NASA SP-7037 (356)
September 5, 1997

AERONAUTICAL ENGINEERING

A CONTINUING BIBLIOGRAPHY WITH INDEXES

National Aeronautics and
Space Administration
Langley Research Center
**Scientific and Technical
Information Program Office**

The NASA STI Program Office . . . in Profile

Since its founding, NASA has been dedicated to the advancement of aeronautics and space science. The NASA Scientific and Technical Information (STI) Program Office plays a key part in helping NASA maintain this important role.

The NASA STI Program Office is operated by Langley Research Center, the lead center for NASA's scientific and technical information. The NASA STI Program Office provides access to the NASA STI Database, the largest collection of aeronautical and space science STI in the world. The Program Office is also NASA's institutional mechanism for disseminating the results of its research and development activities. These results are published by NASA in the NASA STI Report Series, which includes the following report types:

- TECHNICAL PUBLICATION. Reports of completed research or a major significant phase of research that present the results of NASA programs and include extensive data or theoretical analysis. Includes compilations of significant scientific and technical data and information deemed to be of continuing reference value. NASA's counterpart of peer-reviewed formal professional papers but has less stringent limitations on manuscript length and extent of graphic presentations.

- TECHNICAL MEMORANDUM. Scientific and technical findings that are preliminary or of specialized interest, e.g., quick release reports, working papers, and bibliographies that contain minimal annotation. Does not contain extensive analysis.

- CONTRACTOR REPORT. Scientific and technical findings by NASA-sponsored contractors and grantees.

- CONFERENCE PUBLICATION. Collected papers from scientific and technical conferences, symposia, seminars, or other meetings sponsored or cosponsored by NASA.

- SPECIAL PUBLICATION. Scientific, technical, or historical information from NASA programs, projects, and missions, often concerned with subjects having substantial public interest.

- TECHNICAL TRANSLATION. English-language translations of foreign scientific and technical material pertinent to NASA's mission.

Specialized services that complement the STI Program Office's diverse offerings include creating custom thesauri, building customized databases, organizing and publishing research results . . . even providing videos.

For more information about the NASA STI Program Office, see the following:

- Access the NASA STI Program Home Page at ***http://www.sti.nasa.gov***

- E-mail your question via the Internet to help@sti.nasa.gov

- Fax your question to the NASA Access Help Desk at (301) 621-0134

- Telephone the NASA Access Help Desk at (301) 621-0390

- Write to:
  NASA Access Help Desk
  NASA Center for AeroSpace Information
  800 Elkridge Landing Road
  Linthicum Heights, MD 21090-2934

Introduction

This issue of *Aeronautical Engineering, A Continuing Bibliography with Indexes* (NASA SP-7037) lists reports, articles, and other documents recently announced in the NASA STI Database.

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 publication consists of a standard bibliographic citation accompanied, in most cases, by an abstract.

The NASA CASI price code table, addresses of organizations, and document availability information are included before the abstract section.

Two indexes—subject and author are included after the abstract section.

SCAN Goes Electronic!

If you have electronic mail or if you can access the Internet, you can view biweekly issues of *SCAN* from your desktop absolutely free!

Electronic SCAN takes advantage of computer technology to inform you of the latest worldwide, aerospace-related, scientific and technical information that has been published.

No more waiting while the paper copy is printed and mailed to you. You can view *Electronic SCAN* the same day it is released—up to 191 topics to browse at your leisure. When you locate a publication of interest, you can print the announcement. You can also go back to the *Electronic SCAN* home page and follow the ordering instructions to quickly receive the full document.

Start your access to *Electronic SCAN* today. Over 1,000 announcements of new reports, books, conference proceedings, journal articles...and more—available to your computer every two weeks.

Timely Flexible Complete FREE!

For Internet access to *E-SCAN*, use any of the following addresses:

http://www.sti.nasa.gov
ftp.sti.nasa.gov
gopher.sti.nasa.gov

To receive a free subscription, send e-mail for complete information about the service first. Enter **scan@sti.nasa.gov** on the address line. Leave the subject and message areas blank and send. You will receive a reply in minutes.

Then simply determine the SCAN topics you wish to receive and send a second e-mail to **listserve@sti.nasa.gov**. Leave the subject line blank and enter a subscribe command in the message area formatted as follows:

Subscribe <desired list> <Your name>

For additional information, e-mail a message to **help@sti.nasa.gov**.

Phone: (301) 621-0390

Fax: (301) 621-0134

Write: NASA Access Help Desk
NASA Center for AeroSpace Information
800 Elkridge Landing Road
Linthicum Heights, MD 21090-2934

Looking just for *Aerospace Medicine and Biology* reports?

Although hard copy distribution has been discontinued, you can still receive these vital announcements through your *E-SCAN* subscription. Just **subscribe SCAN-AEROMED** in the message area of your e-mail to **listserve@sti.nasa.gov**.

Table of Contents

Records are arranged in categories 1 through 19, the first nine coming from the Aeronautics division of *STAR*, followed by the remaining division titles. Selecting a category will link you to the collection of records cited in this issue pertaining to that category.

Indexes

Two indexes are available. You may use the find command under the tools menu while viewing the PDF file for direct match searching on any text string. You may also view the indexes provided, for searching on *NASA Thesaurus* subject terms and author names.

Selecting an index above will link you to that comprehensive listing.

Document Availability

Select **Availability Info** for important information about NASA Scientific and Technical Information (STI) Program Office products and services, including registration with the NASA Center for AeroSpace Information (CASI) for access to the NASA CASI TRS (Technical Report Server), and availability and pricing information for cited documents.

The New NASA Video Catalog is Here

Free!

To order your copy,
call the NASA Access Help Desk at
(301) 621-0390,
fax to
(301) 621-0134,
e-mail to
help@sti.nasa.gov,
or visit the NASA STI Program
homepage at
http://www.sti.nasa.gov/STI-homepage.html

(Select STI Program Bibliographic Announcements)

Explore the Universe!

Document Availability Information

The mission of the NASA Scientific and Technical (STI) Program Office is to quickly, efficiently, and cost-effectively provide the NASA community with desktop access to STI produced by NASA and the world's aerospace industry and academia. In addition, we will provide the aerospace industry, academia, and the taxpayer access to the intellectual scientific and technical output and achievements of NASA.

Eligibility and Registration for NASA STI Products and Services

The NASA STI Program offers a wide variety of products and services to achieve its mission. Your affiliation with NASA determines the level and type of services provided by the NASA STI Program. To assure that appropriate level of services are provided, NASA STI users are requested to register at the NASA Center for AeroSpace Information (CASI). Please contact NASA CASI in one of the following ways:

E-mail:	help@sti.nasa.gov
Fax:	301-621-0134
Phone:	301-621-0390
Mail:	ATTN: Registration Services NASA Center for AeroSpace Information 800 Elkridge Landing Road Linthicum Heights, MD 21090-2934

Limited Reproducibility

In the database citations, a note of limited reproducibility appears if there are factors affecting the reproducibility of more than 20 percent of the document. These factors include faint or broken type, color photographs, black and white photographs, foldouts, dot matrix print, or some other factor that limits the reproducibility of the document. This notation also appears on the microfiche header.

NASA Patents and Patent Applications

Patents and patent applications owned by NASA are announced in the STI Database. Printed copies of patents (which are not microfiched) are available for purchase from the U.S. Patent and Trademark Office.

When ordering patents, the U.S. Patent Number should be used, and payment must be remitted in advance, by money order or check payable to the Commissioner of Patents and Trademarks. Prepaid purchase coupons for ordering are also available from the U.S. Patent and Trademark Office.

NASA patent application specifications are sold in both paper copy and microfiche by the NASA Center for AeroSpace Information (CASI). The document ID number should be used in ordering either paper copy or microfiche from CASI.

The patents and patent applications announced in the STI Database are owned by NASA and are available for royalty-free licensing. Requests for licensing terms and further information should be addressed to:

National Aeronautics and Space Administration
Associate General Counsel for Intellectual Property
Code GP
Washington, DC 20546-0001

Sources for Documents

One or more sources from which a document announced in the STI Database 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, with an Addresses of Organizations list near the back of this section. 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.

Avail: NASA CASI. Sold by the NASA Center for AeroSpace Information. Prices for hard copy (HC) and microfiche (MF) are indicated by a price code following the letters HC or MF in the citation. Current values are given in the NASA CASI Price Code Table near the end of this section.

Note on Ordering Documents: When ordering publications from NASA CASI, use the document ID number or other report 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.

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: 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: ESDU. Pricing information on specific data, computer programs, and details on ESDU International topic categories can be obtained from ESDU International.

Avail: Fachinformationszentrum Karlsruhe. Gesellschaft für wissenschaftlich-technische Information mbH 76344 Eggenstein-Leopoldshafen, Germany.

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

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: NASA Public Document Rooms. Documents so indicated may be examined at or purchased from the National Aeronautics and Space Administration (JBD-4), Public Documents Room (Room 1H23), Washington, DC 20546-0001, or public document rooms located at NASA installations, and the NASA Pasadena Office at the Jet Propulsion Laboratory.

Avail: NTIS. Sold by the National Technical Information Service. Initially distributed microfiche under the NTIS SRIM (Selected Research in Microfiche) are available. For information concerning this service, consult the NTIS Subscription Section, Springfield, VA 22161.

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: US Patent and Trademark Office. Sold by Commissioner of Patents and Trademarks, U.S. Patent and Trademark Office, at the standard price of $1.50 each, postage free.

Avail: (US Sales Only). These foreign documents are available to users within the United States from the National Technical Information Service (NTIS). They are available to users outside the United States through the International Nuclear Information Service (INlS) representative in their country, or by applying directly to the issuing organization.

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 on the Addresses of Organizations page. The libraries may be queried concerning the availability of specific documents and the possible utilization of local copying services, such as color reproduction.

Addresses of Organizations

British Library Lending Division
Boston Spa, Wetherby, Yorkshire
England

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

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

European Space Agency–
Information Retrieval Service ESRIN
Via Galileo Galilei
00044 Frascati (Rome) Italy

ESDU International
27 Corsham Street
London
N1 6UA
England

Fachinformationszentrum Karlsruhe
Gesellschaft für wissenschaftlich–technische
Information mbH
76344 Eggenstein–Leopoldshafen, Germany

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

NASA Center for AeroSpace Information
800 Elkridge Landing Road
Linthicum Heights, MD 21090–2934

(NASA STI Lead Center)
National Aeronautics and Space Administration
Scientific and Technical Information Program Office
Langley Research Center – MS157
Hampton, VA 23681

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

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

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

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

University Microfilms, Ltd.
Tylers Green
London, England

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

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

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

U.S. Geological Survey Library
Box 25046
Denver Federal Center, MS914
Denver, CO 80225

NASA CASI Price Code Table

(Effective July 1, 1996)

CASI PRICE CODE	NORTH AMERICAN PRICE	FOREIGN PRICE
A01	$ 6.50	$ 13.00
A02	10.00	20.00
A03	19.50	39.00
A04-A05	21.50	43.00
A06	25.00	50.00
A07	28.00	56.00
A08	31.00	62.00
A09	35.00	70.00
A10	38.00	76.00
A11	41.00	82.00
A12	44.00	88.00
A13	47.00	94.00
A14-A17	49.00	98.00
A18-A21	57.00	114.00
A22-A25	67.00	134.00
A99	Call For Price	Call For Price

Important Notice

The $1.50 domestic and $9.00 foreign shipping and handling fee currently being charged will remain the same. Foreign airmail is $27.00 for the first 1-3 items, $9.00 for each additional item. Additionally, a new processing fee of $2.00 per each video ordered will be assessed.

For users registered at the NASA CASI, document orders may be invoiced at the end of the month, charged against a deposit account, or paid by check or credit card. NASA CASI accepts American Express, Diners' Club, MasterCard, and VISA credit cards. There are no shipping and handling charges. To register at the NASA CASI, please request a registration form through the NASA Access Help Desk at the numbers or addresses below.

Return Policy

The NASA Center for AeroSpace Information will gladly replace or make full refund on items you have requested if we have made an error in your order, if the item is defective, or if it was received in damaged condition and you contact us within 30 days of your original request. Just contact our NASA Access Help Desk at the numbers or addresses listed below.

NASA Center for AeroSpace Information
800 Elkridge Landing Road
Linthicum Heights, MD 21090-2934

E-mail: help@sti.nasa.gov
Fax: (301) 621-0134
Phone: (301) 621-0390

Rev. 6/96

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 53 regional depositories responsible for permanent retention of material, inter-library loan, and reference services. At least one copy of nearly every NASA and NASA-sponsored publication, either in printed or microfiche format, is received and retained by the 53 regional depositories. A list of the Federal Regional Depository Libraries, arranged alphabetically by state, appears at the very end of this section. These libraries are not sales outlets. A local library can contact a regional depository to help locate specific reports, or direct contact may be made by an individual.

Public Collection of NASA Documents

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 the STI Database. European requesters may purchase facsimile copy or microfiche of NASA and NASA-sponsored documents FIZ–Fachinformation Karlsruhe–Bibliographic Service, D-76344 Eggenstein-Leopoldshafen, Germany and TIB–Technische Informationsbibliothek, P.O. Box 60 80, D-30080 Hannover, Germany.

Submitting Documents

All users of this abstract service are urged to forward reports to be considered for announcement in the STI Database. This will aid NASA in its efforts to provide the fullest possible coverage of all scientific and technical publications that might support aeronautics and space research and development. If you have prepared relevant reports (other than those you will transmit to NASA, DOD, or DOE through the usual contract- or grant-reporting channels), please send them for consideration to:

ATTN: Acquisitions Specialist
NASA Center for AeroSpace Information
800 Elkridge Landing Road
Linthicum Heights, MD 21090-2934.

Reprints of journal articles, book chapters, and conference papers are also welcome.

You may specify a particular source to be included in a report announcement if you wish; otherwise the report will be placed on a public sale at the NASA Center for AeroSpace Information. Copyrighted publications will be announced but not distributed or sold.

Federal Regional Depository Libraries

ALABAMA

AUBURN UNIV. AT MONTGOMERY LIBRARY
Documents Dept.
7300 University Dr.
Montgomery, AL 36117–3596
(205) 244–3650 Fax: (205) 244–0678

UNIV. OF ALABAMA
Amelia Gayle Gorgas Library
Govt. Documents
P.O. Box 870266
Tuscaloosa, AL 35487–0266
(205) 348–6046 Fax: (205) 348–0760

ARIZONA

DEPT. OF LIBRARY, ARCHIVES, AND PUBLIC RECORDS
Research Division
Third Floor, State Capitol
1700 West Washington
Phoenix, AZ 85007
(602) 542–3701 Fax: (602) 542–4400

ARKANSAS

ARKANSAS STATE LIBRARY
State Library Service Section
Documents Service Section
One Capitol Mall
Little Rock, AR 72201–1014
(501) 682–2053 Fax: (501) 682–1529

CALIFORNIA

CALIFORNIA STATE LIBRARY
Govt. Publications Section
P.O. Box 942837 – 914 Capitol Mall
Sacramento, CA 94337–0091
(916) 654–0069 Fax: (916) 654–0241

COLORADO

UNIV. OF COLORADO – BOULDER
Libraries – Govt. Publications
Campus Box 184
Boulder, CO 80309–0184
(303) 492–8834 Fax: (303) 492–1881

DENVER PUBLIC LIBRARY
Govt. Publications Dept. BSG
1357 Broadway
Denver, CO 80203–2165
(303) 640–8846 Fax: (303) 640–8817

CONNECTICUT

CONNECTICUT STATE LIBRARY
231 Capitol Avenue
Hartford, CT 06106
(203) 566–4971 Fax: (203) 566–3322

FLORIDA

UNIV. OF FLORIDA LIBRARIES
Documents Dept.
240 Library West
Gainesville, FL 32611–2048
(904) 392–0366 Fax: (904) 392–7251

GEORGIA

UNIV. OF GEORGIA LIBRARIES
Govt. Documents Dept.
Jackson Street
Athens, GA 30602–1645
(706) 542–8949 Fax: (706) 542–4144

HAWAII

UNIV. OF HAWAII
Hamilton Library
Govt. Documents Collection
2550 The Mall
Honolulu, HI 96822
(808) 948–8230 Fax: (808) 956–5968

IDAHO

UNIV. OF IDAHO LIBRARY
Documents Section
Rayburn Street
Moscow, ID 83844–2353
(208) 885–6344 Fax: (208) 885–6817

ILLINOIS

ILLINOIS STATE LIBRARY
Federal Documents Dept.
300 South Second Street
Springfield, IL 62701–1796
(217) 782–7596 Fax: (217) 782–6437

INDIANA

INDIANA STATE LIBRARY
Serials/Documents Section
140 North Senate Avenue
Indianapolis, IN 46204–2296
(317) 232–3679 Fax: (317) 232–3728

IOWA

UNIV. OF IOWA LIBRARIES
Govt. Publications
Washington & Madison Streets
Iowa City, IA 52242–1166
(319) 335–5926 Fax: (319) 335–5900

KANSAS

UNIV. OF KANSAS
Govt. Documents & Maps Library
6001 Malott Hall
Lawrence, KS 66045–2800
(913) 864–4660 Fax: (913) 864–3855

KENTUCKY

UNIV. OF KENTUCKY
King Library South
Govt. Publications/Maps Dept.
Patterson Drive
Lexington, KY 40506–0039
(606) 257–3139 Fax: (606) 257–3139

LOUISIANA

LOUISIANA STATE UNIV.
Middleton Library
Govt. Documents Dept.
Baton Rouge, LA 70803–3312
(504) 388–2570 Fax: (504) 388–6992

LOUISIANA TECHNICAL UNIV.
Prescott Memorial Library
Govt. Documents Dept.
Ruston, LA 71272–0046
(318) 257–4962 Fax: (318) 257–2447

MAINE

UNIV. OF MAINE
Raymond H. Fogler Library
Govt. Documents Dept.
Orono, ME 04469–5729
(207) 581–1673 Fax: (207) 581–1653

MARYLAND

UNIV. OF MARYLAND – COLLEGE PARK
McKeldin Library
Govt. Documents/Maps Unit
College Park, MD 20742
(301) 405–9165 Fax: (301) 314–9416

MASSACHUSETTS

BOSTON PUBLIC LIBRARY
Govt. Documents
666 Boylston Street
Boston, MA 02117–0286
(617) 536–5400, ext. 226
Fax: (617) 536–7758

MICHIGAN

DETROIT PUBLIC LIBRARY
5201 Woodward Avenue
Detroit, MI 48202–4093
(313) 833–1025 Fax: (313) 833–0156

LIBRARY OF MICHIGAN
Govt. Documents Unit
P.O. Box 30007
717 West Allegan Street
Lansing, MI 48909
(517) 373–1300 Fax: (517) 373–3381

MINNESOTA

UNIV. OF MINNESOTA
Govt. Publications
409 Wilson Library
309 19th Avenue South
Minneapolis, MN 55455
(612) 624–5073 Fax: (612) 626–9353

MISSISSIPPI

UNIV. OF MISSISSIPPI
J.D. Williams Library
106 Old Gym Bldg.
University, MS 38677
(601) 232–5857 Fax: (601) 232–7465

MISSOURI

UNIV. OF MISSOURI – COLUMBIA
106B Ellis Library
Govt. Documents Sect.
Columbia, MO 65201–5149
(314) 882–6733 Fax: (314) 882–8044

MONTANA

UNIV. OF MONTANA
Mansfield Library
Documents Division
Missoula, MT 59812–1195
(406) 243–6700 Fax: (406) 243–2060

