical-wing transport model with trailing-edge controls</pre>	
[NASA-IM-X-3431]	N77-33116
Transonic aerodynamic characteristics of a	
supercritical-wing transport model with trailing-edge controls, supplement, part	1
[NASA-TM-X-3431-PT-1]	N77-33117
Transonic aerodynamic characteristics of a	
supercritical-wing transport model with trailing-edge controls	
[NASA-TN-X-3431-PT-2]	N77-33118
Transonic aerodynamic characteristics of a	
supercritical-wing transport model with t	trailing
edge controls [NASA-TM-I-3431-PT-3]	N77-33119
Transonic aerodynamic characteristics of a	
supercritical-wing transport model with	
trailing-edge controls [NASA-TH-K-3431-PT-4]	N77-33120
MANTAY, W. R.	
Some results of the testing of a full-scale	e Ogee
tip helicopter rotor; acoustics, loads, a	and
performance [AIAA PAPER 77-1340]	A77-51093
MABUCHAROV, A. A.	-
Practical aerodynamics of maneuvering airc	raft /A
manual for flight personnel/	A77-50693
MARCHESE, V. P.	
Fluidic event sequencing subsystem for AAE	
	A77-49934
MARBCHAL, J. P. CPM56 turbofan maintainability and	
reliability-oriented development	
	N77-33189
MARRA, P. J. Trapped rubber processing for advanced com	051465
[SME PAPER EN 76-172]	A77-51009
MARSH, A. H.	
Airframe noise - A status report, 1977	177 61033
(AIAA PAPBE 77-1268) MASBNTEN, W. K.	A77-51032
Application of UHP adaptive array to	
	-77 54405
Application of UHP adaptive array to navigation/tracking systems	A77-51185
Application of UHP adaptive array to	
Application of UHP adaptive array to navigation/tracking systems HASSIEB, P. P. Experimental results of large-scale struct jet flows and their relation to jet noise	ures in
<pre>Application of UHP adaptive array to navigation/tracking systems MASSIEB, P. P. Experimental results of large-scale struct jet flows and their relation to jet noise production</pre>	ures in e
Application of UHP adaptive array to navigation/tracking systems HASSIEB, P. P. Experimental results of large-scale struct jet flows and their relation to jet noise	ures in
Application of UHP adaptive array to navigation/tracking systems MASSIER, P. P. Experimental results of large-scale struct jet flows and their relation to jet noise production [AIAA PAPER 77-1350] MAULARD, J. Coherent structures in the mixing zone of a	ures 1n e N77-51103
<pre>Application of UHP adaptive array to navigation/tracking systems BASSIEB, P. P. Experimental results of large-scale struct jet flows and their relation to jet noise production [AIAA PAPEE 77-1350] BAOLARD, J. Coherent structures in the mixing zone of a subsonic hot free jet</pre>	ures 1n e A77-51103 a
<pre>Application of UHP adaptive array to navigation/tracking systems HASSIEB, P. P. Experimental results of large-scale struct jet flows and their relation to jet noise production [AIAA PAPEE 77-1350] HAULABD, J. Coherent structures in the mixing zone of a subsonic hot free jet {OMERA, FP NO. 1977-88]</pre>	ures in e A77-51103 a A77-50989
<ul> <li>Application of UHP adaptive array to navigation/tracking systems</li> <li>EASSIEB, P. P. Experimental results of large-scale struct jet flows and their relation to jet noise production [AIAA PAPER 77-1350]</li> <li>MADLARD, J. Coherent structures in the mixing zone of a subsonic hot free jet [ONERA, FP NO. 1977-88]</li> <li>Simultaneous characterization of jet noise and acoustic field by a new application of</li> </ul>	ures 1n e A77-51103 a A77-50989 sources
<pre>Application of UHP adaptive array to navigation/tracking systems #ASSIEB, P. P. Experimental results of large-scale struct jet flows and their relation to jet noise production [AIAA PAPEE 77-1350] #AULABD, J. Coherent structures in the mixing zone of a subsonic hot free jet fOMERA, FP NO. 1977-88] Simultaneous characterization of jet noise and acoustic field by a new application of conditional sampling</pre>	ures 1n e A77-51103 a A77-50989 sources of
<pre>Application of UHP adaptive array to navigation/tracking systems HASSIEB, P. P. Experimental results of large-scale struct jet flows and their relation to jet noise production [AIAA PAPER 77-1350] HOLLABD, J. Coherent structures in the mixing zone of a subsonic hot free jet fowERA, FP NO. 1977-88] Simultaneous characterization of jet noise and acoustic field by a new application of conditional sampling [AIAA PAPER 77-1349]</pre>	ures 1n e A77-51103 a A77-50989 sources
<ul> <li>Application of UHP adaptive array to navigation/tracking systems</li> <li>EASSIEB, P. P.</li> <li>Experimental results of large-scale struct jet flows and their relation to jet noise production [AIAA PAPZE 77-1350]</li> <li>HAULABD, J.</li> <li>Coherent structures in the mixing zone of a subsonic hot free jet fONERA, FP NO. 1977-88]</li> <li>Simultaneous characterization of jet noise and acoustic field by a new application of conditional sampling</li> </ul>	ures 1n e A77-51103 a A77-50989 sources of A77-51102
<pre>Application of UHP adaptive array to navigation/tracking systems MASSIEB, P. F. Experimental results of large-scale struct jet flows and their relation to jet noise production [AIAA PAPER 77-1350] MAULARD, J. Coherent structures in the mixing zone of a subsonic hot free jet fONERA, FP ND. 1977-88] Simultaneous characterization of jet noise and acoustic field by a new application of conditional sampling [AIAA PAPER 77-1349] MAURER, W. D.</pre>	ures 1n a A77-51103 a A77-50989 sources of A77-51102 or
<ul> <li>Application of UHP adaptive array to navigation/tracking systems</li> <li>MASSIEB, P. F.</li> <li>Experimental results of large-scale struct jet flows and their relation to jet noise production [ATAA PAPER 77-1350]</li> <li>MAULARD, J.</li> <li>Coherent structures in the mixing zone of a subsonic hot free jet fongran for an airborne minicomputer</li> </ul>	ures 1n e A77-51103 a A77-50989 sources of A77-51102
<ul> <li>Application of UHP adaptive array to navigation/tracking systems</li> <li>BASSIEB, P. P.</li> <li>Experimental results of large-scale struct jet flows and their relation to jet noise production [AIAA PAPEE 77-1350]</li> <li>MAULABD, J.</li> <li>Coherent structures in the mixing zone of a subsonic hot free jet fONERA, FP NO. 1977-88]</li> <li>Simultaneous characterization of jet noise and acoustic field by a new application of conditional sampling [AIAA PAPEE 77-1349]</li> <li>MAUREE, W. D.</li> <li>Proving the correctness of a flight-directer program for an airborne minicomputer</li> <li>BAUS, J. E.</li> </ul>	x77-51103 a A77-50989 sources of A77-51102 or A77-51261
<ul> <li>Application of UHP adaptive array to navigation/tracking systems</li> <li>MASSIEB, P. F.</li> <li>Experimental results of large-scale struct jet flows and their relation to jet noise production [ATAA PAPEE 77-1350]</li> <li>MAULARD, J.</li> <li>Coherent structures in the mixing zone of a subsonic hot free jet fONERA, PP NO. 1977-88]</li> <li>Simultaneous characterization of jet noise and acoustic field by a new application of conditional sampling [ATAA PAPEE 77-1349]</li> <li>MAUREE, W. D.</li> <li>Proving the correctness of a flight-direct program for an airborne minicomputer</li> <li>HAVS, J. E.</li> <li>Investigation of feasible nozzle configuration for noise reduction in turbofan and turb</li> </ul>	ures 1n e A77-51103 a A77-50989 sources of A77-51102 or A77-51261 tions ofet
<ul> <li>Application of UHP adaptive array to navigation/tracking systems</li> <li>BASSIEB, P. P.</li> <li>Experimental results of large-scale struct jet flows and their relation to jet noise production [AIAA PAPEE 77-1350]</li> <li>HAULABD, J.</li> <li>Coherent structures in the miring zone of a subsonic hot free jet fONERA, FP NO. 1977-88]</li> <li>Simultaneous characterization of jet noise and acoustic field by a new application of conditional sampling [AIAA PAPEE 77-1349]</li> <li>HAUREE, W. D.</li> <li>Proving the correctness of a flight-director program for an airborne minicomputer</li> <li>HAUS, J. E.</li> <li>Investigation of feasible nozzle configuration for noise reduction in turbofan and turb aircraft. Volume 3: Shrouded slot nozzi</li> </ul>	ures 1n e A77-51103 a A77-50989 sources of A77-51102 or A77-51261 tions ofet
<ul> <li>Application of UHP adaptive array to navigation/tracking systems</li> <li>MASSIEB, P. F.</li> <li>Experimental results of large-scale struct jet flows and their relation to jet noise production [AIAA PAPER 77-1350]</li> <li>MOLABD, J.</li> <li>Coherent structures in the mixing zone of a subsonic hot free jet fONERA, FP NO. 1977-88]</li> <li>Simultaneous characterization of jet noise and acoustic field by a new application of conditional sampling [AIAA PAPEE 77-1349]</li> <li>MAUBER, W. D.</li> <li>Proving the correctness of a flight-direct program for an airborne minicomputer</li> <li>MAUS, J. B.</li> <li>Investigation of feasible nozzle configurat for noise reduction in turbofan and turb aircraft. Volume 3: Shrouded slot nozzl configurations ,</li> </ul>	ures in a A77-51103 a A77-50989 sources of A77-51102 or A77-51261 tions ojet le
<ul> <li>Application of UHP adaptive array to navigation/tracking systems</li> <li>HASSIEB, P. P.</li> <li>Experimental results of large-scale struct jet flows and their relation to jet noise production [AIAA PAPEE 77-1350]</li> <li>HAULABD, J.</li> <li>Coherent structures in the mixing zone of a subsonic hot free jet {ONERA, FP NO. 1977-88]</li> <li>Simultaneous characterization of jet noise and acoustic field by a new application of conditional sampling [AIAA PAPEE 77-1349]</li> <li>HAUREB, W. D.</li> <li>Proving the correctness of a flight-director program for an airborne minicomputer</li> <li>HAUS, J. E.</li> <li>Investigation of feasible nozzle configurat for noise reduction in turbofan and turbo aircraft. Volume 3: Shrouded slot nozz. configurationas , [AD-A041782]</li> <li>HAZELSKY, B.</li> </ul>	x77-51103 a A77-50989 sources of A77-51102 or A77-51261 tions ojet le N77-33179
<ul> <li>Application of UHP adaptive array to navigation/tracking systems</li> <li>MASSIEB, P. F.</li> <li>Experimental results of large-scale struct jet flows and their relation to jet noise production [AIAA PAPER 77-1350]</li> <li>MOLLABD, J.</li> <li>Coherent structures in the mixing zone of a subsonic hot free jet fONERA, FP NO. 1977-88]</li> <li>Simultaneous characterization of jet noise and acoustic field by a new application of conditional sampling [AIAA PAPER 77-1349]</li> <li>MAUBER, W. D.</li> <li>Proving the correctness of a flight-direct program for an airborne minicomputer</li> <li>MAUS, J. R.</li> <li>Investigation of feasible nozzle configurat for noise reduction in turbofan and turb aircraft. Volume 3: Shrouded slot nozz configurationas , [AD-A041782]</li> <li>MAZELSKY, B.</li> <li>Investigation of an aluminum rolling helix</li> </ul>	x77-51103 a A77-50989 sources of A77-51102 or A77-51261 tions ojet le N77-33179
<pre>Application of UHP adaptive array to navigation/tracking systems BASSIEB, P. F. Experimental results of large-scale struct jet flows and their relation to jet noise production [AIAA PAPER 77-1350] BAOLARD, J. Coherent structures in the mixing zone of a subsonic hot free jet fowERA, FP NO. 1977-88] Simultaneous characterization of jet noise and acoustic field by a new application of conditional sampling [AIAA PAPER 77-1349] BAURERS W. D. Proving the correctness of a flight-direct program for an airborne minicomputer BAUS, J. E. Investigation of feasible nozzle configuration aircraft. Volume 3: Shrouded slot nozz: configurations , [AD-A041782] BAZELSKI, B. Investigation of an aluminum rolling helix energy absorber</pre>	ures 1n A77-51103 A77-50989 sources of A77-51102 or A77-51261 tions ojet le N77-33179 crash
<ul> <li>Application of UHP adaptive array to navigation/tracking systems</li> <li>MASSIEB, P. F.</li> <li>Experimental results of large-scale struct jet flows and their relation to jet noise production [AIAA PAPER 77-1350]</li> <li>MOLLABD, J.</li> <li>Coherent structures in the mixing zone of a subsonic hot free jet fONERA, FP NO. 1977-88]</li> <li>Simultaneous characterization of jet noise and acoustic field by a new application of conditional sampling [AIAA PAPER 77-1349]</li> <li>MAUBER, W. D.</li> <li>Proving the correctness of a flight-direct program for an airborne minicomputer</li> <li>MAUS, J. R.</li> <li>Investigation of feasible nozzle configurat for noise reduction in turbofan and turb aircraft. Volume 3: Shrouded slot nozz configurationas , [AD-A041782]</li> <li>MAZELSKY, B.</li> <li>Investigation of an aluminum rolling helix</li> </ul>	x77-51103 a A77-50989 sources of A77-51102 or A77-51261 tions ojet le N77-33179
<ul> <li>Application of UHP adaptive array to navigation/tracking systems</li> <li>HASSIEB, P. P.</li> <li>Experimental results of large-scale struct jet flows and their relation to jet noise production [AIAA PAPEE 77-1350]</li> <li>HAULABD, J.</li> <li>Coherent structures in the mixing zone of a subsonic hot free jet {ONERA, FP NO. 1977-88]</li> <li>Simultaneous characterization of jet noise and acoustic field by a new application of conditional sampling [AIAA PAPEE 77-1349]</li> <li>HAUREE, W. D.</li> <li>Proving the correctness of a flight-director program for an airborne minicomputer</li> <li>HAUS, J. E.</li> <li>Investigation of feasible nozzle configurat for noise reduction in turbofan and turbo aircraft. Volume 3: Shrouded slot nozz. configurations , [AD-A041782]</li> <li>HAZELSKY, B.</li> <li>Investigation of an aluminum rolling helix energy absorber [AD-A042084]</li> </ul>	ures in A77-51103 A77-50989 sources of A77-51102 or A77-51261 tions ojet le N77-33179 crash N77-33132
<ul> <li>Application of UHP adaptive array to navigation/tracking systems</li> <li>BASSIEB, P. P.</li> <li>Experimental results of large-scale struct jet flows and their relation to jet noise production [AIAA PAPEE 77-1350]</li> <li>HAULABD, J.</li> <li>Coherent structures in the miring zone of a subsonic hot free jet (ONERA, FP NO. 1977-88]</li> <li>Simultaneous characterization of jet noise and acoustic field by a new application of conditional sampling [AIAA PAPEE 77-1349]</li> <li>HAUREE, W. D.</li> <li>Proving the correctness of a flight-direct program for an airborne minicomputer</li> <li>HAUS, J. R.</li> <li>Investigation of feasible nozzle configurat for noise reduction in turbofan and turb aircraft. Volume 3: Shrouded slot nozz configurations , [AD-A041782]</li> <li>HAZELSKT, B.</li> <li>Investigation of an aluminum rolling helir energy absorber [AD-A042084]</li> <li>BCAINSE, K. G.</li> <li>Gas turbine temperature techniques</li> </ul>	ures 1n A77-51103 A77-50989 sources of A77-51102 or A77-51261 tions ojet le N77-33179 crash
<pre>Application of UHP adaptive array to navigation/tracking systems HASSIEB, P. F. Experimental results of large-scale struct jet flows and their relation to jet noise production [AIAA PAPER 77-1350] HAULABD, J. Coherent structures in the mixing zone of a subsonic hot free jet fONEAN, FP NO. 1977-88] Simultaneous characterization of jet noise and acoustic field by a new application of conditional sampling [AIAA PAPEE 77-1349] HAUBEB, W. D. Proving the correctness of a flight-direct program for an airborne minicomputer HAUSS, J. E. Investigation of feasible nozzle configurat for noise reduction in turbofan and turb aircraft. Volume 3: Shrouded slot nozz configurations , {AD-A041782] HAZELSKY, B. Investigation of an aluminum rolling helix energy absorber [AD-A042084] HCAINSE, K. G. Gas turbine temperature techniques HCCAULEY, J.</pre>	ures in A77-51103 A77-50989 sources of A77-51102 or A77-51261 tions ojet N77-33179 crash N77-33132 A77-50625
<pre>Application of UHP adaptive array to navigation/tracking systems HASSIEB, P. P. Experimental results of large-scale struct jet flows and their relation to jet noise production [AIAA PAPEE 77-1350] HAULABD, J. Coherent structures in the mixing zone of a subsonic hot free jet fONERA, FP NO. 1977-88] Simultaneous characterization of jet noise and acoustic field by a new application of conditional sampling [AIAA PAPEE 77-1349] HAUREE, W. D. Proving the correctness of a flight-direct program for an airborne minicomputer HAUS, J. E. Investigation of feasible nozzle configurat for noise reduction in turbofan and turb aircraft. Volume 3: Shrouded slot nozz configurations , [AD-A041782] HAZELSKT, B. Investigation of an aluminum rolling helix energy absorber [AD-A042084] HCAINSE, K. G. Gas turbine temperature techniques HCCAULET, J. Performance flight tests of the RH-53D desi growth configuration</pre>	A77-51103 A77-51103 A77-50989 sources of A77-51102 or A77-51261 tions ojet N77-33179 crash N77-33132 A77-50625 ign
<pre>Application of UHP adaptive array to navigation/tracking systems HASSIEB, P. F. Experimental results of large-scale struct jet flows and their relation to jet noise production [AIAA PAPER 77-1350] HAULABD, J. Coherent structures in the mixing zone of a subsonic hot free jet fOWERA, FP NO. 1977-88] Simultaneous characterization of jet noise and acoustic field by a new application of conditional sampling [AIAA PAPEE 77-1349] HAUEBE, W. D. Proving the correctness of a flight-director program for an airborne minicomputer HAUS, J. R. Investigation of feasible nozzle configurations fAD-A041782] HZELSKT, B. Investigation of an aluminum rolling helix energy absorber [AD-A042084] HCAINSH, K. G. Gas turbine temperature techniques HCCAULET, J. Performance flight tests of the RH-53D des: growth configuration fSER-651316]</pre>	ures in A77-51103 A77-50989 sources of A77-51102 or A77-51261 tions ojet N77-33179 crash N77-33132 A77-50625
<pre>Application of UHP adaptive array to navigation/tracking systems HASSIEB, P. F. Experimental results of large-scale struct jet flows and their relation to jet noise production [AIAA PAPEE 77-1350] HAULARD, J. Coherent structures in the mixing zone of a subsonic hot free jet [ONERA, FP NO. 1977-88] Simultaneous characterization of jet noise and acoustic field by a new application of conditional sampling [AIAA PAPEE 77-1349] HAUREE, W. D. Proving the correctness of a flight-director program for an airborne minicomputer HAUS, J. E. Investigation of feasible nozzle configuration aircraft. Volume 3: Shrouded slot nozz configurations , [AD-A041782] HAZELSKY, B. Investigation of an aluminum rolling helix energy absorber [AD-A042084] HCAINSH, K. G. Gas turbine temperature techniques HCCAULEY, J. Performance flight tests of the RH-53D des. growth configuration (SER-651316] HCOUNEYL, B. J.</pre>	A77-51103 A77-51103 A77-50989 sources of A77-51102 or A77-51261 tions ofet le N77-33179 crash N77-33132 A77-50625 ign N77-33143
<ul> <li>Application of UHP adaptive array to navigation/tracking systems</li> <li>HASSIEB, P. F.</li> <li>Experimental results of large-scale struct jet flows and their relation to jet noise production [ATAA PAPER 77-1350]</li> <li>HAULABD, J.</li> <li>Coherent structures in the miring zone of a subsonic hot free jet fONERA, FP NO. 1977-88]</li> <li>Simultaneous characterization of jet noise and acoustic field by a new application of conditional sampling [ATAA PAPER 77-1349]</li> <li>HAUEBE, W. D.</li> <li>Proving the correctness of a flight-director program for an airborne minicomputer</li> <li>HAUS, J. R.</li> <li>Investigation of feasible nozzle configuration aircraft. Volume 3: Shrouded slot nozzi configurations [AD-A041782]</li> <li>HAZELSKT, B.</li> <li>Investigation of an aluminum rolling helix energy absorber [AD-A042084]</li> <li>HCAINSH, K. G.</li> <li>Gas turbine temperature techniques</li> <li>MCCAULET, J.</li> <li>Performance flight tests of the RH-53D desi growth configuration (SER-651316]</li> <li>HCOOBHELL, B. J.</li> <li>Accelerated mission test: A vital reliabit</li> </ul>	A77-51103 A77-51103 A77-50989 sources of A77-51102 or A77-51261 tions ofet le N77-33179 crash N77-33132 A77-50625 ign N77-33143
<pre>Application of UHP adaptive array to navigation/tracking systems MASSIEB, P. F. Experimental results of large-scale struct jet flows and their relation to jet noise production [AIAA PAPEE 77-1350] MADLARD, J. Coherent structures in the miring zone of a subsonic hot free jet [ONERA, FP NO. 1977-88] Simultaneous characterization of jet noise and acoustic field by a new application of conditional sampling [AIAA PAPEE 77-1349] MUREE, W. D. Proving the correctness of a flight-director program for an airborne minicomputer MAUS, J. E. Investigation of feasible nozzle configurations for noise reduction in turbofan and turb aircraft. Volume 3: Shronded slot nozzli configurations ; [AD-A041762] MZZELSKT, B. Investigation of an aluminum rolling helix energy absorber [AD-A042084] MCCAULEY, J. Performance flight tests of the RH-53D des growth configuration</pre>	A77-51103 A77-51103 A77-50989 sources of A77-51102 or A77-51261 tions ojet le N77-33179 crash N77-33132 A77-50625 ign N77-33143 lity tool N77-33196
<pre>Application of UHP adaptive array to navigation/tracking systems HASSIEB, P. P. Experimental results of large-scale struct jet flows and their relation to jet noise production [AIAA PAPEE 77-1350] HAULABD, J. Coherent structures in the mixing zone of a subsonic hot free jet fONERA, FP NO. 1977-88] Simultaneous characterization of jet noise and acoustic field by a new application of conditional sampling [AIAA PAPEE 77-1349] HAUREE, W. D. Proving the correctness of a flight-direct program for an airborne minicomputer HAUS, J. E. Investigation of feasible nozzle configurat for noise reduction in turbofan and turb aircraft. Volume 3: Shrouded slot nozz configurations , [AD-A041782] HAZELSKY, B. Investigation of an aluminum rolling helix energy absorber [AD-A042084] HCAINSH, K. G. Gas turbine temperature techniques MCCAULEY, J. Performance flight tests of the RH-53D desi growth configuration</pre>	A77-51103 A77-51103 A77-50989 sources of A77-51102 or A77-51261 tions ojet le N77-33179 crash N77-33132 A77-50625 ign N77-33143 lity tool N77-33196
<pre>Application of UHP adaptive array to navigation/tracking systems MASSIEB, P. F. Experimental results of large-scale struct jet flows and their relation to jet noise production [AIAA PAPEE 77-1350] MADLARD, J. Coherent structures in the miring zone of a subsonic hot free jet [ONERA, FP NO. 1977-88] Simultaneous characterization of jet noise and acoustic field by a new application of conditional sampling [AIAA PAPEE 77-1349] MUREE, W. D. Proving the correctness of a flight-direct program for an airborne minicomputer MAUS, J. E. Investigation of feasible nozzle configurat for noise reduction in turbofan and turb aircraft. Volume 3: Shronded slot nozz configurations ; [AD-A041762] MZZELSKT, B. Investigation of an aluminum rolling helix energy absorber [AD-A042084] MCCAULEY, J. Performance flight tests of the RH-53D des growth configuration</pre>	A77-51103 A77-51103 A77-50989 sources of A77-51102 or A77-51261 tions ojet le N77-33179 crash N77-33132 A77-50625 ign N77-33143 lity tool N77-33196

