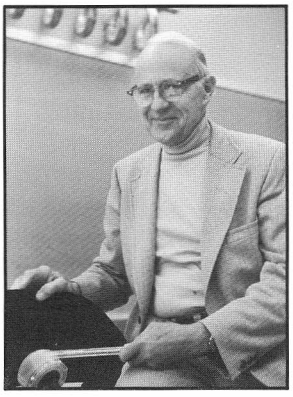
IEEE SOCIETY ON
MICROWAVE THEORY
AND TECHNIQUES

NEWSLETTER

Number 126
Winter/Spring 1990



1990 IEEE Heinrich Hertz Medal Awarded to John D. Kraus

John D. Kraus has received the 1990 Heinrich Hertz Medal. Dr. Kraus (F'54) is the McDougal Professor of Electrical Engineering and Astronomy (Emeritus) and Director of the Radio Observatory of the Ohio State University.

This award recognizes outstanding achievement in electromagnetics. "Contribution may be theoretical or experimental in nature. Desirably, it should be both. The contribution may deal with electromagnetics at any frequency, and may entail, for example: generation, detection, transmission, propagation, or interaction with matter.... The contribution must have been reported widely, and with clarity, to enable others to make further contributions."

Dr. Kraus received B.S., M.S., and Ph.D. degrees in physics in the early 1930s from the University of Michigan. A radio amateur at age 14 and a physics Ph.D. at 23, he trained himself to design experimental apparatus that is elegant in its simplicity. His choice of topics for investigation reveals unusual insight; his own analytical work guided his experimental investigations.

Among his many contributions to antenna development are the helical antenna, widely used for space communications and broadcasting, and the corner reflector, used for TV reception and as a reflecting radar target in safe ship navigation.

By recognizing the importance of electromagnetic radiation from cosmic sources, Dr. Kraus became one of the pioneers of radio astronomy. He designed and built the giant Ohio State University radio telescope now known as "Big Ear." This major accomplishment was the forerunner of many radio telescopes, including the 1,000-foot curved reflector in Nancy, France (1963), the 178-meter interferometer in Cambridge, England, and the antenna built at Pulkov Radio Observatory, USSR (1959). The radio mapping of the sky provided by Dr. Kraus and his associates helped lay the cornerstone for modern astronomy.

As an exemplary engineering educator, Dr. Kraus achieved prominence as a classroom teacher and a lecturer. The program he helped to establish at Ohio State University has been a key training ground for researchers and engineers in antennas and radio astronomy. Most antenna engineers and radio astronomers educated in the last thirty years have used his outstanding textbooks, *Antennas, Electromagnetics,* and *Radio Astronomy.* He has also written two popular science books: *Big Ear* and *Our Cosmic Universe.* All of these books have been translated into foreign languages.

Dr. Kraus received the Navy Meritorious Service Award in 1946, the Sullivan Medal of Ohio State University in 1970, the Outstanding Achievement Award of the University of Michigan in 1981, the IEEE Centennial Medal in 1984, the IEEE Edison Medal in 1985, and the Distinguished Achievement Award of the IEEE Antenna and Propagation Society in 1985. He was elected to the National Academy of Engineering in 1972.

The Heinrich Hertz Medal award comprises a gold medal, bronze replica, certificate, and $10,000.

In This Issue

MTT-S Newsletter Copy Deadlines

Issue	Deadline
Fall	October 1
Winter	December 1
Spring	February 28

Charles Malinow
1926–1989

Charles Malinow of Baltimore, Maryland, died on October 31, 1989, as a result of complications following leg surgery to correct circulation problems. He was 63.

Malinow managed his own business, C.L. Malinow & Co., Inc., a sales representative company serving the microwave community in the greater Baltimore-Washington-Virginia area. Charlie, orphaned at an early age, was reared in Baltimore City, was a graduate of City College, and specialized in electronics and engineering at the Johns Hopkins University. During his multifaceted career in electronics, he worked for Westinghouse, Omni Spectra, and other companies, beginning his career in the infancy of the radar and microwave engineering industries. At the Radiation Lab at The Johns Hopkins University, as throughout his career, he was associated with some of the greatest scientific minds of the microwave community. Charlie served on the 1986 IEEE MTT-S International Microwave Symposium steering committee in local arrangements.

Malinow served with distinction in the armed services during World War II. When he left the Navy with the rank of Chief Petty Officer, he continued to serve in the Coast Guard. For 21 years, he supported his three sons' undergraduate and graduate education. He wanted them to have all the opportunities he never had. As a parent, he showered them with love because of his experiences as an orphan. As his son Kenny observed, "He devoted his life through the field of communications to make the world smaller and believed intensely that a rational, even-handed, and scientific approach could only make the world a better place in which to live."

In business, he was a man of absolute integrity who never pandered to a client's whims and who never sold a product in whose quality and productivity he did not himself absolutely believe. As his son Andy said, "He cherished substance over 'flash' and he was utterly without pretense."

He is survived by his wife, Helene; sons, Kenneth, Andrew, and Martin; and grandchildren, Jordon, Daniel, and Matthew.

Contributions in memory of Charles Malinow can be made to the following charities:

American Diabetes Association
3701 Old Court Road
Baltimore, MD 21208

Save a Heart
302 Reisterstown Road
Baltimore, MD 21208

Charles Malinow: A Tribute

by Ed Niehenke

Charlie Malinow passed away on October 31, 1989. As many of you know, Charlie was a great human being who lived on this earth for 63 years and gave much to the human race.

To the engineering community and specifically to the Microwave Theory and Techniques Society, he gave much. He sponsored meetings every year for both the Baltimore and Washington MTT-S chapters to improve the chapters' programs for the members. He actively worked on the 1986 International Microwave Symposium Steering Committee from its start in 1981 to the event in 1986, adding his personal touches for the attendees from

all around the world. He hosted the summer committee meeting each year aboard his *Taste of Honey* on the Chesapeake, where many of the symposium innovations were dreamed up. He personally designed the welcoming banner, which was hung across the street welcoming the microwave engineers to Baltimore in twelve languages. He, along with his wife Helene, made many contributions to the success of the symposium, and he continually came up with suggestions to enhance it. Charlie told me many times, "Ed, we can do it. The symposium will be a great success, and the symposium attendees will remember Baltimore for years to come." Charlie was proud to be able to serve on the committee, and this experience was a high point in his life.

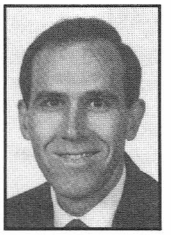
In the business world, Charlie will be remembered for his willingness to supply quality products to his clients as a sales representative for his own company, C.L. Malinow & Co. Any time some technical information about products was required, Charlie made sure the engineers were visited by his principals to supply detailed information to get the job done right. Charlie was a man of integrity and followed this principle in all his dealings.

Charlie will be remembered as a man to be emulated as a husband to his beloved wife of 41 years, Helene, and as a father to his three children. He taught many lessons to his children. He taught them, by example, a reciprocal respect for his devoted wife, to whom he was devoted absolutely and with whom he shared a love and understanding that was as beautiful as it was unique. He taught them to be disciplined and dependable and to accept the responsibilities life imposes with competence and consistency and a strong sense of duty. He taught his family always to be there for one another, with mature caring, love, and good humor. Charlie, in his own inimitable way, was a master teacher.

Charlie will be remembered as a friend to whoever needed his help. Without seeking praise or credit, when a relative of a friend sought help for that unfortunate boy at the National Institute of Health who could only survive in a bubble, it was Charlie who picked up at the airport the one matching blood donor, who came here regularly from Boston to keep that little boy alive, and who entertained him.

Charlie was a gentle and kindly spoken man who never spoke harshly about people. Many of you have received his miniature penny, which he has been giving out over the last decade. He was great because of the richness of his personality and his lifelong commitment and quest to integrate ethics with caring for people and progress.

Mr. Niehenke is an advisory engineer at Westinghouse Electric Corporation in Baltimore, Maryland. He and Charlie Malinow were friends for over 20 years.



Editor's Notes

by Gary Lerude

Please welcome the Winter/Spring issue of the MTT-S Newsletter. I hope you are as glad to receive it as I am to get it to you! As this issue goes to press, the temperature in Dallas is nearing 100°F (38°C), and winter and spring are but distant memories. Hopefully, you've noticed that this issue is late in arriving and have missed the informative mixture of administrative news and feature articles. My apologies. A change in work assignment at the same time I was assuming the role as newsletter editor swamped me, and I have found myself overcommitted with too little time devoted to being the editor. However, we're taking steps to correct that problem and still plan to publish all three issues this year. (See the updated copy deadlines at the bottom of page 1.)

My unfortunate circumstances have left me all the more appreciative of the outstanding job Peter Staecker did publishing the newsletter from 1987–89. He and his team deserve recognition for producing quality articles, publishing on time, and actually reducing the cost of the newsletter over his 3-year term as editor. Peter is facing a new challenge now as chairperson of the steering committee for the 1991 MTT-S International Microwave Symposium, to be held in Boston from June 9–13, 1991.

I would also like to acknowledge the efforts of Zvi Galani, Special Articles Editor until this year, when he was elected to MTT-S AdCom and appointed AdCom Secretary. As Special Articles Editor, Zvi recruited authors to write technical tutorial and review articles and then worked with the authors to ensure the articles were informative and readable. One of Zvi's contributions appears in this issue: "Microwaves To The Rescue" by William Brown. Replacing Zvi, we're fortunate to have recruited John Eisenberg, a consultant in microwave technology who works in the San Francisco Bay Area.

You may notice several changes in format in this newsletter, compared with previous issues. Recognizing the truly worldwide membership of the MTT-S, we're inaugurating a "Transnational Activities" section to consolidate and report on MTT-S news of interest to members in Regions 8–10. (See pages 22–25.) Rolf Jansen has agreed to serve as editor for Region 8, and we are currently recruiting editors for Regions 9 and 10. This step parallels the recent creation of a Transnational Committee as a standing committee of the MTT-S AdCom.

Continued on page 37

Microwaves to the Rescue

by William C. Brown

Microwaves to the rescue of what? And in what form?

The answer: "Microwaves in the form of beamed power transmission to the rescue of the space program and of the Earth from the greenhouse effect."

Are such answers absurdly presumptuous? Perhaps it would seem so at first glance, but an examination of the technologies that can be applied to the current and future problems of space and energy indicates that beamed-power technology could become a very useful tool.

The extent to which space will be developed in the future depends on a better transportation mode in space and on a more convincing reason to develop space than "just because it is out there." The solution to the greenhouse effect and the warming of the Earth depends largely on eliminating or greatly lessening the burning of fossil fuels that accounts for a large part of the carbon dioxide released into the atmosphere.

The technologies being considered to solve these problems are few and, without exception, are wanting in one or more critical aspects that put their future efficacy and acceptance in doubt or that limit the extent of their application.

Beamed power transmission, when combined with other electronic technologies such as electric propulsion and photovoltaic arrays, makes possible new solutions to the space program hiatus and the need for pollution-free sources of energy. Beamed microwave power can be considered as a subsystem for three interactive space systems.

The first of these systems is the Solar Power Satellite System, in which energy is captured from the sun and sent efficiently to Earth via multi-gigawatt but low-power-density microwave beams over a distance of 22,400 miles from geosynchronous orbit.[1,2]

The second system is a greatly improved transportation system between low-Earth orbits that are from 200 to 800 miles above the Earth and geosynchronous orbits that are 22,400 miles above the Earth.[3] The orbital transfer vehicles that are involved use ion thrusters that can lessen the amount of required propellant mass by a factor of ten or more over that of conventional chemical propulsion. The huge thirst of these electric thrusters for electric power and energy is supplied by high-power microwave beams that are emitted from a series of radiating antennas on land masses around the Earth's equator.

The third system, which is closely associated with the equatorial arrangement of transmitters, supplies power to orbiting industrial parks in low-Earth orbit.[4]

All of these systems can be visualized as being interactive with each other. The transmitters of the equatorial-based system can supply electric energy to the industrial parks that, among other functions, could build portions of the solar power satellites, which would then be raised to geosynchronous orbit by the electrically propelled interorbital vehicles. The same basic microwave beamed-power technology is used in all of the microwave subsystems in these three applications.

The basic beamed-power-transmission technology consists of converting dc power into microwave power at the transmitting end, forming the microwave power into electronically steerable microwave beams, and capturing the microwave power and converting it back into dc power at the receiving end. The frequency used will probably be in the 3-gigahertz region because of low attenuation through the atmosphere under all atmospheric conditions. This frequency is also where much of the present, well-advanced technology has been developed.

This technology and its current status will be discussed in some depth in a companion article in a future *Newsletter.* It involves new, unusual antenna technology at both the transmitting and receiving ends and very high efficiencies in the interconversion of microwave and dc power at both ends of the system.

In this article, we will first review alternative energy sources, including the Solar Power Satellite, that could be used to mitigate the greenhouse effect resulting from fossil fuel burning. Then, we will review the need for a better space transportation system and how microwave beamed power in combination with ion thrusters could fulfill that need.

Meeting the Challenge of the Greenhouse Effect

For the first time in human history, mankind in this century has obtained the means for its own extinction. In fact, it has developed two approaches. The first means was the establishment of an arsenal of nuclear weapons which, if used with abandon, seriously threatens mankind's existence. The second approach, less abrupt but potentially as effective, is the buildup of carbon dioxide in the Earth's atmosphere, caused chiefly by the wholesale burning of fossil fuels. The seriousness of the resulting warming of the Earth, or greenhouse effect, is now generally recognized by the world community, which is beginning to evaluate options to mitigate, if not to reverse, this trend.

The enormous scale of the problem that we face can be shown by considering the current energy-generation paradigm in the United States. Fossil fuel burning accounted for over 85 percent of the 76 quads of energy generated in the United States in 1984. A quad of energy is one quadrillion BTUs, or about 300 billion kilowatt hours. Eighty-five percent of 76 quads represents about 20 trillion kilowatt hours of electric energy per year. Most

of our energy requirements, including those for transportation, could be met with electric power. But, to generate that amount of electric energy would require over 2500 gigawatts of generating capability, equivalent to 2500 of our largest 1000-megawatt generating units. The world's energy use is about four times that of the United States, and the use of energy in the Third World countries is rising at a rate several times the growth rate in the developed nations.

Against this backdrop of the world's energy requirements, we evaluate the potential of nonfossil sources of energy and particularly the sources of electrical power and energy. The most recognized alternative to the use of fossil fuels for generation of electrical power is nuclear energy. Energy derived from fission is already a proven approach to generating electrical power and heat. The associated problems are the disposal of nuclear wastes and the safety problems associated with a scale of use which would be at least 20 times that now in use in the United States if the bulk of our energy requirements were met with electrical power. Cogeneration, in which the waste heat from the thermal cycle is used for various heat requirements, would lessen the number of new generating facilities required. But, for the long term, nuclear fission suffers from the fact that the amount of fissionable material on Earth is limited.

So, we turn to nuclear fusion, for which the sources of fuel are virtually unlimited. Unfortunately, however, the future of nuclear fusion as a source of electrical power is very clouded. It has been under a research phase for four decades and many billions of dollar have been spent. Despite its promise, it is far from a proven technology.

In the near term, conservation and the more efficient use of energy could substantially contribute to mitigating the Earth's warming; in fact, current efforts in this direction might be responsible for the drop in the energy used per capita in the developed nations. However, its potential as a substitute for more energy-generating capability becomes very limited as efficiency and conservation approaches become fully exploited.

Other so-called renewable sources of energy such as hydropower, wind power, and geothermal power can and will make their contributions, but they too are limited.

