Boulder, 1896

Boulder, today
Be there—May 21-23, 1985 for the Annual VTS Conference.
President's Message

Sam McConoughy
President
IEEE Vehicular Technology Society

The year 1984 is now history.

The IEEE has celebrated its Centennial. The Society celebrates its 95th year. Reflections about the past, seem to this writer, to show that we have come so very far in the fields of Vehicular Communications, Automotive Electronics, and Land Transportation... and in such a short time! Mostly gone are vacuum tubes, points and condensers, and trolley cars... and quoting from Gilbert & Sullivan, "and none of them will be missed."

Contemplating the future, and the Second Century of the IEEE, is far more exhilarating. While some characterize it as the Information Age that we are entering, it still will be the age of the electrical and electronic engineer.

The next century of progress lies largely in the hands of the young EE’s around the world. But my word of advice to this coming generation is that active participation in the IEEE and its Societies, Groups, and Chapters is one of the most rewarding activities you will ever undertake. Engineering learning doesn’t end with graduation... and the IEEE provides you with a means of maintaining your professional skills. But equally important, are the contacts you make and keep with other professionals. So if you have colleagues who are not members of the IEEE or this Society, take them along to a meeting, loan them a copy of your Transactions, the Spectrum, or this Newsletter. Show them what they are missing! And don’t forget to renew your membership if you’ve not already done so!

Your Board of Directors is in Dearborn during the Convocation ‘84. Minutes of that meeting appear in this issue. Please take the time to read them. Your Board welcomes comments and suggestions from YOU.

Vice President, Bob Fenton, attended the TAB meetings in San Francisco as my alternate. He also attended the Centennial Keys to the Future Program where we sponsored an award recipient. This is also reported in this issue.

If you have not already done so, make plans to attend our next annual conference to be held in Boulder, CO, May 21-23. See inside for additional information.

The Society has again been invited to participate in the Electronic Industries Association’s (EIA) second Land Mobile Showcase of New Products to be held in Washington, DC, Sept. 26-28. More about this in upcoming issues.

The November issue of the Newsletter carried the names of IEEE Fellows, through 1984, who are Society members. I am pleased to announce that those VTS members named below have been elected, effective Jan.1, 1985, as IEEE Fellows.

Mr. Reed E. Fisher
Morris Plains, NJ
For contributions to the implementation of cellular telephony.

Mr. Ernest R. Freekan
Bowie, MD
For leadership in developing electromagnetic compatibility models.

Professor Fusio Isegan
Kyoto University
Kyoto, Japan
For research in radio wave propagation, and for leadership in microwave link development.

We congratulate you, and are honored to have you as members of our Society!

Best Regards,

Editor's Notes

February 1985

A. Kent Johnson
Newsletter Editor

IEEE Vehicular Technology Society Newsletter

February 1985

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Month of
February
March
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November
Final Copy
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9-10-85

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08-11-84
09-11-84
10-11-84
11-11-84
12-11-84
1-11-85

VTS - 85. PLAN ON IT

Colorado hosts the 1985 Vehicular Technology Conference in Boulder on May 21-23, 1985. Make your plans to attend now and encourage your colleagues to join you. The program, both professional and social, has much to offer concerned professionals in their efforts to stay abreast in a field undergoing such dramatic change.

There are many reasons why a visit to Colorado is attractive. The program supplements a full range of technical papers with industrial presentations, meetings of related groups, and an excellent opportunity to meet leading people in the diverse fields which contribute to VTS. Here is your chance to participate in a constructive dialog between those who know and those who need to know.

If you are a regular participant in VTS programs and are familiar with Colorado, you already know why this is a very special opportunity. If you aren't, come join us and find out for yourself.

The conference schedule has been chosen to allow for relaxation and full enjoyment of springtime in the Rockies, either before or after the conference. The Hilton Harvest House Hotel (the conference center) is at the base of the Rockies and provides easy access to Rocky Mountain National Park, mountain fishing and hiking, and some of the most scenic drives in the world.

Arrangements have been made for special discounts for both travel and accommodations.

plan to join us in may. A preliminary program and registration materials will be sent to you shortly. If you don't receive them or want more information, please write or call.

John Murray
Conference Chairman

John Murray Associates
1823 Folsom Street
Boulder, CO 80302
303 444 4871

Denver's Stapleton International Airport is served nationally and internationally by all major airlines and conference attendees may select either a bus, the limousine service or a rent-a-car to make the 45 minute, 25 mile trip to Boulder.

Nearing Boulder, the traveler will ascend a rolling hill and be suddenly presented with a view of the city in the valley below and the red tiled roofs of one of the most architecturally beautiful campuses in the nation.

Visitors to Boulder are captivated by the city's spectacular setting. Deer still graze at the base of the Flatirons, towering outcropping of red sandstone which lies along the mountains that rise abruptly on the west side of Boulder.

Over 10,000 acres of open space and 5,000 acres of mountain parks have ensured the beauty of this natural setting.

The city of Boulder itself still honors the spirit of its first settlers with rows of Victorian houses well preserved by loyal citizens in the Mapleton Hill area. A downtown pedestrian mall within walking distance of the conference site often rocks with the sounds of strolling musicians and assorted magicians in a spirit of enthusiasm that would have been well understood by the early prospectors.

Like Boulder's early settlers you will want to pack lightly but well prepared. Dress during the conference and at all Boulder's night spots is informal but you will want to bring a light jacket for the late spring evenings that follow a typical May day of 70 or 80 degrees. Boulder this time of year will have an occasional late afternoon rain shower.
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James J. Mikulski
Ronald G. Bile
Eric Schimmel

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Conference Coordinator
Newsletter Editor
Society Secretary
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Chairman, Paper of Year Comm.
Senior Past President
Chairman, Membership Committee
Chairman of Publications Comm.
and Transactions Editor
President
Immediate Past President
Awards Committee
Education Committee
Chairman, Personal Radio Committee

TERM
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Chapter News

1985 IEEE Vehicular Technology Society Directory of Chapters and Chairpersons

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Chuck Link-Board Member, William J. Minsky-Committee Chairman, Robert Powers-Chief Office of Science and Technology, FCC at the VTS Board Reception and Dinner held in Dearborn, MI, October, 1984.
Board of Directors Report

Samuel A. Leslie
VTS Secretary

MINUTES OF THE IEEE VTS BOARD OF DIRECTORS MEETING

The IEEE VTS Board of Directors met on October 23, 1984 at the Convergence '84 conference in Detroit. The Board meeting was called to order at 9:00 AM.

