

NAECON 87

18-22 MAY 1987



87CH2450-5



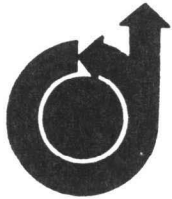
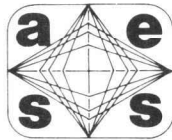
Proceedings of The

IEEE 1987 National Aerospace and Electronics Conference NAECON 1987

Held at the Dayton Convention Center
May 18-22, 1987

Sponsored by

The Institute of Electrical and
Electronics Engineers
Dayton Section
Aerospace and Electronic Systems Society



SAE The Engineering
Resource For
Advancing Mobility



江苏工业学院图书馆
藏书章

This is VOLUME 2

OF FOUR VOLUMES

VOLUME ONE CONTAINS:

Digital Technology and Applications

VOLUME TWO CONTAINS:

Avionics Subsystems and Weapons Technology

Flight Control

Software Development and Management

VOLUME THREE CONTAINS:

Human Interface

Simulation and Training

Command, Control and Communications

VOLUME FOUR CONTAINS:

Aerospace Engineering Systems

Artificial Intelligence

87CH2450-5

ISSN 0547-3578

IEEE National Aerospace and Electronics Conference.

Proceedings of the IEEE National Aerospace and Electronics Conference, NAECON. 1974-

[New York, Institute of Electrical and Electronics Engineers]

v. ill. 29 cm. annual.

Continues: National Aerospace Electronics Conference, Dayton, Ohio. Proceedings.

Conferences for 1974- sponsored by the Institute of Electrical and Electronics Engineers, Dayton Section, and the Aerospace and Electronic Systems Society.

Conferences for 1978- issued in three or more vols.

(Continued on next card)

IEEE National Aerospace and Electronics Conference.

Proceedings of the IEEE National Aerospace and Electronics Conference, NAECON. (Card 2)

Key title: NAECON, ISSN 0547-3578.

1. Electronics in aeronautics -- Congresses. 2. Astrionics -- Congresses. 3. Electronics in military engineering -- Congresses. I. Institute of Electrical and Electronics Engineers. Dayton Section. II. IEEE Aerospace and Electronic Systems Society. III. Title: NAECON. IV. Key title.

TL693.N3

629.1

79-640977

MARC-S

Library of Congress

79

NAECON Records are available from
IEEE Service Center,
445 Hoes Lane, Piscataway, New Jersey 08854
IEEE Catalog Number 87CH2450-5

Unless otherwise indicated, all papers are considered as having been received
April 1, 1987

The NAECON '87 Record is exempt from the requirement for individual export
license under the terms of Title 22, Subchapter M, Article 125, 30-2-2 of the
Regulations of the U.S. Department of State, as amended 1 March 1960.

Copyright and Reprint Permissions: Abstracting is permitted with credit to the
source. Libraries are permitted to photocopy beyond the limits of U.S. copyright law
for private use of patrons those articles in this volume that carry a code at the
bottom of the first page, provided the per-copy fee indicated in the code is paid
through the Copyright Clearance Center, 29 Congress Street, Salem, MA 01970.
Instructors are permitted to photocopy isolated articles for noncommercial classroom
use without fee. For other copying, reprint or republication permission, write to
Director, Publishing Services, IEEE, 345 E. 47th St., New York, NY 10017. All rights
reserved. Copyright © 1987 by The Institute of Electrical and Electronics Engineers,
Inc. Printed in the U.S.A.

President's Message



The NAECON '87 Committee and the Board of Directors are proud to present this official record of the technical papers presented at this, The 39th consecutive NAECON. We feel that, once again, the conference offers an outstanding combination of technical programs and exhibits. This year's theme, "Building Our Future Through Advanced Technology," recognizes the challenge of today's technical community to increase their knowledge and add to the "building blocks" of existing technology.

Many individuals and organizations from both industry and government have worked hard to assemble this conference. We are confident that you will be impressed with the quality of the over 200 technical papers contained in the following pages. In addition to the fifty-eight technical ses-

sions, five tutorials and two special sessions were also presented, with the SDI session being reshowed throughout the conference.

As in past years, the principal sponsorship of NAECON is the Dayton Section of the Institute of Electrical and Electronics Engineers (IEEE) and the Aerospace and Electronic Systems Society (AESS) of the IEEE. Technical co-sponsorship continues to be furnished by the American Institute of Aeronautics and Astronautics (AIAA), the Dayton Section of the Institute of Navigation (ION), the Kittyhawk Chapter of the Association of Old Crows (AOC), the Dayton-Wright Chapter of the Armed Forces Communications and Electronics Association (AFCEA), the Dayton Branch of Sigma-Xi Research Society of America, the Engineering Management Society (EMS), the Air Force Association (AFA), the American Defense Preparedness Association (ADPA), the Society of Automotive Engineers (SAE), the Human Factors Society (HFS), and for the first time this year, the Society of Logistics Engineers (SOLE).

A higher-than-ever level of support from industry has made possible an outstanding exhibits presentation. This has always been an integral part of NAECON and contributes greatly to the overall success and enjoyment of the conference. A listing of our exhibitors, co-sponsors and contributors is included in these pages. A special thanks to all exhibitors for their continued support of NAECON and for working with us through the Dayton Convention Center renovation.

It has been my pleasure to serve as the President of NAECON '87. NAECON is a totally volunteer organization and I am honored to have had the opportunity to have worked with so many whose dedication and energy have made this conference so successful. It is this dedication and loyalty which will continue the traditions of excellence that have become associated with NAECON in the future.

MARY TERBAY
PRESIDENT NAECON '87

TUTORIALS

MONDAY — MAY 18

ARTIFICIAL INTELLIGENCE/ EXPERT SYSTEMS CONCEPTS

8:30 AM to 5:30 PM

Instructors:

David C. Dietz, Senior Scientist, Systems Research Laboratories, Inc.,
Dayton, Ohio
Linda F. Brainard, Systems Analyst, Systems Research Laboratories, Inc.,
Dayton, Ohio

Course Synopsis:

This tutorial will present the concepts of Artificial Intelligence with emphasis on basic definitions and techniques. Some of these include search algorithms, pattern matching and data representations. The more popular AI programming languages, LISP and Prolog will be examined. Several application examples will be explained and demonstrated.

The application of Expert Systems is one of the more dramatic examples of AI. The inner workings of an Expert System, the inference engine, will be described. A typical application will be examined and the resulting expert rule set will be built and demonstrated.

Finally, several promising areas within AI, concurrent processing and neural nets, will be discussed.

