NASA SP-7037(194)

NASA

Aeronautical Engineering
A Continuing Bibliography with Indexes

NASA SP-7037(194)
December 1985

National Aeronautics and Space Administration

(NASA-SP-7037(194)) AERONAUTICAL ENGINEERING: A CONTINUING BIBLIOGRAPHY WITH INDEXES (SUPPLEMENT 194) (National Aeronautics and Space Administration) 108 p HC A06 CSCL 01A 00/01 N86-25322 Unclas 43477

Aeronautical Engineering Aeronautical Engineering Aeronautical Engineering

ACCESSION NUMBER RANGES

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

STAR (N-10000 Series)	N85-32089 – N85-34112
IAA (A-10000 Series)	A85-43293 – A85-47054

This bibliography was prepared by the NASA Scientific and Technical Information Facility operated for the National Aeronautics and Space Administration by RMS Associates.

NASA SP-7037(194)

AERONAUTICAL ENGINEERING

A CONTINUING BIBLIOGRAPHY WITH INDEXES

(Supplement 194)

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 November 1985 in

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

1985

NASA Scientific and Technical Information Branch 1985
National Aeronautics and Space Administration
Washington, DC

This supplement is available as NTISUB/141/093 from the National Technical Information Service (NTIS), Springfield, Virginia 22161 at the price of $9.95 domestic; $19.90 foreign.

INTRODUCTION

This issue of *Aeronautical Engineering -- A Continuing Bibliography* (NASA SP-7037) lists 369 reports, journal articles, and other documents originally announced in November 1985 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA).*

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

Each entry in the bibliography consists of a standard bibliographic citation accompanied in most cases by an abstract. The listing of the entries is arranged by the first nine *STAR* specific categories and the remaining *STAR* major categories. This arrangement offers the user the most advantageous breakdown for individual objectives. The citations include the original accession numbers from the respective announcement journals. The *IAA* items will precede the *STAR* items within each category.

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

An annual cumulative index will be published.

AVAILABILITY OF CITED PUBLICATIONS

IAA ENTRIES (A85-10000 Series)

Publications announced in *IAA* are available from the AIAA Technical Information Service as follows: Paper copies of accessions are available at $10.00 per document (up to 50 pages), additional pages $0.25 each. Microfiche[1] of documents announced in *IAA* are available at the rate of $4.00 per microfiche on demand. Standing order microfiche are available at the rate of $1.45 per microfiche for *IAA* source documents and $1.75 per microfiche for AIAA meeting papers.

Minimum air-mail postage to foreign countries is $2.50. All foreign orders are shipped on payment of pro-forma invoices.

All inquiries and requests should be addressed to: Technical Information Service, American Institute of Aeronautics and Astronautics, 555 West 57th Street, New York, NY 10019. Please refer to the accession number when requesting publications.

STAR ENTRIES (N85-10000 Series)

One or more sources from which a document announced in *STAR* is available to the public is ordinarily given on the last line of the citation. The most commonly indicated sources and their acronyms or abbreviations are listed below. If the publication is available from a source other than those listed, the publisher and his address will be displayed on the availability line or in combination with the corporate source line.

Avail: NTIS. Sold by the National Technical Information Service. Prices for hard copy (HC) and microfiche (MF) are indicated by a price code preceded by the letters HC or MF in the *STAR* citation. Current values for the price codes are given in the tables on page viii.

Documents on microfiche are designated by a pound sign (#) following the accession number. The pound sign is used without regard to the source or quality of the microfiche.

Initially distributed microfiche under the NTIS SRIM (Selected Research in Microfiche) is available at greatly reduced unit prices. For this service and for information concerning subscription to NASA printed reports, consult the NTIS Subscription Section, Springfield, Va. 22161.

NOTE ON ORDERING DOCUMENTS: When ordering NASA publications (those followed by the * symbol), use the N accession number. NASA patent applications (only the specifications are offered) should be ordered by the US-Patent-Appl-SN number. Non-NASA publications (no asterisk) should be ordered by the AD, PB, or other *report* number shown on the last line of the citation, not by the N accession number. It is also advisable to cite the title and other bibliographic identification.

Avail: SOD (or GPO). Sold by the Superintendent of Documents, U.S. Government Printing Office, in hard copy. The current price and order number are given following the availability line. (NTIS will fill microfiche requests, as indicated above, for those documents identified by a # symbol.)

Avail: NASA Public Document Rooms. Documents so indicated may be examined at or purchased from the National Aeronautics and Space Administration, Public Document Room (Room 126), 600 Independence Ave., S.W., Washington, D.C. 20546, or public document rooms located at each of the NASA research centers, the NASA Space Technology Laboratories, and the NASA Pasadena Office at the Jet Propulsion Laboratory.

(1) A microfiche is a transparent sheet of film, 105 by 148 mm in size containing as many as 60 to 98 pages of information reduced to micro images (not to exceed 26.1 reduction).

Avail: DOE Depository Libraries. Organizations in U.S. cities and abroad that maintain collections of Department of Energy reports, usually in microfiche form, are listed in *Energy Research Abstracts.* Services available from the DOE and its depositories are described in a booklet, *DOE Technical Information Center - Its Functions and Services* (TID-4660), which may be obtained without charge from the DOE Technical Information Center.

Avail: Univ. Microfilms. Documents so indicated are dissertations selected from *Dissertation Abstracts* and are sold by University Microfilms as xerographic copy (HC) and microfilm. All requests should cite the author and the Order Number as they appear in the citation.

Avail: USGS. Originals of many reports from the U.S. Geological Survey, which may contain color illustrations, or otherwise may not have the quality of illustrations preserved in the microfiche or facsimile reproduction, may be examined by the public at the libraries of the USGS field offices whose addresses are listed in this introduction. The libraries may be queried concerning the availability of specific documents and the possible utilization of local copying services, such as color reproduction.

Avail: HMSO. Publications of Her Majesty's Stationery Office are sold in the U.S. by Pendragon House, Inc. (PHI), Redwood City, California. The U.S. price (including a service and mailing charge) is given, or a conversion table may be obtained from PHI.

Avail: BLL (formerly NLL): British Library Lending Division, Boston Spa, Wetherby, Yorkshire, England. Photocopies available from this organization at the price shown. (If none is given, inquiry should be addressed to the BLL.)

Avail: Fachinformationszentrum, Karlsruhe. Sold by the Fachinformationszentrum Energie, Physik, Mathematik GMBH, Eggenstein Leopoldshafen, Federal Republic of Germany, at the price shown in deutschmarks (DM).

Avail: Issuing Activity, or Corporate Author, or no indication of availability. Inquiries as to the availability of these documents should be addressed to the organization shown in the citation as the corporate author of the document.

Avail: U.S. Patent and Trademark Office. Sold by Commissioner of Patents and Trademarks, U.S. Patent and Trademark Office, at the standard price of 50 cents each, postage free.

Avail: ESDU. Pricing information on specific data, computer programs, and details on ESDU topic categories can be obtained from ESDU International Ltd. Requesters in North America should use the Virginia address while all other requesters should use the London address, both of which are on page vii.

Other availabilities: If the publication is available from a source other than the above, the publisher and his address will be displayed entirely on the availability line or in combination with the corporate author line.

GENERAL AVAILABILITY

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

PUBLIC COLLECTIONS OF NASA DOCUMENTS

DOMESTIC: NASA and NASA-sponsored documents and a large number of aerospace publications are available to the public for reference purposes at the library maintained by the American Institute of Aeronautics and Astronautics, Technical Information Service, 555 West 57th Street, 12th Floor, New York, New York 10019.

EUROPEAN: An extensive collection of NASA and NASA-sponsored publications is maintained by the British Library Lending Division, Boston Spa, Wetherby, Yorkshire, England for public access. The British Library Lending Division also has available many of the non-NASA publications cited in *STAR.* European requesters may purchase facsimile copy or microfiche of NASA and NASA-sponsored documents, those identified by both the symbols # and * from ESA — Information Retrieval Service European Space Agency, 8-10 rue Mario-Nikis, 75738 CEDEX 15, France.

FEDERAL DEPOSITORY LIBRARY PROGRAM

In order to provide the general public with greater access to U.S. Government publications, Congress established the Federal Depository Library Program under the Government Printing Office (GPO), with 50 regional depositories responsible for permanent retention of material, inter-library loan, and reference services. Over 1,300 other depositories also exists. A list of the regional GPO libraries appears on the inside back cover.

ADDRESSES OF ORGANIZATIONS

American Institute of Aeronautics and Astronautics
Technical Information Service
555 West 57th Street, 12th Floor
New York, New York 10019

British Library Lending Division,
Boston Spa, Wetherby, Yorkshire,
England

Commissioner of Patents and Trademarks
U.S. Patent and Trademark Office
Washington, D.C. 20231

Department of Energy
Technical Information Center
P.O. Box 62
Oak Ridge, Tennessee 37830

ESA-Information Retrieval Service
ESRIN
Via Galileo Galilei
00044 Frascati (Rome) Italy

ESDU International, Ltd.
1495 Chain Bridge Road
McLean, Virginia 22101

ESDU International, Ltd.
251-259 Regent Street
London, W1R 7AD, England

Fachinformationszentrum Energie, Physik, Mathematik GMBH
7514 Eggenstein Leopoldshafen
Federal Republic of Germany

Her Majesty's Stationery Office
P.O. Box 569, S.E. 1
London, England

NASA Scientific and Technical Information Facility
P.O. Box 8757
B.W.I. Airport, Maryland 21240

National Aeronautics and Space Administration
Scientific and Technical Information Branch (NIT-1)
Washington, D.C. 20546

National Technical Information Service
5285 Port Royal Road
Springfield, Virginia 22161

Pendragon House, Inc.
899 Broadway Avenue
Redwood City, California 94063

Superintendent of Documents
U.S. Government Printing Office
Washington, D.C. 20402

University Microfilms
A Xerox Company
300 North Zeeb Road
Ann Arbor, Michigan 48106

University Microfilms, Ltd.
Tylers Green
London, England

U.S. Geological Survey Library
National Center – MS 950
12201 Sunrise Valley Drive
Reston, Virginia 22092

U.S. Geological Survey Library
2255 North Gemini Drive
Flagstaff, Arizona 86001

U.S. Geological Survey
345 Middlefield Road
Menlo Park, California 94025

U.S. Geological Survey Library
Box 25046
Denver Federal Center, MS 914
Denver, Colorado 80225

NTIS PRICE SCHEDULES

(Effective October 1, 1985)

Schedule A
STANDARD PRICE DOCUMENTS AND MICROFICHE

PRICE CODE	PAGE RANGE	NORTH AMERICAN PRICE	FOREIGN PRICE
A01	Microfiche	$ 5.95	$11.90
A02-A03	001-050	9.95	19.90
A04-A05	051-100	11.95	23.90
A06-A09	101-200	16.95	33.90
A10-A13	201-300	22.95	45.90
A14-A17	301-400	28.95	57.90
A18-A21	401-500	34.95	69.90
A22-A25	501-600	40.95	81.90
A99	601-up	*	*
NO1		$40.00	70.00
NO2		40.00	70.00

Schedule E
EXCEPTION PRICE DOCUMENTS AND MICROFICHE

PRICE CODE	NORTH AMERICAN PRICE	FOREIGN PRICE
E01	$ 7.50	15.00
E02	10.00	20.00
E03	11.00	22.00
E04	13.50	27.00
E05	15.50	31.00
E06	18.00	36.00
E07	20.50	41.00
E08	23.00	46.00
E09	25.50	51.00
E10	28.00	56.00
E11	30.50	61.00
E12	33.00	66.00
E13	35.50	71.00
E14	38.50	77.00
E15	42.00	84.00
E16	46.00	92.00
E17	50.00	100.00
E18	54.00	108.00
E19	60.00	120.00
E20	70.00	140.00
E99	*	*

*Contact NTIS for price quote.

IMPORTANT NOTICE

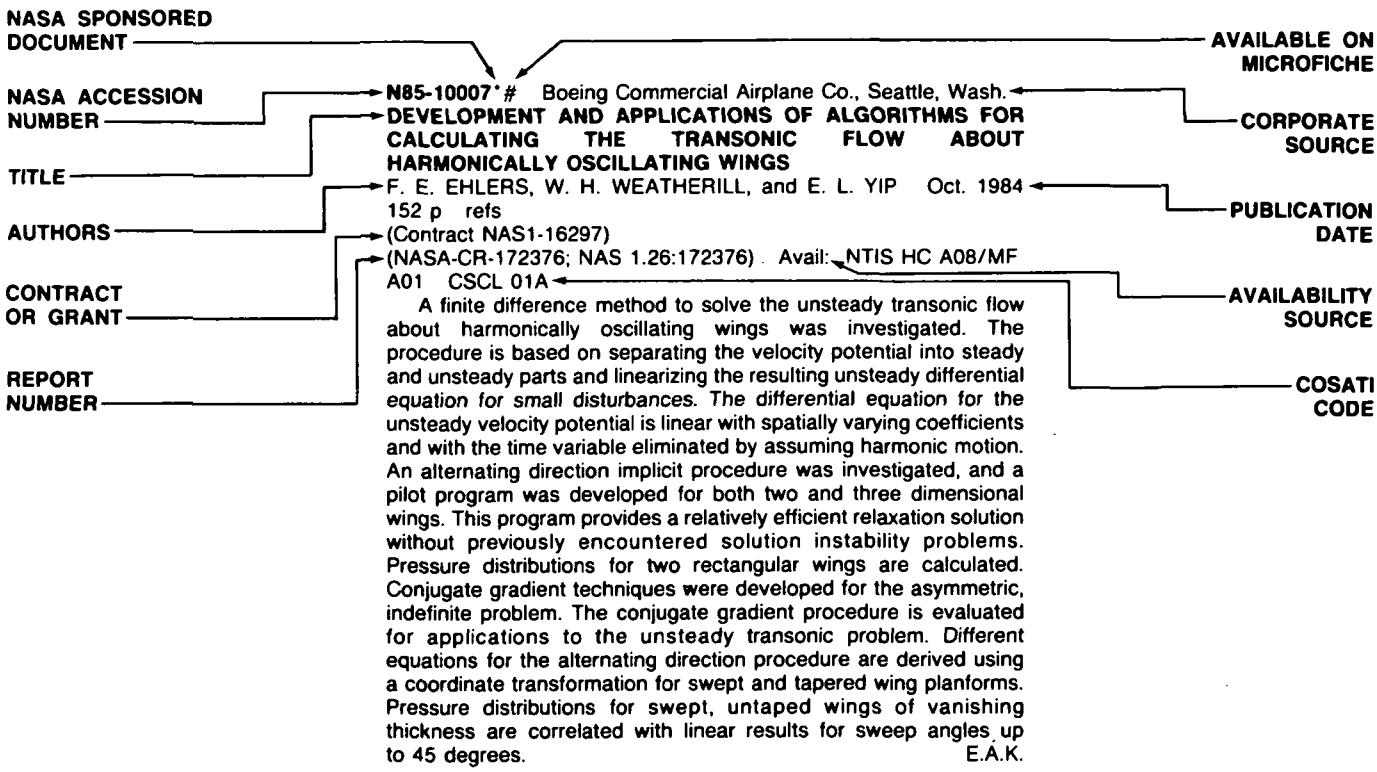
NTIS Shipping and Handling Charges (effective June 1, 1985)
U.S., Canada, Mexico — ADD $3.00 per TOTAL ORDER
All Other Countries — ADD $4.00 per TOTAL ORDER

Exceptions — Does NOT apply to:
ORDERS REQUESTING NTIS RUSH HANDLING
ORDERS FOR SUBSCRIPTION OR STANDING ORDER PRODUCTS *ONLY*

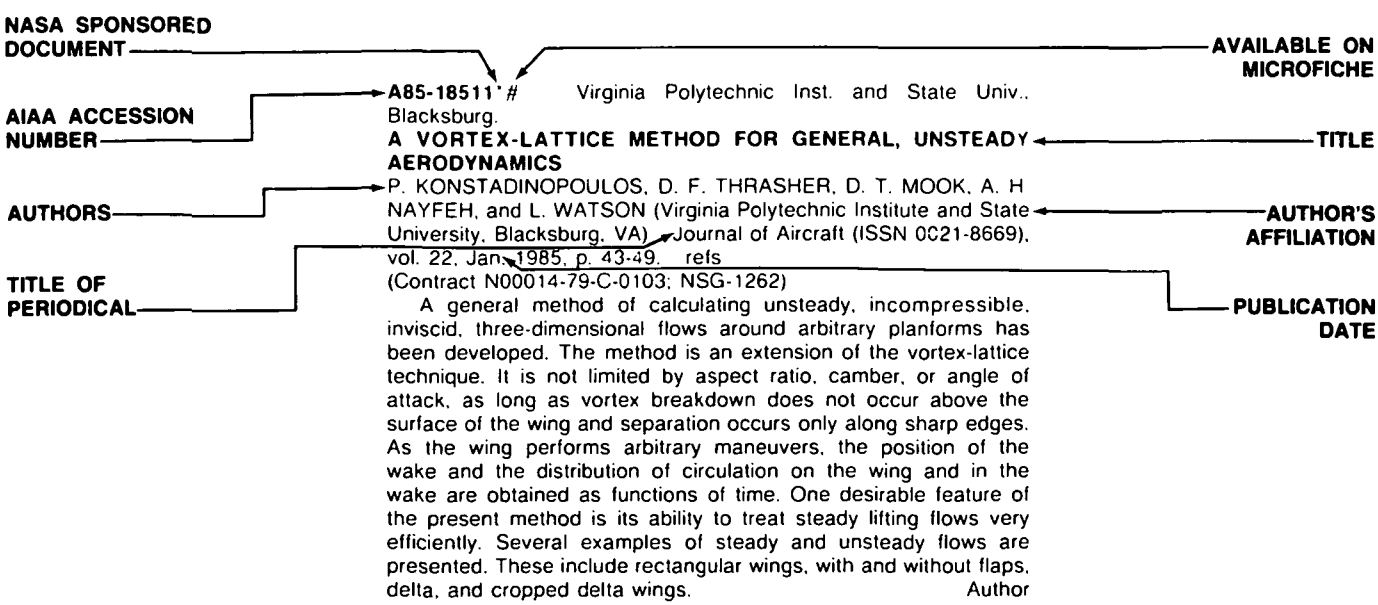
NOTE: Each additional delivery address on an order requires a separate shipping and handling charge.

TABLE OF CONTENTS

TYPICAL CITATION AND ABSTRACT FROM *STAR*



TYPICAL CITATION AND ABSTRACT FROM *IAA*



AERONAUTICAL ENGINEERING

A Continuing Bibliography (Suppl. 194)

DECEMBER 1985

01

AERONAUTICS (GENERAL)

A85-43536
TECHNIQUES FOR IN-SITU MEASUREMENT OF ELECTRICAL BONDING ON AIRCRAFT STRUCTURES
K. J. LODGE and M. W. BASKERVILLE (Plessey Research /Caswell/, Ltd., Allen Clark Research Centre, Towcester, England) Institution of Electronic and Radio Engineers, Journal (ISSN 0267-1689), vol. 55, May 1985, p. 165-171. Research supported by the Ministry of Defence (Procurement Executive), British Aerospace, PLC, and Westland Helicopters, Ltd.

Methods of measuring electrical bonding of large, complex structures such as aircraft are discussed. The importance of measurement method design and result interpretation are stressed. The methods which are described are either large scale, such as potential plotting, potential mapping and infrared scanning, or examine a small area, such as the resistance of individual fasteners. These methods have all been used in situ on service aircraft or large mock-ups. The limitations on the measurement methods are pointed out and the potential uses of the results, to predict poor bonding areas, set specifications etc., suggested. Author

A85-43691
TO FLY ON THE WINGS OF THE SUN - A STUDY OF SOLAR-POWERED AIRCRAFT
D. W. HALL (Lockheed Missiles and Space Co., Inc., Sunnyvale, CA) Lockheed Horizons, June 1985, p. 60-68.

Solar High Altitude Powered Platform (Solar HAPP) aircraft are unmanned remote sensing vehicles designed for cruises lasting up to one year at 20-km altitude, while carrying up to 250 pounds of cameras and electrooptic sensors in an underslung payload pod. It is anticipated that real time IR and UV images of earth features may be more inexpensively and accurately obtained by this means than by the conventional geosynchronous earth resources satellites. Solar HAPPs, with wing spans of over 300 ft and weights of only 2000 lb, require ultralight composite structures with external wire bracing. Solar cells will cover both sides of the vertical wing stabilizers and wing tips, which hinge up in daytime to capture the maximum amount of sunlight. A 15-hp electric propulsion unit drives a low-rpm, large diameter propeller; power will be derived from the solar cells diurnally, and from hydrogen-oxygen fuel cells nocturnally. The fuel gases will be generated in a water electrolyzer during the day by excess solar cell output. O.C.

A85-43877#
FLIGHT CONTROL DYNAMICS OF THE 1903 WRIGHT FLYER
H. R. JEX (Systems Technology, Inc., Hawthorne, CA) and F. E. C. CULICK (California Institute of Techology, Pasadena) IN: Atmospheric Flight Mechanics Conference, 12th, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 534-548. refs
(AIAA PAPER 85-1804)

The Los Angeles Chapter of AIAA is constructing two repliicas of the 1903 Wright Flyer, one of which will be subjected to wind tunnel tests, while the other is to be modified for flight. Attention is given to the control systems of the Flyer and their behavior, comparing key results from vortex lattice computations and scale model wind tunnel tests for this canard-biplane configuration. The implications of the stability and control property analyses conducted for closed loop control by a pilot are derived by means of a quasi-linear pilot-vehicle analysis, and illustrated by simulation time histories. It is shown that the Wright brothers were largely ignorant of dynamic stability considerations, rendering the Flyer unstable in pitch and roll. O.C.

A85-44071
ADVANCED TECHNOLOGY TO BLOSSOM IN NEXT-GENERATION FIGHTER
J. B. SCHULTZ Defense Electronics (ISSN 0278-3479), vol. 17, Aug. 1985, p. 62, 63, 65, 66, 69.

The USAF wants to field an ATF (Advanced Tactical Fighter) in the mid-1990s to assure air superiority. At present it is developing advanced avionics systems, electronic components such as VHSIC, and materials and structures for stealth and high-performance airframe designs that could be integrated into the planned ATF. Principal requirements include: supersonic cruise at high altitude; high maneuverability at supersonic speeds; low-observable or stealth technology for increased survivability; advanced avionics for long-range detection and intercept; and STOL capability. Programs at the USAF's Aeronautical Systems Division that relate to the ATF program are discussed. D.H.

A85-44303
RADIO TECHNICAL COMMISSION FOR AERONAUTICS, ANNUAL ASSEMBLY MEETING AND TECHNICAL SYMPOSIUM, WASHINGTON, DC, NOVEMBER 13-15, 1984, PROCEEDINGS
J. ALCORN, ED. (Radio Technical Commission for Aeronautics, Washington, DC) Washington, DC, Radio Technical Commission for Aeronautics, 1985, 106 p. For individual items see A85-44304 to A85-44307.

The effects of the coming generations of general-aviation aircraft and helicopters on world aviation systems are discussed in reviews presented by government and industry experts. Consideration is given to the increasing numbers of aircraft and types of aircraft, the response of the U.S. national airways system, technological advances in helicopters and general-aviation aircraft, future commuter-aircraft requirements, international corporate-aircraft operations, the implementation of microwave landing systems, FAA accommodation of new developments, and the military perspective on increased general-aviation activity. T.K.

A85-44304#
THE COMING IMPACT OF GENERAL AVIATION AEROPLANE AND ROTORCRAFT ON THE WORLD'S AVIATION SYSTEMS
D. FREER (International Civil Aviation Organization, Air Navigation Bureau, Montreal, Canada) IN: Radio Technical Commission for Aeronautics, Annual Assembly Meeting and Technical Symposium, Washington, DC, November 13-15, 1984, Proceedings . Washington, DC, Radio Technical Commission for Aeronautics, 1985, p. 15-27.

The ongoing growth of the world general-aviation-aircraft and helicopter fleets is discussed from the point of view of the ICAO. The increasing numbers of aircraft and flight hours and the trends toward more turboprop, jet, and multiengine configurations and a greater proportion of business (versus private) use are documented in a series of tables and graphs including projections through the year 1995, and some of the reasons for these developments (i.e., the advantages offered by light aircraft and rotorcraft under direct corporate control) are indicated. It is predicted that the ICAO will respond to these trends by introducing international specifications and regulations, modifying and updating regional plans, designating more general-aviation airports, and expanding flight-information and ATC services. T.K.

A85-44305#
FLIGHT MANAGEMENT AND OTHER AIRCRAFT SYSTEMS DEVELOPMENT
C. B. HUSICK (Fairchild Industries, Inc., Germantown, MD) IN: Radio Technical Commission for Aeronautics, Annual Assembly Meeting and Technical Symposium, Washington, DC, November 13-15, 1984, Proceedings . Washington, DC, Radio Technical Commission for Aeronautics, 1985, p. 49-58.

The response of ATC, flight-management, and airport systems to the predicted growth of the general-aviation (GA) fleet is discussed, with a focus on high-density airspace over North America. It is pointed out that the technological status of GA aircraft will also improve, with more turbofan propulsion, state-of-the-art cockpit instruments, and increased instrument-landing capabilities. A number of strategies to increase the GA capacities of existing commercial airports and divert some GA traffic to convenient smaller airports are evaluated, and the need for carefully organized long-term planning is indicated. T.K.

A85-44974
TWO FEDERAL AGENCIES SUPPORT HYPERSONIC TRANSPORT RESEARCH
H. J. COLEMAN Aviation Week and Space Technology (ISSN 0005-2175), vol. 123, Aug. 19, 1985, p. 44, 45, 47.

Research supported by DARPA and the President's Office of Science and Technology Policy to develop hypersonic (Mach 4-5) military and commercial transports is being conducted. The transports are to allow for a flight time of two to three hours to the Orient and operate at reasonable cost. Engines tested for the hypersonic transport include a hydrogen-cooled engine, an air-breathing engine powered by natural gas or hydrogen, a throttleable solid-fuel gas generator engine, and a combine cycle air-breathing engine. Kerosene and cryogenic-hydrocarbon are being tested as fuel to power the transports. Technology is being developed for advanced materials, lightweight tanks, and engine-airframe integration. Some of the research is also being conducted in NASA facilities. Additional research has been done on kerosene and cryogenic-hydrocarbon fuel to power the transport. I.F.

A85-44976
NAECON 1984; PROCEEDINGS OF THE NATIONAL AEROSPACE AND ELECTRONICS CONFERENCE, DAYTON, OH, MAY 21-25, 1984. VOLUMES 1 & 2
Conference sponsored by IEEE. New York, IEEE, 1984. Vol. 1, 736 p.; vol. 2, 768 p. For individual items see A85-44977 to A85-45161.

Developments related to VLSI are discussed along with topics concerned with signal processing, cartographic data uses, data transmission, avionics system topics, multiapplication signal processing architectures, airborne image processing, target recognition/acquisition, airborne radar and fire control, navigation, air data, weapon guidance and control, Kalman filtering, power generation and control, and flying qualities. Attention is given to integrated control, flight management, multivariable control, self-repairing flight control, all-electric aircraft, digital flight control architecture and reliability, advanced software tools, software acquisition and test issues, software management and quality assurance, expert systems, trends in artificial intelligence, and engineering management. Other areas considered include system performance and workload assessment, human/machine system analysis, advanced avionics display content, reliability, life cycle cost, and flight training and simulation. G.R.

A85-45056#
SELF-REPAIRING FLIGHT CONTROL SYSTEM RELIABILTY & MAINTAINABILITY PROGRAM EXECUTIVE OVERVIEW
P. R. CHANDLER (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH) IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 1 . New York, IEEE, 1984, p. 586-590.

A Flight Control System (FCS) Self-Repairing (SR) Reliability and Maintainability (R&M) Program is described that proposes to exploit the inherent control system redundancies of the Next Generation Fighter (NGF) by fully utilizing its multiple control surfaces via reconfiguration after effector failures. The R&M Program is organized around two major tasks: (1) demonstration of critical SR technologies, and (2) development of SR FCS for the NGF. The first task will have an impact on the Critical Technology Demonstrator and STOL demonstrator, which in turn will affect the NGF. This task will include: Control Mixer Reconfiguration Strategy; Proof of Concept; Positive pilot alert (which will include: situation assessment of the after-failure performance limits); High Performance Flight Demonstration of Reconfiguration Concept; and Maintenance Diagnostics. The second task is designed to provide a simulation/rapid prototyping demonstration of the full capability of reconfiguration for the NGF. It will emphasize the aspects of NGF Control Effector Structure Optimization; Reconfiguration strategies; Proof of Concept; Architecture and Elements; Simulation/Rapid Prototyping Facility; NGF Failure Model; NGF demonstration; and R&M analysis tool. I.S.

A85-45153
REAL-TIME MANAGEMENT OF STRATEGIC PENETRATOR MISSIONS
T. B. DISSANAYAKE and C. D. PERRAS, JR. (Boeing Military Airplane Co., Seattle, WA) IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 2 . New York, IEEE, 1984, p. 1308-1312.

The application of Real-Time Mission Management (RTMM) to strategic penetrator missions is explored. RTMM is defined as the modification in real-time of a pre-mission optimized path in the presence of previously unknown threats and targets in order to maximize the probability of survival and mission effectiveness. The pre-mission and mission phases are outlined. The use of dynamic programming in the pre-mission phase to generate an optimum flight path given terrain and defense beddown is detailed. The mission phase path management is discussed with regard to terrain following, terrain, obstacle and threat avoidance, and target acquisition. The potential for artificial intelligence applications to mission management is outlined. Penetrator survivability is studied in a real-time mission-managed scenario versus one which follows a pre-mission plan. The gain in the probability of penetrator survival with real-time mission management in an environment of unknown threats is significant. Author

A85-45917#
COMBINING QUANTITATIVE AND QUALITATIVE REASONING IN AIRCRAFT FAILURE DIAGNOSIS
R. F. STENGEL (Princeton University, NJ) and D. A. HANDELMAN IN: Guidance, Navigation and Control Conference, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 366-375. refs
(Contract DAAG29-84-K-0048)
(AIAA PAPER 85-1905)

The problem of in-flight failure-origin diagnosis is addressed by combining aspects of analytical redundancy and artificial intelligence theory. The objective is to use the mathematical model designed to simulate aircraft behavior as a supplement to the knowledge used for diagnosis. A method is developed whereby qualitative causal information about a dynamic system is drawn from its model. Based on sensitivities of the equations of motion to worst-case failure modes, a measure of the relative capacity of system elements to affect one another is derived. A diagnosis procedure combining problem reduction and backward-chaining ordered search uses this knowledge to reduce a list of elements capable of failure to a relatively small list of elements suspected of failure. Examples illustrate use of the knowledge base and the problem-solving mechanism that has been developed. Two parameters are found to be crucial to the fault diagnosis: the elapsed time between first detection of a failure and initiation of the diagnosis procedure, and the minimum amount of influence that an element must have on a well-behaved indicator in order to deem the element unfailed. Author

A85-45945#
OPTIMAL FUSELAGE AIMING
B. JARMARK (Saab-Scania AB, Linkoping, Sweden) and G. FORSLING IN: Guidance, Navigation and Control Conference, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 645-651. refs
(AIAA PAPER 85-1961)

A dog fight between two aircraft is usually preceded by a head-on encounter. This initial phase gives the possibility to use the gun for a few seconds, if sure of not colliding with the target. In order to succeed, the trajectory has to be uncoupled to the aiming process to a certain degree. In this paper, the nonlinear and dynamic problem is realistically formulated and optimized by a modified, first-order Differential Dynamic Programming method. A contribution to the outcome can be addressed to a new aircraft feature, having an angle of attack without producing lift force. In studying this fast process, the short period dynamics cannot be neglected, which is herein approximated by a first-order dynamic. The geometry in satisfying the aiming condition is complex, and causes equality constraints on functions of the state. Author

A85-45963#
AN AIRLINE VIEW ON BUILT-IN TEST EQUIPMENT
D. J. TANGNEY (United Airlines, Inc., San Francisco, CA) IN: Guidance, Navigation and Control Conference, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 808-811.
(AIAA PAPER 85-1912)

Built-In Test Equipment (BITE), which has played a significant role in the maintenance of the B 767 airliner's avionics, is effective in the gathering of data on crew-observed faults, in suggesting corrective action, and in verifying system operation. Attention is presently given to the difficulties and inconveniences that have been experienced with BITE to date, and an account is given of guidelines being developed for the design of future airliners' BITE systems. Such BITEs will permit simplified operation from a centrally located keyboard/display unit; stored fault data will be identified with flight number and time, and may either be printed in flight or sent via data link to ground stations in order to expedite maintenance planning. O.C.

A85-46566
FUNDAMENTALS OF FLIGHT OPERATIONS, MAINTENANCE, AND FLIGHT SAFETY [OSNOVY LETNO-TEKHNICHESKOI EKSPLUATATSII I BEZOPASNOSTI POLETOV]
N. I. VLADIMIROV, A. I. PUGACHEV, and V. K. GRINIK Moscow, Izdatel'stvo Transport, 1984, 232 p. In Russian. refs

The principal objectives and the organizational structure of the aviation engineering service are reviewed, as are the principles of flight operations and technical maintenance of aircraft. Attention is given to possible ways of increasing the efficiency of aircraft utilization and flight safety assurance. A classification of flight accidents is presented, and methods for analyzing and investigating such accidents are discussed. V.L.

A85-46583
DIAGNOSING AND PREDICTING THE TECHNICAL CONDITION OF AVIATION EQUIPMENT [DIAGNOSTIROVANIE I PROGNOZIROVANIE TEKHNICHESKOGO SOSTOIANIIA AVIATSIONNOGO OBORUDOVANIIA]
V. G. VOROBEV, V. V. GLUKHOV, IU. V. KOZLOV, V. D. KONSTANTINOV, I. M. SINDEEV et al. Moscow, Izdatel'stvo Transport, 1984, 192 p. In Russian. refs

The principal concepts, objectives, and methods of diagnosing and predicting the technical condition of aviation equipment are presented. Attention is given to diagnostic procedures, synthesis and analysis of diagnostic models, performance control, and fault detection. The discussion also covers the organization and information-methodological support of the prediction of the technical condition of aviation equipment and the use of automatic control systems for the purposes of diagnosis and prediction. V.L.

N85-32089*# Loftin (Laurence K., Jr.), Newport News, Va.
QUEST FOR PERFORMANCE: THE EVOLUTION OF MODERN AIRCRAFT
L. K. LOFTIN, JR. 1985 548 p refs Original contains color illustrations
(Contract NASW-3490)
(NASA-SP-468; NAS 1.21:468) Avail: NTIS HC A23/MF A01; SOD HC $26.00 as 033-000-00902-0 CSCL 01B

The technical evolution of the subsonic airplane is traced from a curiosity at the beginning of World War I to the highly useful machine of today. Included are descriptions of significant aircraft which incorporated important technical innovations and served to shape the future course of aeronautical development, as well as aircraft which represented the state-of-art in a particular time frame or were much used or liked. The discussion is related primarily to aircraft configuration evolution and associated aerodynamic characteristics and, to a lesser extent, to developments in aircraft construction and propulsion. The material is presented in a manner designed to appeal to the nontechnical reader who is interested in the evolution of the airplane, as well as to students of aeronautical engineering and others with an aeronautical background. Author

N85-32090*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
RECENT DEVELOPMENTS IN ROTARY-BALANCE TESTING OF FIGHTER AIRCRAFT CONFIGURATIONS AT NASA AMES RESEARCH CENTER
G. N. MALCOLM and L. B. SCHIFF Jul. 1985 28 p refs
(NASA-TM-86714; REPT-85211; NAS 1.15:86714) Avail: NTIS HC A03/MF A01 CSCL 01B

Two rotary balance apparatuses were developed for testing airplane models in a coning motion. A large scale apparatus, developed for use in the 12-Foot Pressure Wind tunnel primarily to permit testing at high Reynolds numbers, was recently used to investigate the aerodynamics of 0.05-scale model of the F-15 fighter aircraft. Effects of Reynolds number, spin rate parameter, model attitude, presence of a nose boom, and model/sting mounting angle were investigated. A smaller apparatus, which investigates the aerodynamics of bodies of revolution in a coning motion, was used in the 6-by-6 foot Supersonic Wind Tunnel to investigate the

aerodynamic behavior of a simple representation of a modern fighter, the Standard Dynamic Model (SDM). Effects of spin rate parameter and model attitude were investigated. A description of the two rigs and a discussion of some of the results obtained in the respective test are presented. Author

02

AERODYNAMICS

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

A85-43832#
EFFECTS OF ASPECT RATIO ON STALL HYSTERESIS FOR THE WORTMANN AIRFOIL
J. F. MARCHMAN, A. A. ABTAHI, V. SUMANTRAN, and Z. SUN (Virginia Polytechnic Institute and State University, Blacksburg) IN: Atmospheric Flight Mechanics Conference, 12th, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 44-49. Research supported by the Virginia Polytechnic Institute and State University. refs
(Contract N00014-84-K-0093)
(AIAA PAPER 85-1770)

Wind tunnel tests were conducted in the Virginia Tech Stability Wind Tunnel to determine the effects of aspect ratio on the aerodynamic performance of the Wortmann FX63-137 airfoil at Reynolds numbers from 50,000 to 500,000. The tests showed that the stall hysteresis loop behavior of the airfoil is a function of both Reynolds number and aspect ratio. The range of Reynolds number over which a stall hysteresis loop exists is a function of aspect ratio with that range shifting to higher Reynolds number values as aspect ratio increases. Aspect ratio changes also appear to affect the size of the hysteresis loop at a given Reynolds number. Author

A85-43833#
JOUKOWSKY AIRFOIL WITH CIRCULATION CONTROL
V. J. MODI (British Columbia, University, Vancouver, Canada) and F. MOKHTARIAN IN: Atmospheric Flight Mechanics Conference, 12th, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 50-60. refs
(Contract NSERC-A-2181)
(AIAA PAPER 85-1772)

The effectiveness of the moving surface method of boundary layer control is evaluated for a symmetrical Joukowsky airfoil in the cases of a rotating circular cylinder (representing a bound vortex) which is located arbitrarily with respect to the leading edge, and that of the rotating cylinder's substitution for the leading edge. Test program results are compared with those of potential flow analytical and numerical approaches. The analytical model correctly predicts trends but is only qualitative in character. The concept of moving surface boundary layer control appears promising, with rotating leading edge tests indicating significant improvement in maximum lift and stall characteristics. O.C.

A85-43834#
DYNAMIC STALL OVERSHOOT OF STATIC AIRFOIL CHARACTERISTICS
L. E. ERICSSON and J. P. REDING (Lockheed Missiles and Space Co., Inc., Sunnyvale, CA) IN: Atmospheric Flight Mechanics Conference, 12th, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 61-77. refs
(AIAA PAPER 85-1773)

Available experimental data are analyzed to isolate and define the fluid mechanical processes that together produce the observed large dynamic overshoot (and undershoot) of static airfoil characteristics. It is shown that the complicated dynamic stall process is composed of relatively simple unsteady flow phenomena which can be evaluated against the background of more and more sophisticated experiments. The analysis shows that a design code could be formulated for prediction of full scale dynamic stall overshoot (and undershoot) of static airfoil characteristics through analytic extrapolation from subscale experiments. Author

A85-43835*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ON THE WAKE HAZARD ALLEVIATION ASSOCIATED WITH ROLL OSCILLATIONS OF WAKE-GENERATING AIRCRAFT
V. J. ROSSOW (NASA, Ames Research Center, Moffett Field, CA) IN: Atmospheric Flight Mechanics Conference, 12th, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 78-88. refs
(AIAA PAPER 85-1774)

An explanation is provided for the difference in wake vortex alleviation achieved by roll oscillations in flight tests with B-747 and L-1011 transport aircraft. Both aircraft had their landing flaps extended and several spoilers deployed. Numerical analysis shows that the growth in amplitude of the initial waves in the vortex filament is brought about by the sinusoidal instability. In the case of the B-747, growth is enhanced by a vortex whose strength is about the same as the tip vortex which is shed near the fuselage by the inboard end of the flaps. Conversely, the L-1011 is estimated to shed a negligible fuselage vortex and to have a relatively strong wingtip vortex. These characteristics bring about a rotation and amplification of the initial waves in the vortex filaments in the wake of the B-747 but not in the L-1011 vortex wake. An aircraft following the B-747 would then experience only intermittent encounters with the intense parts of the wake vortices so that the time-averaged wake-induced rolling moment is substantially reduced. Author

A85-43836*# Kentron International, Inc., Hampton, Va.
NONLINEAR APPLICATIONS OF SLENDER-BODY THEORY TO MISSILE AERODYNAMICS
M. J. HEMSCH (Kentron International, Inc., Hampton, VA) IN: Atmospheric Flight Mechanics Conference, 12th, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 89-101. refs
(Contract NAS1-18000)
(AIAA PAPER 85-1775)

An evaluation is made of six diverse examples of nonlinear treatments of slender body theory for the prediction of missile aerodynamic behavior. The cases in question are the application of area rule to store carriage design in the drag rise region, the estimation of destabilizing pitching moments associated with transonic projectiles, the pressure loadings on elliptical missile airframes, nonlinear control characteristics, roll control effectiveness in canard missile configurations, and novel approaches for vortex flow modeling. O.C.