ROLL CALL

The following were in attendance:

- Samuel R. McConoughy, President
- Robert E. Fenton, Vice-President
- Arthur Goldsmith, Treasurer
- Fred H. Link, National Site Selection
- Evan Richards, National Conf. Coord.
- Ron Rui, Education Committee
- Eric J. Schimmel, Personal Radio Chairman
- William Hulsky, Vaeh. Electronics Editor
- George F. McClure, Transactions Editor
- Stuart Meyer, Junior Past President
- Charles Lytt, Paper of the Year Comm.
- George F. McClure, Publications Chairman
- Kent Johnson, Newsletter Editor
- Samuel A. Leslie, Secretary

(8 denotes elected Board member)

Twelve of the fourteen present were elected Board members, thus meeting the requirements for a quorum for voting on matters before the Board.

MINUTES OF LAST MEETING

Fred Link moved, George McClure seconded that the minutes of the last meeting be approved as published. The motion carried with all in favor.

TREASURER'S REPORT - Art Goldsmith

Art Goldsmith reported that the 1984 budget appears on track with a deficit still being projected due to the financing of the Convergence '84 conference. However, he noted that the Society is in better financial shape than originally anticipated due to an income of over $8,000 from the Pittsburgh annual conference last May. The projected budget for 1985 anticipates income from the 1984 Convergence which will result in a balanced budget.

The Board noted differences between the financial advisor's report and the treasurer's report on how the Mobility Scholarship fund is treated as a budget item. Art Goldsmith is to resolve these differences with the Society's financial advisor, Dave Talley.

CONFERENCE COMMITTEE REPORT - Fred Link

Fred reported that things are well under way for the 1987 annual conference to be held in the Tampa Bay area. Fred link moved, George McClure seconded that the Ad Hoc Tampa Chapter be authorized to proceed with arrangements for an annual VTS conference in their area. After discussion, George McClure offered a friendly amendment to Fred Link's motion to set the date of the conference to within plus or minus 30 days of May 15, 1987. The vote was unanimous in favor.

Some discussion concerning VTS Conferences from 1988 on ensued, with one possibility being to hold these conferences in the Fall time frame in conjunction with the EIA Land Mobile Showcase conference. Potential conflict with the Convergence '86 and '90 Conferences were noted; no further action on this subject was taken.

Evan Richards submitted a written report which stated that the final report for the 1982 San Diego Conference was finally completed, with a net surplus of $4,408.21 being achieved. Likewise, the final financial report for the 1984 Pittsburgh conference netted a surplus of $8,263.00 for the Society.

The 1985 Boulder Conference, scheduled for May 21-23 at the Hangar Hotel Conference Center is treated schedule with the call for papers being publicized.

Fred Link noted that the 1986 Dallas Conference preparation is a bit behind schedule.

The Board resolved that Stu Meyer and Evan Richards are to follow up on publicizing the Boulder '85 Conference.
STU MAYER moved, George McClore seconded that an elected Board Member write an article for each Newsletter on a rotating basis. Vote was unanimous in favor.

PRESS BOOKS

The Board resolved that the IEEE Press Book on "Land Mobile Communications Engineering" continue to be advertised in the VTS Newsletter. As of July 31, 388 copies of the Press Book had been sold.

NEWSLETTER ADVERTISING - STU MAYER

STU reported that he is ready to go with ad copy for the Newsletter, but that he does not know the Newsletter page costs and therefore is not able to set a rate for the advertisers. Costs were estimated to be around $100 to $200 a page; George McClore is to contact IEEE HQ to determine the actual page cost.

VTS AWARDS PROGRAM - STU MAYER

STU reported that nine names have been added to the Avant Garde list. It was noted that the Fellow Awards application forms have been revised. Sam McGonough is to mail the revised forms to the Board members.

BILL Missy has accepted an assignment to chair the IEEE Field Awards program. STU Mayer continues as the chairman of the Society Awards program, with AI Isberg chairing the Fellow Awards program.

DON NIBLEY FELLOWSHIP AWARD

IEEE HQ has forwarded the check for the first semester to Mr. Metgar.

CENTENNIAL KEYS TO THE FUTURE - BOB FENTON

Bob reported that the money that the Board had approved at the last meeting had not been spent. He asked for an update on the award and was noted that the IEEE Technical Activities Board provided the travel assistance.

STUDENT ACTIVITIES

Art Goldsmith moved that the VTS Board contribute $200 to the Student Activities Committee toward their publication of a student papers book. Ron Rule seconded the motion, and the vote was unanimous in favor.

Sam McGonough noted that a bill of around $150 had been received for the preparation of camera-ready copy for the initial issue of the VTS ad for potential members in the IEEE Potentials magazine. To save reordering preparation charges, Sam is to inform IEEE HQ that the same camera-ready copy is to be used for subsequent ads.

February 1985

SOME GOALS FOR THE 1985 YEAR

1. Provide on-time Board elections,
2. Increase the VTS membership by five percent,
3. Complete the revision of the IEEE Constitution and the VTS Bylaws.

4. Finalize the VTS Awards Program,
5. Complete the advertising program,
6. Provide a publicity program for VTS, and
7. Complete the IEEE VTS Radio Propagation Committee work.

The vote was unanimous in favor.

STU MAYER then moved, Fred Link seconded that the 1985 objectives from Sam McGonough's report, as shown below, be added to the above list of objectives that were carried over from 1984:

1. Improved service to our members by improving the Transactions, Newsletter, and Conferences, by adding educational programs, and broadening Society activities,
2. Greater recognition for contributors to IEEE and Society objectives,
3. Improving coordination and cooperation with other elements of the IEEE and within VTS by means of:
   a. Better communication with Chapter Chairs,
   b. Closer ties with IEEE activities such as Transportation organizations, related societies such as COMSOC, IEEE Sections, Division Directors, IEEE Headquarters, and non-IEEE organizations such as AIAA, EIA, and others with related interests.

The Board vote was unanimous in favor.

IEEE Vehicular Technology Society Newsletter

February 1985

CONSTITUTION AND BYLAWS REPORT - SAM McGONOUGH

Sam reported that the revised VTS Constitution is on the agenda for the December T86 meeting. Also, Roger Mack has prepared a draft of the revised set of bylaws; the secretary is to mail a copy of these bylaws to all Board members for review, with Board members to be prepared for discussion at the next meeting.