David Dietz is a Senior Scientist with Systems Research Laboratories in Dayton, Ohio. He received his B.S. in Physics from the University of Dayton in 1970. He has done graduate work in Physics and Systems Engineering. Mr. Dietz is past Chairman of the Dayton Area SIGART (Special Interest Group on Artificial Intelligence). He is also an Adjunct Professor for Artificial Intelligence at the University of Dayton. His professional memberships include the American Association for Artificial Intelligence and the ACM SIGART. His experience in Artificial Intelligence has included LISP language development, pattern recognition, neuron network simulation, and the application of expert systems. He has developed both FORTRAN LISP and ADA LISP. Mr. Dietz is responsible for the Artificial Intelligence Laboratory at SRL.

Linda Brainard is a Systems Analyst with Systems Research Laboratories. Ms. Brainard has a B.S. in Mathematics from California State in 1976. Her current work includes the design and development of advanced systems in LISP for military and commercial applications. She developed DEXPERT™, an expert system building tool, and conducted SRL's LISP/AI classes. She is involved in enhancement and support of SRL's many AI products using LISP, ADA, and FORTRAN. She is a member of the American Association for Artificial Intelligence (AAAI) and ACM SIGART.

* — * — * — *

FIBER OPTICS DATA BUSES

8:30 AM to 5:30 PM

Instructors:

Rod Katz, Naval Avionics Center, Indianapolis Indiana
Charles W. Kleekamp, Mitre Corporation, Bedford Massachusetts
John A. Kolling, Sperry Corporation, St. Paul, Minnesota
Charles R. Husbands, Mitre Corporation, Bedford Massachusetts
Roger W. Uhlhorn, Harris Corporation, Melbourne, Florida

Course Synopsis:

The successful application of fiber optics by the telecommunications industry has sparked renewed interest in avionics systems applications. The highly integrated avionics systems proposed for the Air Force Advanced Tactical Fighter (ATF) and the Navy Advanced Tactical Aircraft (ATA) require high speed, multiplexed data buses. Because of its superior wideband/high speed performance and inherent resistance to EMI and EMP threats, fiber optics is becoming the technology of choice to implement advanced military avionics data buses.

This tutorial program provides an introductory background in fiber optics technology and the design methodology for fiber optics data transmission systems. Basic data bus/local area network concepts are discussed with an emphasis on the system choices which favor fiber optics. Emerging fiber optics bus standards such as MIL-STD-1773 and the ANSI FDDI bus will be described. Fiber optics implementation of the SAE proposed High Speed Data Bus (HSDB) standard will be discussed and key issues identified. The program will also include advanced technology developments and new avionics bus initiatives such as the development of parallel sensor buses and networks. Proposed enhancements to MIL-STD-1773 including Multiple Speed Data Rate Transmission (MSDRT) and the control of collateral data pipelines will be included.

Rod Katz as Head of the Advanced Communications Technologies Branch, established a significant R&D program in fiber optics at the Naval Avionics Center and was responsible for the definition and administration of 20 contract developments in fiber optics technology, optical sensors and advanced systems concepts. His present position is Staff Consultant for Fiber Optics and Advanced Technologies in the Communication Systems Division - Applied Research Department. He is Task Group Leader for the 8AE AE-9C FO subcommittee with principal responsibility for MIL-STD-1773. Mr. Katz has a B.S.E.E. from the University of Evansville and the Masters Degree in Electronics Engineering from the Rensselaer Polytechnic Institute.

Charles W. Kleekamp is Group Leader for Fiber Optics at Mitre Corp. in Bedford, Mass. He has extensive experience in the application of fiber optics to military systems including programs to replace copper conductors in mobile command and control centers with fiber optics cables. These programs include a 26-pair field deployable voice communications system and remote radar video link systems. Mr. Kleekamp has been very active in developing specifications and standards for military fiber optics components and cables. He has B.S. and M.S. degrees in engineering from the University of Michigan.

John A. Kolling is a Senior Staff Engineer at the Defense Products Groups, Computer Systems Division of Sperry Corporation in St. Paul, Minnesota. He has more than ten years experience in fiber optics technology with responsibility for fiber optics interconnect systems. He has served as project engineer for numerous fiber optics developments including a family of hybrid fiber optics transmitter/receiver modules, MIL-STD-1773 terminals for the AYK-15(A) computer, and a fiber optics signal transfer system for the Ground Launched Cruise Missile (GLCM) control system. Mr. Kolling is a contributor to the SAE AE-9C FO subcommittee and to the ANSI X3T9.5 FDDI Bus STD Committee. He has a B.S.E.E. degree from the University of Minnesota.

Charles R. Husbands has a broad background in the development of communications systems. He has been with Mitre Corporation for thirteen years where he has worked on a variety of communications systems projects most recently concentrating on the application of fiber optics to local area networks. His current position is that of Group Leader for Fiber Optics Systems. Mr. Husbands is a prolific author with many technical papers to his credit. He is a member of the IEEE and Chairman of the SAE AE-9C Fiber Optics Subcommittee. He has a B.S.E.E. degree from the Milwaukee School of Engineering and M.S.E.E. and M.S. in Engineering Mgmt. from Northwestern.

Dr. Roger Uhlhorn is a Principal Engineer and Group Leader for fiber optics design in the Harris Corporation Government Aerospace Systems Division. He coordinates the fiber optic independent research and development activity to provide direction for future fiber optic activity. He has 11 years experience working with fiber optics technology and its application to aerospace systems. Current activities include the development of serial and parallel high speed fiber optic data bus network concepts and components for future avionics systems. Dr. Uhlhorn received the B.S., M.S., and Ph.D. degrees in Electrical Engineering from the University of Illinois at Urbana-Champaign. His paper "Imaging Connector Interconnect System for a Parallel Fiber Optic Data Bus" won the NAECON 1985 Best Paper Award.

* — * — * — *

OPTICAL COMPUTING

8:30 AM to 5:00 PM

Instructor:

Dr. Darrel G. Hopper, Assistant Professor of Electrical and Computer Engineering, Air Force Institute of Technology, WPAFB, Ohio

Course Synopsis:

The advent of a significant installed base of fiber optic cable in telecommunications and data buses is fueling a drive for optical computing. The performance of switching and logic operations on the signal in the photonic form will eliminate inefficient energy conversions to and from the electrical form. This combination of optical communications and computing is known as Integrated Photonics in AFSC Forecast II terminology. Like fiber optics, optical computing components are inherently highly resistant to EMP/EMI effects. Eventually optical processors will be added to main frame supercomputers to increase speed in problems amenable to solution with a parallel architecture and algorithm.