A85-43849*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
SUPERSONIC AERODYNAMIC CHARACTERISTICS OF SOME REENTRY CONCEPTS FOR ANGLES OF ATTACK UP TO 90 DEG
M. L. SPEARMAN (NASA, Langley Research Center, Hampton, VA) IN: Atmospheric Flight Mechanics Conference, 12th, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 214-221. refs
(AIAA PAPER 85-1795)

Past studies of reentry vehicles tested to high angles of attack (up to 90 deg) in the Mach number range from 2 to 4.8 have provided some fundamental insights into the aerodynamic characteristics of such vehicles. Two basic planforms are considered in this paper: highly swept deltas, and circular. The delta concepts include variations in cross section (and thus volume) and in camber distribution. The effectiveness of various types of aerodynamic control devices is also included. The purpose of the paper is to examine the characteristics of the vehicles with a view toward the potential usefulness of such concepts in a flight regime that would include reentry from space into the atmosphere, followed by a transition to sustained atmospheric flight. Author

A85-43850#
AERODYNAMIC EFFECTS OF ASYMMETRIC VORTEX SHEDDING FROM SLENDER BODIES
L. E. ERICSSON and J. P. REDING (Lockheed Missiles and Space Co., Inc., Sunnyvale, CA) IN: Atmospheric Flight Mechanics Conference, 12th, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 222-256. refs
(AIAA PAPER 85-1797)

Existing experimental and theoretical results for the aerodynamic effects of asymmetric vortex shedding from slender bodies at zero side slip are examined. It is found that existing theoretical methods are inadequate because they do not account for the viscous flow effects, including the dominant influence of nonuniform surface roughness, neither do they consider the dominant effects of nosetip geometry and vehicle motion. It is equally difficult to obtain the needed information experimentally in subscale tests because of the large viscous flow effects. For the present the only realistic approach for the aerodynamicist trying to predict the full scale asymmetric vortex effects is to use the upper bounds for vortex-induced side loads and side moments, established through extrapolation from the unsteady vortex-induced loads generated on a circular cylinder in two-dimensional flow. Author

A85-43851*# Northrop Corp., Hawthorne, Calif.
LOW-SPEED EXPERIMENTAL STUDY OF THE VORTEX FLOW EFFECTS OF A FIGHTER FOREBODY HAVING UNCONVENTIONAL CROSS-SECTION
G. E. ERICKSON (Northrop Corp., Aircraft Div., Hawthorne, CA) and J. M. BRANDON (NASA, Langley Research Center, Hampton, VA) IN: Atmospheric Flight Mechanics Conference, 12th, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 257-290. refs
(AIAA PAPER 85-1798)

A low speed wind tunnel investigation is conducted for the vortex flow characteristics of a tailless fighter configuration that features full length, fuselage-blended forebody strakes. Static pressure distributions were obtained on the forebody upper surface, and six-component forces and moments were measured on the complete, 60-deg cropped delta wing-fuselage-centerline vertical fin model at angles of attack and sideslip respectively reaching 50 deg and + or - 20 deg. The surface pressure data reveal that development of concentrated vortices from the sharp edged forebody strakes occurred at moderate and high angles of attack. The blended forebody was effective in capturing the windward vortical flow up to high incidence and sideslip angles. The direct suction effect of the windward vortex on the forebody sidewall was the primary contributor to static directional stability at high angles of attack. These improvements are potentially offset, however, by reduced or unstable roll and yaw damping. Author

A85-43852#
THE EFFECT OF REYNOLDS NUMBER ON NORMAL AND SIDE FORCES ON OGIVE-CYLINDERS AT HIGH INCIDENCE
P. J. LAMONT (Manchester, Victoria University, England) IN: Atmospheric Flight Mechanics Conference, 12th, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 291-299. refs
(AIAA PAPER 85-1799)

This paper presents further evidence to support the critical Reynolds number boundaries for inclined cylinders discovered by the author. Once established these boundaries greatly simplify the analysis of Reynolds number effects on inclined cylinders. They are used in this paper to explain the variation of normal and side forces with incidence in the critical Reynolds number range. The controversial subject of maximum side force is discussed and the rare exceptions to the general rule that maximum side force occurs in either the laminar or the fully turbulent flow regimes are explained. The curious effect of Reynolds number on the sign of the side force on bodies with slender ogive noses is explained and a second change of sign at very high Reynolds number is postulated. Author

A85-43853#
DRAG REDUCTION BY MEANS OF CONTROLLED SEPARATED FLOWS
J. A. C. KENTFIELD (Calgary, University, Canada) IN: Atmospheric Flight Mechanics Conference, 12th, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 300-305. refs
(AIAA PAPER 85-1800)

A description is given of the relatively newly proposed technique of employing controlled separated flows, involving the formation of captive vortices, to induce the bulk flow to follow the contours of an afterbody otherwise too steeply faired to guarantee conventional attached flow. It is shown that the orientation of the axes of the vortices can be skewed, tranverse or parallel to the direction of the bulk flow. The results of three sets of wind-tunnel experiments are described, one carried out on an axisymmetric body, the others on aircraft fuselage configurations, which were intended to establish the effectiveness of controlled separated flows. It was found that significant drag reductions, in the region of 30 percent or more, were obtained with proper use of controlled separated flow. It was concluded that controlled separated flow appears to be of greatest potential benefit where conventional, long, well-faired afterbodies are impractical. Author

A85-43858#
NONAXISYMMETRIC, DISCONTINUOUS BODY, SECOND-ORDER, LINEAR, SUPERSONIC FLOW PREDICTION
L. DEVAN and L. A. KANIA (U.S. Navy, Naval Surface Weapons Center, Dahlgren, VA) IN: Atmospheric Flight Mechanics Conference, 12th, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 350-358. Navy-USAF-supported research. refs
(AIAA PAPER 85-1810)

A second-order, iterative, Van Dyke potential model, developed for bodies with continuous surface derivatives in two earlier papers, is extended to bodies with planar surface slope and inlet discontinuities. Local two-dimensional jump relations for the first- and second-order equations are developed from a combination of conservation and irrotationality equations using the method of 'weak' solutions. The flowfield downstream of a discontinuity is obtained by an explicit MacCormack marching scheme. Good comparisons were obtained with Euler computations for the pressure coefficients just downstream of a discontinuity and for pressure and total load coefficients for complete bodies with discontinuities. Author

A85-43859*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
APPLICATION OF THE SWINT CODE TO WING/BODY/TAIL GEOMETRIES
J. M. ALLEN and J. C. TOWNSEND (NASA, Langley Research Center, Hampton, VA) IN: Atmospheric Flight Mechanics Conference, 12th, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 359-368. refs
(AIAA PAPER 85-1811)

Pressure and force calculations from the SWINT Euler code are presented and analyzed for a variety of configurations ranging from simple axisymmetric bodies to complex bodies with wings, tails, and inlets at speeds covering the supersonic Mach number range. The SWINT results are compared with both experimental data and with results from simpler computational methods to assess the increased accuracy from the Euler solution. It is shown that SWINT gives excellent results on axisymmetric bodies for attached flow; however, a better method of simulating the separation process on such bodies is needed for increased leeside accuracy. Good leeside accuracy, however, is found on a 3 to 1 elliptical body. It is shown that SWINT gives realistic downstream interference effects, resulting in good predictions of the overall aerodynamics for complex wing-body-tail geometries. The QUICK-geometry system has been coupled with SWINT code to provide a simplified geometry definition procedure for complex bodies. The QUICK method is shown to be a preferable alternative to the current

method of inserting the body description directly into the code by FORTRAN statements. Author

A85-43862*# Air Force Armament Lab., Eglin AFB, Fla.
A NUMERICAL INVESTIGATION OF THE AERODYNAMICS OF BICONIC AND NON-CIRCULAR FLARED CONFIGURATIONS
C. J. COTTRELL (USAF, Armament Laboratory, Eglin AFB, FL), G. T. CHAPMAN (NASA, Ames Research Center, Moffett Field, CA), and K. R. ROTH IN: Atmospheric Flight Mechanics Conference, 12th, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 391-398. refs
(AIAA PAPER 85-1814)

Two families of biconic flares and three noncircular flares were studied at Mach numbers from 2 to 4 using a parabolized Navier-Stokes code. All configurations had cone-cyclinder forebodies. The biconic flares were examined to determine if drag could be reduced without significant loss of stability. Only slight drag reduction was found; however, meaningful volume increases were possible with negligible drag penalty. Significant decreases in drag were obtained with the noncircular flares. These configurations maintain considerable pitch stability but sacrifice nearly all yaw stability. The latter can be corrected with fold-out fins that could be readily accommodated on the noncircular flares. Author

A85-43869*# Weapons Systems Research Lab., Adelaide (Australia).
WIND-TUNNEL INVESTIGATION OF THE AERODYNAMIC CHARACTERISTICS OF THE STANDARD DYNAMICS MODEL IN CONING MOTION AT MACH 0.6
C. JERMEY (Department of Defence, Weapons Systems Research Laboratory, Adelaide, Australia) and L. B. SCHIFF (NASA, Ames Research Center, Moffett Field, CA) IN: Atmospheric Flight Mechanics Conference, 12th, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 447-461. refs
(AIAA PAPER 85-1828)

A series of wind-tunnel tests have been conducted on the Standard Dynamics Model (a simplified generic fighter-aircraft shape) undergoing coning motion at Mach 0.6. Six-component force and moment data are presented for a range of angles of attack, sideslip and coning rates. At the relatively low nondimensional coning rates employed, the lateral aerodynamic charactersitics generally show a linear variation with coning rate. Author

A85-43874#
PROJECTILE AERODYNAMICS PREDICTION WITH CSCM-S UPWIND IMPLICIT RELAXATION ALGORITHM
R. C.-C. LUH and C. K. LOMBARD (PEDA Corp., Palo Alto, CA) IN: Atmospheric Flight Mechanics Conference, 12th, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 512-518. refs
(Contract DAAG29-84-C-0002)
(AIAA PAPER 85-1838)

The single level conservative supra-characteristic method (CSCM-S) is an upwind implicit relaxation scheme that makes efficient use of computer resources, is robust and very rapidly convergent. These factors render the unconditionally stable algorithm a useful compromise between parabolized Navier-Stokes methods and two level linearized implicit time dependent methods and, hence, the method is attractive for multidimensional compressible Navier-Stokes problems. In this paper, the aerodynamic prediction capabilities of the CSCM-S scheme are demonstrated by applying the method to the analysis of axisymmetric transonic flow around a projectile. With numerical simulations of different geometric approximations of the complex base/wake region of the flow field, the paper relates directly results of wind tunnel experiment to the free flight condition and another numerical simulation. Attention is given to the consistency and impact on accuracy of numerical boundary conditions, to grid refinement and to small rounding of corners as might occur in model making. Author

A85-43879*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
AERODYNAMICS FOR AN ENTRY RESEARCH VEHICLE
M. J. CUNNINGHAM (NASA, Langley Research Center, Hampton, VA) AIAA, Atmospheric Flight Mechanics Conference, 12th, Snowmass, CO, Aug. 19-21, 1985. 8 p. refs
(AIAA PAPER 85-1793)

A candidate configuration, called the Entry Research Vehicle, is being proposed for a Shuttle launched flight experiment program. This vehicle will be used to demonstrate maneuverability in the upper atmosphere, test developing thermostructure concepts, and measure the atmospheric flight conditions encountered by the vehicle. The techniques used to predict the hypersonic aerodynamics of this vehicle through the various flight regimes in the upper atmosphere are discussed. Results of wind-tunnel data from the Langley Hypersonic Helium Tunnel and Shuttle flight data support the aerodynamic predictions. Author

A85-43925
ON THE THEORY OF OSCILLATING AIRFOILS IN SUPERSONIC AND SONIC FLOW
L. DRAGOS (Bucuresti, Universitatea, Bucharest, Rumania) Zeitschrift fuer angewandte Mathematik und Physik (ISSN 0044-2275), vol. 36, May 1985, p. 481-486. refs

The perturbation produced in a uniform supersonic flow by an oscillating airfoil is investigated analytically using the fundamental-solutions approach of Dragos (1983 and 1984). The corresponding sonic-flow problem is treated as a special case, and the method applied is shown to facilitate the calculation of lift and moment coefficients. T.K.

A85-43977*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
INVISCID ANALYSIS OF ADVANCED TURBOPROP PROPELLER FLOW FIELDS
J. M. BARTON, O. YAMAMOTO (Sverdrup Technology, Inc., Middleburg Heights, OH), and L. J. BOBER (NASA, Lewis Research Center, Cleveland, OH) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 12 p. refs
(Contract NAS3-24105)
(AIAA PAPER 85-1263)

A three-dimensional Euler code, previously developed for high speed propellers, was rewritten and vectorized for the Cray computer. Calculations were compared with previous results and measurements. The new code requires less memory and is more than two times faster than its predecessor. The new boundary conditions produced more accurate results and improved stability. The accuracy and stability characteristics also resulted in reduced manual intervention required to obtain solutions. The code is a useful tool for examining the fluid dynamics and performance of propellers. Author

A85-44130
EXAMPLE OF TRANSONIC GAS FLOW PAST AN ASYMMETRIC PROFILE [PRIMER OBTEKANIIA NESIMMETRICHNOGO PROFILIA ZVUKOVYM POTOKOM GAZA]
S. T. LICHUK and A. A. OREL PMTF - Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki (ISSN 0044-4626), Sept.-Oct. 1984, p. 76-81. In Russian. refs

A particular solution is obtained to equations describing the two-dimensional transonic flow of an ideal gas past an asymmetric profile. A linear combination of four self-similar solutions of the Tricomi equations, depending on three arbitrary constants, is considered. The form of the profile is determined directly from the solution. Two arbitrary constants in this solution define the geometric dimensions of the profile while the third constant defines the flow asymmetry. The aerodynamic characteristics of the asymmetric profile are determined. B.J.

A85-44131
CALCULATION OF FLOW IN THE MAIN PART OF A SUPERSONIC JET WITH ALLOWANCE FOR THE INFLUENCE OF THE NOZZLE EXIT SECTION [K RASCHETU TECHENIIA V OSNOVNOM UCHASTKE SVERKHZVUKOVOI STRUI S UCHETOM VLIIANIIA TORTSA SOPLA]
P. A. NESHCHERET, E. A. KAPUSTIN, and O. E. SHLIK PMTF - Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki (ISSN 0044-4626), Sept.-Oct. 1984, p. 81-85. In Russian. refs

The influence of acoustic feedback from the discrete component of the noise spectrum of a supersonic jet in the presence of a two-dimensional exit-section screen on the position of the transonic section of the jet was investigated. The effect of screen diameter on the dynamic characteristics of the jet was evaluated. Results concerning pressure in the subsonic part of the jet and the effect of radiation reflected from the two-dimensional exit section on the jet turbulence constant are generalized. This makes it possible to develop a method for calculating the subsonic part of the flow under the effect of acoustic feedback. B.J.

A85-44133
STRUCTURE OF A LAMINAR BOUNDARY LAYER WITH DISTRIBUTED SUCTION [STRUKTURA LAMINARNOGO POGRANICHNOGO SLOIA S RASPREDELENNYM OTSOSOM]
S. K. BETIAEV PMTF - Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki (ISSN 0044-4626), Sept.-Oct. 1984, p. 97-104. In Russian. refs

The structure of a two-dimensional steady boundary layer on a grid of high-frequency slits is investigated with reference to the enhancement of the lift-drag ratio of wings through boundary-layer suction. The analysis is carried out in the framework of the Navier-Stokes equations using a combined method of different scales and the matching of asymptotic expansions with maximum simplifications relating to the formulation of the problem and the suction scheme. Conditions of distributed suction are established. B.J.

A85-44152
THE SUPERCRITICAL REGIME OF HYPERSONIC FLOW PAST A DELTA WING [O ZAKRITICHESKOM REZHIME GIPERZVUKOVOGO OBTEKANIIA TREUGOL'NOGO KRYLA]
G. N. DUDIN and I. I. LIPATOV PMTF - Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki (ISSN 0044-4626), May-June 1985, p. 100-106. In Russian. refs

The flow in a three-dimensional boundary layer on a cold delta wing is studied theoretically. The strong interaction of the boundary layer flow with an external inviscid hypersonic flow is considered for the case of an asymptotically small ratio of the surface temperature to the stagnation temperature. Expansions for the flow functions are obtained, and eigenvalues in the region of transition from a supercritical regime to a subcritical one are determined. Results of a numerical solution of the equations of a three-dimensional boundary layer on a cold delta wing are presented. B.J.

A85-44268
ESTIMATION OF STOCHASTIC GUST LOADS, TAKING INTO CONSIDERATION UNSTEADY AIR FORCES [ABSCHAETZUNG VON STOCHASTISCHEN BOEENLASTEN UNTER BERUECKSICHTIGUNG INSTATIONAERER LUFTKRAEFTE]
G. SCHAENZER (Braunschweig, Technische Universitaet, Brunswick, West Germany) Zeitschrift fuer Flugwissenschaften und Weltraumforschung (ISSN 0342-068X), vol. 9, May-June 1985, p. 167-178. In German. refs

During the approach and landing of an aircraft, and in flight at very low altitudes, the response of the aircraft to disturbances caused by gusts is important. Thus, landings under medium turbulence conditions would hardly be possible without the gust-alleviating effects of the unsteady aerodynamic forces. However, the calculation of the aircraft response under consideration of unsteady air forces is a very exacting task, and, therefore, on the basis of practical considerations often not feasible. The present investigation is concerned with approaches which make it possible to obtain an estimate of the stochastic gust loads on the basis of an approximate calculation of the unsteady air forces. The procedure makes use of a modified Kuessner function, taking into account a study conducted by Kuessner (1940). A simple formula used for the description of gust loads during flight through turbulent air shows the effect of atmospheric and aircraft parameters. G.R.

A85-44525
PREDICTION OF LEADING-EDGE VORTEX BEHAVIOUR TO SUPPLEMENT THE SUCTION ANALOGY
N. RILEY (East Anglia, University, Norwich, England) and J. H. B. SMITH (Royal Aircraft Establishment, Farnborough, England) Journal of Engineering Mathematics (ISSN 0022-0833), vol. 19, no. 2, 1985, p. 157-172. refs

An analytical treatment is presented which permits the prediction of the strength and path of leading-edge vortices on thin wings of delta-like planform from a knowledge of the behaviour of the linearized approximation to the attached flow past the wing. This supplements the leading-edge suction analogy, which predicts the forces and moments acting on the wing from the same input. The fundamental assumption is that the vortex lies close to the leading edge. It is represented by a single-line-vortex and the presentation is confined to low-speed flow and plane wings. The treatment is independent of the way the basic attached flow is calculated. Results are shown for two simple planforms, using inputs from three-dimensional lifting-surface theory and from slender-body theory. Author

A85-44626
A NUMERICAL METHOD FOR SECOND ORDER THIN AIRFOIL THEORY
B. FORTUNATO (Bari, Universita, Italy) Meccanica (ISSN 0025-6455), vol. 20, June 1985, p. 171-175. CNR-supported research. refs

In this note a fast-Cauchy integral solver and its application to the solution of symmetric incompressible flows, based on a quadratic thin airfoil theory, are presented. The computed velocity near the leading edge has been corrected with the Lighthill-rule. Some results relative to airfoils and to cascade are reported. Author

A85-44788
HYPERSONIC FLOW PAST A WING AT LARGE ANGLES OF ATTACK WITH A DETACHED SHOCK WAVE [GIPERZVUKOVOE OBTEKANIE KRYLA PRI BOL'SHIKH UGLAKH ATAKI S OTSOEDINENNYM SKACHKOM UPLOTNENIIA]
V. N. GOLUBKIN and V. V. NEGODA Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza (ISSN 0568-5281), May-June 1985, p. 149-157. 12 refs. In Russian.

The problem of hypersonic flow past the windward surface of a delta wing at large angles of attack is analyzed using the method of a thin shock layer. In the case considered here, the shock wave is detached from the leading edge (but attached to the wing apex) and the gas velocity in the shock layer is of the same order of magnitude as the speed of sound. A classification of flow regimes is presented. A general solution is obtained which allows for nonequilibrium physicochemical processes and heat radiation of the gas at high temperatures. V.L.

A85-44850
A REPRESENTATION OF THE AERODYNAMIC CHARACTERISTICS OF A FLIGHT VEHICLE OF VARYING SHAPE [PREDSTAVLENIE AERODINAMICHESKIKH KHARAKTERISTIK LETATEL'NOGO APPARATA IZMENIAIUSHCHEISIA FORMY]
IU. M. GOLDSHTEIN IN: Design of flight vehicles and their systems . Kiev, Izdatel'stvo Naukova Dumka, 1985, p. 101-108. In Russian.

An approach to the computation of the aerodynamic characteristics of flight vehicles is proposed whereby additions to the aerodynamic characteristics resulting from slight changes of the vehicle shape in flight are represented as a linear function of

the coefficients determining changes in the vehicle configurations. It is shown that the coefficients in the proposed expression depend only on the initial shape of the flight vehicle and incoming flow parameters. The approach proposed here is particularly effective during the mathematical modeling of the motion of a flight vehicle. V.L.

A85-44851
THE PROPAGATION OF A SUBSONIC TURBULENT JET IN A CLOSED PLANE CONTAINER OF VARYING LENGTH [RASPROSTRANENIE DOZVUKOVOI TURBULENTNOI STRUI V ZAMKNUTOI PLOSKOI EMKOSTI IZMENIAIUSHCHEISIA DLINY]
G. K. OVCHARENKO and V. I. KONOVALOV IN: Design of flight vehicles and their systems . Kiev, Izdatel'stvo Naukova Dumka, 1985, p. 109-113. In Russian.

A method for calculating the velocity field during the propagation of an isothermal subsonic jet in a plane container is proposed which is based on a semiempirical theory of turbulent jets. The solution obtained makes it possible to determine the geometric and kinematic parameters of jet flow which can be used for the analysis of heat and mass transfer processes at the bounding surfaces. V.L.

A85-45166
AN INVISCID MODEL OF UNSTEADY AEROFOIL FLOW WITH FIXED UPPER SURFACE SEPARATION
M. VEZZA and R. A. MCD. GALBRAITH (Glasgow, University, Scotland) International Journal for Numerical Methods in Fluids (ISSN 0271-2091), vol. 5, June 1985, p. 577-592. refs

Presented in this paper is a new method for the prediction of unsteady, incompressible separated flow over a two-dimensional airfoil. The algorithm was developed from an existing unsteady potential flow model and makes use of an inviscid formulation for the flow field. The airfoil is represented by vortex panels of linearly varying strength which are piecewise continuous at the corners. Discrete vortices with finite cores are used to model the separating shear layers. Following a brief summary of unsteady separation modeling, the theoretical framework is presented and the subsequent numerical implementation is discussed in detail. Results are given for flows which tend asymptotically to the steady state and conclusions are drawn regarding the usefulness of the method. Author

A85-45701*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
COMPARISON OF SUPERCRITICAL AIRFOIL FLOW CALCULATIONS WITH WIND TUNNEL RESULTS
L. S. KING and D. A. JOHNSON (NASA, Ames Research Center, Moffett Field, CA) AIAA Journal (ISSN 0001-1452), vol. 23, Sept. 1985, p. 1301-1307. Previously cited in issue 18, p. 2638, Accession no. A83-40472. refs

A85-45704#
TRANSONIC PANEL METHOD FOR THE FULL POTENTIAL EQUATION APPLIED TO MULTICOMPONENT AIRFOILS
B. OSKAM (Nationaal Lucht- en Ruimtevaartlaboratorium, Amsterdam, Netherlands) AIAA Journal (ISSN 0001-1452), vol. 23, Sept. 1985, p. 1327-1334. refs
(AIAA PAPER 83-1855)

The panel method approach is extended to obtain numerical solutions of the full potential equation for transonic flow. This extension is accomplished by adding a field distribution of source singularities to the conventional distribution of singularities over the boundaries of the field. The unknown source distribution in the field is determined by solving the full potential equation. Shock waves are captured automatically by splitting the transformed flux components and applying upwind differencing to the monotonic, supersonic parts. The transonic panel method limits the space discretization to those parts of the flow domain in which the nonlinear compressibility effects are non-negligible. The method is tested by computing the potential flow over singleand multicomponent airfoils. Author

A85-45716#
MODELING OF TURBULENT FLOWFIELDS THROUGH A CASCADE OF AIRFOILS AT STALL CONDITIONS
C. HAH (General Electric Co., Schenectady, NY) AIAA Journal (ISSN 0001-1452), vol. 23, Sept. 1985, p. 1411-1417. Previously cited in issue 17, p. 2452, Accession no. A83-38091. refs

A85-45791
FREE WAKE ANALYSIS OF HELICOPTER ROTORS
L. MORINO, Z. KAPRIELIAN, JR. (Boston University, MA), and S. R. SIPCIC (Sarajevo, Univerzitet, Yugoslavia) (European Rotorcraft Forum, 9th, Stresa, Italy, Sept. 13-15, 1983) Vertica (ISSN 0360-5450), vol. 9, no. 2, 1985, p. 127-140. refs
(Contract DAAG29-80-C-0016)

A formulation for the free wake analysis of helicopter rotors in incompressible unsteady potential flows is presented here. The formulation encompasses both the theory and its numerical implementation. The theoretical formulation is based on the Green's function method and includes a rigorous discussion of wakes in potential flows. In particular, the issues of wake generation and wake dynamics are thoroughly discussed. The formulation is validated for the case of a single-blade rotor in hover. The numerical results are in good agreement with the generalized wake of Landgrebe and computational results of Rao and Schatzle. Author

A85-45793
FACTORS INFLUENCING ROTOR AERODYNAMICS IN HOVER AND FORWARD FLIGHT
R. H. MILLER (MIT, Cambridge, MA) (European Rotorcraft Forum, 10th, The Hague, Netherlands, Aug. 28-31, 1984) Vertica (ISSN 0360-5450), vol. 9, no. 2, 1985, p. 155-164. refs

The aerodynamic characteristics of rotors are heavily influenced by blade vortex interactions, both in hover and in forward flight. In addition to geometrical considerations, the nature of the vortex, including its roll-up characteristics, must be specified for reasonably accurate aerodynamic analyses. This paper discusses techniques recently developed for treating these problems. Analytically derived blade loads at forward speeds are examined and compared with test results. The problem of rotor aerodynamics in all flight regimes is well known to involve highly complex flow characteristics, only some of which are adequately described by ideal fluid models. For this reason, geometrically simplified models are of value for clarifying the physics of the problem and allowing a more detailed treatment of the flow in the vicinity of the blade. Author

A85-45834#
AERODYNAMIC CHARACTERISTICS OF A CIRCULATION CONTROL ELLIPTICAL AIRFOIL WITH TWO BLOWN JETS
J. K. HARVELL and M. E. FRANKE (USAF, Institute of Technology, Wright-Patterson AFB, OH) Journal of Aircraft (ISSN 0021-8669), vol. 22, Sept. 1985, p. 737-742. Previously cited in issue 17, p. 2453, Accession no. A83-38633. refs

A85-45835*# Technion - Israel Inst. of Tech., Haifa.
CONVERGENCE CHARACTERISTICS OF A VORTEX-LATTICE METHOD FOR NONLINEAR CONFIGURATION AERODYNAMICS
Z. RUSAK, E. WASSERSTROM (Technion - Israel Institute of Technology, Haifa), and A. SEGINER (NASA, Ames Research Center, Moffett Field, CA) Journal of Aircraft (ISSN 0021-8669), vol. 22, Sept. 1985, p. 743-749. Previously cited in issue 18, p. 2637, Accession no. A83-39421. refs

A85-45836*# Old Dominion Univ., Norfolk, Va.
COMPUTATIONAL TECHNIQUE FOR COMPRESSIBLE VORTEX FLOWS PAST WINGS AT LARGE INCIDENCE
O. A. KANDIL (Old Dominion University, Norfolk, VA) Journal of Aircraft (ISSN 0021-8669), vol. 22, Sept. 1985, p. 750-755. Previously cited in issue 19, p. 2792, Accession no. A83-41912. refs
(Contract NSG-1560)

A85-45837*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
EFFECTS OF VISCOSITY AND MODES ON TRANSONIC AERODYNAMIC AND AEROELASTIC CHARACTERISTICS OF WINGS
G. P. GURUSWAMY, P. M. GOORJIAN (NASA, Ames Research Center, Moffett Field, CA), J. W. MARSTILLER (Lockheed Missiles and Space Co., Inc., Sunnyvale, CA), and H. T. Y. YANG (Purdue University, West Lafayette, IN) (Structures, Structural Dynamics and Materials Conference, 25th, Palm Springs, CA, May 14-16, 1984, and AIAA Dynamics Specialists Conference, Palm Springs, CA, May 17, 18, 1984, Technical Papers. Part 2, p. 1-16) Journal of Aircraft (ISSN 0021-8669), vol. 22, Sept. 1985, p. 756-762. Previously cited in issue 13, p. 1832, Accession no. A84-31685. refs

A85-45838*# Notre Dame Univ., Ind.
THE INFLUENCE OF LAMINAR SEPARATION AND TRANSITION ON LOW REYNOLDS NUMBER AIRFOIL HYSTERESIS
T. J. MUELLER (Notre Dame, University, IN) Journal of Aircraft (ISSN 0021-8669), vol. 22, Sept. 1985, p. 763-770. Previously cited in issue 17, p. 2425, Accession no. A84-38010. refs
(Contract NSG-1419; N00014-81-K-2036; N00014-83-K-0239)

A85-45839#
EFFECTS OF A CENTRAL FENCE ON UPWASH FLOWS
W. G. HILL, JR. (Grumman Research Center, Bethpage, NY) Journal of Aircraft (ISSN 0021-8669), vol. 22, Sept. 1985, p. 771-775. Previously cited in issue 06, p. 712, Accession no. A84-18154. refs

A85-45843#
COMPUTATIONAL AERODYNAMIC DESIGN OF THE GULFSTREAM IV WING
R. M. CHANDRASEKHARAN, W. R. MURPHY (Gulfstream Aerospace Corp., Savannah, GA), F. P. TAVERNA, and C. W. BOPPE (Grumman Aerospace Corp., Bethpage, NY) Journal of Aircraft (ISSN 0021-8669), vol. 22, Sept. 1985, p. 797-801. Previously cited in issue 07, p. 845, Accession no. A85-19742.

A85-45849#
SUBCRITICAL DAMPING RATIOS OF A TWO-DIMENSIONAL AIRFOIL IN TRANSONIC FLOW
B. H. K. LEE (National Research Council of Canada, Ottawa) Journal of Aircraft (ISSN 0021-8669), vol. 22, Sept. 1985, p. 828-830. refs

The high frequency version of ONERA's unsteady transonic code is used to compute lift and pitching moment coefficients for a NACA 64A006 airfoil oscillating in pitch and plunge. The aerodynamic data thus obtained are used in conjunction with the U-g method to compute critical flutter speeds and damping ratios based on Frueh and Miller's formula. The results are noted to be close to those of the p-k method, especially for large values of airfoil-air mass ratio. O.C.

A85-45850#
WING SPAN LOADS OF COMPLEX HIGH-LIFT SYSTEMS FROM WAKE MEASUREMENTS
G. W. BRUNE and T. H. HALLSTAFF (Boeing Commercial Airplane Co., Seattle, WA) Journal of Aircraft (ISSN 0021-8669), vol. 22, Sept. 1985, p. 831, 832. refs

Attention is given to wake data obtained for a twin-engine transport aircraft in takeoff configuration, to which a method of calculating wing loads on the basis of well known concepts, relating loading to the strength of trailing vortices, is applied. The results obtained indicate that the combined effects of measurement uncertainties is of minor importance; the only significant drawback of the present technique is its inability to distinguish between lift and side forces. O.C.

A85-47025*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
WIND TUNNEL RESULTS OF ADVANCED HIGH SPEED PROPELLERS IN THE TAKEOFF, CLIMB, AND LANDING OPERATING REGIMES
G. L. STEFKO and R. J. JERACKI (NASA, Lewis Research Center, Cleveland, OH) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 22 p. Previously announced in STAR as N85-29925. refs
(AIAA PAPER 85-1259)

Low speed wind tunnel performance tests of two advanced propellers were completed. The 62.2 cm diameter adjustable pitch models were tested at Mach numbers typical of takeoff, initial climbout, and landing speeds in the 10 by 10 ft Supersonic Wind Tunnel. Both models had eight blades and a cruise design point operating condition of 0.80 Mach number, 10.668 km S.A. altitude, 243.8 m/s tip speed and a high power loading of 301 kW sq m. No adverse or unusual low speed operating conditions were found during the test with either the straight blade SR-2 or the 45 deg swept SR-3 propellers. The 45 deg swept propeller efficiency exceeded the straight blade efficiency by 4 to 5 percent. Typical net efficiencies of the straight and 45 deg swept propeller at a Mach 0.20 takeoff condition were 50.2 and 54.9 percent respectively. At a Mach 0.34 climb condition, the efficiencies were 53.7 and 59.1 percent. Reverse thrust data indicates that these propellers are capable of producing more reverse thrust at Mach 0.20 than a high bypass turbofan engine at Mach 0.20. E.A.K.

A85-47026*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
DYNAMIC STALL PROGRESS IN ANALYSIS AND PREDICTION
L. W. CARR (NASA, Ames Research Center; U.S. Army, Aeromechanics Laboratory, Moffett Field, CA) AIAA, Atmospheric Flight Mechanics Conference, 12th, Snowmass, CO, Aug. 18-21, 1985. 33 p. refs
(AIAA PAPER 85-1769)

A comprehensive review of research in dynamic stall is presented with applications for helicopters, fighter aircraft, and wind turbines illustrated and evaluated. Emphasis is placed on review of research contributing to better understanding of the dynamic stall mechanism, including influence of type of motion, Mach number, Reynolds number, and three-dimensional effects.
Author

N85-32094*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
AERODYNAMIC CHARACTERISTICS OF THE STANDARD DYNAMICS MODEL IN CONING MOTION AT MACH 0.6
C. JERMEY and L. B. SCHIFF Jul. 1985 75 p refs
(NASA-TM-86717; REPT-85215; NAS 1.15:86717) Avail: NTIS HC A04/MF A01 CSCL 01A

A wind tunnel test was conducted on the Standard Dynamics Model (a simplified generic fighter aircraft shape) undergoing coning motion at Mach 0.6. Six component force and moment data are presented for a range of angle of attack, sideslip, and coning rates. At the relatively low non-dimensional coning rate employed (omega b/2V less than or equal to 0.04), the lateral aerodynamic characteristics generally show a linear variation with coning rate.
Author

N85-32096# Nielsen Engineering and Research, Inc., Mountain View, Calif.
NOTES ON UNSTEADY TRANSONIC CASCADE FLOWS Technical Report, 12 Sep. 1983 - 28 Feb. 1985
D. NIXON and K. TZUOO 8 May 1985 93 p
(Contract N00014-83-C-0435)
(AD-A154829; NEAR-TR-343) Avail: NTIS HC A05/MF A01 CSCL 20D

Several topics concerned with the unsteady transonic flow through cascades are considered. The indicial theory developed in previous work for cascade flows is examined and certain shortcomings eliminated. A consequence of this work is that some questions regarding the appropriate far field boundary conditions

to use are raised. The strong shock potential theory previously developed for isolated airfoil flows has been incorporated into the cascade code. A major topic in the present work is the examination of nonunique solutions for cascade flows. The variation of such solutions with cascade gap is studied with the conclusion that the nonunique solutions are unlikely to occur for practical gap/chord ratios. GRA

N85-32098# Naval Ship Research and Development Center, Bethesda, Md. Ship Performance Dept.
AN EVALUATION OF FOUR METHODS OF NUMERICAL ANALYSIS FOR TWO-DIMENSIONAL AIRFOIL FLOWS Final Report
R. BURKE Jul. 1984 31 p
(Contract S12-66001)
(AD-A155202; DTNSRDC/SPD-1139-01) Avail: NTIS HC A03/MF A01 CSCL 20D

This report compares four computer codes for predicting the inviscid and boundary layer flow over two dimensional airfoils. One of the codes obtains the inviscid flow using panel methods, and the boundary layer flow using integral methods. It is the only code considered here that includes both inviscid and boundary layer routines. Another code computes the inviscid flow, also using panel methods, but does not have a boundary layer routine. The remaining two codes calculate the vertical variation of flow variables within the boundary layer using finite differences; the external inviscid flow is not computed, and must be included in the program input. After a brief discussion of the solution method of each computer code, numerical predictions are compared against experimental data from two wind tunnel studies, involving four airfoil geometries. The airfoil shapes are described, and comparisons made between measured and predicted values of pressure distribution, turbulent separation point, and boundary layer parameters. GRA

N85-32100# Naval Postgraduate School, Monterey, Calif.
WIND TUNNEL DRAG EVALUATIONS OF HELICOPTER NOSE SECTIONS M.S. Thesis
R. S. MAIR Mar. 1985 106 p
(AD-A155489) Avail: NTIS HC A06/MF A01 CSCL 14B

This thesis determines the aerodynamic drag parameters for three different generic helicopter nose fuselage sections at various angles of attack and velocities using a 3.5 x 5 foot wind tunnel and a locally constructed three component strain gage balance. A common center section is used with provisions for three different tail sections allowing for nine possible configurations to effect the overall shape of a fuselage. This allows a student in a basic conceptual helicopter design course a quantitative means of comparing general shapes in order to select the best configuration of the fuselage. However, the results are questionable due to problems with the strain gage balance used to determine the aerodynamic forces on the models. GRA

N85-33105*# Scientific Research Associates, Inc., Glastonbury, Conn.
CALCULATION OF STEADY AND UNSTEADY AIRFOIL FLOW FIELDS VIA THE NAVIER-STOKES EQUATIONS Final Report
S. J. SHAMROTH Washington NASA Aug. 1985 110 p refs
(Contract NAS1-15214)
(NASA-CR-3899; NAS 1.26:3899) Avail: NTIS HC A06/MF A01 CSCL 01A

A compressible time-dependent procedure for the two-dimensional ensemble averaged Navier-Stokes equations has been applied to the isolated airfoil problem in steady and unsteady flows. The procedure solves the governing equations via the linearized block implicit technique. Turbulence is modeled either via a mixing length or turbulence energy approach. The equations are solved in general non-orthogonal form with no-slip boundary conditions applied at the airfoil surface. Results are presented for airfoils at constant incidence, an airfoil in ramp motion and an airfoil oscillating through a dynamic stall loop. In general, steady converged solutions are obtained within 70 time steps over the range of Mach numbers considered. Comparisons with measured data show good agreement between computation and measurement. B.W.

N85-33107*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
AERODYNAMIC CHARACTERISTICS OF A DISTINCT WING-BODY CONFIGURATION AT MACH 6: EXPERIMENT, THEORY, AND THE HYPERSONIC ISOLATION PRINCIPLE
J. A. PENLAND and J. L. PITTMAN Aug. 1985 34 p refs
(NASA-TP-2467; L-15951; NAS 1.60:2467) Avail: NTIS HC A03/MF A01 CSCL 01A

An experimental investigation has been conducted to determine the effect of wing leading edge sweep and wing translation on the aerodynamic characteristics of a wing body configuration at a free stream Mach number of about 6 and Reynolds number (based on body length) of 17.9 x 10 to the 6th power. Seven wings with leading edge sweep angles from -20 deg to 60 deg were tested on a common body over an angle of attack range from -12 deg to 10 deg. All wings had a common span, aspect ratio, taper ratio, planform area, and thickness ratio. Wings were translated longitudinally on the body to make tests possible with the total and exposed mean aerodynamic chords located at a fixed body station. Aerodynamic forces were found to be independent of wing sweep and translation, and pitching moments were constant when the exposed wing mean aerodynamic chord was located at a fixed body station. Thus, the Hypersonic Isolation Principle was verified. Theory applied with tangent wedge pressures on the wing and tangent cone pressures on the body provided excellent predictions of aerodynamic force coefficients but poor estimates of moment coefficients. Author

N85-33108*# National Aeronautics and Space Administration, Washington, D. C.
DISCUSSION OF THE PAPER, SOME ASPECTS OF PROPULSION FOR THE AUGMENTER-WING CONCEPT, BY D. C. WHITTLEY
H. SCHMITT Jul. 1985 11 p Transl. into ENGLISH of conf. paper from AGARD p A9 Previously announced as N72-16698
(NASA-TM-77884; NAS 1.15:77884) Avail: NTIS HC A02/MF A01 CSCL 01A

Many modern concepts for STOL and V/STOL aircraft rely on integration of the propulsion system with the wing to create favorable lift interactions, and are known as powered lift concepts. A study of powered lift, concerning management and control of the various propulsive streams or jets is presented, each concept having its own particular objectives and requirements. Some specific objectives of this kind are described which relate to the augmentor wing. Consideration is given to three aspects of the subject, namely the augmentor flap itself, the wind ducting and augmentor primary nozzle, and the choice of powerplant or engine cycle. More generally, comments are made regarding noise attenuation and the prospect for achieving a low overall noise level for jet STOL aircraft of the future. Author

N85-33110*# National Aeronautics and Space Administration, Washington, D. C.
EXPERIMENTAL INVESTIGATIONS ON AIRFOILS WITH DIFFERENT GEOMETRIES IN THE DOMAIN OF HIGH ANGLES OF ATTACK-FLOW SEPARATION
J. KEIL Jul. 1985 83 p refs Transl. into ENGLISH of "Experimentelle Untersuchungen an Fluegeln verschiedener Geometrie im hohen Anstellwinkelbereich" Darmstadt, Inst. fuer Flugtechnik, 16 Mar. 1984 p 1-89 Original language document announced as N84-33393 Transl. by The Corporate Word, Inc., Pittsburgh, Pa.
(Contract NAS2-4006)
(NASA-TM-77892; NAS 1.15:77892) Avail: NTIS HC A05/MF A01 CSCL 01A

Wind tunnel tests were conducted on airfoil models in order to study the flow separation phenomena occurring for high angles of attack. Pressure distribution on wings of different geometries were measured. Results show that for three-dimensional airfoils layout

and span lift play a role. Separation effects on airfoils with moderate extension are three-dimensional. The flow domains separated from the air foil must be treated three-dimensionally. The rolling-up of separated vortex layers increases with angle in intensity and induction effect and shows strong nonlinearities. Boundary layer material moves perpendicularly to the flow direction due to the pressure gradients at the airfoil; this has a stabilizing effect. The separation starts earlier with increasing pointed profiles.
Author (ESA)

N85-33111*# Integrated Systems, Inc., Palo Alto, Calif.
FIXED GAIN AND ADAPTIVE TECHNIQUES FOR ROTORCRAFT VIBRATION CONTROL
R. H. ROY, H. A. SABERI, and R. A. WALKER May 1985 127 p refs
(Contract NAS2-11548)
(NASA-CR-177344; NAS 1.26:177344; T47130) Avail: NTIS HC A07/MF A01 CSCL 01A

The results of an analysis effort performed to demonstrate the feasibility of employing approximate dynamical models and frequency shaped cost functional control law desgin techniques for helicopter vibration suppression are presented. Both fixed gain and adaptive control designs based on linear second order dynamical models were implemented in a detailed Rotor Systems Research Aircraft (RSRA) simulation to validate these active vibration suppression control laws. Approximate models of fuselage flexibility were included in the RSRA simulation in order to more accurately characterize the structural dynamics. The results for both the fixed gain and adaptive approaches are promising and provide a foundation for pursuing further validation in more extensive simulation studies and in wind tunnel and/or flight tests. Author

N85-33112# Aeronautical Research Labs., Melbourne (Australia).
GENERATION BY CONFORMAL MAPPINGS OF AEROFOIL SECTIONS AND OF CERTAIN OTHER SIMPLE SHAPES SUITABLE FOR BOTH AERODYNAMIC AND STRESS-CONCENTRATION PROBLEMS
T. TRAN-CONG Nov. 1984 36 p
(AD-A154901; ARL/AERO-TM-369) Avail: NTIS HC A03/MF A01

This Australian report shows that there are many practical aerofoil shapes obtainable from conformal mapping using simple techniques. Employing the results given here, it is a matter of straightforward application to calculate the pure circulation, inviscid, incompressible flow about the aerofoils of this Memo. The pressure distribution then follows directly. Two-dimensional problems of incompressible Stokes' flow about these cross sections and of stress concentration for an infinite elastic plate with a hole of these shapes can also be solved using the conformal mappings given here. GRA

03

AIR TRANSPORTATION AND SAFETY

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

A85-43873#
DETERMINATION OF THE LOCAL HEAT TRANSFER COEFFICIENTS OF THREE SIMULATED SMOOTH ICE FORMATION CHARACTERISTICS ON A CYLINDER
M. PAIS and S. N. SINGH (Kentucky, University, Lexington) IN: Atmospheric Flight Mechanics Conference, 12th, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 507-511. refs
(AIAA PAPER 85-1836)

Experimental convective local heat transfer coefficients were obtained for a bluff body with simulated protrusions shaped to correspond to a selected set of smooth 2-min, 5-min, and 15-min glaze ice profiles formed on the surface of a 2-in. cylinder in crossflow. A steady state heat flux method was employed. The velocity and turbulent intensity distributions and the local heat transfer rates are measured as a function of Reynolds number. The Nusselt number obtained in the Reynolds number range of 100,000-150,000 were compared with those of NASA Lewis and the University of Tennessee. The results show very good agreement quantitatively and qualitatively with those of NASA Lewis. The local heat transfer rate increases with the Reynolds number, and is noted to decrease as the ice grows. Author

A85-44173
THE DYNAMICS OF A PARACHUTE PANEL DURING OPENING [DINAMIKA PANELI PARASHIUTA PRI RASKRYTII]
A. G. VASILCHENKO and A. T. PONOMAREV Mekhanika Kompozitnykh Materialov (ISSN 0203-1272), May-June 1985, p. 468-474. In Russian. refs

An analysis is made of the stress-strain state of a rectangular plane cell of a parachute panel during opening. An elastic model of the panel is developed on the basis of the theory of soft shells, assuming that the parachute fabric is perfectly elastic. The problem is solved on a computer using an explicit finite difference scheme. The effect of the pressure differential, support compliance, and fabric cut on the stress-strain state of the panel is discussed. The results obtained are compared with the known analytical solutions. V.L.

A85-44306#
THE COMING MIX OF HELICOPTERS AND GENERAL AVIATION OPERATIONS
C. W. JOHNSON (ERA Helicopters, Inc., Anchorage, AK) IN: Radio Technical Commission for Aeronautics, Annual Assembly Meeting and Technical Symposium, Washington, DC, November 13-15, 1984, Proceedings . Washington, DC, Radio Technical Commission for Aeronautics, 1985, p. 61-66.

A projection is made of potential opportunities and difficulties that may arise as a result of the operations of next generation helicopters and fixed wing aircraft in shared airspace. Essential to these considerations are such factors as the increasing numbers of helicopters, their growing passenger and cargo loads and speeds, and the versatility imparted to their operations by the incorporation of avionics and navigational aids that permit all-weather, round-the-clock operations. Attention is given to the prospects for strategically located and instrumented public use heliports and 'helistops' in larger metropolitan areas. O.C.

A85-45969#
GENERIC ERRORS IN AIRBORNE SAFETY-CRITICAL SYSTEMS FROM AN FAA PERSPECTIVE
E. L. ROSS and J. TREACY (FAA, Washington, DC) AIAA, Guidance, Navigation and Control Conference, Snowmass, CO, Aug. 19-21, 1985. 8 p.
(AIAA PAPER 85-1983)

During the time from the start of the Federal Aviation Agency (FAA) until the 1960's, transport aircraft avionic systems were relatively simple from FAA approval standpoints. During this period, as today, the FAA relied on a system's compliance with the safety regulations as the means of reducing to an acceptable level the discovery rate of avionic system errors in revenue service. A new situation developed with the incorporation of modern technology into transport aircraft system design. In connection with this development, in 1970 the FAA revised the general system installation safety requirement to require the applicant to establish an acceptable level of safety for the system/function to be installed. The industry developed document DO-178, 'Software Considerations in Airborne Systems and Equipment Certification'. In 1982 the FAA adopted DO-178 as one means of complying with FAA's safety requirements. Details regarding the present approach are discussed. G.R.

N85-32104# National Bureau of Standards, Gaithersburg, Md.
THE ROLE OF AIRCRAFT PANEL MATERIALS IN CABIN FIRES AND THEIR PROPERTIES Final Report
J. G. QUINTIERE, V. BABRAUSKAS, L. COOPER, M. HARKLEROAD, K. STECKLER, and A. TEWARSON (Factory Mutual Research Corp.) Atlantic City FAA Jun. 1985 119 p refs
(FAA-CT-84-30) Avail: NTIS HC A06/MF A01

Analyses were performed on full-scale aircraft post-crash fire data. In particular the rate and involvement of aircraft wall and ceiling panels are examined. For two full-scale experiments the energy release rate of the interior cabin furnishings were estimated and an estimate of ceiling ignition computed. Also an extensive set of measurements, by several advanced state-of-the-art laboratory flammability devices, was conducted for fire aircraft panel materials. The measurements included piloted ignition by thermal radiation, energy release rate, combustion produce generation rates, lateral flame spread rates in a vertical orientation, flame heights and their heat transfer to a contiguous vertical surface, and for one devices results were obtained at conditions of oxygen concentrations lower than normal air. Comparison among the results for each device show good consistency of the ignition data, but only fair agreement or energy release rate data.
Author

N85-32105# National Transportation Safety Board, Washington, D. C. Bureau of Safety Programs.
AIR CARRIER OVERWATER EMERGENCY EQUIPMENT AND PROCEDURES Safety Study, 1959 - 1984
12 Jun. 1985 26 p refs
(PB85-917006; NTSB/SS-85/02) Avail: NTIS HC A03/MF A01; SOD HC

The chances of surviving air carrier accidents into water would be increased if Federal Aviation Administration (FAA) emergency procedures and FAA approved survival equipment were improved. Current procedures assume that air carrier water contact accidents are primarily ditchings. In fact, a review of air carrier water contact accidents between 1959 and 1984 shows that such accidents are typically inadvertent, with no preparation time, substantial aircraft damage, and a high chance of occupant injury. Often the cabin floods quickly, followed by sinking of the aircraft within minutes. Typically, these accidents do not occur on extended overwater flight (the type of operation to which most FAA water survival regulations currently apply) but close to an airport, during approach or departure. At least 179 fully certificated airports in the United States are located within 5 miles of a significant body of water. The Board recommended the FAA require both life preservers and flotation seat cushions on all air carrier flights, and asked for improvements in life preserver design, packaging, accessibility, and ease of donning. Other recommendations deal with emergency evacuation slides, liferafts, flotation devices for infants, crew post crash survival training, and water rescue plans at airports near water.
Author

N85-32106# RMS Technologies, Inc., Trevose, Pa.
SEAT EXPERIMENTS FOR THE FULL-SCALE TRANSPORT AIRCRAFT CONTROLLED IMPACT DEMONSTRATION Final Report
M. R. CANNON and R. E. ZIMMERMANN Mar. 1985 247 p
(Contract DTFA03-81-C-00040)
(AD-A155024; FAA-CT-84-10) Avail: NTIS HC A11/MF A01
CSCL 01C

As part of the FAA/NASA Controlled Impact Demonstration (CID) with a four-engine jet transport, 22 experimental seats have been placed on the aircraft by the contractor for the FAA. Four additional experimental seats have been directly installed by NASA and the FAA. Also, an originally installed pilot seat was included in the overall series of 27 seat experiments. Of the 22 seats installed by the contractor, 13 have been modified for the intent of improving their structural crashworthiness. These include 12 triple-occupant passenger seats and one flight attendant seat. The modification process was supported by extensive testing and analysis. Initially, identical seats were subjected to both static and dynamic destructive tests. From these tests, much was learned about the failure modes of the seat structure and the loads at which they would occur. Using these data, a design effort (supported by NASTRAN finite element models of the seats) produced methods for improving the capability of the seat structure to sustain crash loads. Prototypes of the designs were fabricated and subjected to identical static and dynamic testing sequences. Where necessary, design improvements were made and retested. Modified experimental seats were then fabricated for installation on the test aircraft. GRA

N85-33113# Mitre Corp., McLean, Va. Metrek Div.
SYSTEM SAFETY STUDY OF MINIMUM TCAS 2 FOR INSTRUMENT WEATHER CONDITIONS Final Report
J. E. LEBRON and S. J. MULDER Jun. 1985 201 p refs
(Contract DTFA01-84-C-00001)
(FAA-PM-85-12; MTR-85W28) Avail: NTIS HC A10/MF A01

An analysis of the air traffic environment in instrument meteorologival conditions (IMC) was conducted to identify those characteristics that have an impact on the level of safety provided by the traffic alert and collision avoidance system (Minimum TCAS 2), and that differ from those characteristics under the more predominant visual conditions. The characteristics assessed include the fraction of aircraft equipped with altitude reporting transponders, the proximity of aircraft operating in these conditions, and the nature of the aircraft maneuvers. The analysis of the level of safety provided by TCAS was extended to include interactions with the air traffic control system. Interactions asessed include the compatibility of TCAS maneuvers with the ATC system and the potential for a domino effect wherein a TCAS advisory might create a new conflict.
Author

04

AIRCRAFT COMMUNICATIONS AND NAVIGATION

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

A85-43564#
A TACAN-BASED APPROACH AND LANDING AID [SYSTEME D'AIDE A L'ATTERRISSAGE A BASE DE TACAN]
M. SCHILLIGER, B. SCHMIT, and P. MAHON (LMT Radio Professionnelle, Boulogne-Billancourt, France) Revue Technique Thomson - CSF (ISSN 0035-4279), vol. 17, March 1985, p. 169-191. In French. Research supported by the Service Technique des Telecommunications et des Equipements Aeronautiques.