NEBRASKA

UNIV. OF NEBRASKA – LINCOLN
D.L. Love Memorial Library
Lincoln, NE 68588–0410
(402) 472–2562 Fax: (402) 472–5131

NEVADA

THE UNIV. OF NEVADA LIBRARIES
Business and Govt. Information Center
Reno, NV 89557–0044
(702) 784–6579 Fax: (702) 784–1751

NEW JERSEY

NEWARK PUBLIC LIBRARY
Science Div. – Public Access
P.O. Box 630
Five Washington Street
Newark, NJ 07101–7812
(201) 733–7782 Fax: (201) 733–5648

NEW MEXICO

UNIV. OF NEW MEXICO
General Library
Govt. Information Dept.
Albuquerque, NM 87131–1466
(505) 277–5441 Fax: (505) 277–6019

NEW MEXICO STATE LIBRARY
325 Don Gaspar Avenue
Santa Fe, NM 87503
(505) 827–3824 Fax: (505) 827–3888

NEW YORK

NEW YORK STATE LIBRARY
Cultural Education Center
Documents/Gift & Exchange Section
Empire State Plaza
Albany, NY 12230–0001
(518) 474–5355 Fax: (518) 474–5786

NORTH CAROLINA

UNIV. OF NORTH CAROLINA – CHAPEL HILL
Walter Royal Davis Library
CB 3912, Reference Dept.
Chapel Hill, NC 27514–8890
(919) 962–1151 Fax: (919) 962–4451

NORTH DAKOTA

NORTH DAKOTA STATE UNIV. LIB.
Documents
P.O. Box 5599
Fargo, ND 58105–5599
(701) 237–8886 Fax: (701) 237–7138

UNIV. OF NORTH DAKOTA
Chester Fritz Library
University Station
P.O. Box 9000 – Centennial and University Avenue
Grand Forks, ND 58202–9000
(701) 777–4632 Fax: (701) 777–3319

OHIO

STATE LIBRARY OF OHIO
Documents Dept.
65 South Front Street
Columbus, OH 43215–4163
(614) 644–7051 Fax: (614) 752–9178

OKLAHOMA

OKLAHOMA DEPT. OF LIBRARIES
U.S. Govt. Information Division
200 Northeast 18th Street
Oklahoma City, OK 73105–3298
(405) 521–2502, ext. 253
Fax: (405) 525–7804

OKLAHOMA STATE UNIV.
Edmon Low Library
Stillwater, OK 74078–0375
(405) 744–6546 Fax: (405) 744–5183

OREGON

PORTLAND STATE UNIV.
Branford P. Millar Library
934 Southwest Harrison
Portland, OR 97207–1151
(503) 725–4123 Fax: (503) 725–4524

PENNSYLVANIA

STATE LIBRARY OF PENN.
Govt. Publications Section
116 Walnut & Commonwealth Ave.
Harrisburg, PA 17105–1601
(717) 787–3752 Fax: (717) 783–2070

SOUTH CAROLINA

CLEMSON UNIV.
Robert Muldrow Cooper Library
Public Documents Unit
P.O. Box 343001
Clemson, SC 29634–3001
(803) 656–5174 Fax: (803) 656–3025

UNIV. OF SOUTH CAROLINA
Thomas Cooper Library
Green and Sumter Streets
Columbia, SC 29208
(803) 777–4841 Fax: (803) 777–9503

TENNESSEE

UNIV. OF MEMPHIS LIBRARIES
Govt. Publications Dept.
Memphis, TN 38152–0001
(901) 678–2206 Fax: (901) 678–2511

TEXAS

TEXAS STATE LIBRARY
United States Documents
P.O. Box 12927 – 1201 Brazos
Austin, TX 78701–0001
(512) 463–5455 Fax: (512) 463–5436

TEXAS TECH. UNIV. LIBRARIES
Documents Dept.
Lubbock, TX 79409–0002
(806) 742–2282 Fax: (806) 742–1920

UTAH

UTAH STATE UNIV.
Merrill Library Documents Dept.
Logan, UT 84322–3000
(801) 797–2678 Fax: (801) 797–2677

VIRGINIA

UNIV. OF VIRGINIA
Alderman Library
Govt. Documents
University Ave. & McCormick Rd.
Charlottesville, VA 22903–2498
(804) 824–3133 Fax: (804) 924–4337

WASHINGTON

WASHINGTON STATE LIBRARY
Govt. Publications
P.O. Box 42478
16th and Water Streets
Olympia, WA 98504–2478
(206) 753–4027 Fax: (206) 586–7575

WEST VIRGINIA

WEST VIRGINIA UNIV. LIBRARY
Govt. Documents Section
P.O. Box 6069 – 1549 University Ave.
Morgantown, WV 26506–6069
(304) 293–3051 Fax: (304) 293–6638

WISCONSIN

ST. HIST. SOC. OF WISCONSIN LIBRARY
Govt. Publication Section
816 State Street
Madison, WI 53706
(608) 264–6525 Fax: (608) 264–6520

MILWAUKEE PUBLIC LIBRARY
Documents Division
814 West Wisconsin Avenue
Milwaukee, WI 53233
(414) 286–3073 Fax: (414) 286–8074

Typical Report Citation and Abstract

❶ **19970001126** NASA Langley Research Center, Hampton, VA USA
❷ **Water Tunnel Flow Visualization Study Through Poststall of 12 Novel Planform Shapes**
❸ Gatlin, Gregory M., NASA Langley Research Center, USA Neuhart, Dan H., Lockheed Engineering and Sciences Co., USA;
❹ Mar. 1996; 130p; In English
❺ Contract(s)/Grant(s): RTOP 505-68-70-04
❻ Report No(s): NASA-TM-4663; NAS 1.15:4663; L-17418; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche
❼ To determine the flow field characteristics of 12 planform geometries, a flow visualization investigation was conducted in the Langley 16- by 24-Inch Water Tunnel. Concepts studied included flat plate representations of diamond wings, twin bodies, double wings, cutout wing configurations, and serrated forebodies. The off-surface flow patterns were identified by injecting colored dyes from the model surface into the free-stream flow. These dyes generally were injected so that the localized vortical flow patterns were visualized. Photographs were obtained for angles of attack ranging from 10’ to 50’, and all investigations were conducted at a test section speed of 0.25 ft per sec. Results from the investigation indicate that the formation of strong vortices on highly swept forebodies can improve poststall lift characteristics; however, the asymmetric bursting of these vortices could produce substantial control problems. A wing cutout was found to significantly alter the position of the forebody vortex on the wing by shifting the vortex inboard. Serrated forebodies were found to effectively generate multiple vortices over the configuration. Vortices from 65’ swept forebody serrations tended to roll together, while vortices from 40’ swept serrations were more effective in generating additional lift caused by their more independent nature.
❽ Author
❾ *Water Tunnel Tests; Flow Visualization; Flow Distribution; Free Flow; Planforms; Wing Profiles; Aerodynamic Configurations*

Key

1. Document ID Number; Corporate Source
2. Title
3. Author(s) and Affiliation(s)
4. Publication Date
5. Contract/Grant Number(s)
6. Report Number(s); Availability and Price Codes
7. Abstract
8. Abstract Author
9. Subject Terms

AERONAUTICAL ENGINEERING

A-Continuing-Bibliography-(Suppl.-356)

SEPTEMBER 5, 1997

01
AERONAUTICS

19970023413 Defence Science and Technology Organisation, Melbourne, Australia
A Review of Australian and New Zealand Investigations on Aeronautical Fatigue During the Period April 1995 to March 1997
Martin, Colin, Defence Science and Technology Organisation, Australia; Jun. 1997; 36p; In English
Report No.(s): DSTO-TN-0086; AR-010-217; Copyright; Avail: Issuing Activity (DSTO Aeronautical and Maritime Research Lab., PO Box 4331, Melbourne Victoria 3001, Australia), Hardcopy, Microfiche

This document is for presentation to the 25th Conference of the International Committee on Aeronautical Fatigue scheduled to be held in Edinburgh, Scotland on 16th and 17th June 1997. A review is given of the aircraft fatigue research and associated activities which form part of the programs of the Aeronautical and Maritime Research Laboratory, the Civil Aviation Safety Authority, and universities in Australia and the Defence Scientific Establishment and the University of Auckland in New Zealand. The review summarizes fatigue-related research programs as well as fatigue investigations on specific military and civil aircraft. Author

Aircraft Safety; Civil Aviation; Flight Safety

19970023432 Defence Science and Technology Organisation, Aeronatuical and Maritime Research Lab., Melbourne, Australia
A Database Compiler for Flight Dynamic Applications
Hill, S. D., Defence Science and Technology Organisation, Australia; Dec. 1996; 37p; In English
Report No.(s): DSTO-TN-0064; AR-009-926; Copyright; Avail: Issuing Activity (DSTO Aeronautical and Maritime Research Lab., PO Box 4331, Melbourne, Victoria 3001, Australia), Hardcopy, Microfiche

This report describes a database system developed by the Air Operations Division (AOD) for aircraft flight dynamic models. A new database format has been established to meet AOD's flight dynamic and performance requirements. A program has been written to create program source code to read and interpolate/extrapolate data stored in the database format. The major advantage of the new database format is that all the information required to read and interpolate/extrapolate a data set is contained within the database. A typical example of the database format, technical descriptions of the syntax, methods of interpolation/extrapolation, method of database interfacing, and procedure for database use are given.
Author

Data Bases; Interpolation; Extrapolation; Aircraft Models; Dynamic Models; Flight Characteristics

19970023478 NASA Ames Research Center, Moffett Field, CA USA
Neural Network Prediction of New Aircraft Design Coefficients
Norgaard, Magnus, Technical Univ. of Denmark, Denmark; Jorgensen, Charles C., NASA Ames Research Center, USA; Ross, James C., NASA Ames Research Center, USA; May 1997; 20p; In English
Contract(s)/Grant(s): RTOP 519-30-12
Report No.(s): NASA-TM-112197; A-976719; NAS 1.15:112197; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This paper discusses a neural network tool for more effective aircraft design evaluations during wind tunnel tests. Using a hybrid neural network optimization method, we have produced fast and reliable predictions of aerodynamical coefficients, found optimal flap settings, and flap schedules. For validation, the tool was tested on a 55% scale model of the USAF/NASA Subsonic High Alpha Research Concept aircraft (SHARC). Four different networks were trained to predict coefficients of lift, drag, moment

of inertia, and lift drag ratio (C(sub L), C(sub D), C(sub M), and L/D) from angle of attack and flap settings. The latter network was then used to determine an overall optimal flap setting and for finding optimal flap schedules.
Author
Neural Nets; Wind Tunnel Tests; Lift; Lift Drag Ratio; Aerodynamic Drag; Angle of Attack; Moments of Inertia

19970023679 NASA Ames Research Center, Moffett Field, CA USA
Direct Adaptive Aircraft Control Using Dynamic Cell Structure Neural Networks
Jorgensen, Charles C., NASA Ames Research Center, USA; May 1997; 20p; In English
Contract(s)/Grant(s): RTOP 519-30-12
Report No.(s): NASA-TM-112198; A-976719A; NAS 1.15:112198; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A Dynamic Cell Structure (DCS) Neural Network was developed which learns topology representing networks (TRNS) of F-15 aircraft aerodynamic stability and control derivatives. The network is integrated into a direct adaptive tracking controller. The combination produces a robust adaptive architecture capable of handling multiple accident and off- nominal flight scenarios. This paper describes the DCS network and modifications to the parameter estimation procedure. The work represents one step towards an integrated real-time reconfiguration control architecture for rapid prototyping of new aircraft designs. Performance was evaluated using three off-line benchmarks and on-line nonlinear Virtual Reality simulation. Flight control was evaluated under scenarios including differential stabilator lock, soft sensor failure, control and stability derivative variations, and air turbulence.
Author
Aerodynamic Stability; On-Line Systems; Neural Nets; Adaptive Control; Aircraft Design; F-15 Aircraft; Real Time Operation; Virtual Reality

19970023937 NYMA, Inc., Brook Park, OH USA
DRA/NASA/ONERA Collaboration on Icing Research, Part 2, Prediction of Airfoil Ice Accretion *Final Report*
Wright, William B., NYMA, Inc., USA; Gent, R. W., Defence Research Agency, UK; Guffond, Didier, Office National d'Etudes et de Recherches Aerospatiales, France; May 1997; 54p; In English
Contract(s)/Grant(s): NAS3-27186; RTOP 548-20-23
Report No.(s): NASA-CR-202349; E-10769; NAS 1.26:202349; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

This report presents results from a joint study by DRA, NASA, and ONERA for the purpose of comparing, improving, and validating the aircraft icing computer codes developed by each agency. These codes are of three kinds: (1) water droplet trajectory prediction, (2) ice accretion modeling, and (3) transient electrothermal deicer analysis. In this joint study, the agencies compared their code predictions with each other and with experimental results. These comparison exercises were published in three technical reports, each with joint authorship. DRA published and had first authorship of Part 1 - Droplet Trajectory Calculations, NASA of Part 2 - Ice Accretion Prediction, and ONERA of Part 3 - Electrothermal Deicer Analysis. The results cover work done during the period from August 1986 to late 1991. As a result, all of the information in this report is dated. Where necessary, current information is provided to show the direction of current research. In this present report on ice accretion, each agency predicted ice shapes on two dimensional airfoils under icing conditions for which experimental ice shapes were available. In general, all three codes did a reasonable job of predicting the measured ice shapes. For any given experimental condition, one of the three codes predicted the general ice features (i.e., shape, impingement limits, mass of ice) somewhat better than did the other two. However, no single code consistently did better than the other two over the full range of conditions examined, which included rime, mixed, and glaze ice conditions. In several of the cases, DRA showed that the user's knowledge of icing can significantly improve the accuracy of the code prediction. Rime ice predictions were reasonably accurate and consistent among the codes, because droplets freeze on impact and the freezing model is simple. Glaze ice predictions were less accurate and less consistent among the codes, because the freezing model is more complex and is critically dependent upon unsubstantiated heat transfer and surface roughness models. Thus, heat transfer prediction methods used in the codes became the subject for a separate study in this report to compare predicted heat transfer coefficients with a limited experimental database of heat transfer coefficients for cylinders with simulated glaze and rime ice shapes. The codes did a good job of predicting heat transfer coefficients near the stagnation region of the ice shapes. But in the region of the ice horns, all three codes predicted heat transfer coefficients considerably higher than the measured values. An important conclusion of this study is that further research is needed to understand the finer detail of of the glaze ice accretion process and to develop improved glaze ice accretion models.
Author
Aircraft Icing; Airfoils; Ice Formation; Computer Programs; Predictions

19970023952 Air Force Logistics Management Center, Gunter AFS, AL USA

Mishap Trend Analysis Regarding Maintenance Discipline and Compliance

Walker, William N., Air Force Logistics Management Center, USA; Mar. 1997; 7p; In English

Report No.(s): AD-A323169; AFLMA-LM-9703003; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

During the LGM Conference of 22 - 23 Jan 97, MAJCOM LGMs expressed concerns with the possibility of problems with discipline and compliance. An independent study was recommended to determine the validity of their concerns. HQ USAF/ILM requested the AFLMA review Class A through Class C mishaps from the last three years and report on causal factors, sub-systems, and year to year comparisons. The Air Force Safety Center Data Operations and Analysis Division provided the data for this study. We identified specific categories as having a significant trend by applying appropriate statistical tests. However, since our analysis was based on an extremely small sample size, the should use caution in interpreting the results. Results include: Overall maintenance mishaps show a decreasing trend. Categories of Discipline, Other/Unknown Reasons, Structural, and F-16 show a decreasing trend. Categories of Part and T-37 show an increasing trend. No other categories showed significantly changing trends. In summary, we find the evidence does not support the perception that there is a problem with maintenance compliance and discipline.

DTIC

Aircraft Maintenance; Statistical Tests; Aircraft Accidents; F-16 Aircraft; T-37 Aircraft; Conferences; Trend Analysis

19970023957 Federal Aviation Administration, Statistics and Forecast Branch, Washington, DC USA

FAA Aviation Forecasts, Fiscal Years 1997-2008

Mar. 1997; 227p; In English

Report No.(s): AD-A322723; FAA-APO-97-1; No Copyright; Avail: CASI; A11, Hardcopy; A03, Microfiche

This report contains the Fiscal Years 1997-2008 Federal Aviation Administration (FAA) forecasts of aviation activity at FAA facilities. These include airports with both FAA and contract control towers, air route traffic control centers, and flight service stations. Detailed forecasts were developed for the major users of the National Aviation System: air carriers, air taxi/commuters, general aviation, and military. The forecasts have been prepared to meet the budget and planning needs of the constituent units of the FAA and to provide information which can be used by State and local authorities, the aviation industry, and the general public. The outlook for the 12-year forecast period is for moderate economic growth, declining real fuel prices, and modest inflation. Bases on these assumptions, aviation activity is forecast to increase by 17.0 percent at the combined FAA and contract towered airports (443 in 1996) and 24.6 percent at air route traffic control centers. The general aviation active fleet is forecast to increase by almost 8.4 percent while general aviation hours flown grow by almost 12.9 percent. U.S. scheduled domestic passenger enplanements are forecast to increase 61.3 percent--air carriers increasing 58.0 percent and regional/commuters growing by 85.9 percent. Total international passenger traffic between the USA and the rest of the world is projected to increase 93.7 percent. International passenger traffic carried on U.S. flag carriers is forecast to increase 95.8 percent.

DTIC

Air Transportation; Air Traffic Control; General Aviation Aircraft; Ground Based Control; Integrated Mission Control Center; Airports; Civil Aviation

19970024844 NASA Ames Research Center, Moffett Field, CA USA

Exact Solutions for Sound Radiation from a Circular Duct

Cho, Y. C., NASA Ames Research Center, USA; Ingard, K. Uno, Massachusetts Inst. of Tech., USA; Jun. 1997; 18p; In English

Contract(s)/Grant(s): RTOP 632-30-34

Report No.(s): NASA-TM-112200; NAS 1.15:112200; A-976769; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This paper presents a method of evaluation of Wiener-Hopf technique solutions for sound radiation from an unflanged circular duct with infinitely thin duct wall, including mean flows.