MCEWAN, N. J. Model for the effect of electric fields on satellite-earth microwave radio propagation 177-49787 HCFADDEN, R. W. Investigation of diagnostic, error detector and self-taught instructional strategies for flight simulator programs [AD-A035682] N77-33216 MCKAGUE, L. Lightning-hazard assessment - A first-pass probabilistic model A77-49346 MCKEE, R. G. Design of a cascade fire apparatus for testing countermeasure effectiveness [AD-A043176] N77-32101 NCLARTY, T. T. Rotorcraft flight simulation with coupled rotor aeroelastic stability analysis. Volume 1: Engineer's manual [ AD-A042462] N77-33207 AD-A042462 N// BCLAUGHLIN, B. J. An analysis of personnel parachutes for use by Marine Corps Force Reconnaissance Units [AD-A041151] N77-33124 HCPHERSON, D. Multiple curved descending approaches and the air traffic control problem [NASA-TM-78430] N77-32104 MELCHIOR, G. ATS-6 European L-band aeronautical experiments 177-49908 BELOSE, R. J. Computer simulation of light aircraft crash 177-49341 MERRILL, N. Output feedback regulator design for jet engine control systems [ NASA-TM-73776 ] N77-33165 MIKOIAN, S. A. Practical aerodynamics of maneuvering aircraft /A manual for flight personnel/ A77-50693 MIKOLOWSKY, W. T. An evaluation of very large airplanes and alternative fuels: Executive summary N77-33154 FAD-A0421121 MILLS, J. F. Purther sensitivity studies of community-aircraft noise exposure (NOISEMAP) prediction procedures [AD-A041781] N77-33 N77-33686 MINAILOS, A. N. The importance of monotonicity of finite difference schemes in straight-through calculation methods A77-50917 MINBCK, R. E. Effect of rotor wake on aerodynamic characteristics of a 1/6 scale model of the rotor systems research aircraft [NASA-TM-X-3548] N77-32083 MINNICK, A. System avicnic architectures for RPVs [ AD-A041502] N77-32145 HIRSKY, W. The effect of drop size on emissions from the primary zone of a gas turbine type combustor A77 A77-48174 MIXSON, J. S. Acoustic loads on upper-surface-blown powered-lift systems **FAIAA PAPER 77-13631** A77-51115 MIYAKE, Y. Unsteady Oseen flow around a flat-plate airfoil A77-49244 BLINABCHIK, R. A. RIW experience at ECOM A77-50483 MONAGRAN, B. C. Buffet characteristics of the P-8 supercritical wing airplane [NASA-TH-56049] N77-32080 HONGIA, H. C. Pollution reduction technology program for small net aircraft engines, phase 1 [NASA-CR-135214] N77-33168