An application of the military medium range Tactical Air Navigation (TACAN) system as an aid to approach and landing flight phases is described. The conventional signal system is employed in a pulsed mode. The round trip signal time is used to measure distance to a beacon, which is in a known location. An interrogation signal is beamed to the TACAN beacon, which responds with the received signal at a different frequency. Inquiry and response are separated by 63 MHz and by shifting of the code signal. TACAN beacons are capable of handling 2700 pulse pairs per second. By adding altitude data to the distance to the beacon, an aircraft can monitor its approach path and descent rate. In the final phase, the calculations can be sufficiently refined to yield the touchdown point. Field tests have demonstrated the system effectiveness, even in guiding helicopters into undeveloped sites using a small, portable beacon. M.S.K.

A85-44052
ALL-WEATHER LOW ALTITUDE PENETRATION [LA PENETRATION BASSE ALTITUDE 'TOUT TEMPS']
Y. AUBERT (Base Aerienne 120, Cazaux, France) Navigation (Paris) (ISSN 0028-1530), vol. 33, July 1985, p. 298-304. In French.

The technologies and piloting techniques incorporated into the Mirage III E fighters of the 4th attack squadron for all-weather maneuvers are outlined. The fighters have on-board radar, an electronic map library and a computer. Data from ground waypoints in front of the aircraft are compared with stored digital maps to ensure that the correct flight path is followed, even when flying in clouds. Navigation is automated by means of coupling inertial gyroscope outputs to the Doppler radar imagery. The stored map also automates altitude adjustments to permit terrain-following flight at 900 km/h at 150 m altitude, including turns. Only pilots with 400 hr flight time in squadrons are allowed into the 4th squadron, and then must undergo 10 months of training before operational flight duty. M.S.K.

A85-44054
GEOMETRIC DETERIORATION OF PRECISION - THE CASE OF NAVSTAR (GPS) AND MULTILATERAL SYSTEMS [LA DEGRADATION GEOMETRIQUE DE LA PRECISION - LE CAS DU NAVSTAR/G.P.S. ET DES SYSTEMES A MULTILATERATION]
P. FOMBONNE Navigation (Paris) (ISSN 0028-1530), vol. 33, July 1985, p. 319-331. In French.

A numerical study is made of the geometry of all possible errors which can be encountered when using multibeam aids to navigation systems to obtain position fixes. All systems, e.g., Loran, Decca or Navstar, require the reception of signals from at least two stations if taken from the earth's surface, and four are taken in space. The distances to each emitter are calculated along either circular, spherical or hyperbolic lines to generate the fix. Calculations are performed of the geometric, precision error, that is, the probability density that the line-of-sight of the signal will deviate a given distance from the shortest path. It is shown that the smallest error will be present when the signals are received orthogonally to each other. M.S.K.

A85-44070
MICROWAVE RECEIVERS ENTER A NEW ERA
J. BARNUM, B. SIMMONS, B. BRASIER, T. MANUAL, and G. LEGRAND (Condor Systems, Campbell, CA) Defense Electronics (ISSN 0278-3479), vol. 17, Aug. 1985, p. 54, 56-58.

A fully synthesized, microprocessor-controlled, scanning superheterodyne microwave receiving system has been developed that has less than 1.8 degree rms integrated phase noise over the 0.5 to 18.5-GHz frequency band. Conventional broadband, scanning electronic intelligence (Elint) receivers often have phase noise worse than 5 to 10 degrees rms, whereas the phase noise needed to accurately determine signal states of new phase modulated transmissions is about 1 to 2 degrees rms. Some narrowband receivers can achieve a 1 degree phase noise, but their limited band coverage and nonscanning operation are severe limitations. the new CS-2002 receiving system overcomes both these limitations. Features claimed are: operator friendliness, a variety of operating modes, design flexibility, possibility of extending frequency to 40 GHz, and cost-effective performance. D.H.

A85-44307#
A BROAD VIEW OF HOW MICROWAVE LANDING SYSTEMS WILL CHANGE THE ENVIRONMENT
E. HANLON (Hazeltine Corp., Commack, NY) IN: Radio Technical Commission for Aeronautics, Annual Assembly Meeting and Technical Symposium, Washington, DC, November 13-15, 1984, Proceedings . Washington, DC, Radio Technical Commission for Aeronautics, 1985, p. 83-90.

An assessment is made of the operational and economic impact of widespread deployment of Microwave Landing Systems (MLSs). MLS is virtually insensitive to geographic and architectural obstructions. Due to its high (5 GHz) operating frequency, the antenna structure used by MLS is small by comparison with those currently used by Instrument Landing Systems (ILSs), and can be collocated with ILSs in existing facilities. MLS also provides multiple approach azimuth and glide path guidance simultaneously to a variety of users, from airliners to helicopters. All MLS installations will be able to operate on any one of 200 channels, or five times as many as are available with ILS. MLS and ILS will coexist in the U.S. National Airspace System for many years, before the ILS phase-out is begun. O.C.

A85-44988
DEFENSE MAPPING AGENCY DIGITAL DATA BASES
H. L. WARUSZEWSKI (Sperry Corp., Flight Systems Div., Albuquerque, NM) IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 1 . New York, IEEE, 1984, p. 70-75.

This paper is concerned with a study which was initiated to look at the availability of the Defense Mapping Agency (DMA) digital data base and its projected completion, taking into account also the types of data available. Applications which utilize the DMA data bases are discussed, giving attention to visual simulation, radar simulation, sensor simulation, radar prediction system, the sensor prediction system, a digital moving map system, mission planning, target planning, terrain following/terrain avoidance, sensor terrain masking, command and control systems, guided missile system, weapon system trainers, military movement planning/trafficability, target aggregation, vertical obstruction survivability, artillery return shelling, ship navigation, point positioning, feature following, and guided missile flight pretraining. Details regarding digital data base status are also discussed. G.R.

A85-44989#
DIGITAL MAP PRODUCTS AND THE AVIONICS REQUIREMENT - CAN DMA MEET THE CHALLENGE?
I. P. BUCK (DMA, Washington, DC) IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 1 . New York, IEEE, 1984, p. 76-81. refs

The Defense Mapping Agency (DMA) has the responsibility to provide mapping, charting, and geodesy (MC and G) support to

the U.S. military services. Details regarding digital MC and G data are considered along with the digital landmass system (DLMS), DLMS enhancements and future directions. The capabilities and limitations of digital MC and G data in support of the avionics function are briefly discussed. The DMA data has been employed in the operational support of such weapons as the Cruise and Pershing II missile systems and a family of aircraft simulators. The utility of the data in support of avionics suites is just now being realized. The unique capabilities of digital MC and G data are to be utilized by a number of terrain related functions. One goal considered is related to the replacement of paper maps and charts in the cockpit with a fully digital map display. G.R.

A85-44994
THE SWITCHED NETWORK APPROACH TO HIGH SPEED COMMUNICATIONS
L. KLOS (General Dynamics Corp., Fort Worth, TX) IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 1 . New York, IEEE, 1984, p. 114-118.

The amount of information transfer required between the various parts of avionic systems is steadily increasing with the further development of these systems, and problems arise regarding the interconnections which have to be provided. The present paper is concerned with an employment of switched communication approaches as an alternative to buses. The considered approaches can have substantial benefits for avionic communications at several levels. The switched network approach involves the routing of all communications through switches, rather than directly between communicating devices. Multiple switches can be connected to each other through 'long distance' links. Attention is given to details concerning the operation of switched networks, an example for the application of these networks, the feasibility of the switched approach, and switched network benefits. G.R.

A85-44995
A UNIFIED APPROACH TO DATA COMMUNICATIONS IN AIRCRAFT
J. L. STAUTBERG and W. P. WHALEN (TRW, Inc., TRW Defense Systems Group, Dayton, OH) IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 1 . New York, IEEE, 1984, p. 119-126. refs

THe Multibus Avionic Architecture Design Study (MAADS) led to the conclusion that a high speed serial data bus would unquestionably be an integral part of future avionic systems. As part of the development of a design example, the definition of a protocol for a high speed serial data bus was undertaken. The high speed serial data bus has a marked similarity to MIL-STD-1553B. In the present paper, a brief review is provided of the study methodology and the criteria used in evaluating protocols. A description is presented of the protocol which has been updated in response to technical critiques. G.R.

A85-45019
GRAVITY EFFECTS ON HIGH ACCURACY INERTIAL NAVIGATION
F. PSOTA and T. SHANAHAN (Singer Co., Kearfott Div., Wayne, NJ) IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 1 . New York, IEEE, 1984, p. 310-314.

Application of gravity deflection compensation to a Kearfott High Accuracy INS (HAINS) is summarized. Flight test data collected at the Central Inertial Guidance Test Facility is analyzed to identify the gravity deflection contribution to overall system performance. The paper discusses the general design of the HAINS INU. It also reviews the analysis procedure employed to evaluate gravity effects and includes detailed analytical results for a number of flight trajectories showing resulting system performance after removal of gravity-induced errors. The conclusions are generally applicable and provide motivation for introducing gravity compensation algorithms into HAINS Quality Systems. Author

A85-45020
FAST REACTION AND HIGH RELIABILITY OF STRAPDOWN NAVIGATION SYSTEMS USING RING LASER GYROS
S. P. DIVAKARUNI and C. E. MUELLER (Honeywell, Inc., Minneapolis, MN) IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 1 . New York, IEEE, 1984, p. 315-322.

The two main benefits of using ring lasgr gyros (RLG) in inertial navigation systems are fast reaction and high reliability. These two important features are demonstrated in this paper using results obtained from military and commercial production hardware. The gyrocompass alignment filters and algorithms employed in each class of systems are described, as are several auxiliary system features that enhance the operational ease of these systems. Reliability data collected from the RLG inertial reference systems (IRS) in operation onboard the Boeing 757 and 767 aircraft are reviewed and shown to be well above the predicted reliability levels. The fast reaction and high reliability features of Honeywell ring laser gyro strapdown navigation systems are shown to be realities as demonstrated in the lab, in the field and over several years. Potential future RLG navigation system applications and enhancements such as GPS-aided systems are briefly discussed. Author

A85-45021
DESIGN ASPECTS, PERFORMANCE ANALYSIS AND TEST RESULTS OF A STRAPDOWN SINGLE GYRO ATTITUDE AND HEADING REFERENCE
U. K. KROGMANN (Bodenseewerk Geraetetechnik GmbH, Ueberlingen, West Germany) IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 1 . New York, IEEE, 1984, p. 323-331.

A sensor concept and its signal processing are described which represent a cost-effective solution for the determination of attitude and heading information. The pitch and roll angles are computed without apparent vertical effects, and the heading possesses no gimbal errors. Complementary information from one two-axis strapdown rate-gyro and two linear accelerometers is applied together with velocity information. The gyro can be oriented in different positions for accurate and quick self-alignment as well as autobiasing. Analytic self-alignment within 3, 5 min was demonstrated with an experimental system offering initial heading accuracy of about 0.3 deg and 0.5 percent navigation performance. Author

A85-45023
GPS/AHRS - A SYNERGISTIC MIX
M. A. STURZA (Litton Aero Products, Canoga Park, CA), A. K. BROWN, and J. C. KEMP (Litton Industries, Guidance and Control Systems Div., Woodland Hills, CA) IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 1 . New York, IEEE, 1984, p. 339-348.

Today's aircraft commonly require expensive high quality inertial navigation equipment to provide accurate position and attitude information for navigation and flight control. By utilizing the Global Positioning System (GPS), which will be the preeminent navigation system of the 1990's, in conjunction with a strapdown Attitude and Heading Reference System (AHRS), equivalent performance can be obtained at substantially reduced cost. A mixed GPS/AHRS system combines the excellent long term navigation performance of GPS with the good short term performance of AHRS under high dynamic conditions. This paper discusses alternative implementations of a mixed GPS/AHRS system. Factors considered in the designs described are performance requirements, system reliability, and overall system cost. Simulations are presented to demonstrate the system performances under different flight scenarios. Author

A85-45032
KALMAN FILTER IMPLEMENTATION IN THE LITTON LR-80 AHRS
D. LOTTMAN, K. HOMB, and A. BROWN (Litton Industries, Guidance and Control Systems Div., Woodland Hills, CA) IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 1 . New York, IEEE, 1984, p. 406-413.

The LR-80 is a strapdown Attitude and Heading Reference System (AHRS) in which a Kalman filter is used to both mechanize alignment and navigation functions and implement measurement updates from a Doppler system and position updates. Nonoptimal heading updates can be taken from a Magnetic Heading Detector to correct heading errors, and 'pseudo-updates' are employed to damp out large tilt errors in a degraded navigation mode where only accurate pitch, roll and heading data are required. Attention is given to the Kalman filter's implementation. O.C.

A85-45033
INTERFACING KALMAN FILTERS WITH THE STANDARD INS
B. E. GRIFFITHS, E. M. GEYER (Analytic Sciences Corp., Reading, MA), and S. L. BERNING (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH) IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 1 . New York, IEEE, 1984, p. 414-421. refs

This paper presents initial results of an ongoing assessment of integrated navigation system accuracy sensitivity to the mechanization and instrument characteristics of the Standard Medium Accuracy INS. Linear covariance analysis is employed to predict integrated system performance for two flight trajectories, gimballed platform and ring laser gyro strapdown INSs, and two NAVAID suites. Cases where the associated Kalman filter is matched and mismatched to the INS are considered. Author

A85-45127#
ERROR CORRECTIVE CODING FOR MIL-STD-1553B AIRCRAFT STORES MANAGEMENT SYSTEMS
P. F. MILLER (USAF, Wright-Patterson AFB, OH) and K. G. CASTOR (USAF, Institute of Technology, Wright-Patterson AFB, OH) IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 2 . New York, IEEE, 1984, p. 1103-1109. refs

The stores management systems on many new aircraft are being converted from analog to digital control. The Department of Defense has chosen the MIL-STD-1553B multiplexed digital data bus as the communication channel for the digital stores management systems. However, for certain types of data transfers such as arming or fire commands, there is insufficient error protection to ensure reliable data or command transfers. This paper examines possible methods of improving system performance within the constraints of MIL-STD-1553B. Author

A85-45129#
TARGET SUPER-RESOLUTION COMPENSATON FOR SPREAD SPECTRUM RADAR WAVEFORMS
K. W. ALBERT (USAF, Bedford, MA) and K. G. CASTOR (USAF, Institute of Technology, Wright-Patterson AFB, OH) IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 2 . New York, IEEE, 1984, p. 1119-1127. refs

In the present investigation of methods which compensate for the target superresolution effects that are generated by the spread spectrum encoding of radar pulses, coherent and incoherent target filters are compared on the basis of output SNR/power ratio. Attention is given to three spread spectrum waveforms, which are respectively intrapulse biphase-coded, interpulse frequency-hopped, and interpulse frequency-hopped with subpulse chirp. In all cases, the incoherent target filter is noted to furnish the superior output power. O.C.

A85-45131#
TECHNOLOGY CONSIDERATIONS OF INTEGRATED COMMUNICATION NAVIGATION IDENTIFICATION AVIONICS (ICNIA)
R. L. HARRIS (USAF, Avionics Laboratory, Wright-Patterson AFB, OH) IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 2 . New York, IEEE, 1984, p. 1138-1148. refs

VLSI, digital filtering, and digital signal processing techniques have facilitated the 'top-down' integration of communication, navigation, and identification (CNI) functions to yield weight, power consumption and size reductions for CNI units that are projected to be of the order of 50 percent those of current systems. While functional complexity has increased, the physical complexity of units primarily reflected in their parts counts, has been reduced. This 'complexity leverage' offers three major advantages for CNI units: (1) new waveforms can be accepted without substantial hardware renovation, largely through simple software reprogramming; (2) an integrated radio system can be more easily rendered resistant to electronic warfare; and (3) digital-domain signal processing is facilitated, taking advantage of emerging advancements in computer design. O.C.

A85-45133
FEASIBILITY OF A UHF/TDM COMMUNICATIONS LINK FOR THE WORLDWIDE AIRBORNE COMMAND POST (WWABNCP) SYSTEM
R. V. KURTZ and R. B. MARCUM (TRW, Inc., TRW Defense Systems Group, Dayton, OH) IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 2 . New York, IEEE, 1984, p. 1166-1172. refs

An account is given of work done on a study of the feasibility of replacing the existing UHF/FDM line-of-sight communication links with time division multiplex (TDM) links in the WWABNCP system. WWABNCP has been established as a component of the Worldwide Military Command and Control System (WWMCCS) to provide a continuous and reliable airborne command, control, and communications capability for the U.S strategic network. The WWABNCP UHF line-of-sight communication system is introduced and a description is given of the need and desirability of upgrading to a digital capability. Requirements and constraints for the UHF LOS link are presented and the analysis which was performed to determine the link parameters is described. Finally, various source and carrier modulation techniques are examined for their capabilities of meeting the derived performance requirements. D.H.

A85-45134
WORLDWIDE AIRBORNE COMMAND POST SWITCHING AND INTERCOMMUNICATION SYSTEM - PRESENT AND FUTURE
B. K. BAUER and D. G. HALDEMAN (TRW, Inc., TRW Defense Systems Group, Dayton, OH) IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 2 . New York, IEEE, 1984, p. 1173-1179.

The mission and objective of the Worldwide Airborne Command Post (WWABNCP) system is to provide for survivable and continued airborne command, control, and communications C3 following a sustained, high order nuclear attack. The WWABNCP system is composed of numerous ground and airborne elements, most importantly the EC-135 and E-4 aircraft which provide essential communication links required by the National Command Authority and SIOP commanders-in-chief. The heart of the C3 function of these aircraft is the audio switching and intercommunication system. Update of this system is being dictated by requirements to improve audio performance, increase the system capability, provide for growth of future communication systems, and enhance the supportability of the system. This paper attempts to describe the present switching and intercommunication system, outline present and projected system problems, postulate the requirements for an updated system, and provide insight into potential system configurations to meet these requirements. Author

A85-45143
A RELIABILITY AND SURVIVABILITY ASSESSMENT TOOL FOR FAULT-TOLERANT INTEGRATED RADIO SYSTEMS
S. BREWSTER (Central State University, Wilberforce, OH) IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 2 . New York, IEEE, 1984, p. 1237-1240. refs

Some of the capabilities of an integrated radio survivability/vulnerability assessment tool known as RADSIM (radio simulation) are discussed. RADSIM has been developed as an aid in assessing the effects of reconfigurability in fault-tolerant, integrated communication/navigation/identification radio avionics system architectures. RADSIM regards an integrated radio system as a collection of components and resources that are configured via software to perform various functions. Operation is simulated by employing switching algorithms on various combinations of components and interconnectivity. RADSIM provides statistical output, uses graphics to aid in following the simulation, and allows priorities to change from one mission segment to another. D.H.

A85-45910*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
GROUND BASED CONCEPT FOR TIME CONTROL OF AIRCRAFT ENTERING THE TERMINAL AREA
H. ERZBERGER and J. CHAPEL (NASA, Ames Research Center, Moffett Field, CA) IN: Guidance, Navigation and Control Conference, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 301-306.
(AIAA PAPER 85-1888)

This paper summarizes current research for increasing the efficiency of traffic flow at hub airports by application of four dimensional (4D) guidance techniques. A method for generating 4D guidance commands to control the landing time of aircraft that are not equipped with on-board 4D guidance systems is described. In one possible implementation the commands are generated in an auxiliary processor linked to the ATC host computer and displayed on a controller's monitor in the form of profile descent advisories. Accurate time control is achieved by generating air traffic controller advisories in a ground-based algorithm that combines aerodynamic, thrust and atmospheric models with an efficient numerical integration method. The time accuracy and fuel efficiency achieved when the pilot responds to these advisories were evaluated in a piloted simulation of a transport aircraft.
Author

A85-46326*# Technion - Israel Inst. of Tech., Haifa.
PREDICTOR LAWS FOR PICTORIAL FLIGHT DISPLAYS
A. J. GRUNWALD (Technion - Israel Institute of Technology, Haifa) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 8, Sept.-Oct. 1985, p. 545-552. refs
(Contract NASW-3302)

Two predictor laws are formulated and analyzed: (1) a circular path law based on constant accelerations perpendicular to the path and (2) a predictor law based on state transition matrix computations. It is shown that for both methods the predictor provides the essential lead zeros for the path-following task. However, in contrast to the circular path law, the state transition matrix law furnishes the system with additional zeros that entirely cancel out the higher-frequency poles of the vehicle dynamics. On the other hand, the circular path law yields a zero steady-state error in following a curved trajectory with a constant radius. A combined predictor law is suggested that utilizes the advantages of both methods. A simple analysis shows that the optimal prediction time mainly depends on the level of precision required in the path-following task, and guidelines for determining the optimal prediction time are given. Author

A85-46500
AIRLINER GPS - NAVIGATING BY SATELLITE
G. WARWICK Flight International (ISSN 0015-3710), vol. 128, Aug. 17, 1985, p. 29-32.

The GPS will provide horizontal positioning to within 100 m, vertical positioning to within 160 m, velocity to within 0.2 kt, and time to within 100 nanosec. It will be able to perform all enroute/terminal phases and nonprecision approach. Since it will not be capable of handling precision approach and landing, it will need to be combined with other navigational aids. The GPS research has led to the development of multisensor area navigation (RNav) systems which could change airways to direct routes in areas with good radar and radio coverage. GPS precisely determines altitude, which could reduce flight level intervals above 29,000 ft. It could improve the accuracy and safety of air traffic control. GPS combined with self-contained inertial navigation could provide the best positioning accuracy for long-range or short-range air navigation. I.F.

A85-46994
EARLY HISTORY OF THE DECCA NAVIGATOR SYSTEM
C. POWELL Institution of Electronic and Radio Engineers, Journal (ISSN 0267-1689), vol. 55, June 1985, p. 203-209. refs

05

AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

A85-43842#
AIRCRAFT INTERCEPT VECTORING IN A KNOWN WIND FIELD
J. F. JONES (General Electric Co., Syracuse, NY) IN: Atmospheric Flight Mechanics Conference, 12th, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 147-153.
(AIAA PAPER 85-1782)

The Euler-Lagrange equations are used to derive the differential equations of motion for minimum time intercept paths on a sphere of specified radius in a known wind field. It was found that a suboptimal solution which greatly simplifies the equations of motion takes only 0.12 percent longer time to reach a specified intercept point for a representative aircraft interceptor mission. Comparisons are made between optimal flight path bearing angle histories and suboptimal solutions in the presence of a realistic wind model. The wind was modeled using a trivariate table lookup function.
Author

A85-43844#
PERFORMANCE AND OPTIMIZATION ANALYSES OF FLIGHT VEHICLE FROM LOW TO VERY HIGH ANGLES OF ATTACK
L. RUAN and J. M. WU (Tennessee, University, Tullahoma) IN: Atmospheric Flight Mechanics Conference, 12th, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 164-178. refs
(AIAA PAPER 85-1784)

A generic study has been performed in selecting various airplane configurations such that the vehicle may fly with the angle of attack in the range of zero to 60 deg. The performance evaluations are made with permissible stability of the vehicle, with a defined objective function for a multiobjective optimization decision process. The input are selected from available wind tunnel aerodynamic data. An effort is made to identify influences from various vortex-lifting auxiliary surfaces on the wing. This includes the selection of canard, strake, and their geometric combinations. Generic recommendations were made in selecting configurations which allow the vehicle to fly up to a very high angle of attack. In the second part of this paper, a technique to simultaneously optimize multiobjective functions with an 'Imaginary Method' is discussed. An optimum poststall maneuver is investigated by using this optimization technique, and then compared with the poststall maneuver without optimization and conventional maneuver. Minimum time turning maneuver and other multiobjective optimum maneuvers for a variety of constraints are calculated. Author

A85-43854*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A HISTORIC REVIEW OF CANARD CONFIGURATIONS
S. B. ANDERSON and T. W. FEISTEL (NASA, Ames Research Center, Moffett Field, CA) IN: Atmospheric Flight Mechanics Conference, 12th, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 306-318. refs
(AIAA PAPER 85-1803)

The first human-powered flight was achieved by a canard-configured aircraft (Wright Brothers). Although other canard concepts were flown with varying degrees of success over the years, the tail-aft configuration has dominated the aircraft market for both military and civil use. This paper reviews the development of canard aircraft with emphasis on stability and control, handling qualities, and operating problems. The results show that early canard concepts suffered adversely in flight behavior because of a lack of understanding of the sensitivities of these concepts to basic stability and control principles. Modern canard designs have been made competitive with tail-aft configurations by using appropriate handling qualities design criteria. Author

A85-43941
SUPERSONIC JUMP JETS
P. KINNUCAN High Technology (ISSN 0277-2981), vol. 5, Sept. 1985, p. 38-43.

In the late 1960s, the Harrier was introduced as the first operational combat aircraft able to take off and land vertically. Such a vertical takeoff and landing (VTOL) capability has great advantages for a number of reasons. On the other hand, the implementation of this capability is costly and there are other problems. For this reason, most practical 'jump jets' are not pure VTOLs. Instead they use an engine with a thrust-vectoring capability which enables them to take off horizontally over short distances as well as vertically. These hybrid aircraft are of two types, including V/STOL (vertical or short takeoff and landing), and STOVL (short takeoff and vertical landing). The Falklands War provided a demonstration of the value of the Harrier, which is a V/STOL. Complex design problems arise when a VTOL capability is combined with a supersonic capability. Attention is also given to the fighters for the 1990s. The U.S. Air Force considers the addition of V/STOL elements to conventional aircraft. G.R.

A85-44073
F-15E ON TRACK
J. JOSS Defense Electronics (ISSN 0278-3479), vol. 17, Aug. 1985, p. 110-112, 116, 118.

The F-15E is a two-seat dual-role fighter for medium-range, all-weather, day/night interdiction missions. Descended from the F-15 Eagle, it will replace a declining tactical interdiction capability composed of FB-111s and F-4s. Primary differences between the F-15E and its fighter predecessors include: a re-engineered rear of the aircraft permitting both the Pratt & Whitney F100 and the General Electric F110 engines to be used; a new wide-field-of-view head-up display; a provision for a low-altitude navigation and targeting infrared system for night; advanced display systems in front and rear cockpits for flying and fighting; and a new radar with enhanced air-to-ground capabilities. A comparison with the F-16XL aircraft is made. D.H.

A85-44238
INFORMATION DISPLAYS FOR PILOTING MODERN AIRCRAFT [PRESENTATION DES INFORMATIONS DE PILOTAGE DANS LES AVIONS MODERNES]
G. VARIN (Centre d'Essais en Vol, Bretigny-sur-Orge, France) Medecine Aeronautique et Spatiale, vol. 24, 2nd Quarter, 1985, p. 80-84. In French.

Air traffic density is high, particularly around urban centers. Still, pilots must seek the most economic or tactically suitable routes, ensure flight safety, and have access to extensive real-time data as to the aircraft and flight status. Information on airspeed, both vertical and horizontal, the flight slope, the attitude, and the energy status must be monitored. Digital CRT and head-up displays (HUD) are now appearing in most military and commercial transport aircraft. The pilot workload in combat aircraft is being further reduced by permitting voice commands. The visual displays are becoming analog, i.e., pictorial rather than quantitative, tailored by human factors engineering to allow for the pilot performance envelope. Aids to navigation signals from, e.g., VOR signals, are also processed and used in the generation of pictorial displays of the aircraft position relative to an intended flight path. The new displays are leading to ergonomically designed cockpits, including a greater visual field of view to offset visual field disruptions by HUD displays. M.S.K.

A85-44239
ORGANIZATION OF THE COCKPIT IN FUTURE AIRCRAFT [ORGANISATION D'UN COCKPIT D'AVION FUTUR]
J.-F. GEORGES and B. SIMON (Avions Marcel-Dassault Breguet Aviation, Vaucresson, France) Medecine Aeronautique et Spatiale, vol. 24, 2nd Quarter, 1985, p. 85-93. In French.

Future combat aircraft will be used for a variety of missions, thereby requiring the pilot to control the aircraft and stores while taking advantage of the full flight loads envelope of the aircraft. The pilots will need as full a field of view as possible as well as the capability to abandon the aircraft quickly. The enhanced maneuvering features and structural strength will expose the pilot to 9 g loads. The cockpit will be redesigned to allow swivelling the pilot 50 deg from vertical orientation to high g loads, while allowing the pilot to keep hands on throttle and stick. New HUD and head-down displays and control configurations will be needed to accommodate the pilot position and provide an extended field of view and flight data. The inclined pilot will be able to give flight commands by voice or tactilely. M.S.K.

A85-44745
TURBOPROP BATTLE HOTS UP
R. BLECH Flight International (ISSN 0015-3710), vol. 128, July 13, 1985, p. 29-31.

A comparative account is given of the design features and performance capabilities of the twin-turboprop, canard-configuration business aircraft designated 'Starship I', 'Avtek 400' and GP-180 'Avanti'. While the last of these employs the most unusual aerodynamic configuration, using three lifting surfaces, it is noted to use conventional aluminum alloy primary structures. The Avtek 400, by contrast, is almost entirely of Kevlar-reinforced polymer composite construction, and the main wing structure of the Starship I is of carbon fiber-reinforced honeycomb sandwich construction. All aircraft feature pressurized cabins and wing-mounted nacelles, with pusher propellers. O.C.

A85-44746
LOCKHEED'S HIGH TECH TEST BED
H. HOPKINS Flight International (ISSN 0015-3710), vol. 128, July 20, 1985, p. 24-26.

An evaluation is made at the Lockheed Corporation's High Technology Test Bed (HTTB) aircraft, which is a C-130 L-100-20 variant that has been further modified to undertake the flight testing of numerous design features optimized for all-weather airlift operations and short, rough airfield takeoffs and landings. Attention is given to the wing aileron, flap and leading edge modifications that will be made to assess the performance of high lift surface configurations. Automatic braking, stability augmentation avionics, fly-by-light fiber-optics control systems, and an airborne digital data system will all be incorporated. O.C.

A85-44748
MONITORING TYRE HEALTH
H. HOPKINS Flight International (ISSN 0015-3710), vol. 128, July 27, 1985, p. 34-36.

A radiometric sensor to determine temperature within the aircraft tire surface has been developed. The device is easily fitted, calibrated and adapted to different aircrafts and is being tested in a British Aerospace 146. The box containing the radiometer and sensors for internal equipment temperature and environmental conditions was mounted on each undercarriage bogie with processing of all the data occurring in the avionics bay of the

plane. The equipment can indicate individual tire problems, such as under-inflation and high temperature which could lead to tire damage. At temperatures above 170 C the tire material and internal adhesion between plies are subjected to strong risk and at temperatures above 190 C/rubber reversion occurs. The results of the radiometric sensor correlate well with the thermocouple probe data. The cost of the device, for a 747 aircraft, is estimated at US $35,000. Life cycle costs are estimated at 3,900 per 1,000 flight hours as compared to $11,600 per 1,000 flight hours for tire burst costs. I.F.

A85-45137
THERMAL DESIGN CRITERIA FOR STANDARDIZED AVIONIC MODULES AS APPLIED TO SYSTEM DESIGN
V. CIRRITO and H. SCHNEIDER (Grumman Aerospace Corp., Bethpage, NY) IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 2 . New York, IEEE, 1984, p. 1199-1206.

This paper defines the Thermal Design Criteria necessary for standardized modules considering a total integrated avionic systems approach. It reviews the design parameters affecting system integration and discusses their impact on vehicle design. Design restraints such as maximum module power, component junction temperature, cooling airflow, heat exchanger design parameters, pressure drop and module retainer requirements are also defined for the Standard Electronic Module (SEM) Format B modules. Confirmation of design capability is presented through the verification of analysis via testing for the SEM Format B modules. Author

A85-45139
THEORETICAL STUDY OF AIRBORNE ELECTROMAGNETIC LEAKAGE
K. A. SHUBERT, J. G. MEADORS, and J. R. BIRCHMEIER (Battelle Columbus Laboratories, OH) IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 2 . New York, IEEE, 1984, p. 1215-1217.
(Contract MDA903-82-C-0398)

A theoretical study was pursued for the characterization and control of low level EM fields associated with the transmission/reflection properties of fine crack structures in airborne vehicles. A viable model was developed as the combination of the two EM modeling techniques. The first technique treated cracks in ground planes of finite thickness under the condition that the EM field was incident from a distance source. The second technique transformed the effects created by a distant source to effects due to a single source in the vicinity of the crack. The resulting history was implemented for specific analysis through a computer program. Author

A85-45140
DETECTION OF ELECTROMAGNETIC RADIATION LEAKAGE THROUGH SMALL STRUCTURAL OPENINGS
J. R. BIRCHMEIER, J. G. MEADORS, and K. A. SHUBERT (Battelle Columbus Laboratories, OH) IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 2 . New York, IEEE, 1984, p. 1218-1222.
(Contract MDA903-82-C-0398)

The detection of small structural openings has been demonstrated using electromagnetic fields from a laser-induced source, a solid state pulser, and a frequency-domain continuous wave source. The fields generated by the different sources were used to probe the crack structures, and the received signals were analyzed to determine if the crack structure had changed. A simple algorithm was developed which used the frequency-domain data to generate an indicator for detecting change in a crack structure. The smallest crack that was reliably detected was 0.020 inches using time-domain techniques and 0.040 inches using frequency-domain techniques. C.D.

A85-45525
THE ECONOMICALITY OF EQUIPPING AIRCRAFT WITH GAS TURBINE-PROPELLER PROPULSION [UNTERSUCHUNGEN ZUR FRAGE DER WIRTSCHAFTLICHKEIT BEIM EINSATZ VON FLUGZEUGEN MIT GASTURBINEN-PROPELLER-ANTRIEB]
D. VON HOERSTEN Braunschweig, Technische Universitaet, Fakultaet fuer Maschinenbau und Elektrotechnik, Dr.-Ing. Dissertation, 1984, 163 p. In German. refs

The performance graph of a new type of propeller (prop-fan) has been generated and compared with published results. Power plant simulations are presented along with conclusions about the significance of design points regarding the comparability of computer results with real power plant performance data. The performance graphs for height-dependent and Mach number-dependent thrust and consumption of the simulated power plant are given and used as input values for the evaluation of direct operational costs. The cost calculations, which are carried out for three different aircraft designs and for fan and prop-fan power plants, show that the use of prop-fan driven aircraft results in considerable savings in fuel and cost. C.D.

A85-45792* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
APPLICATIONS OF NUMERICAL OPTIMIZATION METHODS TO HELICOPTER DESIGN PROBLEMS - A SURVEY
H. MIURA (NASA, Ames Research Center, Moffett Field, CA) (European Rotorcraft Forum, 10th, The Hague, Netherlands, Aug. 28-31, 1984) Vertica (ISSN 0360-5450), vol. 9, no. 2, 1985, p. 141-154. Previously announced in STAR as N85-10036. refs

A survey of applications of mathematical programming methods is used to improve the design of helicopters and their components. Applications of multivariable search techniques in the finite dimensional space are considered. Five categories of helicopter design problems are considered: (1) conceptual and preliminary design, (2) rotor-system design, (3) airframe structures design, (4) control system design, and (5) flight trajectory planning. Key technical progress in numerical optimization methods relevant to rotorcraft applications are summarized. M.A.C.

A85-45794
AN IMPROVED TECHNIQUE FOR TESTING HELICOPTER ROTOR-PYLON AEROMECHANICAL STABILITY USING MEASURED ROTOR DYNAMIC IMPEDANCE CHARACTERISTICS
R. L. BIELAWA (Rensselaer Polytechnic Institute, Troy, NY) (European Rotorcraft Forum, 10th, The Hague, Netherlands, Aug. 28-31, 1984) Vertica (ISSN 0360-5450), vol. 9, no. 2, 1985, p. 181-197. refs

The rationale for and theoretical basis of an improved technique for model testing the aeromechanical stability of rotor-pylon coupled rotorcraft systems, are presented. This improved technique is based on the a priori ability to measure experimentally the dynamic impedance characteristics of the isolated (model) rotor in the frequency domain and makes use of the multivariable Nyquist stability criterion. The technique would be especially useful for evaluating helicopter ground and air resonance characteristics of rotorcraft subject to wide variation in pylon characteristics. An especially important and new feature of this test technique is the ability to make quantitative stability assessments of the coupled rotor-pylon system, over and above the quantitative stability assessment afforded by the Nyquist criterion. Formulations include the mathematical eigenproblem for calculating the characteristic loci, the analytic continuation formulae for quantitative stability assessment, the incorporation of hub constraints and the use of scaling laws for combining rotor and pylon characteristics obtained at different scales. Numerical results include comparisons of analytic stability results obtained using both conventional stability eigensolutions and the new rotor impedance matrix method. These results include a preliminary assessment of the impact of hub constraints on stability. The major finding is that, from a theoretical, mathematical viewpoint, the method is practical. The results also give some implications with regard to accuracy requirements to

be addressed in the eventual practical measurement of rotor impedance. Author

A85-45841*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
EFFECTS OF ACOUSTIC TREATMENT ON THE INTERIOR NOISE OF A TWIN-ENGINE PROPELLER AIRPLANE
T. B. BEYER, C. A. POWELL, E. F. DANIELS (NASA, Langley Research Center, Hampton, VA), and L. D. POPE Journal of Aircraft (ISSN 0021-8669), vol. 22, Sept. 1985, p. 784-788. Previously cited in issue 01, p. 4, Accession no. A85-10875. refs

A85-45842#
LOW-COST DEMONSTRATORS FOR MATURING TECHNOLOGIES
G. ROSENTHAL, S. A. POWERS, W. V. STIRLING (Fairchild Republic Co., Farmingdale, NY), A. W. BALDWINS, and D. L. CARTER (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH) Journal of Aircraft (ISSN 0021-8669), vol. 22, Sept. 1985, p. 789-796. Previously cited in issue 03, p. 258, Accession no. A85-13554. refs
(Contract F33615-83-C-3017)

A85-45844#
EQUATIONS OF MOTION OF A QUASISTEADY FLIGHT VEHICLE UTILIZING RESTRAINED STATIC AEROELASTIC CHARACTERISTICS
W. P. RODDEN and J. R. LOVE (Northrop Corp., Pico Rivera, CA) (Structures, Structural Dynamics and Materials Conference, 25th, Palm Springs, CA, May 14-16, 1984, and AIAA Dynamics Specialists Conference, Palm Springs, CA, May 17, 18, 1984, Technical Papers. Part 2, p. 236-250) Journal of Aircraft (ISSN 0021-8669), vol. 22, Sept. 1985, p. 802-809. Previously cited in issue 13, p. 1914, Accession no. A84-31711. refs

A85-45894*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
QUALIFICATION NEEDS FOR ADVANCED INTEGRATED AIRCRAFT
D. A. MACKALL (NASA, Flight Research Center, Edwards, CA) IN: Guidance, Navigation and Control Conference, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 152-164.
(AIAA PAPER 85-1865)

In an effort to achieve maximum aircraft performance, designers are integrating aircraft systems. The characteristics of aerodynamics, vehicle structure, and propulsion systems are being integrated and controlled through embedded, often flight-critical, electronic systems. This paper addresses the qualification needs for such highly integrated aircraft systems. Based on flight experience with research aircraft, a set of test capabilities is described which allows for complete and efficient qualification of advanced integrated aircraft. Author

A85-45911*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
FUEL CONSERVATIVE GUIDANCE FOR SHIPBOARD LANDING OF POWERED-LIFT STOL AIRCRAFT
D. N. WARNER, JR., L. A. MCGEE (NASA, Ames Research Center, Moffett Field, CA), J. D. MCLEAN, and G. K. SCHMIDT (Analytical Mechanics Associates, Inc., Mountain View, CA) IN: Guidance, Navigation and Control Conference, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 307-317. refs
(AIAA PAPER 85-1889)

A computer-simulation study was undertaken to investigate the application of Fuel Conservative Guidance (FCG) techniques, developed at NASA Ames Research Center, to improve the fuel efficiency and minimize recovery time of powered-lift short-takeoff-and-landing (STOL) airplanes operating from aircraft carriers at sea. The FCG system consists of a set of algorithms whose coefficients and parameters limits match those of the Quiet Short-Haul Research Aircraft. When a flightpath is specified by a set of initial conditions for the aircraft and a set of positional waypoints with associated airspeeds, the FCG synthesizes the necessary guidance commands to capture the specified path at any specified waypoint and to optimize fuel consumption and time fo fly along the path. Closed-form expressions are developed for calculating the altitude profile synthesized by the algorithm. Results of this simulation study show that when restrictions on the approach flightpath imposed for manual operation are removed completely, fuel consumption during the approach was reduced by as much as 38 percent (434 lb of fuel) and the time required to fly the flightpath was reduced by as much as 28 percent (209 sec). Savings because of FCG were produced by: (1) shortening the total flight time and distance, and (2) keeping the airspeed high as long as possible to minimize time spent flying in a powered-lift mode.
Author

A85-45934*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
FLIGHT EVALUATION OF HIGHLY AUGMENTED CONTROLS AND ELECTRONIC DISPLAYS FOR PRECISION APPROACH AND LANDING OF POWERED-LIFT AIRCRAFT
J. A. FRANKLIN and C. S. HYNES (NASA, Ames Research Center, Moffett Field, CA) IN: Guidance, Navigation and Control Conference, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 529-553. refs
(AIAA PAPER 85-1944)

Experiments were conducted on simulators and on the Quiet Short-Haul Research Aircraft to evaluate the effect of highly augmented control modes and electronic displays on the ability of pilots to execute precision approaches and landings on a short runway. It is found that the primary benefits of highly augmented flightpath and airspeed controls and electronic displays are realized when the pilot is required to execute precisely a complex transition and approach under instrument conditions and in the presence of a wide range of wind and turbulence conditions. A flightpath and airspeed command and stabilization system incorporating nonlinear, inverse system concepts produced fully satisfactory flightpath control throughout the aircraft's terminal operating envelope.
V.L.

A85-45946#
OPTIMIZATION OF SKI-JUMP TAKE-OFF PERFORMANCE
J. SHINAR (Technion - Israel Institute of Technology, Haifa), D. EHRENTAL, and R. REUVENI IN: Guidance, Navigation and Control Conference, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 652-659. refs
(AIAA PAPER 85-1962)

Ski-jump take-off technique allows deployment of overloaded VTOL aircraft onboard small ships. Present operational practice using constant thrust deflection is not optimal. In this paper a variable thrust vectoring control law, maximizing the flight path angle, is developed and expressed in a feedback form. Using a realistic aerodynamic-propulsion interference model, it is demonstrated that optimization of the thrust vectoring leads to a significant increase in maximum allowable take-off weight. Such optimal thrust vectoring also provides a faster and shorter take-off and consequently improves aircraft safety. Author

A85-45947#
ACTIVE CONTROL OF HELICOPTER BLADE FLAPPING
R. A. CALICO and J. MARCH (USAF, Institute of Technology, Dayton, OH) IN: Guidance, Navigation and Control Conference, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 660-668. refs
(AIAA PAPER 85-1963)

The equations of motion of a rotating helicopter blade are developed. The blade is assumed to be rigid and to be hinged at its root. The resulting equations when linearized have constant coefficients when the helicopter is hovering but have periodic coefficients when the helicopter is in forward flight. The stability of the blade flapping in forward flight is investigated using Floquet theory and is compared to previous studies. An extension to the

use of Floquet theory is developed which allows the direct design of modal control of periodic systems. This technique is applied to the helicopter blade flapping problem and results are presented for the modal control of an unstable equilibrium. The system is successfully controlled and the instability removed. The modal control affects only the unstable mode of the system leaving the other system mode unaffected. Author

A85-45949#
A SECOND ORDER ADAPTIVE CONTROLLER FOR WING FLUTTER CONTROL
G. L. SLATER (Cincinnati, University, OH) and R. LIVNEH IN: Guidance, Navigation and Control Conference, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 679-687. refs
(Contract F33615-82-K-3609)
(AIAA PAPER 85-1965)

The problem of designing a series-parallel model reference adaptive controller for the control of wing-flutter vibration is studied. The performance of the adaptive controller is examined for several classes of unmodeled dynamics and is also applied to a realistic flutter model. Results indicate that the adaptive controller is generally stable for a wide range of unmodeled dynamics. Instabilities can occur in systems due to several effects however and these are shown to be of serious concern for a realistic control design. Author

A85-46341*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
MINIMUM-FUEL, THREE-DIMENSIONAL FLIGHT PATHS FOR JET TRANSPORTS
F. NEUMAN (NASA, Ames Research Center, Moffett Field, CA) and E. KREINDLER (Technion - Israel Institute of Technology, Haifa) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 8, Sept.-Oct. 1985, p. 650-657. refs

A number of studies dealing with fuel minimization are concerned with three-dimensional flight. However, only Neuman and Kreindler (1982) consider cases involving commercial jet transports. In the latter study, only the climb-out and descent portions of complete long-range flight paths below 10,000 ft altitude have been investigated. The present investigation is concerned with the computation of minimum-fuel nonturning and turning flight paths for climb-outs from 2000 to 10,000 ft for long-range flights (greater than 50 n mi), and for complete flight paths of lengths between 5 and 50 n mi. G.R.