Of all the sources of energy to replace the burning of fossil fuels, the direct use of the sun's energy seems to be the best bet. An existing and successful technology can convert the sun's flux into electric power either directly by means of photovoltaic cells or by means of a thermal cycle using turbine generators. In certain regions of the Earth, including the southern part of the United States, enough sunlight falls onto each square mile to generate 600 million kilowatt hours of electricity per year with a conversion efficiency of only 15%. Urban pollution problems in cities like Los Angeles will stimulate a changeover to electric vehicles. Given the rising pollution problems in the Los Angeles area caused by gasoline-burning cars, the inevitable increase in the cost of gasoline, the rapidly falling cost of converting the sun's energy directly into electric power, and the favorable solar insolation in that area, there is the good possibility of a commitment to finding a solar solution by the year 2000 to the pollution problem caused by automobiles in that region.

The problem with solar energy captured on Earth is that the weather and the day-night cycle make it necessary to build very large collection areas and large, very expensive storage facilities if the arrangement is to be used for base-load electrical power. Extensive areas of the Earth are not favored with large amounts of sunshine, particularly in the winter; hence, the capital cost of the arrays and the energy storage facilities will be a severe problem. However, these considerations will not deter the use of the technology in those areas favored by the amount of sunshine they receive the year around.

For those locations not so well favored, the storage and long-distance power transmission problems can be removed by a complementary technology that captures the sun's energy in geosynchronous orbit with a satellite that is exposed to the sun's radiation almost continuously and then beams the power to Earth by means of a microwave beam. This approach, proposed by Dr. Peter Glaser of Arthur D. Little, Inc. in 1968, eliminates both the energy-storage problem that is unavoidable on all Earth locations and the power transmission problem to areas on Earth remotely located from sunny regions.[1]

This option, which makes intensive use of microwave beamed-power technology, was found by the President's National Commission on Space to be potentially the only large-scale commercial application of space.[5] The concept was studied in considerable depth, not only from technological but also from societal points of view, in an extensive study jointly sponsored by the Department of Energy and NASA between 1977 and 1980.[2] In this extensive study, no insurmountable obstacles were found that would preclude further interest and study. During the last decade, technological progress had been extensive in all aspects of the system and especially in microwave technology. The status of this technology will be discussed in a later issue of the *Newsletter*. The need for an environmentally benign source of electric power has now become recognized as a national and an international goal.

The All-Electronic Space Transportation System

The Solar Power Satellite can become a reality only if the high cost of placing solar power satellites into orbit by conventional chemical propulsion means is lowered greatly by implementing a much better, lower cost technology. This high cost of transporting material by conventional rocket propulsion from the strong gravity of the Earth to geosynchronous orbit has inspired the idea of using the moon's resources for much of the materials that go into a Solar Power Satellite. The material is much more easily transported from the weaker gravity of the moon to a geosynchronous satellite location. However, establishing the moon as a substantial material base will also require much better transportation to and from the Earth. Also,

many construction materials and components still must come from the Earth. In truth, the high transportation costs, based on the use of conventional chemical rockets, make such projects as the Solar Power Satellite, the colonizing of the moon, or a permanent base on Mars appear to be little more than fantasy.

This is bad because, as we have seen, the Solar Power Satellite would be an enormously beneficial use of space. Beamed-power-transmission technology in combination with electric propulsion could solve this problem.

It has long been recognized that if there were a low-mass source of electric power and energy for it, electric propulsion could lower the cost of transportation from low Earth orbit to geosynchronous orbit by at least 90 percent. Unfortunately, the mass of conventional sources of electric energy and power in space is many times the mass of the electric thrusters, which nullifies their potential. As Ernst Stuhlinger states in his pioneering book on electric propulsion, published in 1964, "Even a cursory look at the ion propulsion system reveals that the most critical component from the engineering standpoint is the source of electric power." He went on to state, "The necessity of a concentrated effort to develop efficient and reliable nuclear-electric space power sources in the kilowatt and in the megawatt range cannot be over-emphasized." These statements were made before the potential of beamed microwave power was known.

While electric propulsion technology steadily advanced during the intervening years, a low-mass power source that could be carried aboard the orbital transfer vehicle did not materialize from either nuclear or solar photovoltaic sources. To be more specific, while the specific mass of current ion thruster designs is about 1 kilogram for each kilowatt of power they consume, the specific mass of a projected but as yet undeveloped 100-kilowatt nuclear power source is 30 kilograms for each kilowatt of power generated. This makes it untenable as a power source for LEO-to-GEO (low Earth orbit to geosynchronous Earth orbit) transportation, although such nuclear reactors may be necessary and acceptable for deep space missions and as a source of power on the moon. Likewise, solar arrays are unsuitable for a power source because of their relatively high specific mass (10 kilograms per kilowatt of dc power output) and high susceptibility to radiation damage as they pass relatively slowly through the Van Allen belt.

Microwave beamed-power transmission promises a solution to the electric thruster power source dilemma because the receiving end of the system, carried aboard the vehicle and commonly called the "rectenna," has a specific mass of 1 kilogram per kilowatt, or about the same as that of the ion thruster. Moreover, the power-conditioning interface between the rectenna and the ion thruster is minimal compared with that for either the nuclear-power or photovoltaic-array source.

The combined specific mass of the ion thruster and its electric power source is so low compared with that of previous combinations of thrusters and power sources that comparatively very high accelerations result from the ion thruster. These high accelerations promise to revolutionize LEO-to-GEO transportation and eventually establish a new standard for in-space transportation that will replace the current chemical propulsion method.

These low specific masses for the thruster and its power source allow the thrusters to operate with a ratio of thrust to propellant mass consumed that is at least ten times that of the best conventional rocket propulsion. As a result, the cost of transporting propellants between Earth and low Earth orbit for use in further transportation in space is lowered by 90 percent. To the extent that such transportation is an environmental consideration, its harmful effect will be greatly lessened by fewer flights.

The all-electronic approach to propulsion has other advantages over conventional rocket propulsion.

These include relatively slow acceleration so that the vehicles and their payloads can have relatively low mass densities. Current rocket-propelled interorbital vehicles and their payloads have to be structurally designed to withstand several *g* of acceleration. By contrast, the acceleration of an electrically propelled vehicle will be less than 0.1 *g*, so that space vehicles made in space might be revolutionary in design.

Another characteristic advantage of microwave beamed-power transmission is the modular structure of both its receiving rectenna and the phased-array transmitting antenna. Either of these elements can be made larger easily by simply adding more modules. This gives the technology great flexibility as contrasted with nuclear power, for example, which would necessitate a huge development activity to move from the present 100-kilowatt unit being developed to a 10-megawatt unit. It should be recognized that the all-electronic orbital transfer vehicle will require at least 10,000 kilowatts of received power.

Finally, electrically propelled vehicles are much safer. They reenter the Earth's upper atmosphere on their return journey with the same low velocity they left it with. This is in sharp contrast with a rocket-propelled vehicle, which must reenter the atmosphere with high velocity, use a heat shield, and decelerate with a *g*-force of 3 or 4.

"Transportronics"

These new areas of application for microwaves need a global, all-inclusive term for identification and classification purposes. Such a term will stimulate discussion and dissemination of information. The term "transportronics," a combination of *"transport"* and *"electronics"* is tentatively proposed. The term is particularly applicable to the all-electronic orbital transfer vehicle that uses electronic propulsion and an electronic means of supplying the power for the ion thrusters. But, in a more global or general sense, energy in the transportronic mode is being transported by electronic means that use mass-free electromagnetic beams as distinguished from transporting

energy by boat, airplane, wires, and by all other forms of transportation of energy that have mass. With this definition of the term, the Solar Power Satellite, with its combined use of photovoltaics and beamed microwave power, would qualify as a transportronic application, as would beaming power to orbiting industrial parks.

Such technology is not limited to space applications, but appears to have very limited terrestrial application. One potential terrestrial application is microwave-powered aircraft, in which the Canadian government has recently made substantial technological progress.[6]

Factors Hindering The Adoption of Transportronic Technology

Many factors, both technological and societal, hinder the adoption of beamed microwave power in the applications that have been discussed.

The most serious system consideration that hinders adoption is that, because of orbital mechanics, the phased-array transmitters must be on the equator. If they are at any other place, the dwell time between the microwave beam and the satellite is much too low to be practical. Otherwise, beamed power from the Earth would probably be considered seriously as a source of power for the United States space station, because supplying power on board the space station is a problem with existing technologies.

Other known reasons for using the equator make it the preferred launch site, particularly for satellites in geosynchronous orbits. For these satellites, the higher rotating speed of the Earth at the equator negates the need for cross-range correction of their orbits, making an equatorial launch much less costly. The stable climatic conditions at such launch sites are also favorable.

From a societal and geopolitical point of view, the adoption of these beam-powered space systems depends greatly on the degree of international participation in the development of space. From an economic point of view, such projects as the Solar Power Satellite, which would benefit all nations, appear to require a high degree of international cooperation in planning and developing the system; therefore, general agreement that the equatorial plane would be used to deploy the system in space seems necessary.

In any event, the Arianne launch site near the equator in French Guiana is being used internationally as the preferred launch site for satellites in geosynchronous orbit. The momentum has already started commercially. Perhaps it is not too far fetched to think that an array of transmitters around the equator might be modeled after Intelsat and be operated as a public utility is run in the United States. In this case, the utility would supply beamed microwave power on demand from its satellite customers.

Conclusion

Although it is difficult to predict when there will be major activity in transportronics as described in this paper, the desire for a much greater practical use of space will in time cause it to be seriously considered. The microwave community should be ready to support such an effort.

References

(1) P.E. Glaser. "Power From the Sun; Its Future" *Science,* Vol. 162, pp. 957–861, Nov. 22, 1968

(2) *Final Proceedings of the Solar Power Satellite Program Review.* DOE/NASA Satellite Power System Concept Development Evaluation Program, Conf. 800491, July 1980

(3) W.C. Brown. "LEO to GEO Transportation System Combining Electric Propulsion with Beamed Microwave Power From Earth," Vol. 69, Science and Technology Series. pp 195–217. *Amer. Astronautical Soc. Proceedings of 25th Goddard Memorial Symposium,* 1987, Paper AAS87–126.

(4) W.C. Brown. "A Microwave Powered Orbiting Industrial Park System," *Proceedings of the Eighth Princeton/AIAA/SSI Conference,* May 6–9, 1987, pp 242–251.

(5) "Pioneering the Space Frontier," *Report of the National Commission on Space,* Bantam Books, May 1986, Page 20

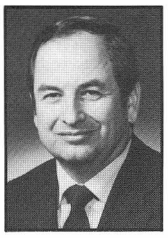
(6) A. Fisher. "Beam-Power Plane." *Popular Science,* Jan 1988, pp 62–66.

Biography

William C. Brown is the representative of the MTT-S to both the Energy Policy and Aerospace R&D Policy committees of the IEEE USAB. He works closely with energy and space developments and problems and on how the microwave community can relate to some current and longer range issues.

Most of Mr. Brown's professional career has been spent with the Raytheon Company. There, he developed crossed-field microwave tubes that resulted in broadband amplifiers generating hundreds of kilowatts of continuous-wave power. He then became involved in finding applications that included microwave beamed-power transmission. The technology was first used in a microwave-powered helicopter in 1964, followed by the DOE/NASA-supported study of the Solar Power Satellite. Mr. Brown then worked on several NASA contracts to extend the technology and range of applications.

Mr. Brown retired from Raytheon in 1964 and is now a consultant on beamed-power devices and system technology. He holds a BS degree from Iowa State University and an MS degree from MIT. He is a Fellow of the IEEE and of IMPI.



Feature Articles for the MTT Newsletter

by Zvi Galani

The MTT Newsletter staff is interested in obtaining feature articles dealing with current topics in the technical and professional areas of interest to MTT members. These articles should provide members with a general understanding of the topic and its significance in current and future activities in the microwave field. I would like to emphasize, however, that these special articles should cover topics in a broad, general sense. Specific design techniques and applications will be covered in the papers appearing at the MTT Symposium and in the Transactions.

If you know of a topic that is current and/or you are willing to contribute an article to the Newsletter, please contact:

John Eisenberg
25 Parson Way
Los Altos, CA 94022
(405) 941-7426

This issue features the first part of the article on beamed microwave power "Microwaves to the Rescue," by William C. Brown. It explains the concepts of beamed microwave power, compares it to other sources of energy, and describes its technological, societal, and geopolitical implications.

A feature article on filters will be published in the next issue of the Newsletter.

The editorial staff of the Newsletter hopes that these articles are informative and useful to the MTT-S community.

Your comments and suggestions are welcome.

(Editor's note: With his election to MTT-S AdCom and appointment as MTT-S Secretary, Zvi has relinquished his role as Feature Articles Editor. We thank Zvi for the excellent job he's done and welcome John Eisenberg, who has agreed to assume the duties of Feature Articles Editor.)

1991 IEEE Microwave Theory and Techniques Society Fellowships and Grants-In-Aid

GRADUATE FELLOWSHIPS

- Several $5,000 fellowship awards each year
- For graduate research studies in microwave engineering on a full-time basis
- Applicants must have attained high academic achievement in engineering or physics
- Award can be granted *in addition* to any other support received by student
- Award cannot be used for equipment purchase, travel, supplies, etc.
- Award made to institution for support of named student
- Faculty supervisor must be MTT-S member.

Application deadline: 22 October 1990

EDUCATIONAL GRANTS-IN-AID

- For individual members of MTT-S
- Number and amount to be based on proposals submitted, proposed ativity, financial justification, and Society budget
- Applicant must be MTT-S member of 5 years standing
- Applicant must be a full-time employee of a degree granting institution of higher learning or a not-for-profit research institution
- Emphasis is on supporting junior faculty members
- Award made to institution for support of named individual research activity (i.e., faculty member, etc.)
- Award may be used for equipment, travel, supplies, or individual use, directly related to a clearly defined microwave activity
- Funds cannot be carried over into second year.

Application deadline: 12 November 1990

For applications for the Fellowships and Grants-in-Aid contact:

Dr. Jorg E. Raue
Chairman, MTT-S Educational Awards Committee
TRW, Electronics Systems Group, R5/1291
One Space Park
Redondo Beach, CA 90278
(213) 813-8224

Requests for application materials must be received no later than 15 October 1990.

Workshop on Emerging Technologies

by Jorg E. Raue
Chairperson,
Long-Range Technical Planning

A workshop on emerging technologies was held in Dallas on December 11, 1989, as a result of recommendations of the MTT-S Long-Range Technical Planning Committee. The objective of this meeting was to plan for an annual Workshop on Emerging Technologies, including establishing the format, location, and technology areas. The meeting focused on

- How to effectively identify emerging technologies of interest to the MTT Society
- Methods to disseminate this information to all MTT members
- Methods to influence the annual MTT-S International Microwave Symposium Program (call for papers, as well as a framework for session titles, focused sessions, and workshops) for timely exposure of emerging technologies

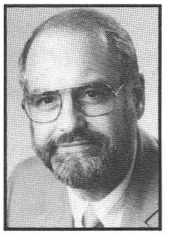
Fifteen of the 18 Technical Committee (TC) chairpersons were present at the meeting. They each presented 10-minute summaries describing new and emerging technologies within their respective areas. They focused on

- State-of-the-art technology in their areas
- Emerging technologies already identified
- Potentially emerging or budding technologies.

Because of the success of this initial meeting, which was shown by the enthusiasm of the participants and by the many examples of interactive efforts among TC chairpersons before the meeting, it was decided to hold this meeting on an annual basis. The meeting will be entitled "Emerging Technologies Workshop." The 18 Technical Committee Chairpersons are charged to gather, coordinate, and present the latest and the newest technologies and trends. The next such workshop will be held on January 15, 1991, in Boston.

Information on emerging technology issues that were identified will be featured in future newsletters. They should be of substantial interest, since they will contribute to the generation of a roadmap for the future thrusts of the MTT Society.