VTS MEET-CHANGE - SAM McGONOUGH

The suggested name of "Mobile Communications and Transportation Society" made at the last meeting as a possible change from the current "Vehicular Technology Society" has met with resistance from several members. The Board therefore decided to abandon further consideration for a name change; however, it was decided that the three areas of interest (Mobile Communications, Vehicular Electronics, and Land Transportation) could be provided as headings on the VTS stationery, pending clarification of the VTS Charter that is pending before IEEE HQ.

ENGINEERING ACCREDITATION BOARD

Bob Fenton submitted one name for consideration.

EXECUTIVE COMMITTEE ELECTION

Fred Link moved, George McClore seconded that the current executive committee continue for the next year in its present form. The vote was unanimous in favor.

CENTENNIAL COMMITTEE

George McClore moved, Bob Fenton seconded that the centennial committee assignments be abolished at the end of this year. The vote was unanimous in favor.

PUBLIC RELATIONS COMMITTEE

STU Mayer moved, George McClore seconded that a Public Relations Committee be formed. The vote was unanimous in favor. STU Mayer is to chair this committee.

TAB/SCM CONFERENCES OF COMMUNICATIONS AND INFORMATION

Eric Schimmel volunteered to write a letter to the TAB/SCM Committee of Communications and Information Policy requesting VTS representation or consultation on matters relating to communications that are to be considered by the FCC.

NEXT MEETING

The next Board meeting was tentatively set for the third week in February 1986, probably February 19.

ADJOURNMENT

Eric Shimmel moved, STU Mayer seconded that the meeting be adjourned at 2:20PM. Vote was unanimous in favor.

Respectfully submitted,

Samuel A. Leslie
IEEE VTS Secretary
Professional Activities

Frank E. Lord
Professional Activities Editor

On October 8, last year as part of the program "IEEE: The Second Century Begins" our numbers one and two, President Reagan in a videotaped message as follows:

"You've been and you remain the pulse of America's technological power, the cutting edge of our world leadership in technology. You apply the theories and principles of science and math to practical problems, and your work serves as a link between scientific discovery and everyday application. You're the real heroes of high-tech, and you have good reason to be proud of your countless achievements.

We look to you for innovation and excellence, and you've never let us down... You already benefit from a modern revolution in worldwide communications. We can anticipate tomorrow's weather and prepare for it. Space technology has taught one life-saving breakthrough after another.... And none of this would have been possible without the contributions of IEEE members."

Hearing this one might certainly expect clear selling for R. R. 5172 which would amend the National Science Foundation charters to promote engineering research and education. This matter was described in a USA Legislative Report reproduced below.

NSF MISSION STATEMENT CHANGED TO PROMOTE PREENGINEERING EDUCATION

When two warring Senate committees came to agreement on amending the NSF charter to elevate engineering as top priority, the way was cleared for enactment of a new law. But the law passed was not the NSF authorization act; it was the National Bureau of Standards Authorization Act.

That vehicle (H. R. 5172) turned out to be the all-purpose tool besides the NSF item, it contains authorization for an entirely new set of programs on manufacturing technology and it contains the customary authorization for NSF's programs. USA and several of its committees had testified in support of the action taken.

Because two standing Senate committees cannot agree on which has authority over the NSF, the NSF has no authority over Act since FY 1981. The charter amendment ratifying the status of engineering was first passed by the House last April as part of the NSF authorization. Sen. Dan Quayle introduced a Senate amendment to make the same change. However, because Senate Orrin Hatch and Slade Gorton, the competing chairmen, refused to concede jurisdiction over NSF, the charter change went in Idaho.

The strong support for raising the status of engineering in the NSF caused key congressmen to seek a way out of the dilemma, and the package was transferred to the NSF bill. "There is a broad support among both scientists and engineers for this amendment," Sen. Gordon said (on Sept. 21). "The incorporation of engineering into the NSF mission statement means a great deal to our nation's engineers, both in the private sector and in academia," Sen. Hatch said (on Oct. 11). "An objection would unnecessarily force them to lose their quest for recognition all over again."

Thus, on Oct. 4 Congress passed basically identical amendments to both bills, but had reached agreement on all the details in the package.

The manufacturing technologies programs come about as a result of Congressional Initiative; it was the National Bureau of Standards Authorization Act.

The legislation was spearheaded by Rep. Don Fuqua and Sen. Slade Gorton. Dr. Ruse Drew supported the Gorton bill and (8. 1286) in testimony before a Senate subcommittee in June 1983. He said IEEE has a special interest in the subject "which is important to many of the technologies that will support advances in manufacturing such as computers, integrated circuits and other sophisticated electronics... Simply stated, it is our work that made the revolution in manufacturing technologies possible." Drew appeared before the Government Activities Council.

Drew followed up by addressing letters to several Administration officials on Oct. 22 urging the President to sign the bill. "... the total benefits to be derived by this legislation greatly outweighs the increased Federal expenditures which its implementation entails," he wrote. "I will urge you to support the signing of R. R. 5172 by the President." The letters were sent to the OMB Director, Commerce Secretary Malcolm Baldrige, Dr. George Keyworth, and R. B. Olesbly, Jr, a Presidential assistant.

Gorton's bill, as he described it (on September 21) was sent to pick winners and losers in the areas of manufacturing technologies... the consortia seeking a Federal match must provide the lion's share of the funding for research... The bill operates through unsolicited proposals which come to the Secondary University, Industrial sectors, and state and local government.

The GAO's point man in the House, Rep. Robert S. Walker, had a different view. Speaking on the House Floor (on Oct. 4) he said the Commerce Department opposes the bill. The Department's official position is that "the legislation is contrary to the National Government should not be in the position of deciding what industries are funded."

IEEE also addressed other items in the NSF authorization and was rewarded when Congress approved a $10 million appropriation for the Institute for Computer Science & Technology, a 100% increase over the Administration's request.

However, President Reagan vetoed the legislation. "Simon & Schuster" the combined efforts of the engineering community and helpful members of Congress came to naught. As you will see in the following piece from a later Legislative Report, the bill that caused the demise of an act that was harmless to the real professional...

IEEE: Vehicular Technology Society Newsletter

The portion of the National Science Foundation Authorization Act which amended the NSF Act of 1950 to place new emphasis on engineering research and education was passed by the Congress as part of the National Bureau of Standards Authorization Act. The President vetoed the bill because he disapproved the section on manufacturing science and technology.