Author

Wiener Hopf Equations; Ducts; Circular Waveguides; Acoustic Properties; Sound Waves

19970024860 Research Triangle Inst., Research Triangle Park, NC USA

AOPA Survey Summary of AGATE Concepts Demonstration October 17-19, 1996, Volume 1, Basic Report ***Final Report***

Jul. 1997; 44p; In English

Contract(s)/Grant(s): NAS1-19214; RTOP 538-07-19-01

Report No.(s): NASA-CR-201713-Vol-1; NAS 1.26:201713-Vol-1; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

An AGATE Concepts Demonstration was conducted at the Annual Aircraft Owners and Pilots Association (AOPA) Convention in 1996. The demonstration consisted of an interactive simulation of a single-pilot, single-engine aircraft in which the participant took off, flew a brief enroute segment and then flew a Global Positioning System (GPS) approach and landing. The participant was provided an advanced 'pathway-in-the-sky' presentation on both a head-up display and a head-down display to follow throughout the flight. A single lever power control and display concept was also provided for control of the engine throughout the flight. A second head-down, multifunction display in the instrument panel provided a moving map display for navigation purposes and monitoring of the status of the aircraft's systems. An estimated 352 people observed or participated in the demonstration, and 144 surveys were collected. The pilot ratings of the participants ranged from student to Air Transport Rating with an average of 1850 hours total flight time. The performance of the participants was surprisingly good, considering the minimal training in a completely new system concept. The overwhelming response was that technologies that simplify piloting tasks are enthusiastically welcomed by pilots of all experience levels. The increase in situation awareness and reduction in pilot workload were universally accepted and lauded as steps in the right direction.
Author
Approach; Aircraft Landing; Single Engine Aircraft; Head-Up Displays; Computerized Simulation; Surveys

19970024906 Nanjing Univ. of Aeronautics and Astronautics, Nanjing, Jiangsu, China
Journal of Nanjing University of Aeronautics and Astronautics, Volume 29
Azhou, Z., Nanjing Univ. of Aeronautics and Astronautics, Nanjing, China; Feb. 1997; 132p; In Chinese; Portions of this document are not fully legible
Report No.(s): PB97-148092; Copyright; Avail: Issuing Activity (Natl Technical Information Service (NTIS)), Microfiche
Contents (Partial): Design of Flight Trajectory Controller for Terrain Following/Terrain Avidance; Robustness Analysis of INS Ground Alignment; The Inverse Kinematics for the Orientation of a Robot Arm Based on Neural Network; Detection of Location and Magnitude of Structural Damage Using Measured Model Data; and Convestive Heat Transfer across Two Cylinders in Line.
NTIS
Aerospace Engineering; Research and Development; China

19970025058 Research Triangle Inst., Research Triangle Park, NC USA
AOPA Survey Summary of AGATE Concepts Demonstration, October 17-19, 1996, Volume 2, Original Survey Data ***Final Report***
Jul. 1997; 446p; In English
Contract(s)/Grant(s): NAS1-19214; RTOP 538-07-19-01
Report No.(s): NASA-CR-201713-Vol-2; NAS 1.26:201713-Vol-2; No Copyright; Avail: CASI; A19, Hardcopy; A04, Microfiche
An AGATE Concepts Demonstration was conducted at the Annual Aircraft Owners and Pilots Association (AOPA) Convention in 1996. The demonstration consisted of an interactive simulation of a single-pilot, single-engine aircraft in which the participant took off, flew a brief enroute segment and then flew a Global Positioning System (GPS) approach and landing. The participant was provided an advanced 'pathway-in-the-sky' presentation on both a head-up display and a head-down display to follow throughout the flight. A single lever power control and display concept was also provided for control of the engine throughout the flight A second head-down, multifunction display in the instrument panel provided a moving map display for navigation purposes and monitoring of the status of the aircraft's systems. An estimated 352 people observed or participated in the demonstration, and 144 surveys were collected. The pilot ratings of the participants ranged from student to Air Transport Rating with an average of 1850 hours total flight time. The performance of the participants was surprisingly good, considering the minimal training in a completely new system concept. The overwhelming response was that technologies that simplify piloting tasks are enthusiastically welcomed by pilots of all experience levels. The increase in situation awareness and reduction in pilot workload were universally accepted and lauded as steps in the right direction.
Author
Global Positioning System; Computerized Simulation; Air Transportation; Workloads (Psychophysiology); Pilot Performance; Navigation Aids; Display Devices

02
AERODYNAMICS

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

19970023441 Louisiana Tech Univ., Dept. of Mathematics and Statistics, Ruston, LA USA
Direct Numerical Simulation of Flow Transition in Compressible Boundary Layer Around Airfoils, *1 Mar. - 30 Sep. 1996*
Liu, Chaoqun, Louisiana Tech Univ., USA; Liu, Zhining, Louisiana Tech Univ., USA; Zhao, Wei, Louisiana Tech Univ., USA; Xiong, Guohua, Louisiana Tech Univ., USA; Feb. 1997; 45p; In English
Contract(s)/Grant(s): F49620-96-I-0122
Report No.(s): AD-A322271; AFOSR-97-0123TR; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The three dimensional development of flow transition in both subsonic and supersonic Joukowsky airfoil boundary layers are studied by direct numerical simulation (DNS). The numerical simulation is performed by a spatial approach. A full compressible Navier Stokes system in curvilinear coordinates is employed so that we can simulate the transition around general geometric configurations. The numerical results agree very well with the linear stability theory (LST) at the linear growth stage for both primary and second modes in the flat plate boundary layers. The whole process of controlled flow transition induced by blowing/suction around airfoils is simulated by directly solving the N-S system with Reynolds number around one million. Some differences are found in comparison to the incompressible counterpart, and some new phenomena for the transition around airfoils are observed which at least qualitatively agree with physics.
DTIC
Compressible Boundary Layer; Airfoils; Boundary Layer Transition; Computational Fluid Dynamics; Navier-Stokes Equation

19970023528 NASA Dryden Flight Research Center, Edwards, CA USA
Flight Wing Surface Pressure and Boundary-Layer Data Report from the F-111 Smooth Variable-Camber Supercritical Mission Adaptive Wing
Powers, Sheryll Goecke, NASA Dryden Flight Research Center, USA; Webb, Lannie D., NASA Dryden Flight Research Center, USA; Jun. 1997; 858p; In English
Contract(s)/Grant(s): RTOP 953-36-00
Report No.(s): NASA-TM-4789; H-2102; NAS 1.15:4789; No Copyright; Avail: CASI; A99, Hardcopy; A10, Microfiche

Flight tests were conducted using the advanced fighter technology integration F-111 (AFTI/F-111) aircraft modified with a variable-sweep supercritical mission adaptive wing (MAW). The MAW leading- and trailing-edge variable-camber surfaces were deflected in flight to provide a near-ideal wing camber shape for the flight condition. The MAW features smooth, flexible upper surfaces and fully enclosed lower surfaces, which distinguishes it from conventional flaps that have discontinuous surfaces and exposed or semi-exposed mechanisms. Upper and lower surface wing pressure distributions were measured along four streamwise rows on the right wing for cruise, maneuvering, and landing configurations. Boundary-layer measurements were obtained near the trailing edge for one of the rows. Cruise and maneuvering wing leading-edge sweeps were 26 deg for Mach numbers less than 1 and 45 deg or 58 deg for Mach numbers greater than 1. The landing wing sweep was 9 deg or 16 deg. Mach numbers ranged from 0.27 to 1.41, angles of attack from 2 deg to 13 deg, and Reynolds number per unit foot from 1.4 x 10(exp 6) to 6.5 x 10(exp 6). Leading-edge cambers ranged from O deg to 20 deg down, and trailing-edge cambers ranged from 1 deg up to 19 deg down. Wing deflection data for a Mach number of 0.85 are shown for three cambers. Wing pressure and boundary-layer data are given. Selected data comparisons are shown. Measured wing coordinates are given for three streamwise semispan locations for cruise camber and one spanwise location for maneuver camber.
Author
Flight Tests; Boundary Layers; Swept Wings; Pressure Distribution; Mach Number; Angle of Attack; Reynolds Number; Supercritical Wings; Pressure Measurement

03
AIR TRANSPORTATION AND SAFETY

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

19970023407 NERAC, Inc., Tolland, CT USA
Integrated Circuits Reliability. (Latest Citations from the Aerospace Database)
Mar. 1997; 6p; In English

Report No.(s): PB97-857171; No Copyright; Avail: Issuing Activity (National Technical Information Service, 5285 Port Royal RD., Springfield, VA 22161, USA), Microfiche

The bibliography contains citations concerning the reliability and fatigue life of electronic circuits subjected to temperature cycling in an environmental chamber. Applications in military aircraft and spacecraft electronic equipment are examined. Reliability testing devices are discussed relative to performance evaluations and utilization.

NTIS

Bibliographies; Spacecraft Electronic Equipment; Integrated Circuits; Data Bases

19970025044 Ohio State Univ., Columbus, OH USA

A New Approach to Aeronautical Decision-Making: The Expertise Method ***Final Report***

Kochan, Janeen A., Ohio State Univ., USA; Jensen, Richard S., Ohio State Univ., USA; Chubb, Gerald P., Ohio State Univ., USA; Hunter, David R., Federal Aviation Administration, USA; Mar. 1997; 43p; In English

Contract(s)/Grant(s): DTFA01-93-C-00041

Report No.(s): AD-A323950; DOT/FAA/AM-97/6; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Four studies of pilot decision making were conducted to formulate a general model of the expert pilot that might be applied to novice pilots in order to increase their decision making skills and reduce their risk of accident involvement. This set of studies began with a series of unstructured interviews of pilots to identify and compile characteristics of the expert pilot. Each succeeding study, then, became more structured in its approach as the characteristics of an expert pilot were more closely defined. From structured interviews conducted as part of the second study, a preliminary definition was obtained that stressed motivation, confidence, superior learning and performance skills, and an intuitive decision making style. The third study evaluated these characteristics as they were possessed by pilots of three types of relatively high performance general aviation aircraft. In the final study, experienced pilots were presented with a plausible general aviation flight scenario using a verbal protocol methodology. The responses of the pilots to this table top simulation were recorded and analyzed. These data suggest that, when compared to competent pilots, expert pilots tend to (1) seek more quality information in a more timely manner; (2) make more progressive decisions to solve problems; and, (3) communicate more readily with all available resources.

DTIC

Aircraft Pilots; Decision Making; Supersonic Aircraft; Maneuvers; Human Performance

04
AIRCRAFT COMMUNICATIONS AND NAVIGATION

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

19970023452 Federal Aviation Administration, Office of Aviation Medicine, Oklahoma City, OK USA

The Effects of Video Game Experience on Computer-Based Air Traffic Controller Specialist, Air Traffic Scenario Test Scores ***Final Report***

Young, Willie C., Federal Aviation Administration, USA; Broach, Dana, Federal Aviation Administration, USA; Farmer, William L., Federal Aviation Administration, USA; Feb. 1997; 13p; In English

Report No.(s): AD-A322774; DOT/FAA/AM-97/4; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The FAA is currently using the Air Traffic Scenario Test (ATST) as a major portion of its selection process. Because the ATST is a PC based application with a strong resemblance to a video game, concern has been raised that prior video game experience might have a moderating effect on scores. Much of the previous research in this area is associated with topics such as the moderating effects of prior comput er experience on scores earned on computerized versions of traditional achievement or power tests, and the effects of practice on video games on individual difference tests for constructs such as spatial ability. The effects of computer or video game experience on work sample scores have not been systematically investigated. The purpose of this study was to evaluate the incremental validity of prior video game experience over that of general aptitude as a predictor of work sample test scores. The Computer Use Survey was administered to 404 air traffic control students who entered the FAA ATCS Nonradar Screen. The resultant responses from this survey related to video games were summed and averaged to create the predictor (VIDEO). Three criterion measures derived from the ATST, (ATSAFE, ARVDELAY, HNDDELAY) were regressed on the cognitive aptitude measure that serves as the initial selection screening test and the predictor (VIDEO). Self-reported experience on video games was found to be significantly related to ARVDELAY and HNDDELAY, accounting for an additional 3.6% of the variance in ARVDELAY, and accounting for an additional 9% of the variance in HNDDELAY. The results suggested that those persons

with video game experience were more efficient at hand-offs and routing aircraft. Future research is recommended to investigate the effect of prior video game experience on learning curves and strategies used in the work sample test.
DTIC
Air Traffic Controllers (Personnel); Psychological Tests; Education; Learning Curves; Computer Techniques

19970023614 Colorado Univ., Center for Aerodynamics Research, Boulder, CO USA
GPS Attitude Determination ***Quarterly Report, Sep. - Nov. 1996***
Axelrad, Penina, Colorado Univ., USA; Feb. 19, 1997; 6p; In English
Contract(s)/Grant(s): N00014-95-I-G032
Report No.(s): AD-A322950; PA-97-008; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

This report summarizes the progress for the first quarter of FY'96-97 by the Colorado Center for Astrodynamics Research (CCAR) on the application of GPS based attitude determination techniques to near-Earth spacecraft. Two areas are addressed - application of an open architecture receiver for spaceborne attitude determination and coarse spacecraft attitude determination based on GPS signal to noise ratios. We have started work with the GEC Plessey GPSBuilder 2 receiver and identified modifications required to use the receiver for attitude determination functions. In particular we made arrangements for the addition of a second RF section to be added to the receiver and determined that the receiver tracking loop must be modified from a frequency lock loop to a phase lock loop (PLL) design. In the area of coarse attitude determination based on SNR, we have made improvements to a fuzzy estimation algorithm which provide attitude estimates at the 7 deg RMS level for flight data sets from CRISTA SPAS and GANE. We have also begun work on a maximum likelihood estimation technique using these same observables. Two research papers funded under this grant were presented at the ION GPS-96 meeting in Kansas City.
DTIC
Global Positioning System; Attitude Indicators; Radio Frequencies; Spacecraft Instruments; Maximum Likelihood Estimates; Algorithms

19970023647 General Accounting Office, Resources, Community and Economic Development Div., Washington, DC USA
Air Traffic Control: Status of FAA's Standard Terminal Automation Replacement System Project
Mar. 1997; 17p; In English
Report No.(s): AD-A323623; GAO/RCED-97-51; B-275244; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The Federal Aviation Administration (FAA) oversees the largest, busiest, and most complex air traffic control system in the world. However, components of the system are aging and are difficult and costly to maintain. FAA projects that it cannot meet projected traffic increases and make required safety and efficiency enhancements without replacing equipment. Since the early 1980s, FAA'S modernization efforts have experienced lengthy schedule delays and substantial cost overruns. Because of such problems, in 1994, FAA restructured its acquisition of the Advanced Automation System-the long-time cent erpiece of its air traffic control modernization program-into more manageable segments. One of these segments is called the Standard Terminal Automation Replacement System (STARS) project. This project is expected to replace 15- to 25-year-old computers and related equipment used at FAA facilities that track aircraft in the airspace surrounding airports.' In September 1996, FAA contracted with Raytheon Corporation to develop, produce, and install STARS. Given FAA'S past schedule and cost problems and the significance of the STARS project, you asked us to examine FAA'S acquisition planning to date. Specifically, you asked us to determine to what extent (1) the schedule estimate for STARS is attainable and (2) cost estimates to make STARS operational are likely to change.
DTIC
Air Traffic Control; Airports; Automatic Control

19970025076 Naval Research Lab., Space Applications Branch, Washington, DC USA
Truetime Model GPS-DC-552 MK 3 GPS Receiver Live Static Test
Powers, Edward D., Naval Research Lab., USA; Jones, Edward C., Naval Research Lab., USA; Apr. 14, 1997; 36p; In English
Report No.(s): AD-A324042; NRL/MR/8150--97-7922; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The GPS Program Offices, Los Angeles Air Force Base, California, has established a Center of Expertise (COE) comprised of several agencies, each providing unique GPS test capabilities for the purpose of developing a Commercial Receiver Test Program (CRTP). The Responsible Test Organization (RTO) for the COE is the 746th Test Group, 46th Guidance Test Squadron, Holloman, Air Force Base, New Mexico. The Naval Research Laboratory (NRL) has been designed as a COE with the responsibility of testing the time output characteristics and accuracy of the commercial receivers. The NRL clock testing facility has time

traceable to the U.S. Naval Observatory and the procedures used are taken from the CORE INS/GR/EGI TEST PLAN prepared by RTO.
DTIC
Global Positioning System; Receivers; Static Tests

05
AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

19970023429 Naval Surface Warfare Center, Dahlgren Div., Dahlgren, VA USA
An Improved Method for Predicting Axial Force at High Angle of Attack ***Final Report***
Moore, Frank G., Naval Surface Warfare Center, USA; Hymer, Tom, Naval Surface Warfare Center, USA; Feb. 1997; 63p; In English
Report No.(s): AD-A322850; NSWCDD/TR-96/240; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

An improved semiempirical method for axial force calculation on missile configurations has been developed. The method uses the theoretical methods currently used in the Naval Surface Warfare Center Aeroprediction Code for zero angle-of-attack (AOA) axial force computations and several wind tunnel data bases to compute changes in axial force at AOA. The method is applicable to bodies alone, wing-body, and wing-body-tail configurations for both zero and non-zero control deflections. It has been developed to allow computation for AOA to 90 deg at any Mach number. However, it has been validated against data only to Mach number of 4.6 and AOA to 40 deg for all configurations. For body alone and wing-body cases, it has been validated to 90 deg AOA. Additional test data or Navier Stokes computations would allow refinement of the improved method. The new method has been compared to several existing techniques. The method was found to be as good as or better than existing techniques, but more general than existing methods in terms of configurations and Mach numbers allowed for the method to be used.
DTIC
Axial Flow; Angle of Attack; Data Bases; Computation; Guidance (Motion); Missile Configurations

19970023433 Defence Science and Technology Organisation, Aeronautical and Maritime Research Lab., Melbourne, Australia
The Implications of Corrosion with Respect to Aircraft Structural Integrity
Cole, G. K., Defence Science and Technology Organisation, Australia; Clark, G., Defence Science and Technology Organisation, Australia; Sharp, P. K., Defence Science and Technology Organisation, Australia; Mar. 1997; 134p; In English
Report No.(s): DSTO-RR-0102; AR0-10-199; Copyright; Avail: Issuing Activity (DSTO, Aeronautical and Maritime Research Lab., PO Box 4331, Melbourne Victoria 3001, Australia), Hardcopy, Microfiche

This report discusses the influence of corrosion on aircraft structural integrity. Brief introductions to corrosion in aircraft and aircraft structural integrity are provided and the literature concerned with the effect of prior corrosion and corrosive environments on static strength and fatigue performance is reviewed. RAAF and overseas experience with structural integrity issues associated with corrosion in aircraft is described, with emphasis placed on corrosion in airframes and other structural elements. The report discusses the difficulties associated with incorporating the effects of corrosion into conventional life management approaches and the contribution of corrosion control programs to continuing airworthiness. Where possible, current research programs throughout the world are reviewed. Finally, potential areas of research are identified, primarily on the basis of their potential usefulness for the future support of RAAF aircraft, and opportunities for collaborative research.
Author
Aircraft Structures; Structural Failure; Aircraft Reliability

19970023446 Naval Air Test Center, Support Systems Dept., Patuxent River, MD USA
Developmental Assist Program for the Evaluation of Dry Air Dehumidification ***Final Report, 11 Mar. - 29 Aug. 1988***
Jump, Joseph G., Naval Air Test Center, USA; Mar. 10, 1997; 27p; In English
Report No.(s): AD-A322263; NATC-SY-50-88-044; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Dry Air Dehumidification is presently being used by European North Atlantic Treaty Organization military forces on operational aircraft to reduce the relative humidity (RH) within the aircraft. The claimed result is the elimination of corrosion of airframes, avionics systems, and propulsion systems with accompanying improvements in systems reliability and availability, as well as lowered support costs. In an effort to improve readiness and reduce maintenance costs, NAVAIRSYSCOM has instituted a two

phased program to evaluate this technology for use on operational Navy aircraft. Phase 1 consisted of identifying flow rates of dry air required to reach a stable RH.
DTIC
Flow Velocity; Air Flow; Dehumidification; Aircraft Maintenance

19970023894 National Aerospace Lab., Tokyo, Japan
Simulation Study for a Fire Helicopter, Part 3, Operational Simulation for a Fire Helicopter
Funabiki, K., National Aerospace Lab., Japan; Okuno, Y., National Aerospace Lab., Japan; Muraoka, K., National Aerospace Lab., Japan; Wakairo, K., National Aerospace Lab., Japan; Oct. 1996; 16p; In Japanese; Portions of this document are not fully legible
Report No.(s): PB97-151104; NAL/TR-1308-Pt-3; No Copyright; Avail: Issuing Activity (Natl Technical Information Service (NTIS)), Microfiche