The TC Chairpersons will coordinate among themselves and make recommendations to the Long-Range Planning Committee regarding future MTT Symposium session titles and workshops. The LRPC will then supply this information to the Symposium Technical Program Committees for evaluation and use.



The Advent of the Signal Microprocessor

by Bill J. Hunsinger

Introduction

In the past 15 years, the power of software-programmable signal processing, embodied in the digital microprocessor, has revolutionized the telecommunication, personal computing, and electronic control industries. Many of the computational techniques directly applicable to radars, spread-spectrum receivers, artificial intelligence, speech recognition and image processing have one thing in common: they require many multiply and accumulate (MAC) operations per second. The digitization and computational requirements of such systems demand the use of large, powerful computers operating in a non-realtime mode. Recently introduced digital signal processors (DSPs) have reduced MAC times to approximately 30 ns, but this is still far too slow for many realtime applications.

A new computational engine called the "Signal MicroProcessor" (SMP) is designed to handle signals just as its counterpart, the digital microprocessor, is designed to handle data. The SMP performs these signal processing functions with MAC times as low as 30 picoseconds and eliminates the need for high-speed analog-to-digital converters (ADCs). The SMP is a massively parallel processor implemented on a single chip, supported by a software operating system, and mounted on a printed circuit board for interface to standard personal computers.

The SMP has been enabled by the new high-speed buffer memory technology called acoustic charge transport (ACT). The ACT is a sample memory that stores a packet of electrons with charge proportional to the amplitude of the input signal at the sampling instant. Each packet of charge is isolated and transported by ultrasound from one processor to the next in the massively parallel computational engine.

Storing sample strength as a quantity of charge has several advantages over the conventional approach of encoding and storing information in the form of bits:

- The problem of encoding wide-bandwidth signals with an ADC is entirely eliminated in some applications; in others the speed and accuracy requirements of the ADC are substantially reduced by the preprocessing performed by the SMP.
- The multiplication process is greatly simplified because a signal stored in the form of an amplitude is multiplied by a coefficient simply by running it through a programmable attenuator. The result is the product of the digitally programmed attenuation and the input signal.

- A programmable attenuator multiplies at rates exceeding 350 million samples per second, consumes little power, and occupies a small fraction of the chip area required for a digital multiplier. Because of this reduction in complexity and power consumption, it becomes practical to implement hundreds or even thousands of multipliers on a single chip, each operating at rates exceeding several hundred million multiplies per second.
- The accumulation process which follows the multipliers is also significantly simplified when the product result is represented by an amplitude, because the summation is inherently accomplished by the bus that connects all the multipliers together. A summing bus accumulates samples at a rate exceeding 45 billion per second, consumes no power, and occupies only the chip area required to make an electrical connection.

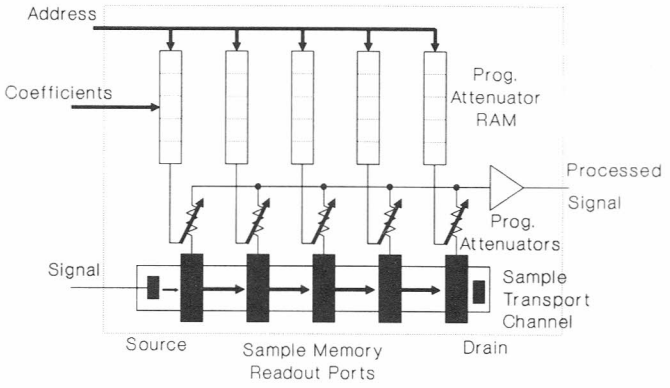
Transporting the sample from multiplier to multiplier with ultrasound greatly simplifies the controller required to coordinate the large number of extremely high-speed parallel processors:

- The timing of the ultrasound transport is precise, reducing errors arising from gate delays that often cause problems in high speed systems.
- Transporting the sample from processor to processor via ultrasound greatly reduces switching noise and the need to filter it out in downstream processors.
- The controller is inherently imbedded in the buffer memory and occupies no additional chip area.
- The processing architecture in which samples are carried between processors substantially reduces the complexity of the software controlling the data flow.

Enabling Technology

The operation of the ACT as a buffer memory in an SMP processor is illustrated in the figure below. The piezoelectric GaAs substrate is fitted with a transducer that generates an ultrasonic wave used to transport the information from one processor to the next. The ultrasonic wave creates a traveling potential well that captures a packet of electrons at the source and transports it down the transport channel; the number of electrons in each packet is proportional to the voltage on the source at the sampling time. The ultrasound transports the subsurface packet down the channel to the drain at the opposite end without the aid of any surface features. Packets are sensed at any point along the propagation path by simply placing an electrode across the clear surface of the transport channel and connecting it to a programmable-attenuator multiplier. Several points should be noted:

- The sample memory port senses the charge but does not change the number of electrons in the packet. True nondestructive sensing is realized.
- The absence of features above the transport channel leaves room for implementing a large number of sample memory readout ports. These ports provide the inputs to the many multipliers located along the channel.
- Moving information from one processor to the next usually gives rise to system noise. The ultrasonic transport mechanism is self-clocking at a single frequency, allowing clock noise to be easily filtered out.
- The sampling rate of ACTs typically runs from 200 MHz to 1 GHz, giving processing rates of tens of billions MAC operations per second.
- The ACT is implemented on semiconducting GaAs so that high speed attenuators, switches and digital RAM required to implement the SMP are monolithically constructed on the SMP substrate.



Signal Microprocessor

Impact and Applications

A first generation SMP implements 128 multipliers and accumulators along with the ACT sample memory on a single chip. This implementation has a multiplier accuracy of 8 by 5 bits. Enhanced accuracy (up to 8- by 8-bit multiples) may be achieved by error correction techniques. This SMP implements a finite impulse response with a processing rate of 45 billion MACs per second, giving equivalent MAC times of less than 30 picoseconds.

This ACT chip is mounted in a one-square-inch flatpack that dissipates less than 3.5 watts. The flatpack is mounted on a PC board and interfaced to a personal computer. The immense processing capability of the SMP is easily controlled with an operating system based on the W.A.V.E. data acquisition and analysis software package. The combination of the ACT processor and a personal computer running W.A.V.E. implements a true SMP, in which signals are treated computationally as entities and processed in real time.

Continued on page 37

1990 AdCom Elections

by Edward C. Niehenke

The annual elections of the MTT-S AdCom were held in Atlanta on September 26, 1989. Seven members were elected to the AdCom; six were elected to 3-year terms and one was elected to a 2-year term. For 3-year terms, the reelected members were Krishna K. Agarwal, E. James Crescenzi, Jr., and Steven J. Temple. Zvi Galani, Barry S. Perlman, and James C. Wiltse were newly elected to 3-year terms. The one 2-year, in-term vacancy left by outgoing President Vladimir G. Gelnovatch was filled by Alton L. Estes. The voting for both the 3- and 2-year terms was close and required many ballots. The nominees were taken from a slate of 15 members proposed by the Nominations Committee and one proposed from the floor by direct nomination. There were no petition candidates this year.

The four reelected members have demonstrated an excellent history of contributions to the MTT-S and will go on to become senior statesmen, while the three new members will bring new ideas and initiatives.

In other elections at the Fall AdCom meeting, Tatsuo Itoh was elected to the position of President, while Ferdo Ivanek was elected Vice President.

That you may become familiar with the three new members of MTT-S AdCom, their biographies follow. The biographies of reelected members have been published in previous *Newsletters*.

Zvi Galani

Zvi Galani received the BSEE degree from the Milwaukee School of Engineering in 1963 and the M.S. and Ph.D. degrees in Electrical Engineering from Cornell University in 1969 and 1972, respectively.

In 1963, he joined the General Electric Company's Communication Products Division and was involved in the design of low-noise microwave sources for multichannel telecommunication systems.

After completing graduate studies in 1972, he accepted the position of Senior Design Engineer with the Raytheon Missile Systems Division Bedford Laboratories. His work consisted of the design of microwave components and subsystems for generation and amplification of microwave signals.

In 1976, Dr. Galani was promoted to manage the Sources and Devices Section in the Missile Microwave and Antenna Department of the Missile Guidance Laboratory. In that position, he supplied technical direction and was active in developing and designing microwave signal sources and exciters for missile seekers. He also was responsible for the technical direction of several GaAs FET technology programs, which, at that time, put Raytheon at the forefront of GaAs power FET technology.

In 1982, he joined the Technical Staff of the Bedford Laboratories as Manager. In that position, his principal tasks have been the solution of critical production problems on major programs such as Hawk, Patriot, Sparrow, and AEGIS ER missile systems, and the management of microwave signal-generation technology development programs.

In 1985, Dr. Galani was promoted to Consulting Engineer, the highest engineering level attainable at Raytheon. This designation is given in special recognition of continuous outstanding achievement over a long period of time.

In January 1986, he joined the MTT-S Membership Services Committee as Chapter Records Chairman. In that capacity, he has been maintaining MTT-S Chapter Chairpersons' and Vice Chairpersons' records and records of MTT-S Chapter meetings. In 1986, he organized the *MTT-S Chapter Officers' Handbook* and distributed it to all the chapter chairpersons. He also contributed to the revised *Chapter Officers' Handbook* in 1989. In 1987, he accepted the duties of Special Articles Editor for the *MTT-S Newsletter.*

Dr. Galani is a senior member of the IEEE and is on the editorial board of *MTT-S Transactions.* He holds numerous patents and has written papers on microwave sources, power FET amplifiers, and amplifier combiner circuits.

Barry S. Perlman

Barry S. Perlman received a BEE degree from CUNY in New York City in 1961 and an MSEE and Ph.D. degree in Electrophysics from the Polytechnic Institute of New York in 1964 and 1973, respectively.

Dr. Perlman is Chief, Microwave/Millimeter Wave Branch, Electronic Technology and Devices Laboratory, USA LABCOM at Fort Monmouth, NJ. He is responsible for research and advanced development of MW/MMW and electro-optical devices, components, and subsystems for radar, EW, communications, and smart weapons. He is also responsible for complementary design and test automation tools and techniques.

He joined RCA in 1961 as a Member of the Technical Staff of the Advanced Communications Laboratory in New York. His main concern then was developing microwave circuits and subsystems. In 1968, he transferred to RCA Laboratories, Princeton, N.J., where he developed bulk-effect GaAs transferred-electron devices. Later, he concentrated on developing analytic models and computer-aided tools to support his research. In 1981, he became Manager for Design and Test Automation and, in 1986, he was appointed Head of Design Automation Research in the Microwave Laboratory. Here he was responsible for developing advanced microwave CAD, modeling, and simulation tools and automated measurement techniques.

Dr. Perlman holds 4 U.S. patents and has published more than 40 technical papers on solid-state devices and components, microwave networks, signal processing, and CAD. He has received four outstanding Engineering Achievement Awards related to microwave device and circuit development and computer-aided engineering. He was elected to the Hall of Fame of INTEREX, a computer users group, and received the Automated Measurement Technology Award from ARFTG (Automated RF Techniques Group).

Dr. Perlman is a Fellow of the IEEE, a member of Sigma Xi, a registered professional engineer in the State of New York, a member of the IEEE Societies on Computers, Microwave Theory and Techniques, and Solid-State Circuits and Systems, and a member of the Solid-State Circuits Council. He was secretary to the MTT Administrative Committee, a member of the Financial Committee, past Treasurer and a member of the Executive Committee of ARFTG, a member of the Technical Program Committees of MTT and DAC, and Chairman of subcommittee MTT-1 (CAD). He is a Deputy and Technical Chairman of IEEE Standards Coordinating Committee 30: AHDL, to develop an analog hardware-description language. He is also a member of the Admission and Advancement Committee and Princeton Chapter Awards Committee. He is listed in *Who's Who in Science and Technology* and *Who's Who in the East*.

James C. Wiltse

Dr. Wiltse has been at the Georgia Institute of Technology since 1978, and, since 1979, has been Associate Director of the Georgia Tech Research Institute, where his technical activities have been involved in various microwave, millimeter-wave, radar, radiometry, and communications projects. Before coming to Georgia Tech, he spent 14 years with Martin Marietta Corporation, Orlando, FL, where, for 5 years, he was Director of Research and Technology. Earlier, he was the Director of Advanced Technology for Electronic Communications (now a division of E-Systems), St. Petersburg. He has published 80 technical articles, contributed to several books, and made numerous presentations at technical meetings and symposia.

His IEEE activities have included serving as a member of the Editorial Board of the *Proceedings,* the AdCom for the MTT-S, the Editorial Review Boards of the *IEEE Transactions on Antennas and Propagation,* and the Chairman of the Atlanta and Orlando Sections of Area 3 (Georgia). He was the 1980 MTT-S National Lecturer and a member of the IEEE Delegation to the Soviet Popov Society Meeting in 1979. He also was the General Chairman of the 1984 IEEE National Radar Conference, Chairman of the Professional Program for Southcon/81, and Cochairman of the Technical Program for the 1979 International Microwave Conference, and is a member of the Southcon Board of Directors. Besides serving on several technical program committees and as session chairman at various symposia, he has been an Associate Editor of the *Microwave Journal,* General Chairman of SPIE symposia on millimeter waves, and Cochairman, Technical Program Committee, 10th, 12th and 13th International Conferences on Infrared and Millimeter Waves.

Dr. Wiltse is an IEEE Fellow, a member of Sigma Xi, Tau Beta Pi, and Eta Kappa Nu, and received the IEEE Outstanding Engineer of the Year (1975) and Outstanding Service Award (1989) citations for Region 3 (Southeastern U.S.). He is listed in several biographical references.

Call for Nominations 1991 AdCom Elections

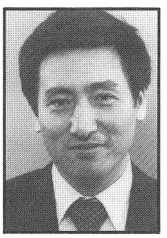
The MTT-S AdCom will elect members for 1991 at the Fall meeting, which is to be held October 12–13, 1990 in San Diego. The Nominations Subcommittee will nominate at least two candidates for each AdCom vacancy as of January 1, 1991. (AdCom members who have served three consecutive terms are ineligible for reelection.)

The MTT-S By-Laws provide three means for nominating candidates:

- Nomination by the Nominations Subcommittee
- Nomination by petition, signed by 25 MTT-S members, and submitted to the Nominations Subcommittee by September 1
- Informal nomination by one or more chapters and submitted to the Nominations Subcommittee by September 15. (The Nominations Subcommittee is not required to accept the nomination, however.)

The Nominations Subcommittee needs your help in identifying good candidates for AdCom. For more information, contact:

Harlan Howe (617) 272-3000, X2451 or John Horton (213) 813-1156



President's Message

by Tatsuo Itoh

As we enter the last decade of the 20th century, the environment of the MTT community is changing rapidly. I believe that preparations for the technical prosperity of the MTT community in the next century should begin now. If the MTT-S activities are to compete, we must create and implement a plan now for technical prosperity. In

1989, the Long-Range Planning Committee began a strategic plan under the name of MTT 2000. As the 1990 president, I fully endorse implementation of this plan, with some possible improvements and enhancements. MTT 2000 consists of three interrelated elements: (1) emerging technology, (2) information dissemination and exchange, and (3) global activities.