The Manufacturing Science and Technology Act was attached to the NSF Authorization Act on the floor of the 98th Congress. In his statement of disapproval, the President stated:

Title III of R. R. 5172 would establish a new program providing Federal financial support for a variety of research, development, education, and training activities, whose purported purpose would be to improve manufacturing technologies, including robotics and automation. These activities would total $250 million during fiscal years 1985-1988, and represent an unwarranted role for the Federal government. The decisions on how to allocate investments for improving manufacturing technologies are best left to American industry. It is highly doubtful that this Act and resulting Federal expenditures would improve the competitiveness of U.S. manufacturing.

The new role for the Federal government would also serve as the basis for a Federal industrial policy to influence our nation's technological development. This Administration has steadfastly opposed such a role for the Federal government.

Staff people at NSF expect that special attention to laws. Congress will likely make changes in the "engineering" amendments in the new Congress. Congress will probably recommend that the NSF pursue its management of science and education programs, engineering Research Center program, and plans to meet the instrumentation and facilities needs of universities and research. The issue of by-passing peer review of proposals is one that Congress will consider. The Administration cannot plan to make many changes in legislation to the legislative process. The Administration is likely to provide a new policy for managing science and education programs and meeting the demands of university researchers. The issue of by-passing peer review of proposals is one that Congress will consider. The Administration is likely to provide a new policy for managing science and education programs and meeting the demands of university researchers.
FCC EMISSION DESIGNATOR REVISED

In a relatively obscure action, the FCC has amended Part 9 of its rules with the adoption of new emission designators which are the result of the 1970 World Administrative Radio Conference. The pertinent appendix from the Third Report and Order in FCC Docket 25999 is reproduced below.

Appendix A. Part 2 of Chapter 1 of Title 47 of the Code of Federal Regulations has been amended as follows:

1. Section 2.270 is revised to read as follows:

1.327 Signal, emission, and transmission characteristics. The following types of designating emission, modulation, and transmission characteristics shall be used:

(a) Emissions are designated according to their classification and their necessary modulation.

(b) A mixture of three symbols are used to describe the main characteristics of carrier waves. Designations are classified and symbolized according to the following characteristics:

(i) First symbol - type of modulation of the main carrier;

(ii) Second symbol - type of signal(s) modulating the main carrier;

(iii) Third symbol - type of information to be transmitted.

Note: A fourth and fifth symbol are provided for additional information. The additional symbol(s) are printed in italics in the [1] or [2] subcolumn. A sample symbolization is designated by the first symbol(s) of the added symbol(s).

(c) Emission in which the main carrier is amplitude-modulated (including single-carrier modulation).

(d) Emission in which the main carrier is frequency-modulated.

(e) Emission in which the main carrier is phase-modulated.

(f) Frequency modulation.

(ii) Single-carrier, noncoherent

(iii) Single-carrier, coherent

(iv) Single-carrier, suppressed-carrier

(iii) Double-carrier

(iv) Double-carrier, noncoherent

(v) Double-carrier, coherent

(vi) Double-carrier, phase-modulated

(iii) Multiple-carrier, noncoherent

(iv) Multiple-carrier, coherent

2. Table of necessary symbols:

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
<th>Necessary Bandwidth</th>
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<tr>
<td>A, B, C</td>
<td>Single-carrier, noncoherent</td>
<td>3, 7, 11 MHz</td>
</tr>
<tr>
<td>D, E, F, G, H</td>
<td>Double-carrier, noncoherent</td>
<td>6, 10, 14 MHz</td>
</tr>
<tr>
<td>I, J</td>
<td>Double-carrier, coherent</td>
<td>6, 10, 14 MHz</td>
</tr>
<tr>
<td>K, L</td>
<td>Multiple-carrier, noncoherent</td>
<td>6, 10, 14 MHz</td>
</tr>
<tr>
<td>M, N</td>
<td>Multiple-carrier, coherent</td>
<td>6, 10, 14 MHz</td>
</tr>
</tbody>
</table>

3. Table of necessary designators:

<table>
<thead>
<tr>
<th>Description</th>
<th>Necessary Bandwidth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous wave telegraphy</td>
<td>15 words per minute</td>
</tr>
<tr>
<td>Teleprinter by sound signals of a symbolized carrier</td>
<td>30 words per minute</td>
</tr>
<tr>
<td>Selective calling with single-carrier modulation</td>
<td>30 words per minute</td>
</tr>
<tr>
<td>Teleprinter by sound signals of a symbolized carrier</td>
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## Frequency Multiplication

### TVI-1: Frequency Division Multiplication

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<tbody>
<tr>
<td>Single-sideband, transmission relay</td>
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<td>$D$</td>
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<tr>
<td>Double-sideband, radio relay system</td>
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<td>$D$</td>
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<tr>
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Evan Richards, National Conference Chairman and Fred Link, Board Member at VTS Board Meeting in Dearborn, Michigan.
Automotive Electronics

Dateline: Detroit

Bill Fleming
Automotive Electronics Editor

GM's HIGH-MOUNT STOP LIGHT

General Motors has introduced the high-counted stop light for a number of its cars in advance of the Government regulation, which requires them on all 1986 models. The new lamp will be initially installed inside and low in the center of the car's rear window with a special light-shielding gasket. In future cars, GM intends to integrate the light into the car bodies. The 1.2-square inch visible area from 45 degrees to the left or right. In addition, its bulb can be replaced without need for special tools [1].

A feature called a quick hand warmer has been introduced by Toyota on its Cressida export models. The heater warms the driver's hands on the steering wheel in cold climates during start-up. The heater employs a PTC thermistor heating element, made of BaTiO3, which has an electrical resistance characteristic that increases sharply when a certain temperature level is reached, making it very suitable for a safe heater with built-in automatic safety switching to preclude overheating. The unit is mounted under the steering column, and sends warm air onto the driver's hands by means of a 5200 RPM electric motor. The heater automatically cuts off after a 6.6 minute operation, by which time the car heater should be feeding warm air into the vehicle [2].

Essential Components in Toyota Quick Hand Warmer

AUTOMOTIVE ELECTRONICS TECHNOLOGIES FOR THE '80's

Jerry Rivard, Chief Engineer of Ford's Electrical and Electronics Division, predicted that the dollar content of electronics in the average U.S. vehicle would more than double in the next decade [4].