This tutorial program provides an introduction to optical computing. First, optical computing is defined and put into perspective relative to electronic computing. Then the technology is reviewed. Materials and devices are discussed with an emphasis on their construction, characteristics, and current capabilities and the evolution which may be expected during the next 10 years. Algorithms and architectures are presented for a number of problems with laboratory optical digital computing concepts. Software development requirements are contrasted to the similar process of programming currently available parallel electronic computers. A proposed design for a complete optical computer by the Frame Logic Optical Computing (FLOC) approach will be used to tie optical computing concepts together.

Dr. Darrel G. Hopper is an Assistant Professor in the Air Force Institute of Technology, Department of Electrical and Computer Engineering, at Wright-Patterson AFB, Ohio. Dr. Hopper has analyzed optical information processing for the DoD for five years. He has over fifty publications to his credit and is currently designing and breadboarding a digital optical computer by his FLOC technique.

* — * — * — *

KALMAN FILTERING WITH APPLICATIONS TO MULTISENSOR INTEGRATION

8:30 AM to 5:00 PM

Instructors:

Joseph A. D'Appolito, Division Staff Analyst,
The Analytic Sciences Corporation
David A. Whitney, Member of the Technical Staff,
The Analytic Sciences Corporation

Course Synopsis:

Optimal estimation theory, and in particular, Kalman filtering, forms the basis for all modern multisensor system integration algorithms. This course provides an overview of Kalman filtering and its application to multisensor system integration. The course emphasizes the practical application of Kalman filtering rather than abstract theory. A brief review of random processes and the state-space characterization of linear dynamic systems which are essential to understanding Kalman filtering are first discussed. Then a simple, algebraic derivation of the Kalman filter, together with physical interpretation and pertinent examples, are presented. Finally, the issue of practical suboptimal Kalman filter design is discussed and illustrated with several examples from diverse programs including the AN/ARN-101, USAF INU and GPs.

Dr. Joseph A. D'Appolito has over twenty years experience in the application of modern estimation and control theory to the analysis, design and evaluation of integrated multisensor navigation systems. He developed original computer-based techniques for performance evaluation of Kalman filter integrated multisensor navigation systems in the mid-60's. He has participated in or directed the analysis, design, and evaluation for the Air Force, including the Standard INU, AN/ARN-101, DILS, GEANS, MICRON, 621B/Inertial, Beacon/Inertial and GPS/Inertial systems. In addition to inertial navigation, Dr. D'Appolito has worked extensively in the areas of stochastic systems identification and modeling for a broad range of navigation, guidance, communications and signal processing problems at TASC. Dr. D'Appolito received the B.E.E. degree from Rensselaer Polytechnic Institute, the M.S.E.E. and E.E. degrees from Massachusetts Institute of Technology, and the Ph.D. in Electrical Engineering from the University of Massachusetts.

David A. Whitney has been employed as a statistician at TASC since 1980, where he has worked on a variety of system test and evaluation activities. He has responsibility for the technical direction of several test data processing and system modeling activities involving both inertial components and sonar systems. He has also been involved in the development of new algorithms for estimating parameters and validating the structure for large-dimensioned models implemented in Kalman filters for test data processing. He is the author of several publications relating to parameter identification and Kalman filtering. Mr. Whitney holds an A.B. degree from Princeton University, M.S. degrees in Applied Mathematics and Statistics from the University of Illinois, and is currently working toward the Ph.D. degree at the Massachusetts Institute of Technology. He is a member of Sigma XI, SIAM, and ASA.

* — * — * — *

INTRODUCTION TO REAL-TIME FLIGHT SIMULATION AND TRAINERS

9:30 AM to 4:30 PM

Instructors/Subjects:

Richard Heintzman - Overview, History, Visual Systems
Arthur T. Gill - Coordinator, Visual Displays/Image Input Devices
Frank M. Cardullo - Air Vehicle Modeling, Aerodynamics
Dr. Kenneth B. Donovan - Radar and Visual Digital Image Generation
H. Reed Puckett - Avionics Processors, Electronic Combat
Mark T. Adducchio - Maintenance Trainers

Course Synopsis:

This tutorial will acquaint engineers and managers with many of the design considerations, performance capabilities, limitations, and pitfalls associated with real-time, man-in-the-loop simulation. Both training simulators and R&D simulators which support aircraft development and research will be addressed. Emphasis will be placed on discussion of parameters which are key drivers of performance, complexity and cost.

The tutorial outline: OVERVIEW - History, Elements of a Simulator, Simulator Architectures; AIR VEHICLE - Basic Modeling Principles, Flight, Aerodynamics; VISUAL SYSTEMS - Overview, Displays, Image Generation; AVIONICS - Overview, IR/EO Sensors, Radar, Data Bases, Avionics Processors, Electronic Combat; and MAINTENANCE TRAINERS - Definitions, Types, Trends.

Frank M. Cardullo is an associate professor in the Watson School of Engineering, Applied Science and Technology at the State University of New York at Binghamton. He is a consultant to numerous major aerospace companies and has held engineering positions with industry, working in visual simulation, motion and force cueing, and vehicle dynamics modeling.

Richard J. Heintzman is the Technical Expert for the Aircrew Training Systems Division, Deputy for Engineering, Aeronautical Systems Division. He has coordinated R&D supporting flight simulators and use of simulators in the aircraft industry. He was instrumental in the development of numerous visual systems both in-house at ASD and under contract.

H. Reed Puckett is a Member of the Technical Staff, Electronic Combat Operations, AAI Corporation. He has been an integral part of the electronic combat simulation history at AAI and has been a leading figure in the application of new technology to the simulation field.

Arthur T. Gill is an Electronics Engineer in the Visual and Avionics Simulation Branch, Deputy for Engineering, Aeronautical Systems Division. He has previous experience in coordinating R&D activities for development of visual simulation display technology and at ASD, has been actively involved in the development of several visual systems under contract.

Dr. Kenneth B. Donovan is Manager of the Advanced Simulation Technologies Engineering Unit, Simulation and Control Systems Department, General Electric Co. - Daytona Beach. He is responsible for R&D of simulation techniques for existing and emerging computer image generation (CIG) products including spatial modeling tools, real time image generation algorithms, photographic texture techniques, simulator display techniques and applications of CIG technology.

Mark T. Adducchio is a Project Engineer in the Maintenance Training Systems Branch, Deputy for Engineering, Aeronautical Systems Division. At ASD, he has provided technical support for the GLCM Missile Procedures Trainer and maintenance trainers for the F-15, F-16 and the B-52 OAS.