Any technical society exists for the technological area it nurtures. Generally, the MTT is perceived as dealing with mature technology. Therefore, if we stand still, we lose out technologically. It is important to capture emerging technology within and related to MTT activities, including the spectral region approaching optics. The areas in which MTT technologies are applied must be divergent. Although the strongest application areas depend substantially on the countries in which they are located, defense applications are a mainstay of microwave technology. Because of the globalization of economics and changing human needs, it is important to recognize that the MTT technologies can affect many other areas much more than those now in use. These areas include industry, commerce, communications, consumption, medicine, and the environment. Shortly before the winter AdCom meeting, the Long-Range Planning Committee, in collaboration with the Technical Committees, organized an emerging technology workshop and planning meeting in Dallas. This is a first effort aimed at achieving technical goals. It is very likely that the present Technical Committee activities can be enhanced, which is one of my goals. *(Editor's note: See the related article in the Technology Section.)*

One of the most important services a professional society provides for its membership is information dissemination and exchange, typically in the form of publications and symposia. Although the *Transactions* remains the premier and archival publication of the Society, the need for a quick-turnaround publication is acute and long overdue. The Publications Committee has initiated an effort to implement a *Letters Journal*. The plan and budget for start-up of the *Microwave and Guided Wave Letters* were approved at the winter AdCom meeting in Dallas. The Home Video Tutorial, also initiated by the Publications Committee, can supply substantial response to the needs of members to learn both emerging and mature technologies. Also, a task force was appointed for re-evaluating our Distinguished Lecturers/Speakers Bureau program. The future of the IMS, in terms of its format and plan, is being studied by the Long-Range Planning Committee.

I am a strong advocate for enhancing the trans-national character of the Society. The AdCom is in the process of elevating the Trans-national Committee from the International Liaison function under the Membership Committee to a standing committee. I have asked that this new standing committee formulate a strategic plan. The MTT-S has traditionally been very sensitive to trans-national technical activities; however, I feel that the MTT-S can do much more on the global scene. The world is changing very quickly. We will have a changing Europe beyond 1992 and Eastern Europe is changing daily; these changes will supply opportunities for diversified applications of MTT technologies. The burgeoning Pacific Basin has much potential for contributions to many emerging technologies and diversified applications on an international scale. To be sensitive to the technical development in these areas, as well as the rest of world, MTT-S must have a leading role in the technical issues, which now have global effect. Expedient free flow of technical information is essential for the benefit of the MTT worldwide community. One of the suggestions of the Long-Range Planning Committee, which I concur with, is greater participation of non-U.S. MTT members on the Technical Committees (MTT-1 through MTT-18).

A major issue of which I am concerned in regard to the trans-national activities is the so-called, "Restructuring of the IEEE Volunteer Organization." This proposal has been studied to some extent at the Board of Directors level of the IEEE. The concept presented by the Volunteer Restructuring Committee is "to strengthen the international character of the IEEE by restructuring the Board of Directors to be more international in scope. This is to be accomplished by creating, where desired, geographic area-specific entities within the IEEE which assume responsibility for those functions which are restricted to their geographic area." The intent is "to increase the autonomy of area-specific entities so that they can perform their major functions relatively independently of the IEEE Board of Directors. This would free the IEEE Board of Directors from area-specific problems, allowing it to concentrate on the more worldwide issues of technology, education, and international growth." When I heard this proposal, my immediate reaction was confusion and concern. I found that my concerned view is shared by many of the society presidents. (See, for example, the AP-S President's message in a recent AP-S Newsletter.) This is an important issue for the MTT-S AdCom. Therefore, I have assigned the task of investigating this issue to an adhoc committee comprised of members from the Trans-national Committee and Operations Committee. Input from all MTT-S members worldwide would be welcome regarding this matter.

Finally, the financial health of the Society continues to be an important item to be mindful of. Despite the number of enthusiastic views and projects presented above, the Society should always approach these activities with a financial consideration. We should remember that any critical endeavor such as the *Letters Journal* start-up should be done only if we have substantial financial reserves. Therefore, we should avoid a deficit-spending mode and create and keep a healthy monetary reserve. Thanks to the tremendous efforts of all the AdCom members, particularly by our most able Treasurer and his committee, our budgeting and auditing process continues to improve.

Outgoing President's Report

by Vladimir G. Gelnovatch

Time flies when you're having fun, or so the saying goes. I am writing this in late November as I prepare to attend the fourth MTT-S AdCom meeting of the year, in Dallas, Texas. This meeting, normally held in January, was moved to December because of the early date of the 1990 International Microwave Symposium (IMS). The pinnacle of 1989 for the society was, of course, the June 1989 IMS in Long Beach, California. It was very successful, both technically and financially.

One of the my deepest concerns when I began my tenure as president was the deteriorating financial picture fueled largely by the poor surpluses generated from the Las Vegas and New York City symposia. To compound the problem, these low surpluses came two years in a row, giving the appearance of a trend. Since the symposium surplus gives the MTT-S the needed financial independence and flexibility required for such worthy functions as scholarships and publications, it was imperative to get the IMS back to financial health. I am happy to report that the surplus from Long Beach will probably be over $200,000. This increased income, together with recently instituted austerity measures and a new two-tier zero-base-budget format have resulted in the possibility of a small surplus in 1989 rather than the large deficit predicted earlier. *(Editor's note: The surplus from the Long Beach symposium was approximately $200,000, and MTT-S ended 1989 with a surplus of $115,000.)*

My second most important thrust this year was to get a firm direction for the MTT-S in developing a vision of what we want for our society beyond the year 2000. Accordingly, I have commissioned the Long-Range Planning Committee to develop a plan that I called MTT-2000. I want particular emphasis placed on the Pacific Basin. The first draft is due in December 1989. Other accomplishments included the publication of 2,150 pages of the MTT-S Transactions in 1989 and the addition of ten new chapters, including five in Region 8 and one in Region 10.

In 1989, it became obvious that an organization the financial size of the MTT-S needed more than just one volunteer in the position of treasurer. We provided two new positions designed for either AdCom members or nonmembers that will greatly aid the treasurer. We recognize that for non-AdCom members, these positions can be gateways for eventual AdCom membership. We also formulated a standing budget committee chaired by the vice president. The objective is to save valuable AdCom meeting time by letting the budget committee review each budget expenditure request and make recommendations to the full AdCom for approval or non-approval. At the previous three meetings, this system proved efficient and time-saving. It also allows the vice president to formulate the budget he or she will have to work with as president.

My most pleasant task was to present awards and Fellow Grade memberships at the IMS. The most pleasurable one was the award to Harry Cooke, with whom I happened to work on a project 26 years ago when I was a new engineer. My most unpleasant experience was the anxiety of coping with a "crank letter" from an unsigned "Senior Member" berating a special editor.

Finally, as I leave office I have some high-level concerns, the first being the society-Technical Activities Board (TAB) relationships, which I have found confusing and weak. I was never able to make them work fully for the benefit of the MTT-S. The strength of IEEE is at the society level, and TAB, in my humble opinion, adds little aside from another layer of "overhead." The same comment holds for the Regional Activities Board (RAB), which is the proposed reorganization of the IEEE. I heard much explanation of the restructuring at the August TAB meeting and from Division IV President Len Carlson who briefed MTT-S/AdCom on it in September 1989. I still do not entirely understand the full ramifications of it but feel extremely uncomfortable about it. The current proposal does not change the role of the technical societies, but since we exist within the framework of TAB, there will be changes. For any reader interested in this subject, I recommend an article published on this subject in the December AP Newsletter by the president of the AP, Irene C. Peden, who was good enough to send me an advance copy. *(Editor's note: see the related article on the TAB restructuring in this issue.)*

Also, if the trend toward making all societies alike continues, we might well lose our society individuality and identity. In my estimation, this would be very bad.

In conclusion, thanks to all who helped steer this huge ship called MTT-S through 1989. We are the most dynamic and productive society in the IEEE, and I was honored to be your president.

Fall 89 AdCom Meeting Highlights

by Tatsuo Itoh

The Fall 89 AdCom meeting was held on September 26 and 27, 1989, at the Marriott Marquis in Atlanta, Georgia. The AdCom President, V. (Walt) Gelnovatch, opened the meeting at 8:00 pm. After the President's message, the IEEE Vice President for Technical Activities, Troy Nagle, summarized the changes in the TAB structure, which will introduce a mechanism for a stronger involvement of the Society Presidents. This presentation was followed with the Division IV Director's Report by Len Carlson. This is the first time that the report was personally presented by the Division IV Director for three consecutive AdCom meetings.

Most of the remainder of the evening was used for the AdCom elections for 1990. It has been the normal practice to hold election of the AdCom at the fall meeting. Six 3-year positions and one 2-year intern position were filled. Among the candidates placed on the ballot by the Nominations Committee and one nominated from the floor, three current AdCom members (Kris Agarwal, Jim Crescenzi, and Steve Temple) were re-elected for additional 3-year terms. Three new members (Barry Perlman, Zvi Galani, and Jim Wiltse) were elected for 3-year terms. Barry Perlman was the AdCom secretary during 1989. Zvi Galani has been very active as the Chapter Records officer for the Membership Committee, and Jim Wiltse has been the chairman of the Technical Committee on Millimeter Waves (MTT-6). Another round of elections was subsequently held for the one 2-year vacancy. Al Estes, who was serving a 1-year term on AdCom, was re-elected for this 2-year position.

Tatsuo Itoh was elected President for 1990, and Ferdo Ivanek was elected AdCom Vice President. Ferdo has served on the AdCom for several years and is the Coordinator for Intersocietal Activities. *(Editor's note: See related article with detailed biographies of the elected AdCom members in this issue.)*

Two by-laws changes were approved. One creates a Pioneer Award for an individual or a team, not exceeding three people, who have made outstanding pioneering technical contributions. The second modifies the Nomination Subcommittee, stipulating that the chairman shall now be a past president of the AdCom or an honorary life member.

The Membership Committee reported a healthy growth in membership and the number of chapters; this year, eight chapters were formed. The need to further clarify the role of the Speakers Bureau was discussed.

The Education Committee reported the implementation of the first student paper contest at the Dallas Symposium in 1990. Besides the report on the success of the Long Beach Symposium, the Meetings and Symposia Committee received letters of interest to hold the 1997 Symposium from both the Dallas and the Denver Chapters.

The Publications Committee presented a proposal for starting the *Letters Journal* in 1991. The AdCom provisionally approved the proposal, but it must be submitted through the approval channels at the IEEE level. More detailed financial studies on income and expenses under various subscription options will be submitted at the December AdCom meeting for final resolution.

The Long-Range Planning Committee submitted a proposal to elevate the International Liaison Activity to major committee status, in recognition of the growing importance of global activities of the MTT. This proposal was approved and the necessary by-laws change will be submitted to AdCom for formal approval.

TAB Highlights

by Ferdo Ivanek

I attended the November 16–17, 1989 Technical Activities Board (TAB) meeting in Tarpon Springs, Florida, because both the 1989 President and Vice President were unable to attend. It was a particularly favorable opportunity for me to get acquainted with the TAB, because the Orientation and Management Seminar for 1990 Society/Council and Committee Officers was held in the same place on November 15. The following information presented at this seminar is worth passing on:

- The major IEEE-wide issues identified are: professional ethics, transnationalism, electronic publishing, and continuing education.
- The IEEE publishes 22.6 percent of the world's literature in computers and 26.2 percent in electrical engineering.
- There are 754 IEEE chapters worldwide.
- Inflation-adjusted IEEE dues in 1989 are 15.17 (1967: 25.00).
- The financial effect of volunteer work: if it had to be performed by paid staff, the membership dues would have to be increased to $600.

The TAB meetings consist of the caucus, which offers the opportunity for informal preliminary discussion; of the Presidents' Forum, which makes room for additional consideration; and of the decision-making meeting, which is very efficient as a result of the two preparatory meetings. The issues dealt with can be broadly categorized either as housekeeping or as outreach. Most housekeeping issues are only of interest to society officers who have to comply with the various IEEE practices. The current ones of immediate interest to the MTT-S are reported at the ADCOM meetings. The outreach issues are similarly reported and discussed, and the ones of broadest interest deserve special mention in this Newsletter.

The proposed "Restructuring of the IEEE Volunteer Organization" was the most hotly discussed issue at this TAB meeting. The text of this proposal is already available to all IEEE members. (Refer to page 5 of the November 1989 issue of *The Institute*.) There was strong disagreement on the part of the society presidents and their delegated representatives, and a motion was passed in opposition to the proposal in its present form.

Please note that this issue is open to general discussion within the IEEE. (Refer to item 3.B of the published proposal.) It will be given due consideration by the MTT-S ADCOM, and inputs from MTT-S chapters worldwide and from individual members would be welcome. Watch for additional published news and discussion in this matter, such as the Presidents Column on page 4 of the December 1989 issue of *The Institute* and the viewpoint expressed by S.H. Durrani on page 5 of the same issue.

Another matter of broader interest to the IEEE membership is the fund-raising plan for developing a limited-run TV series with an "engineer hero" as its central character. The stimulus comes from successful TV series whose heroes are medical doctors and lawyers. The proposed mix of technology and entertainment would be aimed at public television audiences. Any good story ideas? Feel free to contribute!

1989 TAB Highlights

by Vladimir G. Gelnovatch

The third TAB meeting of 1989 was held in Pittsburgh on August 17 and 18, 1989. As in the past, the format was to hold various TAB committee and task force meetings before the TAB OpCom. The issues and recommendations resulting are then brought to TAB OpCom, along with other issues for TAB approval.

Video tapes for training new society officers and members of AdCom have been authorized. These will not be a substitute for the officer indoctrination meetings and presentations, but will acquaint officers and new members with such fundamental items as staff support options, society operations, duties, privileges, and restrictions. Current authorization is for one approximately 14-minute tape.

A number of societies have requested dedicated IEEE support, and some have actually implemented it through the use of ombudsmen at IEEE headquarters. There are a number of these society implementations in place, which were used as models, including the LEOS, IMS, Power Engineering Society, and the Computer Society. They range in format from five dedicated people at Headquarters under IEEE control and paid by the society (LEOS model), to an outside consultant and lobbyist employed by IMS. Costs vary greatly and implementation is a strong function of society needs. A list of options, including some not described above, will be published soon.

Irv Engelson presented a TAB reorganization plan. The reorganization need has been driven by the move of the technical activities staff from New York City to Piscataway, New Jersey. Eighty percent of the current staff is not expected to move, and a large portion of the remaining staff is expected to leave once they realize the full effect of the new site's rural location. There is the need to lessen the responsibility for Irv, as the staff has grown over the years. It can be expected that there will be much Society/Headquarters communication disruption because of this move.

There is a plan for reorganizing IEEE/TAB because of the growth and changing nature of the IEEE. An ad hoc restructuring committee concluded that "the current structure is not well suited to the efficient and responsive operation in the current environment, and will be even less so into the 1990s." It is not my intention to document thoroughly this restructuring in this short report other than to add my comment that I believe that this will result in a new window of communication for the IEEE societies through the proposed Presidents Forum. This will allow the society presidents to meet at an institutionalized gathering to discuss matters of their own choosing. More information will be forthcoming through IEEE channels. *(Editor's note: See the related article in this issue.)*

International participation in society administration continues to be a problem to some societies and to RAB/TAB in general. A number of more successful society models were discussed (including the MTT-S). Because of the size and diversity of the various societies, no conclusion was reached with respect to this question.