A85-46499
MISSION ADAPTIVE WING
J. MOXON Flight International (ISSN 0015-3710), vol. 128, Aug. 10, 1985, p. 22-25.

The USAF/NASA mission adaptive wing (MAW) being developed is a smooth, flexible surface, controlled by digital computers and moved by high-speed actuators. The MAW is being tested on an F-111. The actuators convert the motion of a spinning torque tube to a rotary output that through the linkages can move the inboard trailing edge 30 deg/sec and the outboard 40 deg/sec. The first phase of the study will collect aerodynamic and structural data and also test the four MAW control modes. The cruise camber determines the best wing configuration for least drag while the maneuver camber determines the maximum lift-to-drag ratio. The maneuver load control automatically shifts the pressure of the wing and the maneuver enhancement/gust alleviation improves the instantaneous maneuver performance. All four modes are to interact and be sequenced automatically. Additional modes are also being studied. The MAW program should provide useful data and a good basis for future development. I.F

A85-46524
THE SOVIETS EXPLAIN THE KA-32 HELIX
M. LAMBERT Interavia (ISSN 0020-5168), vol. 40, Aug. 1985, p. 853-855.

The Soviet civil Ka-32 helicopter is in production in two versions, one a land-based craft and the second for shipboard or over-water operation. The Ka-32 is compact, has a coaxial rotor system, and can operate in all weather specifically in Arctic fog and icing, independent of ground assistance. The fuselage of the helicopter is only 11.3 m long and its maximum weight with a slung load is no less than 12,600 kg. Its main function is carrying slung loads for up to a maximum of 5000 kg. The pilot is allowed full power because of the coaxial rotor and is able to determine reserve power from the turbine temperature gauge. The APU provides all the electrical and hydraulic power necessary for running systems and starting engines. However, the Ka-32 is not capable of high speeds because of the drag of the widely separated rotors. Directional control is achieved by using differential collective pitch through the rudder pedals. The blades can be manually folded, which means no rerigging is required away from the main base. The electrical equipment and avionics are outdated, but reliable. I.F.

A85-46525
AN-124 - THE WORLD'S LARGEST AIRCRAFT
B. SWEETMAN Interavia (ISSN 0020-5168), vol. 40, Aug. 1985, p. 857-859.

The Antonov An-124 is the largest aircraft in the world; it can carry a 150 ton load for 4500 km, with a maximum range of 16,500 km. The advanced wing section design, of a flat top and undercut trailing edge, allows for greater wing span for a given weight and more internal volume for fuel. The artificial stability used to control the aircraft reduces the aircraft's weight, drag, and system complexity. The lightest materials available, such as glass-fiber-reinforced plastic (GFRP) and carbon-fiber composite (CFC) were used for the airframe and its components. The complex landing gear permits the aircraft to be operated from semiprepared surfaces and allows for vertical loading. The vehicle is powered by four Lotarev D-18T turbofans. The engine has a design life of 18,000-20,000 hours with a 4000-6000 hour time between overhauls (TBO). It has conventional electromechanical instruments and a computer system for onboard data and diagnosis. The An-124 also has military transport capabilities. I.F.

A85-46564
WEIGHT DESIGN AND EFFICIENCY OF PASSENGER AIRCRAFT. HANDBOOK (2ND REVISED AND ENLARGED EDITION) [VESOVOE PROEKTIROVANIE I EFFEKTIVNOST' PASSAZHIRSKIKH SAMOLETOV. SPRAVOCHNIK /2ND REVISED AND ENLARGED EDITION/]
V. M. SHEININ and V. I. KOZLOVSKII Moscow, Izdatel'stvo Mashinostroenie, 1984, 552 p. In Russian. refs

Methods of optimum weight design are examined, with particular attention given to solving structural weight problems on computers. The discussion covers the theory of weight calculation, the concept of the weight growth factor, the theory of weight prediction and control, the principles of minimum-weight design, weight analysis, and methods for calculating centering and moments of inertia. V.L.

A85-46597
KA-32 MULTIMISSION HELICOPTER DESIGNED TO OPERATE IN HARSH CLIMATE
Aviation Week and Space Technology (ISSN 0005-2175), vol. 123, Sept. 2, 1985, p. 69.

The Soviet Ka-32 utility helicopter has been designed for both land-based transport operations and a variety of shipboard missions, all of which, as in the case of Arctic icebreaker escort duties, have led to the design of a configuration well suited for harsh environments. The Ka-32 is equipped for all-weather day/night flying, using an automatic flight control system and a radar that facilitates instrument approaches to remote landing sites. Two 2225-hp turboshaft engines are employed. The cabin has provisions for up to 16 passengers or 4000 kg of cargo, but can also undertake airlifts of externally carried loads. The two rotors of the helicopter contrarotate and incorporate thermoelectric deicing systems. O.C.

A85-46623
IMPROVING ENGINE TESTING THRU AUTOMATION USING A MINICOMPUTER
J. E. WHITEFORD and W. L. CARPENTER, JR. (Sverdrup Technology, Inc., Tullahoma, TN) IN: International Instrumentation Symposium, 30th, Denver, CO, May 7-10, 1984, Proceedings . Research Triangle Park, NC, ISA, 1984, p. 519-528.

The certification requirements for new aircraft engines established by the Federal Aviation Agency (FAA) involve extensive engine testing, both at altitude and sea level, followed by analysis of the test results. Depending upon these results, the engine may or may not be certified for use with commercial aircraft. The determination of endurance represents one of the objectives of certification testing. Because of the repetitive nature of endurance testing, it was determined that an automated system would be cost effective in terms of engine operating costs, testing costs, and analysis. In addition, an automated system will enable the manufacturer to satisfactorily complete the FAA certification test requirements in less calendar time. The implementation of an automated flight cycling system is discussed, taking into account a closed-loop system using stepping motors. The stepping motors are interfaced to a host processor via a multichannel microprocessor-based controller. G.R.

A85-46997#
PEGASUS - AN INTERMEDIATE/ADVANCED NAVY JET TRAINER AIRCRAFT
AIAA Student Journal (ISSN 0001-1460), vol. 23, Spring 1985, p. 4-13. refs

The prize-winning design for a Navy jet trainer aircraft in the AIAA/Bendix Naval Trainer design competition is described. The design, referred to as Pegasus, met or exceeded all present Navy requirements and was advanced enough to be operable into the 21st century. The strongest feature of the design was the basic configuration. The wings contained canards which added positive lift and lessened the difficulty of takeoffs and landings, as well as decreased the overall weight. The aft podded engines were extremely efficient and easily installed and maintained. The control configured techniques were designed to alter flying qualities. Pegasus can be used as a trainer aircraft and then altered for regular flying. Simple software changes in the control techniques will allow the aircraft to adapt to future fighter requirements. With all these features incorporated into the design the total takeoff gross weight (TOGW) of the aircraft was 12,000 lb. The design was feasible and cost effective. I.F.

A85-47049
MAJOR FOKKER 50 UPGRADE GROWS OUT OF F-27 REENGINING PROGRAM
M. FEAZEL Aviation Week and Space Technology (ISSN 0005-2175), vol. 123, Aug. 26, 1985, p. 34, 35, 37.

The Fokker 50-seat transport aircraft now includes 80-90 percent new parts, compared to an original plan to simply re-engine the Fokker 27. Firm orders for 32 aircraft are expected to grow to 300-350 aircraft over a 25 yr period, with a projected production rate of two aircraft per month. Aerodynamic refinements will increase the fuel efficiency by 4-5 percent, and the installation of PW 124 engines with more shaft horsepower will furnish 30 percent gain in fuel efficiency. A six-blade, smaller diameter propeller will be installed instead of a four-blade propeller to reduce noise at the expense of a 1-1.5 percent performance penalty. Advanced avionics in the cockpit will be modular for ease of replacement. The increased expenses associated with many of the new structural parts will be offset by automating much of the production process. M.S.K.

N85-32110*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
STUDY OF AN EFFICIENT LONG-RANGE MACH 2.7 SUPERSONIC TRANSPORT CONFIGURATION CONCEPT
P. D. GALL Jul. 1985 53 p refs
(NASA-TM-86414; NAS 1.15:86414) Avail: NTIS HC A04/MF A01 CSCL 01C

A long range Mach 2.7 supersonic transport configuration concept was studied utilizing linear theory methods. The configuration was sized to carry 290 passengers 6,000 nautical miles nonstop. The final configuration has a maximum takeoff gross weight of 687,200 pounds, a wing loading of 69.8 lbf/sq.ft. and a thrust weight ratio of .278. The most significant result is that a significantly improved trimmed maximum lift drag ratio of 11.04 can be obtained for a supersonic transport at Mach 2.62 and 55,000 feet. Author

N85-32111*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
PRELIMINARY SIZING AND PERFORMANCE OF AIRCRAFT
D. E. FETTERMAN, JR. Jul. 1985 115 p refs
(NASA-TM-86357; NAS 1.15:86357) Avail: NTIS HC A06/MF A01 CSCL 01C

The basic processes of a program that performs sizing operations on a baseline aircraft and determines their subsequent effects on aerodynamics, propulsion, weights, and mission performance are described. Input requirements are defined and output listings explained. Results obtained by applying the method to several types of aircraft are discussed. Author

N85-32113# Aeronautical Research Labs., Melbourne (Australia).
A PHASE-LOCKED FREQUENCY MULTIPLIER FOR THE SIGNAL AVERAGING OF THE VIBRATION OF THE WESSEX HELICOPTER INPUT SPIRAL BEVEL PINION
P. D. MCFADDEN Jan. 1985 25 p
(AD-A154914; ARL/AERO-TM-423) Avail: NTIS HC A02/MF A01 CSCL 01C

This Australian report provides details of the design of a phase-locked frequency multiplier for the conversion of a signal derived from the alternator of the Wessex helicopter into a pulse train suitable for controlling the sampling and signal averaging by a computer of the vibration of the input spiral bevel pinion in the Wessex main rotor gearbox. The frequency multiplier is implemented as a series of four phase-locked loops, and features an oscillator which maintains the loops at approximately the correct frequency in standby mode thereby reducing the time to lock when the input signal is applied. GRA

N85-32114# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
THE MEASUREMENT OF AIRCRAFT WINDSCREEN HAZE AND ITS EFFECT ON VISUAL PERFORMANCE Final Report
H. L. TASK and L. V. GENCO Feb. 1985 46 p
(Contract AF PROJ. 7184)
(AD-A154949; AFAMRL-TR-85-016) Avail: NTIS HC A03/MF A01 CSCL 06P

A new method of measuring haze in installed aircraft transparencies is developed and explained. Using data obtained with the new method, equations were derived to help predict target detection performance as it is affected by windscreen haze, windscreen transmissivity, ambient illumination, mean target luminance, target contrast and target size. The equations may be applied to many transparency types and configurations. Graphs are provided to show the effects of another of typical visibility conditions. No similar relationships were found for older methods of measuring haze. GRA

N85-32115# Air Force Academy, Colo.
FLIGHT CONTROL SYSTEM FOR A COMPUTER CONTROLLED AIRCRAFT WITH LIMITED SENSORS
T. P. WEBB 30 Apr. 1985 63 p
(AD-A155107; USAFA-TN-85-4) Avail: NTIS HC A04/MF A01 CSCL 01D

The Department of Electrical Engineering at the United States Air Force Academy is attempting, through one of its senior design courses, to design, build, and fly a computer controlled aircraft. The Department of Aeronautics was asked to help design the flight control system to be implemented by the on-board digital computer. The project involved building and testing a wind tunnel model of the aircraft to determine its aerodynamic characteristics, performing mass tests on the actual aircraft to determine inertia characteristics, developing a 12 degree-of-freedom nonlinear aircraft simulation computer program, and designing the actual flight control system. This report describes only the last task. A complete flight control system for a small computer controlled aircraft was designed using only yaw rate, heading, lateral load factor, airspeed, altitude, and rate of climb feedback. This multi-input multi-output control problem was done using the classical root locus technique on a linearized system model. The simulation results revealed surprisingly good performance, considering the limitation on sensors. GRA

N85-32116# Army Aviation Engineering Flight Activity, Edwards AFB, Calif.
ARTIFICIAL AND NATURAL ICING TESTS YEH-60A QUICK FIX HELICOPTER Final Report, 5 Jan. - 21 Mar. 1984
E. J. TAVARES, P. J. SULLIVAN, M. L. HANKS, and R. WORATSCHEK Jun. 1984 88 p
(AD-A155147; AD-F630645; USAAEFA-83-21) Avail: NTIS HC A05/MF A01 CSCL 01C

These tests were conducted to establish a moderate icing flight envelope for the helicopter with the AN/ALQ-151(V)2 countermeasures system installed. A total of 12.3 hours were flown in the icing environment. After damage to an unprotected direction finding (DF) dipole antenna during an icing encounter, the original DF dipole antennas were removed and a prototype thermoelectrically anti-iced DF dipole antenna was installed in position no. 3 (aft right side). During these tests 4 deficiencies and 16 shortcomings were noted. The two icing related deficiencies are: damage to the DF antenna element mounts and phenolic blocks caused by excessive element oscillations induced by ice accumulation; and erroneous readings on the Rosemount Icing Rate Indicator caused by electromagnetic interference from the electronic countermeasures system which prevents simultaneous safe operation of the ECM system and the blade deicing system. The two non-icing related deficiencies are: interference between the main rotor blades and the upper elements of the aft DF dipole antennas during rearward ground taxi and the inadequate cabin heat. The YEH-60A Quick Fix helicopter as originally configured (unheated DF antennas) was not suitable for flight in a moderate icing environment. GRA

N85-32117# Aeronautical Research Labs., Melbourne (Australia).
PROPOSAL FOR MODIFICATIONS TO THE WESSEX HELICOPTER MAIN ROTOR GEARBOX VIBRATION MONITORING PROGRAM
P. D. MCFADDEN Jan. 1985 31 p
(AD-A155196; ARL/AERO-TM-422) Avail: NTIS HC A03/MF A01 CSCL 01C

Modifications to the RAN Recorded Tape Vibration Analysis Program for the condition monitoring of the main rotor gearbox in the Wessex helicopter are proposed to take advantage of recent developments in the techniques of signal averaging and computer enhancement of vibration data. GRA

N85-32118# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CHINA HAS DEVELOPED A NEW VERSION OF FIGHTER AIRCRAFT
17 Apr. 1985 15 p Transl. into ENGLISH from Conmilit. (China), v. 96, no. 11, Nov. 1984 p 10-11, 14-15
(AD-A155293; AD-F300613; FTD-ID(RS)T-0020-85) Avail: NTIS HC A02/MF A01 CSCL 01C

This translation of a Chinese document describes the development of a new fighter aircraft. The contents of this note show that this aircraft has a delta main wing, two turbo jet engines and an excellent capacity of supersonic and high-altitude climb. From the synthesis of different documents, this is a new, modified MiG-21 attack plane. The nose air intake was expanded, and the aircraft has the feature of being able to fly under all weather conditions. The aircraft was fitted with a fire control system and more advanced electronic equipment. It has a single vertical tail and two all-flying tailplanes. According to the guesswork of some experts, this new fighter aircraft is perhaps the expanded version of the MiG-21. GRA

N85-33116*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ENERGY EFFICIENT TRANSPORT TECHNOLOGY: PROGRAM SUMMARY AND BIBLIOGRAPHY
D. B. MIDDLETON, D. W. BARTLETT, and R. V. HOOD Sep. 1985 54 p refs
(NASA-RP-1135; L-15921; NAS 1.61:1135) Avail: NTIS HC A04/MF A01 CSCL 01C

The Energy Efficient Transport (EET) Program began in 1976 as an element of the NASA Aircraft Energy Efficiency (ACEE) Program. The EET Program and the results of various applications of advanced aerodynamics and active controls technology (ACT) as applicable to future subsonic transport aircraft are discussed. Advanced aerodynamics research areas included high aspect ratio supercritical wings, winglets, advanced high lift devices, natural laminar flow airfoils, hybrid laminar flow control, nacelle aerodynamic and inertial loads, propulsion/airframe integration (e.g., long duct nacelles) and wing and empennage surface coatings. In depth analytical/trade studies, numerous wind tunnel tests, and several flight tests were conducted. Improved computational methodology was also developed. The active control functions considered were maneuver load control, gust load alleviation, flutter mode control, angle of attack limiting, and pitch augmented stability. Current and advanced active control laws were synthesized and alternative control system architectures were developed and analyzed. Integrated application and fly by wire implementation of the active control functions were design requirements in one major subprogram. Additional EET research included interdisciplinary technology applications, integrated energy management, handling qualities investigations, reliability calculations, and economic evaluations related to fuel savings and cost of ownership of the selected improvements. Author

N85-33117# Federal Aviation Administration, Oklahoma City, Okla.
GENERAL AVIATION AIRWORTHINESS ALERTS, NO. 85
Aug. 1985 15 p
(FAA-AC-43-16; ALERT-85) Avail: NTIS HC A02/MF A01

A current listing of aircraft components and related possible modes of malfunction and failure is presented. This information is listed by aircraft make and model and is of a precautionary nature. G.L.C.

N85-33118*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
FLUTTER CLEARANCE OF THE SCHWEIZER 1-36 DEEP-STALL SAILPLANE
M. W. KEHOE and J. F. ELLISON Aug. 1985 78 p refs
(NASA-TM-85917; REPT-85136; NAS 1.15:85917) Avail: NTIS HC A05/MF A01 CSCL 01C

A Schweizer 1-36 sailplane was modified for a controlled, deep-stall flight program. This modification allowed the horizontal

stabilizer to pivot as much as 70 deg leading edge down. Ground vibration and flutter testing were accomplished on the sailplane with the horizontal stabilizer in the normal flight and deep-stall flight positions. Test results indicated satisfactory damping levels and trends for the structural modes of the sailplane. The modified sailplane was demonstrated to be free of aeroelastic instabilities to 83 KEAS with the horizontal stabilizer in the normal flight position and to 39 KEAS with the horizontal stabilizer in the deep-stall flight position. This flight envelope was adequate for the controlled, deep-stall flight experiments. Author

N85-33119*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
QUALIFICATION NEEDS FOR ADVANCED INTEGRATED AIRCRAFT
D. A. MACKALL 1985 16 p refs Presented at the AIAA Conf., Snowmass, Colo., 19-21 Aug. 1985
(NASA-TM-86731; H-1291; NAS 1.15:86731) Avail: NTIS HC A02/MF A01 CSCL 01C

In an effort to achieve maximum aircraft performance, designers are integrating aircraft systems. The characteristics of aerodynamics, vehicle structure, and propulsion systems are being integrated and controlled through embedded, often flight critical, electronic systems. The qualification needs for such highly integrated aircraft systems are addressed. Based on flight experience with research aircraft, a set of test capabilities is described which allows for complete and efficient qualification of advanced integrated aircraft. Author

N85-33120# Societe Nationale Industrielle Aerospatiale, Paris (France).
NEW MATERIALS NEEDS IN AERONAUTICS [LES BESOINS DE L'AERONAUTIQUE EN NOUVEAUX MATERIAUX]
J. BALAZARD 1985 13 p refs In FRENCH Presented at l'Avenir des Plastiques et Caoutchoucs dans les Transports SEPIC/APCT Colloq.
(SNIAS-851-502-101) Avail: NTIS HC A02/MF A01

The use of composite materials in aeronautics is discussed. The selection criteria comprising technical and economic factors are described. Cost components are outlined. Applications in aircraft and spacecraft structures are examined. The competition provided by metallurgical developments is mentioned.
Author (ESA)

06

AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

A85-44051
THE ICARUS MULTICOLOR VISUAL DISPLAY SYSTEM FOR FIGHTER AIRCRAFT [SYSTEME DE VISUALISATION MULTICOULEURS POUR AVION DE COMBAT 'ICARE']
G. CREUTIN Navigation (Paris) (ISSN 0028-1530), vol. 33, July 1985, p. 289-297. In French.

The multimodal visual display screen installed in the Mirage 2000 fighter for combined navigation and stores control during low-altitude flight is described. The display is driven by an integrated digital system multiplexing data from terrain-following radar, and dual inertial systems, and provides head-up and head-down displays. The copilot in the rear seat receives only a head-down display. The terrain-following radar permits automated low-altitude flight at optimized velocities, and is subject to manual override. The pilot is presented with a tricolor map of the terrain, with options for the area ahead, below and behind, and calculations of projected flight time and fuel consumption for different flight paths expressed symbolically. The system was devised to lower the pilot workload, enhance flight safety and allow the pilot and navigator to keep watch on the sky. M.S.K.

A85-44072
THE B-1B HAS ARRIVED
L. A. MCCLELLAND Defense Electronics (ISSN 0278-3479), vol. 17, Aug. 1985, p. 72-74, 76, 78 (4 ff.).

The B-1B electronics-intensive bomber has evolved into one of the USAF's most successful endeavors, and has begun replacing the aging fleet of B-52 bombers. Both the offensive and defensive avionics systems are discussed in some detail including multimode radar, terrain following and terrain avoidance, and ECM systems. The program remains on-cost and ahead of schedule. Fifty-two B-1Bs have already been procured and 48 more are in the FY-86 budget. D.H.

A85-44074
AIR FORCE STANDARDIZING AVIONICS
G. MONAHAN, JR. (USAF, Office of the Deputy Chief of Staff for Research, Development and Acquisition, Washington, DC) Defense Electronics (ISSN 0278-3479), vol. 17, Aug. 1985, p. 120-122, 125, 126, 128, 130.

Taking a multilevel approach towards the standardization of avionics - in components, circuit boards, black boxes, hardware and software - the USAF is seeking to reduce costs, increase interoperability and make room for the technology of the future. Breakthroughs in computer and electronics technologies have enabled hardware standardization on the highest level, the line-replaceable unit; standardizing the form, fit and function (F3) of such units promises significant savings in support and development costs. Software, applicability, architecture, organizational structure, implementation, current advances, and future directions are topics covered. D.H.

A85-44240
INFORMATION DISPLAYS IN THE MODERN AIRCRAFT - THE EQUIPMENT MANUFACTURER'S POINT OF VIEW [PRESENTATION DES INFORMATIONS DANS LES AERONEFS MODERNES POINT DE VUE DE L'EQUIPEMENTIER]
M. ARGOUSE (Societe d'Applications Generales d'Electricite et de Mecanique, Paris, France) Medecine Aeronautique et Spatiale, vol. 24, 2nd Quarter, 1985, p. 94-103. In French.

For years, aircraft designers concentrated on enhancing an aircraft's performance on the longitudinal axis. Now, more attention is given to navigating along that axis to a goal. Although the aircraft may be maneuvered in terms of attitude, the pilot needs continuous data on the distance and orientation of the aircraft relative to the ground. The direction in which the aircraft moves can be represented by lines intersecting at a point on a horizon line. The attitude, altitude, lift-drag and engine power displays must be combined with the flight path data. Much of the data can be extracted from gyroscope, aids to navigation, radar and external sensors signals. The resolution of the displays increases with nearness to touchdown. The objective is to simplify the displays as much as possible, furnish sufficient data, and minimize the pilot workload. The data can now be presented in both head-up and head-down displays, which contain symbolic, computer-generated imagery. The on-board computer must therefore maintain in memory a spherical view in space at different resolutions, for maneuvering and cruise conditions, for instant display. Finally, the capability to predict the aircraft position in the future must also be provided. M.S.K.

A85-44769#
ELECTRONICS - KEY TO FUTURE MILITARY HELICOPTERS
E. SKIBBE and D. WURSTER D & A Journal, June 1985, p. 5-9. In English and German.

The application of electronics to the German Federal Army's PAH-1 and PAH-2 antitank helicopters and to future generations of military helicopters is described. The PAH-1 was an adapted BO 105 helicopter from Messerschmitt-Boelkow-Blohm, and the PAH-2 has been undergoing joint development to meet French and German requirements. An antitank helicopter must have optimal flight characteristics and modern electronics to carry out such combat missions; electronic systems play decisive parts in flight and engine control, navigation, night vision, target acquisition

and attack, self-protection and electronic warfare, radio equipment, and simulation for training purposes. In coming programs for Air Force and Navy helicopters, it will be practical to make use of a part of the electronics of the PAH-2. D.H.

A85-44990
F-15 DIGITAL MAP FEASIBILITY DEMONSTRATION SYSTEM
W. R. HANCOCK (Sperry Corp., Flight Systems Div., Albuquerque, NM) IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 1 . New York, IEEE, 1984, p. 82-89.

It has been recognized that moving map displays represent a highly desirable addition to modern aircraft avionics particularly during the attack and interdiction roles. The A-7, F-111, and F-18 aircraft employ already a film projection system to provide an automated map display which is primarily used during navigation. It is pointed out that the benefits which can be derived from a digitally generated map display can greatly enhance the usefulness of the moving map displays. The present paper is concerned with the Aft Display Group developed for the Advanced Fighter Capability Demonstrator (AFCD) program. In the context of this program, an advanced, integrated control and display suite was installed in the aft cockpit of an F-1582. This report provides a description of the hardware utilized in the aft crew station display system. G.R.

A85-44991
ENHANCED TERRAIN MASKED PENETRATION PROGRAM
G. M. BARNEY (Texas Instruments, Inc., Dallas) IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 1 . New York, IEEE, 1984, p. 90-96.
(Contract F33615-83-C-1077)

It is pointed out that a pressing need exists for effective all-weather low-altitude penetration and survival in many types of military aircraft. In connection with Soviet advances, it is essential that penetrating aircraft must exploit all possible means to evade detection, impede tracking, and defeat missile guidance and fusing. The considered program will develop, simulate, and test advanced terrain-following/terrain-avoidance (TF/TA) techniques to improve the performance and reduce the radiated signature of terrain-masked, penetrating aircraft. An electronic terrain map (ETM) will be integrated with a terrain-following radar to provide vertical and lateral terrain-following commands, radar control, and covert navigation. G.R.

A85-44992
INTEGRATED TERRAIN ACCESS/RETRIEVAL SYSTEM
G. O. BURNHAM (Texas Instruments, Inc., Lewisville) IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 1 . New York, IEEE, 1984, p. 97-105.

The ITARS program objective is to develop and demonstrate a flightworthy digital terrain access and retrieval system, implemented with a flexible VHSIC-based modular architecture. The ITARS will interface to and support a variety of avionics subsystems and functions including TF/TA, navigation, threat avoidance, and displays. As such, the ITARS will be ideally situated to take advantage of and bring together major current-technology thrusts: digital map technology, VHSIC technology, and Air Force Pave Pillar/ASID programs. To successfully merge these three technologies into the ITARS, the program must systematically address several issues such as: (1) how digital terrain data are used to support pilot needs including TF/TA, navigation, threat avoidance, and displays; (2) what is the digital map technology required to support these functions; (3) what flightworthy system implementation best supports these requirements. This paper presents the approach, schedule, and results from preliminary studies conducted to support Digital Map technology required for ITARS. Specific topics to be discussed include data base requirements, alternate digital terrain data sources, and mission needs. Author

A85-44993
FUTURE ELECTRONIC MAP SYSTEMS
J. W. WEBER (Hughes Aircraft Co., El Segundo, CA) IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 1 . New York, IEEE, 1984, p. 106-111.

Studies and laboratory demonstrations have shown the potential for improving mission performance through the application of stored digital terrain data to navigation, threat avoidance, and terrain following/terrain avoidance functions as well as in generating pictorial displays that can improve an aviator's situational awareness. However, the technology must be developed to support the successful integration of terrain data with current and future avionic subsystems. Issues that must be addressed include the availability of terrain and threat data, processor and data bus capacities to support multiple simultaneous users of the data, bulk storage sufficiently large to contain hypsographic, feature, threat, and mission data for an operationally meaningful area, and an architecture that supports multiple users, growth to accommodate new users, and reliable operation. Author

A85-44999
SYSTEM ENGINEERING TAKES THE BYTE OUT OF MIL-STD-1553
A. FIELD (Fairchild Republic Co., Farmingdale, NY) IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 1 . New York, IEEE, 1984, p. 148-153.

Reviewing the four year period during which the A-10 Mux Bus was developed, flight tested and put into production, the realization is made that the unfamiliarity of most engineers in 1977, caused too much concentration on MIL-STD-1553 at the expense of system integration. It was not until hardware delivery that the integration problems become evident, and their resolution often endangered program schedules and threatened cost overruns. MIL-STD-1553 is now commonplace. Interface boards are readily available that perform all the difficult 1553 tasks, and subsystems developed contain interfaces that are bus compatible. For the successful development of any new operational Mux Bus system, there must be an equal balance of effort between good system engineering design and strict adherence to the guidelines of MIL-STD-1553. In this paper, the A-10A INS is described, and the major problems encountered during its development are discussed. Author

A85-45000
PAVE PILLAR AVIONICS - AN ARCHITECTURE FOR THE FUTURE
L. KLOS (General Dynamics Corp., St. Louis, MO) IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 1 . New York, IEEE, 1984, p. 156-162.
(Contract F33615-82-C-1704)

'Pave Pillar' is a U.S. Air Force program aimed at the definition of avionics architecture requirements for fighter aircraft development programs coming to fruition in the 1990s; it emphasizes data fusion and subsystem interaction, higher levels of software complexity, an expansion of optimal control techniques for fault tolerance, and standardization for maintenance simplification and lower costs. As a generic approach for avionics integration, Pave Pillar will furnish required aircraft subsystem functions with enhanced survivability and mission effectiveness, while casting the pilot in the role of a weapons system manager, rather than the conventional subsystem operator/information integrator. Attention is given to functionally oriented system partitioning, a family of common implementing hardware and software modules, a family of communications network, and a decision support and automation approach to pilot interactions. O.C.

A85-45001
AVIONICS AS AN EXPERT SYSTEMS DOMAIN
L. D. POHLMANN (Boeing Military Airplane Co., Wichita, KS) and F. J. DICKEY (Boeing Aerospace Co., Seattle, WA) IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 1 . New York, IEEE, 1984, p. 163-169.

The subfields of artificial intelligence, particularly expert systems, are beginning to receive widespread consideration in the design and development of military weapons systems. Because of recent successes in commercial and industrial sectors, such attention seems to be well deserved. Unfortunately, this attention is also accompanied by a lot of confusion as the military aerospace industry begins to learn what ES technology can and cannot be expected to do, and where ES technology should and should not be applied. This paper compares and contrasts military avionics with other domains where ES seems to have been successfully applied. Author

A85-45003
DEVELOPMENT OF CONSENSUS MODULAR AVIONICS STANDARDS
R. GILBERTSON (Arinc Research Corp., Annapolis, MD) IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 1 . New York, IEEE, 1984, p. 182-187.

The need for low cost, highly reliable LRUs, and the desire to use newly available VLSI and Very High Speed ICs in highly integrated avionics, require novel packaging, cooling, mounting, built-in testing, and fault diagnosis concepts. Mission parameters relating to the installation of LRUs, such as EMI/EMP protection and accessibility for maintenance under adverse weather conditions and chemical/biological warfare environments, will also influence system architecture design. Attention is presently given to the formulation of preliminary module interface standards informed by the aforementioned considerations. O.C.

A85-45018
A TECHNIQUE FOR DETERMINING THE EFFECTS OF AIRCRAFT COMPONENTS ON THE PATTERN OF RADAR ANTENNAS BEFORE THEY ARE BUILT
J. J. HAVRILLA (Westinghouse Defense and Electronics Center, Baltimore, MD) IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 1 . New York, IEEE, 1984, p. 304-308.

Attention is given to a technique for the measurement of antenna patterns in the presence of a near field disturbance, presently applied to the case of a field probe placed on an aircraft fuselage to measure amplitude and phase data at various points along the length of the proposed antenna aperture. This data was stored in a computer and converted into an antenna pattern by means of an FFT process, followed by the application of the correct weighting function to each of the points. A random process is also introduced in order to simulate manufacturing tolerance errors. O.C.

A85-45025#
ADAPTABLE AIR DATA COMPUTER STANDARDIZATION
R. A. GEMIN (USAF, Aeronautical Systems Div., Wright-Patterson AFB, OH) IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 1 . New York, IEEE, 1984, p. 355-358. refs

A development status account is given of computer air data standardization in view of prospective design efforts toward centralized, integrated, and distributed air data systems. Attention is given to a U.S. Air Force and Navy program for the development of a Standard Central Air Data Computer, with emphasis on the degree of compatibility that may be achieved between program standardization and adaptability criteria. The adaptability in question is the ability to alter the function of standard hardware by means of a software change. O.C.

A85-45026
A STANDARD CENTRAL AIR DATA COMPUTER (SCADC) WITH WORLDWIDE APPLICATIONS
C. RADFORD (Marconi Avionics, Ltd., Rochester, England) IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 1 . New York, IEEE, 1984, p. 359-364.

The development phase has been concluded for the joint U.S. Air Force and Navy Standard Central Air Data Computer (SCADC). While the current simplex SCADC configurations are readily applicable to mature aircraft types, the fly-by-wire aircraft entering service typically require duplex or triplex air data systems; this is noted to increase the scope of SCADC. Attention is presently given to the benefits derivable from the retrofitting of multichannel systems with a standardized product, as well as to the difficulties involved. An account is given of the inherent flexibility of SCADC in addressing such requirements. O.C.

A85-45027
ADVANCED AIR DATA SYSTEM CONCEPTS
A. DIMITRIOU and D. HOPMANN (Rosemount, Inc., Eden Prairie, MN) IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 1 . New York, IEEE, 1984, p. 365-371. refs

In the novel approach to primary air data measurement and presentation discussed, which represents an initial step toward a distributed system, a high accuracy digital sensor is incorporated which capitalizes on the increased flexibility furnished by advanced digital data bus techniques. By taking advantage of existing, on-board computing capacity, conventional central air data computers can be eliminated. This increases maintainability, reliability and survivability, while weight, power, size and costs are decreased. The evolution of a purely distributed, smart sensor-based air data system is foreseen on this basis. Attention is given to the impingement method being employed. O.C.

A85-45102
EFFECTS OF SPECIFICATION ON AIRBORNE DISPLAY HARDWARE
F. T. BUHLER and J. BARBARASCH (Kaiser Electronics, San Jose, CA) IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 2 . New York, IEEE, 1984, p. 904-910.

Optimal Specification of military airborne cockpit displays is examined. The result of optimal specification can be more effective displays at lower cost. Specification of the display as a function of mission accomplishment is stressed. Parametric characterization of displays independent of internal parameters is emphasized. Parameters are grouped into five general categories. A tutorial relating display parameters to the internal design complexity of electronics for a CRT display is presented. Conclusions are drawn which assist the display specifier in attaining optimal specifications. Author

A85-45103#
A QUANTITATIVE MEASURE OF MONOCHROME CRT DISPLAYS
T. A. LIBERIO (USAF, Aeronautical Systems Div., Wright-Patterson AFB, OH) IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 2 . New York, IEEE, 1984, p. 911-914.

Efforts to develop a technically reliable means of evaluating monochrome CRT displays for aircraft cockpits are reviewed. Consideration is given to the development of design criteria for CRT displays based on the physical aspects of vision. These design parameters include spectral output; luminance; resolution; and contrast ratio. Some basic test equipment used in measuring CRT parameters are described, including spectroradiometer systems; slit aperture photometers; and video pattern/symbol generators. I.H.

A85-45142
RELIABILITY ANALYSIS OF THE A129 INTEGRATED MULTIPLEX SYSTEM
B. W. JOHNSON and P. M. JULICH (Harris Corp., Government Aerospace Systems Div., Melbourne, FL) IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 2 . New York, IEEE, 1984, p. 1229-1236. refs

The A129 Integrated Multiplex System (IMS) is a highly reliable multicomputer system designed to implement automatic flight control tasks for the A129 helicopter. The primary functions of the IMS system include navigation; fire control; stability augmentation; and engine monitoring. Additional tasks include: communications control; maintenance assistance and weapons systems control. The motivation for developing a fault tolerant IMS system design are examined, and the techniques used to determine the reliability of the system are described. Consideration is given to the use of a fault tree procedure for analysis of the major IMS subsystems. The impact of fault coverage and reliability analysis in improving overall system performance is assessed. I.H.

A85-45152
AIRBORNE ELECTRONIC TERRAIN MAP SYSTEM - CONCLUSIONS
R. L. HERBELIN, J. W. WEBER (Hughes Aircraft Co., El Segundo, CA), and D. M. SMALL (USAF, Avionics Laboratory, Wright-Patterson AFB, OH) IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 2 . New York, IEEE, 1984, p. 1301-1307.

The capabilities and limitations of the Airborne Electronic Terrain Map System (AETMS) are discussed. AETMS is the first system to generate a wide variety of plan and perspective view cockpit display formats in real time from elevation and feature data produced by the Defense Mapping Agency. An overview of the system is given, including the regional memory, data processor, display generator, and support equipment. The operating modes are summarized, and plan and perspective views are shown and discussed. The lessons learned while using AETMS are summarized. C.D.

A85-45156
DIGITAL FLIGHT CONTROL AND AVIONICS INTEGRATION TECHNIQUES
D. E. SWIHART (USAF, Aeronautical Systems Div., Wright-Patterson AFB, OH) and A. M. ARABIAN (General Dynamics Corp., Fort Worth, TX) IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 2 . New York, IEEE, 1984, p. 1329-1331.

Terrain-following flight control systems currently being designed will employ a single pilot, thereby requiring a higher degree of automatic redundancy management to compensate for past systems' second crew member. Attention is presently given to techniques that promise the achievement of an acceptable level of flight safety in these conditions, which entail the integration of avionics with flight controls. Failure recognition is noted to be a critical function of terrain-following systems; total failure recognition is precluded in single thread systems, due to incomplete coverage, as well as in redundant systems, due to the need for an output monitor. O.C.

A85-45524
PREVENTING COLLISIONS IN AIR TRAFFIC - A SYSTEM ANALYSIS WITH SPECIAL EMPHASIS ON TRANSPONDER-ASSISTED ON-BOARD SYSTEMS WITH SELECTIVE ADDRESSING [KOLLISIONSVERHUETUNG IM LUFTVERKEHR - EINE SYSTEMANALYSE UNTER BESONDERER BERUECKSICHTIGUNG TRANSPONDERGESTUETZTER BORDSYSTEME MIT SELEKTIVER ADRESSIERUNG]
W. SCHROER Braunschweig, Technische Universitaet, Fakultaet fuer Maschinenbau und Elektrotechnik, Dr.-Ing. Dissertation, 1984, 148 p. In German. refs

The methodology of using on-board systems to prevent collisions in air traffic is discussed. The possibilities of counteracting air-to-air communication conflicts is examined, emphasizing the boundary conditions of secondary radar-transponder system with selective addressing. The conflict recognition methods considered include: optical observation, measurement of the slant range, transmission of the barometric height, and measurement of the separation and angle. Methods of resolving conflict include vertical and horizontal maneuvering, rules of avoidance, and guided maneuvering. C.D.

A85-45550
CONSTRUCTION OF A SPECIAL COMPUTER FOR IMAGE PRODUCTION USING SYNTHETIC APERTURE RADAR [BEITRAEGE ZUR KONSTRUKTION EINES SPEZIALRECHNERS ZUR BILDERZEUGUNG BEI EINEM RADAR MIT SYNTHETISCHER APERTUR]
A. WIEGMANN Braunschweig, Technische Universitaet, Fakultaet fuer Maschinenbau und Elektrotechnik, Dr.-Ing. Dissertation, 1984, 156 p. In German. refs

The digital part of a data processor in a sidelooking radar with synthetic aperture aboard aircraft used in land surveying is discussed. The principle of the radar system is briefly described, and a rearrangement register for the system is developed and optimized. A fast Fourier transform (FFT) is used for the azimuth correlation. This algorithm is described and given in a general form which can be used in different versions for individual processing steps. Possible processor structures for calculating the FFT are considered, and a special computer for performing the azimuth correlation in SAR is sketched. C.D.

A85-45939#
THE USE OF ADA IN DIGITAL FLIGHT CONTROL SYSTEMS
T. F. WESTERMEIER and H. E. HANSEN (McDonnell Aircraft Co., St. Louis, MO) IN: Guidance, Navigation and Control Conference, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 597-603. refs
(AIAA PAPER 85-1953)

A microprocessor-based, parallel-processing flight control system has been built around the F-15 Eagle Dual Control Augmentation System and has been successfully flight tested. The microprocessors are programmed using Ada, the Department of Defense standard high order language. It is widely agreed that Ada has the potential for reducing software life cycle costs through increased programmer productivity. To use Ada and realize the productivity gains, however, the compiler must be reasonably efficient. The use of Ada is discussed, therefore, from these two interrelated standpoints: software productivity and compiler efficiency. The productivity gains and the level of efficiency actually achieved are highlighted. Author

A85-45975*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
DESIGN OF AN EXPERT-SYSTEM FLIGHT STATUS MONITOR
V. A. REGENIE and E. L. DUKE (NASA, Flight Research Center, Edwards, CA) AIAA, Guidance, Navigation and Control Conference, Snowmass, CO, Aug. 19-21, 1985. 9 p.
(AIAA PAPER 85-1908)

The present technology used to monitor systems in flight tests is not advanced enough for the modern avionics in high performance aircraft. Research is being conducted at NASA's

Dryden Flight Research Facility to design an expert system to monitor test flights. The expert system is to automatically detect any problems in the flight control system (FCS), interpret the problem from the information contained in its knowledge base, inform the systems engineer, and recommend solutions. The data is to be downlinked from the aircraft to the control room. The expert system will lessen the responsibilities of the engineers by providing them with fast, expert advice. Time is the most critical factor in flight testing and the expert system will be able to quickly recognize discrepancies and provide corrections. A demonstration of the expert system, not operating in real time, has already been tested. I.F.

A85-46119
AIRBORNE OPTICAL INFORMATION SYSTEMS (HANDBOOK) [AVIATSIONNYE SISTEMY INFORMATSII OPTICHESKOGO DIAPAZONA /SPRAVOCHNIK/]
IU. V. BAIBORODIN, V. A. VOLKOV, V. K. VIALOV, L. Z. KRIKSUNOV, V. P. KUCHIN et al. Moscow, Izdatel'stvo Mashinostroenie, 1985, 264 p. In Russian. refs

Reference data on airborne optical information systems are summarized. The data are grouped under the following headings: instruments for measuring the motion parameters of flight vehicles; instruments and systems for celestial and terrestrial navigation; coordinators and tracking systems; systems providing information on the air situation; and systems providing information on the ground situation. The data included in the book cover the general design, principles of operation, and the principal technical and performance characteristics of the optical information systems and their components. V.L.

N85-33121*# National Aeronautics and Space Administration. *Ames Research Center, Moffett Field, Calif.*
DEVELOPMENT OF A TEMPERATURE-COMPENSATED HOT-FILM ANEMOMETER SYSTEM FOR BOUNDARY-LAYER TRANSITION DETECTION ON HIGH-PERFORMANCE AIRCRAFT
H. R. CHILES and J. B. JOHNSON Aug. 1985 9 p refs Presented at the IEEE/CIASF Conf., Stanford, Calif., 26-28 Aug. 1985
(NASA-TM-86732; H-1292; NAS 1.15:86732) Avail: NTIS HC A02/MF A01 CSCL 01D

A hot-film constant-temperature anemometer (CTA) system was flight-tested and evaluated as a candidate sensor for determining boundary-layer transition on high-performance aircraft. The hot-film gage withstood an extreme flow environment characterized by shock waves and high dynamic pressures, although sensitivity to the local total temperature with the CTA indicated the need for some form of temperature compensation. A temperature-compensation scheme was developed and two CTAs were modified and flight-tested on the F-104/Flight Test Fixture (FTF) facility at a variety of Mach numbers and altitudes, ranging from 0.4 to 1.8 and 5,000 to 40,000 ft respectively. Author

07

AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and on-board auxiliary power plants for aircraft.

A85-43649
CONDITION MONITORING OF JET ENGINES
J. S. STECKI and B. T. KUHNELL (Monash University, Clayton, Australia) Lubrication Engineering (ISSN 0024-7154), vol. 41, Aug. 1985, p. 485-493. refs

The application of ferrographic and 'direct' spectrometric oil analysis techniques to monitoring of jet engines is discussed and illustrated. The effectiveness of failure detection and diagnosis of the individual techniques is compared. The results show that the reliability of wear detection and diagnosis of engine state would be greatly enhanced if these techniques were applied together. Author

A85-43699#
THE EFFECT OF DIRECT HEATING ON COMBUSTION EFFICIENCY OF THE CHAMBER OF JET ENGINE IN THE SIMULATION TEST ON THE GROUND
S. YU, G. LIN, and Z. WANG (Beijing Power Plant Research Laboratory, People's Republic of China) Journal of Engineering Thermophysics, vol. 6, May 1985, p. 187-190. In Chinese, with abstract in English. refs

A calculation method of combustion efficiency from a theoretical model has been developed to show the effect of direct heating on the combustion efficiency of the combustor of a jet engine. This theoretical equation is clarified using a large number of experimental data from the model of the main combustor of jet engine, and the testing combustor. The semiempirical equation, which can calculate the efficiency of combustion in the case of pure air from experimental results for the different pollutant conditions, has been obtained. Author

A85-43778#
F404/RM12 - A KEY STEP IN THE F404 GROWTH PLANS
W. J. DAUB (General Electric Co., Aircraft Engine Business Group, Lynn, MA) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 10 p.
(AIAA PAPER 85-1461)

The present paper is concerned with the F404 aircraft engine, which had been developed in the mid-1970s by an American aerospace company for the U.S. Navy F/A-18 Hornet. In the design and development of this engine a new philosophy was employed. According to this philosophy, a balanced design is to be produced, taking into account an engine for which primary emphasis is on operability, reliability, maintainability, and low cost raher than strictly high performance and low weight. The outstanding results which have been achieved in the F/A-18 program to date demonstrate the success of the new approach. The F404 engine has consequently been selected to power a number of other aircraft. Attention is given to the development of the F404 for many users, the F404 growth road map, details regarding the consistent design/development philosophy, the importance of properly addressing each customer's unique requirements, the internal cross-flow of information, and the development of a modified engine for the Swedish Air Force. G.R.

A85-45036
MEETING THE ELECTRIC POWER NEEDS FOR AIRCRAFT DIGITAL ELECTRONICS
I. S. MEHDI (Boeing Military Airplane Co., Seattle, WA) IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 1 . New York, IEEE, 1984, p. 434-438.