He went on to say that new and improved electronic technologies are the key to successful achievement of this vision. He focused attention on ten significant technologies that will play major roles in the coming decade:

- Electronic Packaging
- Multiplex Wiring
- Sensors
- Power Devices
- Microprocessors
- Memories
- Displays
- Voice Synthesis and Recognition
- Mobile Communication

He cited a broad range of new product ideas, such as: satellite navigation, CBT information systems with on-screen controls and voice command control of vehicle functions, keyless ignition, vehicle attitude control, and computer-controlled suspensions.
A Ten-Year Vision of New Electronic Systems Which Can Be Expected to Appear

**VEHICLE COMPUTER**
- **SAFETY AND CONVENIENCE**
  - Rear view mirror CRT with fog and rain sensor
  - Forward collision warning system
  - Emergency vehicle presence identification with priority radio
  - Road traffic information
  - Vehicle controls
  - Collision avoidance automatic guidance
  - Integrated chassis control system
  - Driver assistance
  - High adaptive speed control

**POWERTRAIN COMPUTER**
- **POWERTRAIN CONTROLS**
  - BEV (Battery Electric Vehicle) controls
  - Hydrogen IC engine controls
  - Polymer electrolyte fuel cell controls
  - Hybrid vehicle controls
- **INFORMATION SYSTEM**
  - Driver maintenance monitor
  - Driver assistance
  - High adaptive speed control
  - Vehicle communication

**BODY COMPUTER**
- **AUDIO SYSTEM**
  - Remote control
  - Rear seat video system
- **OTHER INFORMATION SYSTEM**
  - Vehicle maintenance monitor
  - Driver assistance
  - High adaptive speed control

**NEW ELECTRONIC SYSTEMS EXPECTED TO APPEAR ON VEHICLES WITHIN THE NEXT FIVE YEARS**

**ADVANCED INSTRUMENTATION, CONTROL, AND INFORMATION SYSTEMS**

The Big Three automakers in the U.S. are experimenting with advanced instrumentation, control, and information systems that feature multifunctional touch-sensitive cathode-ray-tube screens. Both Ford Motor and Buick Motor are planning to build prototype cars equipped with CRTs as well as other special features this year for tests under actual driving conditions. CRT instrumentation systems will probably appear next fall in standard production automobiles (8-10). Ford's Lincoln-Mercury Division will build 50 Comet prototype vehicles—experimental modifications of the current Continental Mark VII—that include 7-inch diagonal CRTs mounted in the center of the instrument panel. The Zenith-supplied CRT is equipped with an infrared beam touch system. Similarly, GM plans to build 50 experimental cars to evaluate CRT technology (7). The system will include functions of climate control, audio system control, and trip information. Although Chrysler Corporation has not yet announced plans, a company spokesman did say that dashboard CRTs are the way to go.

To counter the recently introduced GM Delco-Bowes audio system, Chrysler has introduced Ultimate Sound Stereo. The new system features 36 watts of power, a five band graphic equalizer, six speakers with 5-by-7-inch speaker, and soft touch buttons. This radio was designed cooperatively with Mitsubishi Electric in Tokyo. At this time Chrysler is the only car maker of the Big Three to continue to offer its voice-alert system that uses speech synthesis chips to provide verbal diagnostic or safety messages to the car driver and/or occupants. A means for disconnecting the system is now provided by Chrysler for customers who are annoyed by the eleven message system. GM has yet to incorporate speech synthesis systems in its cars and Ford Motor last year discontinued its voice system, introduced in 1983, after customers complained (5).
REFERENCES

Communications

J. R. Cruz
Communications Editor

With this issue we start what we hope to be a continuous series of tutorial articles on topics of interest to our readership. The first articles of this series is an overview of spread spectrum techniques and its applications to mobile radio. The topic could not be more timely or critical. As we reported in a recent Vehicular Technology Newsletter, Bill Chapman is with Sperry Corporate Technology Center in Colorado Springs and is developing a new spread spectrum system for mobile radio applications. We thank him for his willingness to share his views with our VTS membership. Other articles, on topics such as pilot-based SSB, are currently under preparation by recognized contributors in the field.

We continue publishing our regular features on abstracts and new literature, with your help we hope to expand the features to conference announcements, meetings and conference reports, new products and publications, books and book reviews and thesis abstracts.

Any suggestions or comments you may have on the content or format of our contributions are sincerely welcomed. Please address your correspondence to:

Dr. J.R. Cruz Communications Editor IEEE Vehicular Technology Newsletter
School of Electrical Engineering
The University of Oklahoma Norman, OK 73019

ABSTRACTS


This paper presents a study of the Bit Error Rate (BER) degradation resulting from base station switching in digital mobile radio systems using base station diversity to combat shadow fading. The degradation is caused by the discontinuities of the signal received by the mobile unit when transmission is switched from one base station to another. To evaluate this effect, a simple statistical model has been devised for the spatial variations of shadow fading. The model consists of a one-parameter spatial autocorrelation function for the (Gaussian) decorrelation value of

the fading loss, which can be easily simulated. The parameter in a correlation function can be varied to emulate different fading conditions in the urban environment. The shape of the autocorrelation function can similarly be varied. This model was used to evaluate the performance of a variable spreading gain and Phase-Shift-Keying (PSK) modulation. The results indicate that the performance of the SSR is insignificantly affected by switching for BER values above 3 x 10^-5 for two-PSK and 1.5 x 10^-5 for four-PSK. Adding a hysteresis into the switching test can reduce or increase the switching degradation, depending on the threshold value.


The effect of preamphump on the noise power output of FM detectors for SSB-FM is studied. Two cases are considered: namely, when the modulating signal is assumed to be sinusoidal and when it is a Gaussian random process. For both cases the noise is random process. For the case of the Gaussian modulating signal, the improvement is shown to be significant for low signal levels. For Gaussian process, the improvement is obtained at equalization gain in the interval (0.1-0.5).


Recently, multiplication-free digital filters have been proposed for a variety of applications to digital radio systems and information processing. The absence of multiplication is obtained by constraining each coefficient to a constant. In this way, multipliers are substituted by shift registers and, if appropriate, some adders. The optimal power-of-two coefficients must be computed through a nonlinear optimization procedure.

February 1985

Until now the problem of adapting the power-of-two coefficients of baseband transversal equalizers in the case of time-varying channel conditions was unique. In this paper two algorithms are proposed to cope with this problem and are compared from the viewpoint of complexity, accuracy, and other aspects. The algorithm is an application example, transmission of a biphase FSK digital radio system over a multipath fading channel is considered.