PLENARY SESSION

TUESDAY, 19 MAY 1987

9:00 AM - 12 Noon

CONVENTION CENTER THEATRE

Moderator:

Lieutenant General William E. Thurman,
Commander, Aeronautical Systems
Division, WPAFB



LT. GEN. W. E. THURMAN

Speakers:

General Lawrence A. Skantze,
Commander AFSC, Andrews AFB

General Earl T. O'Loughlin,
Commander AFLC, Wright-Patterson AFB

Mr. Joseph T. Gallagher, Vice President &
General Manager, Aircraft Division,
Northrop Corporation

Mr. Edwin A. Goldberg, Vice President & General Manager, TRW Electronic
Systems Group, TRW Inc.



GEN. L. A. SKANTZE

General LAWRENCE A. SKANTZE is Commander, Air Force Systems Command, Andrews Air Force Base, Md. He directs the research, development, test and acquisition of aerospace systems for Air Force operational and support commands. He assumed this command in August, 1984.

The general is a command pilot and wears the senior missile badge. His military decorations and awards include the Distinguished Service Medal with one oak leaf cluster, Legion of Merit with one oak leaf cluster, Meritorious Service Medal with one oak leaf cluster and Army Commendation Medal.

General Skantze is no stranger to NAECON nor Wright Patterson Air Force Base. He was Deputy for AGM-69A SRAM at ASD in 1971. In 1979 he took command of the Aeronautical Systems Division until August 1982.



GENERAL EARL T. O'LOUGHLIN

General EARL T. O'LOUGHLIN is Commander of Air Force Logistics Command, headquartered at Wright-Patterson AFB, Ohio. His command mission is to provide worldwide technical logistics support to all Air Force active and reserve force activities, 60 allied nations and designated U.S. government agencies.

General O'Loughlin is a command pilot with more than 6,000 flying hours and extensive experience in strategic bombing, reconnaissance, refueling, and maintenance systems. His career has run the gamut, from flying B-29s on combat missions over North Korea in 1953 to serving on the Air Staff at the Pentagon in Washington, D.C. When he commanded the 380th Bombard-

ment Wing in upstate New York during the mid-seventies, his wing won the Fairchild Trophy as best bombardment wing during the Strategic Air Command's annual bombing and navigation competition. In addition, he served two tours of duty in Southeast Asia.

His previous assignments have included vice commander of Air Force Logistics Command, commander San Antonio and Oklahoma Air Logistics Centers, and deputy chief of staff for maintenance and deputy chief of staff for contracting and manufacturing at Air Force Logistics Command headquarters.

Mr. JOSEPH T. GALLAGHER is Vice President and General Manager of the Aircraft Division of Northrop Corporation, a Los Angeles-based diversified aerospace firm which operates primarily in the fields of aircraft, electronics, and technical and management support services. Prior to his present assignment, Mr. Gallagher has held several positions at Northrop, including Vice President of Engineering.

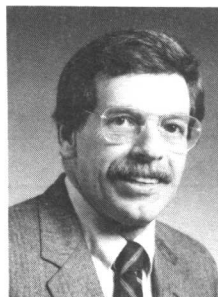
The Aircraft Division is Northrop's largest operating organization. Fighter aircraft and large commercial aircraft structures are designed and produced, and research and development in a wide range of aeronautical technologies are performed at the division's Hawthorne and El Segundo, California facilities.

Mr. Gallagher has an HNC degree from Belfast College of Technology in Aeronautical Engineering, a MSC degree from Cranfield Institute of Aeronautical Sciences, and a Juris Doctor in Law from Southwestern University School of Law. He has continued his education in avionics and mathematics at UCLA, and in management at Harvard Business School.

Mr. Gallagher is a Fellow of the Royal Aeronautical Society, and a Fellow and Chairman of the Design Integration Technical Committee for AIAA. He is a member of the Aerospace Council of the SAE, a member of the Institute of Electrical and Electronic Engineers, Inc., a member of NASA Advisory Council, and the USA member on the NATO AGARD Flight Mechanics Panel.



JOSEPH T. GALLAGHER



EDWIN A. GOLDBERG

Mr. EDWIN A. GOLDBERG is the Vice President and General Manager of the Electronic Systems Group of TRW's Electronics & Defense Sector. This \$800M per year operating group of TRW is responsible for advanced electronic research as well as development, analysis, and design of avionic, ground, and spacecraft electronic systems. Products include special purpose communication systems, digital signal processing equipment, telemetry subsystems, anti-jam communication processors, satellite communications payloads, electronic warfare systems, and microelectronic components.

Mr. Goldberg has 31 years of experience in electronic systems development. He joined TRW in 1956, went to the Aerospace Corporation at its inception in 1960 and returned to TRW in 1965.

He has held numerous line and project management positions related to missile, spacecraft, aircraft, and ground-based systems development. Functionally, he has been responsible for applications of guidance and control, position determination and tracking, ground station operations, strategic and tactical communications, command and control, ballistic missile defense, trainers and simulators, high energy lasers, avionics, and data base management systems.

Mr. Goldberg received a B.S. degree from Yale University in 1954 and an M.S. degree from Massachusetts Institute of Technology in 1956, both in electrical engineering. He has been a member of the teaching staff at the Massachusetts Institute of Technology, the University of California at Los Angeles, and the University of California. He and his wife, Gayle, live in Los Alamitos.

Co-Sponsors

BENDIX AEROSPACE
100 Wilson Boulevard
Arlington, Virginia 22209

Bendix Aerospace develops and manufactures products used in military/civil aircraft including avionics; displays; flight and fuel controls; generators; test systems, and wheels and brakes.

THE BOEING COMPANY
333 W. First Street
Dayton, Ohio 45402

Proven leaders in weapons system development, avionics system integration, advanced avionics hardware and software, and electronics technology.

CONCEPT INDUSTRIES, INC.
5335 Far Hills Ave.
Suite 204
Dayton, OH 45429
(513) 433-0442

James R. Atchison
Vice-President Engineering

Concept Industries, Inc. (CII) is a small business specializing in providing technical, management, cost analysis, and software services to Department of Defense agencies and major aerospace corporations.

CUBIC CORPORATION
9333 Balboa Ave.
San Diego, CA 92138-5587
(619) 277-6780

Cubic Defense is a systems company in the field of electronics specializing in Air Combat Training ranges for the Air Force and Navy. Other key products include Simulation, Range Instrumentation, Location, Space and Data Link Systems.

DBA SYSTEMS, INC.
11781 Lee Jackson Memorial Highway
Fairfax, Virginia 22033-3360
(703) 591-0800

DBA Systems, Inc. and subsidiaries, MTL Systems, Inc. and EERG, develop imagery, mapping, charting, geodesy, sensors, camouflage, concealment and deception, C³I, and threat simulation systems.