A piloted flight simulation is carried out to investigate operational subjects such as crew coordination between pilots and the boom operator, emergency operations, and acceptability of the interfaces. The simulated operations were defined so as to involve the whole operation from take-off to landing, including two sets of fire fighting operations and water recharging. It is concluded that the pilot-flying should request the pilot-not-flying and the boom operator to call out necessary information such as heading, distance from the building, and margin of the ejection boom control range. The pilots concluded that a side mounted distance indicator which can be seen when looking outside the cockpit is effective in maintaining a proper distance from the building. A simulation for a one engine inoperative condition during fire fighting is also carried out. A series of other operations, such as the dumping of remaining water, retraction of the boom, and acceleration and escape from the building were also conducted smoothly.
NTIS
Helicopters; Fire Fighting; Emergencies

19970023899 General Accounting Office, National Security and International Affairs Div., Washington, DC USA
Report to Congressional Committees. Navy Aviation: F/A-18E/F will Provide Marginal Operational Improvement at High Cost
Jun. 1996; 104p; In English
Report No.(s): GAO/NSIAD-96-98; B-260367; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

The F/A-18E/F program, at a projected total program cost of $63.09 billion (fiscal year 1996 dollars)/$89.15 billion (then-year dollars), is one of the most costly aviation programs in the Department of Defense (DOD). It is the successor to several unsuccessful attempts to modernize the Navy's tactical aviation fleet and is intended to complement and eventually replace the Navy's F/A-18C/D and F-14 aircraft. GAO's review focused on determining whether continued development of the F/A-18E/F is the most cost-effective approach to modernizing the Navy's tactical aircraft fleet. Specific objectives were to (1) determine whether operational deficiencies in the F/A-18C/D cited by the Navy to justify the need for the F/A-18E/F have materialized and, if they have, the extent to which the E/F would correct them, (2) ascertain whether the F/A-18E/F will provide an appreciable increase in operational capability over the F/A-18C/D, and (3) review the reliability of the cost estimates for the F/A-18E/F and compare those estimates with the costs of potential alternatives to the E/F program.
Derived from text
Defense Program; Cost Analysis; Cost Effectiveness; F-14 Aircraft; Operating Costs; Cost Estimates

19970024001 NERAC, Inc., Tolland, CT USA
Aircraft Landing Brakes. (Latest Citations from the NTIS Bibliographic Database)
Mar. 1997; 50p; In English
Report No.(s): PB97-857619; Copyright; Avail: Issuing Activity (Natl Technical Information Service (NTIS)), Microfiche

The bibliography contains citations concerning the design, development, and applications of aircraft braking systems. Topics include a discussion of antiskid/antilocking braking systems, disc brakes, and properties of brakes and tires during braking and cornering of the aircraft. The effects of friction, wear, material composition, and weather conditions on the performance of aircraft braking systems are also presented.
NTIS
Bibliographies; Aircraft Landing; Brakes (For Arresting Motion); Design Analysis; Product Development

19970024871 NERAC, Inc., Tolland, CT USA
Helicopters: Vibration Analysis. (Latest Citations from the NTIS Bibliographic Database)
Mar. 1997; 50p; In English

Report No.(s): PB97-857486; Copyright; Avail: Issuing Activity (Natl Technical Information Service (NTIS)), Microfiche

The bibliography contains citations concerning rotor induced vibration in helicopters and rotary wing aircraft. Topics include coupled rotor/airframe vibration analysis, the influence of atmospheric turbulence on vibration, model and full scale wind tunnel testing, and flight and ground tests. Methods of vibration reduction are investigated, including blade tip sweep, blade tip design optimization, blade tabs, and vibration isolators. Adaptive control systems are discussed in a separate bibliography.

NTIS

Vibration; Design Analysis; Rotary Wing Aircraft; Blade Tips

19970025019 NERAC, Inc., Tolland, CT USA

Stealth Aircraft Technology. (Latest citations from the Aerospace Database)

Mar. 1997; 50p; In English

Report No.(s): PB97-857601; Copyright; Avail: Issuing Activity (Natl Technical Information Service (NTIS)) (US Sales Only), Microfiche

The bibliography contains citations concerning design, manufacture, and history of aircraft incorporating stealth technology. Citations focus on construction materials, testing, aircraft performance, and technology assessment. Fighter aircraft, bombers, missiles, and helicopters represent coverage.

Author

Bibliographies; Aircraft Performance; Detection; Bomber Aircraft

19970025073 Air Force Inst. of Tech., School of Engineering, Wright-Patterson AFB, OH USA

Multiple Model Adaptive Estimation and Control Redistribution for the Vista F-16

Lewis, Robert W., Sr., Air Force Inst. of Tech., USA; Dec. 1996; 247p; In English

Report No.(s): AD-A324050; AFIT/GE/ENG/96D-29; No Copyright; Avail: CASI; A11, Hardcopy; A03, Microfiche

Performance characteristics of a Multiple Model Adaptive Estimation and Control Redistribution (MMAE/CR) algorithm are evaluated against single and double actuator and sensor failures. MMAE alone can compensate for sensor failures, whereas Control Redistribution compensates for actuator failures by redistributing commands, initially intended for failed actuators, to the unfailed actuators in such a way that the desired system response is achieved. Both failure detection and compensation capabilities are developed and analyzed through an extensive amount of simulation data, particularly addressing multiple failures. Simulations are performed utilizing the high fidelity, non-linear six degree of freedom Simulation Rapid Prototyping Facility for the VISTA F-16, for both benign and maneuvering scenarios. Methods utilized to incorporate the MMAE/CR techniques are examined and modifications required to enhance performance are also presented. Results are presented which indicate the techniques incorporated provide an excellent means of both failure detection and compensation for the failures of both actuators and sensors. Approximately 98 percent of all secondary failures were successfully detected, and the majority of these detections are shown to occur in less than .5 seconds. The techniques of Multiple Model Adaptive Estimation and Control Redistribution are shown to complement each other well by providing improved failure detection in the face of actuator failures through the redistribution of the dither signal (used to enhance identifiability when there are no maneuvering commands to excite the system), and improved control authority through enhanced state variable estimation in the face of sensor failures.

DTIC

F-16 Aircraft; Adaptive Control; Flight Control; Maneuverability; Failure; Detection; State Estimation; Algorithms

07
AIRCRAFT PROPULSION AND POWER

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

19970023994 Prins Maurits Lab. TNO, Rijswijk, Netherlands

The Determination of Hazardous Compounds During Controlling of the Air Intake and Exhaust of the Engine of the F-16

Final Report Bepaling van schadelijke componenten bij de controle van de luchtinlaat en-uitlaat van de motor van de F-16

Groeneveld, F. R., Prins Maurits Lab. TNO, Netherlands; Feb. 1997; 25p; In Dutch

Contract(s)/Grant(s): A96/KLu/413

Report No.(s): AD-A323193; PML-1996-A97; TDCK-TD96-0424; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

During a post flight control of the F-16 the atmosphere and the temperature of the air intake and exhaust were measured. The following compounds were determined: carbon monoxide, carbon dioxide, nitrogen oxides, sulphur dioxide, PAH, hydrocarbons, aldehydes and dust or soot dust. PAH were found in a concentration of the TWA-value (0.2 mg/m3) in the atmosphere of the exhaust. In the air intake low concentrations of hydrocarbons were found. The other compounds were far below the TWA-value. The temperature in the exhaust decreased from 45 to 35 deg C and in the air intake from 30 to 25 deg C during a measuring period of an hour. PAH were also found in the soot dust impacted on the floor under the exhaust of the start engine. It is not expectable that the soot dust will whirl from the floor.
DTIC
F-16 Aircraft; Soot; Low Concentrations; Hydrocarbons; Flight Control; Air Intakes

19970024876 NYMA, Inc., Aerospace Analysis Sec., Brook Park, OH USA
NPAC-Nozzle Performance Analysis Code ***Final Report***
Barnhart, Paul J., NYMA, Inc., USA; Jul. 1997; 82p; In English
Contract(s)/Grant(s): NAS3-27186; RTOP 522-41-43
Report No.(s): NASA-CR-204129; NAS 1.26:204129; E-10798; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche
A simple and accurate nozzle performance analysis methodology has been developed. The geometry modeling requirements are minimal and very flexible, thus allowing rapid design evaluations. The solution techniques accurately couple: continuity, momentum, energy, state, and other relations which permit fast and accurate calculations of nozzle gross thrust. The control volume and internal flow analyses are capable of accounting for the effects of: over/under expansion, flow divergence, wall friction, heat transfer, and mass addition/loss across surfaces. The results from the nozzle performance methodology are shown to be in excellent agreement with experimental data for a variety of nozzle designs over a range of operating conditions.
Author
Nozzle Design; Thrust; Models; Internal Flow; Pressure Distribution; Newton-Raphson Method; Flow Distribution

19970024913 Washington Univ., Seattle, WA USA
Applicability of Thrust Augmenting Ejectors in a Supersonic Cruise Configuration
Hertzelle, Wendell S., Washington Univ., USA; Apr. 18, 1997; 92p; In English
Report No.(s): AD-A323966; AFIT-97-019; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche
Thrust augmenting ejectors were analyzed by the author in an attempt to see if they could be used to provide a significant thrust increase over the baseline thrust of a primary core. This was done for the purpose of determining if leaving the ejectors open in the cruise configuration of the High Speed Civil Transport would lead to a thrust increase that would at least offset the weight of the ejectors themselves. If this was found to be true then the fuel economy of the HSCT might be improved by leaving them open and not closing them during cruise. In analyzing the ejectors, no assumptions were made regarding inlet nor outlet configurations, so an attempt was made to find the point of optimal thrust augmentation by varying secondary stream bypass Mach number and the amount of flow entrainment. Two solutions were found to each mixing scenario, one subsonic and the other supersonic. These two solutions were each analyzed and ones not satisfying the Second Law of Thermodynamics were eliminated. Analytic diffuser and bleed losses were also explored in the analysis of the ejector flow. Within the limitations of the assumption s discussed in this paper, appreciable thrust augmentations have been discovered over a large range of bypass Mach numbers and entrained mass flows. This lead the author to the conclusion that ejectors warrant further research beyond a first order analysis, and serious thought should be put into leaving them open in cruise.
DTIC
Thrust Augmentation; Aerodynamic Configurations; Ejectors; Supersonic Transports; Supersonic Flight; Turbofan Engines; Mass Flow; Jet Mixing Flow; Supersonic Diffusers

19970024917 Detroit Diesel Allison, Indianapolis, IN USA
Coordinates for a High Performance 4:1 Pressure Ratio Centrifugal Compressor ***Final Report***
McKain, Ted F., Detroit Diesel Allison, USA; Holbrook, Greg J., Detroit Diesel Allison, USA; Jul. 1997; 82p; In English
Contract(s)/Grant(s): NAS3-23268; RTOP 523-26-13
Report No.(s): NASA-CR-204134; NAS 1.26:204134; E-10833; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche
The objective of this program was to define the aerodynamic design and manufacturing coordinates for an advanced 4:1 pressure ratio, single stage centrifugal compressor at a 10 lbm/sec flow size. The approach taken was to perform an exact scale of an existing DDA compressor originally designed at a flow size of 3.655 lbm/sec.
Author
Centrifugal Compressors; Pressure Ratio; Aerodynamics; Design Analysis; Structural Analysis

19970024921 NASA Lewis Research Center, Cleveland, OH USA

Numerical Assessment of Four-Port Through-Flow Wave Rotor Cycles with Passage Height Variation

Paxson, D. E., NASA Lewis Research Center, USA; Lindau, Jules W., National Academy of Sciences - National Research Council, USA; Jun. 1997; 16p; In English; 33rd; Joint Propulsion Conference and Exhibit, 6-9 Jun. 1997, Seattle, WA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Contract(s)/Grant(s): RTOP 505-26-33

Report No.(s): NASA-TM-107490; NAS 1.15:107490; E-10787; AIAA Paper 97-3142; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The potential for improved performance of wave rotor cycles through the use of passage height variation is examined. A Quasi-one-dimensional CFD code with experimentally validated loss models is used to determine the flowfield in the wave rotor passages. Results indicate that a carefully chosen passage height profile can produce substantial performance gains. Numerical performance data are presented for a specific profile, in a four-port, through-flow cycle design which yielded a computed 4.6% increase in design point pressure ratio over a comparably sized rotor with constant passage height. In a small gas turbine topping cycle application, this increased pressure ratio would reduce specific fuel consumption to 22% below the un-topped engine; a significant improvement over the already impressive 18% reductions predicted for the constant passage height rotor. The simulation code is briefly described. The method used to obtain rotor passage height profiles with enhanced performance is presented. Design and off-design results are shown using two different computational techniques. The paper concludes with some recommendations for further work.

Author

Computational Fluid Dynamics; Flow Distribution; Rotors

19970024924 Prins Maurits Lab. TNO, Rijswijk, Netherlands

The Determination of Hazardous Compounds during Controlling of the Air Intake and Exhaust of the Engine of the F-16 ***Final Report Bepaling van schadelijke componenten bij de controle van de luchtinlaat en -uitlaat van de motor van de F-16***

Groeneveld, F. R., Prins Maurits Lab. TNO, Netherlands; Feb. 1997; 22p; In Danish

Contract(s)/Grant(s): A96KLu413

Report No.(s): PML-1996-A97; TD96-0424; Copyright; Avail: Issuing Activity (TNO Prins Maurits Lab., P.O. Box 45, 2280 AA Rijswijk, The Netherlands), Hardcopy, Microfiche

During a post flight control of the F-16 the atmosphere and the temperature of the air intake and exhaust were measured. The following compounds were determined: carbon monoxide, carbon dioxide, nitrogen oxides, sulphur dioxide, PAH, hydrocarbons, aldehydes and dust or soot dust. PAH were found in a concentration of the TWA-value (0.2 mg/cu m) in the atmosphere of the exhaust. In the air intake low concentrations of hydrocarbons were found. The other compounds were far below the TWA-value. The temperature in the exhaust decreased from 45 to 35 C and in the air intake from 30 to 25 C during a measuring period of an hour. PAH were also found in the soot dust impacted on the floor under the exhaust of the start engine. It is not expectable that soot dust will whirl from the floor.

Author

Exhaust Gases; Exhaust Systems; Aircraft Engines; Air Intakes; Atmospheric Temperature; Carbon Dioxide; Carbon Monoxide; Nitrogen Oxides; Sulfur Dioxides; Polycyclic Aromatic Hydrocarbons; Hydrocarbons; Aldehydes

19970024936 Sverdrup Technology, Inc., Arnold Engineering Development Center Group, Arnold AFS, TN USA

Adaptation of a Three-Dimensional Numerical Simulation to Represent Gas Turbine Engine Compression Systems ***Final Report, 1 Sep. 1995 - 14 Dec. 1996***

Chalk, Jacqueline C., Sverdrup Technology, Inc., USA; Apr. 1997; 86p; In English

Report No.(s): AD-A323897; AEDC-TR-97-1; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

A new three-dimensional compression system simulation was constructed by coupling the three-dimensional Navier Stokes flow solver, NPARC, with source terms that model the effects of turbomachinery components. A stage by stage characteristic technique adapted from the one-dimensional compressor code, DYNTECC, was used to calculate the turbomachinery source terms. This report discusses the development, adaptation, and implementation of the stage characteristic approach for calculating sources used in NPARC. The distribution of the source terms from the one-dimensional domain to the three-dimensional domain is presented, and an investigation of the radial distribution of the sources during pre-stall compressor performance was conducted. A simple compressor, consisting of a single transonic rotor, was modeled because experimental data were available for comparison. DTIC

Gas Turbine Engines; Turbomachinery; Computerized Simulation; Turbocompressors; Boundary Value Problems; Navier-Stokes Equation; Incompressible Flow; Transonic Flow; Rotors; Stokes Flow

19970025061 NASA Lewis Research Center, Cleveland, OH USA

Effect of Flow Misalignment and Multi-Hole Interaction on Boundary-Layer Bleed Hole Flow Coefficient Behavior

Davis, David O., NASA Lewis Research Center, USA; Grimes, Marcus, Military Academy, USA; Schoenenberger, Mark, Case Western Reserve Univ., USA; Jun. 1997; 10p; In English; Mechanical Engineeringm Congress and Exhibit, 17-22 Nov. 1996, Atlanta, GA, USA; Sponsored by American Society of Mechanical Engineers, USA

Contract(s)/Grant(s): RTOP 523-36-13

Report No.(s): NASA-TM-107480; E-10768; NAS 1.15:107480; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The effect of flow misalignment on the flow coefficient behavior of a 20 deg. boundary-layer bleed hole and the effect of the interaction between two 90 deg. bleed holes separated by two hole diameters on flow coefficient behavior has been studied experimentally. Both tests were run at freestream Mach numbers of 0.61, 1.62 and 2.49. The flow misalignment study was conducted over a range of 0 to 30 deg. The results show that neither flow misalignment nor hole interaction has much effect on the flow coefficient for the subsonic case. For the supersonic cases, flow misalignment causes significant degradation in the performance of the slant hole. For the supersonic normal hole interaction cases, depending on the hole orientation, either an increase or decrease in overall flow coefficient was observed. The largest change in flow coefficient, 6% increase at near choke conditions, occurred when the holes were oriented in line with the flow direction.

Author

Misalignment; Flow Coefficients; Boundary Layer Flow

08
AIRCRAFT STABILITY AND CONTROL

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

19970023578 Air Force Inst. of Tech., School of Engineering, Wright-Patterson AFB, OH USA

Manual Tracking Flight Control with Amplitude and Rate Constrained Dynamic Actuators

Miller, Russel B., Air Force Inst. of Tech., USA; Jan. 1997; 149p; In English

Report No.(s): AD-A323184; AFIT/DS/ENG/96-15; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

A new control methodology for manual flight control, viz., real-time tracking control, is developed. Amplitude and rate constrained dynamic actuators are considered. Optimal tracking control is made possible by the use of unique reference signal prediction strategies which extrapolate the reference signal over the optimization horizon. A receding horizon, linear-quadratic inner-loop controller is employed in conjunction with an outer-loop nonlinear element. The constraint effects mitigation strategy is to optimally track a modified reference signal which yields feasible actuator commands over the optimization horizon when the pilot demanded reference is too aggressive to be tracked by the inner-loop optimal control law. A discrete-time implementation yields computationally inexpensive, closed-form solutions which are implementable in real-time and which afford the optimal tracking of an exogenous, unknown a priori reference signal. The developed control algorithm is applied to an open-loop unstable aircraft model, with attention being given to the trade-offs associated with the conflicting objectives of aggressive tracking and saturation avoidance. One-step ahead constraint mitigation is shown to provide substantial improvement in the constrained system response, while slightly more complicated constraint mitigation strategies yield stronger stability properties.