Restructuring of the IEEE TAB

by Kiyo Tomiyasu

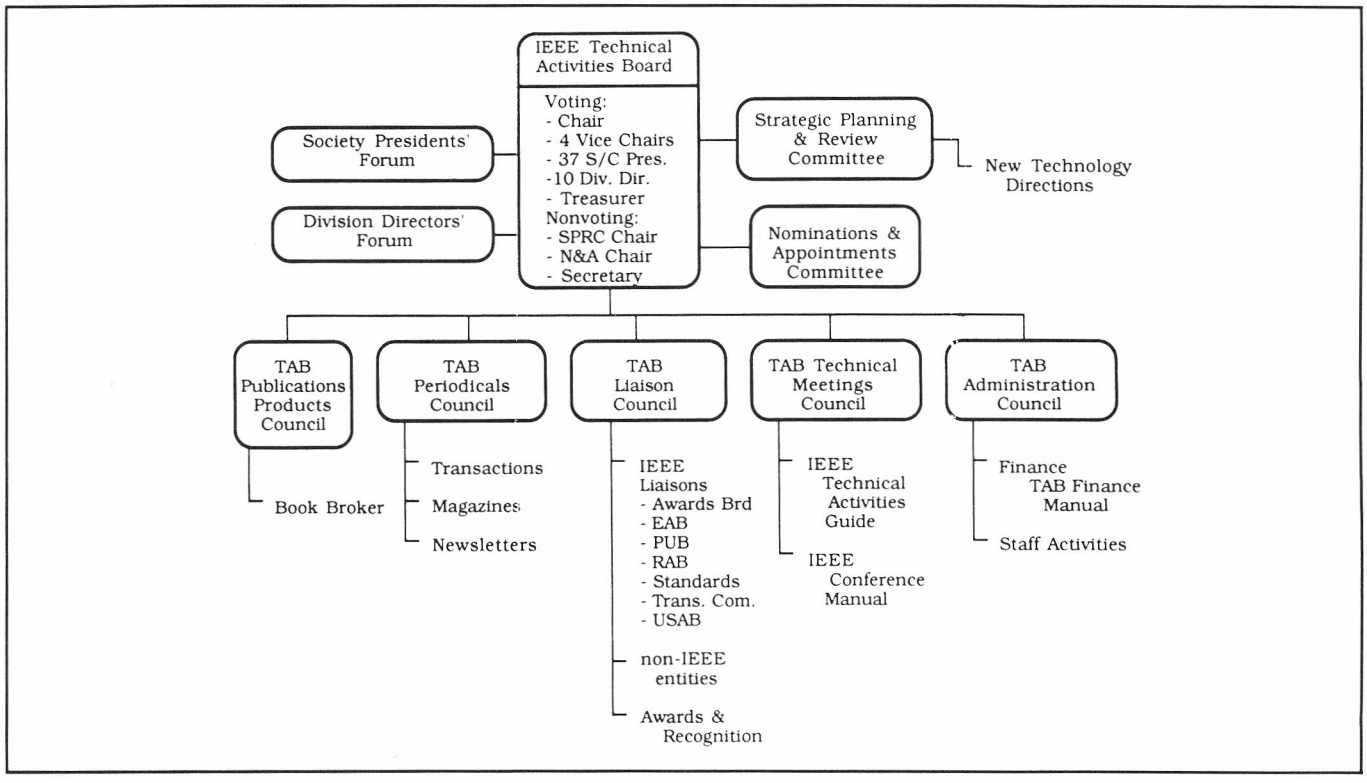
In 1990, the Societies, through their respective Presidents, will have a greater effect on the technical aspects of the entire IEEE. Operational innovations by a Society can be shared with other Societies. Corporate memory will be improved and programmatic efforts can be concluded and implemented. Issues of concern to Societies can be aired and brought forth for action and resolution. These are the essential goals in restructuring the Technical Activities Board (TAB).

How are these to be accomplished? The accompanying organizational diagram, prepared by IEEE Vice President of Technical Activities, H. Troy Nagle, will help visualize the structure, with five new councils and the relationships among them. (The new structure was described on page 7 of the November 1989 issue of "The Institute.") The IEEE By-Laws revision to restructure the TAB was adopted by the IEEE Board of Directors on August 20 at its meeting in Pittsburgh.

Specifically, a Forum of Society Presidents and another Forum of Division Directors were established and formalized. Items of interest, issues of concern, and those involving other entities within the IEEE can be raised at these Forums. These items can be brought forth to TAB and to the appropriate newly established Councils for consideration, discussion, action, resolution, and implementation.

Each council will be chaired by a TAB Vice Chairman to be elected by TAB from among the present or past Division Directors or Society Presidents. The Councils for Periodicals, Publications Products, and Meetings will have Divisional representatives appointed for 2-year staggered terms to allow for longer corporate memory and enough time for satisfactory resolution of issues. Other members will be appointed to the Councils as appropriate. The five new Councils and their areas of responsibility are shown on the diagram.

The new TAB structure is based on the legislative model of the U.S. Congress. The efficacy of the technical aspects of the IEEE is expected to be improved greatly. A copy of the complete Revised IEEE By-Law 311–Technical Activities Board can be obtained from IEEE Corporate Headquarters in New York.



Division IV Representative's Report

by Chet Smith
Division Representative

The Society Periodicals Committee (SPC) met at IEEE Headquarters on September 18th, 1989, followed the next day by a meeting of the full Technical Publications Board (PUB). IEEE is undergoing a major reorganization, and is shifting a number of offices out of New York City to new facilities in Piscataway, NJ. The changes will be reported as they occur in the IEEE newsletter, *The Institute*. A number of standing committees are being eliminated, others are being merged, and several new ones are being created in response to reworked charters.

SPC, as such, was phased out as of January 1, 1990. Its duties have been assumed by a new entity directly under the Technical Activities Board (TAB) to be called the IEEE Periodicals Council. The charter of this new council includes a number of non-archival periodicals such as newsletters issued by Societies, Regions, and Sections, besides Transactions, Journals, Technical Letters, and IEEE Magazines. The *Proceedings, The Institute,* and *Spectrum* will continue to be handled by specific groups, also reporting directly to TAB. In all cases, the groups responsible for periodicals will be reporting to the Technical Publications Board in terms of content, frequency, and the like.

The questions of Conference Records appearing as issues of *Transactions* has been resolved. TAB went beyond the request of SPC to phase out this practice over a period of 3 years and adopted a change in the bylaws, effective immediately, that prohibits the use of *Transactions* as a vehicle for *Conference Records of Proceedings. Conference Records* are to be handled through the Open-Order Plan (OOP), out of Piscataway. Some Societies have already adopted a policy of using conference surplus funds to mail copies of *Conference Records* to all of their members. (Aside: The proper term is "surplus" or "reserve". Never refer to excess over expenses as

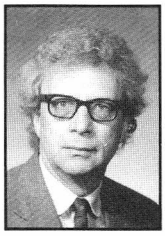
"profits." The IRS may overhear and decide IEEE is not non-profit, after all.) PUB went on record as encouraging submission of meritorious conference papers to the appropriate *Transactions* for consideration under the full peer review system for publication in a regular issue at a later date.

A few authors have complained (who and to whom?) about the review process taking too long. Most Societies are reasonably efficient in processing papers, but the complaints do seem to have merit in some instances. SPC suggests that the individual Societies include publications personnel on their respective boards. I believe the Division IV Societies are already doing this, either by appointing an elected member as a publications overseer or by having editors participate as ex officio, or both. The idea of a so-called "Author's Bill of Rights" was brought up as a way of ensuring timely handling of submitted papers. The notion that some policy or bylaw be generated was discussed, but nothing came of it at this time.

Headquarters reports that the IEEE now enjoys a 25-percent share of the publications market world-wide of all technical publications. This is a 5-percent gain in the last 7 years. This growth can be expected to continue. The increase is mainly due to the recent upsurge in IEEE magazines. Transactions are often highly technical discussions of ongoing research. Magazines are geared more to the working engineers, who must incorporate the technology into specific designs. Since the audience of a typical magazine is the working engineer in a position to directly influence purchases, magazines are very attractive to advertisers.

Considerable care is advised to any Society contemplating launching an IEEE magazine. Because of an unfortunate, but artistic, cover layout of a proposed IEEE magazine, the Institute was recently served with an injunction for trademark infringement. The layout and type sizes were somewhat similar to an existing commercial magazine, although the content was quite different. The situation appears to have been resolved more or less amicably. The lesson in all of this is to consult Publications Services before stirring up more snakes than you can kill.

Mostly, SPC and PUB meetings consist of reviews of progress in various areas, reports, and reviews of problem areas with consequent assignment of action items. Once in a while, something comes up that has more than ordinary entertainment value. The June issue of *IEEE Technology and Society Magazine* featured a historical survey article entitled, "Socially Camouflaged Technology: The Case of the Electromechanical Vibrator" (*IEEE T&S,* Jun 89, pp 3–23). The subject matter created quite a stir, but the main point seems to have been about the marketing of applied technology in such a way as to conceal the real or intended use. Since the author's affiliation was not given, some speculated that the article might have been a put-on. This aspect will be checked out. Put-on or not, the opening sentence makes a telling point: "Certain commodities are sold in the legal market place for which the expected use is either illegal or socially unacceptable."



Martin Schneider Running for Division IV Director

Martin V. Schneider, MTT-S AdCom member since 1985, is a candidate for Division IV Director of IEEE. Running against Martin for the 1991–1992 term are W. Kenneth Dawson and Clark E. Johnson, Jr. According to Leonard Carlson, the present director, the Division IV Director has oversight of the five electromagnetic and radiation societies (MTT-S, AP-S, EMC-S, MAG-S, and NPS-S), providing the link between these societies' 28,000 members and the IEEE Board of Directors. In addition to being an ex-officio member of the five society administrative committees, the Division IV Director serves on several other advisory and coordinating committees during the 2-year term.

Martin Schneider is a research manager at AT&T Bell Laboratories in Holmdel, New Jersey, where he directs advanced work on devices, circuits, and components for high data rate communications links. He holds a PhD in physics from the Swiss Federal Institute of Technology in Zurich. As a member of MTT-S AdCom, Martin is chairperson of the Publications Committee, where he oversees the MTT-S *Transactions;* MTT-S books published by IEEE Press; the "Home Video Tutorials on Emerging Technologies;" and, beginning in 1991, the *Microwave and Guided Wave Letters* journal. Previously, Martin was chair of the Membership Services Committee, from 1986 through 1988.

W. Kenneth Dawson is a division head with TRIUMF in Vancouver, British Columbia, Canada, where he is involved in computing and controls for medium and large scale physics applications. He holds a BScA in applied physics from Laval University and MA and PhD degrees in Nuclear Physics from Queen's University. He serves on the Nuclear and Plasma Science Society (NPS-S) AdCom as a past president.

Clark E. Johnson, Jr. is self-employed as a consultant based in Denver, Colorado. He consults on high density information storage technologies, focused on magnetics and on the problems of high-definition television as they relate to U.S. competitiveness. He holds a BS in physics and an MS in electrical engineering from the University of Minnesota. He is a past president of the Magnetics Society (1983–84) and served as a Congressional Engineering Fellow in 1988.

Ballots will be mailed to members by September 1 and must be returned by noon, November 1. The September issue of the *IEEE Institute* will have more information on the candidates and their platforms.

MTT-S Meetings and Symposia

by Mario A. Maury, Jr.
Chairperson

Future MTT-S Symposia

The following is a list of International Microwave Symposium sites through 1997, along with the symposium chairperson. If you are interested in participating, please contact the Chairperson directly; the steering committee can always use the help, and this is a good way to actively support your society.

- **1991—Boston, Massachusetts, June 9–13, 1991**
  Peter W. Staecker, Chairperson
  M/A COM, Inc.
  (617) 272–3000, extension 1602
- **1992—Albuquerque, New Mexico, June 1–5, 1992**
  Jerry Hausner, Chairperson
  R & D Associates
  (505) 345–8236
- **1993—Atlanta, Georgia, June 14–18, 1993**
  Pete Rodrigue, Chairperson
  Georgia Institute of Technology, MRC
  (404) 894–2994
- **1994—San Diego, California, May 23–27, 1994**
  Don Parker, Chairperson
  Hughes/RSG
  (213) 615–2576
- **1995—Orlando, Florida, May 16–18, 1995**
  Keith Huddleston, Chairperson
  Martin Marietta
  (305) 356–7201
- **1996—San Francisco, California, June 17–21, 1996**
  Jim Crescenzi, Chairperson
  Watkins-Johnson Co.
  (415) 493–4141, extension 2506
- **1997—Denver, Colorado**
  Hussain A. Haddad, Chairperson
  Ball Aerospace
  (303) 460–2114

1998 MTT-S Symposium Site Proposals

We have received letters of intent from two excellent East Coast locations for 1998:

- Baltimore, Maryland—Steve Stitzer, Chairperson
- Boston, Massachusetts—Steve Temple, Chairperson

Sites will be inspected during the Fall, and final proposals and choice will be made at the January 1991 AdCom meeting.

1999 and 2000 MTT-S Symposium Proposals Requested

We will be returning to the West Coast in 1999, and we have expressions of interest from Anaheim, California and Portland, Oregon. In the Year 2000, we will be in the Middle or East Coast of the country, and we've had interest already shown from St. Louis, Missouri. Letters of intent must be received by the following deadlines to be considered:

Year	Location	Letter of Intent Deadline	Chosen by
1999	West	December 1990	October 1991
2000	Middle	September 1991	June 1992

Chapters wishing to host any of these symposia are encouraged to submit their proposals to my attention:

Mario A. Maury, Jr., Chairperson
MTT-S Meetings & Symposia Committee
Maury Microwave Corporation
8610 Helms Avenue
Cucamonga, CA 91730
Phone: (714) 987–4715, extension 200.

It is our current intent to plan the symposium for 8 years out; this should allow adequate site-selection options. Starting in June 1992, site selection will be made on an annual basis.

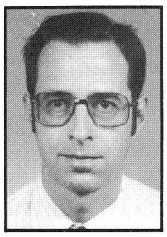
Meetings and Symposia Committee

We have expanded the committee, and the following is a list of members and their individual responsibility.

Members	Responsibilities
M.A. Maury, Jr. (1)	Chairperson
J. Wiltse	Vice Chairperson
R. Bryan	Finance Liaison (2)
R. Jansen	European Liaison
J.K. McKinney	Publicity Liaison (3)
D. McQuiddy (1)	Symposium Services
E. Niehenke	Symposium Operations & Manuals
G. Oltman, Jr. (1)	Site Negotiations Committee
R. Sparks	International Meetings
H. Ellowitz (4)	Exhibit Management
L. Whicker (4)	Conference Management

(1) Members of Site Negotiating Committee.
(2) Will coordinate activities with Finance Committee.
(3) Will coordinate activities with Publicity and Public Relations Committee.
(4) These are advisory members of the committee, since they supply services under contract.

We are creating a permanent staff under Ed Niehenke to help him develop symposia guidelines and operating manuals. This staff will be on call to assist and advise individual chairpersons in doing their duties.



Automatic RF Techniques Group News

by Raymond W. Tucker, Jr.

The Automatic RF Techniques Group (ARFTG) is an independent professional society affiliated with MTT-S as a confference committee. ARFTG's primary interests are in computer-aided microwave analysis, design, and measurement. ARFTG holds two conferences each year, one in conjunction with the MTT-S International Microwave Symposium and a second in late fall.

Changing of the Guard

This will be my last ARFTG NEWS. I have enjoyed keeping the members of MTT-S aware of the activities of ARFTG for the last 2½ years. It has also been my privilege to represent ARFTG at MTT-S Administrative Committee (AdCom) meetings. This committee meets three times a year, and there are some very long meetings. However, these meetings are long because each skilled microwave engineer who serves cares very deeply for the Society. These engineers have donated their time and talent for the benefit of others. It has been an honor to work with them on meetings and conference committees, and I look forward to future work for the Society.

35th ARFTG Conference

ARFTG held its 35th Technical Conference on May 10–11, 1990, in Dallas, Texas, in conjunction with the International Microwave Symposium. The focus topic for this conference was, "Enhancing the Accuracy of Automated Microwave Measurements."

34th ARFTG Conference

ARFTG held its 34th Technical Conference on November 30 and December 1, 1989 at the Westin Cypress Creek Hotel in Fort Lauderdale, Florida.

Frank Mendoza, TRW, served as the conference chairperson. The ten manufacturers' exhibits displaying automated measurement hardware and software were coordinated by Bill Pastori, Maury Microwave.