MONNERIE, B. Aerodynamic problems of helicopter blade tips [ONBRA, TP NO. 1977-112] 47 77-50998 MONTAGUE, H. Voice control systems for airborne environments [AD-A043252] N77-32524 MONTEGANI, P. J. Measurement of far field combustion noise from a turbofan engine using coherence functions [FIAA PAPER 77-1277] A77-51038 Neasurement of far field combustion noise from a turbofan engine using coherence functions [NASA-TM-73748] N77-33 N77-33163 HORA VECK, J. P. Rain erosion resistant fluoroelastomer radome and antenna coatings 177-49731 MORF BY, C. L. New scaling laws for hot and cold jet mixing noise based on a geometric acoustics model [AIAA PAPER 77-1287] A77-51047 HORGAN, E. EUROCONTROL and radar A77-48413 MORRIS, J. W. Fluidic event sequencing subsystem for AAES A77-49934 HOSS, J. E., JR. Effect of slotted casing treatment with change in Reynolds number index on performance of a jet engine [NASA-TP-1058] N77-32154 HOTULEVICH, V. P. Heat transfer at the critical point of a cylinder during intensive blowing A77-48054 MUIRHBAD, V. U. A research program to reduce interior noise in general aviation airplanes [NASA-CR-155154] N77-33959 MUNN, J. Eight-channel resolver simplifies digital flight controls A77-51354 MUBSON, A. G. Airframe noise of the DC-9 [AIAA PAPER 77-1272] A77-51035 HURATA, S. Unsteady Oseen flow around a flat-plate airfoil A77-49244 MURAVEV, G. The technical conception of the IL-62M -Aerodynamic features A77-49655 MORTHY, H. S. S. Bird Strike nazards: A bibliography, 1971 - 1976 [NAL-BIBL-SER-77] N77-33 N77-33131 MUTHUKBISHNAN, M. Experimental and analytical separation of hydrodynamic, entropy and combustion noise in a gas turpine combustor [AIAA PAPER 77-1275] A77-51036