The advent of microprocessors and the reliance on more and more software stored in memory to control essential functions have put some new demands on aircraft electrical power systems. This paper provides a brief background to the electrical system development process. It attempts to identify the requirements imposed by the new digital electronics and discusses the possible solutions to meet their requirements. The requirements are characterized by various levels of equipment criticality, the changing methods of generation and distribution of power, and the electromagnetic threats imposed due to changing aircraft structures reducing the inherent protection provided by metal skinned aircraft. Solutions affecting the power system and utilization equipment are proposed for consideration. Author

A85-45037
IMPROVED SECONDARY POWER SYSTEM EFFICIENCY THROUGH EXPANDED ELECTRICAL POWER USE
I. S. MEHDI and E. T. REIQUAM (Boeing Military Airplane Co., Seattle, WA) IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 1 . New York, IEEE, 1984, p. 439-443.

This paper discusses an aircraft electric power system concept with potential for substantially increasing the efficiency of the entire secondary power system package. The feasibility of the concept is not limited to an 'all-electric' airplane, although electrical replacement of some functions normally powered by sources other than electrical increases the potential for energy savings. One of the methods of increasing efficiency involves use of a hybrid system in which only part of the generated power is regulated to standard voltage and frequency. The remainder is used either as 'raw' wild voltage, wild-frequency, both being proportional to engine speed, or is totally reconstructed to either regulated dc or to controlled variable voltage, variable frequency. Another means of energy conservation involves the time-honored standby, weight reduction. In the system discussed in this paper, the weight reduction results from use of equipment for multiple functions. It is concluded that secondary power system losses can be reduced by as much as 30 to 40 percent by minimizing the processing and power refinement. Also, innovative system development and integration can achieve even greater benefits than those shown. Author

A85-45854*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
VIBRATION AND FLUTTER OF MISTUNED BLADED-DISK ASSEMBLIES
K. R. V. KAZA and R. E. KIELB (NASA, Lewis Research Center, Cleveland, OH) Journal of Propulsion and Power (ISSN 0748-4658), vol. 1, Sept.-Oct. 1985, p. 336-344. Previously cited in issue 05, p. 602, Accession no. A85-16095. refs

A85-45860#
IMPACT BENDING OF A ROTATING, RIGID-PLASTIC FAN BLADE
T. SHIOYA (Tokyo, University, Japan) and W. J. STRONGE (Cambridge University, England) Journal of Propulsion and Power (ISSN 0748-4658), vol. 1, Sept.-Oct. 1985, p. 375-380. refs

Damage caused by bird impact on a blade in a rotating fan has been idealized as transverse impact of a fluid jet on a semi-infinite, rigid-plastic beam with a centrifugal force acting parallel to the initial axis of the beam. In this preliminary dynamic analysis, the centrifugal force limits travel of the plastic hinges away from the impact point and decreases the deflection of the beam. A kink forms at the impact point; the amplitude of this kink is related to a moment of the impact force and is inversely proportional to the centrifugal force. Author

A85-45861*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
PREDICTED CHANGES IN ADVANCED TURBOPROP NOISE WITH SHAFT ANGLE OF ATTACK
S. L. PADULA and P. J. W. BLOCK (NASA, Langley Research Center, Hampton, VA) Journal of Propulsion and Power (ISSN 0748-4658), vol. 1, Sept.-Oct. 1985, p. 381-387. Previously cited in issue 01, p. 75, Accession no. A85-10884. refs

A85-45862#
NOISE TESTING OF AN ADVANCED DESIGN PROPELLER IN A WIND TUNNEL
B. M. GLOVER, JR., E. I. PLUNKETT, and C. D. SIMCOX (Boeing Commercial Noise Technology Laboratory, Seattle, WA) Journal of Propulsion and Power (ISSN 0748-4658), vol. 1, Sept.-Oct. 1985, p. 388-392. Previously cited in issue 10, p. 1454, Accession no. A85-26320. refs

A85-45869#
ADVANCED DESIGN PROPELLER NOISE TESTING IN AN ANECHOIC CHAMBER
E. I. PLUNKETT, P. C. TOPNESS, and C. D. SIMCOX (Boeing Commercial Noise Technology Laboratory, Seattle, WA) Journal of Propulsion and Power (ISSN 0748-4658), vol. 1, Sept.-Oct. 1985, p. 415, 416. Previously cited in issue 12, p. 1695, Accession no. A85-30193.

A85-46221
COMBUSTION EFFICIENCY OF A HYDROGEN-KEROSENE FUEL IN A STRAIGHT-THROUGH CHANNEL [EFFEKTIVNOST' GORENIIA VODORODOKEROSINOVOGO TOPLIVA V PRIAMOTOCHNOM KANALE]
IU. M. ANNUSHKIN and G. F. MASLOV Fizika Goreniia i Vzryva (ISSN 0430-6228), vol. 21, May-June 1985, p. 30-32. In Russian. refs

Results of an experimental study of the combustion efficiency of a composite hydrogen-kerosene fuel in a straight-through channel are reported. It is shown that the completeness of the combustion of the composite fuel has a maximum depending on the relative content of hydrogen in the fuel. The position of the maximum is determined by the coefficient of excess air in the combustion chamber and by the general combustion efficiency of the fuel. V.L.

A85-47021*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
LARGE-SCALE ADVANCED PROPFAN (LAP) PROGRAM PROGRESS REPORT
D. A. SAGERSER (NASA, Lewis Research Center, Cleveland, OH) and S. G. LUDEMANN (United Technologies Corp., Hamilton Standard Div., Windsor Locks, CT) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 26 p. Previously announced in STAR as N85-29964. refs
(AIAA PAPER 85-1187)

The propfan is an advanced propeller concept which maintains the high efficiencies traditionally associated with conventional propellers at the higher aircraft cruise speeds associated with jet transports. The large-scale advanced propfan (LAP) program extends the research done on 2 ft diameter propfan models to a 9 ft diameter article. The program includes design, fabrication, and testing of both an eight bladed, 9 ft diameter propfan, designated SR-7L, and a 2 ft diameter aeroelastically scaled model, SR-7A. The LAP program is complemented by the propfan test assessment (PTA) program, which takes the large-scale propfan and mates it with a gas generator and gearbox to form a propfan propulsion system and then flight tests this system on the wing of a Gulfstream 2 testbed aircraft. Author

N85-32119*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Business Group.
COMPONENT-SPECIFIC MODELING Annual Status Report, 1 Jan. - 31 Dec. 1984
R. L. MCKNIGHT 1985 131 p
(Contract NAS3-23687)
(NASA-CR-174925; NAS 1.26:174925; ASR-2) Avail: NTIS HC A07/MF A01 CSCL 21E

Accomplishments are described for the second year effort of a 3-year program to develop methodology for component specific modeling of aircraft engine hot section components (turbine blades, turbine vanes, and burner liners). These accomplishments include: (1) engine thermodynamic and mission models; (2) geometry model generators; (3) remeshing; (4) specialty 3-D inelastic stuctural analysis; (5) computationally efficient solvers, (6) adaptive solution strategies; (7) engine performance parameters/component response variables decomposition and synthesis; (8) integrated software architecture and development, and (9) validation cases for software developed. Author

N85-32120*# National Aeronautics and Space Administration. Dryden (Hugh L.) Flight Research Center, Edwards, Calif. 21e
PERFORMANCE IMPROVEMENTS OF A HIGHLY INTEGRATED DIGITAL ELECTRONIC CONTROL SYSTEM FOR AN F-15 AIRPLANE
T. W. PUTNAM, F. W. BURCHAM, JR., M. G. ANDRIES (Pratt and Whitney Aircraft, West Palm Beach, Fla.), and J. B. KELLY (Pratt and Whitney Aircraft, West Palm Beach, Fla.) Aug. 1985 14 p refs Presented at the AIAA Guidance and Control Conf., Snowmass, Colo., 19-21 Aug. 1985
(NASA-TM-86748; H-1312; NAS 1.15:86748; AIAA-85-1876)
Avail: NTIS HC A02/MF A01

The NASA highly integrated digital electronic control (HIDEC) program is structured to conduct flight research into the benefits of integrating an aircraft flight control system with the engine control system. A brief description of the HIDEC system installed on an F-15 aircraft is provided. The adaptive engine control system (ADECS) mode is described in detail, together with simulation results and analyses that show the significant excess thrust improvements achievable with the ADECS mode. It was found that this increased thrust capability is accompanied by reduced fan stall margin and can be realized during flight conditions where engine face distortion is low. The results of analyses and simulations also show that engine thrust response is improved and that fuel consumption can be reduced. Although the performance benefits that accrue because of airframe and engine control integration are being demonstrated on an F-15 aircraft, the principles are applicable to advanced aircraft such as the advanced tactical fighter and advanced tactical aircraft. Author

08

AIRCRAFT STABILITY AND CONTROL

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

A85-43826
ATMOSPHERIC FLIGHT MECHANICS CONFERENCE, 12TH, SNOWMASS, CO, AUGUST 19-21, 1985, TECHNICAL PAPERS
Conference sponsored by AIAA. New York, AIAA, 1985, 553 p. For individual items see A85-43827 to A85-43877.

Among the topics discussed are the estimation of aircraft stability derivatives by means of the modified gain-extended Kalman filter, robust parameter identification for nonlinear systems using a principal-components regression algorithm, a Joukowsky airfoil with circulation control, aircraft wake hazard alleviation associated with roll oscillations, predicting the nonlinear aerodynamic characteristics of maneuvering missiles, minimum time-turning, energy management in three-dimensional minimum time interception, cross-coupling in pilot/vehicle systems, and the aerodynamic effects of asymmetric vortex shedding from slender bodies. Also covered are the vortex flow effects of a fighter forebody with unconventional cross section, drag reduction by means of controlled separated flows, a historical review of canard configurations, supersonic flow prediction, Godunov's method for supersonic tactical missile computations, the application of inviscid multiple zones to supersonic missiles, an atmospheric guidance law for planar skip trajectories, measurements of canard-induced roll oscillations, and optimal flight paths through microburst wind profiles. O.C.

A85-43827#
ON-LINE ESTIMATION AND IDENTIFICATION OF AIRCRAFT STABILITY DERIVATIVES USING THE MODIFIED GAIN EXTENDED KALMAN FILTER
J. L. SPEYER and E. Z. CRUES (Texas, University, Austin) IN: Atmospheric Flight Mechanics Conference, 12th, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 1-9. Research sponsored by the General Dynamics Corp. refs
(AIAA PAPER 85-1762)

A new on-line state and parameter identification algorithm called the modified gain extended Kalman filter (MGEKF) is applied to the problem of on-line state estimation and identification of the stability derivatives of a F-111 type vehicle. The conceptual basis for the MGEKF is the existence of a class of nonlinear functions which allow a universal linearization with respect to the measurement function. This class includes the problem of identification of linear systems. The previous single output formulation is extended to a multioutput formulation where the available measurements are only acceleration and pitch rate, and not elevator deflection. The filter formulation includes a simplified Dryden wind gust model. The inclusion of the wind gust model results mainly in a very slow response in the estimation of the stability derivatives associated with the acceleration state; the estimates of the stability derivatives associated with the pitch rate still respond very quickly. The accuracy of the acceleration stability derivatives depends upon the amplitude and frequency components of the persistently exciting dither signal. Author

A85-43838#
THE ROLL MOTION OF A WRAPAROUND FIN CONFIGURATION AT SUBSONIC AND TRANSONIC MACH NUMBERS
Y. H. KIM (Agency of Defense Development, Test and Evaluation Div., Republic of Korea) and G. L. WINCHENBACH (USAF, Armament Laboratory, Eglin AFB, FL) IN: Atmospheric Flight Mechanics Conference, 12th, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 112-118. refs
(AIAA PAPER 85-1777)

The subsonic and transonic rolling motion of a wraparound fin configuration is analyzed using the differential equation of motion in conjunction with various expansions of the roll moment coefficient. The aerodynamic roll coefficients and derivatives obtained during this investigation were extracted from the experimentally measured roll orientation versus time profiles using a nonlinear numerical integration data reduction routine. These motion profiles were derived from free flight tests conducted at atmospheric pressure and over a Mach number range from 0.58 to 1.09. The original analysis of these data using a conventional roll moment expansion was unsuccessful in adequately matching the experimentally measured roll profiles. The present analysis using a modified expansion technique showed that different values of the roll damping derivative exists depending on the direction of spin. Also, it is shown that the roll driving moment is a function of velocity throughout the transonic region. Author

A85-43840#
MINIMUM TIME TURNING
B. JARMARK (Saab-Scania AB, Linkoping, Sweden) IN: Atmospheric Flight Mechanics Conference, 12th, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 131-135.
(AIAA PAPER 85-1780)

An easily solved optimal control problem is given for the dynamic turn performance of a fighter aircraft in a horizontal plane, using a realistic aircraft model. Optimal control strategies are developed, on the basis of the Hamiltonian, for throttle actuation, maneuvering for speed gain or speed loss prevention, etc. The present technique is applicable to on-board calculation of optimal maneuvers, and may be found useful in the comparative assessment of different aircraft from the viewpoint of turning performance. O.C.

A85-43841*# Virginia Polytechnic Inst. and State Univ., Blacksburg.
ENERGY MANAGEMENT OF THREE-DIMENSIONAL MINIMUM-TIME INTERCEPT
H. J. KELLEY, E. M. CLIFF (Virginia Polytechnic Institute and State University, Blacksburg), and H. G. VISSER IN: Atmospheric Flight Mechanics Conference, 12th, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 136-146. NASA-supported research. refs
(AIAA PAPER 85-1781)

A real-time computer algorithm to control and optimize aircraft flight profiles is described and applied to a three-dimensional minimum-time intercept mission. The proposed scheme has roots in two well known techniques: singular perturbations and neighboring-optimal guidance. Use of singular-perturbation ideas is made in terms of the assumed trajectory-family structure. A heading/energy family of prestored point-mass-model state-Euler solutions is used as the baseline in this scheme. The next step is to generate a near-optimal guidance law that will transfer the aircraft to the vicinity of this reference family. The control commands fed to the autopilot (bank angle and load factor) consist of the reference controls plus correction terms which are linear combinations of the altitude and path-angle deviations from reference values, weighted by a set of precalculated gains. In this respect the proposed scheme resembles neighboring-optimal guidance. However, in contrast to the neighboring-optimal guidance scheme, the reference control and state variables as well as the feedback gains are stored as functions of energy and heading in the present approach. Some numerical results comparing open-loop optimal and approximate feedback solutions are presented. Author

A85-43845*# California Univ., Davis.
CROSS COUPLING IN PILOT/VEHICLE SYSTEMS
R. A. HESS (California, University, Davis) and D. C. WATSON IN: Atmospheric Flight Mechanics Conference, 12th, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 179-185. NASA-supported research. refs
(AIAA PAPER 85-1787)

Multiloop pilot/vehicle analysis is applied to the problem of determining crossfeed techniques which may be employed by pilots in minimizing the effects of vehicle cross coupling. As used here, cross coupling refers to unwanted vehicle motion which occurs in one control axis or loop as the result of pilot control actuation in another control axis or loop. The minimization or elimination of such cross coupling can contribute significantly to the 'workload' associated with tasks like nap-of-the-earth helicopter flight. In contrast, situations arise in which pilot's may use vehicle cross coupling to improve performance by coordinating two control actuations in the control of a single response variable. A crossfeed model is developed based upon simple control system design principles and configured in a manner amenable to pilot pursuit or precognitive control activity. A handling qualities theory developed to analyze single loop tasks is applied to the multiloop problem. The crossfeed model is applied to five different vehicles/configurations ranging from helicopters to fighter aircraft. Results indicate relatively simple crossfeed commands can significantly reduce cross coupling and, in some improve handling qualities as predicted by the single loop theory. Author

A85-43846#
LOOP SEPARATION PARAMETER FOR LANDING FLYING QUALITIES
E. DIDOMENICO and D. J. BIEZAD (USAF, Institute of Technology, Wright-Patterson AFB, OH) IN: Atmospheric Flight Mechanics Conference, 12th, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 189-196. refs
(AIAA PAPER 85-1788)

A conventional pilot model is combined with classical root locus and frequency response methods to establish a new criterion, the Loop Separation Parameter, specifically intended for longitudinal flying qualities evaluation during the landing phase of flight. When applied to flight test data Loop Separation Parameter shows strong correlation with pilot ratings for aircraft approaching touchdown. The modeling process itself provides insight into the possible causes of pilot induced oscillations during landing, and analysis of test data indicates a transition in pilot emphasis from pitch attitude control on approach to flight path angle control in the landing flare. Author

A85-43847#
FLIGHT EVALUATION OF LONGITUDINAL FLYING QUALITIES PARAMETERS
R. F. STENGEL (Princeton University, NJ) and M. E. MURPHY IN: Atmospheric Flight Mechanics Conference, 12th, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 197-204. refs
(Contract N62269-80-C-0720)
(AIAA PAPER 85-1789)

Flight tests were conducted using Princeton University's Variable-Response Research Aircraft, which simulated a range of aircraft/control configurations including conventional and high-order systems. Five test pilots evaluated 45 configurations for pitch response, final approach using an aircraft carrier mirror landing aid, and flared touchdown. Their handling qualities ratings were correlated with military flying qualities specifications as well as five alternate criteria. Although there was good correlation between ratings for actual (high-order) and equivalent-system (low-order) configurations, interpretation of results for high-order systems was inconclusive, indicating a need for further tests. Correlation of the pilots' handling qualities ratings with the alternate criteria generally were weak, although a second-order control anticipation parameter and a gain/phase margin criterion showed promise. Author

A85-43848#
DEVELOPMENT OF TIME RESPONSE CRITERIA FOR ROTORCRAFT AT HOVER AND LOW SPEED
D. G. MITCHELL and R. H. HOH (Systems Technology, Inc., Hawthorne, CA) IN: Atmospheric Flight Mechanics Conference, 12th, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 205-213. refs
(AIAA PAPER 85-1790)

A revision to the rotorcraft flying qualities military specification, MIL-H-8501A, is currently being developed. As a part of this revision process, new flying qualities criteria are needed to define short-term response characteristics. Rotorcraft manufacturers have expressed a desire to use time-domain-based criteria as much as possible, and in response to this desire, a set of time response criteria for short-term attitude control of rotorcraft in the hover and low-speed range has been developed. This paper describes the process followed in deriving these criteria, and compares them with more conventional frequency-domain-based criteria. Author

A85-43855#
INTERACTION BETWEEN DISPLAY DYNAMICS AND HANDLING QUALITIES IN MANUAL CONTROL TASKS
M. INNOCENTI (Auburn University, AL) IN: Atmospheric Flight Mechanics Conference, 12th, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 319-325. refs
(Contract F49620-82-C-0035)
(AIAA PAPER 85-1805)

New advanced displays have been shown to alter the flying qualities of piloted aircraft. Present handling qualities specifications do not include the effect of the display. A preliminary analysis of the influence of the display in a single axis tracking task is performed. The display is modeled by a set of parameters and a relation with tracking performance and pilot ratings is established via fixed-base simulation. Author

A85-43856#
EXPERIMENTAL INVESTIGATION OF THE SHORT PERIOD RESPONSE REQUIREMENTS OF MIL-F-8785C
R. E. BAILEY (Calspan Advanced Technology Center, Buffalo, NY) IN: Atmospheric Flight Mechanics Conference, 12th, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 326-336. refs
(Contract F33615-83-C-3603)
(AIAA PAPER 85-1806)

An investigation of the short period frequency requirements of MIL-F-8785C was performed using the USAF/TIFS in-flight simulator. Thirty-five evaluations of eighteen configurations were conducted. The experiment examined the minimum frequency boundary at three values of (n/alpha) for one true airspeed. The experiment included the effects of pilot location and evalution task. Tha data indicate that the current requirement is essentially valid for aircraft which do not exhibit significant direct lift. The minmum acceptable frequency boundary may be relaxed when the pilot station is forward of the center of rotation. Also, the phasing between the normal acceleration and pitch rate responses has been shown to be a critical determinant of longitudinal short period flying qualities that can be quantified as an effective pilot location. Author

A85-43871*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
MEASUREMENTS OF CANARD-INDUCED ROLL OSCILLATIONS
J. KATZ (NASA, Ames Research Center, Moffett Field, CA) and D. LEVIN (Technion Research and Development Foundation, Ltd., Haifa, Israel) IN: Atmospheric Flight Mechanics Conference, 12th, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 483-493. Research supported by the Technion - Israel Institute of Technology. refs
(AIAA PAPER 85-1830)

A small canard wing was installed in front of a delta wing which was mounted on a free-to-roll sting balance in a low-speed wind tunnel. The leading edge vortices, originating from the canard, enhanced self-induced roll oscillations at test conditions for which the basic delta wing would otherwise have been stable. Time-dependent roll angle, and normal and side force data recorded during these oscillations are presented along with their phase relations. It was found that the canard increased the range of angle of attack at which self-induced oscillations occurred. Also, at an angle of attack of about 46 deg asymmetric oscillations are observed. Author

A85-43872*# Princeton Univ., N. J.
OPTIMAL FLIGHT PATHS THROUGH MICROBURST WIND PROFILES
M. L. PSIAKI and R. F. STENGEL (Princeton University, NJ) IN: Atmospheric Flight Mechanics Conference, 12th, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 494-503. FAA-supported research. refs
(Contract NGL-31-001-252)
(AIAA PAPER 85-1833)

The problem of safe microburst wind shear encounter during the approach and climb-out flight phases is addressed using flight path optimization. The purpose was to investigate the physical limits of safe penetration and to determine control strategies that take full advantage of those limits. Optimal trajectories for both jet transport and general aviation aircraft were computed for encounters with idealized and actual microburst profiles. The results demonstrate that limits to control system design rather than to the aircraft's physical performance may be the deciding factor in an aircraft's capability for safe passage through a wide class of microbursts. The best control strategies responded to airspeed loss in an unconventional manner: by raising the nose to maintain lift. Author

A85-44683
SINGULAR PERTURBATION THEORY OF LONGITUDINAL DYNAMIC STABILITY AND RESPONSE OF AIRCRAFT
P. Y. XU (Northwestern Polytechnical University, Xian, People's Republic of China) Aeronautical Journal (ISSN 0001-9240), vol. 89, May 1985, p. 179-184.

The estimation of the relative orders of the coefficients in the linear differential equations of longitudinal small perturbation of aircraft is used to analyze the classical simplified theory for the short- and long-period modes by the singular perturbation methods. The leading terms of the asymptotic expansions give the eigenvalues for short- and long-period modes with fairly good accuracy, except that the damping part of the eigenvalue for the long-period mode has relative error of the order of 10 percent. These approximate eigenvalues are improved by the method of strained coordinates which accounts for most of the differences. The dynamic response due to initial disturbances of velocity, angle of attack, and angle of pitch are also derived. Author

A85-45040#
A USER FRIENDLY INTRODUCTION TO HANDLING QUALITIES
T. R. TWISDALE (USAF, Flight Test Center, Edwards AFB, CA) IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 1 . New York, IEEE, 1984, p. 457-463.

An account is given of the most important factors in aircraft handling quality research, specifications, design practices, and flight testing. Handling qualities are defined as the closed-loop interaction between pilot, aircraft, and data displays. The characterization of 'good' handling qualities in a consistent fashion is noted to be difficult due to variability in pilot ratings, which is in turn caused by differences in training, experience, task performance criteria, task evaluation, etc. It is concluded that a more complete understanding of handling qualities must await a more complete understanding of human dynamics. O.C.

A85-45042
INTEGRATED FLIGHT/PROPULSION CONTROL - HIDEC MODES
W. A. YONKE, R. J. LANDY, and J. M. CUSHING (McDonnell Aircraft Co., St. Louis, MO) IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 1 . New York, IEEE, 1984, p. 472-478.

In NASA's Highly Integrated Digital Electronic Control (HIDEC) program, the flight propulsion control modes designated Trajectory Control/Energy Management (TC/EM) and engine Variable Operating Line (VOL) mode will be implemented and tested aboard an F-15 aircraft. The TC/EM mode reduces intercept time, minimizes fuel usage, and maximizes endurance. The VOL mode increases aircraft acceleration and turn capability with increased thrust. Flight propulsion control integration has been effected through the installation of a Digital Electronic Flight Control System in the F-15 airframe, and Digital Engine Electronic Controls on the two PW1128 engines used by the F-15. TC/EM will also serve as a stepping stone to other trajectory control applications, such as terrain following and terrain avoidance. O.C.

A85-45044
AEROSERVOELASTIC MODELING METHODOLOGY FOR ACTIVE CONTROL SIMULATION
H. M. YOUSSEF and N. A. RADOVCICH (Lockheed-California Co., Burbank, CA) IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 1 . New York, IEEE, 1984, p. 487-494.

Attention is given to the aeroservoelastic modeling and analysis methodology employed in the design of digital Active Control Systems (ACSs) for aircraft load alleviation, elastic mode suppression, and handling and ride quality improvement, in the case of the final design stage; where such analytical procedures are crucial for the verification of an ACS's fulfillment of performance and safety criteria. The simulation presented can represent system nonlinearities, servo modeling, a six-degree-of-freedom aircraft,

sensor dynamics (which include aeroelastic effects), autopilot coupling, multichannel computation, and mechanism monitoring. The test data used are derived from the L-1011-500 aircraft's ACS development program. O.C.

A85-45048#
ROBUSTNESS ENHANCEMENT FOR LQG DIGITAL FLIGHT CONTROLLER DESIGN
P. S. MAYBECK, W. G. MILLER, and J. M. HOWEY (USAF, Institute of Technology, Wright-Patterson AFB, OH) IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 1 . New York, IEEE, 1984, p. 518-525. refs

Controllers designed by means of the LQG (Linear system Quadratic cost - Gaussian noise) methodology have the structure of a full-state feedback controller, but with states as estimated by a Kalman filter. Full-state feedback controllers vary in robustness, but all meet or exceed fundamental stability robustness guarantees, while insertion of the filter into the controller removes such guarantees. To enhance controller characteristics, implicit model-following is used to generate very robust full-state feedback laws, and then the filter is tuned in a particular manner to allow a symptotic recovery of these particularly good robustness properties. These two means of enhancement are applied to a specific digital flight controller design and their capabilities are assessed. Author

A85-45049
A ROBUST FLIGHT CONTROL DESIGN FOR THE C-135 AIRCRAFT HOROWITZ'S METHOD
R. W. BETZOLD (USAF, Washington, DC), I. M. HOROWITZ (Colorado, University, Boulder), and C. H. HOUPIS (USAF, Institute of Technology, Wright-Patterson AFB, OH) IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 1 . New York, IEEE, 1984, p. 526-533. refs

This paper demonstrates the design of a lateral flight controller for the C-135 aircraft using the Horowitz frequency response approach. A single controller is designed for the entire flight envelope of the aircraft from high speed, high altitude cruise to a low altitude approach condition. A three degree-of-freedom lateral model is reduced to a two degree-of-freedom model. The equations of motion assume a linearized aircraft model operating around equilibrium flight conditions allowing only small perturbations from equilibrium. Robustness of the design is guaranteed since the variations in flight parameters are considered throughout the entire design process. Robustness is demonstrated by simulating the compensated aircraft at the extremes of the flight envelope considered. Author

A85-45050
REAL-TIME ANALYSIS OF A DIGITAL MULTILOOP FLIGHT CONTROL SYSTEM
K. S. RATTAN and A. SARWAL (Wright State University, Dayton, OH) IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 1 . New York, IEEE, 1984, p. 534-539.
(Contract F33615-82-K-3603)

This paper investigates the hardware implementation of a flight controller for the longitudinal axis of the YF-16 aircraft. The real-time analysis of the digital multiloop control system was carried out by first digitizing the existing continuous controllers and subsequently implementing these digital controllers on a microprocessor. A software package was developed to perform the required control functions. The microprocessor system was interfaced to an analog computer on which the aircraft axis was implemented. The error contributors that influenced system performance were studied and the design was modified to reduce these errors. Pulse and frequency responses of the system outputs were obtained and a comparison of these results for different digitization method was made. Author

A85-45051
DESIGN OF DIRECT DIGITAL FLIGHT-MODE CONTROL SYSTEMS FOR HIGH-PERFORMANCE AIRCRAFT WITH MULTIPLE ACTUATOR NON-LINEARITIES
B. PORTER (Salford, University, England) IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 1 . New York, IEEE, 1984, p. 540-547. refs

The synthesis of discrete-time tracking systems incorporating Lur'e plants with multiple nonlinearities is illustrated in this paper by the design of fast-sampling digital controllers and associated inner-loop compensators for the automatic control of the longitudinal motions of the F-16 aircraft with both flaperon and elevator nonlinearities. In particular, it is demonstrated that fuselage pitch pointing and vertical translation maneuvers are readily achievable for large classes of nonlinear actuator characteristics such as 'deadzone' provided that the controller and transducer parameters are chosen so as to ensure that state-bounded absolutely stable tracking occurs. Author

A85-45052
DESIGN AND MICROPROCESSOR IMPLEMENTATION OF AN INTEGRATED LOAD ALLEVIATION-PITCH MANOEUVRE FLIGHT CONTROLLER FOR RELAXED STABILITY AIRCRAFT
A. BRADSHAW and S. E. BURGE (Salford, University, England) IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 1 . New York, IEEE, 1984, p. 550-557. refs

The design methodologies of Porter and Bradshaw (1981) for integrated digital flight control systems are used to design fast-sampling error-actuated digital controllers which effect pitch maneuvers while simultaneously alleviating wing loads induced by the maneuvers and by discrete gusts, in the case of a dynamically unstable transport/tanker aircraft. The closed-loop structure of such systems is analyzed in order to demonstrate, along with the presentation of real-time analog computer-microprocessor simulation results, that there is no fundamental difficulty in the design of such controllers for dynamically unstable aircraft. Author

A85-45053#
MULTIVARIABLE DIGITAL FLIGHT CONTROL DESIGN OF THE X-29A USING OUTPUT FEEDBACK
R. S. FELDMAN (USAF, Eglin AFB, FL) and J. J. DAZZO (USAF Institute of Technology, Wright-Patterson AFB, OH) IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 1 . New York, IEEE, 1984, p. 558-569. refs

Multivariable design using output feedback and a proportional plus integral controller are applied to the X-29A forward swept-wing aircraft. A linearized state-space aircraft model is used in a number of different flight conditions. The computer aided design program MULTI is used to develop the control laws. Separate longitudinal and lateral controllers are developed for each of eight maneuvers at five different flight conditions: 0.4 Mach, sea level; 0.9 Mach, 50k ft; 1.2 Mach, 15k ft; 0.7 Mach, 15k ft; and 0.9 Mach, sea level. A universal lateral controller that is effective for all maneuvers at all flight conditions is developed. Finally, a minimum gain universal lateral controller requiring only three distinct gains is developed which would reduce the gain scheduling usually required of flight controllers. Maximum possible maneuvers are performed without exceeding control input limitations. Author

A85-45054
SYNTHESIS OF DIRECT LIFT CONTROL LAWS VIA EIGENSTRUCTURE ASSIGNMENT
K. M. SOBEL, E. Y. SHAPIRO, and R. H. ROONEY (Lockheed-California Co., Burbank, CA) IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 1 . New York, IEEE, 1984, p. 570-575. refs

Recent advances in control technology provide the means of designing advanced multimode control laws which provide improved

weapon delivery capability and a reduced pilot workload. Direct lift control is of benefit both in offensive and defensive maneuvers and is presently an area of high research interest. In this paper, eigenstructure assignment is applied to an AFTI/F-16 aircraft model in order to design a direct lift controller. Author

A85-45055
QUANTITATIVE SYNTHESIS OF HIGHLY UNCERTAIN, MULTIPLE INPUT-OUTPUT, FLIGHT CONTROL SYSTEM FOR THE FORWARD SWEPT WING X-29 AIRCRAFT
J. G. WALKE (USAF, Washington, DC), I. M. HOROWITZ (Colorado, University, Boulder), and C. H. HOUPIS (USAF, Institute of Technology, Wright-Patterson AFB, OH) IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 1 . New York, IEEE, 1984, p. 576-583. refs

In this paper, the stabilization of multiple input multiple output (MIMO) unstable and nonminimum phase systems using the Singular G Method of Horowitz et al. (1983) is investigated. This method is not fully developed in the current literature, thus this paper aims to develop a straightforward procedure through its application to the forward swept wing experimental aircraft, the X-29. The said procedure is developed and applied only to the design of the longitudinal flight control system. The feedback loops are designed to make the equivalent loop transmission minimum phase and the closed-loop system stable with large enough stability margins to accommodate a range of flight conditions with a fixed set of inner loop compensation. Then a set of prefilters are chosen for each flight condition to achieve the desired closed-loop time responses for a 'vertical translation' maneuver. This type of maneuver is becoming the more popular or desired type for modern aircraft. The results of this investigation indicate that the 'Singular G Method' does indeed lead to larger stability margins than obtainable by use of Horowitz's (1978) 'Optimal Blending Method'. A fixed set of inner loop compensation is found which makes the equivalent loop transmission minimum phase and the closed-loop system stable. A separate set of prefilters is needed for each flight condition to achieve the desired closed-loop responses. This leads to a need for scheduled compensation and since the closed-loop response characteristics (not their stability) are sensitive to plant parameter variation, numerous operating points will have to be scheduled. Author

A85-45057
A CONTROL LAW FOR THE SELF-REPAIRING/DIGITAL FLIGHT CONTROL SYSTEM
T. SADEGHI and G. ROSENTHAL (Fairchild Republic Co., Farmingdale, NY) IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 1 . New York, IEEE, 1984, p. 591-595. refs

The self-repairing flight control is a concept to detect, isolate, and recover from failed or damaged elements in the flight control system. In this paper, 'a first cut' into the design of a multiinput, multioutput control law having a command augmentation system-type configuration applicable to self-repairable flight control systems is described. The control law is designed simultaneously for the feedback and command augmentation loops utilizing twice as many control surfaces than outputs to be tracked. The flight control system employing this control law becomes attractive when one or more control surfaces are inoperative. The linearized longitudinal model of the AFTI/F-16 is used to demonstrate the validity of the design. Author

A85-45063
THE USE OF RESIDUE ARITHMETIC FOR FAULT DETECTION IN A DIGITAL FLIGHT CONTROL SYSTEM
T. V. VU (Harris Corp., Government Aerospace Systems Div., Melbourne, FL) IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 1 . New York, IEEE, 1984, p. 634-638. refs

Residue arithmetic is well-known for its error-checking capability. However, residue number systems (RNS) are seldom used in fault-tolerant arithmetic units because of the complexity of difficult operations such as scaling, sign determination, magnitude comparison, overflow detection, etc. This paper presents a unified algorithm for error detection and for a broad range of residue-interacting operations in RNS. Since they now share a large common part of hardware, the latter operations can be conveniently preceded by an error check and carried out at a significantly reduced cost. Author

A85-45064
AN ADVANCED SIGNAL SELECTION ALGORITHM
C. SOETAERT (Boeing Military Airplane Co., Seattle, WA) IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 1 . New York, IEEE, 1984, p. 639-644.

An advanced algorithm which redundancy manages triplex flight control sensors through successive failures to the simplex operating level has been developed and lab tested. High integrity first and second fault isolation (referred to as coverage) of like sensors has been demonstrated in tests of the algorithm operating in a closed loop control system with a simulated high performance aircraft. Good coverage (99 percent) of the second fault in triplex sensor sets gives comparable reliability to quad-redundant sensors in a configuration that allows fault isolation only to the duplex level. The use of a triplex architecture in lieu of quadruplex allows substantial hardware complexity and life-cycle cost reduction. Author

A85-45065
TRIPLEX BUS-CONNECTED INTER-UNIT SELECTED FCS CONFIGURATION
M. E. MCSHARRY and M. D. MCFARLAND (Boeing Military Airplane Co., Seattle, WA) IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 1 . New York, IEEE, 1984, p. 645-651. refs

Reliability trade studies have demonstrated that increased reliability can be achieved by adopting a bus interconnected, distributed flight control system (DFCS) configuration. Interunit selection allows any sensor to be used by any flight control computer and extends this capability to include all possible combinations of computers, sensors, and actuators. Evaluation of the suitability of interunit selected architecture using buses conforming to MIL-STD-1553B as the control system buses is being performed in the Boeing Military Airplane Company Integrated Control Redundancy Management Laboratory (ICRML). This evaluation centers on the ability to handle the redundant aspects of the Digital Flight Control System which include bus loading, data latency and data skew. These aspects may affect system throughput, redundancy management of other DFCS elements, and the ability to redundancy manage the bus controller assignment as a result of failures in the controller hardware or the flight control computer associated with it. Author

A85-45066* Textron, Inc., Irvine, Calif.
A REVIEW OF FOREIGN TECHNOLOGY IN AIRCRAFT FLIGHT CONTROLS
M. D. HEWETT, H. A. REDIESS, E. C. BUCKLEY (Textron, Inc., Irvine, CA), and C. R. SPITZER (NASA, Langley Research Center, Hampton, VA) IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 1 . New York, IEEE, 1984, p. 652-659.

A survey of U.S. and foreign technology in aircraft flight controls was conducted for NASA Langley Research Center as a data base for planning future research and technology programs. The survey covers control and hardware configurations of major contemporary systems on operational aircraft, R&D flight programs, advanced aircraft developments and significant research and technology programs. This paper concentrates on the foreign technology elements and findings of the survey with primary emphasis on Western Europe, where most of the advanced technology resides. Author

A85-45155#
FLIGHT TEST OF A HELICOPTER FLY-BY-WIRE/LIGHT ACTUATION CONTROL SYSTEM
C. R. ABRAMS and S. T. DONLEY (U.S. Navy, Naval Air Development Center, Warminster, PA) IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 2 . New York, IEEE, 1984, p. 1321-1328. Army-supported research.

A highly failure-tolerant actuation system concept has been developed for use by advanced military helicopters which emphasizes inherent fail-operational capability and employs a simple analog monitoring circuit to achieve two-fail-operational capability. A fly-by-wire/fly-by-light control system is synthesized for the collective control axis of an AH-1S Cobra helicopter that has been modified through the addition of a four-blade rotor. Flight tests conducted with this helicopter have demonstrated the feasibility of the failure compensation features of the actuation system concept. O.C.

A85-45795* Massachusetts Inst. of Tech., Cambridge.
PERIODIC CONTROL OF THE INDIVIDUAL-BLADE-CONTROL HELICOPTER ROTOR
R. M. MCKILLIP, JR. (MIT, Cambridge, MA) (European Rotorcraft Forum, 10th, The Hague, Netherlands, Aug. 28-31, 1984) Vertica (ISSN 0360-5450), vol. 9, no. 2, 1985, p. 199-225. NASA-sponsored research. refs

This paper describes the results of an investigation into methods of controller design for linear periodic systems utilizing an extension of modern control methods. Trends present in the selection of various cost functions are outlined, and closed-loop controller results are demonstrated for two cases: first, on an analog computer simulation of the rigid out of plane flapping dynamics of a single rotor blade, and second, on a 4 ft diameter single-bladed model helicopter rotor in the MIT 5 x 7 subsonic wind tunnel, both for various high levels of advance ratio. It is shown that modal control using the IBC concept is possible over a large range of advance ratios with only a modest amount of computational power required. Author

A85-45876
GUIDANCE, NAVIGATION AND CONTROL CONFERENCE, SNOWMASS, CO, AUGUST 19-21, 1985, TECHNICAL PAPERS
Conference sponsored by AIAA. New York, AIAA, 1985, 849 p. For individual items see A85-45877 to A85-45968.

The papers presented in this volume provide an overview of recent theoretical and experimental research in the field of guidance, navigation, and control. Topics discussed include flying qualities in the time domain, space telescope moving target tracking, the role of robotics in space system operations, and the use of expert systems for adaptive control of large space structures. Papers are also presented on linear guidance laws for space missions, improved feedback algorithms for optimal maneuvers in vertical plane, wheel configurations for combined energy storage and attitude control systems, and application of adaptive control to space stations. V.L.

A85-45877*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
APPLICATION OF FREQUENCY DOMAIN HANDLING QUALITIES CRITERIA TO THE LONGITUDINAL LANDING TASK
S. K. SARRAFIAN and B. G. POWERS (NASA, Flight Research Center, Edwards, CA) IN: Guidance, Navigation and Control Conference, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 1-12. refs
(AIAA PAPER 85-1848)

Three frequency-domain handling qualities criteria have been applied to the observed data to correlate the actual pilot ratings assigned to generic transport configurations with stability augmentation during the longitudinal landing task. The criteria are based on closed-loop techniques using pitch attitude, altitude rate at the pilot station, and altitude at the pilot station as dominating control parameters during this task. It is found that most promising results are obtained with altitude control performed by closing an inner loop on pitch attitude and closing an outer loop on altitude. V.L.

A85-45878#
FLYING QUALITIES IN THE TIME DOMAIN
E. G. RYNASKI (Calspan Corp., Advanced Technology Center, Buffalo, NY) IN: Guidance, Navigation and Control Conference, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 13-20. refs
(AIAA PAPER 85-1849)

A specific response envelope criterion developed directly from the MIL-F-8785 data base is proposed for the short-term longitudinal response requirements of the Category C flight phase. The new criterion, the angle of attack time history response envelope, is validated by using flight test data from the LAHOS program and moving base ground simulator data of the NLR (The Netherlands) program. V.L.

A85-45879#
REDUCING LANDING DISPERSIONS THROUGH FLIGHT CONTROL IMPROVEMENTS ON A TURBOPROP-POWERED TRANSPORT AIRCRAFT (THE LOCKHEED HIGH TECHNOLOGY TEST BED)
E. S. BARLAND (Lockheed-Georgia Co., Marietta, GA) IN: Guidance, Navigation and Control Conference, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 21-29.
(AIAA PAPER 85-1850)

The effects on landing dispersion characteristics of approach speed, glideslope angle, and airframe and flight systems improvements were studied through a piloted, six-degree-of-freedom flight simulation program. Simulated landing approaches were flown in instrument meteorological conditions to a low breakout altitude, followed by transition to visual references for touchdown. Each touchdown was documented by attitude, sink rate, airspeed, and longitudinal and lateral displacement from aimpoint. Atmospheric conditions were appropriately divided among calm, turbulence, and crosswinds. Following acquisition of baseline data on a standard C-130H flying a normal ILS approach, initial configuration changes were introduced to allow a six-degree glideslope angle and a 20 percent reduction in approach speed. The landing footprint was reduced by more than half. Additional improvements, including stability augmentation, spoilers for roll control and direct lift control, and auto-throttles, produced further dramatic improvements in landing footprint. These configuration and system changes, to be implemented on the Lockheed High Technology Test Bed, are discussed. Simulation facilities, vehicle modeling, and pilot tasks are described. Landing dispersion data are presented. Author

A85-45880*# Purdue Univ., Lafayette, Ind.
CLOSED-LOOP, PILOT/VEHICLE ANALYSIS OF THE APPROACH AND LANDING TASK
D. K. SCHMIDT (Purdue University, West Lafayette, IN) and M. R. ANDERSON IN: Guidance, Navigation and Control Conference, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 30-38. refs
(Contract NAG4-1)
(AIAA PAPER 85-1851)

Optimal-control-theoretic modeling and frequency-domain analysis is the methodology proposed to evaluate analytically the handling qualities of higher-order manually controlled dynamic systems. Fundamental to the methodology is evaluating the interplay between pilot workload and closed-loop pilot/vehicle performance and stability robustness. The model-based metric for pilot workload is the required pilot phase compensation. Pilot/vehicle performance and loop stability is then evaluated using frequency-domain techniques. When these techniques were applied to the flight-test data for thirty-two highly-augmented fighter configurations, strong correlation was obtained between the analytical and experimental results. Author

A85-45881*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
IN-FLIGHT EVALUATION OF PURE TIME DELAYS IN PITCH AND ROLL
D. T. BERRY (NASA, Flight Research Center, Edwards, CA) IN: Guidance, Navigation and Control Conference, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 39-46. refs
(AIAA PAPER 85-1852)

An in-flight investigation of the effect of pure time delays in pitch and roll was undertaken. The evaluation tasks consisted of low lift-to-drag-ratio landings of various levels of difficulty and formation flying. The results indicate that the effect of time delay is strongly dependent on the task. In the pitch axis, in calm air, spot landings from a lateral offset were most strongly influenced by time delay. In the roll axis, in calm air, formation flying was most strongly influenced by time delay. However, when landings were made in turbulence, flying qualities in pitch were only slightly degraded, whereas in roll they were severely degraded. Author

A85-45882*# Systems Technology, Inc., Hawthorne, Calif.
INVESTIGATION OF LIMB-SIDESTICK DYNAMIC INTERACTION WITH ROLL CONTROL
D. E. JOHNSTON and D. T. MCRUER (Systems Technology, Inc., Hawthorne, CA) IN: Guidance, Navigation and Control Conference, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 47-57. refs
(Contract NAS2-11454)
(AIAA PAPER 85-1853)

A fixed-base simulation has been carried out to investigate and quantify limb/manipulator dynamics and interactions between the neuromuscular subsystem, force sensing sidestick configuration, high-gain command augmentation, and command filtering, and also to investigate possible relationships between these interactions and the roll ratchet phenomenon. The data obtained support the suggestion that the roll ratchet phenomenon is a closed-loop pilot-vehicle system interaction in which the pilot's neuromuscular system dynamics play a central role. Ratchet tendencies are shown to be most severe on force sensing sidestick manipulators with small stick deflections. V.L.