DELCO SYSTEMS OPERATIONS
DELCO ELECTRONICS CORPORATION
6767 Hollister Avenue
Goleta, CA 93117

Delco's products include our Magic-V MIL-STD-1750A, all VLSI computer for missile, space and avionics applications. The Low Cost Inertial Navigation System, the solution to a full spectrum of strapdown guidance and navigation systems, and Delco's integrated avionics capabilities currently being applied to the C-17A Mission Computer and Electronic Display System.

Co-Sponsors

EATON CORPORATION AIL DIVISION
Commack Road
Deer Park, New York 11729

Eaton Corporation's AIL Division designs, develops and produces advanced electronic systems for electronic warfare, electronic support, radar, air traffic control and display, and other applications.

FAIRCHILD WESTON SYSTEMS INC.
Syosset, New York

Fairchild Weston Systems is a world leader in the design and development of Reconnaissance, Combat Surveillance, C³ countermeasures, ATE, Avionics, Armament and Training Simulation Systems, Recorders, Data Links & Telemetry.

FORD AEROSPACE & COMMUNICATIONS CORPORATION
5100 Springfield Pike S201
Dayton, OH 45431
(513) 253-1101

FORD AEROSPACE is an international leader in advanced electro-optical systems, defense systems, satellite communications, high-speed information systems, operations support, and tactical missile systems.

**GENERAL ELECTRIC COMPANY/RCA
AEROSPACE BUSINESS GROUP**
2900 Presidential Drive
Fairborn, Ohio 45324

GE Aerospace focuses GE and, now, RCA combined resources to provide defense systems, products and services to the United States Government and to U.S. Allies throughout the world.

GOODYEAR AEROSPACE CORPORATION
333 W. First Street, Suite 258
Dayton, Ohio 45402

Goodyear Aerospace Corporation, Akron, Ohio, is a highly diversified aerospace manufacturer, specializing in Digital Systems, Flight Simulators, Guidance Systems, Reconnaissance Systems and Aircraft Products.

HEWLETT-PACKARD
9080 Springboro Pike
Miamisburg, Ohio 45342
(513) 433-2223

Hewlett-Packard Company is an international manufacturer of measurement and computation products and systems used in industry, business, engineering, science, health care and education.

Co-Sponsors

HONEYWELL AEROSPACE AND DEFENSE
Central Region Sales Office
4540 Honeywell Court
P.O. Box 217
Dayton, Ohio 45401

Honeywell Aerospace and Defense designs and produces advanced navigation, flight management, test equipment, cockpit instrumentation, electro-optical and training systems for the DOD and commercial markets.

HUGHES AIRCRAFT COMPANY
7200 Hughes Terrace
Los Angeles, CA 90045-0066
(213) 568-7200

Electronic Technologies for a Stronger Defense

Hughes Aircraft Company specializes in high technology electronics for the scientific, military and aerospace communities. Its capabilities are based on a series of technical firsts—in air defense, missiles and avionics, command and control and industrial electronics.

IBM FEDERAL SYSTEMS DIVISION
EXECUTIVE PLAZA I
6600 Rockledge Drive
Bethesda, Maryland 20817

Avionics Systems Integrator for HH-60A and Combat Talon II; Provides central computers for B-1B, F-15, and B-52 G/H aircraft; Develops/produces advanced hardware/software for EW Systems; A DoD VHSIC contractor and developer of the VHSIC Common Signal Processor.

control and industrial electronics.

ILC DATA DEVICE CORPORATION
Airport International Plaza
Bohemia, Long Island, New York 11716

Designer, developer and producer of 1553 data bus multiplex systems, high reliability data conversion components and systems, custom hybrids and related test instruments. Power hybrids and power management subsystems, qualified and certified to MIL-STD-1772.

KRUG INTERNATIONAL
Technology Systems Division
P.O. Box 3036-Overlook Branch
Dayton, Ohio 45431-0036
(513) 426-2405

KRUG International's Dayton-based Technology Systems Division provides test and ground support equipment, simulation, training and information management systems, and wind tunnel models/hardware.

LEAR SIEGLER, INC.
Astronics Division, Santa Monica, California
Instrument and Avionic Systems Division,
Grand Rapids, Michigan

Lear Siegler, Inc., Aerospace Group, designs and manufactures systems for flight management, data collection and control, and weapons management.

Co-Sponsors

LITTON APPLIED TECHNOLOGY
645 Almanor Avenue
Sunnyvale, California 94088-3478
Phone (408) 365-4092

Litton Applied Technology designs, develops and manufactures: Radar Warning Systems; Simulation and Training products for Electronic Warfare; and computers for special applications.

LITTON COMPUTER SERVICES
1430 Oak Court
Dayton, OH 45430
(513) 429-6450 Tom Bahan

Services and systems; computer programming and software development; data systems design; systems engineering and engineering services; operations analysis; technical communication programs; systems operational test and evaluation; turnkey data systems, logistic systems. Headquarters at Mt. View, California. Facilities at various locations.

LITTON SYSTEMS, INC.
Amecom Division
College Park, Maryland 20740
Guidance & Control Systems Division
Woodland Hills, California 91364
Dayton Telephone (513) 223-3285

AMECOM: Electronic Reconnaissance, Emitter Locating, Jamming, Countermeasures, and Antenna Systems. High-Speed Data-Buss Telecommunications, Voice Switching Networks, Multi-level Secure Systems.

GUIDANCE & CONTROL: Development and production of Advanced Technology Inertial Navigation/Reference Systems for military vehicles utilizing tuned rotor, laser and fiber optic gyro techniques. Extensive system integration and support capability.

LTV AIRCRAFT PRODUCTS GROUP
P.O. Box 655907, M/S: 49L-11
Dallas, Texas 75265-5907

LTV Aircraft Products Group is a military aircraft modernization contractor and a manufacturer of aircraft subassemblies and components for military and commercial use.

MACAULAY-BROWN, INC.
3915 Germany Lane
Dayton, Ohio 45431
(513) 426-3421

MacB provides support to government/industry in Electronic Warfare and Human Factors specializing in systems analysis, flight test, software analysis, computer modeling and human factors.

MAGNAVOX
Government and Industrial
Electronics Company
1313 Production Road
Fort Wayne, Indiana 46808

UHF and VHF Airborne Radio Communications Systems, Electronic Countermeasures, NAVSTAR, Airborne and Groundbased User Terminals, Missile Warhead Fuzing Systems, Voice and Data Modems, Electro Optical Systems.