#### N

NALIMOV, IU. S.
Investigation of the state of dynamic stress and
the influence of service time on the fatigue
strength of turbine rotor blades of aircraft
gas-turbine engines
A77-48632
BASH, J. M.
An integrated marine navigation system
A77-51199
NAUMENKO, V. I.
Aircraft electric machines with intensive cooling
systems
A77-50678
BAYPEH, A. H.
Three dimensional steady and unsteady asymmetric
flow past wings of arbitrary planforms
[NASA-CB-145235] N77-33102
NBALE, D. H.
Experimental and analytical separation of
hydrodynamic, entropy and combustion noise in a
gas turbine combustor
[AINA PAPER 77-1275] A77-51036

NECHAEV, IU. N.		
Practical aerodynamics of maneuvering aircraft /A		
manual for flight personnel/		
A77-50693		
WELSON, B. B.		
An optimality criteria approach to the minimum		
weight design of aircraft structures		
FAD-A042759] N77-32140		
NEUHART, D. H.		
Performance of plain-type spoilers applied to the		
GA/W/-1 Wing		
A77-49344		
NG, K. W.		
Effect of simulated forward speed on the jet noise		
of inverted velocity profile ccannular nozzles		
[AIAA PAPER 77-1329] A77-51083		
BICHOLLS, J. A.		
The effect of drop size on emissions from the		
primary zone of a gas turbine type combustor		
A77-48174		
NICOLAS, J. J.		
New computation method of turbine blades film		
cooling efficiency		
[ONERA, TP NO. 1977-85] A77-50988		
HOSOVSKII, I. G.		
Concerning of the warmen of fuel man		

Some regularities of the wearing of fuel pump plunger spheres A77-49374

## 0

- OETTING, R. B. Performance of plain-type spoilers applied to the GA/W/-1 winq A77-49344 OPFT, A. H. Multipath and performance tests of TRSB receivers [AD-A041891] OKEEPE, J. V. Cabin noise behavior of a USB STOL transport [AIAA PAPER 77-1365] OHAW, R. A.
- OMAN, R. A. Fluid dynamics of diffuser augmented wind turbines A77-48899
- ORLOFF, K. L. Determining the lift and drag distributions on a three-dimensional airfoil from flow-field velocity surveys [NASA-TM-73247] N77-32079

OBTH, B. C. Direct-connect tests of hydrogen-fueled supersonic combustors

## Ρ

PACKMAN, A. B.	
Effect of simulated forward speed on the T	et noise
of inverted velocity profile coannular r	ozzles
[AIAA PAPER 77-1329]	A77-51083
PADULA, S. L.	
Acoustic scattering of point sources by a	BOVING
prolate spheroid	,
FAIAA PAPER 77-13261	A77-51080
PANDOLPI, M.	
Preliminary investigations of the unsteady	flowin
turbojet engines during transients	
[ POBL-PP-174]	N77-32164
PATIL, P. B.	177 J2104
The effect of drop size on emissions from	the
primary 2cne of a gas turbine type combu	
primary zone of a gas curbine type comb	A77-48174
	A//-481/4
PAULSON, C. V.	• .
Air traffic centrol experimentation and ev	aluation
test	
[AD-A041971]	N77-33136
[AD-A041971] PEGG, R. J.	N77-33136
PEGG, R. J. Some measured and calculated effects of a	tip
PEGG, R. J.	tip
PEGG, R. J. Some measured and calculated effects of a	tip
PEGG, R. J. Some measured and calculated effects of a vortex modification device on impulsive	tip noise
PEGG, R. J. Some measured and calculated effects of a vortex modification device on impulsive (AIAA PAPER 77-1341) PENNOCK, A. P.	tip noise
PEGG, R. J. Some measured and calculated effects of a vortex modification device on impulsive [AIAA PAPER 77-1341] PENNOCK, A. P. Porward speed effects on blown flap noise	tip noise
PEGG, R. J. Some measured and calculated effects of a vortex modification device on impulsive [AIAA PAPER 77-1341] PENNOCK, A. P. Forward speed effects on blown flap noise [AIAA PAPER 77-1315]	tip noise A77-51094
PEGG, R. J. Some measured and calculated effects of a vortex modification device on impulsive [AIAA PAPER 77-1341] PENNOCK, A. P. Porward speed effects on blown flap noise	tip noise A77-51094