A85-45887#
ACTIVE AEROELASTIC OSCILLATION CONTROL ON THE F/A-18 AIRCRAFT
L. W. TRAME, L. E. WILLIAMS, and R. N. YURKOVICH (McDonnell Aircraft Co., St. Louis, MO) IN: Guidance, Navigation and Control Conference, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 94-104.
(Contract N00019-75-C-0424)
(AIAA PAPER 85-1858)

Testing during the Full Scale Development of the F/A-18 Hornet Strike Fighter revealed an unacceptable 5.0 to 6.0 Hz oscillation at low altitude and high speed when the aircraft was loaded with high pitch inertia stores on the outboard wing pylons and AIM-9 Sidewinder missiles on the wingtips. A structural-aerodynamic interaction mechanism is established to sustain the oscillations. It was shown that these oscillations were not reinforced by coupling through the control system and were not due to classical flutter. Attempts were made to solve the problem by biasing the normal orientation of the wing control surfaces and the AIM-9 wingtip missiles. This reduced the oscillations but did not completely eliminate them. An Active Oscillation Suppression System, using existing flight control system components, was developed, flight tested, and incorporated into the production control system to solve the problem. Author

A85-45888*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
DEVELOPMENT OF CONTROL LAWS FOR A FLIGHT TEST MANEUVER AUTOPILOT FOR AN F-15 AIRCRAFT
G. S. ALAG and E. L. DUKE (NASA, Flight Research Center, Edwards, CA) IN: Guidance, Navigation and Control Conference, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 105-110. refs
(AIAA PAPER 85-1859)

An autopilot can be used to provide precise control to meet the demanding requirements of flight research maneuvers with high-performance aircraft. This paper presents the development of control laws within the context of flight test maneuver requirements. The control laws are developed using eigensystem assignment and command generator tracking. The eigenvalues and eigenvectors are chosen to provide the necessary handling qualities, while the command generator tracking enables the tracking of a specified state during the maneuver. The effectiveness of the control laws is illustrated by their application to an F-15 aircraft to ensure acceptable aircraft performance during a maneuver. Author

A85-45889#
FLIGHT TEST EVALUATION OF ACTIVE RIDE CONTROL SYSTEM FOR TACTICAL AIRCRAFT
C. J. SCHERZ and P. B. TUCKER (McDonnell Aircraft Co., St. Louis, MO) IN: Guidance, Navigation and Control Conference, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 111-118. refs
(AIAA PAPER 85-1860)

Results of flight test evaluations of an active control gust alleviation system employing angle-of-attack as the primary command signal are given. The design goal for the system was to provide improved longitudinal ride qualities for low altitude high speed operations of tactical type aircraft. The flight test results show that the system provides significant ride improvement. Correlation of pilot comments and flight test acceleration measurements indicate that aircraft response to discrete, or sharp edge gusts is generally of more concern to the pilots than the aircraft response to continuous, or random turbulence. Discrete gusts that produce negative incremental accelerations at the pilot station prompted strongest adverse pilot comments. Consequently, primary effort was directed to reducing pilot station negative acceleration response to discrete, or near discrete gusts. The wing trailing edge flaps were used in conjunction with the aircraft stabilators as the gust alleviation system force/moment generators. A noseboom mounted high frequency response differential pressure transducer was used to measure angle-of-attack for the primary input command signal to the gust alleviation system. Author

A85-45890#
ASYMMETRIC AEROSERVOELASTIC MODELING FOR ACTIVE CONTROL SIMULATION
H. M. YOUSSEF (Lockheed-California Co., Burbank, CA) IN: Guidance, Navigation and Control Conference, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 119-123. refs
(AIAA PAPER 85-1861)

An asymmetric simulation of the aircraft Active Control System for load alleviation, elastic mode suppression, and handling qualities is described. The aeroservoelastic (ASE) model containing the structural representation, the unsteady aerodynamic function, and the actuation system was utilized. The simulation was used to study the maneuver load control, gust responses, skew effect between the computational channels, cross-channel monitors threshold, stability margins, and sensitivity of different system parameters. The ASE model provided the frequency responses and the gain and phase of the sensor signals for control surface deflection and gust input and their eigenvalues. A minimax curve fitting procedure was used to produce the transfer functions of these responses in the frequency range of interest. C.D.

A85-45909*# Texas Instruments, Inc., Lewisville.
OPTIMAL DISTURBANCE SUPPRESSION WITH APPLICATION TO WIND SHEAR
J. R. BROUSSARD (Texas Instruments, Inc., Lewisville) IN: Guidance, Navigation and Control Conference, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 291-300. refs
(Contract NAS1-17493)
(AIAA PAPER 85-1886)

A novel quadratic cost function composed of stochastic and deterministic contributions is used in the design of a digital flight control system for a small commercial jet with wind shear present. The optimal output feedback control design is configured to suppress the effect of the wind shear disturbance and maintain closed loop stability. A new algorithm is presented for finding the feedback gain. A proportional-integral control design with wind shear suppression is tested in a detailed nonlinear simulation of a commercial jet during the landing approach. Author

A85-45913#
DESIGN OF THE ROBUST FLIGHT CONTROL SYSTEM BY REALIZABLE LINEAR COMPENSATOR
T. KIMURA, E. TOKUDA, M. TAKAHAMA (Mitsubishi Heavy Industries, Ltd., Nagoya Aircraft Works, Japan), and R. TAGAWA (Hokkaido University, Sapporo, Japan) IN: Guidance, Navigation and Control Conference, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 334-341.
(AIAA PAPER 85-1897)

A method to design a robust flight control system with a constant gain compensator and constant closed loop transfer functions is described. The method is used to design a control augmentation system (CAS) for longitudinal flight control at Mach 0.9. Some factors influencing the response of the CAS to pilot command are examined, including actuator nonlinearity; gusts; sensor noise; and the variation of aerodynamic coefficients in different flight conditions. Some advantages of the proposed method in comparison with conventional methods are considered, including: the ability to independently specify the transfer functions between the reference input and the controlled variable; and linear feedback control. A block diagram of a realizable version of the linear compensator is provided. I.H.

A85-45914*# Kansas Univ., Lawrence.
SENSITIVITY ANALYSIS OF AUTOMATIC FLIGHT CONTROL SYSTEMS USING SINGULAR VALUE CONCEPTS
A. HERRERA-VAILLARD (Institute for Electrical Research, Cuernavaca, Mexico), J. PADUANO, and D. DOWNING (Kansas, University, Lawrence) IN: Guidance, Navigation and Control Conference, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 342-348. refs
(Contract NCC2-293)
(AIAA PAPER 85-1899)

A sensitivity analysis is presented that can be used to judge the impact of vehicle dynamic model variations on the relative stability of multivariable continuous closed-loop control systems. The sensitivity analysis uses and extends the singular-value concept by developing expressions for the gradients of the singular value with respect to variations in the vehicle dynamic model and the controller design. Combined with a priori estimates of the accuracy of the model, the gradients are used to identify the elements in the vehicle dynamic model and controller that could severely impact the system's relative stability. The technique is demonstrated for a yaw/roll damper stability augmentation designed for a business jet. Author

A85-45915#
USE OF THE PSEUDO-INVERSE FOR DESIGN OF A RECONFIGURABLE FLIGHT CONTROL SYSTEM
S. J. RAZA (Pakistan Aeronautical Complex, Attock, Pakistan) and J. T. SILVERTHORN (USAF, Test Pilot School, Edwards AFB, CA) IN: Guidance, Navigation and Control Conference, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 349-356. refs
(AIAA PAPER 85-1900)

A technique for the design of a reconfigurable flight control system using the pseudo-inverse is developed and applied. Each individual control surface is treated independently, resulting in coupling of the longitudinal and lateral-directional response. Linearized aircraft equations of motion are developed, taking into account the effect of this coupling. A basic flight control system is designed that is capable of generating generic longitudinal, lateral and directional commands. Using a transformation matrix, these generic inputs are defined as some linear combination of the available control surfaces. For each failure case considered, unique transformation matrices are developed using the pseudo-inverse and reconfiguration is achieved by implementing the appropriate transformation matrix. The design is tested against a six degree-of-freedom, nonlinear simulation. Reconfiguration achieved by this design is shown to provide desirable flying qualities in the event of one primary control surface failure. Response is also found to be good for parameter variation. Author

A85-45916#
QUANTITATIVE FEEDBACK DESIGN APPROACH TO ROBUST FLYING QUALITIES
P. WEI (Lockheed-Georgia Co., Marietta, GA) IN: Guidance, Navigation and Control Conference, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 357-365. refs
(AIAA PAPER 85-1902)

The quantitative feedback technique is applied in conjunction with the Neal-Smith criterion to pilot-in-the-loop flight control system design. The Neal-Smith criterion is reviewed, and the effects of pilot model uncertainties on the flying qualities are investigated. The variation in the pilot model parameters and the possible pilot compensation work are hypothesized as a set of pilot models, and these models are combined with the aircraft model to develop a set of uncertain control plants. The boundaries of the system performance requirements are specified based on the Neal-Smith criterion. The application of the quantitative feedback technique and the equivalent system approach to the shaping filter design and the resultant robust aircraft flying qualities are shown. C.D.

A85-45928*# California Univ., Berkeley.
MULTIVARIABLE CONTROL OF VTOL AIRCRAFT FOR SHIPBOARD LANDING
M. BODSON (California, University, Berkeley) and M. ATHANS (MIT, Cambridge, MA) IN: Guidance, Navigation and Control Conference, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 473-481. refs
(Contract NGL-22-009-124; NAG2-243; NAG2-237)
(AIAA PAPER 85-1928)

The problem of the automatic landing of VTOL aircraft on small ships is considered. Linear quadratic optimal control theory is used to design a VTOL ship motion tracking controller. Optimal root-loci and step responses are obtained to study the dynamics of the closed-loop system. Standard deviations of the ship motion tracking errors, and of the VTOL control amplitudes are computed, illustrating the tradeoff between accurate tracking, and limited control authority. Multivariable robustness margins are also obtained. The tracking of the vertical motion presents the difficulty of requiring large variations of the VTOL total thrust, a control which is limited both in amplitude and in bandwidth. Lateral controls are less restricted, but the motions are strongly coupled, with some adverse couplings in the ship motions, and in the aircraft dynamics. The advantage of the LQ control theory is demonstrated however, by its ability to account for these couplings in a robust

manner, and, when possible, to use them to limit the control amplitudes. Author

A85-45935*# California Univ., Davis.
IDENTIFICATION OF PILOT DYNAMICS FROM IN-FLIGHT TRACKING DATA
R. A. HESS (California, University, Davis) and M. A. MNICH IN: Guidance, Navigation and Control Conference, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 554-563. NASA-sponsored research. refs
(AIAA PAPER 85-1945)

Data from a representative flight task involving an F-14 'pursuer' aircraft tracking a T-38 'target' aircraft in a 3G wind-up turn and in level flight are processed using a least squares identification technique in an attempt to identify pilot/vehicle dynamics. Comparative identification results are provided by a Fourier coefficient method which requires a carefully designed and implemented input consisting of a sum of sinusoids. The least-squares results compare favorably with those obtained by the Fourier technique. An example of crossover frequency regression is discussed in the light of the conditions of one of the flight configurations. V.L.

A85-45936#
HANDLING-QUALITIES INVESTIGATION OF CONVENTIONAL HELICOPTER DIRECTIONAL CONTROL CHARACTERISTICS
C. C. BIVENS (U.S. Army, Aeromechanics Laboratory, Moffett Field, CA) IN: Guidance, Navigation and Control Conference, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 564-580. refs
(AIAA PAPER 85-1947)

A piloted simulation was conducted to investigate the directional stability and control characteristics of selected single-main-rotor/tail-rotor configurations under various wind and turbulence conditions. The objective was to model the first-order effects contributing to the loss of tail-rotor control experienced by pilots of the OH-58 series aircraft and to investigate the handling-qualities parameters that reduce or eliminate tail-rotor control problems. A simple tail-rotor model predicts the reduction in yaw damping and control power at certain relative wind azimuth angles which contribute to a loss of directional control. For the specified flight task, a loss of directional control occurred only for tail winds and quartering tail winds greater than 20 knots. For wind speeds greater than 20 knots, configurations with larger values of yaw damping were less susceptible to a loss of directional control; for winds greater than 30 knots, lower values of weathercock stability also had a beneficial effect. V.L.

A85-45954*# Draper (Charles Stark) Lab., Inc., Cambridge, Mass.
THE APPLICATION OF THE DETECTION FILTER TO AIRCRAFT CONTROL SURFACE AND ACTUATOR FAILURE DETECTION AND ISOLATION
W. F. BONNICE, E. WAGNER, P. MOTYKA (Charles Stark Draper Laboratories, Inc., Cambridge, MA), and S. R. HALL (MIT, Cambridge, MA) IN: Guidance, Navigation and Control Conference, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 732-740. Research supported by the Fannie and John Hertz Foundation. refs
(Contract NAS1-17556)
(AIAA PAPER 85-1973)

The performance of the detection filter in detecting and isolating aircraft control surface and actuator failures is evaluated. The basic detection filter theory assumption of no direct input-output coupling is violated in this application due to the use of acceleration measurements for detecting and isolating failures. With this coupling, residuals produced by control surface failures may only be constrained to a known plane rather than to a single direction. A detection filter design with such planar failure signatures is presented, with the design issues briefly addressed. In addition, a modification to constrain the residual to a single known direction even with direct input-output coupling is also presented. Both the detection filter and the modification are tested using a nonlinear aircraft simulation. While no thresholds were selected, both filters demonstrated an ability to detect control surface and actuator failures. Failure isolation may be a problem if there are several control surfaces which produce similar effects on the aircraft. In addition, the detection filter was sensitive to wind turbulence and modeling errors. Author

A85-45955#
TOTALLY ROBUST CONTROL - A NEW CONCEPT FOR DESIGN OF FLIGHT CONTROL SYSTEMS
A. C. ROBINSON (Battelle Columbus Laboratories, Columbus, OH) IN: Guidance, Navigation and Control Conference, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 741-745.
(AIAA PAPER 85-1974)

A radically different design methodology is suggested, which makes use of the recent control and response histories to predict what effect future control changes will have. This is coupled with a technique for local determination of the desired response to provide a control algorithm which can adapt in a fraction of a second to extreme changes in characteristics of the controlled system, such as reversal of the control effectiveness. The new type of controller is nonlinear, but it can produce responses very similar to those of linear systems, if that is desired. The capabilities are illustrated with simulation results involving a variety of second-order linear and nonlinear systems. Author

A85-45956#
IMPROVED FEEDBACK ALGORITHMS FOR OPTIMAL MANEUVERS IN VERTICAL PLANE
J. SHINAR (Technion - Israel Institute of Technology, Haifa) and V. FAINSTEIN IN: Guidance, Navigation and Control Conference, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 746-756. refs
(AIAA PAPER 85-1976)

In this paper a modified feedback algorithm is presented for time-optimal medium-range interception in the vertical plane. The basis of this new uniformly valid control approximation has been the critical analysis of the apparent deficiencies exhibited by previously used zeroth-order control laws developed by singular perturbation methods. The proposed modified algorithm corrects the observed deficiencies by combining reformulated singular perturbation models with heuristic control engineer concepts without hurting the attractiveness of the feedback control scheme for real-time implementation. Numerical examples indicate a substantial improvement in the control behavior, as well as in the pay-off, compared to a previous algorithm. Author

A85-45965#
STABILITY OF ADAPTIVE CONTROL ALGORITHMS - THEORETICAL EXAMINATION AND SIMULATION FOR F-4 FLIGHT CONTROL
B. K. WALKER (MIT, Cambridge, MA) and J. A. COETSEE IN: Guidance, Navigation and Control Conference, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 821-827. Research supported by the Charles Stark Draper Laboratory, Inc. refs
(AIAA PAPER 85-1966)

A theoretical examination is made of three types of parameter estimation schemes employed as components in adaptive control algorithms. This examination shows that when bounded disturbances are present the parameter estimation error of these schemes is restricted to a bounded hypersphere in the parameter space when the reference input to the closed loop system is sufficiently rich. This implies that the closed loop adaptive control system will remain stable if this hypersphere is sufficiently small and the input is sufficiently rich. Further examination shows that intermittent batch parameter estimation yields the fastest convergence of the parameter estimates in the adaptive control setting. Two adaptive control schemes based upon batch parameter estimation are then suggested and their performance compared to a representative nonintermittent scheme and two 'covariance resetting' schemes. Finally, a brief description is given of a

computer simulation study of these adaptive control strategies for flight control of the F-4 aircraft. Author

A85-45967#
DIGITAL COMPUTER ARCHITECTURE AS APPLIED TO AN ADVANCED FLIGHT CONTROL SYSTEM
A. R. DIETRICH and F. J. THOMAS (Allied Bendix Aerospace, Bendix Flight Systems Div., Teterboro, NJ) IN: Guidance, Navigation and Control Conference, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 836-841.
(AIAA PAPER 85-1949)

This paper discusses the architecture of a redundant digital computer in an advanced flight control application. System architecture and level of redundancy is driven by the failure survivability requirements of a particular aircraft application. The architecture of a single digital channel in a redundant flight control system is presented and shown to be applicable with minimal design changes to various system applications with different levels of redundancy. The high performance computation section is presented along with the parallel I/O processing and redundancy management functions. Applications of this architecture are discussed along with the enhancements in technology that have been integrated into the architecture during the maturity and miniaturization of the design. Also discussed are future architecture enhancements which will include the incorporation of VHSIC technology and the use of high speed data busses to reduce the present high I/O requirements of Flight Control applications. Author

A85-45970*# Purdue Univ., Lafayette, Ind.
FLIGHT CONTROL LAW SYNTHESIS FOR AN ELASTIC VEHICLE BY EIGENSPACE ASSIGNMENT
D. K. SCHMIDT and J. B. DAVIDSON (Purdue University, West Lafayette, IN) AIAA, Guidance, Navigation and Control Conference, Snowmass, CO, Aug. 19-21, 1985. 49 p. refs
(Contract NAG1-254)
(AIAA PAPER 85-1898)

Eigenspace assignment is explored as a control-law synthesis approach for 'shaping' the transient response of an elastic aircraft. A direct technique is utilized for synthesizing a full-state- as well as a reduced-order-output-feedback control law and the selection of the desired eigenspace is discussed. Robustness issues and results are evaluated and robustness recovery with full state estimation is demonstrated. Also, an appropriate implementation of state estimation to preserve the desired transient response (or desired eigenspace) is presented. Problems regarding actuator bandwidth and unmodeled modes are noted. Author

A85-45974#
DESIGN OF FAST NON-INTERACTING DIGITAL FLIGHT-MODE CONTROL SYSTEMS FOR HIGH-PERFORMANCE AIRCRAFT
B. PORTER, T. MANGANAS (Salford, University, England), and A. MANGANAS AIAA, Guidance, Navigation and Control Conference, Snowmass, CO, Aug. 19-21, 1985. 8 p. refs
(Contract AF-AFOSR-85-0208; SERC-GR/C/77653)
(AIAA PAPER 85-1903)

In order to remove all 'slow' modes from plant outputs, discrete-time tracking systems incorporating fast-sampling error-actuated digital PID controllers are introduced. It is shown that the resulting discrete-time tracking systems exhibit set-point tracking characteristics which are both fast and noninteracting of the kind previously achievable only for regular multivariable plants with full-rank first Markov parameters. These general results are used to design fast noninteracting direct digital flight-mode control systems for the F-16 aircraft which successfully effect pitch pointing and vertical translation maneuvers. Author

A85-45976*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
DEVELOPMENT AND VALIDATION OF A GENERAL PURPOSE LINEARIZATION PROGRAM FOR RIGID AIRCRAFT MODELS
E. L. DUKE and R. F. ANTONIEWICZ (NASA, Flight Research Center, Edwards, CA) AIAA, Guidance, Navigation and Control Conference, Snowmass, CO, Aug. 19-21, 1985. 12 p. refs
(AIAA PAPER 85-1891)

This paper discusses a FORTRAN program that provides the user with a powerful and flexible tool for the linearization of aircraft models. The program LINEAR numerically determines a linear systems model using nonlinear equations of motion and a user-supplied, nonlinear aerodynamic model. The system model determined by LINEAR consists of matrices for both the state and observation equations. The program has been designed to allow easy selection and definition of the state, control, and observation variables to be used in a particular model. Also, included in the report is a comparison of linear and nonlinear models for a high-performance aircraft. Author

A85-46327*# Princeton Univ., N. J.
ANALYSIS OF AIRCRAFT CONTROL STRATEGIES FOR MICROBURST ENCOUNTER
R. F. STENGEL (Princeton University, NJ) and M. L. PSIAKI Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 8, Sept.-Oct. 1985, p. 553-559. FAA-supported research. Previously cited in issue 06, p. 724, Accession no. A84-17967. refs
(Contract NGL-31-001-252)

A85-46339#
APPLICATION OF A NEW MULTIVARIABLE MODEL-FOLLOWING METHOD TO DECOUPLED FLIGHT CONTROL
K. KANAI (Defense Academy, Kanagawa, Japan), P. N. NIKIFORUK (Saskatchewan, University, Saskatoon, Canada), S. UCHIKADO, and N. HORI Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 8, Sept.-Oct. 1985, p. 637-643. refs

A new model-following controller for multivariable, linear, time-invariant systems is described and applied to the decoupled longitudinal control of a control-configured-vehicle-type aircraft. The controller is composed of an input dynamics compensator and a state feedback block. This approach enables decoupling and control of systems that cannot be done by state feedback alone. The key concept is that of system augmentation by utilizing a unimodular matrix to assure the nonsingularity of a control matrix. Two methods of generating the control input are described. In the first, the control input is synthesized by explicitly using the plant state variables. In the second, the input and output of the plant are used. Author

A85-47031#
AN INVESTIGATION OF FLYING QUALITIES REQUIREMENTS FOR A STOL FIGHTER IN APPROACH AND LANDING
K. D. CITURS and J. H. CATON (McDonnell Aircraft Co., St. Louis, MO) AIAA, Atmospheric Flight Mechanics Conference, 12th, Snowmass, CO, Aug. 18-21, 1985. 8 p.
(AIAA PAPER 85-1807)

In the first phase of a simulation study conducted to examine the flying quality requirements of fighter aircraft engaged in precision maneuvers for short takeoff and landing, the primary purpose was the determination of the range of acceptable longitudinal and lateral-directional dynamics in landing, as well as the desirability of the blending of direct lift and direct side force modes with conventional aircraft responses. The second phase of the study investigated the effect of tighter task and touchdown requirements, while expanding the longitudinal data base employed in the first phase. O.C.

N85-32122*# National Aeronautics and Space Administration. Dryden (Hugh L.) Flight Research Center, Edwards, Calif.
DEVELOPMENT AND VALIDATION OF A GENERAL PURPOSE LINEARIZATION PROGRAM FOR RIGID AIRCRAFT MODELS
E. L. DUKE and R. F. ANTONIEWICZ Aug. 1985 14 p refs Presented at the AIAA Guidance, Navigation, and Control Conf., Snowmass, Colo., 19-21 Aug. 1985
(NASA-TM-86737; H-1295; NAS 1.15:86737; AIAA-85-1891) Avail: NTIS HC A02/MF A01 CSCL 01C

A FORTRAN program that provides the user with a powerful and flexible tool for the linearization of aircraft models is discussed. The program LINEAR numerically determines a linear systems model using nonlinear equations of motion and a user-supplied, nonlinear aerodynamic model. The system model determined by LINEAR consists of matrices for both the state and observation equations. The program has been designed to allow easy selection and definition of the state, control, and observation variables to be used in a particular model. Also, included in the report is a comparison of linear and nonlinear models for a high performance aircraft. Author

N85-32123*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
IN-FLIGHT EVALUATION OF PURE TIME DELAYS IN PITCH AND ROLL
D. T. BERRY Aug. 1985 11 p refs Presented at the AIAA Conf., Snowmass, Colo., 19-21 Aug. 1985
(NASA-TM-86744; H-1308; NAS 1.15:86744) Avail: NTIS HC A02/MF A01 CSCL 01C

An in-flight investigation of the effect of pure time delays in pitch and roll was undertaken. The evaluation tasks consisted of low lift-to-drag-ratio landings of various levels of difficulty and formation flying. The results indicate that the effect of time delay is strongly dependent on the task. In the pitch axis, in calm air, spot landings from a lateral offset were most strongly influenced by time delay. In the roll axis, in calm air, formation flying was most strongly influenced by time delay. However, when landings were made in turbulence, flying qualities in pitch were only slightly degraded, whereas in roll they were severely degraded. Author

N85-32125# National Aeronautical Establishment, Ottawa (Ontario).
A PRELIMINARY INVESTIGATION OF HANDLING QUALITIES REQUIREMENTS FOR HELICOPTER INSTRUMENT FLIGHT DURING DECELERATING APPROACH MANEUVERS AND OVERSHOOT
S. KERELIUK and M. MORGAN Feb. 1985 35 p
(AD-A154650; NAE-AN-26; NRC-24173) Avail: NTIS HC A03/MF A01 CSCL 01B

This investigation was carried out to highlight deficiencies of helicopters handling qualities when performing low speed instrument approaches. Steep decelerating MLS (Microwave Landing System) approaches to a decision height of 50 feet, simultaneously decelerating to 20 knots, were perfromed in an airborne simulator - a variable-stability Bell 205A helicopter. Tracking performance, in terms of height, azimuth and speed errors was of an acceptable standard, but pilot workload was extremely high, especially during the overshoot phase. Benefits of different levels of control system augmentation were not readily apparent in this high workload environment. In view of the results of this investigation, a follow-on program is proposed where further attempts will be made to determine the effects of display and control sophistication on pilot workload during slow-speed helicopter instrument procedures. GRA

N85-33122*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
DEVELOPMENT OF CONTROL LAWS FOR A FLIGHT TEST MANEUVER AUTOPILOT FOR AN F-15 AIRCRAFT
G. S. ALAG and E. L. DUKE Aug. 1985 9 p refs Presented at the AIAA Conf., Snowmass, Colo., 19-21 Aug. 1985
(NASA-TM-86736; H-1294; NAS 1.15:86736) Avail: NTIS HC A02/MF A01 CSCL 01C

An autopilot can be used to provide precise control to meet the demanding requirements of flight research maneuvers with high-performance aircraft. The development of control laws within the context of flight test maneuver requirements is discussed. The control laws are developed using eigensystem assignment and command generator tracking. The eigenvalues and eigenvectors are chosen to provide the necessary handling qualities, while the command generator tracking enables the tracking of a specified state during the maneuver. The effectiveness of the control laws is illustrated by their application to an F-15 aircraft to ensure acceptable aircraft performance during a maneuver. R.J.F.

N85-33123*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
FLIGHT TEST EXPERIENCE AND CONTROLLED IMPACT OF A LARGE, FOUR-ENGINE, REMOTELY PILOTED AIRPLANE
R. W. KEMPEL and T. W. HORTON Aug. 1985 17 p refs Presented at the SFTE 16th Ann. Symp., Seattle, 29 Jul. - 2 Aug. 1985
(NASA-TM-86738; H-1298; NAS 1.15:86738) Avail: NTIS HC A02/MF A01 CSCL 01C

A controlled impact demonstration (CID) program using a large, four engine, remotely piloted transport airplane was conducted. Closed loop primary flight control was performed from a ground based cockpit and digital computer in conjunction with an up/down telemetry link. Uplink commands were received aboard the airplane and transferred through uplink interface systems to a highly modified Bendix PB-20D autopilot. Both proportional and discrete commands were generated by the ground pilot. Prior to flight tests, extensive simulation was conducted during the development of ground based digital control laws. The control laws included primary control, secondary control, and racetrack and final approach guidance. Extensive ground checks were performed on all remotely piloted systems. However, manned flight tests were the primary method of verification and validation of control law concepts developed from simulation. The design, development, and flight testing of control laws and the systems required to accomplish the remotely piloted mission are discussed. Author

N85-33124*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
APPLICATION OF FREQUENCY DOMAIN HANDLING QUALITIES CRITERIA TO THE LONGITUDINAL LANDING TASK
S. K. SARRAFIAN and B. G. POWERS Aug. 1985 15 p refs Presented at the AIAA Guidance, Navigation, and Control Conf., Snowmass, Colo., 19-21 Aug. 1985
(NASA-TM-86728; H-1288; NAS 1.15:86728; AIAA-PAPER-85-1848) Avail: NTIS HC A02/MF A01 CSCL 01C

Under NASA sponsorship, an in-flight simulation of the longitudinal handling qualities of several configurations for the approach and landing tasks was performed on the USAF/AFWAL Total In-Flight Simulator by the Calspan Corporation. The basic configuration was a generic transport airplane with static instability. The control laws included proportional plus integral gain loops to produce pitch-rate and angle-of-attack feedback loops. The evaluation task was a conventional visual approach to a flared touchdown at a designated spot on the runway with a lateral offset. The general conclusions were that the existing criteria are based on pitch-attitude response and that these characteristics do not adequately discriminate between the good and bad configurations of this study. This paper describes the work that has been done to further develop frequency-based criteria in an

effort to provide better correlation with the observed data.
Author

N85-33125*# Calspan Advanced Technology Center, Buffalo, N.Y.
THE INTERPRETATION OF FLYING QUALITIES REQUIREMENTS FOR FLIGHT CONTROL SYSTEM DESIGN Final Report, Feb. 1984 - Mar. 1985
E. G. RYNASKI Aug. 1985 88 p refs
(Contract NASA ORDER L-65611B; F33615-83-C-3603)
(NASA-CR-177942; REPT-7205-8; NAS 1.26:177942) Avail: NTIS HC A05/MF A01 CSCL 01C

An experimental flight test program was designed for the Total In Flight Simulator (TIFS) directed toward the interface between flying qualities requirements and flight control system design criteria. The eventual goal is to provide an interpretation or translation of flying qualities requirements for use by the flight control system designer. Specifically, an angle of attack and pitch rate command system matrix involving both short term and long term dynamics are specified for evaluation. Flying qualities criteria and flight control system configuration or architecture can be independent was demonstrated. Finally, additional configurations are proposed to evaluate the efficacy of dynamic decoupling. Author

09

RESEARCH AND SUPPORT FACILITIES (AIR)

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

A85-43870*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ROTARY-BALANCE EXPERIMENTS ON A MODERN FIGHTER AIRCRAFT CONFIGURATION AT HIGH REYNOLDS NUMBERS
G. N. MALCOLM (NASA, Ames Research Center, Moffett Field, CA) IN: Atmospheric Flight Mechanics Conference, 12th, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 462-482.
(AIAA PAPER 85-1829)

NASA Ames Research Center's research program to investigate high-angle-of-attack aerodynamic phenomena associated with high-performance aircraft includes the development and use of rotary balance apparatuses for wind balance apparatuses for wind tunnel tests of airplane models in a coning motion. A large scale apparatus, developed for testing models at high Reynolds numbers in the Ames 12-Foot Pressure Wind Tunnel, was recently tested with an 0.05-scale F-15 fighter model. Measurements were made at low subsonic Mach numbers and chord Reynolds numbers of 1 to 5.5 million, with angles of attack from 0 to 90 deg and sideslip angles from -15 to +15 deg. Effects of Reynolds number, spin-rate parameter, model attitude, presence of a nose boom, and model/sting mounting angle were investigated. Author

A85-44049
CAPABILITIES OF THE HIGH SPEED ANECHOIC WIND TUNNEL AT LYON UNIVERSITY [PERFORMANCES DE LA SOUFFLERIE ANECHOIQUE A GRANDES VITESSES DE L'ECOLE CENTRALE DE LYON]
M. SUNYACH, B. BRUNEL, and G. COMTE-BELLOT (Lyon, Ecole Centrale, Lyons, France) Revue d'Acoustique, vol. 18, no. 73, 1985, p. 316-330. In French. Research supported by the Etablissement Public Regional de Rhone-Alpes, Ecole Centrale de Lyon, Delegation a l'Amenagement du Territore et a l'Action Regionale, DGRST, and CNRS. refs

The characteristics of the feed duct, the wind tunnel and the experiments run in the convergent-divergent anechoic wind tunnel at Lyon University are described. The wind tunnel was designed to eliminate noise from the entrance of air or from flow interactions with the tunnel walls so that noise caused by the flow-test structure interactions can be studied. The channel contains 1 x 1 x 0.2 m glass and metal foil baffles spaced 0.2 m apart. The flow is forced by a 350 kW fan in the primary circuit, and a 110 kW blower in the secondary circuit. The primary circuit features a factor of four throat reductions, followed by a 1.6 reduction before the test section. Upstream and downstream sensors permit monitoring of the anechoic effectiveness of the channel. Other sensors allow modeling of the flow structures in the tunnel. The tunnel has been used to examine turbulent boundary layers in flows up to 140 m/sec, turbulence-excited vibrations in walls, and the effects of laminar and turbulent flows on the appearance and locations of noise sources. M.S.K.

A85-44750
GETTING HOOKED
K. WALKER Flight International (ISSN 0015-3710), vol. 128, Aug. 3, 1985, p. 24-26.

The proposed British Skyhook project is a crane which can capture the Harrier in the hover position and place it where necessary. The crane has an active control system and sensors in order to stabilize the pickup mechanism when the base of the crane moves due to the ship's movement. The average h.p. necessary for the crane to operate is 500. Considering a ship speed of 15 kt. and accounting for vertical motion, 750 h.p. is required and for lateral motion 1300 h.p. is needed. In order for the aircraft to be captured the pilot must position it within the 10 ft cube capture window. When the vehicle is in position the IR system of the crane automatically detects its presence and the lock-on jack and pick-up probe are activated. The pilot reduces power, but maintains altitude and the lock-on jack draws the aircraft into the docking cradle. An internal lock is then engaged and the vehicle can be idled or shut down. To launch the aircraft it is swung out from the hangar, the engine is started and the lock-on jack extended. The pilot increases power until hover is reached and then the lock-on jack releases the aircraft and retracts. I.F.

A85-45117
REALISM PROVIDED IN A PROCEDURAL TRAINER
D. G. HERR (Honeywell, Inc., West Covina, CA) IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 2 . New York, IEEE, 1984, p. 1034-1037.

A procedural trainer provides training in adherence to checkout and trouble-shooting procedures by monitoring the student and giving feedback on errors as they occur. Often this type of trainer has a lack of realism necessary for the transfer of training to real life situations. In the F-15 Aircraft Maintenance Trainer models were overlaid on a procedural architecture providing the benefits of a procedural trainer along with modeled simulation. The procedural simulation and student monitoring is controlled by a data base containing the encoded procedures. The data base is easily modified so the reaction of the trainer including the models, to some extent, can be quickly adjusted to provide the most realistic simulation. Author

A85-45118
COST EFFECTIVENESS OF SIMULATED AIRCRAFT MAINTENANCE TRAINING SYSTEMS
D. W. COUCH and E. H. STEVENS (Honeywell, Inc., West Covina, CA) IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 2 . New York, IEEE, 1984, p. 1038-1043.

Previous studies have shown that maintenance training using Simulated Aircraft Maintenance Trainers (SAMTs) produces technicians that are as adequately trained for Flight Line Maintenance as those that are trained using operational aircraft. Based on these findings, a model has been prepared to assess the cost effectiveness of the SAMTs. Data detailing actual equipment usage prior to F-15 and F-16 SAMT installation and usage after the SAMT installation is evaluated. The results of this evaluation lead to a straightforward model that can be used to

determine the cost savings that are realized through deployment of SAMTs to Air Force bases. Author

A85-45119
EVALUATION OF DEFENSE MAPPING AGENCY LEVEL V HIGH RESOLUTION DATA FOR TRAINING SIMULATOR APPLICATIONS
M. R. NICOL (USAF, Aeronautical Systems Div., Wright-Patterson AFB, OH), G. A. GUTOWSKI, and C. E. WRIGHT (General Electric Co., Daytona Beach, FL) IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 2 . New York, IEEE, 1984, p. 1048-1056.

The U.S. Air Force Aeronautical Systems Division's Visual and Avionics Simulation Branch has undertaken an evaluation of the suitability of the Defense Mapping Agency's 'Level V' high resolution data base, which furnishes increased feature density, novel feature types, and new classes of data, for simulator applications. Attention is given to a visual evaluation in which visual data bases were generated for each of five Level V sample geographical areas; these were subsequently displayed on a real time simulator visual system to assess dynamic simulation adequacy. O.C.

A85-45124
REAL TIME SIMULATION OF AIRBORNE RADAR SYSTEMS
R. A. WEEKS (Northrop Corp., Pico Rivera, CA) IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 2 . New York, IEEE, 1984, p. 1083-1088.

Attention is given to the simulation of the search, imaging, and tracking modes of both air-to-air and air-to-ground airborne radar systems. The importance of such simulations has been enhanced by the increasing complexity and versatility of current and projected airborne radars. Emphasis is presently given to the 'human engineering' aspects of radar system design which ensure effective operator interaction, such as the critical display of radar operational status data to crew members when the autonomous execution of radar operations must be considered in addition to crew interactions. O.C.

A85-45971#
THE COLLINS AFDS MAINTENANCE SYSTEM FOR THE BOEING 757/767
J. E. GRUETTNER (Rockwell International Corp., Cedar Rapids, IA) AIAA, Guidance, Navigation and Control Conference, Snowmass, CO, Aug. 19-21, 1985. 5 p.
(AIAA PAPER 85-1911)

The AFDS maintenance provides a flight line maintenance capability for fault detection and fault isolation. A capability is provided for squawk related testing of a Line Replaceable Unit (LRU). These tests verify operation of the LRU and the establishment of interfaces to that LRU. The Maintenance System contains a self test capability. The Maintenance Control and Display Panel (MCDP) is the centralized maintenance computer located in the equipment bay. The MCDP contains buttons to initiate tests and respond to simple questions and contains a display sufficient for communicating abbreviated English language messages. In flight, only faults known to create a Flight Deck Effect are reported. Each of the flight computers provide fault reporting and ground test capability. They provide maintenance data to the MCDP via ARINC 429 Buses. Author

A85-45972#
JA-37 DIGITAL AUTOMATIC FLIGHT CONTROL SYSTEM (DAFCS) OPERATIONAL MAINTENANCE EXPERIENCE
D. G. BAILEY (Honeywell Systems and Research Center, Minneapolis, MN) and C. O. CARLSSON (Saab-Scania, Linkoping, Sweden) AIAA, Guidance, Navigation and Control Conference, Snowmass, CO, Aug. 19-21, 1985. 7 p.
(AIAA PAPER 85-1913)

The Digital Automatic Flight Control System (DAFCS) used on the Saab-Scania JA-37 Viggen Interceptor is described, with attention given to its functional configuration, mechanization, and operational maintenance test experience. It is noted that the JA-37 DAFCS contains comprehensive in-flight and pre-flight built-in test (BIT) provisions to support effective maintenance. The DAFCS mean time between failures exceeds the time predicted (102.4 flight-hr versus 41.4 hr); the total flight maintenance time equals 0.02 maintenance personnel hr/flight-hr; BIT erroneous fault indications are equal to the predicted value of 40 percent. V.L.

10

ASTRONAUTICS

Includes astronautics (general); astrodynamics; ground support systems and facilities (space); launch vehicles and space vehicles; space transportation; spacecraft communications, command and tracking; spacecraft design, testing and performance; spacecraft instrumentation; and spacecraft propulsion and power.

A85-43863*# Michigan Univ., Ann Arbor.
EFFECT OF MAXIMUM LIFT TO DRAG RATIO ON OPTIMAL AEROASSISTED PLANE CHANGE
J. R. JOHANNESEN, N. X. VINH (Michigan, University, Ann Arbor), and K. D. MEASE (California Institute of Technology, Jet Propulsion Laboratory, Pasadena) IN: Atmospheric Flight Mechanics Conference, 12th, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 399-407. refs
(Contract JPL-956416)
(AIAA PAPER 85-1817)

The influence of the maximum lift-to-drag ratio on the turning performance of an Orbital Transfer Vehicle is analyzed. Chapman's variables are used to formulate the equations of motion which are valid for both atmospheric flight and flight in a vacuum in a Newtonian gravitational field. Of the six adjoint variables involved in the variational formulation, four exact integrals and two approximate relations are obtained. This leads to an approximate but explicit control law for the lift and bank control. The control law is tested numerically for a whole range of entry speeds, from parabolic entry to near-circular entry with several values of maximum lift-to-drag ratio. The extensive numerical results, which are very accurate as compared to the exact optimal values, show that the maximum plane change for any speed ratio V(entry)/V(final) is simply proportional to the maximum lift-to-drag ratio, and depends solely on this parameter. Author

A85-43865*# Texas Univ., Austin.
NEW ANALYTICAL RESULTS FOR AOTV GUIDANCE
D. G. HULL (Texas, University, Austin) IN: Atmospheric Flight Mechanics Conference, 12th, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 416-420.
(Contract NAS7-100)
(AIAA PAPER 85-1820)

Minimum energy-loss turns of an Aero-assisted, Orbital Transfer Vehicle (AOTV) performing the atmospheric portion of an orbital-plane-change maneuver are developed using the heading angle as the independent variable. Because the heading angle is monotonic, several difficulties previously encountered using the flight path angle, which is not monotonic, as the independent variable are eliminated. In addition, the solution of the optimal control problem reduces to the solution of a fourth-order polynomial which can be accomplished analytically. Author

A85-43878*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
AN ANALYSIS OF THE SPACE SHUTTLE HYPERSONIC ENTRY TRIM ANOMALY
J. C. YOUNG (NASA, Langley Research Center, Hampton, VA) and J. T. FINDLAY (Flight Mechanics and Control, Inc., Hampton, VA) AIAA, Atmospheric Flight Mechanics Conference, 12th, Snowmass, CO, Aug. 19-21, 1985. 7 p. refs
(AIAA PAPER 85-1764)

This paper reviews a parameter identification methodology developed to investigate the hypersonic longitudinal trim misprediction apparent in the NASA Space Shuttle Orbiter entry flights. The method combines an analysis using a measured versus predicted technique in conjunction with a multilinear regression analysis to identify prediction deficiencies using quasi-static longitudinal data in the hypersonic flight regime (Mach 6 through 26). In general, the results of this extraction confirm results previously obtained by other Shuttle investigators with the exception of elevon effectiveness. Further analysis and/or flight data will be required to resolve the conflicting elevon results. A combination of this analytical tool and other flight data will enable flight data interpretation with the potential for identifying the sources of the Shuttle's hypersonic trim misprediction to an accuracy consistent with updating preflight prediction methodology for future spacecraft. Author

A85-44124
ADVANCES IN COMPUTER-GENERATED IMAGERY FOR FLIGHT SIMULATION
J. K. YAN (Singer Co., Link Flight Simulation Div., Sunnyvale, CA) IEEE Computer Graphics and Applications (ISSN 0272-1716), vol. 5, Aug. 1985, p. 37-51. refs

Early flight simulators simulated only the motion and instruments of the simulated aircraft. Computer-generated imagery (CGI) was first employed in flight simulators more than a decade ago. However, early CGI systems had a number of major deficiencies which restricted their use to such training missions as takeoff and landing. Advances in electronics and algorithms make it now feasible to eliminate most of the deficiencies of early CGI systems. In the present paper, a description is presented of the progress which has been made over the past decade. The evolution of the CGI architecture is discussed, taking into account the scene manager, the geometric processor, and the video processor. Attention is also given to database primitives, translucency, and texture mapping. G.R.

A85-44848
THE EFFECT OF THE MAGNUS MOMENT ON THE MOTION STABILITY OF AN ASYMMETRIC FLIGHT VEHICLE [VLIIANIE MOMENTA MAGNUSA NA USTOICHIVOST' DVIZHENIIA ASIMMETRICHNOGO LETATEL'NOGO APPARATA]
V. N. PENIA and A. V. KARNAUKH IN: Design of flight vehicles and their systems . Kiev, Izdatel'stvo Naukova Dumka, 1985, p. 90-97. In Russian.

The effect of the Magnus moment on the vibrational motion of an asymmetric flight vehicle relative to its center of mass is investigated analytically using asymptotic methods of nonlinear mechanics. For both resonance and nonresonance motion, averaged equations are obtained which allow the qualitative and quantitative analysis of the effect of the Magnus moment on the angular motion of an asymmetric rotating flight vehicle. In the nonresonance case, the Magnus moment is shown to reduce the damping of free vibrations and to result, at high angular velocities relative to the longitudinal axis, in a loss of stability of the transverse vibrations of the flight vehicle. In the resonance case, the Magnus moment increases the forced component of the solid angle of attack associated with the asymmetry of the flight vehicle. V.L.

A85-45126#
SATELLITE ORBIT DETERMINATION FROM AN AIRBORNE PLATFORM
M. M. SHEPARD and J. J. FOSHEE (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH) IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 2 . New York, IEEE, 1984, p. 1099-1102.

This paper describes the requirements, approach, and problems associated with autonomous satellite orbit determination from an airborne platform. The ability to perform orbit determination from an airborne platform removes the reliance on ground control facilities. Aircraft orbit determination offers a more robust system in that it is less susceptible to direct attack, sabotage, or nuclear disaster. Ranging on a satellite and the processing of range/range-rate data along with INS inputs to produce a set of orbital parameters to be transmitted to user terminals are discussed. Several algorithms that could be utilized by the user terminal to recover the satellite position/velocity data from the transmitted message are presented. The ability to compress the ephemeris message to a small size while remaining autonomous for a long period of time, as would be needed in future military communication satellites, is discussed. Author

A85-45919#
HEURISTICALLY-GUIDED PLANNING FOR MISSION CONTROL/DECISION SUPPORT
O. L. DEUTSCH, J. V. HARRISON, and M. B. ADAMS (Charles Stark Draper Laboratory, Inc., Cambridge, MA) IN: Guidance, Navigation and Control Conference, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 386-395.
(AIAA PAPER 85-1909)

The autonomous control of 'intelligent' vehicles is formulated in terms of a hierarchy of control functions. The planning problem for the highest level of the hierarchy can be posed as a constrained statistical optimization problem. A technique is described for solving this problem in real-time, facilitating replanning in the face of events that cannot be predicted a priori with certainty. A heuristically-guided depth first stochastic search based on the simulated annealing technique and an on-line Monte Carlo simulation of future vehicle/environmental interactions are essential elements. The technique provides robustness and adaptability in generating plans that achieve near-optimal utility while satisfying problem constraints. Simulation results indicate planner efficiencies that will support a spectrum of real-time applications using presently available processors. Author

A85-45921#
AN ADAPTIVE GUIDANCE ALGORITHM FOR AEROSPACE VEHICLES
J. E. BRADT, J. W. HARDTLA, and E. J. CRAMER (Boeing Aerospace Co., Seattle, WA) IN: Guidance, Navigation and Control Conference, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 415-423. refs
(AIAA PAPER 85-1917)

The specifications for proposed space transportation systems are placing more emphasis on developing reusable avionics subsystems which have the capability to respond to vehicle evolution and diverse missions while at the same time reducing the cost of ground support for mission planning, contingency response and verification and validation. An innovative approach to meeting these goals is to specify the guidance problem as a multi-point boundary value problen and solve that problem using modern control theory and nonlinear constrained optimization techniques. This approach has been implemented as Gamma Guidance (Hardtla, 1978) and has been successfully flown in the Inertial Upper Stage. The adaptive guidance algorithm described in this paper is a generalized formulation of Gamma Guidance. The basic equations are presented and then applied to four diverse aerospace vehicles to demonstrate the feasibility of using a reusable, explicit, adaptive guidance algorithm for diverse applications and vehicles. Author

A85-45937#
INTEGRATION OF DIGITAL AIRCRAFT CONTROLS - BENEFITS AND DANGERS
H. HECHT (SoHaR, Inc., Los Angeles, CA) and J. Y. HUNG (USAF, Wright-Patterson AFB, OH) IN: Guidance, Navigation and Control Conference, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 581-586. refs
(AIAA PAPER 85-1951)

The need for the integration of digital aircraft controls is examined, and a distinction is drawn between functional and physical integration. Functional integration permits the achievement of performance and operational advantages, with a clean separation maintained between flight critical and other functions. Physical integration provides, in addition, savings in equipment and installation, but in most cases the scope of the flight critical functions will be enlarged. Thus, careful trade-offs are required in each instance to determine which type of integration will yield the highest overall benefits. V.L.