At the ARFTG Awards Banquet, Bernard Leake received the ARFTG Automated Measurements Technology Award for his application of the automated electronic tuner to noise figure measurements, and Harold E. Stinehelfer, Sr., was presented the ARFTG Automated Measurements Career Award for his career of meritorious achievement and outstanding contributions to the field of automated microwave time domain measurements.

The focus topic for this conference was On-Wafer Testing. A fine technical program was put together by Kevin Kerwin, Hewlett-Packard. A panel session on "The Future of On-Wafer Testing" was well received. The papers presented at the conference were:

"Development Of On-Wafer Standards At NIST" Dylan Williams, NIST, Boulder, CO

"Wafer Level ANA Calibration At NIST" Roger Marks, NIST, Boulder, CO

"Development Of Calibration And Verification Standards In Microstrip And Coplanar Waveguide," Bill Oldfield, Wiltron Co., Morgan Hill, CA

"26 GHz Wafer Noise Parameter And S-Parameter Measurements Using A Solid State Tuner," Michael Fennelly, Automatic Testing & Networking, Inc., Woburn, MA

"Results Of A Multisite Round Robin To Examine Probed Measurements Of An Impedance Standard Substrate," Jeff Raggio, TRW S&D, Redondo Beach, CA

"A Universal Vector Network Analyzer Calibration Technique," John L. Barr & Michael J. Pervere, Hewlett Packard, Santa Rosa, CA

"LRM: An Ideal On-Wafer Calibration Technique," Andrew Davidson, Eric Strid & Keith Jones, Cascade Microtech, Inc., Beaverton, OR

"Improved Accuracy Of On-Wafer MMIC Measurements," H.B. Sequeira and M.W. Trippe, Martin-Marietta Laboratories/GAMMA Monolithics, Baltimore, MD

"On-Wafer Power Measurements," Dale E. Dawson and Mike L. Salif, Westinghouse Electric Corporation, Baltimore, MD

"Problems Characterizing Millimeter Wave ModFets," Brian Hughes, Hewlett Packard Co., Santa Rosa, CA, and Paul Tasker, Cornell University, Ithica, NY

"Analysis Of Circuit Parameters Using TSD Method," Harold Stinehelfer, Made-It Associates, Inc., Lunenburg, MA

"A Possible Source Of Error In On-Wafer Calibration," James C. Rautio, Sonnet Software, Inc., Liverpool, NY

"Ka Band On-Wafer Noise Figure Measurement System," Lawrence Dunleavy, Hughes Aircraft Company, Torrance, CA

"A Cost-Effective Production DC/RF On-Wafer Measurement System," Eric S. Copeland, Matthew Borg, and Kevin J. Kewin, Hewlett Packard Company, Santa Rosa, CA

"An Integrated Approach To High-Volume Production And Automated Testing Of Microwave Power Modules Using Distributed PCs," Deon Glajchen, Avantek Inc., Santa Rosa, CA

Join ARFTG

ARFTG brings you the latest techniques in RF, microwave and millimeter-wave analysis, design, and measurements. State-of-the-art papers are presented twice a year. If you are involved in automated techniques, come join your peers and keep current with our evolving technology. For more information on ARFTG, write: ARFTG, RR# 1, Box 204A, Ava, NY 13303

Meetings and Short Courses of Interest

Meeting	Date	Location	Contact for More Information
GaAs IC Symposium	October 7–10, 1990	New Orleans, LA	Suzanne Kuntz (202) 347–5900
International Conference on Directions in Electromagnetic Wave Modeling	October 22–24, 1990	New York City	Professor Henry L. Bertoni (718) 260–3478
The Fourth Biennial IEEE Conference on Electromagnetic Field Computation	October 22–24, 1990	Toronto, Canada	Mrs. Margaret Tompsett (416) 978–6528
Short Course on Microwave Circuit Design: Linear and Nonlinear	October 24–26, 1990	Dallas, TX	George Vendelin (408) 867–2291; or Alfred Riddle (408) 262–3575
Short Course on Microwave Circuit Design: Linear and Nonlinear	October 29–31, 1990	Boston, MA	George Vendelin (408) 867–2291; or Alfred Riddle (408) 262–3575
Short Course on Modern Microwave Semiconductor Devices, Components, and Applications	October 22–25, 1990	Palo Alto, CA	University Consortium for Continuing Education (818) 995–6335
International Conference on Physical Concepts of Materials for Novel Optoelectronic Device Applications	October 27, 1990 November 2, 1990	Aachen, Federal Republic of Germany	In Europe: SPIE 49–228–219062 In North America and Asia: SPIE (206) 676–3290
International Conference on Millimeterwave & Microwave (ICOMM–90)	December 19–21, 1990	Dehra Dun, India	In U.S.A.: Prof. Banmali Rawat (702) 784–6927 In India: Dr. A.S. Bains 0135–24779
9th International Zurich Symposium & Technical Exhibition on Electromagnetic Compatibility	March 12–14, 1991	Zurich, Switzerland	Dr. Balint T. Szentkuti +41 31 62 52 58
1991 U.S. Conference on GaAs Manufacturing Technology	April 7–10, 1991	Reno, NV	Suzanne Kuntz (202) 347–5900
1991 MTT-S International Microwave Symposium	June 11–14, 1991	Boston, MA	Peter Staecker (617) 272–3000, EXT. 1602
1991 SBMO International Microwave Symposium	July 22–25, 1991	Rio De Janeiro, Brazil	Mauro S. Assis +55 21 2167108

1989 SBMO International Microwave Symposium "Microwaves—Stepping Into A New Decade"

by Edmar Camargo and Denise Consoni

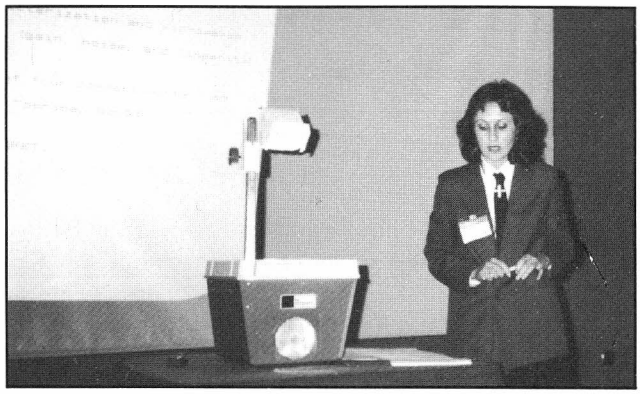
The 1989 SBMO International Microwave Symposium was the third international event organized by the Brazilian Microwave Society (SBMO), in cooperation with various other institutions: IMT/EEM (Instituto Maua de Tecnologia/Escola de Engenharia Maua), LME-EPUSP (Laboratorio de Microelectronica, Escola Politecnica, Universidade de Sao Paulo), IEEE MTT-S (Microwave Theory and Technique Society) and AP-S (Antennas and Propagation Society), IEEE Section Sul-Brasil, IEE (The Institution of Electrical Engineers), CAPES, CNPq, FINEP and FAPESP (Brazilian Research Foundations), SCT (Secretary of Science and Technology/Sao Paulo), the British Council, TELEBRAS (Telecomunicacoes Brasileiras/SA), EMBRATEL (Empresa Brasileira de Telecomunicacoes S/A), and VARIG (Brazilian Airlines, official air carrier).

From July 24 to July 27, a significant part of the international and Brazilian Microwave communities were gathered at the Maksoud Plaza in Sao Paulo, enjoying the opportunity to talk about topics of common interest. Anyone entering the halls of this charming hotel during those four days could not miss the international environment created by smiling English, German, Italian, French, Spanish and Portuguese-speaking people, eagerly discussing their professional activities on microwaves and its applications.

Dr. A. Octavio M. de Andrade, from the Instituto Maua de Tecnologia, was the Chairman of the Steering Committee and welcomed the nearly 500 attendees on Monday morning.

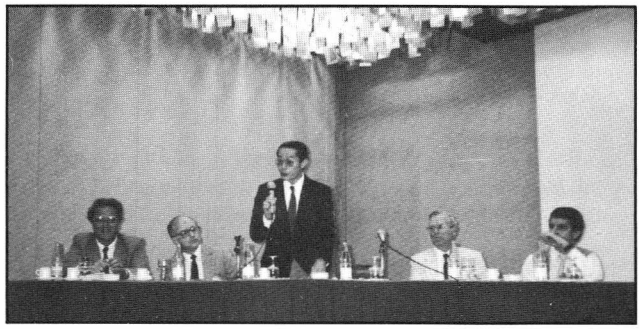
During the plenary sessions, the wide range of microwave applications was displayed through the elucidating lectures given by Theodore Saad ("The Story of the MIT Radiation Laboratory"), Reinhard Knerr ("Lightwave Communications"), Kenneth L. Carr ("The Future of Microwaves in Medicine"), and A.W. Kraszewski ("RF and Microwave Dielectric Properties of Agricultural Products and their Applications").

Other applications and relevant subjects on microwaves were addressed in the 36 invited papers, which greatly contributed to the international forum of this meeting. 101 technical papers were presented in 29 sessions, comprising a wide variety of topics: phased arrays, printed antennas, millimeterwaves, radar, satellite communications, optics, measurements, dielectric resonators, propagation, devices, acoustics, electromagnetic theory, MMICs and others. The high level of the papers' contents and the smoothly running sessions, counting on intensive participation of the audience, demonstrated the importance of this conference for the local and international microwave communities.



Dr. Denise Consoni presenting a technical paper.

Fruitful discussions and valuable experiences were shared during the panel sessions, which tackled three exciting issues: "The Future of Optical Communications," "Education in Microwaves," and "Key Success Factors for GaAs MMICs in Brazil." During this latter panel, an intense debate was conducted, in an innovative way, by Dr. Alejandro Chu (M/A-COM) on the problems affecting the national and international development of GaAs MMICs. Education has proven to be a theme of special concern for the microwave society, and various methods for attracting good students into the microwave field were proposed and discussed during the panel on this subject. Also, to increase students' interest in the area, two short courses on optics and radar were offered during the symposium.



Dr. J. Kleber C. Pinto, Dr. Ronald Gutman, Dr. Alejandro Chu, Mr. Richard A. Sparks, and Mr. Mauro Coimbra at the panel discussion on "Key Success Factors for GaAs MMICs in Brazil."

The small but representative Microwave Exhibition, comprising 20 Brazilian and foreign microwave companies, was well visited; good contacts were established between participants and industry delegates. The emerging Brazilian microwave industry, basically dedicated to

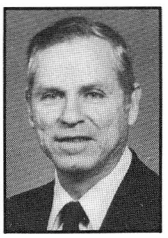
the production of telecommunication items (some of them developed through contracts with Brazilian universities), had the chance to display the progress they have achieved over the last few years, in spite of the country's economic difficulties.

A new channel of collaboration was also inaugurated during the event through the establishment of an IEEE MTT-S Chapter in Sao Paulo, which will be coordinated by Dr. D. Consoni from the Universidade de Sao Paulo.

The atmosphere of the symposium was cheered at the cocktail reception, hosted by the exhibitors, and especially during the Banquet, highlighted by the presence of members from the school of Samba "Vai-Vai." The samba musicians and dancers succeeded in bringing to the participants a taste of good Brazilian Carnival.

We believe that the 1989 SBMO symposium met the expectations and provided new perspectives on international collaboration, as we enter a new decade of microwave technology.

Mrs. Dick Sparks, Mr. Theodore Saad, and Dr. Octavio de Andrade at the banquet.



2nd International Symposium on Recent Advances in Microwave Technology

by Dick Sparks

The 2nd International Symposium on Recent Advances in Microwave Technology (ISRAMT '89), cosponsored by the University of Nevada, Reno, USA, and the Chinese Institute of Electronics, was held in Dragon Spring, Movenpick Hotel, located in the western suburb of Beijing, People's Republic of China, from September 4–8, 1989. The registration started on September 4 and the symposium was declared open on September 5 with opening remarks by Professor Feng Si-zhang, Symposium Chairperson, and Professor Banmali Rawat, Technical Program Committee Chairperson from the University of Nevada, Reno.

The Plenary Session started at 10:00 a.m. with Professor B. Rawat, USA, and Professor Feng Si-zhang, China, as cochairpersons. Papers by Professor Rawat, Professor Ke You-an (China), and Professor H.P. Groll (Germany) were presented in this session. Professor Rawat discussed the analysis and design of a simple dielectric loaded Gunn-oscillatory cavity, while Professor Ke You-an's paper on "Microwave Image Reconstruction-An Inverse Problem" was presented by his wife, Professor (Mrs.) Ke You-an. Dr. Groll gave an excellent presentation of industrial applications of millimeter waves. This session, like all other sessions in the conference, had very lively discussions from participants.

In the afternoon, three parallel sessions were held: Analytical and Numerical Methods-I, Wave Scattering, and Feeds and Microwave Measuring Systems.

On September 6, the six morning sessions were Analytical and Numerical Methods-II, Analytical and Numerical Methods-III, Calculations of Antenna Characteristics, Antennas-I, Microwave Measurements, MMIC and SIT. The six afternoon sessions were Waveguide and Components, Transitions and Nonreciprocal Components, Antennas-II, Radar Systems, Amplifiers and CAD, and Gunn Oscillators and Switches.

In the evening, a reception organized by the Chinese Institute of Electronics was chaired by Professor Rawat. Professor Zhang Zhi-Ying and Professor Wu Jiaxiang from China and Professor Groll were the distinguished speakers at the reception. They spoke about the importance of such international interaction for the development of microwave technology and world peace. The international scientific community can achieve what is almost impossible through our political leaders.

After the September 6 reception, the ISRAMT International Advisory Committee had a formal meeting from 9:00 to 10:30 p.m. This was the first formal meeting of the committee and many important decisions about future conferences were made. This meeting was attended by Professor Rawat, Dr. B. Johnson (USA), Dr. I. Frigyes (Hungary), Dr. Groll, Dr. S. Shtrikman (Israel), Dr. B.P. Sinha (Canada), Dr. T.K. Ishi (USA), Dr. K. Kurokawa (Japan), Dr. Zong Sha (China), and Dr. Feng Si-zhang. Some new members were added to the list of advisory committee to reflect better international representation. Also, Professor Rawat and Dr. Johnson were elected Chairperson and Vice Chairperson, respectively, of the advisory committee for a 3-year term ending September 30, 1992. In the future, one more vice chairman will be added to the list. The committee has approved the following tentative schedule for future ISRAMT conferences.

3rd 1991	Reno, Nevada, USA
4th 1993	New Delhi, India
5th 1995	Kiev, USSR
6th 1998	Budapest, Hungary
7th 2000	To be decided

On the third day of the conference there were six morning sessions: Dielectric Resonators and Filters-I, Radiowave Propagation and Communication Systems, Oscillators, Dielectric Resonators and Filters-II, Microwave Applications, and FET Circuits. Three afternoon sessions discussed Dielectric Resonators, Imaging and Radiometers, and Nonlinear Circuits.

A total of 123 papers were presented in 25 sessions. The presentations by internationally renowned microwave experts like Dr. Kurokawa on HEMT devices, Dr. Groll on Millimeter Wave Applications, and Dr. Ke You-an (China) were interesting and thought provoking. There were 160 participants in the conference, of which 35 were from outside China. This number is really very encouraging considering the turmoil in China just three months before the conference.
The following is the international breakdown of the participants:

China	125
USA	12
Spain	4
Canada	4
Hong Kong	3
Japan	3
Israel	2
India	1
Italy	1
Hungary	1
Germany	1
Korea	1
Brazil	1
USSR	1
Total	160

The best part of these sessions was that the participants had very lively, free and frank discussions about various topics, even outside the conference halls. The conference proceedings is a beautiful hard-bound volume published by International Academic Press, a Pergamon Press, and edited by Professors Rawat and Z. Siyong.