destructible parachute A77-49342

PERFITT, T. B.	
Tactical and long-range navigation in the	
AN/ABN-101/V/	
	A77-51192
PERRY, J. E.	
dide area illuminator development for US Co	ast
Guard HH-3F melicopter	
[AD-A041425]	N77-32132
PERULLI, M.	
Coherent structures in the mixing zone of a	L
subsonic hot free jet	
[ONERA, 12 NO. 1977-88]	A77-50989
Simultaneous characterization of jet noise	sources
and acoustic field by a new application of	f
conditional sampling	
[AIAA PAPER 77-1349]	A77-51102
PESCHIER, T. D.	
A research program to reduce interior noise	e 11
general aviation airplanes	
[ NASA-CR-155154 ]	N77-33959
PHILIPPE, JJ.	
Aerodynamic problems of helicopter blade ti	
[ONERA, FP NO. 1977-112]	A77-50998
PICKBL, P. E.	
Tactical and long-range navigation in the	
AN/ARN-101/V/	
	A77-51192
PINKEL, B.	
A guide for estimation of aeroacoustic load	ls on
A guide for estimation of aeroacoustic load flight vehicle surfaces, volume 1	
A guide for estimation of aeroacoustic load flight vehicle surfaces, volume 1 [AD-A041198]	ls on N77-32090
A guide for estimation of aeroacoustic load flight vehicle surfaces, volume 1 [AD-A041198] PIUKER, R. A.	
A guide for estimation of aeroacoustic load flight vehicle surfaces, volume 1 [AD-A041198] PINKER, R. A. The noise from unheated supersonic jets in	
<ul> <li>A guide for estimation of aeroacoustic load flight vehicle surfaces, volume 1 (AD-A041198)</li> <li>PINKER, R. A.</li> <li>The noise from unheated supersonic jets in simulated flight</li> </ul>	N77-32090
A guide for estimation of aeroacoustic load flight vehicle surfaces, volume 1 [AD-A041198] PINKER, R. A. The noise from unheated supersonic jets in simulated flight [AIAA PAPER 77-1327]	
A guide for estimation of aeroacoustic load flight vehicle surfaces, volume 1 [AD-A041198] PINKER, R. A. The noise from unheated supersonic jets in simulated flight [AIAA PAPEE 77-1327] PITTENN, J. L.	N77-32090 A77-51081
<ul> <li>A guide for estimation of aeroacoustic load flight vehicle surfaces, volume 1 (AD-A041198)</li> <li>PINKER, R. A.</li> <li>The noise from unheated supersonic jets in simulated flight [AIAA PAPEE 77-1327]</li> <li>PITTEAN, J. L.</li> <li>Vortex lattice prediction of subsonic aerod</li> </ul>	N77-32090 A77-51081
A guide for estimation of aeroacoustic load flight vehicle surfaces, volume 1 [AD-A041198] PINKER, R. A. The noise from unheated supersonic jets in simulated flight [AIAA PAPEE 77-1327] PITTENN, J. L.	N77-32090 A77-51081 Synamics
<ul> <li>A guide for estimation of aeroacoustic load flight vehicle surfaces, volume 1 [AD-A041198]</li> <li>PIBKER, R. A. The noise from unheated supersonic jets in simulated flight [AIAA PAPER 77-1327]</li> <li>PITTEAN, J. L. Vortex lattice prediction of subsonic aerod of hypersonic vehicle concepts</li> </ul>	N77-32090 A77-51081
<ul> <li>A guide for estimation of aeroacoustic load flight vehicle surfaces, volume 1 (AD-A041198)</li> <li>PINKER, R. A. The noise from unheated supersonic jets in simulated flight [AIAA PAPEE 77-1327]</li> <li>PITTMAN, J. L. Vortex lattice prediction of subsonic aerod of hypersonic vehicle concepts</li> <li>POIS SON-QUINTON, P.</li> </ul>	N77-32090 A77-51081 Synamics A77-49343
A guide for estimation of aeroacoustic load flight vehicle surfaces, volume 1 [AD-A041198] PINKER, R. A. The noise from unheated supersonic jets in simulated flight [AIAA PAPEE 77-1327] PITTBAN, J. L. Vortex lattice prediction of subsonic aerod of hypersonic vehicle concepts POISSON-QUINTON, P. Evolution of aircraft design through the co	N77-32090 A77-51081 Synamics A77-49343
<ul> <li>A guide for estimation of aeroacoustic load flight vehicle surfaces, volume 1 [AD-A041198]</li> <li>PINKER, R. A. The noise from unheated supersonic jets in simulated flight [AIAA PAPER 77-1327]</li> <li>PITTHAN, J. L. Vortex lattice prediction of subsonic aerod of hypersonic vehicle concepts</li> <li>POISSON-QUINTON, P. Evolution of aircraft design through the co of the control configured vehicle</li> </ul>	N77-32090 A77-51081 Synamics A77-49343 Ducept
<ul> <li>A guide for estimation of aeroacoustic load flight vehicle surfaces, volume 1 (AD-A041198)</li> <li>PINKER, R. A. The noise from unheated supersonic jets in simulated flight [AIAA PAPEE 77-1327]</li> <li>PITTHAN, J. L. Vortex lattice prediction of subsonic aerod of hypersonic vehicle concepts</li> <li>POISSON-QUINTON, P. Evolution of aircraft design through the co of the control configured vehicle [OKEAN, J. NO. 1977-129]</li> </ul>	N77-32090 A77-51081 Synamics A77-49343
<ul> <li>A guide for estimation of aeroacoustic load flight vehicle surfaces, volume 1 [AD-A041198]</li> <li>PINKER, R. A. The noise from unheated supersonic jets in simulated flight [AIAA PAPEE 77-1327]</li> <li>PITTBAN, J. L. Vortex lattice prediction of subsonic aerod of hypersonic vehicle concepts</li> <li>POISSON-QUINTON, P. Evolution of aircraft design through the co of the control configured vehicle [ONERA, T2 NO. 1977-129]</li> <li>POICARO, C. F.</li> </ul>	N77-32090 A77-51081 Synamics A77-49343 oncept A77-51004
<ul> <li>A guide for estimation of aeroacoustic load flight vehicle surfaces, volume 1 (AD-A041198)</li> <li>PINKER, R. A. The noise from unheated supersonic jets in simulated flight [AIAA PAPEE 77-1327]</li> <li>PITTHAN, J. L. Vortex lattice prediction of subsonic aerod of hypersonic vehicle concepts</li> <li>POISSON-QUINTON, P. Evolution of aircraft design through the co of the control configured vehicle [OKEAN, J. NO. 1977-129]</li> </ul>	N77-32090 A77-51081 Synamics A77-49343 oncept A77-51004
<ul> <li>A guide for estimation of aeroacoustic load flight vehicle surfaces, volume 1 [AD-A041198]</li> <li>PINKER, R. A. The noise from unheated supersonic jets in simulated flight [AIAA PAPEE 77-1327]</li> <li>PITTBAN, J. L. Vortex lattice prediction of subsonic aerod of hypersonic vehicle concepts</li> <li>POISSON-QUINTON, P. Evolution of aircraft design through the co of the control configured vehicle [ONERA, T2 NO. 1977-129]</li> <li>POICARO, C. F. A mathematical model of transcontinental ba [IAP PAPEE 77-167]</li> <li>POINIAKOV, V. V.</li> </ul>	N77-32090 A77-51081 Synamics A77-49343 oncept A77-51004 Lloon A77-51460
<ul> <li>A guide for estimation of aeroacoustic load flight vehicle surfaces, volume 1 [AD-A041198]</li> <li>PINKER, R. A. The noise from unheated supersonic jets in simulated flight [AIAA PAPER 77-1327]</li> <li>PITTMAN, J. L. Vorter lattice prediction of subsonic aerod of hypersonic vehicle concepts</li> <li>POISSON-QUINTON, P. Evolution of aircraft design through the co of the control configured vehicle [OKERA, T2 NO. 1977-129]</li> <li>POLCARO, C. F. A mathematical model of transcontinental ba [IAP PAPER 77-167]</li> <li>POZNIAKOV, V. V.</li> <li>Some mathematical aspects of the correlation</li> </ul>	N77-32090 A77-51081 Synamics A77-49343 Dncept A77-51004 Lloon A77-51460
<ul> <li>A guide for estimation of aeroacoustic load flight vehicle surfaces, volume 1 [AD-A041198]</li> <li>PINKER, R. A. The noise from unheated supersonic jets in simulated flight [AIAA PAPEE 77-1327]</li> <li>PITTBAN, J. L. Vortex lattice prediction of subsonic aerod of hypersonic vehicle concepts</li> <li>POISSON-QUINTON, P. Evolution of aircraft design through the co of the control configured vehicle [ONERA, T2 NO. 1977-129]</li> <li>POICARO, C. F. A mathematical model of transcontinental ba [IAP PAPEE 77-167]</li> <li>POINIAKOV, V. V.</li> </ul>	N77-32090 A77-51081 Synamics A77-49343 oncept A77-51004 Liloon A77-51460 Dn Lity
<ul> <li>A guide for estimation of aeroacoustic load flight vehicle surfaces, volume 1 [AD-A041198]</li> <li>PINKER, R. A. The noise from unheated supersonic jets in similated flight [AIAA PAPEE 77-1327]</li> <li>PITTEAN, J. L. Vortex lattice prediction of subsonic aerod of hypersonic vehicle concepts</li> <li>POISSON-QUINTON, P. Evolution of aircraft design through the co of the control configured vehicle [ONERA, T2 NO. 1977-129]</li> <li>POICARO, C. F. A mathematical model of transcontinental ba [IAP PAPEE 77-167]</li> <li>POZNIAKOV, V. V. Some mathematical aspects of the correlation theory of aircraft precision and reliabil</li> </ul>	N77-32090 A77-51081 Synamics A77-49343 Dncept A77-51004 Lloon A77-51460
<ul> <li>A guide for estimation of aeroacoustic load flight vehicle surfaces, volume 1 [AD-A041198]</li> <li>PINKER, R. A. The noise from unheated supersonic jets in simulated flight [AIAA PAPER 77-1327]</li> <li>PITTEMAN, J. L. Vortex lattice prediction of subsonic aerod of hypersonic vehicle concepts</li> <li>POISSON-QUINTON, P. Evolution of aircraft design through the co of the control configured vehicle [ONERA, T2 NO. 1977-129]</li> <li>POICARO, C. F. A mathematical model of transcontinental ba [IAP PAPER 77-167]</li> <li>POZMIAKOV, V. V. Some mathematical aspects of the correlation theory of aircraft precision and reliabij</li> <li>PRAUSA, J. W.</li> </ul>	N77-32090 A77-51081 Synamics A77-49343 oncept A77-51004 Liloon A77-51460 on Lity A77-50709
<ul> <li>A guide for estimation of aeroacoustic load flight vehicle surfaces, volume 1 (AD-A041198)</li> <li>PINKER, R. A.</li> <li>The noise from unheated supersonic jets in simulated flight [AIAA PAPEE 77-1327]</li> <li>PITTHAN, J. L.</li> <li>Vortex lattice prediction of subsonic aerod of hypersonic vehicle concepts</li> <li>POISSON-QUINTON, P.</li> <li>Evolution of aircraft design through the co of the control configured vehicle [ONEBA, T2 NO. 1977-129]</li> <li>POICARO, C. F.</li> <li>A mathematical model of transcontinental ba [IAF PAPEE 77-167]</li> <li>POIMIAKOV, V. V.</li> <li>Some mathematical aspects of the correlation theory of aircraft precision and reliabil</li> <li>PRAUSA, J. W.</li> <li>Accuracy evaluation of augmented multilater</li> </ul>	N77-32090 A77-51081 Synamics A77-49343 oncept A77-51004 Liloon A77-51460 on Lity A77-50709
<ul> <li>A guide for estimation of aeroacoustic load flight vehicle surfaces, volume 1 [AD-A041198]</li> <li>PINKER, R. A. The noise from unheated supersonic jets in simulated flight [AIAA PAPER 77-1327]</li> <li>PITTEMAN, J. L. Vortex lattice prediction of subsonic aerod of hypersonic vehicle concepts</li> <li>POISSON-QUINTON, P. Evolution of aircraft design through the co of the control configured vehicle [ONERA, T2 NO. 1977-129]</li> <li>POICARO, C. F. A mathematical model of transcontinental ba [IAP PAPER 77-167]</li> <li>POZMIAKOV, V. V. Some mathematical aspects of the correlation theory of aircraft precision and reliabij</li> <li>PRAUSA, J. W.</li> </ul>	N77-32090 A77-51081 Synamics A77-49343 oncept A77-51004 Liloon A77-51460 on Lity A77-50709 ation
<ul> <li>A guide for estimation of aeroacoustic load flight vehicle surfaces, volume 1 (AD-A041198)</li> <li>PINKER, R. A.</li> <li>The noise from unheated supersonic jets in simulated flight [AIAA PAPEE 77-1327]</li> <li>PITTHAN, J. L.</li> <li>Vortex lattice prediction of subsonic aerod of hypersonic vehicle concepts</li> <li>POISSON-QUINTON, P.</li> <li>Evolution of aircraft design through the co of the control configured vehicle [ONEBA, T2 NO. 1977-129]</li> <li>POICARO, C. F.</li> <li>A mathematical model of transcontinental ba [IAF PAPEE 77-167]</li> <li>POIMIAKOV, V. V.</li> <li>Some mathematical aspects of the correlation theory of aircraft precision and reliabil</li> <li>PRAUSA, J. W.</li> <li>Accuracy evaluation of augmented multilater</li> </ul>	N77-32090 A77-51081 Synamics A77-49343 oncept A77-51004 Liloon A77-51460 on Lity A77-50709