Co-Sponsors

NORDEN SYSTEMS, INC.
A Subsidiary of United Technologies Corporation
5100 Springfield Pike, Suite 410
Dayton, Ohio 45431-1231
(513) 256-1141

Norden Systems, the company that began with the famous bombsight, now produces advanced radar systems for JOINT STARS, the B-52 and the A-6F, integrated F-111D displays and airborne EW systems.

NORTHROP CORPORATION
1840 Century Park East
Century City
Los Angeles, CA 90067

Northrop Corporation: A diversified advanced technology company that operates primarily in the fields of aircraft, electronics, and technical and support services.

RAYTHEON COMPANY
5200 Springfield Pike, Suite 219
Dayton, OH 45431-1255

Raytheon, an international, technology-based company, provides electronic systems, equipment and components; energy services; military and civilian aircraft; major appliances; heavy construction equipment; and educational materials.

RJO ENTERPRISES, INC.
101 Woodman Drive
Dayton, Ohio 45431
(513) 252-8609

Systems and logistics engineering services; software design and development; test program set development; logistics support analysis; independent verification and validation; program management support; technical publications management.

ROCKWELL INTERNATIONAL
Autonetics Strategic Systems Division
Electronics Operations
3370 Miraloma Avenue
Anaheim, California 92803-4192
(714) 762-4654

Autonetics Strategic Systems Division (ASSD), known for their dedication to quality in Guidance & Control, will also highlight their capabilities in Target Recognition, Tech Mod, Power Controllers, Trainers and MATE.

THE SINGER COMPANY
Electronic Systems Division
Kearfott Guidance and Navigation Division
One First National Plaza, Suite 600
Dayton, Ohio 45402

The Singer Company Electronic Systems Division—Designs/builds navigation computers, multiplex systems, tactical guidance and C³I systems.

Kearfott Guidance and Navigation Division—Designs/manufactures TRG and RLG AHRs, INS including USAF standard precision and B-1B INS.

Co-Sponsors

SOFTECH, INC.
System Sciences Group
3100 Presidential Drive
Fairborn, Ohio 45324
(513) 429-2771

SofTech provides an effective blend of systems and software engineering skills for information systems, logistics, electronic warfare, and avionics applications. SofTech is an industry leader in systems analysis and design, JO-VIAL and Ada implementation, and system validation technology.

SYSTEMS AND APPLIED SCIENCES CORPORATION
1020 Woodman Drive, Suite 200
Dayton, OH 45432
Phone: (513) 254-8408

SASC provides wide ranging services, including: ILS, laboratory operation, systems engineering, systems software and integration support, application programming, database administration, program management, and IV&V.

SYSTEMS RESEARCH LABORATORIES, INC.
2800 Indian Ripple Road
Dayton, Ohio 45440-3696

Systems Research Laboratories, Inc., is an engineering research and development company that provides high technology services and products to customers in Government and Industry.

TASC—THE ANALYTIC SCIENCES CORPORATION
3040 Presidential Drive
Fairborn, Ohio 45324
(513) 426-1040

AT TASC we provide program management support to a full spectrum of military customers, with a degree of independence unparalleled in our industry.

TEXAS INSTRUMENTS INCORPORATED
P.O. Box 660246, M/S 3127
Dallas, Texas 75266
(214) 995-1188 Dallas
(513) 258-3877 Dayton

Airborne radar, flir, electronic warfare, defense suppression, reconnaissance sensors, artificial intelligence, IFF, VHSIC, GPS, precision guided weapons.

TRW
Electronics & Defense Sector
1400 Talbott Tower
Dayton, Ohio 45402
(513) 223-6266

TRW develops and delivers integrated avionics systems that incorporate advanced, multi-function antennas, high resolution microwave receiver systems, VHSIC-based processing systems, and Ada operating systems.

Co-Sponsors

UNISYS
Defense Systems
5200 Springfield Pike, Suite 315
Dayton, Ohio 45431
(513) 254-8080

Unisys is the new corporation formed by the merger of Sperry and Burroughs. The corporation is a leading manufacturer of commercial information and defense systems.

VEDA INCORPORATED
5200 Springfield Pike
Suite 200
Dayton, Ohio 45431

Veda specializes in providing quality professional services in the areas of Systems Engineering and Analysis, Test and Evaluation, Software Engineering, Logistics Engineering and Training Systems.

VITRO CORPORATION
14000 Georgia Avenue
Silver Spring, Maryland 20906-2972
(301) 231-1000

"A major systems engineering firm for military, government, and industry clients. The company is an industry leader in software engineering, systems integration and technical support."

WESTINGHOUSE ELECTRIC CORPORATION
Wright Point Office Park
5200 Springfield Pike, Suite 301
Dayton, Ohio 45431-1255

Research, development, production and support of defense systems products, and services for DoD, NASA, FAA, and other government agencies, and the aerospace industry.

CONTRIBUTORS

Hamilton Standard Division, United Technologies Corporation
Lockheed Corporation
Sundstrand Corporation