Besides the conference presentations, the Chinese Organizing Committee also arranged technical visits to the Beijing Institute of Radio Measurement, Institute of Electronics Academia Sinica, and Beijing Broadcast Equipment Factory (BBEF). These visits were planned well in advance. At each of these facilities, we were welcomed by the Director/Deputy Director in a conference hall with Chinese tea/juice. After the briefing, there was a 30-minute video presentation about the research/development activities of the establishment, followed by visits to various sections. We all were impressed with technological advances made by China in the microwaves/communications field in the last 15 years.

They have developed microwave components up to the 35-GHz frequency range. The components were sophisticated with high efficiency and low noise figures. The Chinese government is exporting the microwave/communication components and systems to the USA, Korea, Japan, Germany and other European countries.

In the evening of September 8, a banquet was arranged by CIE. The main highlights of the banquet were delicious Chinese food, beautiful dances by four tribal professional dancers from a western province of China, and closing remarks by Professors Zong Sha, Rawat, Feng Si Zhang and other Chinese dignitaries. The University of Nevada, Reno, and Chinese Institute of Electronics were thanked for cosponsoring the conference, as well as URSI, IEEE-Beijing Section, and Natural Science Foundation of China for kind cooperation. The conference was declared closed with full success and an invitation to all the participants for the 3rd ISRAMT to be held in Reno, Nevada, USA, in 1991.

September 9 was the day for sightseeing tours to Great Wall, Ming Tomb, Forbidden City, downtown Beijing, and the Unknown Underground City. The life in general in Beijing was perfectly normal, and the shops were crowded as usual.

On September 10, the participants headed back to their homelands with the sweet memories of the Great Wall, famous Tianemen Square, great Chinese hospitality, and the first international conference held in Beijing after the June turmoil.

IEEE Region 10 Colloquium

by Peter Staecker

During the last two weeks of last October, a Region 10 (India, Far East, and Australia) Colloquium was attended by delegates from member Societies of IEEE. The itinerary was divided into two separate tracks: an eastbound group originating in India, proceeding to Singapore and Australia, and a westbound contingent starting in Australia, followed by Singapore and India. The groups traveling on each track had a common half-way meeting point in Singapore, where a TAB OpCom meeting was attended by all participants. The purpose of the tour was to deliver technical talks, while at the same time exchanging ideas with the technical leadership of the Sections and Chapters of the Region. The colloquium was attended by about 30 representatives from IEEE Divisions and Societies. The author participated in the Australia-Singapore portion of the westbound track.

Australia: Sydney and Canberra (October 18–20)

While half the delegation in Sydney visited the University of Sydney, I was treated to the hospitality of CSIRO (Commonwealth Scientific and Industrial Research Organization) in Epping. In a visit coordinated by Dr. Bruce Thomas, leader of the Earth-Station Antenna Group in the

division of Radiophysics, and chairperson of the AP/MTT New South Wales Chapter, I spent the morning with Dr. Peter Somlo of CSIRO's National Measurement Laboratory (similar to the U.S. NIST activity), discussing his activity with microwave measurement techniques. Following a well-attended (and tasty) barbecue, I spoke to a group of about 20 microwave engineers on my prepared topic: Millimeter-wave Devices, Circuits and Subassemblies: Merging Disciplines for the 1990s. The discussion that followed touched on topics of power generation as well as subsystem integration.

In addition to their antenna activity, the CSIRO Division of Radiophysics pursues microwave and millimeter device efforts within their Solid-State Devices Group. The group fabricates FETs, HEMTs, Schottky mixers and varactor diodes and is planning to commercialize this activity through a recently established company, Triune Pty Ltd.

On the 19th, our grouplet hopped on a chartered bus (Australia was then in the midst of a domestic airline strike which renewed everyone's interest in ground transportation) to Canberra and arrived 4 hours later at the University of New South Wales in the Australian Capital Territory. The IEEE ACT Section planned a workshop on Systems Engineering and Signal Processing with participants from both the IEEE group and researchers at the Electrical Engineering Department of the University College at the Australian Defence Force Academy. There was time during this excursion to view the history and engineering elegance of a city that was designed from scratch to serve as Australia's national capital in the early 20th century.

Singapore (October 22–23)

After a travel day on 21 October (9 hours by jet from Sydney to Singapore), and with minimal jet lag, we joined the eastbound track group for a TAB OpCom meeting on Sunday, 22 October, conducted by Troy Nagel, VP of Technical Activities. Prominent on the agenda were discussions of the restructuring of TAB and the IEEE volunteer organization. A proposed international IEEE member opinion survey was reviewed by Fernando Aldana, and plans and suggestions for next year's colloquium were discussed.

A visit to the National University of Singapore (NUS) on Monday confirmed an impression of close cooperation between government and university research activities and the needs of industry. An innovation-oriented teaching philosophy established by the Engineering Faculty is designed to prepare the student for a successful and productive career in industry. Government funding of critical technologies was evident here as well: we visited a solid state research laboratory within NUS where researchers were preparing a newly-delivered MBE machine for HBT material growth.

Professor Ah-Choy Liew of the Electrical Engineering Faculty of NUS, and Immediate Past Director of Region 10, coordinated our arrangements and visits in Singapore with a precision hospitality that is the hallmark of this city.

Impressions

Although prior commitments forced me to return at the end of the Singapore leg, the journey was of great value to me. Just as governments and institutions within individual nations can cooperate to instruct their next generation in innovative uses of technology, so can engineers from all countries exchange ideas and philosophies and grow to understand and appreciate neighboring cultures and customs.

1991 IEEE Microwave Theory and Techniques Society Undergraduate Scholarships

- For children of MTT-S members
- Not limited to engineering
- $1,000—$2,500 each
- Renewable for 4 years
- Given to meritorious students based on PSAT/SAT test scores, academic record, GPA, class rank, leadership, career goals, significant extracurricular and community activities.
- Application forms for the IEEE Microwave Theory and Techniques Undergraduate Scholarship can be obtained from the Citizens' Scholarship Foundation of America (CSFA).
- Requests for applications forms should be made in writing before December 1, 1990 and refer to the MTT-S Undergraduate Scholarship.
- Complete applications must be sent to CSFA and postmarked before February 1, 1991

Citizens' Scholarship Foundation of America
1505 Riverview Road
P.O. Box 297
St. Peter, Minnesota 56082
Telephone: (507) 931-1682

For further information on the Scholarship, contact:

Dr. Reynold Kagiwada
3117 Malcolm Avenue
Los Angeles, CA 90034
(213) 814-1970

MTT-S Publications Notes

Coauthored by
Martin V. Schneider
and
Peter W. Staecker

New Letters Journal

To meet the growing needs of MTT members to be informed on recent advances in the field, through short contributions and letters, the publication of a letters journal has been approved by AdCom. The proposal, prepared by Tatsuo Itoh, Martin Schneider, and Peter Staecker, has been approved by the IEEE Publications Board and the TAB Periodicals/Society Publications Committee. A summary of the new journal follows:

Title: *Microwave and Guided Wave Letters*

Objective: Inform MTT members through short contributions on recent advances in fields of interest; offer engineers and scientists an opportunity to publish short contributions with a turnaround time of less than 3 months.

Starting Date: January 1991

Frequency of Publication: Monthly

Editor in Chief: Tatsuo Itoh, Hayden Centennial Professor of Engineering, University of Texas at Austin, Austin, Texas. Tatsuo will be assisted by at least two associate editors, who will be appointed to meet the requirement of a fast turnaround time.

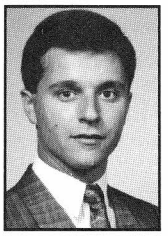
Promotion & Marketing: Arye Rosen, David Sarnoff Research Center, Princeton, NJ. Arye is preparing a call for papers and for promotional material to attract potential subscribers who are not members of the MTT Society.

Cost: The *Letters Journal* will be distributed free of charge to all MTT members during the first year of publication. In the following years, the *Letters Journal* will become the core publication of MTT-S; that means all MTT-S members will receive it as part of their membership benefits. The members will also have the option of subscribing to the *IEEE Transactions on Microwave Theory and Techniques* at a subscription price of $12 per year.

New Transactions Editor

Effective January 1990, Stephen A. Maas replaced Rodney Tucker as editor of the *Transactions*. Rodney accepted an offer to become Chairperson of the Department of Electrical Engineering at the University of Melbourne in Australia, making if difficult for him to be our editor; however, he will remain a member of AdCom. On behalf of the officers and members of MTT-S, we would like to thank both Rodney and his editorial secretary, Francine Liftofsky, for their dedication and excellent work, which made the *Transactions* a first-rate professional publication.

Steve Maas won the Microwave Prize for the best paper in 1989, and he has published two books and a number of widely read and used engineering papers. He is a member of the faculty of the Department of Electrical Engineering at UCLA in Los Angeles, California. We are happy to have Steve on our team and wish him good success with his challenging assignment. The search committee that recommended Steve for the editor's position included Barry Spielman, Walt Gelnovatch, Tatsuo Itoh, Reinhard Knerr, Fred Rosenbaum, Martin Schneider, and Rod Tucker.



Home Video Tutorials

by Olivier Scaramucci

More than half a millennium ago, when Gutenberg printed the Latin bible with his movable metal process, millions of people were offered a unique possibility to have a book at home.

Today, with more than 65 percent of American households owning a VCR, the videotape business is soaring. A year ago, Martin Schneider, under the auspices of the MTT Society, created an ambitious program of videotapes providing Home Video Tutorials on Emerging Technologies to IEEE members. Ten experts give state-of-the-art overviews on various subjects including superconductivity, astronomy, lightwave communications, and heterostructure junctions. The program envisioned for 1990 will cover eight topics, with the participation of other societies and videotapes in different languages to increase IEEE activities abroad. Gutenberg, you would be surprised!

IEEE Home Video Tutorials on Emerging Technologies

Co-produced by
Olivier Scaramucci, IEEE/MTT Home Video Tutorial
Martin V. Schneider, IEEE/MTT Publications
Richard P. Moos, AT&T Bell Laboratories
Peter Wiesner, IEEE Educational Activities Department

The Impact of Coherent Detection Techniques on Terrestrial and Planetary Atmospheric Research, and on the Discovery of Interstellar Molecules* by Pierre Encrenaz, Observatoire de Paris, 92190 Meudon, France.

Coherent detection techniques of millimeter and submillimeter-waves have dramatically improved in the last two decades. The cooling of Schottky receivers, the use of both homo- and pseudomorphic HEMTs, and the technology of superconducting (SIS) junctions have increased the receiver sensitivities by two orders of magnitude. Interstellar molecules which could barely be detected in the seventies are now being observed with radiotelescopes in a few seconds. The detections of deuterated species, of acetone, sodium and potassium chloride show that the interstellar medium is far more complicated than previously assumed.

While the astronomical observations need to be done from high altitude sites (high platforms, balloons, airplanes, satellites), the telluric lines (molecular oxygen, water vapour, ozone) can be observed from both the ground and from space. The data obtained from the atmospheric studies will permit more accurate short and long range weather predictions.

Quasioptical System Design for Millimeter Wavelengths, by Paul F. Goldsmith, Department of Physics and Astronomy, University of Massachusetts, Amherst, MA.

Quasioptical propagation is gaining increasing acceptance as a valuable transmission medium for millimeter wavelengths. A wide variety of radar and radiometric systems and subsystems have been developed using quasioptical techniques. Quasioptical systems depend on availability of building blocks or components for carrying out particular functions. Some of these are quite similar to waveguide approaches used at longer wavelengths, and some derive from infrared and optical technology.

Quasioptical propagation using Gaussian beams (Gaussian optics) has been the basis of most system designs employing free space transmission. The lecture reviews the basics of Gaussian beam propagation, and the Gaussian optics components which have proven especially useful.

High Performance Field Effect Transistors, by Lauren F. Palmateer, School of Electrical Engineering, Cornell University, Ithaca, NY 14853.

Over the past few years, AlInAs/GaInAs/InP Modulation Doped Field Effect Transistors (MODFETs) have proven superior device performance over the more conventional AlGaAs/GaAs MODFET and have attracted a great deal of attention for low noise millimeter-wave device applications. DC and rf device characterization of high performance 0.2 μm gate length AlInAs/GaInAs/InP MODFETs are presented. Unity current gain cutoff frequencies of 100 to 120 GHz and maximum frequencies of oscillation in excess of 180 GHz are reported.

Transport phenomena effecting the performance of the MODFETs are discussed. Hot electron effects have been observed in 0.2 μm gate length AlInAs/GaInAs/InP MODFETs at both dc and at rf frequencies. These results demonstrate that real space transfer of electrons out of the GaInAs quantum well is occurring. These MODFETs show improved performance at dc and microwave frequencies.

* Also available in French.

MTT Society Series

Six experts present a state-of-the-art of the field in five lecture videotapes.

CAD OF HYBRID AND MONOLITHIC MICROWAVE AND MILLIMETER-WAVE MICS, Rolf H. Jansen, Industrial Microwave and RF Techniques Inc., West Germany
PRODUCT No.: HV0115-6

GALLIUM INDIUM ARSENIDE HETEROSTRUCTURES FOR LOW NOISE AMPLIFICATION, HIGH SPEED LOGIC CIRCUITS, AND LIGHTWAVE DETECTION, April S. Brown, Oustanding Technical Achievement Award Winner, Hughes Research Laboratories, and Umesh K. Mishra, Technical Staff, Advanced Devices, Hughes Research Laboratories
Product No.: HV0116-4

GALLIUM ARSENIDE-KEY TO MODERN MICROWAVE TECHNOLOGY,
Edward C. Niehenke, Westinghouse Defense and Electronics Center, Baltimore, MD
Product No.: HV0117-2

LIGHTWAVE COMMUNICATIONS, Reinhard Knerr, AT&T Bell Laboratories, Technical Staff
Product No.: HV0118-0

HIGH TC SUPERCONDUCTIVITY: FACTS AND FANCY, Richard E. Howard, AT&T Bell Laboratories, Microelectronics Research Department
Product No.: HV0119-8

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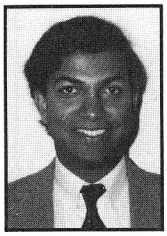


Membership Development

by Fazal Ali

European Microwave Conference Report

Membership Booth—Twenty new members enrolled with the IEEE and took advantage of the free membership offer by the MTT-S at the 19th European Microwave Conference held in September 1989 in London. Also, a good number of people (50) interested in joining MTT-S took application forms from the booth.

The membership booth was a success because of the enthusiastic involvement of the officers and members of the IEEE Region 8 and the UK-Ireland MTT-S/AP-S Chapter. Also adding to the booth's success was servicing of many inquiries concerning IEEE/MTT-S membership. Special thanks to Mr. Ian Williamson and Mr. Terry Oxley of the UK-Ireland MTT-S Chapter for organizing and supporting the membership booth.

Twelve European universities had booths at the conference. On behalf of the MTT-S Membership Committee, we were able to disseminate information regarding the IEEE MTT-S Student Membership Program and application forms.

REGION 8 Chapter Chairpersons' Meeting—A chapter chairpersons' luncheon meeting was held on September 6, 1989, at the Wembley Conference Centre in London. This meeting was co-organized by Mr. Richard Sparks (MTT-S International Liasion) and Mr. Ian Williamson (UK-Ireland chapter chairpersons). Several chapter chairpersons from the IEEE Region, along with Professor Itoh (MTT-S President) and Mr. Mario Maury (MTT-S AdCom) were present at the meeting. The meeting was chaired by Mr. Richard Sparks.

On behalf of the Membership Services Committee, a plaque of appreciation and a check for $200 was delivered to Mr. Ian Williamson for the UK-Ireland Chapter's outstanding efforts in promoting MTT-S membership in Region 8–10.