PRIBME, G. D. New air traffic control communications and data systems #77-48252

## R

RADCHENKO, M. I. Practical aerodynamics of maneuvering aircraft /A manual for flight personnel/ A77-50693 RAFFY, P. Investigation of subsonic fan noise sources by fluctuating pressure measurements on rotating blades [AIAA PAPER 77-1321] A77-51075 BAMSDEW, G. R. The effect or simulated aerodynamic heating on the strength of three rocket motor case steels [RPE-IR-45] N77-3224 N77-32240 RANEY, J. T. Precision location, navigation and guidance using DME techniques A77-51180 RASHUSSEN, H. Transonic pressure distribution on an aircraft wing model during rocket sled runs [ AD-A041633 ] N77-32085 RAVENHALL, R. Platform for a swing root turbomachinery blade [NASA-CASE-LEW-12312-1] N77-N77-32148 BAYL, C. The influence of the inlet duct contour on forward

A77-48240

radiated fan noise [AIAA PAPSE 77-1355] A77-51108

REESE, I. H. Air traffic control experimentation and evaluation test FAD-A0419711 N77-33136 REHM. K. D. Precision location, navigation and guidance using DME techniques A77-51180 REITZIG, R. L-band antenna for aircraft-to-satellite communications A77-48362 RESHOTKO, E. Measurement of far field combustion noise from a turbofan engine using coherence functions [AIAA PAPER 77-1277] A77-51038 easurement of far field combustion noise from a turbofan engine using coherence functions [NASA-TM-73748] N77-33163 RESIDE. D. Reliability, availability, maintainability/logistics /RAM/LOG/ A7/-50456 RICE, E. J. Acoustic performance of inlet multiple-pure-tone SUPPRESSORS INStalled on NASA Quiet Engine 'C' FAIAA PAPER 77-1333] A77-5 A77-51087 Acoustic performance of inlet multiple-pure-tone suppressors installed on NASA quiet engine C
[NASA-TM-73713] N77-32158 RICHTER, A. B. Preliminary results of USAF experience with engine monitoring and diagnostics N77-33199 RIEBE, G. D. Theoretical parametric study of the relative advantages of winglets and wing-tip extensions [NASA-TP-1020] N77-33112 RINGBEIM, M. Airplane noise: Dimensions and means of noise reduction [ELAB-STF44-A75080] N77-33696 ROGER, K. L. Airplane math modeling methods for active control design N77-33212 BOGEES, V. A. B. Detail design aspects of a helicopter transmission system A77-47999 ROSKAN, J. A research program to reduce interior noise in general aviation airplanes [NASA-CR-155154] N77-33959 BOZENDAAL, B. L. VSEG: A sequented mission analysis program for low and high speed aircraft. Volume 2: Program users manual N77-33100 [NASA-CR-2808] RUDENKO, O. V. Aerodynamic effects during supersonic flow past a laser beam A77-48515

## S

SAGNES, A.	
Turbulent effects in axial compressors	
[ AA AF-NT-77-20 ]	N77-33180
SAMORHIN, V. F.	
The aerodynamic noise of gliders	
	A77-48513
SANDEBS, K.	
Estimation of helicopter performance by an	
extended energy method improved by flight	t tests
	A77-51613
SARIN, S. L.	
A novel concept for suppressing internally	
generated aircraft engine noise	
(AIAA PAPER 77-1356)	A77-51109
SAROHIA, V.	
Effect of flight on jet noise from superson	n 1C
underexpanded flows	
(AIAA PAPER 77-1328]	A77-51082
Experimental results of large-scale struct	ures in
jet flows and their relation to jet noise	e
production	
FAIAA PAPER 77-1350]	177-51103

#### PERSONAL AUTHOR INDEX

SATLER, W. I. Deburring - Requirements of the aircraft [SME PAPER ME76-124] A77-51007 SCHAEFER, J. W. Acoustic performance of inlet multiple-pure-tone suppressors installed on NASA Quiet Engine 'C' [AIAA PAPER 77-1333] A77-5 Acoustic performance of inlet multiple-pure-tone suppressors installed on NASA quiet engine C A77-51087 [NASA-TM-73713] N77-32158 SCHHID, H. Air traffic control and the initial operation of supersonic transport aircraft - A review of preparatory measures 177-48415 SCHNID, P. E. Single pass Doppler positioning for Search and Rescue satellite missions 177-51186 SCHNDERER, H. Monte Carlo sigulation of VOR/DME holding procedures. Basic notions and applications [ESA-TT-419] N77-33142 SCHOBNSTER, J. A. Acoustic loads on upper-surface-blown powered-lift systems [AIAA PAPER 77-1363] A77-51115 SCHORTTMER, G. L. An operational video tape recording system utilizing IRIG standard 129-73 segmented helical scan recording format A77-49873 SCHWANZ, R. C. Consistency in aircraft structural and flight control analysis N77-33213 SCHWARTZ, M. M. Rohrbond SME PAPER AD76-2801 A77-51015 SCOLLY, J. K. Acquisition of test compatible avionics - An updated approach A77-49645 SELDWER, K. F100 multivariable control synthesis program: Evaluation of a multivariable control using a real-time engine simulation [NASA-TP-1056] N77-33169 SENSBURG, O. Impact of a command and stability augmentation system on gust response of a combat aircraf N77-33210 SERGIEVSKII, B. D. Heat transfer at the critical point of a cylinder during intensive blowing 177-48054 SERELL, A. R. Wind tunnel and analytical investigation of over-the-wing propulsion/air frame interferences for a short-maul aircraft at Mach numbers from 0.6 to 0.78 [NASA-CE-2905] N77-33114 SHAMIE, J. Aeroelastic stability of complete rotors with application to a testering rotor in forward flight A77-49180 SHANKS, R. E. Variation of pitching moment with engine thrust for a twin-engine commercial jet aircraft N77-32131 [NASA-FM-1-3569] SHIDLER, P. A. Some results of the testing of a full-scale Ogee tip helicopter rotor; acoustics, loads, and performance [AIAA PAPER 77-1340] A77-51093 SHIPCHANDLER, T. System avionic architectures for RPVs f AD-A0415021 N77-32145 SHIPNAN, C. H. Logistics planning simulation model for USAF spare engine management A77-50510 SHIVASHANKARA, B. N. Gas turbine engine core noise source isolation by internal-to-far field correlations A77-51037