The signal levels around and within eight suburban houses were measured at 800 MHz. These measurements are needed in refining the requirements for portable-radio communication systems that can accommodate low-power radiotelephone nets. The measurements were made from an indoor receiver and an omnidirectional or omnidirectional/ low-gain antenna馈. Large-scale distributions of the mean signal levels across the houses are disappointingly large. The decrease in mean signal level with distance ranges from 5.6 dB/km for the eight houses. Signal decreases of the order of 70 dB/km are found. The change in signal level with distance ranges from 0.6 to 1.8 dB/km for the eight houses. The decrease in signal level with distance ranges from 0.6 to 1.8 dB/km for the eight houses. The decrease in signal level with distance ranges from 0.6 to 1.8 dB/km for the eight houses. The change in signal level with distance ranges from 0.6 to 1.8 dB/km for the eight houses. The change in signal level with distance ranges from 0.6 to 1.8 dB/km for the eight houses.


A new robust FM demodulator (RFD) is a simplified version of the maximum likelihood demodulator (MLD) [1] which incorporates a new technique to improve system interference immunity. The RFD is applied to combat the adjacent channel interference and its improvement factor is slightly negiligible smaller than that of the MLD.


A Land-Mobile Satellite System (LMSS) is a satellite-based communications network which provides voice and data communications to mobile users in vehicles, ships, and airplanes. By placing a "relay tower" at a height of 22,300 km above the earth, LMSS can provide wide-ranging, high-speed point-to-point communications. The LMSS system can be used to support a variety of services, such as two-way alphanumeric service, full-duplex voice service, and half-duplex voice service. A Network Management Center (NMC) will handle the channel requests, channel assignments, and in general, the network control functions. A pool of channels is managed by the NMC to be shared by all mobile users.

An integrated demand-assigned multiple-access protocol has been developed for the experimental LMSS. The pool of channels is divided into reservation channels and information channels. The information channels can be assigned by the NMC to either voice channels or data channels. Each mobile user must send a request through one of the reservation channels to the NMC via the FHSS system. If the NMC determines that there is a channel available, the NMC will send an assignment message back to the user and assign an information channel to the user. The NMC will periodically update the partition between the reservation channels, voice channels, and data channels. The voice system will be used to provide voice broadcast and voice select service. The data channels will be used to provide voice on-board switching and variable bandwidth assignment are discussed.


A potentially valuable implementation of a satellite computer communication network is the Packet Switching for Mobile Earth Stations (PSMES) network. The network is designed to provide a flexible communications system that can be used for a wide variety of applications, ranging from data transmission to voice communication. The network is based on a low-orbit satellite system, which provides a high-speed, low-latency communication link between the earth stations and the satellites. The network is designed to support voice and data communication services, as well as a variety of other applications. The network is designed to be scalable, allowing it to be expanded as needed. The network is also designed to be robust, capable of withstanding damage from natural disasters and other events. The network is designed to be easy to use, with a user-friendly interface. The network is designed to be cost-effective, with lower costs than many other communication systems. The network is designed to be reliable, with high availability and low error rates. The network is designed to be secure, with a variety of security features. The network is designed to be flexible, with the ability to be configured for different applications and environments. The network is designed to be efficient, with low power consumption and low latency. The network is designed to be scalable, allowing it to be expanded as needed. The network is designed to be robust, capable of withstanding damage from natural disasters and other events. The network is designed to be easy to use, with a user-friendly interface. The network is designed to be cost-effective, with lower costs than many other communication systems. The network is designed to be secure, with a variety of security features. The network is designed to be flexible, with the ability to be configured for different applications and environments. The network is designed to be efficient, with low power consumption and low latency.
Spread Spectrum Applications to Mobile Radio: Past, Present and Future

William W. Chapman

Recent regulatory actions draw attention to the promise and limitations of this evolving technology.

Spread Spectrum — An Overview

The history of spread spectrum systems makes for very interesting reading, a detailed account of which is presented in (9). Originally developed to resist intentional jamming and provide low-probability-of-interception (LP/I) communications, these systems have since been recognized as capable of providing a multitude of additional services. Because the signals employed have extremely high time-bandwidth products the waveforms can be designed so as to have very favorable correlation properties, and as such can be used to provide precise radionavigation services, and can further be used to provide a code-division multiple access (CDMA) capability. Systems such as the Global Positioning System (GPS) have capitalized upon the properties of spread spectrum signals to provide extremely accurate navigational services to mobile users (e.g., planes and ships at sea).

In order to achieve time-bandwidth products on the order of 10^6 to 10^8 (higher in some cases) two approaches are commonly used. The first, called direct sequence (DS) or pseudo-noise (PN) modulation, multiplexes the information bearing carrier (typically BPSK modulated by the message data) by a pseudo-random sequence of 1's and -1's at a much higher bit rate (commonly referred to as the chip rate) than that of the baseband message. As such, the resulting signal bandwidth is predominantly determined by the bandwidth of the PN sequence. At the receiver the PN sequence is removed from the received signal prior to message recovery by again multiplying by the original pseudo-random waveform (which requires that code synchronization be achieved and maintained for the duration of the transmission). Code-division multiple access capability is achieved by modulating the signal of each user by a different PN sequence, the set being appropriately chosen to provide low cross-correlation between all possible members of the set. Fig. 1 depicts a typical transmitter/receiver pair for direct sequence spread spectrum systems.

The other method commonly employed, called frequency hopping (FH) modulation, shifts the frequency of the transmitted carrier at a relatively fast rate. Prior to hopping, the message data is typically modulated onto the carrier by standard frequency-shift-keying or phase-shift-keying, neither of which requires coherent demodulation at the receiver. Again, code-division multiplexing is provided by assigning users different hopping patterns, and by error correction coding to offset the effects of frequency "hitch." A typical transmitter/receiver pair is shown in Fig. 2. If the carrier hops at a rate faster than the message bit rate the system is referred to as a fast-hopping system. Conversely, if the rate is slower it is referred as a slow-hopping system.

Nowhere has the impact of modern technology been more pronounced than in the areas of voice and data communications. From ELF transmission to underwater submarine to lightweight transmission over fiber optic cables, it seems as if no region of the frequency spectrum has gone unvisited by this ongoing revolution. It is, therefore, not surprising to find that even such established technologies as VHF/UHF radio systems are being looked at anew.