11

CHEMISTRY AND MATERIALS

Includes chemistry and materials (general); composite materials; inorganic and physical chemistry; metallic materials; nonmetallic materials; and propellants and fuels.

A85-43651
BETA TITANIUM ALLOYS IN THE 80'S; PROCEEDINGS OF THE SYMPOSIUM, ATLANTA, GA, MARCH 8, 1983
R. R. BOYER, ED. (Boeing Commercial Airplane Co., Seattle, WA) and H. W. ROSENBERG, ED. (TIMET, Pittsburgh, PA) Symposium sponsored by the Metallurgical Society of AIME. Warrendale, PA, Metallurgical Society of AIME, 1984, 515 p. For individual items see A85-43652 To A85-43673.

Among the topics discussed are the use of beta-Ti in the SR-71 aircraft, the microstructure and properties of beta-Ti alloys, the effects of hydrogen, heat treatment, and omega-phase formation on beta-Ti, the primary processing of beta- and near-beta-Ti alloys, the 'processing window' for grain size control in metastable beta-Ti, grain growth in beta III-Ti, the processing and properties of Ti-17 alloy for aircraft and turbine applications, the isothermal forging of beta- and near-beta-Ti alloys, the torsional properties of beta-Ti in automotive suspension springs, and the martensitic Transage Ti alloys. Also covered are Ti-Nb superconductors, and property compilations for such commercial and developmental beta-Ti alloys as beta-III, Ti-15-3, Ti-17, Transage 134, and cast and wrought Transage 175. O.C.

A85-43652
BETA TITANIUM ON THE SR-71 - HISTORICAL NOTE I
R. R. BOYER (Boeing Commercial Airplane Co., Seattle, WA) and H. W. ROSENBERG (TIMET, Pittsburgh, PA) IN: Beta titanium alloys in the 80's; Proceedings of the Symposium, Atlanta, GA, March 8, 1983 . Warrendale, PA, Metallurgical Society of AIME, 1984, p. 1-8.

Some of the early history of beta titanium development and use is traced. The Ti-13V-11Cr-3Al alloy was used extensively on the Lockheed SR-71. By-today's standards, Ti-13V-11Cr-3Al must be judged to be an obsolete alloy. It is difficult to produce and fabricate into parts that meet required strength and toughness properties. Yet the use of the alloy on the SR-71 remains a success story to this day. In no small measure, this is a tribute to the metallurgical and managerial skills of all those involved. Author

A85-43662
DEVELOPMENT AND PROPERTIES OF TI-15V-3CR-3SN-3AL (TI-15-3)
P. J. BANIA, J. A. HALL (TIMET, Henderson, NV), and G. A. LENNING (Northrop Corp., Aircraft Div., Hawthorne, CA) IN: Beta titanium alloys in the 80's; Proceedings of the Symposium, Atlanta, GA, March 8, 1983 . Warrendale, PA, Metallurgical Society of AIME, 1984, p. 209-229. refs

The desire to reduce total manufacturing costs associated with titanium airframe structures led to an extended series of programs aimed at developing a superior titanium sheet alloy. The new alloy was intended to lower manufacturing costs by being cold-strip producible, as well as cold formable. In addition, the alloy was to offer higher performance through improved mechanical properties. The alloy which met these program goals was Ti-15V-3Cr-3Sn-3Al (Ti-15-3.) This paper summarizes the chronological development of the Ti-15-3 alloy and gives a general metallurgical background of the alloy. Physical and mechanical properties are reviewed, as well as general processing and formability characteristics. Finally, the effects of hydrogen on mechanical properties and formability are also reviewed. Author

A85-43663
PROCESSING AND PROPERTIES OF THE TI-17 ALLOY FOR AIRCRAFT GAS TURBINE APPLICATIONS
T. K. REDDEN (General Electric Co., Aircraft Engine Business Group, Cincinnati, OH) IN: Beta titanium alloys in the 80's; Proceedings of the Symposium, Atlanta, GA, March 8, 1983 . Warrendale, PA, Metallurgical Society of AIME, 1984, p. 239-254. refs

Ti-17 was conceived as a deep hardenable engine disk alloy for intermediate operating temperatures, below about 800 F. As such, it filled an important need in advanced General Electric engines. In this paper, the principles attending the alloy development of Ti-17 are traced. Properties are presented and related to micro structure. Ti-17 is superior to Ti-6Al-4V in strength, hardenability, toughness, crack growth and fatigue properties. Author

A85-43671
TI-17 PROPERTIES
H. W. ROSENBERG (TIMET, Pittsburgh, PA) IN: Beta titanium alloys in the 80's; Proceedings of the Symposium, Atlanta, GA, March 8, 1983 . Warrendale, PA, Metallurgical Society of AIME, 1984, p. 433-439.

Ti-17 was developed for use in advanced GE engines. The alloy is suitable for compressor components where deep hardenability, strength, toughness, creep and fatigue are critical. Unlike the typical beta or near beta alloy, Ti-17 offers considerable creep strength to 800 F (430 C). This feature distinguishes Ti-17 from all competing beta and near beta compositions. Ti-17 is useful in sections up to 152mm in thickness. Author

A85-43672
TI-10V-2FE-AL PROPERTIES
R. R. BOYER (Boeing Commercial Airplane Co., Seattle, WA) and H .W. ROSENBERG (TIMET, Pittsburgh, PA) IN: Beta titanium alloys in the 80's; Proceedings of the Symposium, Atlanta, GA, March 8, 1983 . Warrendale, PA, Metallurgical Society of AIME, 1984, p. 441-456. refs

Ti-10V-2Fe-3Al is a high strength near beta forging alloy useful for engines and airframes. It offers the opportunity to use near-net shape forging techniques. To the forger this means low temperature isothermal forging using economical die materials using less input material. To the end user, Ti-10V-2Fe-3Al offers high strength and hardenability with excellent toughness and low anisotropy in heavy sections. Author

A85-43980#
LIFE PREDICTION AND CONSTITUTIVE MODELS FOR ENGINE HOT SECTION ANISOTROPIC MATERIALS
G. A. SWANSON (United Technologies Corp., Pratt and Whitney Group, East Hartford, CT) and R. C. BILL (U.S. Army, Propulsion Laboratory, Cleveland, OH) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 11 p. refs
(AIAA PAPER 85-1421)

This paper discusses the first-year results of a five-year program to develop life prediction and constitutive models for hot section anisotropic materials. Initial tests have been run on a single crystal material (PWA 1480) and on an overlay coating and an aluminide diffusion coating. Literature surveys of candidate models have been completed and preliminary models are in the process of being evaluated. Some of the initial test and modeling results are presented. Author

A85-44125
MODEL TESTS OF AIRCRAFT INTERIOR PANEL FLAMMABILITY
A. ABRAMOWITZ and T. I. EKLUND (FAA Technical Center, Atlantic City, NJ) (International Conference on Fire Safety, 10th, San Francisco, CA, Jan. 7-11, 1985) Journal of Fire Sciences (ISSN 0734-9041), vol. 3, Mar.-Apr. 1985, p. 129-140. refs

Prototype aircraft interior panels were installed as ceilings in a quarter-scale enclosure model lined with a nonflammable insulating material. Flashover conditions were generated by a 52-kilowatt propane burner. The heat requirements for flashover, with an inert ceiling, agreed with those predicted by an NBS correlation for full-scale room fires. The flammability of the prototype panels was experimentally found to be related to their ignition temperatures. In these tests, Nomex honeycomb panels with epoxy impregnated facesheets as well as those with phenolic impregnated Kevlar, sustained ignition. The panels faced with phenolic impregnated fiberglass or graphite did not burn. Author

A85-44200
USING AVIATION OILS ON THE BASIS OF THEIR ACTUAL CONDITION [O PRIMENENII AVIATSIONNYKH MASEL PO FAKTICHESKOMU SOSTOIANIIU]
B. G. BEDRIK Khimiia i Tekhnologiia Topliv i Masel (ISSN 0023-1169), no. 6, 1985, p. 20, 21. In Russian.

It has been shown in an earlier study (Bedrik et al., 1983) that changing oil in aircraft systems in accordance with a fixed calendar schedule or after a fixed number of service hours is not an optimum approach since no allowance is made for the actual service conditions. Here, a new approach is examined whereby the decision to change oil is based on the actual condition of the oil. This approach involves monitoring oil parameters directly during operation and requires that the performance parameters of the oil and of the system (e.g., engine) and the acceptable limits of their variation be accurately established with allowance for specific service conditions. The advantages of this approach and the problems involved are briefly discussed. V.L.

A85-44250#
DAMAGE TOLERANCE DESIGN FOR AIRCRAFT HUBS MADE OF CAST MAGNESIUM ALLOY
Y. ZHOU (Ministry of Aero-Industry, People's Republic of China), K. LI, and C. CHEN (Huazhong University of Science and Technology, People's Republic of China) Acta Mechanica Solida Sinica, March 1985, p. 44-56. In Chinese, with abstract in English. refs

The behaviors of fracture, fatigue, and fatigue crack propagation in a cast magnesium alloy are systematically studied. In particular, the fatigue crack growth under constant loading, overloading conditions, and the spectrum loading consistent with service conditions are investigated in detail. The method of predicting lifetimes for the hubs in question and some available basic data for design are provided. All results obtained from this study are verified by testing the full-scale components under analogous loading conditions. Author

A85-45138#
FIELD AND LABORATORY INVESTIGATION OF KAPTON INSULATED AIRCRAFT WIRING
G. A. SLENSKI (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH) IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 2 . New York, IEEE, 1984, p. 1207-1214.

A laboratory and field evaluation is conducted of the service properties of Kapton-insulated aircraft wiring, using both electrical and mechanical testing methods to ascertain the integrity of wiring insulation. Attention is given to the insulation's susceptibility to hydrolysis. Hydrolytic degradation incurred in field service is noted to follow an Arrhenius relationship, reducing mechanical properties; the hydrolytic rate of reaction is sufficiently slow in most environments, however, to have no impact on aircraft operational life. Kapton's degradation is accelerated by mechanical stress and UV radiation. O.C.

A85-45738
NEW CARBON FIBERS AND THE AIRCRAFT OF THE FUTURE [LES NOUVELLES FIBRES DE CARBONE ET L'AVION DE DEMAIN]
J. M. TREMILLON (Societe Nationale Elf Aquitaine, Paris, France) Materiaux et Techniques (ISSN 0032-6895), vol. 73, June-July 1985, p. 289-291. In French.

The characteristics of a new generation of carbon fibers being developed for mass production and targeted to satisfy the performance, mass, and cost criteria for applications in aircraft primary structures are described. Use of T 300 fibers in aircraft composites will depend on enhancing the fiber's resistance to stretching, breaking, water absorption and impact damage. The techniques employed to achieve the objectives will consist of the type and configuration of reinforcement and the matrix chosen. The appropriate fiber properties are being obtained by adjusting the manufacturing process, including curing and surface treatment steps. The new T 400 and T 700 fibers have exibited stretching and impact damage resistances superior to those of the T 300 fibers which are presently produced. The pulling resistance of T 700 fiber-reinforced materials has also proven better than that exhibited by T 300 materials when T 700 materials are laminated in diverse orientations to offset transverse forces. M.S.K.

A85-45739
THE STATE OF THE ART OF REINFORCED PLASTICS [ETAT ACTUEL DE L'EVOLUTION DES PLASTIQUES RENFORCES]
N. D. LAETSCH (Du Pont de Nemours International, S.A., Geneva, Switzerland) Materiaux et Techniques (ISSN 0032-6895), vol. 73, June-July 1985, p. 293-297. In French. refs

The material properties, manufacturing techniques, and tests of fiber-reinforced plastics intended for implementation as aircraft components are reviewed. The attractiveness of the composites is due to lower production costs and lighter weight. Composites are being designed with microstructures which resemble those of bone and wood, two strong natural materials. Thermosetting epoxy and phenolic resins receive the most attention as matrix materials, the former for strength, the latter for fire retardation. Although glass fibers have well known, satisfactory properties, they are heavy. Development efforts are therefore concentrating on Kevlar and carbon fibers as reinforcements. Carbon fibers are generally stronger and more expensive, while Kevlar has a higher pulling resistance and is thus preferable in some applications. Kevlar-carbon fiber hybrids provide enhanced properties. Since interlaminar defects are the predominant cause of failure, manufacturing and inspection techniques (particularly ultrasound and acoustic imaging) are being evaluated for reducing the incidence of faulty products. M.S.K.

A85-46489
CRACK GROWTH IN ALUMINIUM ALLOY SHEET MATERIAL UNDER FLIGHT-SIMULATION LOADING
J. SCHIJVE (Delft, Technische Hogeschool, Netherlands), A. M. VLUTTERS, ICHSAN, and J. C. PROVO KLUIT International Journal of Fatigue (ISSN 0142-1123), vol. 7, July 1985, p. 127-136. refs

Flight simulation tests are widely used in the study of fatigue problems by the aircraft industry and by aeronautical research laboratories. For a number of reasons, the flight-simulation test has replaced the conventional fatigue test with a constant mean load and a constant load amplitude. Two important aspects found in an evaluation of various aspects involved in planning load/time histories for flight-simulation tests are related to the numerous very small load cycles and the rarely occurring high loads. For many load spectra the number of load cycles with a small amplitude is so large that simulation of these cycles implies very long testing times. Possibilities regarding the omission of small cycles and the truncation of high loads have recently been explored in crack growth tests on Al-alloy sheet material. The present paper summarizes the results obtained by Vlutters (1982), Ichsan (1983), and Provo Kluit (1978). G.R.

N85-32208# Defence Research Establishment, Ottawa. (Ontario).
OBSERVATIONS OF THE USE OF THE SETAPOINT DETECTOR
J. R. COLEMAN and L. D. GALLOP Dec. 1984 16 p In ENGLISH and FRENCH
(AD-A154533; DREO-TN-84-33) Avail: NTIS HC A02/MF A01 CSCL 21D

In a previous investigation, a variety of tests were used to study the low temperature flow behavior of aviation turbine fuels. These included both specification fuels, and others that had higher than usual freeze points, but whose use might become necessary in the future. One procedure employed the Setapoint detector, manufactured by Stanhope Seta Ltd. This device measures the resistance to passage of a fuel pumped back and forth across a screen during a programmed cooling regime. In an attempt to find the reason for certain abnormal test results obtained using the Setapoint detector, a review of experimental results was conducted. Visual observations made during the tests were considered in conjunction with the stop flow and flow points. A number of distinct modes of behaviour, some leading to aberrant results, were identified. The instrument appeared best suited to specification aviation fuels, and middle distillates that produce fine homogeneous wax deposits during the test. GRA

12

ENGINEERING

Includes engineering (general); communications; electronics and electrical engineering; fluid mechanics and heat transfer; instrumentation and photography; lasers and masers; mechanical engineering; quality assurance and reliability; and structural mechanics.

A85-43546
ULTRASONIC WELD BONDING OF PRIMARY STRUCTURES
R. L. RODGERS (U.S. Army, Applied Technology Laboratory, Fort Eustis, VA) ManTech Journal, vol. 10, no. 2, 1985, p. 3-10. Army-supported research. refs

A program was undertaken by Hughes Helicopters to develop and optimize an ultrasonic weld bonding procedure for the fabrication of primary structural components for helicopters. The procedure, a combination of ultrasonic welding and adhesive bonding, was developed through a series of coupon tests. Adhesive bond quality and weld quality were evaluated through various T-shear, fatigue, and environmental salt-spray tests. It was concluded that the surface conditions for adhesive bonding and ultrasonic welding appear to be incompatible: the anodized surface suitable for adhesive bonding appears to be unweldable while the etched surface suitable for welding is subject to environmental degradation. Application of pressure during cure results in higher bond strengths and means of doing this are examined. The ultrasonic welding equipment requires greater control and monitoring capabilities regarding frequency, power, and force. Recommendations for necessary further study are given. D.H.

A85-44053
THE TECHNICAL EVOLUTION OF ON-BOARD CLOCKS [EVOLUTION TECHNIQUE DES HORLOGES EMBARQUEES]
R. MOREAU (ONERA, Chatillon-sous-Bagneux, France) (SEE and Institut Francais de Navigation, Journee d'Etudes sur l'Evolution de la Navigation: Horloges, Satellites, Gif-sur-Yvette, France, Oct. 1984) Navigation (Paris) (ISSN 0028-1530), vol. 33, July 1985, p. 305-318. In French. refs

Ultrastable oscillators produce signals locked on a set frequency, and thereby provide a basis of navigational calculations using fixed, repeating radio signals. The phase shifts in a received signal, when compared to a reference signal, serve as input for calculations of distance from the beacon. The necessary long-term accuracy of such beacons has led to the use of atomic clocks as generators of the beat frequency. Atomic clocks are part of the Loran, Omega, Transit, GPS, Geoloc and Glonoss navigational systems. The use of clocks on board aircraft is constrained by weight, volume, and dynamic and radiation considerations. Cs vapor in a 7 x 25 cm tube shows promise for an on-board atomic clock, provided sufficient progress is made in the associated sensing and signal generating equipment, particularly quartz resonators. However, even if mass-produced, atomic clocks would remain high in cost. M.S.K.

A85-44270
FLOW VISUALIZATION IN WATER CHANNELS BY MEANS OF A PROCEDURE FOR THE GENERATION OF VERY SMALL AIR BUBBLES [STROEMUNGSSICHTBARMACHUNG IN WASSERKANAELEN MITTELS EINES VERFAHRENS ZUR ERZEUGUNG KLEINSTER LUFTBLAESCHEN]
G. NEUWERTH (Aachen, Rheinisch-Westfaelische Technische Hochschule, West Germany) Zeitschrift fuer Flugwissenschaften und Weltraumforschung (ISSN 0342-068X), vol. 9, May-June 1985, p. 187-189. In German.

A85-44365
APPLICATIONS OF WAVELENGTH DIVISION MULTIPLEXING (WDM) AND TIME DIVISION MULTIPLEXING (TDM) TO AIRCRAFT DATA LINKS
C. E. POLCZYNSKI (Lockheed-California Co., Burbank) and G. DUCK (JDC Optics, Inc., Ottawa, Canada) IN: Fiber optics: Short-haul and long-haul measurements and applications II; Proceedings of the Meeting, San Diego, CA, August 21, 22, 1984. Bellingham, WA, SPIE - The International Society for Optical Engineering (SPIE Proceedings. Volume 500), 1984, p. 108-112.

Preliminary results on development of a fiber optic system from transmitting multiple channels of data over a single optical fiber cable are given. The system employs advanced WDM and TDM techniques to greatly reduce weight and volume of interconnect wiring on modern aircraft. The following components are described: (1) fiber optic receiver for reception of data bursts, (2) a 6 channel TDM (mux and demux) for data rates over 175 KBPS per channel, (3) an 8 channel WDM multiplexer and demultiplexer. Problem areas associated with multichannel (greater than 4) WDM technology are discussed. Author

A85-44749
SFENA BACKS LASER GYROS
G. SEDBON and G. WARWICK Flight International (ISSN 0015-3710), vol. 128, Aug. 3, 1985, p. 19-21.

Two ring laser gyros are now being manufactured in France for use in a 12 cm path-length triangular microgyro and a 33 cm path-length triangular laser gyro. The 12 cm microgyro has a drift

accuracy of 1 deg per hr, useful for tactical missiles with short flight duration or for helicopters with an inertial system that can be integrated with a Doppler velocity sensor to produce an autonomous navigation system. The 33 cm laser gyro is a medium-accuracy rate sensor; it has a drift of 0.01 deg per hr and is useful for fixed-wing aircraft inertial systems. A high accuracy, 60 cm path-length laser gyro for maritime navigation with a drift of less than 0.001 deg per hour is being developed. Also being developed is a three-axis laser gyro with square laser cavities which produces a laser with fewer mirrors and electrodes resulting in higher cost efficiencies. New research has produced a three-axis gyro using 21 cm path-length square cavities inside a ball roughly 8 cm in diameter. A smaller tennis-ball-sized three-axis gyro could be constructed with improvements in mirrors. I.F.

A85-44832
DESIGN OF FLIGHT VEHICLES AND THEIR SYSTEMS [PROEKTIROVANIE LETATEL'NYKH APPARATOV I IKH SISTEM]
V. S. BUDNIK, ED. Kiev, Izdatel'stvo Naukova Dumka, 1985, 204 p. In Russian. For individual items see A85-44833 to A85-44863.

A multiple approach to the design of aerospace vehicles is considered along with the processing characteristics of systems for automated design work in the initial stage of aerospace vehicle design, complex problems in the theory of optimal control and differential games, the choice of allowable errors regarding the parameters of mathematical models of aerospace vehicles, and a study of the sensitivity of mathematical models of aerospace vehicles. Attention is also given to the combination of a semigroup approach and the method of Lagrange multipliers as a suitable means for the solution of distinct optimization problems with constraints in the form of inequalities, a method for increasing the search rate in a search for extrema, and the realization of combinatorial objectives on an electronic computer. Other subjects discussed are related to the construction of a graphical structural representation of a layout diagram for an aerospace vehicle, a flywheel energy storage device, and the effect of vibration on the tightness of rubber-metal valve seals. G.R.

A85-44858
VALIDATION OF PROCEDURES FOR RELIABILITY EVALUATION AND CONFIRMATION [K OBOSNOVANIIU METODIK OTSENKI I PODTVERZHDENIIA NADEZHNOSTI]
A. I. FEDIAKIN IN: Design of flight vehicles and their systems . Kiev, Izdatel'stvo Naukova Dumka, 1985, p. 152-158. In Russian. refs

The reliability of the various systems of a flight vehicle can be estimated by using such a general criterion as the probability of a set of performance functions not overshooting the zero level. It is shown that the information available at the design stage can be used to validate distribution laws and to estimate the probability of a non-Gaussian process without overshoots and its a priori distribution. This information includes statistical data on the primary (strength, structural, and service) factors, tolerances and nominal values of the primary factors, and test results for systems similar to the system being designed. V.L.

A85-44860
GUARANTEED RELIABILITY ESTIMATES FOR VARIOUS AMOUNTS OF INFORMATION ON THE PRIMARY FACTORS [OPREDELENIE GARANTIROVANNYKH OTSENOK NADEZNNOSTI PRI RAZLICHNYKH OB'EMAKH INFORMATSII O PERVICHNYKH FAKTORAKH]
A. V. DEMCHENKO and V. V. NIKOLAEV IN: Design of flight vehicles and their systems . Kiev, Izdatel'stvo Naukova Dumka, 1985, p. 162-166. In Russian. refs

Finding appropriate distribution laws for quantities that determine reliability is essential in the design of flight vehicles. When the available statistical data are insufficient for the derivation of distribution laws, it is recommended that laws resulting in guaranteed reliability estimates be formulated. Here, methods are presented for obtaining guaranteed reliability estimates for various amounts and types of available primary data, and the accuracy of the resulting estimates is assessed. V.L.

A85-44861
USING THE RICE DISTRIBUTION IN EVALUATING THE RELIABILITY OF STRUCTURES [ISPOL'ZOVANIE RASPREDELENIIA RAISA PRI OTSENKE NADEZHNOSTI KONSTRUKTSII]
E. S. PEREVERZEV and A. I. KUSHCH IN: Design of flight vehicles and their systems . Kiev, Izdatel'stvo Naukova Dumka, 1985, p. 166-172. In Russian. refs

Analytical expressions for calculating the probability of trouble-free operation are obtained on the basis of the Rice distribution for a load-strength parametric model. The expressions proposed here can be used to evaluate the reliability of structural elements at the design stage. An illustrative example is presented. V.L.

A85-45006
DIGITAL SIGNAL PROCESSING UTILIZING A GENERIC INSTRUCTION SET
V. V. W. MOSLEY, J. BRONDER, and A. WENK (Westinghouse Defense and Electronics Center, Baltimore, MD) IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 1 . New York, IEEE, 1984, p. 208-214. refs

In order to maintain a degree of technological equivalence between software and hardware in advanced VLSI development efforts, a set of generic instructions has been defined in the form of Ada-callable procedures which invoke a complex sequence of events for the execution of vector instructions in signal processing modules. Attention is presently given to real time signal processing functions in the cases of fighter aircraft fire control radar, passive sonar surveillance, communications systems' FSK demodulation and bit regeneration, and electronic warfare support measures and countermeasures. Generalized examples of each application are given as data flow graphs. O.C.

A85-45038
EXPERIMENTAL CASCADED DOUBLY FED VARIABLE SPEED CONSTANT FREQUENCY GENERATOR SYSTEM
J. A. WEIMER (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH) and T. H. ORTMEYER (Clarkson College of Technology, Potsdam, NY) IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 1 . New York, IEEE, 1984, p. 444-451.

Brushless variable speed constant frequency (VSCF) electric power generation may be obtained using cascaded symmetrically wound machines. The feasibility of using these machines as the basis for a stand-alone aircraft generator system was investigated. The concept is attractive as the system operates without hydraulics and employs a solid state power converter which operates at a fraction of the system output power and frequency. These factors combine to offer a system of relatively low complexity with the potential for high-reliability operation. This paper reviews the steady state results of an experimental, cascaded doubly fed VSCF generator system. In addition, this paper discusses the operation of the microprocessor-controlled inverter section of the solid state power converter. Author

A85-45058
A COMPACT ELECTROMECHANICAL ACTUATOR
S. P. SMITH (Kollmorgen Corp., Radford, VA) IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 1 . New York, IEEE, 1984, p. 598-605.

The compact electromechanical actuator hardware presented, which was developed for the B 727 upper rudder, exemplifies the type of technoloy which would replace hydraulic units in other applications. This system incorporates such design features as the retraction of a roller screw into a hollow motor hub, the journaling of the motor's shaft in the roller nut, and torque-limiting

by a planetary ring gear which is allowed to slip under control by spring-loaded balls. Attention is given to tradeoffs entailed by the meeting of specifications that establish size and weight constraints. O.C.

A85-45340
AERONAUTICAL SATELLITE DATA LINK STUDY
W. SANDRIN, K. MACKENTHUN, S. RHODES (COMSAT Laboratories, Clarksburg, MD), H. CHEN (TRW Antenna Systems Laboratory, Redondo Beach, CA), and W. HAGMANN (Brown, Boveri et Cie. AG, Baden, Switzerland) COMSAT Technical Review, vol. 15, Spring 1985, p. 1-38. refs

A satellite-based data communications system for commercial aircraft is proposed. The system can be used to generate both air traffic control and company communications data services via L-band satellite. It is shown that the maximum satellite capacity of the system can be provided by the Inmarsat space segment. Attention is given to the potential cost savings which can be obtained through the shared use of satellites and earth stations in the Inmarsat system. The modulation coding scheme proposed for the data link uses differential phase shift keying (DPSK) modulation and a rate 1/2 convolutional code with interleaved code symbols and soft detection Viterbi decoding. A block diagram of the systems organization is given and a map showing the area of satellite coverage in the North Atlantic is provided. I.H.

A85-45470
STIRLING ENGINES FOR AIR FORCE APPLICATIONS
V. J. VAN GRIETHUYSEN (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH) IN: IECEC '84: Advanced energy systems - Their role in our future; Proceedings of the Nineteenth Intersociety Energy Conversion Engineering Conference, San Francisco, CA, August 19-24, 1984. Volume 3 . La Grange Park, IL, American Nuclear Society, 1984, p. 1913-1916. USAF-sponsored research.

The Mobile Power System Analysis program was used to evaluate various energy conversion systems currently under development for future Air Force ground power needs (e.g., for remote radar and communication sites, and aircraft maintenance support and air base facilities). The Stirling engine is determined to have high potential for Air Force applications. Both the free-piston and kinematic Stirling engine have a high potential for exceeding the performance of current MEP systems for their applicable power levels. Several possible ground power applications for the Stirling engine within the Air Force are described. B.J.

A85-45671#
USE OF A RADIANCE AMPLIFIER FOR VISUALIZING SEEDED AERODYNAMIC FLOWS
M. PHILBERT and J. P. FALENI (ONERA, Chatillon-sous-Bagneux, France) La Recherche Aerospatiale (English Edition) (ISSN 0379-380X), no. 1, 1985, p. 65-71.

A light intensifier is used as the basis of a wind tunnel flow visualization technique. Attention is given to the visualization of vortex breakdown in the wake of a delta wing, using high speed cinematography, and the results obtained are compared with those available on the basis of laser velocimetry and laser tomography. A pulsed YAG laser is used in the present apparatus to illuminate the particle-seeded flow on which vortex breakdown is observed. O.C.

A85-45801
REPAIR AND REJUVENATION PROCEDURES FOR AERO GAS-TURBINE HOT-SECTION COMPONENTS
S. R. BELL (Turbine Services, Ltd., Hatfield, England) (Meeting on Refurbishing of Superalloy Components for Gas Turbines, London, England, May 16, 1984) Materials Science and Technology (ISSN 0267-0836), vol. 1, Aug. 1985, p. 629-634.

The general procedures for repairing aero gas-turbine hot-section components are described. A number of examples are given in order to illustrate particular repair processes: (1) the welding of nozzle guide vanes made from high-strength, nickel-base alloy, demonstrating the effect of microstructural refinement and welding techniques; (2) the brazing of similar nozzle guide vanes, with emphasis on the advantages of using a halide cleaning process and of modifying the braze alloy by adding a powder having a composition close to that of the parent metal; (3) the use of an improved coating system to upgrade components; (4) the possibility of using MCrAlY coatings applied by low-pressure plasma spraying; and (5) hot isostatic pressing as a method of restoring creep life. Author

A85-45802
REFURBISHING SUPERALLOY COMPONENTS FOR GAS TURBINES
Y. LINDBLOM (FFV Materials Technology, Linkoping, Sweden) (Meeting on Refurbishing of Superalloy Components for Gas Turbines, London, England, May 16, 1984) Materials Science and Technology (ISSN 0267-0836), vol. 1, Aug. 1985, p. 636-641. refs

Maintenance techniques designed to ensure the safe operation of turbine blades are reviewed. The discussion covers cleaning, inspection, and nondestructive testing procedures and prediction of the performance life of turbine blades of B1900, IN738, Nimonic 105, and Udimet 500 alloys. New types of coatings that are deposited by plasma spraying and hot isostatic pressing are examined. V.L.

A85-45803
IMPROVING RELIABILITY AND LIFETIME OF REJUVENATED TURBINE BLADES
J. WORTMANN (Motoren- und Turbinen-Union Muenchen GmbH, Munich, West Germany) Materials Science and Technology (ISSN 0267-0836), vol. 1, Aug. 1985, p. 644-650. refs

A procedure for rejuvenating diffusion-coated turbine blades with creep-induced damage is reported. The treatment proposed here, which consists of hot isostatic pressing, is shown to be capable of rejuvenating turbine blades with a creep life consumption of more than 50 percent; a more than 100-percent improvement in the minimum creep life of the used blades, as tested on a hot-gas rig, is achieved. Results obtained for a blade of Nimonic 108 alloy are presented. V.L.

A85-45845#
STOCHASTIC CRACK PROPAGATION IN FASTENER HOLES
J. N. YANG, W. H. HSI (George Washington University, Washington, DC), S. D. MANNING (General Dynamics Corp., Fort Worth, TX), and J. L. RUDD (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH) (Structures, Structural Dynamics, and Materials Conference, 26th, Orlando, FL, Apr. 15-17, 1985, Technical Papers. Part 1, p. 225-233) Journal of Aircraft (ISSN 0021-8669), vol. 22, Sept. 1985, p. 810-817. Previously cited in issue 13, p. 1893, Accession no. A85-30251. refs
(Contract F33615-83-K-3226)

A85-45847*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
PROBABILISTIC COMBINATION OF VEHICLE DYNAMIC VIBRATION AND ACOUSTICALLY INDUCED RANDOM ACCELERATIONS
R. W. SCHOCK and L. P. TUELL (NASA, Marshall Space Flight Center, Huntsville, AL) (Structures, Structural Dynamics and Materials Conference, 25th, Palm Springs, CA, May 14-16, 1984, Technical Papers. Part 1, p. 193-199) Journal of Aircraft (ISSN 0021-8669), vol. 22, Sept. 1985, p. 825, 826. Previously cited in issue 13, p. 1910, Accession no. A84-31646.

A85-45856*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
INTERNAL COMBUSTION ENGINE COMBUSTION CHAMBER PROCESS STUDIES AT NASA LEWIS RESEARCH CENTER
H. J. SCHOCK (NASA, Lewis Research Center, Cleveland, OH) Journal of Propulsion and Power (ISSN 0748-4658), vol. 1, Sept.-Oct. 1985, p. 351-353. Previously cited in issue 19, p. 2749, Accession no. A84-40242. refs

A85-45957#
GENERIC FAULTS - THE FIRST WORD
D. G. CANNON (Boeing Commercial Airplane Co., Seattle, WA) IN: Guidance, Navigation and Control Conference, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 757-763.
(AIAA PAPER 85-1979)

The achievement of highly reliable, full time critical control system designs, such as those of fly-by-wire and fly-by-light flight control systems, is through the institution of development methods which increase the likelihood of faults' detection and toleration by redundant system architectural practices and reconfiguration capabilities. Management methods must accordingly give attention to factors that can be computed to act as predictors of fault and error performance on the basis of physical data. O.C.

A85-46482#
COMBINED ANALYSIS AND OPTIMIZATION OF EXTENDED HEAT TRANSFER SURFACES
A. N. HRYMAK, G. J. MCRAE, and A. W. WESTERBERG (Carnegie-Mellon University, Pittsburgh, PA) ASME, Transactions, Journal of Heat Transfer (ISSN 0022-1481), vol. 107, Aug. 1985, p. 527-532. Research supported by the Exxon Foundation. refs

This study presents an efficient numerical method to discover the optimal shape for a fin subject to both convective and radiative heat loss. Problem formulation is a finite element approximation to the conduction equation embedded within and solved simultaneously with the shape optimization problem. The approach handles arbitrary equality and inequality constraints. Grid points move to conform to the fin shape during the problem solution, reducing the number of elements required in the solution. Author

A85-46825#
AN ANALOGUE METHOD FOR CRACK PROPAGATION LIFE PREDICTION
F. ZHANG Acta Aeronautica et Astronautica Sinica, vol. 6, April 1985, p. 194-200. In Chinese, with abstract in English.

N85-33527*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
MAN-VEHICLE SYSTEMS RESEARCH FACILITY ADVANCED AIRCRAFT FLIGHT SIMULATOR THROTTLE MECHANISM
S. S. KURASAKI and W. C. VALLOTTON *In its* 19th Aerospace Mech. Symp. p 251-257 Aug. 1985
Avail: NTIS HC A17/MF A01 CSCL 13M

The Advanced Aircraft Flight Simulator is equipped with a motorized mechanism that simulates a two engine throttle control system that can be operated via a computer driven performance management system or manually by the pilots. The throttle control system incorporates features to simulate normal engine operations and thrust reverse and vary the force feel to meet a variety of research needs. While additional testing to integrate the work required is principally now in software design, since the mechanical aspects function correctly. The mechanism is an important part of the flight control system and provides the capability to conduct human factors research of flight crews with advanced aircraft systems under various flight conditions such as go arounds, coupled instrument flight rule approaches, normal and ground operations and emergencies that would or would not normally be experienced in actual flight. Author

N85-33535*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
CIRCULATION CONTROL LIFT GENERATION EXPERIMENT: HARDWARE DEVELOPMENT
T. L. PANONTIN *In its* 19th Aerospace Mech. Symp. p 363-378 Aug. 1985
Avail: NTIS HC A17/MF A01 CSCL 13M

A circulation control airfoil and its accompanying hardware were developed to allow the investigation of lift generation that is independent of airfoil angle of attack and relative flow velocity. The test equipment, designed for use in a water tunnel, includes the blown airfoil, the support systems for both flow visualization and airfoil load measurement, and the fluid control system, which utilizes hydraulic technology. The primary design tasks, the selected solutions, and the unforseen problems involved in the development of these individual components of hardware are described. Author

N85-33536*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
TWO-PLANE BALANCE AND SLIP-RING DESIGN
P. M. LUNA *In its* 19th Aerospace Mech. Symp. p 379-387 Aug. 1985
Avail: NTIS HC A17/MF A01 CSCL 13M

A 3.25 cm (1.28 in.) two plane balance and eight channel slip ring assembly has been designed to measure and transmit the thrust (667-N;150-lb) and torque (135-N-m;100-lb-ft) components produced by wind tunnel model turboprops and drive motors operating at 300 Hz. Author

N85-33538*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
SELECTING STEP SIZES IN SENSITIVITY ANALYSIS BY FINITE DIFFERENCES
J. IOTT (Virginia Polytechnic Inst. and State Univ., Blacksburg), R. T. HAFTKA (Virginia Polytechnic Inst. and State Univ., Blacksburg), and H. M. ADELMAN Aug. 1985 14 p refs
(NASA-TM-86382; L-15938; NAS 1.15:86382) Avail: NTIS HC A02/MF A01 CSCL 20K

This paper deals with methods for obtaining near-optimum step sizes for finite difference approximations to first derivatives with particular application to sensitivity analysis. A technique denoted the finite difference (FD) algorithm, previously described in the literature and applicable to one derivative at a time, is extended to the calculation of several simultaneously. Both the original and extended FD algorithms are applied to sensitivity analysis for a data-fitting problem in which derivatives of the coefficients of an interpolation polynomial are calculated with respect to uncertainties in the data. The methods are also applied to sensitivity analysis of the structural response of a finite-element-modeled swept wing. In a previous study, this sensitivity analysis of the swept wing required a time-consuming trial-and-error effort to obtain a suitable step size, but it proved to be a routine application for the extended FD algorithm herein. Author

N85-33540*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Business Group.
ELEVATED TEMPERATURE CRACK GROWTH Annual Report
J. F. YAU, S. N. MALIK, K. S. KIM, R. H. VANSTONE, and J. H. LAFLEN Aug. 1985 71 p refs
(Contract NAS-23940)
(NASA-CR-174957; NAS 1.26:174957; ASR-1) Avail: NTIS HC A04/MF A01 CSCL 20K

The objective of the Elevated Temperature Crack Growth Project is to evaluate proposed nonlinear fracture mechanics methods for application to combustor liners of aircraft gas turbine engines. During the first year of this program, proposed path-independent (P-I) integrals were reviewed for such applications. Several P-I integrals were implemented into a finite-element postprocessor which was developed and verified as part of the work. Alloy 718 was selected as the analog material for use in the forthcoming experimental work. A buttonhead, single-edge notch specimen was designed and verified for use in elevated-temperature strain control testing with significant inelastic strains. A crack mouth opening displacement measurement device was developed for further use. Author

13

GEOSCIENCES

Includes geosciences (general); earth resources; energy production and conversion; environment pollution; geophysics; meteorology and climatology; and oceanography.

A85-44109
FORECASTING DRY MICROBURST ACTIVITY OVER THE HIGH PLAINS
R. M. WAKIMOTO (California, University, Los Angeles) Monthly Weather Review (ISSN 0027-0644), vol. 113, July 1985, p. 1131-1143. refs
(Contract NSF ATM-83-19486)

The active dry microburst days during the 1982 JAWS (Joint Airport Weather Studies) Project in Colorado are examined for common characteristics. The environments on these days are shown to have similar thermodynamic structures in the vertical. In the morning, a shallow radiation inversion is capped by a deep, dry-adiabatic boundary layer. Moisture is present at midlevels. By evening the radiation inversion has been replaced by a superadiabatic layer at the surface. Solar heating of the boundary layer is shown to be important for producing an environment favorable for dry microbursts. A model is proposed that can be used by forecasters to issue a 'wind shear watch' to the general public and aviation community. Peak downdraft speeds associated with dry microbursts appear to be a result of negative buoyancy, owing to the evaporation of precipitation during the descent below cloud base. These downward velocities are of the same magnitude as the horizontal wind speeds. Entrainment of subcloud air into the downdraft is considered minimal. Author

A85-45352
PERFORMANCE PREDICTION OF THE WELLS SELF-RECTIFYING AIR TURBINE
S. RAGHUNATHAN and C. P. TAN (Belfast, Queen's University, Northern Ireland) IN: IECEC '84: Advanced energy systems - Their role in our future; Proceedings of the Nineteenth Intersociety Energy Conversion Engineering Conference, San Francisco, CA, August 19-24, 1984. Volume 1 . La Grange Park, IL, American Nuclear Society, 1984, p. 1-6. Research supported by the Department of Energy of England. refs

An experimental and analytical study of the effects of geometric and aerodynamic variables on the performance of the Wells self-rectifying axial flow air turbine is presented. Experiments were performed in a unidirectional flow rig. Two approaches to the prediction of the performance of the Wells turbine were described, both of which were based on two-dimensional cascade theory and isolated aerofoil data. Finally, comparisons of the predicted results with the experimental results were made. Author

A85-45848#
TIME-INVARIANT STRUCTURE OF NONSTATIONARY ATMOSPHERIC TURBULENCE
G. TREVINO (Michigan Technological University, Houghton, MI) Journal of Aircraft (ISSN 0021-8669), vol. 22, Sept. 1985, p. 827, 828. refs
(AIAA PAPER 85-1834)

Nonstationary atmospheric turbulence has a well defined, time-invariant statistical structure which is appropriately posed in terms of aircraft response parameters, and which suggests that there is a mode in which the effects of nonstationary turbulence can be incorporated into preliminary design analyses in a unified, cogent fashion. The present results obviate arbitrary assumptions and/or decisions on the time-dependence of the statistical structure of nonstationary turbulence, and show how the effects of nearly all types of nonstationary turbulent behavior can be incorporated into a single response statistic. O.C.

14

LIFE SCIENCES

Includes life sciences (general); aerospace medicine; behavioral sciences; man/system technology and life support; and planetary biology.

A85-43857*# Systems Technology, Inc., Hawthorne, Calif.
INVESTIGATION OF OUTSIDE VISUAL CUES REQUIRED FOR LOW SPEED AND HOVER
R. H. HOH (Systems Technology, Inc., Hawthorne, CA) IN: Atmospheric Flight Mechanics Conference, 12th, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 337-349. NASA-supported research. refs
(AIAA PAPER 85-1808)

Knowledge of the visual cues required in the performance of stabilized hover in VTOL aircraft is a prerequisite for the development of both cockpit displays and ground-based simulation systems. Attention is presently given to the viability of experimental test flight techniques as the bases for the identification of essential external cues in aggressive and precise low speed and hovering tasks. The analysis and flight test program conducted employed a helicopter and a pilot wearing lenses that could be electronically fogged, where the primary variables were field-of-view, large object 'macrotexture', and fine detail 'microtexture', in six different fields-of-view. Fundamental metrics are proposed for the quantification of the visual field, to allow comparisons between tests, simulations, and aircraft displays. O.C.

N85-33700# Boeing Commercial Airplane Co., Seattle, Wash. Program Engineering and Maintenance Service.
THE DEVELOPMENT AND EVALUATION OF COLOR DISPLAY SYSTEMS FOR AIRBORNE APPLICATIONS. PHASE 1: FUNDAMENTAL VISUAL, PERCEPTUAL, AND DISPLAY SYSTEM CONSIDERATIONS Final Report, Sep. 1983 - Jul. 1984
L. D. SILVERSTEIN and R. M. MERRIFIELD 18 Jul. 1985 328 p refs Sponsored in part by Navy
(Contract DTFA01-83-C-20033)
(FAA/PM-85-19; D6-53012) Avail: NTIS HC A15/MF A01

A great number of complex, interacting factors determine the effectiveness of a color display system. Many of these factors characterize visual displays in general, while others are specifically related to the production of use of color. Because it is difficult, if not unwise, to isolate and consider human visual and perceptual factors separately from color display system hardware characteristics, both operator and display system requirements must be analyzed according to common functional units. The objectives of the study were to review the current philosophy and standards on the airborne applications of electronic color display systems, develop guidelines for specifying and measuring color CRT display performance parameters, conduct a survey of currently available color systems, review and evaluate existing system capabilities, and predict future trends and applications in color display systems and componentry. Author

15

MATHEMATICAL AND COMPUTER SCIENCES

Includes mathematical and computer sciences (general); computer operations and hardware; computer programming and software; computer systems; cybernetics; numerical analysis; statistics and probability; systems analysis; and theoretical mathematics.

A85-43690
THE LOCKHEED CYBERNETICS CONSOLE - AN ARTIFICIAL INTELLIGENCE TOOL
A. FRINK, A. MORRISON, and T. PALMIERI (Lockheed-California Co., Burbank, CA) Lockheed Horizons, June 1985, p. 25-38.

The Lockheed Cybernetics Console (LCC), which is a compact, stand-alone multicomputer system developed with a view to the prospective data processing requirements of advanced multimission aircraft, represents a first step toward the formulation of 'fifth generation', artificial intelligence (AI) function-incorporating avionics. The host computer of the LCC is a 68010 processor with 16 million bytes of RAM for program execution; also incorporated are two hard disk drives for data and program storage of up to 360 million bytes. The graphics capability of the LCC features dual CRTs, one of which is a high resolution color monitor and the other a monochrome monitor with full graphic window system. Attention is given to the possible use of the LCC as a crew console aboard advanced early warning aircraft, and as the basis of AI systems for such future combat aircraft as the Advanced Tactical Fighter, in which the voice synthesis and speech-recognition capabilities of the LCC, as well as its interactive graphics, will constitute a 'pilot's associate' expert system actively aiding in such decision-making tasks as enemy aircraft identification. O.C.

A85-43828*# Integrated Systems, Inc., Palo Alto, Calif.
IDENTIFICATION OF INTEGRO-DIFFERENTIAL SYSTEMS FOR APPLICATION TO UNSTEADY AERODYNAMICS AND AEROELASTICITY
N. K. GUPTA (Integrated Systems, Inc., Palo Alto, CA) and K. W. ILIFF (NASA, Flight Research Center, Edwards, CA) IN: Atmospheric Flight Mechanics Conference, 12th, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 10-21. refs
(AIAA PAPER 85-1763)

Integrodifferential equations for unsteady aerodynamic and aeroelastic phenomena are identified by means of several approaches. When the product of the frequency of motion and maximum time delay is much smaller than unity, the integral term can be approximated by a constant; when greater than unity, however, approximation of the integral is not possible. Approximations of integrodifferential models are needed to obtain identifiability. While the least-squares method may be used for model determination, the maximum likelihood technique is needed for accurate parameter estimation. High angle of attack and post stall/spin regions appear to have characteristics that can be satisfied by indicial models. O.C.