DTIC

Aircraft Models; Control Theory; Flight Control; Manual Control; Optimal Control

19970023617 Moscow Inst. of Aviation Technology, USSR

Investigation of Pilot Induced Oscillation Tendency and Prediction Criteria Development ***Final Report, Feb. 1994 - Mar. 1995***

Efremov, Alexander V., Moscow Inst. of Aviation Technology, USSR; Rodchenko, Victor V., Tsentralni Aerogidrodinamicheskii Inst., Russia; Boris, Sergey, Gromov Flight Research Inst., Russia; May 1996; 298p; In English

Report No.(s): AD-A322290; SPC-94-4028; SPC-94-4027; WL-TR-96-3109; SPC-94-4029; No Copyright; Avail: CASI; A13, Hardcopy; A03, Microfiche

This report documents the results of work of three Russian institutions directed towards the development of criteria for analysis and prediction of pilot-induced oscillation (PIO) tendencies. The first section of the report covers work done at the Moscow Aviation Institute to determine some of the basic influences of PIO and develop new criteria or modify existing criteria for the prediction of PIO tendencies. The second section describes work done at the Central Aerohydrodynamic Institute to investigate PIO tendencies utilizing a ground-based simulator to evaluate the effects of feel system dynamics and control sensitivities on PIO

tendencies. The third section describes work done at the Gromov Flight Research Institute on the use of TU-154 in-flight simulator to evaluate and validate various criteria for the prediction of PIO tendencies in flight for Class III aircraft.
DTIC
Pilot Induced Oscillation; Human Factors Engineering; Flight Simulation; Flight Tests; TU-154 Aircraft; Dynamic Control; Flight Control; Aircraft Maneuvers

19970023646 Air Force Inst. of Tech., School of Engineering, Wright-Patterson AFB, OH USA
Modern Flight Control Design, Implementation, and Flight Test
Edwards, Phillip T., Air Force Inst. of Tech., USA; Mar. 1997; 141p; In English
Report No.(s): AD-A323621; AFIT/GAE/ENY/97M-01; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

This thesis addresses the application issues raised implementing flight control designs derived from optimal control theory and the challenges in obtaining acceptable handling qualities when using these techniques. Using the USAF TPS FCS project as the controller architecture, four controllers were designed using classical methods, and H2, H3, and mixed H2/H optimal control theory. These designs were implemented in the Calspan VSS 2 Learjet, simulating unstable aircraft longitudinal dynamics and a limited handling qualities flight test evaluation was performed. The design phase found the optimal control techniques, as applied, difficult to design to handling qualities specifications. The H2, H3 and mixed H2/H controllers were unstable and often contained high frequency poles, which were difficult to implement. The flight test rated the designs acceptable on approach, but no handling qualities level for approach was determined.
DTIC
Aerodynamic Characteristics; Control Systems Design; Control Theory; Controllability; Flight Characteristics; Flight Control

19970023993 Air Force Inst. of Tech., Wright-Patterson AFB, OH USA
The Effects of Elevator Rate Limiting and Stick Dynamics on Longitudinal Pilot-Induced Oscillations
Peters, Patrick J., Air Force Inst. of Tech., USA; Mar. 1997; 147p; In English
Report No.(s): AD-A323192; AFIT/GAE/ENY/97M-02; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

This report presents the results of an investigation into the effects of elevator rate limiting and stick dynamics on longitudinal pilot-induced oscillations (PIO). A simulation study was conducted to prepare for the flight test, but also to gain insight into the effects of rate limiting and stick dynamics. Due to the non-numerical nature of the simulation results, a flexible three-phase flight test plan was developed, first varying the rate limits, then varying the stick dynamics, and finally flying a matrix determined in the first two phases. There were three major conclusions. First, the offset landing task flown was insufficient to consistently uncover handling qualities deficiencies of the aircraft configuration flown. Second, rate limiting did not necessarily cause PIOs. At very low rate limits the problem was lack of pitch response, not PIO. Any oscillations were very low frequency and small in amplitude. Third, for this configuration and task, variations in stick spring constant and natural frequency had negligible effect on the performance of the system with respect to assigned PIO and Cooper-Harper ratings. These conclusions are specific to this system and may not apply to all aircraft, especially aircraft where PIO tendencies are driven by much higher rate limits.
DTIC
Pilot Induced Oscillation; Controllability; Flight Tests

19970024867 Polish Academy of Sciences, Warsaw, Poland
Nonlinear Aircraft Flutter as the Hopf Bifurcation in a Multi-Degree of Freedom Dynamical System Exhibiting Heredity
Nielinowy flatter samolotu jako bifurkacja hopfa w lkladzie dynamicznym o wielu stopniach swobody z pamiecia
Grzedzinski, Janusz, Polish Academy of Sciences, Poland; 1997; ISSN 0208-5658; 96p; In Polish
Report No.(s): IFTR-2/1997; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

A new method is presented of local stability analysis of aeroelastic systems exhibiting heredity. An example of such a system is a flexible aircraft in a subsonic flow. The unsteady aerodynamic forces acting on an aircraft depend on the history of motion due to the influence of the shedding of the vortex wake behind an aircraft at earlier instants of time. Therefore, the aerodynamic operator relating the unsteady aerodynamic forces to deflections of an aircraft structure is of the form of the convolution integral. Consequently, the equation of disturbed, steady, rectilinear flight is of the form of an integro-differential equation. There exists the critical value of flight velocity, called critical flutter velocity, above which the steady motion becomes unstable. In a nonlinear aeroelastic system the flutter phenomenon corresponds to the instability known as the Hopf bifurcation, resulting in finite amplitude oscillations. These oscillations tend asymptotically to the limit cycle in a certain two dimensional attracting subspace called center manifold. Consequently, an asymptotic motion of an aircraft in the neighborhood of bifurcation point is fully described by the set of two nonlinear ordinary differential equations of the first order having phase-shift symmetry, despite the number of physical degrees of freedom of an aircraft. The method presented allows for the restriction of an aeroelastic system to the center man-

ifold, and gives the general algorithm for deriving such a system of two differential equations in terms of the power series expansions. Approximation of the center manifold equations can be obtained up to the desired order provided that derivatives of matrix transfer function of the aeroelastic system are known at the bifurcation point with respect to the flight velocity and frequency of oscillations. There is also no formal restriction on the number of degrees of freedom used for the description of the aircraft structure. by using the near-identity transformation the center manifold equations were brought to the well-known Poincare normal form for the Hopf bifurcation, thus describing classical and degenerate bifurcations as well. The results of sample limit cycle calculations are included concerning the simple model of a thin, two-dimensional airfoil with nonlinear springs, and also gliders with nonlinear control systems. The results of calculations were compared with those of harmonic balance method, and for the airfoil also with those of numerical integration of the equations of motion.
Author
Nonlinear Systems; Aerodynamic Forces; Degrees of Freedom; Dynamical Systems; Stability Tests; Aeroelasticity; Subsonic Flow; Unsteady Aerodynamics

09
RESEARCH AND SUPPORT FACILITIES (AIR)

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

19970023423 NERAC, Inc., Tolland, CT USA
Flight Simulator Training. (Latest Citations from the NTIS Bibliographic Database)
Mar. 1997; 2p; In English
Report No.(s): PB97-857197; No Copyright; Avail: Issuing Activity (National Technical Information Service, 5285 Port Royal RD., Springfield, VA 22161, USA), Microfiche

The bibliography contains citations concerning simulation methods and simulators for use in air flight training, with emphasis on military programs. Subjects include fidelity of the simulation, maneuvering, visual fields and perception, flight control, guidance, and motion simulation. The citations explore aircraft, helicopter, and spacecraft simulators used for pilot training and upgrading of skills. References to training concepts and pilot performance are included.
NTIS
Bibliographies; Training Simulators; Pilot Training; Motion Simulation; Flight Training; Flight Simulators; Flight Control

19970023769 Nevada Univ., Dept. of Civil Engineering, Reno, NV USA
Development of Field Validation Tests for Coal-Tar Emulsions ***Final Report***
Sebaaly, Peter E., Nevada Univ., USA; Rahman, Mohammad, Nevada Univ., USA; Hardin, Kevin, Nevada Univ., USA; Schiake, Bernie, Nevada Univ., USA; Mar. 1997; 30p; In English
Report No.(s): AD-A323447; DOT/FAA/AR-96-45; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Field quality assurance and quality control (QA/QC) programs represent the most important step toward ensuring the construction of a successful project. However, in order for QA/QC programs to be implemented, a set of simple and yet effective tests must be available which can be conducted in the field during the construction process. The objective of this study was to investigate the available QA/QC programs for coal-tar emulsions and to further evaluate the ones that proved reliable. The research evaluated four different tests. Two of these tests were proven reliable and yet simple and were recommended for inclusion in a QA/QC program.
DTIC
Quality Control; Emulsions

10
ASTRONAUTICS

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

19970024873 NASA Lewis Research Center, Cleveland, OH USA

Comparison of High Aspect Ratio Cooling Channel Designs for a Rocket Combustion Chamber

Wadel, Mary F., NASA Lewis Research Center, USA; Jun. 1997; 14p; In English; 33rd; Joint Propulsion Conference and Exhibit, 6-9 Jul. 1997, Seattle, WA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Contract(s)/Grant(s): RTOP 242-20-06

Report No.(s): NASA-TM-107473; NAS 1.15:107473; E-10762; AIAA Paper 97-2913; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

An analytical investigation on the effect of high aspect ratio (height/width) cooling channels, considering different coolant channel designs, on hot-gas-side wall temperature and coolant pressure drop for a liquid hydrogen cooled rocket combustion chamber, was performed. Coolant channel design elements considered were: length of combustion chamber in which high aspect ratio cooling was applied, number of coolant channels, and coolant channel shape. Seven coolant channel designs were investigated using a coupling of the Rocket Thermal Evaluation code and the Two-Dimensional Kinetics code. Initially, each coolant channel design was developed, without consideration for fabrication, to reduce the hot-gas-side wall temperature from a given conventional cooling channel baseline. These designs produced hot-gas-side wall temperature reductions up to 22 percent, with coolant pressure drop increases as low as 7.5 percent from the baseline. Fabrication constraints for milled channels were applied to the seven designs. These produced hot-gas-side wall temperature reductions of up to 20 percent, with coolant pressure drop increases as low as 2 percent. Using high aspect ratio cooling channels for the entire length of the combustion chamber had no additional benefit on hot-gas-side wall temperature over using high aspect ratio cooling channels only in the throat region, but increased coolant pressure drop 33 percent. Independent of coolant channel shape, high aspect ratio cooling was able to reduce the hot-gas-side wall temperature by at least 8 percent, with as low as a 2 percent increase in coolant pressure drop. The design with the highest overall benefit to hot-gas-side wall temperature and minimal coolant pressure drop cooling can now be done in relatively short periods of time with multiple iterations.

Author

Combustion Chambers; High Aspect Ratio; Cooling; Channels; Computer Programs; Design

11
CHEMISTRY AND MATERIALS

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

19970023529 Alabama Univ., Huntsville, AL USA

Atomic Oxygen Task *Final Report*

Hadaway, James B., Alabama Univ., USA; Mar. 27, 1997; 13p; In English

Contract(s)/Grant(s): NAS8-38609

Report No.(s): NASA-CR-202795; NAs 1.26:202795; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report details work performed by the Center for Applied Optics (CAO) at the University of Alabama in Huntsville (UAH) on the contract entitled 'Atomic Oxygen Task' for NASA's Marshall Space Flight Center (contract NAS8-38609, Delivery Order 109, modification number 1). Atomic oxygen effects on exposed materials remain a critical concern in designing spacecraft to withstand exposure in the Low Earth Orbit (LEO) environment. The basic objective of atomic oxygen research in NASA's Materials & Processes (M&P) Laboratory is to provide the solutions to material problems facing present and future space missions. The objective of this work was to provide the necessary research for the design of specialized experimental test configurations and development of techniques for evaluating in-situ space environmental effects, including the effects of atomic oxygen and electromagnetic radiation on candidate materials. Specific tasks were performed to address materials issues concerning accelerated environmental testing as well as specifically addressing materials issues of particular concern for LDEF analysis and Space Station materials selection.

Author

Oxygen Atoms; Aircraft Design; Exposure; Environment Effects; Accelerated Life Tests

12
ENGINEERING

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

19970023419 National Aerospace Lab., Tokyo, Japan
Wind Model near a High Building for Helicopter Flight Simulator
Harada, Masashi, National Aerospace Lab., Japan; Okuno, Yoshinori, National Aerospace Lab., Japan; Nov. 1996; ISSN 0389-4010; 26p; In Japanese
Report No.(s): NAL-TR-1311; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Simulation tests of a fire helicopter for high buildings are being conducted cooperatively between the National Aerospace Laboratory (NAL) and the Tokyo Fire Department. Many factors affect the mission of the fire helicopter. One of the most important factors is the heavily turbulent wind and shear forces near high buildings. In simulating the mission of the fire fighting, it is necessary to generate the wind in real time depending on both the time and location of the measuring point. When the height of the building was assumed to be infinite, it was feasible to make such wind by using a two dimensional Discrete Vortex Method. It was also shown that this method is adaptive to make the wind around the building whose height is not so longer than its width. Author

Fire Fighting; Buildings; Real Time Operation; Helicopters; Turbulence; Flight Simulators

19970023445 Defence Science and Technology Organisation, Aeronautical and Maritime Research Lab., Melbourne, Australia
Evaluation of Innovative NDI Methods for Detection of Widespread Fatigue Damage
Sharp, P. K., Defence Science and Technology Organisation, Australia; Rowlands, D. E., Defence Science and Technology Organisation, Australia; Clark, G., Defence Science and Technology Organisation, Australia; Aug. 1996; 67p; In English
Report No.(s): AD-A322266; DSTO-TR-0366; DODA-AR-009-749; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

High-performance high-strength aircraft components such as the F/A-18 FS488 bulkhead can experience catastrophic failure in fatigue tests from very small cracks. At the same time, the efficiency of design methods used for these components results in highly uniform stressing, and a large number of fatigue cracks all growing at approximately the same rate - multi-site cracking. These circumstances place extreme demands upon the use of Non-Destructive Inspection (NDI) methods for finding and characterising defects, and when surface treatments such as peening are also employed to extend service fatigue life, it becomes almost impossible to detect the small crack arrays which are of concern. This report examines and evaluates some novel Non-Destructive Inspection techniques, that may allow numerous small cracks (less than 1 mm) over a large area to be detected. Conventional NDI techniques are also used for comparative purposes. The novel techniques used are (1) Holographic Interferometry, (2) Structural Integrity Monitor, and (3) Laser Ultrasonics. This report examines the extent to which each technique can locate cracks on a large polished specimen representing part of a bulkhead. Techniques which perform well in this evaluation will be further evaluated on a large peened specimen.
DTIC

Fatigue (Materials); Fault Detection; Nondestructive Tests; Cracks; Fatigue Tests; Aircraft Structures

19970023698 Lehigh Univ., Dept. of Mechanical Engineering and Mechanics, Bethlehem, PA USA
Unsteady Three-Dimensional Aerodynamic Flow ***Final Report, 15 Feb. 1995 - 14 Feb 1997***
Rockwell, Donald O., Lehigh Univ., USA; Feb. 28, 1997; 8p; In English
Contract(s)/Grant(s): F49620-95-I-0220
Report No.(s): AD-A322579; AFOSR-533040; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The overall objective of this program is to determine the instantaneous flow structure on delta wings at high angle-of-attack, as well as from cylindrical bodies, which are subjected to basic classes of motion. New techniques of high-image density particle image velocimetry provide the instantaneous vorticity fields and streamline patterns, thereby allowing interpretation of the underlying physics using critical point theory. This type of quantitative interpretation of the flow structure is crucial for performing vorticity balances on wings and bodies and thereby optimization of overall performance characteristics. Furthermore, for the case of the delta wing at high angle-of-attack, local control techniques are applied simultaneously at leading and trailing-edges of the

wing, in order to alter the crucial features of vortex breakdown and subsequent large-scale stall. Such control techniques have application to a wide variety of separated flows from wings and cylindrical bodies.
DTIC
Unsteady Aerodynamics; Aerodynamic Characteristics; Control Systems Design; Cylindrical Bodies; Delta Wings; Separated Flow; Three Dimensional Flow; Vortex Breakdown; Vorticity; Unsteady Flow

19970023851 Department of the Navy, Washington, DC USA
Pulse Controlled Motion Conversion System for Magnetostrictive Motor
Riedl, Harold R., Inventor, Department of the Navy, USA; Feb. 11, 1997; 7p; In English; Supersedes AD-D018277
Patent Info.: Filed 31 Mar. 1995; US-Patent-Appl-SN-414884; US-Patent-5,602,434
Report No.(s): AD-D018441; No Copyright; Avail: US Patent and Trademark Office, Microfiche

Axial elongation of a magnetostrictive element during a power phase of operation in a motor, effects conversion of axial force to a torque applied to a rotor through cam discs held in axial engagement by a clutch disc during axial force transfer. Rotor rotation by such torque angularly displaces the cam discs relative to each other against the bias of a spring device during the power phase, followed by a free wheeling phase during which axial withdrawal of the clutch disc occurs in response to contraction of the magnetostrictive element and angular restoration of the cam discs to a limit position under the spring bias.
DTIC
Magnetostriction; Rotors; Clutches; Electric Motors

19970023898 Florida Agricultural and Mechanical Univ., Lab. for Modern Fluid Physics, Tallahassee, FL USA
Nonlinear Issues in the Aerothermochemistry of Gases and Materials and the Associated Physics and Dynamics of Interfaces ***Final Report, 1 Jan. 1992 - 31 Dec. 1996***
Johnson, Joseph A., III, Florida Agricultural and Mechanical Univ., USA; 1996; 52p; In English
Contract(s)/Grant(s): NAGw-2930
Report No.(s): NASA-CR-204656; NAS 1.26-204656; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

Our research and technology are focused on nonlinear issues in the aerothermochemistry of gases and materials and the associated physics and dynamics of interfaces. Our program is now organized to aggressively support the NASA Aeronautics Enterprise so as to: (a) develop a new generation of environmentally compatible, economic subsonic aircraft; (b) develop the technology base for an economically viable and environmentally compatible high-speed civil transport; (c) develop the technology options for new capabilities in high-performance aircraft; (d) develop hypersonic technologies for air-breathing flight; and (e) develop advanced concepts, understanding of physical phenomena, and theoretical, experimental, and computational tools for advanced aerospace systems. The implications from our research for aeronautical and aerospace technology have been both broad and deep. For example, using advanced computational techniques, we have determined exact solutions for the Schrodinger equation in electron-molecule scattering allowing us to evaluate atmospheric models important to reentry physics. We have also found a new class of exact solutions for the Navier Stokes equations. In experimental fluid dynamics, we have found explicit evidence of turbulence modification of droplet sizes in shock tube flow with condensation. We have developed a new diagnostic tool for the direct estimation of flow velocities at MHz sampling rates in quasi-one dimensional turbulent flow. This procedure suggests an unexpected confirmation of the possibility of 'natural' closure in Reynolds stresses with deep implications for the development of turbulent models. A transient increase is observed in both the spectral energy decay rate and the degree of chaotic complexity at the interface of a shock wave and a turbulent ionized gas. Even though the gas is apparently brought to rest by the shock wave, no evidence is found either of the expected relaminarization. A unique diamond-shaped nozzle has been designed for a detailed investigation of the effect of significant streamwise vorticity on the acoustic and IR characteristics of supersonic jets. Our results provide convincing evidence of the significant effect of vorticity on the far-field noise for the diamond jet as compared to the conventional round jets. We have found that the countercurrent shear layer mixes much more efficiently than conventional coflowing shear layers. We also developed the fluid thrust vectoring procedures which use counter flow to vector a jet. Our materials research has shown that the steep stress gradients at the fiber-matrix interface could be the primary cause of interface cracks after the processing of metallic and intermetallic matrix composites. New techniques have been evolved for: the microcharacterization of materials including microplastic strain and, point by point, the misorientation and plasticity for matrix composites; thermally induced stress measurements and load relaxation; the growth and characterization of metallic matrix composite interfaces; and for the growth of ferrite materials by pulsed laser deposition. The FAMU commitment to the HBCU Research Center also continues to be broad and deep.
Author
Aerothermochemistry; Hypersonic Flight; Aerospace Systems; Aircraft Performance; Supersonic Jet Flow; Metal Matrix Composites; Ionized Gases; Fluid Dynamics; Gas Jets

19970023986 Defence Science and Technology Organisation, Aeronautical and Maritime Research Lab., Melbourne, Australia

Elastic/Plastic Finite Element Analysis of the F-111 Fuel Flow Vent Hole Number 13

Paul, J., Defence Science and Technology Organisation, Australia; Chapman, P., Defence Science and Technology Organisation, Australia; Searl, A., Defence Science and Technology Organisation, Australia; Nov. 1996; 92p; In English; Original contains color illustrations

Report No.(s): DSTO-TR-0454; AR-009-944; Copyright; Avail: Issuing Activity (DSTO Aeronatical and Maritime Research Lab., PO Box 4331, Melbourne Victoria 3001, Australia), Hardcopy, Microfiche

The finite element method is used to determine the stress analysis for a fatigue critical location, at Fuel Flow Vent Hole in the Wing Pivot Fitting of an F-111 aircraft. The material behavior was represented by a unified constitutive model. The aim of the present work is to generate the residual stress distributions following one (or more) applications of Cold Proof Load Test, as an input to the Durability and Damage Tolerance Analyses (DADTA).

