

## IN THIS ISSUE . . .

|                              |                      |
|------------------------------|----------------------|
| President's Message          | 1                    |
| Satellite Navigation on Land | 2                    |
| Automobile Navigation        | 6                    |
| Soviet Union's GLONASS       | 13                   |
| GPS Program Status           | 18                   |
| GPS in the Commercial World  | 22                   |
| Civil Access to NAVSTAR GPS  | 26                   |
| Inside AESS                  | 30                   |
| Foreign Technology Abstracts | Centerfold Insert    |
| Conference Information       | Insert Inside Covers |

## ABOUT THE COVER . . .

The map is Detroit — and the display shows the car's route in blue. (Freeways are purple and other roads yellow.) Details are in the article in this issue.

*Photograph courtesy of General Motors*



## IEEE AEROSPACE AND ELECTRONIC SYSTEMS SOCIETY

The Aerospace and Electronic Systems Society is a society, within the framework of the IEEE, of members with professional interests in the organization, design, development, integration and operation of functional systems for space, air, ocean or ground environments. These systems include, but are not limited to, navigation, avionics, spacecraft, aerospace power, radar, sonar, telemetry, defense, transportation, and command and control. All members of the IEEE are eligible for membership in the Society and will receive this *Magazine* and the *Transactions* upon payment of the annual Society membership fee.

*The Society Board of Governors, Organization, and its Committees will be found on cover 3.*

|                                 |                  |  |
|---------------------------------|------------------|--|
| EDITOR-IN-CHIEF                 | Lee D. Dickey    | 1615 White Way Drive, Arlington, TX 76013, (817) 277-9992                  |
| ASSISTANT EDITOR — AESS Affairs | Joseph F. Kasper | TASC, 8301 Greensboro Dr., Ste 1000, McLean, VA 22102, (803) 734-4100 x262 |
| ADMINISTRATIVE EDITOR           | David B. Dobson  | 6411 Chillum Place, NW, Washington, DC 20012, (202) 722-2246               |
| CONTRIBUTING EDITORS            |                  |  |
| Careers                         | Don C. Friedmann | 4220 Falstaff Road, Baltimore, MD 21215, (301) 859-6007                    |
| Foreign Technology              | Joan Doerr       | Westinghouse, MS 1138, P.O. Box 746, Baltimore, MD 21203, (301) 765-2858   |
| Patents                         | Ben J. Goldfarb  | 1001 Playford Lane, Silver Spring, MD 20901                                |
| New Horizons                    | Paul J. Nahin    | Dept. EE, Kingsbury Hall, Univ. NH, Durham, NH 03824, (603) 862-1357       |
| Research & Publications         | Steven Riter     | Dept. EE, Univ. Texas at El Paso, El Paso, TX 79902                        |
| USAB                            | John J. Kelleher | 3717 King Arthur Road, Annandale, VA 22003, (703) 560-4438                 |
| EDITOR EMERITUS                 | Ben J. Goldfarb  | 1001 Playford Lane, Silver Spring, MD 20901                                |

### THE INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC.

Henry L. Bachman, *President*  
Russell C. Drew, *President-Elect*  
Bruno O. Weinschel, *Past President*  
Merrill W. Buckley, *Executive Vice President*  
Ramiro Garcia Soza, *Secretary*  
Edward J. Doyle, *Treasurer*

Ronald G. Hoelzeman, *Vice President, Educational Activities*  
Carleton A. Bayless, *Vice President, Professional Activities*  
Charles H. House, *Vice President, Publication Activities*  
Robert S. Duggan, Jr., *Vice President, Regional Activities*  
Donald C. Fleckenstein, *Director, Standards Activities*  
Emerson W. Pugh, *Vice President, Technical Activities*

### HEADQUARTERS STAFF

Eric Herz, *Executive Director and General Manager*  
Elwood K. Gannett, *Deputy General Manager*  
Thomas W. Bartlett, *Controller*  
Donald Christiansen, *Editor of IEEE Spectrum*  
Thomas C. White, *Public Information*  
Charles F. Stewart, Jr., *Staff Director, Administration Services*

, *Staff Director, Educational Services*  
Donald L. Suppers, *Staff Director, Field Services*  
Leo Fanning, *Staff Director, Professional Activities*  
David L. Staiger, *Staff Director, Publishing Services*  
Sava I. Sherr, *Staff Director, Standards Services*  
Irving Engelson, *Staff Director, Technical Activities*

IEEE AEROSPACE AND ELECTRONIC SYSTEMS MAGAZINE is published monthly by The Institute of Electrical and Electronics Engineers, Inc., 345 East 47th Street, New York, NY 10017. Responsibility for the contents rests upon the authors and not upon the IEEE, the Society, or its members. IEEE Service Center (for orders, subscriptions, address changes): 445 Hoes Lane, Piscataway, NJ 08854. Telephones: Headquarters 212-705 + extension; Information—7900, General Manager—7910, Controller—7748, Educational Services—7860, Publishing Services—7560, Region/Section Services—7751, Technical Services—7890. IEEE Service Center (201) 981-0060. Washington Office/Professional Services (202) 785-0017. NY Telecopier No. (212) 752-4929. Telex No. 236-411 (International messages only). This Journal is available in either microfiche or printed form. Additional copies may be purchased at \$3.00 (first copy only) by IEEE members and \$6.00 per copy by nonmembers. Annual subscription price: IEEE members, dues plus Society fee. Price for nonmembers available on request. **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: (1) those post-1977 articles 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 St., Salem, MA 01970, (2) pre-1978 articles without fee. Instructors are permitted to photocopy isolated articles for noncommercial classroom use without fee. For other copying, reprint or republication permission, write to the Director of Publishing Services at IEEE Headquarters. All rights reserved. Copyright © 1987 by The Institute of Electrical and Electronics Engineers, Inc. Printed in U.S.A. Second-class postage paid at New York, NY, and additional mailing offices. Postmaster: Send address changes to *IEEE Aerospace and Electronic Systems Magazine*, 445 Hoes Lane, Piscataway, NJ 08854.

This publication was formerly known as the *IEEE Aerospace and Electronic Systems Society Newsletter* (USPS 212-660) which was distributed to members only. Back copies of these issues are not available.