A case in point is the recent attention being paid to spread spectrum techniques. These systems, which were originally developed for military use, have benefited tremendously from recent advances in the areas of integrated circuit technology and surface acoustic wave devices, and the concurrent increases in signal processing capabilities. With the reduced cost of signal processing equipment it was only a matter of time before attention turned to possible applications in the civilian sector. Such has been the case, and the variety of systems which have been proposed emphasizes the potential these systems might hold. Among the suggested applications are cellular mobile radio systems, wireless data terminals, cordless telephone, radiolocation systems, multiple access to satellite resources, and packet radio networks. The common link between these systems is that each would enjoy one or more benefits by utilizing spread spectrum techniques that would not be obtainable through more conventional modulations.

In this context the most commonly quoted benefits are a resistance to cochannel interference in areas of high spec- tral occupancy, multiple access capability with little inter-user coordination, improved performance over multipath channels, and a potential increase in spectral efficiency in interference limited environments. For example, a wireless data terminal, developed and tested by Hewlett-Packard (5), allows for indoor transmission at relatively high data rates among multiple terminals even in severe multipath environments (e.g., a warehouse structure with a large steel content).

However, a considerable debate has arisen over the detri- mental effects which might occur (primarily to nearby or collocated non-spread spectrum systems) as a result of employing wide-band signals of this form (more on this later). Before considering further the role spread spectrum techniques might play in future radio systems it will be instructive to define certain terms and characterize various concepts fundamental to the theory of spread spectrum systems.

Spread spectrum systems employ modulation techniques which result in a transmitted bandwidth far in excess of that required by conventional methods. While several forms of spread spectrum modulation exist, the two most common are pseudo-noise and frequency hopping. See refs. (1) and (2) for an introductory discussion.

* Spread spectrum systems employ modulation techniques which result in a transmitted bandwidth far in excess of that required by conventional methods.
IEEE Vehicular Technology Newsletter

Other techniques have been employed to spread the transmitted bandwidth, among these are time hopping, whereby the signal is divided into time slots, each of which contains a single data element, and (or) chip (or spread) FM. Hybrid of the above are also possible and are, in fact, becoming the preferred approach in many military satellite communications since the amount by which the bandwidth of the original signal is expanded determines to a great extent its ability to resist interference, whether intentional or simply coincidental. In time hopping, the transmitted signal bandwidth to that of the original "unspread" signal is referred to as the processing gain (PG) of the spread spectrum system. The interested reader should consult [1], [2], [3], and [4] for further information on spread spectrum techniques.

Applications to Mobile Radio

One of the first civilisation applications to be seriously proposed for spread spectrum systems was that of cellular mobile radio in 1977 (ref. [7]). Among the potential benefits which Cooper and Neubauer (in the original paper) was message privacy, ease of digital data transmission, and a claimed higher spectral efficiency as compared to more conventional FMapproaches. While the actual efficiency of such a system has never been verified by field trials, subsequent analyses indicated the potential for substantially higher user populations, see [7].

The impetus behind the development of cellular mobile radio systems has been the need to provide mobile telephone service to large numbers of people. A recurring past system typically employed a single high power base station with a coverage area that spanned the entire service area. As such, each frequency channel could be used throughout the service area. Thus, the number of simultaneous users in any large urban area was limited by the number of channels within the assigned allocation. Consequently, large groups of users were denied access to the cellular radio network. This situation has been drastically altered by the recent FCC ruling to open up large portions of the spectrum from 900 to 9000 MHz for cellular radio systems. The results of this action has already been felt with the proliferation of cellular systems being set up in most of the large urban areas of the country. The layout of a typical cellular radio system is depicted in Fig. 3. As shown, the region to be serviced is subdivided into a number of small areas or cells, each of which contains a base station. In mobile-to-mobile or mobile-to-fixed site communications all transmissions are routed through these base stations. Also shown is a central controller which serves to implement a strategy of chosen, assign base stations, route calls between bases, and manage the load on the system. Regardless of the modulation method employed, full duplex transmission of cellular mobile radio systems is achieved by dividing the frequency allocation into two equal sub-bands, one for base-to-mobile communications (downstream), the other for mobile-to-base communications (upstream).

In narrowband FM systems a considerable increase in spectral flexibility over that obtained by using single bandwidth allocation may be realized by reassigning channels to multiple base stations, these being sufficiently far enough removed from one another to result in minimal levels of overlapping channel interference. In order to implement this the service area is grouped into "clusters" of N contiguous cells, within which no channel assignments are duplicated (see [8] for more on the topology of such cellular systems). In a spread spectrum system the use of multiple base stations uniformly distributed over the service area allows for a considerable decrease in transmitted power during a given link. Furthermore, since the use of spread spectrum modulation techniques results in more uniformly distributed interference levels, while each user utilizes the entire frequency allocation, the interference resulting from any given source is greatly reduced as compared to that in a single base station configuration. To provide a strong link, the cell-site systems and frequency-shift-keyed systems have been proposed for mobile radio applications, see [9]. In either implementation all users would be assigned a specific set of codes which would be used to transfer data over the transmission channel, and in frequency translated form to the base. The signal sets employed are typically generated from a linear code such as a modulo 2 code plus a single constant to minimize "code noise" within the system. In order to further reduce inter-user interference these systems would employ a random sequence to adjust transmit power levels during upstream transmission so as to maintain the average received signal power constant.

Why Spread Spectrum?

From a technical perspective there are numerous reasons to consider spread spectrum techniques for mobile radio applications. Limited space precludes a comprehensive examination of all of these, but several of the major considerations are as follows:

1) Multipath fading, a fundamental characteristic of radio wave propagation over urban channels, provides one of the primary motivations for considering spread spectrum techniques. Also referred to as Rayleigh fading, this phenomenon results from the multiplicity of paths over which the received signal has traversed before arriving at the receiver antenna. When a given street is lined with trees, for example, the signal received at 900 MHz might result in this error since is Rayleigh distributed at any given position [11] (hence its name). This fading component is very frequency dependent, and in frequency by more than the coherence bandwidth of the channel, typically 100-300 KHz, will experience almost uncorrelated fading, and exhibits a negative exponential probability density function. Since these fades result from the standing wave pattern set up by the reflected and refracted waves, the relative maxima and minima can differ at two closely spaced frequencies apart. Thus, at 900 MHz a vehicle travelling at 60 mph can experience 50 to 100 fades over a period of one second!

In order to combat this fading, narrowband systems must either include a considerable margin in their power budget (typically around 20 dB), or employ some form of spatial diversity. On the other hand, fast frequency hopping signals exhibit resistance to multipath fading because the frequencies hops will typically be separated in frequency by more than the channel coherence bandwidth. Hence, the required fading margin that must be included in the system is only on the order of 2-3 dB. (A tutorial on the use of spread spectrum techniques to combat multipath fading can be found in [15].)