Derived from text

F-111 Aircraft; Residual Stress; Wings; Stress Distribution; Load Tests; Finite Element Method

19970024768 NASA Lewis Research Center, Cleveland, OH USA

Rotordynamic Instability Problems in High-Performance Turbomachinery 1996

Rotordynamic Instability Problems in High-Performance Turbomachinery 1996; May 1997; 300p; In English; 8th, 6-8 May 1996, College Station, TX, USA; Sponsored by NASA Lewis Research Center, USA; Also announced as 19970024769 through 19970024787

Contract(s)/Grant(s): RTOP 233-1B-1B

Report No.(s): NASA-CP-3344; E-10502; NAS 1.55:3344; No Copyright; Avail: CASI; A13, Hardcopy; A03, Microfiche

The first rotordynamics workshop proceedings emphasized a feeling of uncertainty in predicting the stability of characteristics of high-performance turbomachinery. In the second workshop proceedings these uncertainties were reduced through programs established to systematically resolve problems, with emphasis on experimental validation of the forces that influence rotordynamics. In the third proceedings many programs for predicting or measuring forces and force coefficients in high-performance turbomachinery produced results. Data became available for designing new machines with enhanced stability characteristics or for upgrading existing machines. In the fourth proceedings there emerged trends towards a more unified view of rotordynamic instability problems and several encouraging new analytical developments. The fifth workshop supported the continuing trend toward a unified view with several new developments in the design and manufacture of new turbomachineries with enhanced stability characteristics along with new data and associated numerical/theoretical results. The sixth workshop report provided field experience and experimental results, and expanded the use of computational and control techniques with integration of damper, bearing, and eccentric seal operation results. The seventh workshop report provided field experiences, numerical, theoretical, and experimental results and control methods for seals, bearings, and dampers with some attention given to variable thermophysical properties and turbulence measurements, and introduction of two-phase flow results. In the present workshop, active magnetic bearings (AMB's) evolve into a new method of measuring rotordynamic coefficients with discussions on honeycomb seals, drop of magnetically supported rotors, seals, bearings and dampers with new data being reported. The intent of the workshop and this proceedings is to provide a continuing impetus for an understanding and resolution of these problems.

Author

Turbomachinery; Rotor Dynamics; Turbulent Flow; Magnetic Bearings; Two Phase Flow; Seals (Stoppers); Conferences; Rotary Stability; Rotors

19970024770 Korea Inst. of Tech., Seoul, Korea, Republic of

A Test Apparatus and Preliminary Test Results for Rotordynamic Coefficients of a Swirl-Controlled Hybrid Bearing

Kimm Chang-Ho, Korea Inst. of Tech., Korea, Republic of; Lee, Yong-Bok, Korea Inst. of Tech., Korea, Republic of; Choi, Dong-Hoon, Hanyang Univ., Korea, Republic of; Rotordynamic Instability Problems in High-Performance Turbomachinery 1996; May 1997, pp. 13-22; In English; Also announced as 19970024768; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

A swirl-controlled hybrid (hydrostatic and hydrodynamic) bearing has been newly proposed and tested to determine stiffness, damping, and added-mass rotordynamic coefficients in addition to static operating characteristics in comparison to a conventional hybrid bearing. A new facility for testing the swirl-controlled hybrid bearing is described which has a capability of manipulating strength and direction of the swirl inside the bearing clearance. A new swirl-control mechanism is realized by pairing swirl and anti-swirl orifices to and against rotational direction of the rotor, respectively. The swirl-control mechanism is used to achieve effective control of the tangential flow inside the bearing clearance. Preliminary test results show that the swirl-control mechanism has a possibility of improving whirl-frequency ratio as well as has a capability of controlling critical speeds. However, the swirl-

controlled bearing may need a great deal of effort in design modification for being considered as a serious candidate for a smart bearing, especially in the centered position and at high-speed ranges.
Author
Rotor Dynamics; Bearings; Turbulent Wakes; Hydrodynamics; Hydrostatics; Rotors; Performance Tests

19970024773 Texas A&M Univ., College Station, TX USA
The Acoustic Influence of Cell Depth on the Rotordynamic Characteristics of Smooth-Rotor/Honeycomb-Stator Annular Gas Seals
Kleynhans, George, Texas A&M Univ., USA; Childs, Dara, Texas A&M Univ., USA; Rotordynamic Instability Problems in High-Performance Turbomachinery 1996; May 1997, pp. 49-76; In English; Also announced as 19970024768; No Copyright; Avail: CASI; A03, Hardcopy; A03, Microfiche

A two-control-volume model is employed for honeycomb-stator/smooth-rotor seals, with a conventional control-volume used for the through flow and a 'capacitance-accumulator' model for the honeycomb cells. The control volume for the honeycomb cells is shown to cause a dramatic reduction in the effective acoustic velocity of the main flow, dropping the lowest acoustic frequency into the frequency range of interest for rotordynamics. In these circumstances, the impedance functions for the seals can not be modeled with conventional (frequency-independent) stiffness, damping, and mass coefficients. More general transform functions are required to account for the reaction forces, and the transfer functions calculated here are a lead-lag term for the direct force function and a lag term for the cross-coupled function. Experimental measurements verify the magnitude and phase trends of the proposed transfer functions. These first-order functions are simple, compared to transfer functions for magnetic bearings or foundations. For synchronous response due to imbalance, they can be approximated by running-speed-dependent stiffness and damping coefficients in conventional rotordynamics codes. Correct predictions for stability and transient response will require more general algorithms, presumably using a state-space format.
Author
Honeycomb Structures; Seals (Stoppers); Rotor Dynamics; Rotors; Stators; Performance Prediction

19970024774 Boeing North American, Inc., Rocketdyne Div., Canoga Park, CA USA
A Comparison of Experimental Rotordynamic Coefficients and Leakage Characteristics Between Hole-Pattern Gas Damper Seals and a Honeycomb Seal
Yu, Zeping, Boeing North American, Inc., USA; Childs, Dara, Texas A&M Univ., USA; Rotordynamic Instability Problems in High-Performance Turbomachinery 1996; May 1997, pp. 77-93; In English; Also announced as 19970024768; No Copyright; Avail: CASI; A03, Hardcopy; A03, Microfiche

Honeycomb annular seals are an attractive design alternative due to their superior static and dynamic performance. However, their implementation in industrial practice has been delayed by the following characteristics: (a) manufacturing time can be appreciable, and (b) they can seriously damage the shaft if rubbing occurs. to minimize these problems, 'hole-pattern' gas damper seals, which are formed by simply drilling holes into an annular smooth seal, were manufactured and tested. The hole-pattern damper seal stator can be made of high-strength plastic materials which are less likely to damage a shaft during rubbing. The experimental results presented demonstrate that, compared to a honeycomb seal, a hole-pattern damper seal with 3.18 mm hole diameters and a high percentage of hole surface has achieved: (a) an average of 12 percent reduction in leakage rate, and (b) considerably higher effective damping, especially under high speeds and low inlet pressure ratio conditions.
Author
Honeycomb Structures; Seals (Stoppers); Rotor Dynamics; Damping; Structural Analysis; Holes (Mechanics); Leakage; Manufacturing; Plastics; Rotors

19970024775 Demag A.G., Delaval Turbomachinery, Duisburg, Germany
Dynamic Labyrinth Coefficients From a High-Pressure Full-Scale Test Rig Using Magnetic Bearings
Wagner, Norbert G., Demag A.G., Germany; Steff, Klaus, Demag A.G., Germany; Rotordynamic Instability Problems in High-Performance Turbomachinery 1996; May 1997, pp. 95-111; In English; Also announced as 19970024768; Original contains color illustrations; No Copyright; Avail: CASI; A03, Hardcopy; A03, Microfiche

A safe rotor dynamic design for high pressure centrifugal compressors requires precise knowledge of the dynamic labyrinth coefficients. The objective of the test rig design and operation is to simulate original high-pressure compressor conditions in every aspect as well as possible. A key technology for this task is the use of active magnetic bearings. Static and dynamic calibration of the system is performed immediately before and after each test run as part of the test cycle. The input/output signals of the magnetic bearing system are fed into a data acquisition and analysis system for off-line data processing. A new analysis method uses basic ideas from magnetic bearing control theory. The equations of motion are prepared in such a way that the identification of

the spring and damper coefficients reduces to a linear curve fit in the frequency domain. A coherence-based filter algorithm improves the quality of the results, which are presented in numerical and graphical form. The method is applied to determine the four coefficients for the centered position as well as the full matrices for arbitrary rotor position. Some typical results visualize the effect of different geometrical and operational parameters.
Author
Centrifugal Compressors; Magnetic Bearings; Labyrinth; Full Scale Tests; Equations of Motion; Rotor Dynamics; Rotors; Dynamic Pressure

19970024776 Kobe Univ., Japan
A Study on Dynamic Characteristics of Double Spiral Grooved Seals
Iwatsubo, H., Kobe Univ., Japan; Nishino, T., Kobe Univ., Japan; Ishimaru, H., Kobe Univ., Japan; Rotordynamic Instability Problems in High-Performance Turbomachinery 1996; May 1997, pp. 113-134; In English; Also announced as 19970024768; No Copyright; Avail: CASI; A03, Hardcopy; A03, Microfiche

Double Spiral Grooved Seals(DSGS) are often used for pumps because of lower leakage and removal of impurities through the groove path. Thus, it is important to investigate the dynamic characteristics of DSGS. In this study, the fluid force induced by DSGS is experimentally and theoretically investigated. In the experimental study, the fluid forces induced by DSGS with different helix angles are measured under various conditions such as the pressure difference between inlet and outlet of the seal, preswirl velocity and the ratio of whirling speed to rotating speed of the rotor. In the theoretical study, different models are considered for static and dynamic analysis. In the static analysis, a three-layer bulk flow in which the flow in DSGS is divided into two groove flows and a clearance flow is introduced. The results of the static analysis are used for the dynamic analysis. In the dynamic analysis, however, DSGS is looked upon as a circumferential grooved seal with grooves on both rotor and stator. At that time, the governing equations are derived using continuity and momentum equations. These equations are solved numerically by using the perturbation method. The results show that the calculated tangential forces are in good agreement with the experimental ones but the radial forces don't agree as well.
Author
Turbomachinery; Dynamic Characteristics; Seals (Stoppers); Pumps; Grooves; Continuity Equation; Momentum Theory; Rotors; Design Analysis; Leakage

19970024777 Technische Univ., Munich, Germany
Experimental Rotordynamic Coefficients of Short Labyrinth Gas Seals
Kwanka, K., Technische Univ., Germany; Magel, M., Technische Univ., Germany; Rotordynamic Instability Problems in High-Performance Turbomachinery 1996; May 1997, pp. 135-144; In English; Also announced as 19970024768; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

In the design stage, the fluid-induced forces in labyrinth seals must be predicted exactly to avoid unstable vibrations of turbomachinery. For a validation of the used numerical codes, a comparison of the calculated with the measured dynamic coefficients is required. In addition, damping coefficients are necessary to realistically predict the destabilizing effects for certain seals and how this can be modified. For short labyrinth gas seals only few measured data are available. With a new, recently presented identification procedure this lack of experimental data is reduced. The measured dynamic coefficients show the expected strong, dependency on the entry swirl and the pressure ratio. For all seal geometries and test parameters presented in the paper the cross-coupled stiffness increases almost linearly along with the entry swirl. On the other hand the direct damping tends to be irregular. The influence of the seal on the stability is clearly different when the damping is considered, too.
Author
Turbomachinery; Labyrinth Seals; Leakage; Rotor Dynamics; Rotors; Vibration; Dynamic Stability; Dynamic Structural Analysis; Vibration Damping

19970024778 Texas A&M Univ., College Station, TX USA
Upstream Swirl Effects on the Flow Inside a Labyrinth Seal
Morrison, Gerald L., Texas A&M Univ., USA; Johnson, Mark C., Texas A&M Univ., USA; Rotordynamic Instability Problems in High-Performance Turbomachinery 1996; May 1997, pp. 145-160; In English; Also announced as 19970024768; Original contains color illustrations; No Copyright; Avail: CASI; A03, Hardcopy; A03, Microfiche

The flow field inside a seven cavity tooth on rotor labyrinth seal was measured using a 3D laser Doppler anemometer system. The seal was operated at a Reynolds number of 24,000 and a Taylor number of 6,600 using water as the working fluid. Swirl vanes were placed upstream of the seal to produce positive, negative, and no preswirl. It was found that the axial and radial velocities were minimally effected. The tangential velocity, both in the clearance region and the seal cavities on the rotor, were greatly altered

by the preswirl. By applying negative preswirl, the tangential velocity was suppressed, even in the seventh cavity. The turbulence levels decreased as the preswirl varied from negative to positive.
Author
Labyrinth Seals; Turbomachinery; Turbulence; Fluid Flow; Rotors; Secondary Flow; Leakage

19970024779 New South Wales Univ., Sydney, Australia
Effects of Misalignment on the Stability and Inbalance Response of Statically Indeterminate Rotating Machinery
Feng, N. S., New South Wales Univ., Australia; Hahn, E. J., New South Wales Univ., Australia; Rotordynamic Instability Problems in High-Performance Turbomachinery 1996; May 1997, pp. 163-175; In English; Also announced as 19970024768; Sponsored in part by Pacific Power (Northern Region).; No Copyright; Avail: CASI; A03, Hardcopy; A03, Microfiche

In statically indeterminate rotor bearings systems, where the rotor is supported by one or more hydrodynamic bearings, the reactions at each hydrodynamic bearing, and hence its stiffness and damping properties depend not only on the bearing type, the operating conditions, and the bearing dimensions but also on the relative misalignment between the journal and the bearing housing. This misalignment has a significant influence on the vibration behaviour of the rotor bearing system, in particular, on its stability and inbalance response. Additional complications arise if non symmetric bearing types such as elliptic or tilting pad bearings are present. An iterative procedure is outlined which enables the bearing reactions to be determined at any speed, thereby enabling even large systems such as turbomachinery to be rapidly analysed in conjunction with existing linear rotor bearing vibration analysis software. Sample numerical examples show how misalignment and bearing type can affect the natural frequencies, the stability threshold and the inbalance response of such statically indeterminate systems.
Author
Turbomachinery; Journal Bearings; Dynamic Structural Analysis; Linear Vibration; Hydrodynamics; Misalignment; Rotors; Rotor Dynamics

19970024780 Technische Univ., Darmstadt, Germany
Theoretical Identification of the Rotordynamic Coefficients in the Impeller-Diffuser Domain of a Centrifugal Pump
Fongang, R., Technische Univ., Germany; Colding-Jorgensen, J., Colding Consult, Denmark; Nordmann, R., Technische Univ., Germany; Rotordynamic Instability Problems in High-Performance Turbomachinery 1996; May 1997, pp. 177-195; In English; Also announced as 19970024768; No Copyright; Avail: CASI; A03, Hardcopy; A03, Microfiche

A fluid model based on the unsteady potential flow theory is developed to investigate the hydrodynamic forces acting on a rotating impeller caused by the impeller-fluid-diffuser interaction in a centrifugal pump with vaneless or vaned diffuser. The impeller is assumed to have an infinite number of vanes perfectly guiding the flow and its center executes a whirling motion about the diffuser center. The flow is taken to be 2-dimensional, incompressible, inviscid, and irrotational in the absolute coordinate system. The hydrodynamic forces are presented as a superposition of steady forces due to the diffuser asymmetry and unsteady forces due to the impeller center eccentricity, velocity and acceleration. The stiffness, damping and inertia coefficients are deduced from the unsteady forces decomposed into radial and tangential components relative to the orbit described by the impeller center. In comparison with most of the theoretical and experimental results found in the literature, the analysis seems to give good prediction. The study of the influence of some parameters on the results in the case of the vaned diffuser also attests to the qualitative validity of the model. It appears that, under certain operating conditions, the fluid forces on the impeller have a destabilizing effect on the pump rotor.
Author
Impellers; Rotor Dynamics; Inviscid Flow; Potential Flow; Rotors; Unsteady Flow; Centrifugal Pumps; Diffusers; Hydrodynamics; Turbulence; Flow Theory; Loads (Forces)

19970024781 Virginia Polytechnic Inst. and State Univ., Blacksburg, VA USA
Evaluation of AMB Rotor Drop Stability
Kirk, R. G., Virginia Polytechnic Inst. and State Univ., USA; Raju, K. V. S., Virginia Polytechnic Inst. and State Univ., USA; Ramesh, K., Virginia Polytechnic Inst. and State Univ., USA; Rotordynamic Instability Problems in High-Performance Turbomachinery 1996; May 1997, pp. 197-208; In English; Also announced as 19970024768; Sponsored in part by the Virginia Center for Innovative Technology and the Dresser-Rand Turbo Products Div.; No Copyright; Avail: CASI; A03, Hardcopy; A03, Microfiche

The use of active magnetic bearings (AMB) for turbomachinery has enjoyed substantial growth during the past decade. The advantages to many applications make this a very attractive solution for potentially low loss and efficient support for both radial and thrust loads. New machinery must be shop tested prior to shipment to the field for installation on-line. One necessary test is the operation of the emergency drop or overload touchdown bearings. A major concern treated by this paper is the calculation

of the transient response and contact forces on the radial backup bearings. The calculation technique is reviewed and results of transient response evaluation of a full-size test rotor will be documented for various levels and distribution of both static and dynamic unbalance. Recommendations are also given as to how a rotor should be shop tested to improve the probability of stable operation on the test stand and in the field operating condition.
Author
Turbomachinery; Magnetic Bearings; Rotors; Transient Response; Loads (Forces); Structural Stability; Structural Analysis

19970024783 Texas A&M Univ., College Station, TX USA
Rotordynamic Instability from an Anti-Swirl Device
Vance, John, Texas A&M Univ., USA; Handy, Steven B., Texas A&M Univ., USA; Rotordynamic Instability Problems in High-Performance Turbomachinery 1996; May 1997, pp. 231-245; In English; Also announced as 19970024768; No Copyright; Avail: CASI; A03, Hardcopy; A03, Microfiche

A swirl damper intended for high temperature turbomachinery applications was experimentally investigated for its damping characteristics. The results were disappointing in that only a small amount of damping was obtained. Instead, an instability was produced at a speed which exhibited backward whirl. The rotor rig that was used exhibited backward whirl over a speed range between two critical speeds. This backward whirl could be prematurely induced by the use of the swirl gas damper. At high damper pressures, the rotor system exhibited an instability. The exact nature of this instability is not known, however, possible causes are presented. The observations discussed in this paper are also important to those who design swirl brakes or anti-swirl guide vanes for labyrinth seals. The principles involved are similar in that the flow into a labyrinth seal is turned to swirl anti-rotationally as it enters the seal, same as the swirl gas damper.
Author
Turbomachinery; Damping; Rotor Dynamics; Rotors; Rotation; Labyrinth Seals; Rotary Stability; Design Analysis