SHORT, B. J. A flight investigation of the wake turbulepce change on a E-747 aircraft [ WASA-TM-73263] N77-33130 SHROOT, B. L. Aerodynamic characteristics at Mach numbers from Configuration with a design Mach number of 1.8 [NASA-TH-X-3559] N77-3: N77-32081 SHU, T. C. research program to reduce interior noise in general aviation airplanes [NASA-CP-155154] N77-33959 SHOBERT, G. L. Pressure distributions on a 1- by 3-meter semispan wing with a nonstreamwise tip in subsonic flow [NASA-TH-72755] N77-331 N77-33103 SINACORI, J. B. Researcher's guide to the NASA Ames Flight \* Simulator for Advanced Aircraft (FSAA) [NASA-CR-2875] N77-33230 SIVKOV, G. P. Practical aerodynamics of maneuvering aircraft /A manual for flight personnel/ A77-50693 SKUPIN, W. Simulation of traffic loading for approach and landing systems with statistical interrogation A77-48686 SLATFORD, J. Civil airworthiness requirements for powerplant reliability N77-33185 SLIVINSKY, C. Analysis of inherent errors in asynchronous digital flight controls FAD-A0418131 N77-33206 SLOAN, D. The influence of the inlet duct contour on forward radiated fan noise FAIAA PAPER 77-13551 A77-51108 SHITH, C. L. The need for a workable collision avoidance system - Nov A77-50662 SHITE, H. W. A research program to reduce interior noise in general aviation airplanes FNASA-CR-1551541 N77-33959 SMYTH, R. Methods of improving the performance reliability of advanced military power plant systems N77-33198 SNYDER, R. G. Evaluation of inflatable /'air bag'/ occupant restraint systems for aircraft application A77-49951 SOBDEE, J. F. P100 multivariable control synthesis program Evaluation of a multivariable control using a real-time engine simulation N77-33169 [NASA-TP-1056] SOKOLSKIY, V. M. On the works of S. S. Nezhdanovsky in the field of flight based on reactive principles, 1880 -) - 1895 N77-33040 SPRTREER Measurement of the multipath propagation at the Brunswick test airport N77-32107 The Brunswick DLS test airport area - a non clean environment N77-32108 SPRINGER, R. Measurements of the influence of static and dynamic interference on an ILS-receiver and measurement of the capture effect with the double frequency procedure TUBS/SFE58/501 N77-33140 SPRUNG, C. Maintenance methods for improving propulsion system reliability N77-33184 STAPLEPORD. R. L. Researcher's guide to the NASA Ames Plight Simulator for Advanced Aircraft (PSAA) [NASA-CB-2875] N77-33230

STARON, N. A navigation device to help helicopters to land on ocean platforms [ONERA, PP NO. 1977-71] 177-50983 STRIN. G. P-8C adaptive flight control laws [NASA-CB-2880] N77-33202 P-8C adaptive flight control extensions [ NASA-CR-2881 ] N77-33203 STENGEL, B. P. Stability of the pilot-aircraft system in maneuvering flight 177-49340 STOCK, H. W. The role of the boundary layer in supersonic pressure perturbations along a weak wavy wall A77-48290 STOLDT. U. Measurements of the influence of static and dynamic interference on an ILS-receiver and measurement of the capture effect with the double frequency procedure [TUBS/SFB58/50] N77-33140 STORE, W. J. Performance and design of a vertical seeking seat steering system A77-49945 STOREY. J. Aircraft trajectories from radar extrapolations to long term prediction 177-48414 STRAHLE, W. C. Experimental and analytical separation of hydrodynamic, entropy and combustion noise in a gas turbine combustor [AIAA PAPEE 77-1275] A77-51 A77-51036 STRABN, A. B. An operational video tape recording system utilizing IRIG standard 129-73 segmented helical scan recording format A77-49873 STRASZEWSKI, B. Notes on the pollution of airplanes and helicopters by chemicals during agricultural jobs [NASA-TT-P-17444] N77-33129 STRINGAS, B. J. High velocity jet noise source location and reduction. Task 4: Development/evaluation of techniques for inflight investigation [AD-A041849] N77-33175 STUBBS, S. H. Behavior of aircraft antiskid breaking systems on dry and wet runway surfaces: A slip-ratio-controlled system with ground speed reference from unbraked nose wheel [NASA-IN-D-8455] N77-33150 [NASA-IN-D-0455] SUSSMAN, N. B. Cabin noise behavior of a USB STOL transport [AIAA PAPER 77-1365] SWADLING, S. J. Detail design in aircraft A77-51117 177-48000 SWIERSTRA. S. Aircraft trajectories from radar extrapolations to long term prediction A77-48414 SZEWCZYK, V. S. New scaling laws for hot and cold jet mixing noise based on a geometric acoustics model [AIAA PAPSE 77-1287] 177-51047 SZUCH, J. R. P100 multivariable control synthesis program: Evaluation of a multivariable control using a real-time engine simulation [NASA-TP-1056] N77-: N77-33169 T TAM, C. K. W. An experimental investigation of the trailing edge

noise mecaanism [AIAA PAPER 77-1291] A77-51049 TAWNER, J. A. Behavior of aircraft antiskid breaking systems on dry and wet runway surfaces: A slip-ratio-controlled system with ground speed reference from unbraked nose wheel [NASA-TN-D-8455] N77-33150 TATRO, G. Subsystem design analysis light weight alternator (model test program). Addendum 2 [AD-A041257] N77-33171 TEBNYSON, R. C. The need for improved aircraft crashworthiness design 177-09073 TEREN, P. Minimum time acceleration of aircraft turbofan engines by using an algorithm based on nonlinear programming [NASA-TM-73741] N77-33167 TESKE, H. E. Vortex interactions and decay in aircraft wakes [ NAS A-C B-2870 ] N77-33105 TESTER, B. J. New scaling laws for hot and cold jet mixing noise based on a geometric acoustics model [AIAA PAPER 77-1287] A77-51047 THOMAS, D. A precision voltage reference unit for calibrating airborne data acquisition systems [RAE-TR-76164] N77-32474 THORBBURG, D. D. The GPS Centrol Segment and its service to the GPS Jser A77-51202 TORNSKOBITER, H. Experimental investigation on the influence of component faults on turbojet engine performance N77-33197 TSIGABOV, H. K. Numerical analysis of the axisymmetric flow past a pervious shell with a hole at the vertex A77-50938 TSUJINOTO, Y. Unsteady Oseen flow around a flat-plate airfoil 177-49244 TURNER, M. R. A practical optimum selection procedure for a motivator in active flutter suppression system design on an aircraft with underwing stores N77-33209 TUTTLE, W. D. USAP experience in aircraft accident survivability A77-49949 TYLER, D. Investigation of diagnostic, error detector and self-taught instructional strategies for flight simulator programs [AD-A035682] 177-33216

## U

ULLRICH, R. Simulation of traffic loading for approach and landing systems with statistical interrogation A77-48686 ULRY, D. N. Evaluation of composite wing for XFV-12A airplane [AD-A041208] N77-33152 UNGAR, B. E. A quide for estimation of aeroacoustic loads on flight vehicle surfaces, volume 1 [AD-A041198] N77-32090 UTTAM, B. J. Loran-C data acquisition and handling for improved accuracy A77-51200

## V

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B receivers		
N77-33135		
Producibility aspects of advanced composites for		
A77-51006		
DOLSE IN		
N77-33959		
٩77-33200		

,

VASILENKO, H. T.	
Radar systems with phased-array antennas	
	A77-51277
WASSBUR, D.	
A navigation device to help helicopters to	land on
ocean platforms	
[ONERA, TP NO. 1977-71]	<b>λ77-5098</b> 3
VAUCHBRET, X.	1
Influence or the noise level in a transon	
tunnel on the aerodynamic characteristic models	S 01
GONERA, TP NO. 1977-110]	177-50996
VERASANY, V.	a//-30390
Investigation of feasible nozzle configura	tions
for noise reduction in turbofan and turb	
aircraft. Volume 3: Shrouded slot pozz	
configurations	
[ AD-A041782 ]	N77-33179
VERET, C.	
Review of optical techniques with respect	to
aero-engine applications	
[ONERA, FP NO. 1977-80]	A77-50987
VLASOV, E. V.	
The aerodynamic noise of gliders	
	A77-48513
VOBVODZINSKII, V. A.	
Airport electrical and lighting equipment	A77-50676
	A//-500/0
VOLPBET, B. A. Airport electrical and lighting equipment	
withold electrical and lighting edalphend	A77-50676
VON GLANN, U.	ATT 50070
Interim noise correlation for some OTW	
configurations using external jet-flow d	eflectors
[AIAA PAPER 77-1317]	A77-51072
VONBUN, F. O.	
Single pass Doppler positioning for Search	and
Rescue satellite missions	
	A77-51186