VOLUME 1

Table of Contents

Digital Technology and Applications	1		
VLSI COMPONENTS/PACKAGING	3		
Organizer: R. E. Strawser, AFALC/EREA, Wright Patterson AFB, OH			
Moderator: L. S. Vallimont, AFWAL/AAD, Wright Patterson AFB, OH			
A VLSI Processor Engine to Support Calculation of the Vector Wave Equation	4		
J. W. De Groat and J. Diaz, AFIT/ENG.			
The Architecture and VHSIC Implementation of a Digital Fin Actuator Controller for Advanced Missiles	8		
S. Thielker, G. Shao and W. Hanna, McDonnell Douglas Astronautics Co.			
Design of a VLSI 32-Bit Word-Addressable Hardware Stack for a Stack-Frame Microprocessor	14		
L. S. Peterson, R. D. Dixon and R. E. Siferd, Wright State University.			
An Integrated Design Environment for Micro-electronic Device Replacement	†		
T. Glum and G. Gaugler, SM-ALC/MMEHD.			
Dielectric Loss Effects on the Performance of a Thin-Film, Uniformly-Distributed RC Notch Network	20		
E. S. Kolesar, AFIT/ENG.			
SIGNAL PROCESSING	25		
Organizer: T. Jones, AFWAL/AAAT-2, Wright Patterson AFB, OH			
Moderator: J. Westercamp, University of Dayton			
Audio Visual: J. Bastian, ADI, Inc.			
Applications of the General Electric A/VLSI Programmable Signal Processor	26		
K. Barnett, General Electric Company.			
Impact of Optical Interconnects on VLSI Architectures	32		
T. Oseth, S. Yalamanchili, and D. Lee, Honeywell, Inc., Systems and Research Center and C. Sullivan, Honeywell, Inc., Physical Sciences Center.			
Smart Memories for Military Applications	39		
G. Ott, Texas Instruments.			
Linear Voltage Controlled Filters Using OTAs	44		
J. Ferrell, Lockheed-Georgia Company.			
Programmable Multiplexed Digital Signal Processing	47		
D. Adams and S. Babb, General Dynamics/Space Systems Division.			
Analysis of a Hybrid Bearing Estimating System With Noise	54		
D. W. Mauritzen, Purdue University and Magnavox Government and Industrial Company.			
Multi GHz Digital Channelizers	60		
E. Drogin, Eaton Corporation, AIL Division.			
2D FIR Digital Filters, The McClellan Transform	†		
J. Bastian, Analytic Sciences Inc.			
CARTOGRAPHIC DATA USES		65	
Organizer & Moderator: G. Burnham, Texas Instruments			
Integrated Terrain Access/Retrieval System (ITARS) Robust Demonstration System.		66	
W. K. Lau and S. A. Bernstein, Merit Technology and B. T. Fine, Hughes Aircraft Company.			
Radar Systems Analysis Using DTED Data		73	
G. L. Bair and D. A. Johnson, Merit Technology Incorporated.			
A Covert Radar Scan Control Algorithm		80	
K. K. Christensen, Texas Instruments.			
The Sperry Digital Map System		88	
H. Waruzewski, Honeywell Inc., Sperry Defense Systems Division.			
Cockpit Avionics: Charting the Course for Mission Success		97	
G. Burnham, S. A. Smith and K. L. Davis, Texas Instruments.			
DATA TRANSMISSION I		101	
Organizer: G. D. Thorpe, ASD/ENASF, Wright Patterson AFB, OH			
Moderator: D. J. Thorpe, ASD/ENASF, Wright Patterson AFB, OH			
Audio Visual: J. Hurwitz, ASD/ENASF, Wright Patterson AFB, OH			
A Custom VLSI Solution for MIL-STD-1553B		102	
H. P. Zogalla, LITEF, GmbH, Federal Republic of Germany.			
MIL-STD-1553 VLSI Components		109	
S. Friedman, ILC Data Device Corporation.			
Flight Testing of a Fiber Optic Databus		112	
R. Bogenburger and W. Schneider, Messerschmitt-Bolkow-Blohm GmbH Helicopter and Aircraft Division.			
SP-Net: A Draft Signal Processor Network Protocol		120	
D. Burns, ASD/AXTM.			
DATA TRANSMISSION II		125	
Organizer: G. D. Thorpe, ASD/ENASF, Wright Patterson AFB, OH			
Moderator: W. A. Thomas, ASD/ENASF, Wright Patterson AFB, OH			
Audio Visual: J. Hurwitz, ASD/ENASF, Wright Patterson AFB, OH			
Design Considerations for Modularly Autonomous Protocols		†	
W. Smith, ASD/ENFZ and L. Datta, WSU			
Collision Initiated Bus Arbitration		126	
P. Schwartz, Honeywell Regelsysteme GmbH.			

Table of Contents

Draft STANAG 3910, High Speed Data Transmission Links Under STANAG 3838 (MIL-STD-1553 B) or DOD-STD-1773 Control <i>H. J. Birli and W. Steudle, Standard Elektrik Lorenz AG (SEL) and J. Potthaus, Federal Office for Military Technology and Procurement.</i>	131		
A High Speed Fiber Optic Data Bus for Avionics Applications <i>W. J. Bermingham, E. A. Alfonsi, and W. A. Rosen, NADC.</i>	137	A Review of Traditional System Reconfiguration Techniques and Their Applicability to the Unique Requirements of Digital Avionics <i>M. R. Rutenburg, ITT Avionics.</i>	192
A LAN Suitable for Aerospace Application <i>M. P. Varga, Jr., Honeywell Inc., Sperry Space Systems Division.</i>	143	FIBER OPTICS	199
Redundancy Considerations for a Fiber Optic Token Passing Bus <i>S. S. Schnetzler, M. Madden and T. A. McDermott, Jr., Lockheed Georgia Company.</i>	†	Organizer & Moderator: <i>P. D. Ivone, ASD/ENASAF, Wright Patterson AFB, OH</i> Audio Visual: <i>R. DeLong, ASD/ENASAF, Wright Patterson AFB, OH</i>	
ADVANCED AVIONICS ARCHITECTURE I Organizer: <i>J. C. Ostgaard, AFWAL/AAAS, Wright Patterson AFB, OH</i> Moderator: <i>S. Benning, AFWAL/AAAS-1, Wright Patterson AFB, OH</i> Audio Visual: <i>K. Purdy, AFWAL/AAAS-1, Wright Patterson AFB, OH</i>	157	MFOX: The Military Standard Multiprocessor Fiber Optic Transceiver <i>J. R. Hunter, RADC/DCLW, Griffiss AFB, NY.</i>	†
Design of a Passive Star-Coupled Fiber Optic High Speed Data Bus for Military Aircraft <i>R. W. Uhlhorn, Harris Corporation/GASD.</i>	158	The Dynamics of Deterministic Chaos in Single Mode Optical Fibre Laser Transmission <i>A. M. Selvan, Indian Institute of Tropical Meteorology.</i>	200
Interfacing a HSDB to a PI Bus, Study Through Implementation <i>S. S. Schnetzler, M. G. Madden and T. A. McDermott, Lockheed Georgia Company.</i>	151	MFOX: Technology, Transceiver Design and Performance <i>D. J. Channin, RCA Laboratories.</i>	208
Tradeoffs in Avionics Signal Processing Configuration <i>K. E. Williams, Texas Instruments.</i>	165	Reliability Considerations in Fiber Optic Ring and Star Networks <i>J. Stein, Pennsylvania State University.</i>	†
The Time Critical Subfunction Coprocessor <i>J. Cross and B. Leininger, UNISYS.</i>	169	INFORMATION CONTROL AND DISPLAY	219
Ada and Avionics Computers at TELDIX <i>M. Burford, TELDIX GmbH.</i>	†	Organizer: <i>J. C. Byrd, ASD/ENASI, Wright Patterson AFB, OH</i> Moderator: <i>W. Watkins, ASD/ENASI, Wright Patterson AFB, OH</i> Audio Visual: <i>E. Sorenson, ASD/ENASI, Wright Patterson AFB, OH</i>	
ADVANCED AVIONICS ARCHITECTURE II Organizer: <i>J. C. Ostgaard, AFWAL/AAAS, Wright Patterson AFB, OH</i> Moderator: <i>S. Benning, AFWAL/AAAS-1, Wright Patterson AFB, OH</i> Audio Visual: <i>K. Purdy, AFWAL/AAAS-1, Wright Patterson AFB, OH</i>	173	Beam Index Display—The Answer to Modern Cockpit Design <i>R. Forstmann, AEG, Aktiengesellschaft, West Germany.</i>	220
Designing a Master Executive for a Distributed Multiprocessor Avionics System <i>B. D. Clausen, Symbolic Systems.</i>	174	The CMU (Cockpit Mock-up)—A Design Tool for Display and Control Concepts for Future Helicopters <i>W. Schumacher and M. Starke, E S G, Elektronik System GmbH, Munich, West Germany.</i>	225
Laboratory Facility for F-15E Avionics Systems Integration Testing <i>M. B. Smith and G. T. Bochantin, McDonnell Aircraft Company.</i>	180	Three-Dimensional Stereographic Display <i>A. Bridges, Advanced Electronics Division, Lockheed Georgia Company and J. Reising, AFWAL/FIGR.</i>	233
Distributed Control Architecture for CNI Pre-processors <i>V. R. Subramanyam and L. R. Stine, TRW Military Electronics and Avionics Division.</i>	183	Legibility of a CRT Color Map Display in Bright Sunlight <i>V. A. Spiker, S. P. Rogers and J. G. Cicinelli, Anacapa Sciences, Inc.</i>	241
A User Protocol for a Fiber-Optic High-Speed Serial Data Bus <i>J. C. Snow, Harris Corporation, GASD.</i>	188	User Interface Prototyping in Military Systems <i>R. C. Schwalm, M. E. Thomas, R. J. White and R. D. Williams, Texas Instruments, Inc.</i>	247
		Control of Raster Positional Movement in High Resolution Multicolor Projectors <i>J. A. Ross, Systems Research Laboratories, Inc.</i>	255
		Big Picture: A Solution to the Problem of Situation Awareness <i>P. A. King, McDonnell Aircraft Company.</i>	261