19970024784 Allied-Signal Corp., Turbocharging Systems, Torrance, CA USA
Turbocharger Rotordynamic Instability and Control
Sahay, Sunil N., Allied-Signal Corp., USA; LaRue, Gerry, Allied-Signal Corp., USA; Rotordynamic Instability Problems in High-Performance Turbomachinery 1996; May 1997, pp. 247-257; In English; Also announced as 19970024768; No Copyright; Avail: CASI; A03, Hardcopy; A03, Microfiche

Turbochargers operate over a wide range of speed and lubricating oil inlet conditions. The speed varies between zero to as high as 230,000 rpm, and the oil inlet pressure and temperatures range from 15 to 75 psi, and 0 to 250 F. Due to aerodynamic and heat transfer considerations, a great majority of turbochargers for automotive application use a 'double overhung' rotor-bearing configuration with radial flow wheels. Typically, these turbochargers use 'fully floating' (free to rotate), plain cylindrical bore bearings, which are subject to various subsynchronous instabilities, such as oil whirl and resonant whip. Experience shows that turbochargers can run satisfactorily with a limited amount of bearing instability, provided the whirl orbit does not exceed a certain percentage of the bearing clearance space. Accurate analytical prediction of bearing instability onset and whirl orbit magnitude is very difficult at the present time due to the nonlinearity and complexity involved. The well-known solutions for controlling oil film instability such as non cylindrical bore, tilting pad, and ball bearings are NOT very attractive due to high manufacturing cost. However, the use of a 'semi floating' bearing (free to rotate but constrained from rotation) with a plain cylindrical bore, can offer a cost effective solution. Compared to fully floating bearings, the unstable whirl orbit can be reduced by more than 35%. The future work at the author's company involves the use of a Bearing Test Rig to better understand the nature of these instabilities, and to experimentally obtain the bearing characteristics for use in a Rotordynamics computer program.
Author
Turbocompressors; Rotor Dynamics; Rotary Stability; Design Analysis; Ball Bearings; Rotation; Turbomachinery; Rotors

19970024785 Technische Univ., Vienna, Austria
State Space Adaptive Control for a Lumped Mass Rotor Excited by Nonconservative Cross-Coupling Forces
Wurmsdobler, P., Technische Univ., Austria; Jorgl, H. P., Technische Univ., Austria; Springer, H., Technische Univ., Austria; Rotordynamic Instability Problems in High-Performance Turbomachinery 1996; May 1997, pp. 259-267; In English; Also announced as 19970024768; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

An adaptive pole-assignment controller is presented in conjunction with a state space model identification for an active magnetic bearing system, consisting of a single mass suspended in an active magnetic bearing excited by nonconservative cross-cou-

pling forces. Simulation results show the success of this algorithm for parameter changes in closed loop operation with system noise but without set point changes.
Author
Magnetic Bearings; Nonconservative Forces; Rotors; Adaptive Control; Feedback Control; Rotary Stability; Vibration Damping; Rotor Dynamics

19970024786 Far East Levingston Shipbuilding Ltd., Singapore
Nonlinear Response of Rotor to Stator Rubs
Wei, Yang, Far East Levingston Shipbuilding Ltd., Singapore; Tang, Xikuna, Far East Levingston Shipbuilding Ltd., Singapore; Hogat, Stanley, Far East Levingston Shipbuilding Ltd., Singapore; Rotordynamic Instability Problems in High-Performance Turbomachinery 1996; May 1997, pp. 269-278; In English; Also announced as 19970024768; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

Rub interaction that happens between rotor and stator of rotating machinery induces complex nonlinear vibration phenomena. In general, the transient contact and rub between rotor and stator influence on the operating conditions of rotating machinery in following aspects: (A) The contact forces induced by rotor/stator rubs increased the system stiffness. In other words, it is equivalent to introducing a support to the machine system. (B) The advent of contact presents impact to the system and brings about severe transient and nonlinear characteristics. (C) The tangent friction force due to the relative motion between the rotor and stator in contact may cause the reverse whirl motion of the rotor and severe friction which affects the normal stress conditions and causes local thermal distortion of the rotor. (D) The contact introduces the coupling effect which feeds impact force back to the system and complicates the operating conditions of rotating machinery further. The vibration induced by rotor/stator rubs has been studied by many scholars. Some results are obtained by experiments, engineering experiences and theoretical analysis . Recent study related the complex vibration regimes to the chaotic behaviors of nonlinear system. It is stated that, in case of partial lateral rubs, for instance, the 1/2x sub-harmonic component relative to the rotating frequency of the rotor is observed in the vibration spectra of the rotor. And, with the increase of the rotating frequency of the rotor the denominator of the fractional sub-harmonic spectral components is changing depending on the ratio of rotating frequency versus the first natural frequency of the rotor. The spectra of the rub vibration are also affected by the severity of rubs. Especially in full annular rub case, the 2x of rotating frequency superharmonic component is observed. A theoretical dynamic parametric excitation vibration model and some other models are proposed which facilitated the research on the rub interactions. In most of these researches the impact and friction forces induced by the contact are represented by additional stiffness and damping coefficient variations in different rub cases which reflected the characteristics of the rub forces. But the impact force feedback mechanism has not been presented sufficiently. In this paper, the author proposed a new model of the rotor stator rubs derived from classical mechanical theory which takes the feedback of the impact forces into consideration. The response characteristics of rubs in different rub severity at different speed are presented based on a simple rotor/stator system. Some experimental results are presented also in comparison with the numerical simulations. Author
Nonlinear Systems; Rotors; Stators; Vibration; Dynamic Models; Rotary Stability; Rotor Dynamics; Friction

19970024854 Institute for Computer Applications in Science and Engineering, Hampton, VA USA
Interaction of Sound from Supersonic Jets with Nearby Structures ***Final Report***
Fenno, C. C., Jr., National Academy of Sciences - National Research Council, USA; Bayliss, A., Northwestern Univ., USA; Maestrello, L., NASA Langley Research Center, USA; Jun. 1997; 30p; In English; 35th; AIAA Aerospace Sciences, 1997, Reno, NV, USA
Contract(s)/Grant(s): NAS1-19480; RTOP 505-90-52-01
Report No.(s): NASA-CR-201708; NAS 1.26:201708; ICASE-97-31; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A model of sound generated in an ideally expanded supersonic (Mach 2) jet is solved numerically. Two configurations are considered: (1) a free jet and (2) an installed jet with a nearby array of flexible aircraft type panels. In the later case the panels vibrate in response to loading by sound from the jet and the full coupling between the panels and the jet is considered, accounting for panel response and radiation. The long time behavior of the jet is considered. Results for near field and far field disturbance, the far field pressure and the vibration of and radiation from the panels are presented. Panel response crucially depends on the location of the panels. Panels located upstream of the Mach cone are subject to a low level, nearly continuous spectral excitation and consequently exhibit a low level, relatively continuous spectral response. In contrast, panels located within the Mach cone are subject to a significant loading due to the intense Mach wave radiation of sound and exhibit a large, relatively peaked spectral

response centered around the peak frequency of sound radiation. The panels radiate in a similar fashion to the sound in the jet, in particular exhibiting a relatively peaked spectral response at approximately the Mach angle from the bounding wall.
Author
Supersonic Jet Flow; Aeroacoustics; Aircraft Structures; Interactions; Computational Fluid Dynamics; Pressure Distribution; Velocity Distribution

19970025045 Wright Lab., Flight Dynamics Directorate, Wright-Patterson AFB, OH USA
Computations of Supersonic Vortical Flows Around Ogive-Cylinders Using Central and Upwind Differences ***Final Report, 1 Jul. 1994 - 1 Mar. 1996***
Josyula, Eswar, Wright Lab., USA; Mar. 1997; 52p; In English
Contract(s)/Grant(s): AF Proj. 2307
Report No.(s): AD-A323843; WL-TR-96-3061; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

This work is part of a cooperative research, development, test and evaluation program that brings scientists and engineers from various English-speaking countries together for collaborative studies to improve technology to solve technical problems. The current TTCP work project WTP-2 KTA 2-12, 'Application of CFD to the prediction of Missile Body Vortices' focuses on the ability of the three-dimensional Navier-Stokes equations to predict flowfields about high length-to-diameter bo dies at moderate angles of attack (8 deg less than a less than 14 deg) for supersonic Mach numbers. This report documents this author's computational results for the five test cases. The five test cases are as follows. Mach 1.45 at a = 14 deg, Mach 1.8 at a = 14 deg, Mach 2.5 at a = 14 deg, Mach 3.5 at a = 8 deg, and Mach 3.5 at a = 14 deg. The experimental body is 13 diameters long with the diameter of the cylindrical afterbody of 3.7 inches. Laminar and turbulent computations are shown with comparisons to experimental data. The experimental validation data was provided by the Defence Research Agency (UK). The computations were performed with an existing Navier-Stokes code FDL3DI developed in the Wright Laboratory. The surface pressure and pitot pressure predictions matched with the experimental data reasonably well. The k-e turbulence model was found to be highly dissipative for capturing vortical flows. Local grid refinement was considered to be an important aspect of capturing the vortical flows accurately.
DTIC
Computational Fluid Dynamics; Supersonic Flow; Aerodynamic Configurations; Navier-Stokes Equation; Laminar Flow; Boundary Layer Flow; Three Dimensional Flow; Missile Bodies; Ogives; Turbulence Models; Turbulence; Afterbodies

13
GEOSCIENCES

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

19970023749 Naval Facilities Engineering Service Center, Port Hueneme, CA USA
Advanced Fuel Hydrocarbon Remediation National Test Location: Biopile Remediation
Heath, Jeff; Lory, Ernie; Mar. 1997; 4p; In English
Report No.(s): AD-A323445; NFESC-TDS-2018-ENV-Rev; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

Biopile remediation is an environmental cleanup t echnology that uses naturally occurring microbes such as bacteria and fungi to destroy organic contaminants in soil. Certain species of bacteria are able to consume organic pollutants as a food source, thus detoxifying the pollutants. Biopile remediation is effective in treating soils contaminated with petroleum hydrocarbons such as gasoline, grease, jet fuels, diesel fuels, and motor oil. The microbes 'appetite' is enchanced by blowing air through the contaminated soil pile to provide oxygen and adding fertilizer to provide additional solid nutrients.
DTIC
Jet Engine Fuels; Diesel Fuels

19970023761 Corps of Engineers, Vicksburg, MS USA
Advanced Fuel Hydrocarbon Remediation National Test Location: Biocell Treatment of Petroleum Contaminated SOIls
Heath, Jeff, Corps of Engineers, USA; Lory, Ernie, Corps of Engineers, USA; Mar. 1997; 4p; In English
Report No.(s): AD-A323444; TDS-2017-ENV-Rev; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

Many military installations face the problem of disposing of small quantities of petroleum hydrocarbon contaminated soils. Biocells are engineered systems that use naturally occurring microbes to degrade fuels and oils into simpler, nonhazardous, and nontoxic compounds. Biocells are able to treat soils contaminated with petroleum based fuels and lubricants, including diesel, jet fuel, and lubricating and hydraulic oils. The microbes use the contaminants as a food source and thus destroy them. by carefully

monitoring and controlling air and moisture levels, degradation rates can be increased and total treatment time reduced over natural systems.
DTIC
Jet Engine Fuels; Lubricating Oils

14
LIFE SCIENCES

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

19970023806 Defence and Civil Inst. of Environmental Medicine, Downsview, Ontario Canada
Defence and Civil Institute of Environmental Medicine and Air Transport Group Human Study of CC-l30 Operations *Final Report*
Banks, R. D., Defence and Civil Inst. of Environmental Medicine, Canada; Hendy, K. C., Defence and Civil Inst. of Environmental Medicine, Canada; Fraser, W. D., Defence and Civil Inst. of Environmental Medicine, Canada; Thompson, M. M., Defence and Civil Inst. of Environmental Medicine, Canada; Jamieson, D., Defence and Civil Inst. of Environmental Medicine, Canada; Wright, H., Defence and Civil Inst. of Environmental Medicine, Canada; Gee, T., Defence and Civil Inst. of Environmental Medicine, Canada; Meek, I. M., Defence and Civil Inst. of Environmental Medicine, Canada; Latullppe, J., Defence and Civil Inst. of Environmental Medicine, Canada; Davis, B., Defence and Civil Inst. of Environmental Medicine, Canada; Cole, M., Defence and Civil Inst. of Environmental Medicine, Canada; Nov. 1996; 91p; In English
Report No.(s): AD-A323536; DCIEM-96-R-66; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

The Defence and Civil Institute of Environmental Medicine (DCIEM) and Air Transport Group (ATG) were tasked to conduct a joint study of human factors concerning the CC-130 Hercules aircraft. The aim of the study was to establish human factors issues relevant to air accidents, and to recommend preventative measures. The study was organized around two working groups: the Crew Behaviour Assessment Group (CBAG) and the Flight Performance Assessment Group (FPAG). The CBAG developed a method of measuring the ability of the crew to coordinate their activities efficiently and manage their workload. The FPAG developed a method of measuring the accuracy and consistency of simulator flight along an aircraft flight path. Data to support the development of both methods were obtained from a simulator study of 23 ATG crews. The results defined the characteristics of high proficiency Aircraft Commanders (ACs) and those of less proficient ACs. Less proficient ACs seemed to focus primarily upon systems-related, procedural cross-checking and rechecking of information, and had more open-loop communication which supports the contention that these individuals were becoming task overloaded. The results suggest that a proportion of ATG crews are adversely overloaded by the occurrence of unexpected flight events and certain system failures. Since behaviour can be influenced by training, this study recommends a review and modification of the current CC-130 training program, including Aircrew Coordination Training (ACT).
DTIC
C-130 Aircraft; Human Factors Engineering; Flight Paths; Flight Crews; Flight Characteristics

19970023849 Army Safety Center, Fort Rucker, AL USA
Flightfax; Spatial Disorientation, Volume 25
Apr. 1997; 12p; In English
Report No.(s): AD-A323538; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Basic to any discussion of spatial-disorientation controls is recognizing that there are two types of SD. The challenge of Type 1 SD is to find a way to apply controls (the appropriate course of action) when you are unaware that you are in an SD situation. The challenge of Type 2 SD is to apply the right controls to the specific SD situation. Identifying appropriate controls for both types of SD was an issue at last fall's Tri-Service Spatial Disorientation in Rotary Wing Operations Conference held at Fort Rucker. This conference produced control proposals in four major categories: (1) education, (2) training, (3) research, and (4) equipment. What follows is a discussion of these proposals, modified slightly to include input from the Aviation Leaders' Training Conference and the Aviation Brigade Safety Officer Conference held in January 1997 and input from standardization pilots and human factors experts at Fort Rucker.
DTIC
Human Factors Engineering; Flight Safety; Aircraft Safety

19970023893 National Aerospace Lab., Tokyo, Japan

In-Flight Measurement of Eye Scanning Characteristics of Helicopter Pilots

Kawahara, H., National Aerospace Lab., Japan; Funahiki, K., National Aerospace Lab., Japan; Wakairo, K., National Aerospace Lab., Japan; Tanaka, K., National Aerospace Lab., Japan; Watanabe, A., National Aerospace Lab., Japan; Oct. 1996; 14p; In Japanese; Portions of this document are not fully legible

Report No.(s): PB97-151138; NAL/TR-1310; No Copyright; Avail: Issuing Activity (Natl Technical Information Service (NTIS)), Microfiche

Attempts to study the control behavior of helicopter pilots have been conducted with the aim of providing fundamental information for future cockpit design, establishing procedures and training. A series of in-flight measurements of human visual scanning behavior during various flight phases were carried out: (1) hovering, (2) level light, (3) coordinated turning, and (4) approach and landing. A total of 12 pilots participated in the experiment, each of whom performed 15 repetitions.

NTIS

Human Behavior; In-Flight Monitoring; Pilot Performance; Eye Movements; Helicopters

19970024829 Civil Aeromedical Inst., Human Factors Research Lab., Oklahoma City, OK USA

Effects of Simulated General Aviation Altitude Hypoxia on Smokers and Nonsmokers ***Final Report***

Nesthus, Thomas E., Civil Aeromedical Inst., USA; Garner, Robert P., Civil Aeromedical Inst., USA; Mills, Scott H., Civil Aeromedical Inst., USA; Wise, Robert A., OMNI Corp., USA; Mar. 1997; 63p; In English

Report No.(s): AD-A323899; DOT/FAA/AM-97/7; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

General aviation pilots are permitted to fly without the use of supplemental oxygen up to an altitude of 12,500 ft. However, hypoxia occurs at altitudes under 12,500 ft. Personal lifestyle, physical conditioning, and illness can interact with hypoxia to affect performance. This study evaluated physiological and cognitive performance of smokers and nonsmokers during sessions of mild hypoxia. Nine male smokers and 9 nonsmokers performed the Multi-Attribute Task Battery (MATB) while breathing oxygen mixtures that simulated sea level, 5,000 ft., 8,000 ft., and 12,500 ft. altitude conditions. Four physiological measures: transcutaneous partial pressures of oxygen and carbon dioxide (P(tc)O2 and P(tc)CO2), heart rate (HR), and oxyhemoglobin saturation (SaO2), demonstrated significant trends across the simulated altitude conditions and for some measures, between groups. Results of the physiological measures obtained, confirmed the study's targeted levels of hypoxia. Smokers exhibited elevated HR and lower P(tc)CO2 values, compared with nonsmokers. Elevated HR is consistent with nicotine effects. Reduced P(tc)CO2 values may indicate greater hyperventilation among the smokers. Smokers may have experienced a reduction of peripheral vision and their ability to visually monitor several tasks simultaneously.