2) As previously alluded to, spread spectrum techniques allow large groups of users to simultaneously access a centrally located resource by employing code-division multiplexing. Such an approach is of particular appeal in multipoint-to-multipoint systems where multiple users compete for access to the common resource. This is referred to as the processing gain (PG) required in frequency-division or time-division multiple access schemes.

3) Spread spectrum systems are by nature digitally oriented with a few exceptions, since it is only difficult in transmitting digital data, digitised voice, automatic status updates, etc. The pace with which all communications are transmitted, and the assumption that there exist the opportunity for considering a system which is inherently oriented towards digital communications.

spread Spectrum Overlays

The ability of spread spectrum systems to suppress interference within the received signal's bandwidth occurs whether the interference is an intentional jammer, or simply unintentional cochannel noise. Thus, there is every reason to believe that the techniques of spread spectrum operations can operate in the presence of multiple cochannel signals, as might be characteristic of operation in urban areas. Consequently, there has been considerable recent discussion over the possibility of employing spread spectrum systems in an overlaid manner. For our purposes we will define an overlay operation, both spectrally and geographically, of a spread spectrum system(s) and a more conventional narrowband system(s).

The feasibility of overlaid operation is very much a function of the application considered, as well as the level of spectral occupancy within the proposed band. While the near-far problem would render many such systems (either individually or jointly) imperable for unacceptable periods of time, certain applications might be quite amenable to such an implementation. The potential benefits of overlaid operation include flexibility of spectrum allocation, concurrent use by several user groups of the same frequency band, and the possibility of increasing spectral efficiency in under-utilized allocations.

A situation which has been studied in some detail (e.g., see refs. [13] and [14]) is that of overlaid mobile radio. In [13] an analysis of overlaid cellular mobile radio systems is presented. The spread spectrum system considered is an adaptation of the differentially coherent phase-shift-keyed frequency hopped system originally proposed by Cooper and Neubauer. It is in fact operation with existing narrowband FM systems appears feasible under suitable restrictions (e.g., proper frequency hop signal design, collocated FM and spreading systems, and the inclusion of power control techniques within the spread spectrum system). Furthermore, in [14] favorable results are also arrived at regarding overlaid operation in the UHF television bands.

Regulatory Issues

The recent interest in spread spectrum technologies has not gone unnoticed by the Federal Communications Commission, which recently released a Notice of Inquiry requesting comments from the public on the suitability of these widespread emissions for civilian use, see [15]. Currently the FCC regulations do not contain any sections that explicitly govern the use of spread spectrum systems, and as such anyone desiring to implement such a system typically must obtain special permission from the FCC. As a result of this, and in response to the replies received to the Notice of Inquiry, the Federal Communications Commission released a Further Notice of Inquiry and Notice of Proposed Rulemaking (see [16]) which set forth certain proposed regulations governing the operation of low power spread spectrum devices. The proposed rules would allow spread spectrum systems to operate essentially on all frequencies (with certain exceptions) above 70 MHz under Part 15 of the FCC rules.

Obviously such a blanket use of the spectrum would create havoc were it not for additional restrictions, as such power limitations are included within the proposed rules. However, the nature of the proposed power restrictions have been the source of some concern among parties interested in developing spread spectrum systems for civilian use. As currently stated the regulations would provide for the operation of frequency hopping systems limited to a field strength of between 500 and 5000 microwatts (depending upon the type of operation) at a distance of 3 meters from the transmitting antenna. Furthermore, direct sequence sequences would be limited to a field strength of 33 mV/m in regardless of the operating frequency. Considering manufacturers interested in developing spread spectrum systems for applications such as radio-navigation or mobile radio would not be able to operate their systems under the proposed regulations.

It remains to be seen how the regulatory issues will be settled, but in the mean time it should certainly be the source of much concern. One certainly true is that this issue has potentially wide spreading ramifications for the future use of the radio spectrum, and as such should be given serious consideration by anyone involved in the design or development of RF systems.

References


Graz, the capital of the province of Styria, will be the venue for the 1985 ISATA Symposium. This will be held from 23rd — 27th September, 1985, with the collaboration of AVL LIST Ges.m.b.H. Graz, which, for over 35 years, has been dedicated to research, development and design of internal combustion engines, as well as the development and production of automotive testing and diagnostic equipment.

Technical sessions will be held in the Congress Centre of Graz where the papers presented will cover the whole range of automotive technology and automation, including: computer-aided testing; engine and emission testing; component testing; lubricant testing; automation of manufacturing processes; robotics; flexible manufacturing systems; diagnostics; quality control; computer-aided engineering; future product development; instrumentation and sensors; fuel economy; vehicle management systems; safety; micro-processors and microelectronics. SPECIAL EMPHASIS WILL BE PLACED ON INTEGRATED COMPUTER-AIDED ENGINEERING AND MANUFACTURING. There will be a special session for the exhibitors and suppliers to the automotive industry.

The official language of the Symposium will be English.

One day and a half will be set aside for technical visits to various facilities at AVL, BMW Steyr and General Motors Austria.

Evening activities arranged include a reception by invitation of the Lord Mayor of Graz and a dinner offered by the Provincial Governor at Eggenberg Palace, a banquet and a Styrian Folklore evening.

There will be a special ladies programme for delegates' wives.

The Symposium will, once again, be drawing on the expertise and support of the ISATA coordinating committee, which will be responsible for vetting the papers submitted.

Authors wishing to give papers at the Symposium should submit the title and a short summary of 100—150 words to the organisers before 25th January 1985. In order to allow sufficient time for printing, the full manuscript should be received by 14th May 1985. IT SHOULD BE STRESSED THAT AUTHORS WILL BE REQUIRED TO PAY FULL REGISTRATION FEES.

Space at the Congress Centre of Graz will be set aside to provide a static exhibition area. Car manufacturers, suppliers of equipment and other companies wishing to exhibit should contact the Symposium organisers as soon as possible.

Advertising space is available in the Symposium programme, which is distributed on a worldwide basis to 15,000 executives in the automotive field. Advertising space is also available in the Symposium proceedings, which are distributed to all delegates and used as standard reference works all over the world. Companies wishing to advertise should contact the organisers as soon as possible.

Following the success of recent ISATA symposia with over 400 delegates from 24 countries attending, the 1985 Symposium should be an even more important and successful event.