A85-45005
A SIGNAL PROCESSOR WITH DISTRIBUTED CONTROL AND MULTIDIMENSIONAL SCALABILITY
R. B. STEVES (Texas Instruments, Inc., Dallas) IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 1 . New York, IEEE, 1984, p. 201-207.

The requirements definition, architectural development and implementation program are discussed for a data flow signal processor system. The design of a high-bandwidth message-based communication system for multiprocessors is described, and the use of data flow control at the task level is discussed as applied to vector-oriented problems. The communication network and data flow control system allow cooperation of vector, scalar, and other resource types within a common control structure. The advantages of data flow with respect to reconfiguration of the target machine for spare resource insertion are covered. A major system-level requirement is compatibility with the company's VHSIC Phase 1 development program; as VHSIC technology becomes available, it will provide a major improvement in processor capabilities. Current development progress, plans and areas for further study are presented. D.H.

A85-45041#
A GRAPHICAL APPROACH TO UNDERSTANDING AND PREVENTING THE PHENOMENON OF ALIASING
A. L. REUTER (USAF, Flight Test Center, Edwards AFB, CA) IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 1 . New York, IEEE, 1984, p. 464-469.

Aliasing changes a signal, sometimes seriously, by adding frequency content which shouldn't be there. For the airplane designer and flight tester aliasing can cause problems with airplane response (ride qualities, handling qualities, etc.) and data analysis. Aliasing, which arises during analog to digital, digital to analog, and digital to digital operations, is a well understood phenomenon. Surprisingly however, the experience is that it is too widely ignored or improperly countered. In this paper an attempt is made to create an appreciation of the phenomenon, the damage it can do, and a simple, successful means of preventing that damage. Author

A85-45068
THE SDF - A RADAR AVIONICS SOFTWARE DEVELOPMENT ENVIRONMENT
J. A. RADER and D. J. MELLEMA (Hughes Aircraft Co., El Segundo, CA) IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 2 . New York, IEEE, 1984, p. 671-675.

A Software Development Facility (SDF) for the interaction of avionics software with radar hardware is described. The SDF objectives are summarized, and the central development facility and system integration laboratory are described in terms of their tools and functions. The SDF testing and integration philosophy are briefly addressed along with future plans for the facility. C.D.

A85-45073
REINVENTING THE DAIS WHEEL IN ADA
L. GEARHART (TRW, Inc., TRW Defense Systems Group, Redondo Beach, CA) IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 2 . New York, IEEE, 1984, p. 703-709. refs

A distributed avionics executive for a MIL-STD-1750A/MIL-STD-1553B architecture using Ada and its interface to a global executive is described. The implementation completely avoids the use of 1750A assembler code. Synchronization is managed completely with Ada rendezvous. Principal executive services are made available to user tasks through Ada packages. Packages for data management, event management, and task management are described. Some of the issues involved in the design of a full Ada-based distributed executive, including efficiency issues, are discussed. C.D.

A85-45076
A CONCEPT FOR MORE TEST TIME ON FLIGHT SOFTWARE
R. J. SYLVESTER IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 2 . New York, IEEE, 1984, p. 723-726.

A concept for obtaining additional test time on flight software by achieving a high degree of commonality among hardware and software is proposed. In particular, the key system requirements for an Air Crew Training Device must be reflected in the design of the integrated test facility and in the Avionics Integrated Support Facility. The additional test time provided by the concept leads to enhanced integrity, acquisition schedule improvement, maintenance commonality, and configuration management simplification. The disadvantages include institutional impacts on business and

government and some technical matters, including increased complexity. C.D.

A85-45101
THE USE OF A SIMULATED MULTIFUNCTION KEYBOARD (SMFK) IN MFK SOFTWARE DEVELOPMENT PROJECTS
D. L. DRESEL (TRW, Inc., Defense Systems Group, Dayton, OH) IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 2 . New York, IEEE, 1984, p. 898-903. refs

This paper describes a Simulated Multifunction Keyboard (SMFK) which can greatly facilitate the MFK software development process and eliminate and problems of MFK display availability. The software is designed to functionally simulate the MFK hardware display and provides a mechanism to switch input data into the MFK software under test. The SMFK can provide automatic documentation for software test procedures as well as repeatable operation test demonstrations and execution timing estimates. The interaction of the SMFK software with MFK software is illustrated in a flow diagram. I.H.

A85-45146
ADVANCED COMPUTER AIDED ENGINEERING REQUIREMENTS FOR ELECTRONICS
P. E. BEYER, M. A. MARTIN, and M. H. MCCARTNEY (Boeing Military Airplane Co., Wichita, KS) IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 2 . New York, IEEE, 1984, p. 1255-1261.

The initial results of an Air Force program to develop advanced design concepts for Computer Aided Engineering (CAE) of electronic components are presented. The functional and operational requirements of a CAE system are described with respect to circuit design; chassis box design; data storage and communication requirements; and support system interface requirements. A design concept is proposed for an array of CAE/CAD workcells which provide access to a number of design tools. I.H.

A85-45148#
DYNA-METRIC - NEW CAPABILITIES
B. J. WIELAND (USAF, Logistics Command, Wright-Patterson AFB, OH) IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 2 . New York, IEEE, 1984, p. 1280-1283. refs

Dyna-METRIC, a Dynamic Multiechelon Technique for Recoverable Item Control, is an analytical model developed by the Air Force to improve the management of multiindenture reparable spare parts. A general overview of the basic components of the Dyna-METRIC model is given, and some new features incorporated into the fourth version of the model are described. The improved features include: the ability to consider the depot as more than a supply of stock; sortie-based part failure determination; and greater flexibility in assigning part repair times. I.H.

A85-45927#
REDUCED CONSERVATISM IN TIME DOMAIN STABILITY ROBUSTNESS BOUNDS BY STATE TRANSFORMATION - APPLICATION TO AIRCRAFT CONTROL
R. K. YEDAVALLI and Z. LIANG (Stevens Institute of Technology, Hoboken, NJ) IN: Guidance, Navigation and Control Conference, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 467-472. refs
(AIAA PAPER 85-1926)

This paper addresses the issue of 'conservatism' in the time domain stability robustness bounds obtained by Liapunov approach. A state transformation is employed to improve the upper bounds on the linear time-varying perturbation of an asymptotically stable linear time-invariant system for robust stability. This improvement is due to the variance of the conservatism of Liapunov stability condition with respect to the basis of the vector space in which the Liapunov function is constructed. The proposed analysis is applied to a VTOL aircraft control example to provide a constant linear state feedback control that is stability robust for the given range of parameter variations. Author

A85-45929#
MULTI-INPUT MULTI-OUTPUT AUTOMATIC DESIGN SYNTHESIS FOR PERFORMANCE AND ROBUSTNESS
V. C. GORDON (U.S. Navy, San Diego, CA) and D. J. COLLINS (U.S. Naval Postgraduate School, Monterey, CA) IN: Guidance, Navigation and Control Conference, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 482-489. refs
(AIAA PAPER 85-1929)

Time domain pole placement design procedures are combined with a method of using the return difference matrix singular values in order to improve the robustness of a multiinput and multioutput (MIMO) design. The technique, which uses modern numerical optimization routines and can assist the designer in obtaining robustness in the face of cross-coupling perturbations, is described. Its application to several problems discussed in recent literature is shown. C.D.

A85-45930*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
STABILITY ROBUSTNESS IMPROVEMENT USING CONSTRAINED OPTIMIZATION TECHNIQUES
V. MUKHOPADHYAY (NASA, Langley Research Center, Hampton, VA) IN: Guidance, Navigation and Control Conference, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 490-496. refs
(Contract NAG1-199)
(AIAA PAPER 85-1931)

In a multiloop feedback control system, stability margin improvement by singular value shaping can be achieved by a noise adjustment procedure. A direct method for shaping singular value spectrum using constrained optimization technique is described. The design algorithm minimizes a standard LQG performance index while trying to satisfy minimum singular value constraints at the plant input, or output, or at both. Selected parameters of a stabilizing control law are used as the design variables. The capabilities of this method are demonstrated using a two input two output system representing a drone aircraft and its lateral attitude control system. Author

A85-45938*# Draper (Charles Stark) Lab., Inc., Cambridge, Mass.
ADVANCED INFORMATION PROCESSING SYSTEM - FAULT DETECTION AND ERROR HANDLING
J. H. LALA (Charles Stark Draper Laboratory, Inc., Cambridge, MA) IN: Guidance, Navigation and Control Conference, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 587-596.
(Contract NAS9-16023)
(AIAA PAPER 85-1952)

The Advanced Information Processing System (AIPS) is designed to provide a fault tolerant and damage tolerant data processing architecture for a broad range of aerospace vehicles, including tactical and transport aircraft, and manned and autonomous spacecraft. A proof-of-concept (POC) system is now in the detailed design and fabrication phase. This paper gives an overview of a preliminary fault detection and error handling philosophy in AIPS. Author

A85-45940#
DESIGN FOR AN ADA-BASED ARCHITECTURE FOR CRITICAL FLIGHT CONTROLS
D. B. MULCARE, L. E. DOWNING, and L. A. BARTON (Lockheed-Georgia Co., Marietta, GA) IN: Guidance, Navigation and Control Conference, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 604-614. refs
(AIAA PAPER 85-1954)

Improvements to the existing development methodology for critical digital flight control systems (DFCS) that have been achieved

through the use of the Ada programming language are examined. In particular, attention is given to the system-to-software design transition, design verification, design description clarity, and the impact on software architecture. An example illustrating the application of the improved methodology to the development of a quadruplex DFCS system/software architecture in a system simulator is presented. V.L.

A85-45966#
SINGULAR VALUE ANALYSIS OF COMPETITIVE MULTI-INPUT/MULTI-OUTPUT MANUAL CONTROL SYSTEMS
R. C. SCHWANZ (Rockwell International Corp., Systems Dept., El Segundo, CA) IN: Guidance, Navigation and Control Conference, Snowmass, CO, August 19-21, 1985, Technical Papers . New York, AIAA, 1985, p. 828-835. refs
(AIAA PAPER 85-1943)

The singular values of matrices selected from the output measurement equations are suggested as useful measures of the performance of a dynamical process possessing an integrated control system. Evaluation of the performance of competing integrated control systems is also facilitated with singular values, provided the output measurement sets of each subsystem and the integrated system are consistent. The manual control of an augmented, reduced static stability aircraft in landing approach is used as an illustration. Author

A85-45973#
GENERIC FAULT-TOLERANCE TECHNIQUES FOR CRITICAL AVIONICS SYSTEMS
L. J. YOUNT (Sperry Corp., Commercial Flight Systems Div., Phoenix, AZ) AIAA, Guidance, Navigation and Control Conference, Snowmass, CO, Aug. 19-21, 1985. 6 p. refs
(AIAA PAPER 85-1980)

This paper discusses various categories of design errors (generic faults) in both software and hardware, addressing the perceived benefits of techniques for 'software fault-tolerance' as an alternative to 'fault-avoidance' techniques. The unique analysis problems introduced by the application of complex digital processors and software to flight-critical avionics systems are identified as distinct from the analysis problems associated with earlier analog systems. Software fault-tolerance techniques are shown to be capable of reducing the required software error rate for individual software packages to levels that permit empirical verification, including software packages associated with systems having system-error-rate requirements of 10 to the -9th per hour. Author

A85-46822#
EIGENSTRUCTURE ASSIGNMENT AND ITS APPLICATION IN DESIGN OF FLIGHT CONTROL SYSTEM
Z. GEN and D. FU (Nanjing Aeronautical Institute, People's Republic of China) Acta Aeronautica et Astronautica Sinica, vol. 6, April 1985, p. 164-171. In Chinese, with abstract in English. refs

The present paper is concerned with an extension of the basic concept and the algorithm of eigenstructure assignment. A general conclusion is drawn regarding the assignment of freedoms in the case of the eigenstructure, taking into account a completely controllable linear time-invariant system. Two new algorithms are provided for assigning the eigenstructure with multiple eigenvalues and/or with complex conjugate eigenvalues. The application of the eigenstructure assignment method to the design of a flight control system is illustrated with the aid of a numerical example involving an aircraft flight control system. G.R.

N85-32794*# National Aeronautics and Space Administration. Dryden (Hugh L.) Flight Research Center, Edwards, Calif.
DESIGN OF AN EXPERT-SYSTEM FLIGHT STATUS MONITOR
V. A. REGENIE and E. L. DUKE Aug. 1985 11 p Presented at the AIAA Guidance and Control Conf., Snowmass, Colo., 19-21 Aug. 1985
(NASA-TM-86739; H-1300; NAS 1.15:86739; AIAA-85-1980)
Avail: NTIS HC A02/MF A01 CSCL 09B

The modern advanced avionics in new high-performance aircraft strains the capability of current technology to safely monitor these systems for flight test prior to their generalized use. New techniques are needed to improve the ability of systems engineers to understand and analyze complex systems in the limited time available during crucial periods of the flight test. The Dryden Flight Research Facility of NASA's Ames Research Center is involved in the design and implementation of an expert system to provide expertise and knowledge to aid the flight systems engineer. The need for new techniques in monitoring flight systems and the conceptual design of an expert-system flight status monitor is discussed. The status of the current project and its goals are described. Author

N85-32846# California Univ., Livermore. Lawrence Livermore Lab.
DYNA3D, INGRID, AND TAURUS: AN INTEGRATED, INTERACTIVE SOFTWARE SYSTEM FOR CRASHWORTHINESS ENGINEERING
D. J. BENSON, J. O. HALLQUIST, and D. W. STILLMAN Apr. 1985 9 p Presented at the ASME Intern. Computers in Eng. Conf. and Exhibition, Boston, 4 Aug. 1985
(Contract W-7405-ENG-48)
(DE85-010928; UCRL-92218; CONF-850862-2) Avail: NTIS HC A02/MF A01

An integrated, interactive set of finite element programs for crashworthiness analysis was developed. The DYNA3D has the following four capabilities that are critical for the efficient and accurate analysis of crashes: (1) fully nonlinear solid, shell, and beam elements for representing a structure; (2) a broad range of constitutive models for representing the materials; (3) sophisticated contact algorithms for the impact interactions; and (4) a rigid body capability to represent the bodies away from the impact zones at a greatly reduced cost without sacrificing any accuracy in the momentum calculations. A general purpose mesh generator is used to generate the large and complex data files for DYNA3D, INGRID. The INGRID also doubles as a geometric modeller. The TAURUS, an interactive post processor, is used to display DYNA3D output. In addition to the standard monochrome hidden line display, time history plotting, and contouring, TAURUS generates interactive color displays on eight color video screens by plotting color bands superimposed on the mesh which indicate the value of the state variables. It is found that color is as important as hidden line removal in aiding the analyst in understanding results. The basic methodologies of the programs are presented along with several crashworthiness calculations. DOE

16

PHYSICS

Includes physics (general); acoustics; atomic and molecular physics; nuclear and high-energy physics; optics; plasma physics; solid-state physics; and thermodynamics and statistical physics.

A85-44037
RADIATION, PROPAGTION, FLUID-STRUCTURE COUPLING; COLLOQUIUM ON AERONAUTICAL ACOUSTICS, 9TH, COMPIEGNE, FRANCE, NOVEMBER 14-16, 1984, REPORTS. PARTS 1 & 2 [RAYONNEMENT, PROPAGATION, COUPLAGE FLUIDE-STRUCTURE; COLLOQUE D'ACOUSTIQUE AERONAUTIQUE, 9TH, COMPIEGNE, FRANCE, NOVEMBER 14-16, 1984, COMMUNICATIONS. PARTS 1 & 2]
Colloquium sponsored by the Association Aeronautique et Astronautique de France and Groupement des Acousticiens de Langue Francaise. Revue d'Acoustique, vol. 18, no. 72 & 73, 1985, Pt. 1, 183 p.; pt. 2, 190 p. In French. For individual items see A85-44038 to A85-44050.

Analytical tools which have been devised for examination of acoustic phenomena of interest in aerospace applications are presented. The techniques include a finite element method for elasto-acoustic coupling in a surface, a finite difference model for acoustic propagation in ducts and a variational formulation for acoustic radiation from axisymmetric structures. The situations studied also cover acoustic energy transfer near the ring frequency in a cylinder and in a cylindrical shell excited by a plane wave. Finally, attention is devoted to the propagation of acoustic radiation in a turbomachinery duct. M.S.K.

A85-44038
A SURFACE FINITE ELEMENT METHOD FOR ELASTO-ACOUSTIC COUPLING [UNE METHODE D'ELEMENTS FINIS DE SURFACE POUR LE COUPLAGE ELASTO-ACOUSTIQUE]
J. B. MARIEM and J. M. A. HAMDI (Compiegne, Universite de Technologie, France) Revue d'Acoustique, vol. 18, no. 72, 1985, p. 9-36. In French. refs

Finite element variational models are presented for elasto-acoustic coupling between a shell and an external fluid medium. Integral equations are employed to account for the displacement field of the shell surface due to contact with the fluid. The equilibrium state of the elastic surface is represented in variational form and consideration is given to the energy potential exchanged between the surface and the fluid because of the surrounding pressure field. Green's function is then applied to obtaining a solution. The technique is applied to model a double pressure layer and a rigid, baffled surface. Methods are also presented for discretizing the surface and for extending the equations to structures experiencing loading from different fluids such as fuel in a tank and the ambient atmosphere. M.S.K.

A85-44039
MECHANISMS OF ACOUSTICAL ENERGY TRANSFER BY A CYLINDRICAL SHELL NEAR THE RING FREQUENCY [MECANISMES DE TRANSFERT D'ENERGIE ACOUSTIQUE PAR UNE COQUE CYLINDRIQUE AU VOISINAGE DE LA FREQUENCE D'ANNEAU]
M. BARBE, M. GOTTELAND, and C. CACCIOLATI (Lyon, Institut National des Sciences Appliquees, Villeurbanne, France) Revue d'Acoustique, vol. 18, no. 72, 1985, p. 77-91. In French. Research supported by the Institut National des Sciences Appliquees de Lyon and Aerospatiale. refs

An analytical model is developed for the propagation of acoustic energy through a long cylinder with a large radius, such as encountered in aerospace applications. An acoustic wave is assumed to strike the exterior of the shell obliquely, part of the energy being reflected, the other absorbed. Account is taken of the displacements of the shell towards the interior, the appearance of a circular mode for the acoustic energy, the acoustic impedance of the shell, and the frequencies of the reflected and transmitted energy. A mass law is obtained for certain frequency zones. The law is useful for predicting when the acoustic energy transmitted to the interior will be zero. The model can be applied to controlling the noise levels transmitted to the interior of a fuselage. M.S.K.

A85-44040
THE TRANSMISSION OF ACOUSTIC ENERGY BY A FINITE CYLINDRICAL SHELL EXCITED BY EXTERNAL PLANE WAVES [TRANSMISSION D'ENERGIE ACOUSTIQUE PAR UNE COQUE CYLINDRIQUE FINIE EXCITEE PAR DES ONDES PLANES EXTERNES]
C. CACCIOLATI, M. GOTTELAND, and M. BARBE (Lyon, Institut National des Sciences Appliquees, Villeurbanne, France) Revue d'Acoustique, vol. 18, no. 72, 1985, p. 92-101. In French. Research supported by the Institut National des Sciences Appliquees de Lyon and Aerospatiale.

A qualitative method is presented for sensitivity analyses of acoustic coupling between cylindrical shells such as found in aerospace structures. The shells are excited by an exterior plane wave. The analysis is carried out in terms of coupling among the exterior and structural natural modes and the structural and cavity natural modes. Strong coupling is shown to be limited to cases of coincidence of resonance frequencies and when numerous identical incident waves arrive from multiple directions. Coupling will in any case be confined to low frequencies. Limits are defined for the necessary number of frequencies which must be considered when predicting whether or not coupling will occur. M.S.K.

A85-44041
THE PROPAGATION OF ACOUSTIC MODES IN THE ANNULAR CIRCULAR DUCT OF TURBOMACHINERY IN THE PRESENCE OF SWIRLING MEAN FLOW [PROPAGATION DES MODES ACOUSTIQUES DANS LE CONDUIT ANNULAIRE CYLINDRIQUE D'UNE TURBOMACHINE EN PRESENCE DE L'ECOULEMENT MOYEN TOURNANT]
P. ANDRE (SNECMA, Moissy-Cramayel, France) Revue d'Acoustique, vol. 18, no. 72, 1985, p. 104-127. In French.

An analytical technique is defined for predicting the cut-off frequency of an acoustic mode in a swirling mean flow in a turbomachinery duct. The cut-off frequency is of interest because below it the acoustic energy can contribute to the sound level of turbojets. The flow, subsonic, is decomposed into swirling and irrotational components. The swirl induced by the turning turbine blades has a significant impact on the cut-off frequency. Judicious selection of the number of blades, fixed and/or mobile, can be used to control the range of the cut-off frequency. Several examples are provided for applying the calculations to study approach flight phases, when emitted noise has the greatest nuisance value. M.S.K.

A85-44045
A TECHNIQUE FOR THE EVALUATION OF THE MAGNITUDE OF ACOUSTIC POWER RADIATED FROM THE DUCT OF A TURBOJET USING A POINT MEASUREMENT [TECHNIQUE D'EVALUATION DES NIVEAUX DE PUISSANCE ACOUSTIQUE RAYONNEE A PARTIR D'UNE MESURE UNIQUE DANS UN CONDUIT DE TURBOREACTEUR]
J. JULLIARD (SNECMA, Moissy-Cramayel, France) Revue d'Acoustique, vol. 18, no. 73, 1985, p. 206-216. In French.

Data from an internal parietal sensor are shown to be sufficient for measuring the global noise emitted from the duct of a turbojet turning at transonic speeds. The concept is based on analytical consideration of the acoustic power, comprising multiple frequencies, along discrete radiation paths. In the case of a cylindrical duct, the noise propagation will be directional and of a magnitude which is a function of the harmonic of the turbine rotational speed. Fast measurements of the wall pressure, when considered in the context of a specific frequency, yields the modal composition of the sound waves. The acoustic energy is obtained by integration of a one-dimensional Bessel function on a section of the duct. It is expected that the technique can be extended to

identify other noise sources and to the characterization of the modal energy distribution. M.S.K.

A85-44046
NOISE BANDS ASSOCIATED WITH THE TURBULENCE-ROTOR INTERACTION [BRUIT DE RAIES ASSOCIE A L'INTERACTION TURBULENCE-ROTOR]
J. M. CAILLEAU (SNECMA, Moissy-Cramayel, France) Revue d'Acoustique, vol. 18, no. 73, 1985, p. 217-233. In French. refs

It is known that atmospheric turbulence ingested by a turbojet intake will contribute to noise outputs near the frequency of the blade rotational speed and its harmonics. The sound level increases with nearness to the ground, where turbulence is most intense. The turbulent flow entering the duct is modeled in terms of the transverse and axial scale lengths and the flow speed, with free turbulent structures assumed to have a Gaussian distribution. The flow treated is subsonic and incompressible, and encounters thin, slightly cambered blades. Attention is given to the acoustic pressure field, the acoustic power and the spectra of the radiated noise. A sensitivity analysis is performed for the modal power as a function of directivity, the number of rotor blades, the coherence length of the turbulence, the rate of turbulence and the compressor regime. Finally, a comparison is favorably made with experimental data. The techniques used are concluded useful for designing acoustic damping systems for turbojets. M.S.K.

A85-44996
EVOLUTION OF A 100 MPBPS FIBER OPTIC SERIAL DATA BUS FOR AEROSPACE APPLICATIONS
R. W. UHLHORN, A. E. GEESLIN, and T. H. OTTEN (Harris Corp., Government Aerospace Systems Div., Melbourne, FL) IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 1 . New York, IEEE, 1984, p. 127-134. refs

Future aircraft and spacecraft will incorporate high speed data buses connecting avionics subsystems immersed in an electromagnetically hostile environment. The benefits of using fiber optics as the data transfer medium of choice for such systems are well known. Anticipating the use of high speed fiber optic data buses in avionics systems of the future, a company-sponsored program was initiated to explore component-through-system aspects of the technology. This paper describes the evolutionary steps in the development of a 100 Mbps Serial Fiber Optic Data Bus for aerospace applications. Beginning with a discussion of several possible protocols and applications, the development of each major subsystem is discussed. A token passing protocol is used to maximize bus efficiency. Development hardware supporting a 32 terminal network including an LED transmitter, APD receiver and user interface equipment, as well as test results from evaluation of the bus receivers and transmitters in a bus signaling environment, are described. Testing methods are discussed and test results are presented. Author

A85-45670#
PSEUDO-NOISE AND NOISE
R. LEGENDRE (ONERA, Chatillon-sous-Bagneux, France) La Recherche Aerospatiale (English Edition) (ISSN 0379-380X), no. 1, 1985, p. 55-63.

Lighthill's distinction between noise, which includes all disturbances propagating to the far field at the speed of sound, and pseudonoise, which constitutes the remaining disturbances, must be retained in order to correctly analyze the results of measurements of pressure variations in the near field and extrapolate them without excessive error, in the prediction of noise reaching the ground from aircraft. In the case of turbulent flows, pseudonoise and noise are closely interrelated, since the violent and random agitation of the fluid yields interference which permits only a fraction of acoustical power to escape. Attention is given to subsonic phenomena. O.C.

A85-45710*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
EFFECT OF INITIAL CONDITION ON SUBSONIC JET NOISE
K. B. M. Q. ZAMAN (NASA, Langley Research Center; George Washington, University, Hampton, VA) AIAA Journal (ISSN 0001-1452), vol. 23, Sept. 1985, p. 1370-1373. refs

The initial boundary-layer state can significantly affect the radiated noise from an axisymmetric jet. Jets with initially laminar boundary layers are found to emit more noise. Thus, 'cleaner' far-field noise characteristics are achieved in tripped jets. Data suggest that the additional noise in the initially laminar case partly originates from the first stage of pairing of the coherent shear-layer vortices. Author

A85-45840*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
NOISE RADIATION PATTERNS OF COUNTER-ROTATION AND UNSTEADILY LOADED SINGLE-ROTATION PROPELLERS
P. J. W. BLOCK (NASA, Langley Research Center, Hampton, VA) Journal of Aircraft (ISSN 0021-8669), vol. 22, Sept. 1985, p. 776-783. Previously cited in issue 01, p. 71, Accession no. A85-10830. refs

N85-32983# Federal Aviation Administration, Washington, D.C. Office of Environment and Energy.
FAA/GAMA (FEDERAL AVIATION ADMINISTRATION/GENERAL AVIATION MANUFACTURER'S ASSOCIATION) PROPELLER AIRCRAFT NOISE TEST PROGRAM, SALINA MUNICIPAL AIRPORT, SALINA, KANSAS
Feb. 1985 44 p
(AD-A154818; FAA-EE-85-1) Avail: NTIS HC A03/MF A01 CSCL 20A

In September, 1984, the FAA, with the cooperation and support of the General Aviation Manufacturers' Assoc. (GAMA), conducted a noise measurement program on small propeller-driven aircraft at Salina Municipal Airport, Salina, Kansas. The program objectives were: (1) to obtain takeoff noise data using prepared international and U.S. certification procedures for propeller-driven small airplanes; and (2) to measure the benefits of noise abatement takeoff procedures being developed by the manufacturers for inclusion in the Pilot's Operating Handbook. For the five twin and four single engine aircraft tested, the results show an average noise reduction of 4.4 decibels when using reduced power procedures after takeoff. GRA

N85-33752 National Physical Lab., Teddington (England). Div. of Radiation Science and Acoustics.
A THEORETICAL APPRAISAL OF THE USE OF GROUND-PLANE MICROPHONES FOR AIRCRAFT NOISE MEASUREMENTS
R. C. PAYNE and G. F. MILLER Dec. 1984 38 p refs
(NPL-AC-103; ISSN-0143-7143) Avail: Issuing Activity

It is demonstrated theoretically that the use of a ground-plane microphone arrangement for aircraft noise measurements successfully removes the effects of constructive and destructive interference which occur with the conventional 1.2 m high microphone location. The arrangement recommended consists of a 0.4 m diameter hard, rigid baffle placed flush with the surrounding ground. The microphone should be offset from the center of the baffle by three-quarters of the baffle radius and mounted in such away that a line drawn from it to the center of the baffle is perpendicular to the projected line of aircraft flight. The importance of ensuring a flush baffle placement is stressed, the baffle should be recessed into the ground. Measurement performance depends on the shape of the noise spectrum (including tonal content) and on the angle of sound incidence. Author (ESA)

N85-33810# Department of the Air Force, Washington, D.C.
REMOVABLE CLEANABLE ANTIREFLECTION SHIELD Patent Application
H. L. TASK, inventor (to Air Force) 10 Jan. 1985 9 p
(AD-D011735; US-PATENT-APPL-SN-690212) Avail: NTIS HC A02/MF A01 CSCL 06Q

A replaceable anti-reflection shield for the glare surface beneath the windscreen an aircraft is described which comprises a flexible panel of light absorbing material, such as black cloth, velvet, canvas or plastic, of size and configuration corresponding to that of the glare surface for placement on and conformance to the contour of the glare surface beneath the windscreen, and peripheral attaching means such as adhesive strips, snaps. Velcro strips, suction cups, or similar devices, on the flexible panel for detachably securing the peripheral edges of the panel to the glare surface. Whereby the panel is easily removed for cleaning or replacement. GRA

17

SOCIAL SCIENCES

Includes social sciences (general); administration and management; documentation and information science; economics and cost analysis; law and political science; and urban technology and transportation.

A85-43776#
TEACHING UNDERGRADUATE AIRBREATHING PROPULSION AT THE US AIR FORCE ACADEMY
J. D. MATTINGLY (U.S. Air Force Academy, Colorado Springs, CO) and W. H. HEISER (Tennessee, University, Tullahoma) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 21st, Monterey, CA, July 8-10, 1985. 7 p. refs
(AIAA PAPER 85-1145)

This paper summarizes the status of the teaching of airbreathing propulsion to the undergraduate students of the United States Air Force Academy. This is one of the most active and productive propulsion curricula in the country. The emphasis of the paper is on course philosophy and content in general, and on the goals and experiences of the flagship course on propulsion design in particular. Author

A85-44097
OBTAINING TITLE AND FINANCING TRANSPORT CATEGORY AIRCRAFT NATIONAL AND INTERNATIONAL IMPLICATIONS
J. T. STEWART, JR. (Zuckert, Scoutt, Rasenberger, and Johnson, Washington, DC) Journal of Air Law and Commerce (ISSN 0021-8642), vol. 50, no. 2, 1985, p. 191-218. refs

The most important elements of U.S. and international law relating to the possession of title to transport category aircraft are discussed with a view to their influence on lenders, purchasers, and sellers of such aircraft. Security interests have influenced the adoption by almost all states of the U.S. of the Uniform Commerical Code (Louisiana is the only exception), and the Federal Aviation Act has been amended to accommodate the changing environment of deregulation. The international community has amended international undertakings to recognize the viable use of aircraft by permitting the delegation of authority from the countries of registry to the countries of the operators. It is suggested that computerized information services may be harnessed to effectively implement the international flow of aircraft registry and ownership data. O.C.

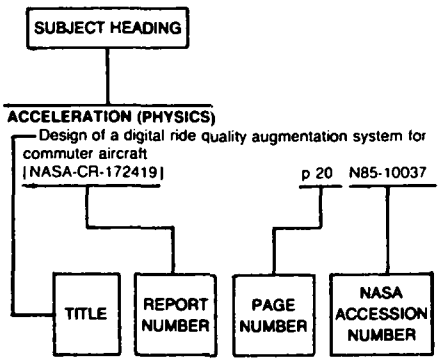
A85-44098
A NEW PROPOSAL FOR THE REFORM OF COMMERICAL AIR CRASH LITIGATION
A. J. CHALK (Southern Methodist University, Dallas, TX) Journal of Air Law and Commerce (ISSN 0021-8642), vol. 50, no. 2, 1985, p. 219-252. refs

A critical evaluation is conducted of the current system of litigation for aircraft accidents, and its performance is compared with the features of a hypothetical insurance system which circumvents the shortcomings of current tort liability. While tort liability is a system suited to the resolution of conflict among separate parties, insurance is a contractual matter between parties who interact in advance. A carefully structured passenger insurance system would transfer the locus of decision-making authority to the consumer, thereby eliminating the problems associated with tort liability. O.C.

A85-45150#
A COMPARISON OF VARIOUS LIFE CYCLE COST MODELS
L. R. WELCH (USAF, Avionics Systems Div., Wright-Patterson AFB, OH) IN: NAECON 1984; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 21-25, 1984. Volume 2 . New York, IEEE, 1984, p. 1287-1292. refs

Life Cycle Cost (LCC) prediction has become an important step in the acquisition of avionics systems. Many models have been developed in an attempt to predict a system's LCC early in the acquisition process. This paper presents a synopsis of various LCC models which have been developed: the Reliability, Maintainability and Cost Model (RMGM), the Freiman Analysis of Systems Technique Equipment Model (FAST-E), the Programmed Review of Information for Costing and Evaluation (PRICE) Model, the TI-59 Handheld Calculator Aircraft Top Level Life Cycle Cost (TI-59 ATL2C2) Model, and the Avionics Laboratory Predictive Operations and Support (ALPOS) Cost Model. Each synopsis discusses important aspects of the model, including a description of the model, a summary of model inputs and outputs, and the accessibility of the model. A table comparing the various characteristics of the models are also presented. Author

Typical Subject Index Listing



The subject heading is a key to the subject content of the document. The title is used to provide a description of the subject matter. When the title is insufficiently descriptive of the document content, the title extension is added, separated from the title by three hyphens. The (NASA or AIAA) accession number and the page number are included in each entry to assist the user in locating the abstract in the abstract section. If applicable, a report number is also included as an aid in identifying the document. Under any one subject heading, the accession numbers are arranged in sequence with the AIAA accession numbers appearing first.

A

B

C

D

E

F

G

H

I

J

K

L

M

N

O

P

Q

R

S

T

U

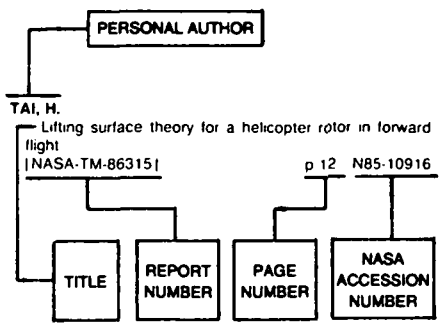
V

W

X

Y

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 listed (e.g., NASA report, translation, NASA contractor report). The page and accession numbers are located beneath and to the right of the title. Under any one author's name the accession numbers are arranged in sequence with the AIAA accession numbers appearing first.

A

B

AUTHOR

C

D

E

F

G

H

I

J

K

L

M

N

O

P

Q

R

S

T

U

V

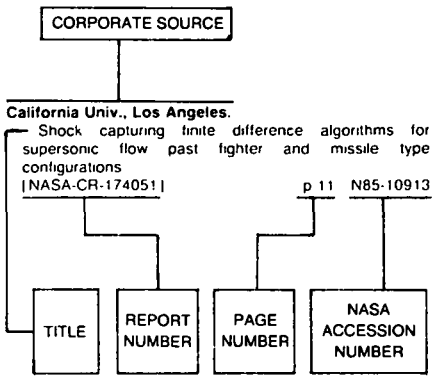
W

X

Y

Z

Typical Corporate Source Index Listing



Listings in this index are arranged alphabetically by corporate source. The title of the document is used to provide a brief description of the subject matter. The page number and the accession number are included in each entry to assist the user in locating the abstract in the abstract section. If applicable, a report number is also included as an aid in identifying the document.

SOURCE

O

P

R

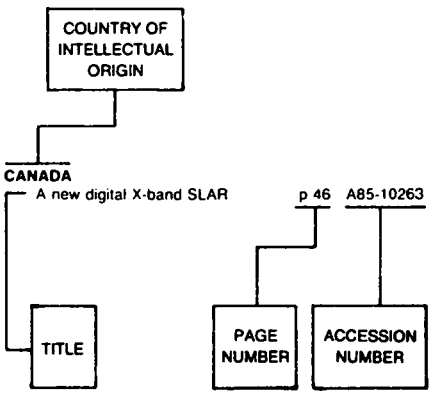
S

T

V

W

Typical Foreign Technology Index Listing

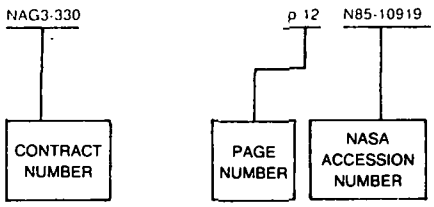


Listings in this index are arranged alphabetically by country of intellectual origin. The title of the document is used to provide a brief description of the subject matter. The page number and the accession number are included in each entry to assist the user in locating the citation in the abstract section.

S

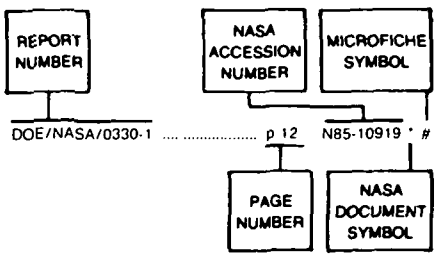
U

Typical Contract Number Index Listing



Listings in this index are arranged alpha-numerically by contract number. Under each contract number, the accession numbers denoting documents that have been produced as a result of research done under that contract are arranged in ascending order with the AIAA accession numbers appearing first. The accession number denotes the number by which the citation is identified in the abstract section. Preceding the accession number is the page number on which the citation may be found.

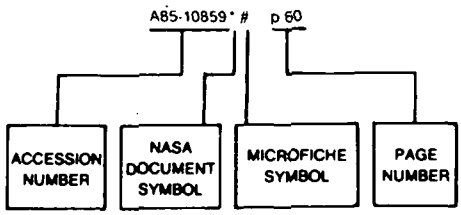
Typical Report Number Index Listing



Listings in this index are arranged alphanumerically by report number. The page number indicates the page on which the citation is located. The accession number denotes the number by which the citation is identified. An asterisk (*) indicates that the item is a NASA report. A pound sign (#) indicates that the item is available on microfiche.

REPORT

Typical Accession Number Index Listing



Listings in this index are arranged alphanumerically by accession number. The page number listed to the right indicates the page on which the citation is located. An asterisk (*) indicates that the item is a NASA report. A pound sign (#) indicates that the item is available on microfiche.

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
NASA SP-7037 (194)		

4. Title and Subtitle	5. Report Date
Aeronatuical Engineering A Continuing Bibliography (Supplement 194)	December 1985
	6. Performing Organization Code
7. Author(s)	8. Performing Organization Report No.
	10. Work Unit No.
9. Performing Organization Name and Address National Aeronautics and Space Administration Washington, D.C. 20546	11. Contract or Grant No.
	13. Type of Report and Period Covered
12. Sponsoring Agency Name and Address	14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstract

This bibliography lists 369 reports, articles and other documents introduced into the NASA scientific and technical information system in November 1985.

17. Key Words (Suggested by Author(s))	18. Distribution Statement
Aeronautical Engineering Aeronautics Bibliographies	Unclassified - Unlimited

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price*
Unclassified	Unclassified	112	$9.95/HC

*For sale by the National Technical Information Service, Springfield, Virginia 22161

NASA-Langley, 1985

FEDERAL DEPOSITORY LIBRARY PROGRAM

The Federal Depository Library Program provides Government publications to designated libraries throughout the United States. The Regional Depository Libraries listed below receive and retain at least one copy of nearly every Federal Government publication, either in printed or microfilm form, for use by the general public. These libraries provide reference services and inter-library loans; however, they are *not* sales outlets. You may wish to ask your local library to contact a Regional Depository to help you locate specific publications, or you may contact the Regional Depository yourself.

ARKANSAS STATE LIBRARY
One Capitol Mall
Little Rock, AR 72201
(501) 371-2326

AUBURN UNIV. AT MONTGOMERY LIBRARY
Documents Department
Montgomery, AL 36193
(205) 279-9110, ext. 253

UNIV. OF ALABAMA LIBRARY
Documents Dept.—Box S
University, AL 35486
(205) 348-7369

DEPT. OF LIBRARY, ARCHIVES AND PUBLIC RECORDS
Third Floor—State Cap.
1700 West Washington
Phoenix, AZ 85007
(602) 255-4121

UNIVERSITY OF ARIZONA LIB.
Government Documents Dept.
Tucson, AZ 85721
(602) 626-5233

CALIFORNIA STATE LIBRARY
Govt. Publications Section
P.O. Box 2037
Sacramento, CA 95809
(916) 322-4572

UNIV. OF COLORADO LIB.
Government Pub. Division
Campus Box 184
Boulder, CO 80309
(303) 492-8834

DENVER PUBLIC LIBRARY
Govt. Pub. Department
1357 Broadway
Denver, CO 80203
(303) 571-2131

CONNECTICUT STATE LIBRARY
Government Documents Unit
231 Capitol Avenue
Hartford, CT 06106
(203) 566-4971

UNIV. OF FLORIDA LIBRARIES
Library West
Documents Department
Gainesville, FL 32611
(904) 392-0367

UNIV. OF GEORGIA LIBRARIES
Government Reference Dept.
Athens, Ga 30602
(404) 542-8951

UNIV. OF HAWAII LIBRARY
Govt. Documents Collection
2550 The Mall
Honolulu, HI 96822
(808) 948-8230

UNIV. OF IDAHO LIBRARY
Documents Section
Moscow, ID 83843
(208) 885-6344

ILLINOIS STATE LIBRARY
Information Services Branch
Centennial Building
Springfield, IL 62706
(217) 782-5185

INDIANA STATE LIBRARY
Serials Documents Section
140 North Senate Avenue
Indianapolis, IN 46204
(317) 232-3686

UNIV. OF IOWA LIBRARIES
Govt. Documents Department
Iowa City, IA 52242
(319) 353-3318

UNIVERSITY OF KANSAS
Doc. Collect—Spencer Lib.
Lawrence, KS 66045
(913) 864-4662

UNIV. OF KENTUCKY LIBRARIES
Govt. Pub. Department
Lexington, KY 40506
(606) 257-3139

LOUISIANA STATE UNIVERSITY
Middleton Library
Govt. Docs. Dept.
Baton Rouge, LA 70803
(504) 388-2570

LOUISIANA TECHNICAL UNIV. LIBRARY
Documents Department
Ruston, LA 71272
(318) 257-4962

UNIVERSITY OF MAINE
Raymond H. Fogler Library
Tri-State Regional Documents Depository
Orono, ME 04469
(207) 581-1680

UNIVERSITY OF MARYLAND
McKeldin Lib.—Doc. Div.
College Park, MD 20742
(301) 454-3034

BOSTON PUBLIC LIBRARY
Government Docs. Dept.
Boston, MA 02117
(617) 536-5400 ext. 226

DETROIT PUBLIC LIBRARY
Sociology Department
5201 Woodward Avenue
Detroit, MI 48202
(313) 833-1409

MICHIGAN STATE LIBRARY
P.O. Box 30007
Lansing, MI 48909
(517) 373-0640

UNIVERSITY OF MINNESOTA
Government Pubs. Division
409 Wilson Library
309 19th Avenue South
Minneapolis, MN 55455
(612) 373-7813

UNIV. OF MISSISSIPPI LIB.
Documents Department
University, MS 38677
(601) 232-5857

UNIV. OF MONTANA
Mansfield Library
Documents Division
Missoula, MT 59812
(406) 243-6700

NEBRASKA LIBRARY COMM.
Federal Documents
1420 P Street
Lincoln, NE 68508
(402) 471-2045
In cooperation with University of Nebraska-Lincoln

UNIVERSITY OF NEVADA LIB.
Govt. Pub. Department
Reno, NV 89557
(702) 784-6579

NEWARK PUBLIC LIBRARY
5 Washington Street
Newark, NJ 07101
(201) 733-7812

UNIVERSITY OF NEW MEXICO
Zimmerman Library
Government Pub. Dept.
Albuquerque, NM 87131
(505) 277-5441

NEW MEXICO STATE LIBRARY
Reference Department
325 Don Gaspar Avenue
Santa Fe, NM 87501
(505) 827-2033, ext. 22

NEW YORK STATE LIBRARY
Empire State Plaza
Albany, NY 12230
(518) 474-5563

UNIVERSITY OF NORTH CAROLINA AT CHAPEL HILL
Wilson Library
BA/SS Documents Division
Chapel Hill, NC 27515
(919) 962-1321

UNIVERSITY OF NORTH DAKOTA
Chester Fritz Library
Documents Department
Grand Forks, ND 58202
(701) 777-2617, ext. 27
(in cooperation with North Dakota State Univ. Library)

STATE LIBRARY OF OHIO
Documents Department
65 South Front Street
Columbus, OH 43215
(614) 462-7051

OKLAHOMA DEPT. OF LIB.
Government Documents
200 NE 18th Street
Oklahoma City, OK 73105
(405) 521-2502

OKLAHOMA STATE UNIV. LIB.
Documents Department
Stillwater, OK 74078
(405) 624-6546

PORTLAND STATE UNIV. LIB.
Documents Department
P.O. Box 1151
Portland, OR 97207
(503) 229-3673

STATE LIBRARY OF PENN.
Government Pub. Section
P.O. Box 1601
Harrisburg, PA 17105
(717) 787-3752

TEXAS STATE LIBRARY
Public Services Department
P.O. Box 12927—Cap. Sta.
Austin, TX 78753
(512) 471-2996

TEXAS TECH UNIV. LIBRARY
Govt. Documents Department
Lubbock, TX 79409
(806) 742-2268

UTAH STATE UNIVERSITY
Merrill Library, U.M.C. 30
Logan, UT 84322
(801) 750-2682

UNIVERSITY OF VIRGINIA
Alderman Lib.—Public Doc.
Charlottesville, VA 22901
(804) 924-3133

WASHINGTON STATE LIBRARY
Documents Section
Olympia, WA 98504
(206) 753-4027

WEST VIRGINIA UNIV. LIB.
Documents Department
Morgantown, WV 26506
(304) 293-3640

MILWAUKEE PUBLIC LIBRARY
814 West Wisconsin Avenue
Milwaukee, WI 53233
(414) 278-3000

ST. HIST LIB. OF WISCONSIN
Government Pub. Section
816 State Street
Madison, WI 53706
(608) 262-4347

WYOMING STATE LIBRARY
Supreme Ct. & Library Bld.
Cheyenne, WY 82002
(307) 777-6344

National Aeronautics and
Space Administration
Code NIT-4

Washington, D.C.
20546-0001

Official Business
Penalty for Private Use, $300

BULK RATE
POSTAGE & FEES PAID
NASA Washington, DC
Permit No. G-27

NASA

POSTMASTER: If Undeliverable (Section 158 Postal Manual) Do Not Return