VOLUME 2

Table of Contents

Avionics Subsystem and Weapon Technology

IMAGE PROCESSING

- Organizer & Moderator: *A. Ackerman, IMATH Associates* 267
- A New Effective Method of Feature Extraction for Ship Target Recognition 270
G. Guo, X. Chen and B. Hu, National University of Defense Technology, People's Republic of China.
- Design of a Multiple Electronic Sensor Acquisition and Display Workstation for Advanced Tactical Surveillance Systems Studies 277
S. Glidewell, Lockheed Georgia and E. G. Baxa and R. J. Schalkoff, Clemson University.
- Automatic Target Recognizer: Past, Present and Future †
R. Aggarwal, Honeywell Systems & Research.
- ORIPS: A Laboratory Tool for Image Analysis 282
M. C. Nosek, AFWAL-AAWW-3.

AIRBORNE RADAR & FIRE CONTROL

- Organizer: *T. Velkoff, ASD/ENAMR, Wright Patterson AFB, OH* 287
- Detection of Interrupted Signals 288
B. Uzunoglu, Fairchild Communications & Electronics.
- Certain Design Aspects of Truncated Corner Reflector Deployed in a Localizer Antenna System 295
M. C. C. Mouly, V. V. R. Prasad, P. S. K. S. Prasad, and K. U. Bhaskar, VRS Engineering College, India.
- The Basics of SAR Applied to the B-1 Radar †
M. Longbrake, ASD/TAEA.
- Blue Time Advantage for a Real Time Air Combat Effectiveness Index 302
C. T. Stewart, Boeing Military Airplane Company.
- Frequency Modulation by Synthetic Doppler: Theory and Some Novel Applications 310
E. J. Baghdady, EJB Research Associates.

- AN/APG-67 Multimode Radar Performance Evaluation 317
R. L. Nevin, General Electric, Aerospace Electronic Systems Department and J. C. Hill, Northrop Corporation.

NAVIGATION

- Organizer: *W. Bjornnes, ASD/ENACN, Wright Patterson AFB, OH* 325
- Moderator: *B. Welch, ASD/ENACN, Wright Patterson AFB, OH*
- An Avionics Expert System for Ground Threat Assessment 326
H. Lind and R. Stenerson, Boeing Military Airplane Company

- Integrated Inertial Reference System for Flight Control and Navigation 332
U. K. Krogmann, Bodenseewerk, West Germany.

- Mechnization Equations for a Miniature Accelerometer Based Inertial Measurement Unit Employing the Coriolis Acceleration Principle †
D. Y. Hsu, Litton Guidance and Control Systems Division.

- Error Analysis of a Strapdown Inertial Navigation System with Single Axis Stabilization 342
S. Ren, Z. Guo, and Z. Li, University of Northwestern Polytechnical University, China.

- MLS/INS Terminal Area Navigation †
S. P. Karatsinides, Lear Siegler, Inc.

- Multiprocessor Implementations of Real-Time Multi-Sensor Integration Avionics 350
C. Bowman and G. Snashall, VERAC, Inc.

- Flight Path Planning Under Uncertainty for Robotic Air Vehicles 359
A. Meng, Texas Instruments.

- Yuma Flight Test Validation of an Integrated GPS/Inertial Navigation System 367
S. Teasley, Texas Instruments.

AIR DATA

- Organizer: *L. Thomas, NAVAIR, Crystal City* 375
- Moderator: *R. Gemin, ASD/ENASA, Wright Patterson AFB, OH*
- A Prototype Strapdown IRU with Passive Fiber Optic Gyros 376
H. L. Gubbins, Lear Siegler, Inc.
- Accuracies for Digital Multiple Output Air Data Systems for Angle of Attack, Pitot and Static Pressure Measurements 383
F. W. Hagen and R. V. DeLeo, Rosemount, Inc.
- Future Trends in Air Data—CADC or ADSU? 391
R. A. de Verteuil, GEC Avionics Ltd.

KALMAN FILTERING

- Organizer: *P. Maybeck, AFIT/ENG, Wright Patterson AFB, OH* 397
- Moderator: *G. M. Siouris, ASD/ENSSE, Wright Patterson AFB, OH*
- Multisensor Tracking of a Manuevering Target in Clutter 398
A. Houles, STCAN (LAS/DEM), Paris, France and Y. Bar-Shalom, University of Connecticut.
- Estimation of Aspect Angles by Kalman Filtering with Respect to Electro-optical Target Classification 407
M. Ehrhardt, Elektronik System GmbH, West Germany.
- Federated Square Root Filter for Decentralized Parallel Processes 1448
N. Carlson, Integrity Systems Inc.

† Manuscript unavailable for publication.