## W

WALIA. P. Subsystem design analysis light weight alternator (model test program). Addendum 2 [AD-A041257] N77-33171 WALKER, D. Q. Aircraft sideline noise: A technical review and analysis of contemporary data [ AD-A042076 ] N77-33685 WALKER, R. W. A-37B fatigue sensor evaluation program: Full scale test and field aircraft instrumentation [AD-A042114] N77-33156 WALSH, B. Airframe composite materials A77-51353 WALTON, J. D., JR. Georgia Tech high temperature solar test facility 177-49745 WALTRUP, P. J. Direct-connect tests of hydrogen-fueled supersonic combustors 177-48240 WANNER, J.-C. Evolution of aircraft design through the concept of the control configured vehicle [ONERA, TP NO. 1977-129] A77-51004 WATERS, W. J. Nickel base alloy [NASA-CASE-LEW-12270-1] N77-32280 WATSON, P. A. Model for the effect of electric fields on satellite-earth microwave radio propagation A77-49787 WEAVER, T. S. Effects of temperature on avionics reliability A77-50497 WEBER, R. L. The life cycle cost impacts of unsafe designs 177-50462 WEIJTS, A. G. L. M. A new high-brightness, all-weather, ASDE /Airport Surface Detection Equipment/ 177-49224

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WELGE, H. B.	
Wind tunnel and analytical investigation over-the-wing propulsion/air frame int for a short-haul aircraft at Mach numbe 0.6 to 0.78	of
over-the-wing propulsion/air frame into	erierences
0.6 to 0.78	
[NASA-CR-2905]	877-33114
WELLS, O. D.	
Wind tunnel and analytical investigation	
over-the-wing propulsion/air frame into	
for a short-haul aircraft at Mach numbe 0.6 to 0.78	
[NASA-CR-2905]	N77-33114
WEMPLE, T. E.	
Nultiple curved descending approaches and	1 the air
traffic control problem	*37 22404
[NASA-TM-78430] Westphal	N77-32104
Recognition and elimination of interfere	nce
Recognition and elimination of interfere disturbances by modification of the ra- of landing systems with spatial modula	dio field
of landing systems with spatial modula	tion
degree diagrams	
WHITCONB, B. T.	N77-32123
Methods for reducing subscnic drag due to	n lift
	N77-32093
WHITE, R. P., JR.	
Some measured and calculated effects of a	
vortex modification device on impulsive [AIAA PAPER 77-1341]	e noise A77-51094
WHITBLAW, J. H.	A / /~ 51094
Perodynamic and thermodynamic characteri:	stics of
kerosene-spray flames	
	A77-48181
WIEBSMA, S. Design of a cascade fire apparatus for to	
countermeasure effectiveness	escind
FAD-A0431761	N77-32101
WIGETHAN, C. W. Multipath and performance tests of TRSE	
Multipath and performance tests of TRSB	receivers
[AD-A041891] WILBY, J. F.	N77-33135
A quide for estimation of aeroacoustic le	oads on
flight vehicle surfaces, volume 1	
[AD-A041198]	N77-32090
WILBELD, K.	
Flight mechanical problems in connection interception process	with the
interception process	N77-32121
WILLIANSON, G. G.	
Vortex interactions and decay in aircraft	
[NASA-CR-2870]	N77-33105
WILLIS, C. M. Acoustic loads on upper-surface-blown por	uorod_lift
systems	ered-rric
[AIAA PAPER 77-1363]	A77-51115
WILSON, J. D.	
Calculation of vortex breakdown locations	s for flow
over delta wings	A77-49345
WILSON, S. G.	
WILSON, S. G. Fir traffic control experimentation and (	evaluation
test	
[AD-A041971]	N77-33136
WOODS, M. A. The transfer of the German North MATRAC '	to the
EUROCONTFOL Centre of Maastricht	co une
	A77-48412
WOODWARD, C.	
SENDS /Safe Ejection Envelope Display Sy:	stem/
	A77-49932

## Y

YANG, J. W. Plight inspection data and crack initiation times A77-50466 YIP, L. P. Pressure distributions on a 1- by 3-meter semispan wing with a nonstreamwise tip in subsonic flow (NASA-TN-72755) YOUNG, P. D. Wing rock as a lateral-directional aircraft limit cycle oscillation induced by nonlinear aerodynamics occurring at high angle of attack (AD-A042104) YU, J. C. An experimental investigation of the trailing edge noise mechanism (AIAA PAPER 77-1291) A77-51049

## Z

ZANNETTI, L. Preliminary investigations of the unsteady flow in turbojet engines during transients [PUBL-PP-174] N77-32164

ZHUKOV, V. V. Airport electrical and lighting equipment

A77-50676

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AERONAUTICAL ENGINEERING / A Special Bibliography (Suppl 91)

JANUARY 1978

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N77-33686	N77-33156
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477-32140	177-49873
AF-A FOSR-2968-76	P49620-77-C-0023
₩77-33206	N77-33154
CNR-75-00353.07-115.6799	NASW-2791 N77-33128
N77-32164	N77-33129
DA PROJ. 1F2-62209-AH-76	
	NAS1-12939 A77-51006
N77-32143	NAS1-13383 N77-33202
N77-33101	N77-33203
N77-33207	NAS1-13599 N77-33100
DA PROJ. 1G2-62207-AH-89	NAS1-13939 N77-33105
N77-32136	NAS1-13986 N77-33121
DA PROJ. 111-61102-AH-45	
N77-32083	NAS1-14282 A77-51071
DN PROJ. 1L2-6311-D-157	NAS1-14667 N77-33147
N77-33155	NAS1-14673 A77-51108
DAAD07-75-C-0108	NAS1-14696 A77-51035
A77-51180	NAS2-9024 N77-33230
DAAG29-C-027 A77-51092	NAS3-17863 A77-51069
DAAJ02-74-C-0039	NAS3-17866 A77-51028
N77-32136	A77-51083
DAAJ02-75-C-0015	NAS3-18284 N77-33114
N77-33132	NAS3-18560 N77-33168
DAAJ02-75-C-0018	NAS3-20031 A77-51084
N77-32162	NAS3-20036 A77-48898
DAAJ02-75-C-0025	NAS4-2347 N77-33201
N77-32143	NAS7-100 A77-51082
N77-33207	A77-51103
DOT-FA72WA-3053	NGL-05-046-002
N77-33179	N77-32104
DOT-FA74WA-3445	NGR-05-007-414
N77-33135	A77-49180
DOT-FA76WA-3821	NGR-17-002-072
177-51034	¥77-33104
DOT-05-30034 A77-51048	RGR-47-004-090
DOT-OS-5023947	N77-33102
A77-48474	NGR-47-004-116
DOT-OST-30034	N77-33200
N77-33175	NGR-47-005-181
DOT-1SC-707-6	N77-33148
N77-33136	RRC A-8927 A77-47980
DRME-74/607 N77-33180	NSP DCB-73-03431-A01
E(11-1)-2616 A77-48899	¥77-51261
EPA-R-802925 A77-48174	NSG-1099 A77-50466
F29601-74-C-0055	NSG-1170 A77-51261
N77-33171	RSG-1301 N77-33959
F30602-76-C-0127	
	NSG-2095 A77-51092
N77-32524	NSG-3015 A77-51036
F33615-73-C-1238	N00014-75-C-1198
N77-32147	A77-51185
F33615-73-C-2031	N00014-75-C-9432
N77-33177	A77-49340
F33615-74-C-1107	N00019-70-C-0391
¥77-32129	A77-51184
P33615-75-C-3017	N00019-71-C-0451
₩77-32090	A77-51184
F33615-76-C-0507	N00019-73-C-0537
N77-33685	A77-51184
N77-33686	
	N00019-74-C-0183
P33615-76-C-1215	N77-33143
N77-32145	N77-33144
F33615-76-C-2021	N00123-74-C-0900
¥77-51047 I	¥77-51184

N00123-75-C-0715
A77-51184
N00156-75-C-0944
A77-50467
862269-74-C-0577
877-33152
N62269-76-C-0199
N77-33158
505-02-23 N77-32080
505-02-25 N77-33201
505-03-32 877-33168
505-04 N77-32082
505-05 N77-32154
N77-33169
505-06-15-02 N77-33103
505-07-41-06 N77-33157
505-07-41-08 B77-33157
505-08-31-01 N77-33150
505-10-11-03 N77-33104
505-10-12 N77-32079
505-10-21-05 N77-32083
505-10-26-01 177-33107
505-11-21-03 177-32081
505-15-22-01 \$77-33102
513-52-01-31 #77-32131
514-52-01 N77-33105
517-51-03-00 177-33115
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791-40-08-01 177-33112

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