DTIC

Hypoxia; General Aviation Aircraft; Oxygen; Physiology; Tobacco; Human Factors Engineering; High Altitude; Flight Simulation; Pilots (Personnel)

19970024853 Civil Aeromedical Inst., Oklahoma City, OK USA

Stereochemical Determination of Selegiline Metabolites in Postmortem Biological Specimens

Kupiec, T. C., Civil Aeromedical Inst., USA; Chaturvedi, A. K., Civil Aeromedical Inst., USA; Jul. 1997; 14p; In English

Contract(s)/Grant(s): DTAM-B-96-TOX-202

Report No.(s): DOT/FAA/AM-97/14; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The Federal Aviation Administration's Toxicology and Accident Research Laboratory determines the presence of drugs, volatiles, and primary combustion gases in biological samples from aircraft accident victims and also establishes any medical condition for which the drugs might have been taken. In this study, findings related to an aircraft accident are reported. Along with biological specimens from the pilot of this fatal accident, two types of tablets found at the accident scene were submitted for analysis. These tablets were identified as levodopa and selegiline, commonly prescribed for the treatment of Parkinson's disease. Selegiline, a stereospecific compound, is biotransformed into (-)-N-desmethylselegiline, (-)-methamphetamine, and (-)-amphetamine. During this process, the chiral center of the parent molecule is not affected. The latter two levorotatory metabolites cannot be easily distinguished by routine analysis from their dextrorotary isomers, which are controlled substances. Therefore, it was prudent to differentiate these isomers to prove or disprove the controlled substance categorization. Initial immunoassay drug screenings revealed the presence of amphetamine class drugs (867 ng/ml) and amphetamine/methamphetamine (261 ng/ml) in urine and methamphetamine (46 ng/ml) in blood. The gas chromatography-mass spectrometry (GC/MS) results revealed the presence of methamphetamine in the concentrations of 76 ng/ml of blood and 685 ng/ml of urine. The level of amphetamine was 52 ng/ml in blood and 320 ng/ml in urine. To determine the stereospecificity of these amines, the isolated amines from the biosamples were derivatized by a stereospecific agent, (S)-(-)-N- (trifluoroacetyl)prolyl chloride, and characterized by a GC/MS method to be levorotatory. The 2.14 ratio of (-)-methamphetamine to (-)-amphetamine concentrations in the urine was consistent with a

selegiline study in the recent literature. The stereospecific analysis, in conjuction with the history of the pilot being on Parkinson's medications, suggests that the source of these amines was selegiline. This conclusion substantiates the importance of the identification of enantiomers in evaluating and interpreting related analytical results for accident investigations.
Author
Aircraft Accidents; Metabolites; Methamphetamine; Accident Investigation; General Aviation Aircraft

19970024933 Army Aeromedical Research Lab., Aircrew Health and Performance Div., Fort Rucker, AL USA
Spatial Disorientation in US Army Helicopter Accidents: An Update of the 1987-1992 Survey to Include 1993-1995 ***Final Report***
Braithwaite, Malcolm, Army Aeromedical Research Lab., USA; Groh, Shannon, Army Aeromedical Research Lab., USA; Alvarez, Eduardo, Army Aeromedical Research Lab., USA; Mar. 1997; 29p; In English
Contract(s)/Grant(s): DA Proj. 3M1-62787-A-879
Report No.(s): AD-A323898; USAARL-97-13; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report updates the survey of U.S. Army helicopter accidents (1987-92) to include fiscal years 1993 through 1995. Those accidents in which spatial disorientation (SD) was considered to have played a major role were identified and compared to those in which SD played no part. In addition, an attempt was made to identify the factors behind each SD accident together with potential solutions. of the 970 accidents now on the database, 30% were considered to have had SD as a major or contributory factor. of particular note is the increased incidence of SD during helicopter operations during night aided flight. SD remains a n important source of attrition of Army helicopter operations, costing an average of $58 million and 14 lives each year. The contribution of SD accidents to the overall accident rate is not getting smaller. The increase in risk associated with the use of night vision devices when compared to day flying is of particular concern. Recommendations are made in the following four areas: (1) education, (2) training, (3) research, and (4) equipment. In addition, control factors are discussed both on an individual, U.S. Army, and triservice basis.
DTIC
Aircraft Accidents; Helicopters; Disorientation; Physiological Effects; Aircraft Maneuvers

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.

19970023711 Massachusetts Inst. of Tech., International Center for Air Transportation, Cambridge, MA USA
Existing and Required Modeling Capabilities for Evaluating ATM Systems and Concepts ***Final Report***
Odoni, Amedeo R., Massachusetts Inst. of Tech., USA; Bowman, Jeremy, Massachusetts Inst. of Tech., USA; Delahaye, Daniel, Massachusetts Inst. of Tech., USA; Deyst, John J., Massachusetts Inst. of Tech., USA; Feron, Eric, Massachusetts Inst. of Tech., USA; Hansman, R. John, Massachusetts Inst. of Tech., USA; Khan, Kashif, Massachusetts Inst. of Tech., USA; Kuchar, James K., Massachusetts Inst. of Tech., USA; Pujet, Nicolas, Massachusetts Inst. of Tech., USA; Simpson, Robert W., Massachusetts Inst. of Tech., USA; Mar. 1997; 169p; In English
Contract(s)/Grant(s): NAG2-997
Report No.(s): NASA-CR-204978; NAS 1.26:204978; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

ATM systems throughout the world are entering a period of major transition and change. The combination of important technological developments and of the globalization of the air transportation industry has necessitated a reexamination of some of the fundamental premises of existing Air Traffic Management (ATM) concepts. New ATM concepts have to be examined, concepts that may place more emphasis on: strategic traffic management; planning and control; partial decentralization of decision-making; and added reliance on the aircraft to carry out strategic ATM plans, with ground controllers confined primarily to a monitoring and supervisory role. 'Free Flight' is a case in point. In order to study, evaluate and validate such new concepts, the ATM community will have to rely heavily on models and computer-based tools/utilities, covering a wide range of issues and metrics related to safety, capacity and efficiency. The state of the art in such modeling support is adequate in some respects, but clearly deficient in others. It is the objective of this study to assist in: (1) assessing the strengths and weaknesses of existing fast-time models and tools for the study of ATM systems and concepts and (2) identifying and prioritizing the requirements for the development of additional modeling capabilities in the near future. A three-stage process has been followed to this purpose: 1. Through the analysis of two case studies involving future ATM system scenarios, as well as through expert assessment, modeling capabilities and supporting tools needed for testing and validating future ATM systems and concepts were identified and described. 2. Existing fast-

time ATM models and support tools were reviewed and assessed with regard to the degree to which they offer the capabilities identified under Step 1. 3 . The findings of 1 and 2 were combined to draw conclusions about (1) the best capabilities currently existing, (2) the types of concept testing and validation that can be carried out reliably with such existing capabilities and (3) the currently unavailable modeling capabilities that should receive high priority for near-term research and development. It should be emphasized that the study is concerned only with the class of 'fast time' analytical and simulation models. 'Real time' models, that typically involve humans-in-the-loop, comprise another extensive class which is not addressed in this report. However, the relationship between some of the fast-time models reviewed and a few well-known real-time models is identified in several parts of this report and the potential benefits from the combined use of these two classes of models-a very important subject-are discussed in chapters 4 and 7.
Author
Air Traffic Control; Air Transportation; Computer Networks; Management Planning; Evaluation

19970023792 Air Force Inst. of Tech., School of Engineering, Wright-Patterson AFB, OH USA
An Approach to Evaluate Software Effectiveness
Schalick, Timothy J., Air Force Inst. of Tech., USA; Dec. 1996; 205p; In English
Report No.(s): AD-A323339; AFIT/GCS/ENG/96D-24; No Copyright; Avail: CASI; A10, Hardcopy; A03, Microfiche

The Air Force Operational Test and Evaluation Center (AFOTEC) is tasked with the evaluation of operational effectiveness of new systems for the Air Force. Currently, the software analysis team within AFOTEC has no methodology to directly address the effectiveness of the software portion of these new systems. This research develops a working definition for software effectiveness, then outlines an approach to evaluate software effectiveness-- the Software Effectiveness Traceability Approach (SETA). Effectiveness is defined as the degree to which the software requirements are satisfied and is therefore application-independent. With SETA, requirements satisfaction is measured by the 'degree of traceability' throughout the software development effort. A degree of traceability is determined for specific pairs of software life-cycle phases, such as the traceability from software requirements to high-level design and low-level design to code. The degrees of traceability are combined for an overall software effectiveness value. It is shown that SETA can be implemented in a simplified database, and basic database operations are described to retrieve traceability information and quantify the software's effectiveness. SETA is demonstrated using actual software development data from a small software component of the avionics subsystem of the C-17, the Air Force's newest transport aircraft.
DTIC
Computer Programs; Program Verification (Computers); Software Engineering; C-17 Aircraft; Avionics

19970023966 Air Force Inst. of Tech., School of Engineering, Wright-Patterson AFB, OH USA
Nested Fork-Join Queuing Networks and Their Application to Mobility Airfield Operations Analysis
Willits, Craig J., Air Force Inst. of Tech., USA; Mar. 1997; 191p; In English
Report No.(s): AD-A323251; AFIT/DS/ENS/97-01; No Copyright; Avail: CASI; A09, Hardcopy; A02, Microfiche

A single-chain nested fork-join queuing network (FJQN) model of mobility airfield ground processing is proposed. In order to analyze the queuing network model, advances on two fronts are made. First, a general technique for decomposing nested FJQNs with probabilistic forks is proposed, which consists of incorporating feedback loops into the embedded Markov chain of the synchronization station, then using Marie's Method to decompose the network. Numerical studies show this strategy to be effective, with less than two percent relative error in the approximate performance measures in most realistic cases. The second contribution is the identification of a quick, efficient method for solving for the stationary probabilities of the A(n)/Ck/r/N queue. Unpreconditioned Conjugate Gradient Squared is shown to be the method of choice in the context of decomposition using Marie's Method, thus broadening the class of networks where the method is of practical use. The mobility airfield model is analyzed using the strategies described above, and accurate approximations of airfield performance measures are obtained in a fraction of the time needed for a simulation study. The proposed airfield modeling approach is especially effective for quick-look studies and sensitivity analysis.
DTIC
Mathematical Models; Queueing Theory; Markov Processes; Aircraft Maintenance; Probability Distribution Functions; Markov Chains; Conjugate Gradient Method; Airports

19970025024 Air Force Inst. of Tech., School of Engineering, Wright-Patterson AFB, OH USA
Analysis of a Methodology for Linear Programming Optimality Analysis
Jeong, Chanseok, Air Force Inst. of Tech., USA; Mar. 1997; 143p; In English
Report No.(s): AD-A324045; AFFIT/GOR/ENS/97J-01; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

The methodology of Johnson, Baner, Moore, and Grant can be applied to large scale linear programming models. A methodology for optimality analysis of linear programs was developed to create metamodels using response surface methodology techniques such as experimental design and least squares regression. A metamodel consists of a simple equation which is able to predict the optimal objective function value of a linear program. What is needed is some large scale application of the techniques to verify how accurate they are. In the research, I plan to use the large scale LP model, STORM. I use the 'Hot Start' idea for the efficiency of STORM program calculation. The developed metamodels of the large scale LP can provide some useful information about the relationships between the objective function value and the right-hand-side vector and coefficients of the objective function (unit cost vector) by varying the right-hand-side vector and unit cost vector.
DTIC
Computer Programs; Linear Programming; C-17 Aircraft; C-5 Aircraft; Scale Models; Regression Analysis

16
PHYSICS

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

19970023683 Alabama Univ., Materials Processing Lab., Huntsville, AL USA
X-Ray Imaging Study ***Final Report***
OBrien, Susan K., Alabama Univ., USA; Workman, Gary L., Alabama Univ., USA; Jul. 22, 1996; 16p; In English
Contract(s)/Grant(s): NAS8-38609
Report No.(s): NASA-CR-205030; NAS 1.26:205030; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
The space environment in which the Space Station Freedom and other space platforms will orbit is truly a hostile environment. For example, the currently estimated integral fluence for electrons above 1 Mev at 2000 nautical miles is above 2 x 1O(exp 10) electrons/sq cm/day and the proton integral fluence is above 1 x 10(exp 9) protons/sq cm/day. At the 200 - 400 nautical miles, which is more representative of the altitude which will provide the environment for the Space Station, each of these fluences will be proportionally less; however, the data indicates that the radiation environment will obviously have an effect on structural materials exposed to the environment for long durations. The effects of this combined environment is the issue which needs to be understood for the long term exposure of structures in space. At the same time, there will be substantial potential for collisions between the space platforms and space debris. The current NASA catalogue contains over 4500 objects floating in space which are not considered payloads. This debris can have significant effects on collision with orbiting spacecraft. In order to better understand the effect of these hostile phenomena on spacecraft, several types of studies are being performed to simulate at some level the effect of the environment. In particular the study of debris clouds produced by hypervelocity impact on the various surfaces anticipated on the Space Station is very important at this point in time. The need to assess the threat of such debris clouds on space structures is an on-going activity. The Space Debris Impact facility in Building 4612 provides a test facility to monitor the types of damage produced with hypervelocity impact. These facilities are used to simulate space environmental effects from energetic particles. Flash radiography or x-ray imaging has traditionally provided such information and as such has been an important tool for recording damage in situ with the event. The proper operation of the system can provide much useful information with respect to parametric analysis of the hypervelocity experiment. The following report outlines the procedures developed to optimize the operation of the x-ray imaging system and its operational characteristics.
Author
X Ray Imagery; Hypervelocity Flow; Data Acquisition; Investigation

19970023685 McDonnell-Douglas Aerospace, Long Beach, CA USA
Reactions of Residents to Long-Term Sonic Boom Noise Environments ***Final Report***
Fields, James M., Wyle Labs., Inc., USA; Jun. 1997; 170p; In English
Contract(s)/Grant(s): NAS1-20103; RTOP 537-09-21-04
Report No.(s): NASA-CR-201704; NAS 1.26:201704; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche
A combined social survey and noise measurement program has been completed in 14 communities in two regions of the western USA that have been regularly exposed to sonic booms for many years. A total of 1,573 interviews were completed. Three aspects of the sonic booms are most disturbing: being startled, noticing rattles or vibrations, and being concerned about the possi-

bility of damage from the booms. Sonic boom annoyance is greater than that in a conventional aircraft environment with the same continuous equivalent noise exposure. The reactions in the two study regions differ in severity.
Author
Sonic Booms; Noise Measurement; Continuous Noise; Vibration; Surveys

19970024874 NASA Lewis Research Center, Inst. for Computational Mechanics in Propulsion, Cleveland, OH USA
Numerical Simulation of the Effect of Heating on Supersonic Jet Noise
Hixon, R., NASA Lewis Research Center, USA; Shih, S.-H., NASA Lewis Research Center, USA; Mankbadi, Reda R., Cairo Univ., Egypt; May 1997; 22p; In English
Contract(s)/Grant(s): NCC3-531; RTOP 523-36-13
Report No.(s): NASA-CR-202338; NAS 1.26:202338; ICOMP-97-04; E-10717; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The axisymmetric linearized Euler equations are used to simulate noise amplification and radiation from a supersonic jet. The effect of heating on the noise field of the jet is studied and compared to experimental results. Special attention was given to boundary treatment, and the resulting solution is stable and nearly free from boundary reflections.
Author
Jet Aircraft Noise; Aeroacoustics; Sound Generators; Sound Propagation; Numerical Analysis; Computerized Simulation

19970024916 NASA Lewis Research Center, Inst. for Computational Mechanics in Propulsion, Cleveland, OH USA
Effect of Coannular Flow on Linearized Euler Equation Predictions of Jet Noise
Hixon, R., NASA Lewis Research Center, USA; Shih, S.-H., NASA Lewis Research Center, USA; Mankbadi, Reda R., Cairo Univ., Egypt; May 1997; 30p; In English
Contract(s)/Grant(s): NCC3-531; RTOP 523-36-13
Report No.(s): NASA-CR-202339; NAS 1.26:202339; E-10718; ICOMP-97-05; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

An improved version of a previously validated linearized Euler equation solver is used to compute the noise generated by coannular supersonic jets. Results for a single supersonic jet are compared to the results from both a normal velocity profile and an inverted velocity profile supersonic jet.
Author
Jet Aircraft Noise; Supersonic Jet Flow; Computational Fluid Dynamics; Aeroacoustics; Noise Prediction (Aircraft); Navier-Stokes Equation

19970025021 AeroChem Research Labs., Inc., Princeton, NJ USA
Ejector Noise Suppression with Auxiliary Jet Injection ***Final Report***
Berman, Charles H., AeroChem Research Labs., Inc., USA; Andersen, Otto P., Jr., AeroChem Research Labs., Inc., USA; Jun. 1997; 54p; In English
Contract(s)/Grant(s): NAS3-27246; RTOP 244-02-01
Report No.(s): NASA-CR-202305; NAS 1.26:202305; E-10570; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

An experimental program to reduce aircraft jet turbulence noise investigated the interaction of small auxiliary jets with a larger main jet. Significant reductions in the far field jet noise were obtained over a range of auxiliary jet pressures and flow rates when used in conjunction with an acoustically lined ejector. While the concept is similar to that of conventional ejector suppressors that use mechanical mixing devices, the present approach should improve thrust and lead to lower weight and less complex noise suppression systems since no hardware needs to be located in the main jet flow. A variety of auxiliary jet and ejector configurations and operating conditions were studied. The best conditions tested produced peak to peak noise reductions ranging from 11 to 16 dB, depending on measurement angle, for auxiliary jet mass flows that were 6.6% of the main jet flow with ejectors that were 8 times the main jet diameter in length. Much larger reductions in noise were found at the original peak frequencies of the unsuppressed jet over a range of far field measurement angles.
Author
Noise Reduction; Jet Aircraft Noise; Injection; Mass Flow; Turbulence; Suppressors; Flow Velocity

17
SOCIAL SCIENCES

Includes social sciences (general); administration and management; documentation and information science; economics and cost analysis; law, political science, and space policy; and urban technology and transportation.

19970023593 General Accounting Office, Washington, DC USA

Tactical Aircraft: Restructuring of the Air Force F-22 Fighter Program

Cooper, David E., General Accounting Office, USA; Murphy, Robert D., General Accounting Office, USA; Best, David B., General Accounting Office, USA; Jun. 1997; 30p; In English

Report No.(s): GAO/NSIAD-97-156; B-276815; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The F-22 is an air superiority aircraft with a capability to deliver air-to-ground weapons. Advanced technology being developed for the F-22 makes it '. . . a very ambitious, challenging program, probably the most challenging program in recent times,' according to the Department of Defense's (DOD) Defense Science Board. The most significant features include supercruise, the ability to fly efficiently at supersonic speeds without using fuel-consuming afterburners; low observability to adversary systems that have the objective of locating and shooting the F-22- and integrated avionics to significantly improve the pilot's battlefield awareness. The F-22 program began the engineering and manufacturing development phase of the acquisition process in 1991. According to the fiscal year 1997 President's budget, the Air Force planned to develop the F-22 and build nine development aircraft, two nonflying structural test articles, and four preproduction aircraft at a cost of about $17.4 billion. The Air Force planned to buy 76 aircraft during the LRIP phase of the program and 362 aircraft during the full-rate production phase. The total estimated production cost was about $48 billion. The Assistant Secretary of the Air Force for Acquisition engaged a Joint Estimate Team (JET) because management reviews of the F-22 program indicated potential cost growth. In February 1997, the Under Secretary of Defense for Acquisition and Technology approved the Air Force's proposed plan to restructure the F-22 program based on the results of the JET's review. JET concluded that the F-22 engineering and manufacturing development program would require additional time and funding to reduce risk before the F-22 enters production. JET estimated that the development cost would increase by about $1.45 billion. Also, JET concluded that F-22 production cost could grow by about $13 billion (from $48 billion to $61 billion) unless offset by various cost avoidance actions, identified as tier 1 and tier 2 initiatives. These initiatives are being further defined by a study team chartered by the Assistant Secretary of the Air Force for Acquisition. That team is scheduled to report its conclusions in the fall of 1997. We have not reviewed the basis for the revised savings estimates that are now being devised by the team. We have issued a number of reports concerning the F-22 fighter program.

Author

Product Development; Defense Program; Aircraft Structures; F-22 Aircraft; Manufacturing; Congressional Reports

Subject Term Index

Q

R

S

T

U

V

W

X

Personal Author Index

O

P

R

S

T

V

W

X

Y

Z

Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
NASA SP-7037 (356)		

4. Title and Subtitle	5. Report Date
Aeronautical Engineering A Continuing Bibliography (Supplement 356)	September 5, 1997
	6. Performing Organization Code

7. Author(s)	8. Performing Organization Report No.
	10. Work Unit No.
9. Performing Organization Name and Address	
NASA Scientific and Technical Information Program Office	11. Contract or Grant No.

12. Sponsoring Agency Name and Address	13. Type of Report and Period Covered
National Aeronautics and Space Administration Langley Research Center Hampton, VA 23681	Special Publication
	14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstract

This report lists reports, articles and other documents recently announced in the NASA STI Database.

17. Key Words (Suggested by Author(s))	18. Distribution Statement
Aeronautical Engineering Aeronautics Bibliographies	Unclassified – Unlimited Subject Category – 01

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	54	A04/HC

For sale by the NASA Center for AeroSpace Information, 800 Elkridge Landing Road, Linthicum Heights, MD 21090-2934