MTT-S Membership Statistics

	# Members
• As of June 30, 1990	9,932
• As of June 30, 1989	10,552

MTT-S Distinguished Lecturers

by L.N. Medgyesi-Mitschang
Distinguished Lecture Coordinator

Dr. Walter R. Curtice and Professor John R. Whinnery have been named by AdCom as the MTT-S Distinguished Lecturers for the U.S. regions of IEEE, and Professor Vittorio Rizzoli has been named the MTT-S Distinguished Lecturer for the European region of IEEE. All three members are known widely and are respected in industry and academia. Through the lectureship program, many MTT-S members will have the opportunity to interact with these outstanding members of our profession.

Dr. Curtice will speak on "Nonlinear FET Modeling, A Mixture of Art and Science." Dr. Curtice received BEE, MS, and Ph.D. degrees from Cornell University in 1958, 1960, and 1962, respectively. Upon graduation from Cornell University, he joined the Microwave and Power Tube Division of Raytheon as a Senior Research and Development Engineer. He participated in microwave tube development programs and in experimental and theoretical research on linear-beam and cross-field devices. From 1967 to 1973, he was associated with the University of Michigan, where he was engaged in research on microwave semiconductors, with emphasis on GaAs devices.

In 1973, Dr. Curtice joined RCA Laboratories, Princeton, New Jersey, as a Member of the Technical Staff in the Microwave Technology Center. His early work involved silicon IMPATT and TRAPATT devices. He then concentrated on GaAs devices and developed the two-dimensional electron-temperature model for GaAs field-effect transistors; then he developed an improved model for GaAs FET integrated-circuit simulation, and, more recently, he directed the nonlinear-device modeling effort. In 1984, he received the RCA Laboratories Outstanding Achievement Award for the development of advanced techniques for computer simulation of III-V compound, field-effect transistors.

Dr. Curtice was Manager of Computer-Aided Design and Modeling at Microwave Semiconductor Corporation, Somerset, New Jersey, from April 1987 to December 1988. He became an independent consultant in 1989. He has written more than 50 technical papers, has 10 U.S. patents issued to him, and was elected a Fellow of the IEEE in 1988. He is also a member of Tau Beta Pi, Etta Kappa Nu, and Sigma Xi.

The title of Professor Whinnery's lecture is: Relationship Between Optics and Microwaves. Professor John R. Whinnery received his B.S. and Ph.D. degrees from the University of California, Berkeley in 1937 and 1948, respectively. He is an eminent educator and researcher in our profession, well known as coauthor of the pioneering

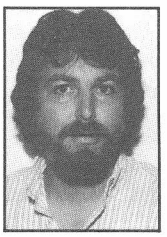
text in electromagnetics, *Fields and Waves in Modern Radio.*

He is a Fellow of the IEEE and holder of numerous other honors and citations including: IEEE Centennial Medal, 1984; IEEE Medal of Honor, 1985; Guggenheim Fellow, 1959; Member, National Academy of Engineering, 1965; Member, National Academy of Sciences, 1972; Outstanding Educator of America, 1974; Lamme Award, American Society for Engineering Education, 1975; Fellow, Optical Society of America, 1977; Distinguished Alumnus Award, University of California at Berkeley, 1980; Appointed University Professor, University of California, 1980; American Academy of Arts and Sciences, 1980; Distinguished Alumni Award, UC, Berkeley; Engineering Alumni Society, 1980; Honorary Professor, Chengdu Institute of Radio Engineering, Chengdu, People's Republic of China, 1986; University Anniversary Commemorative Medal, Catholic University of Chile, 1986; Founders Award, National Academy of Engineering, 1986; Berkeley Citation, UC, Berkeley, 1987; Fellow, American Association for the Advancement of Science, 1987. He has served the IEEE in numerous capacities, including member of the Board of Directors.

Professor Vittorio Rizzoli, a leading authority on nonlinear microwave circuits, will discuss modern CAD techniques being developed to treat this challenging field. Professor Rizzoli obtained his degrees in Electronic Engineering from the University of Bologna, Italy. His thesis dealt with the computer-aided analysis of multistrip components for MICs, with particular emphasis on the design criteria for interdigitated couplers. From 1971 to 1973, he held a research grant issued by Fondazione Ugo Bordoni and joined the Centro Onde Millimetriche in Pontecchio Marconi, Bologna, where he was involved in the development of IF circuitry for a millimeter-wave circular-waveguide communications system. In 1973, he was with the Stanford Park Division of the Hewlett Packard Company (Palo Alto, CA), where he was engaged in microwave transistor modeling and medium-power amplifier design.

In 1974, he joined the University of Bologna, Italy, as an Associate Professor of Circuit Theory, and became a Full Professor of Electromagnetic Fields and Circuits in 1980. His teaching and research activities have been devoted to several topics, including the theory of electromagnetic propagation in optical fibers and the simulation and design of passive and active microwave integrated circuits. More recently, he has been engaged in the development of algorithms and software tools for the computer-aided design of nonlinear circuits. Among other achievements, he has developed the first general-purpose harmonic-balance simulator with optimization capabilities. He has authored or coauthored more than 70 technical papers in the fields of electromagnetic propagation, microwave circuit CAD, and related subjects.

Professor Rizzoli is a member of the IEEE, of the editorial board of the *IEEE Transaction on Microwave Theory and Techniques,* and of John Wiley's *International Journal of Microwave and Millimeter-wave Computer Aided Engineering.* Since 1987, he has also been a member of the Technical Program Committee of the European Microwave Conference.



Pizza or Professionalism?

by Mike Golio
Chairperson, Chapter Activities Committee

As I was preparing to write this column, a friend of mine suggested that it might be worthwhile to discuss the advantages of thinking of engineering as a profession—as opposed to merely a job. She mentioned the personal and professional payoffs of becoming active in IEEE and talked about the technical advantages offered by developing close professional contacts through the MTT-Society. As I thought about the benefits I have received because of my own involvement in IEEE, I realized that this was an important issue that needed to be discussed. Before I could organize my ideas on this subject, however,another friend suggested that it is also important for engineers to be multidimensional—that a professional society should spend some time planning social events, too. He mentioned how successful a recent IEEE student/professional pizza party had been. "Why don't you explain to everyone how to plan an IEEE pizza party?" he asked.

Well, I thought about professional issues, and I thought about pizza. The choice was difficult, but after a hard day of dealing with bad VSWR and poor third-order intercept point, there is nothing more comforting to me than stuffing my mouth with those cheese-covered slices and quaffing down several cold ones. Those of you who have noticed my exponential weight growth in recent years now know the cause. For me, a successful diet will have to begin with improving my circuit design skills.

So let me explain the steps involved for you to plan your own MTT-Society chapter pizza party.

- Attend a regular meeting or other function of your chapter. This is an absolutely critical step in the process, unless you are capable of communicating to other engineers via mental telepathy.
- Introduce yourself to your chapter officers and volunteer to organize the event. After the officers have regained consciousness, assure them that you are serious and that you will expend the effort required to organize the event.
- Choose a location. A pizza parlor is one obvious choice. You might also consider pizza delivery to a park or other location. You will need to decide what kind of atmosphere you want. For example, do you want music? Personally, I prefer head-banger heavy metal rock-'n-roll, but I have a close friend who speaks highly of the important social significance of rap. You probably have your own preference.

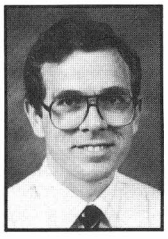
- Publicize the event. Flyers and mailings are usually effective. Local electronics firms and university engineering buildings are likely targets for your flyers. I would suggest you avoid placing flyers in city or county jails—unless you know something about your local IEEE members that I don't. Your chapter officers should be able to help with this. They will have developed publicity means to announce their regular meetings and know how to do the same for you.
- Finally, come and enjoy the event. This should be easy.

Well, that's about all there is to it. However, because many of our MTT-S newsletter subscribers have become managers, they are no longer capable of reading more than 10 words at a time or any words not preceded by a bullet. So for the managers:

Executive Summary of How to Have an IEEE Pizza Party

- Attend IEEE meeting
- Volunteer
- Choose location
- Publicize
- Enjoy

Have fun. Next time maybe I'll get around to addressing those professional issues.



Running a Successful Short Course

by Dan Swanson

The Santa Clara Valley MTT chapter has been running an annual short course since 1975. Topics have included solid-state devices, high-volume microwave applications, designing non-linear circuits, and microwave measurements. We meet on a Saturday in late March and supply each participant with a copy of course notes, as well as a box lunch and coffee during breaks. The fee is $50 for IEEE members and $60 for non-members; students pay $25. (The fees are generally paid by our employers.) Our attendance varies from 150 to 300, depending on the topic.

A very successful formula for running the course was used the first year and has been used since. These guidelines can help you organize a successful short course in your area.

First, pick a timely topic. Anything related to MMICs and solid-state devices has been very popular. Measurement and component design are also popular topics. If possible, include one or two survey presentations to help tie things together. Following talks can then go into more detail. Six to eight talks, ranging from thirty to 50 minutes in a 1-day session, is about right.

Second, pick a central location with good facilities and a beautiful view. We are lucky to have the Stanford Linear Accelerator facility available to us free of charge. Campus meeting rooms are often available for little or no charge. Hotel meeting rooms can also be inexpensive, if you buy food service.

Third, supply a good lunch as well as morning and afternoon coffee breaks. Engineers love to eat! They also like to visit over coffee and a doughnut with that friend they haven't seen for a year. Our box lunch and coffee are supplied by a local volunteer group that raises tuition money for needy students.

Fourth, the chapter chairperson must delegate the work load. Over the years, we have developed a schedule of firm dates for when things need to happen. Each task is assigned to a chapter officer. The chairperson's biggest task is lining up the speakers, which takes much persistent telephoning. Don't be discouraged if a candidate turns you down; ask him or her to recommend someone else you could talk with, and two or three calls later, you have just the person you were looking for.

Other tasks include coordinating the food service, reminding speakers to turn in copies of their slides, making name tags, printing the course fliers, printing the course notes, handling registration as people arrive, and renting extra tables and chairs. It is important to advertise several months in advance in your local IEEE magazine, as well as sending course announcements to the local MTT, *Electron Devices,* and *Circuits and Systems* mailing lists.

Finally, sit back and relax when the whole thing is done! We reward our speakers, ourselves, and our spouses with a fancy dinner that evening. We also give the speakers a small honorarium and present a "Best Paper" prize, determined by secret ballot among the course participants.

The whole thing would not be possible without the help of our local IEEE council office. The council office handles our mailings and collects the advance registrations as they come in. They can also coordinate insurance bonds if necessary. Don't forget that your IEEE section is financially responsible for your activities. You should submit a simple 1-page budget to your section for approval. The two biggest line items will be food and printing of course notes. Be sure to order at least 10 percent above what you think you will need 2 to 3 weeks before the course date. If you need funds to get started, your section might be able to help. You should also submit a financial statement after your successful course.

I hope you have found these comments to be useful, if not inspiring. Your first short course might be a little intimidating; the next will be easier, and soon you will develop your own formula for success.

Intersocietal Relations

by Ferdo Ivanek
MTT-S AdCom Vice President

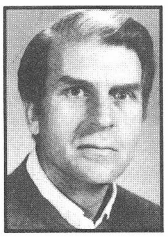
Several changes have occurred since my report in the issue Number 125 of the MTT-S *Newsletter*. First, we have been informed that the Technical Activities Advisory Committee (EAB-TAAC) has been abolished, and therefore we are not represented on the Educational Activities Board at this time. Second, the MTT-S has joined the IEEE Superconductivity Committee that was established in 1989. The following table summarizes our intersocietal activities.

This is my final report in the capacity of Coordinator for MTT-S Intersocietal Relations. I am pleased to announce that Harold Sobol has taken over for 1990. He also serves as the MTT-S Representative to the CCIP. Erwin Belohoubek resigned as Representative to the Standards Coordinating Committee and has been replaced by Jerry Fiedziuszko. Our ex-officio TAB Representative for 1990 is Tatsuo Itoh, MTT-S President.

After having served for two years as Coordinator for Intersocietal Relations, I would like to thank our Representatives for their efforts in behalf of our society. As a result, we are now more effectively contributing to and benefiting from the activities of the IEEE as a whole that are of greatest interest to the MTT-S.

MTT-S Representation in Other Professional and IEEE Activities

IEEE Board	Committee or Council	Representative
Standards Board	Standards Coordinating Committee	J. Fiedziuszko
	SCC 26: Photonics	D. Paul
	SCC 28: Non-Ionizing Radiation	J. Osepchuk
Technical Activities Board	TAB	T. Itoh
	Solid-State Circuits Council	P. Greiling V. Gelnovatch
	Steering Committee of the Journal of Lightwave Technology	N. Dietrich P. Stabile
	Superconductivity	E. Belohoubek A. Silver
United States Activities	Aerospace R&D	W. Brown, Jr. S. Okwit
	Communications Information Policy (CCIP)	H. Sobol
	Defense R&D	D. McQuiddy, Jr. G. Thoren
	Energy	W. Brown, Jr.
	Engineering R&D	H. Sobol R. Gutmann
	Health Care Engineering Policy	K. Carr
	Man and Radiation (COMAR)	R. Petersen
	Professional Activities Council for Engineers (PACE)	L.M. -Mitschang R. Moore
Conferences and Other Societies	GaAs Symposium	P. Greiling
	International Microwave Power Institute (IMPI)	J. Osepchuk
	Union of Radio Science—International (URSI)	A. Oliner



COMAR Activities

by R.C. Petersen

The Committee on Man and Radiation (COMAR) has as its primary area of interest the biological effects of nonionizing radiation. COMAR examines and interprets the pertinent literature and presents its findings officially by drafting position statements supported by background documents. At present, the following IEEE Position Papers have been adopted: "Human Exposure to Microwaves and Other Radiofrequency Electromagnetic Fields" (1982); "Absence of Hazardous Levels of Nonionizing Radiation from VDTs" (1984); and "Biological Effects of Power Frequency Electric and Magnetic Fields" (1988). An IEEE Position Statement "Health Aspects of Exposure to Electromagnetic Fields from RF Sealers and Dielectric Heaters" has also been drafted for review.

In addition to position statements, COMAR presents its findings by drafting information reports on various subjects. At present, several reports in draft form address the following subjects: "Medical Applications of Electromagnetic Fields" (including microwave hyperthermia, microwave imaging, noncontact sensing of organ and tissue movement, tissue growth and healing, electrofusion and electroporation, and magnetic resonance imaging and spectroscopy); "EMP-RF Pulses" (including EMP generator restrictions, public concern about EMP facilities, leukemia litigation and its driving of EMP fears); and "Industrial and Broadcast Frequencies" (including RF dielectric heaters and safety aspects of broadcast frequency radiation).

At its June 21, 1989, meeting during the Eleventh Annual Meeting of the Bioelectromagnetics Society in Tucson, AZ, updated drafts of background documents pertaining to each subject where an entity position had previously been adopted and drafts of the informational reports (above) were discussed. It was agreed that comments forwarded to each subcommittee chairperson would be considered and, where appropriate, would be included in revised drafts available for discussion at the November '89 COMAR meeting.

A major topic of discussion at the June 21 meeting was mechanisms for promptly responding to public concerns about radiation issues and whether or not this is the prime objective of COMAR. This discussion was driven in part by a recent series of three articles in "The New Yorker" by Paul Brodeur, author of the book *The Zapping of America.* To support his tale of danger and cover-up, the author cites the results of a few controversial epidemiological studies which show a possible association between cancer promotion and exposure to 60-Hz magnetic fields. (Actually the association is with wiring configuration, not with the magnetic flux density.) He also claims that dangers are associated with exposure to pulsed RF/microwave fields and with the ELF/VLF magnetic fields from VDTs. The latter claim is based on the outcome of the only study (out of several) that showed a weak association between VDT use and miscarriage among support/clerical workers who used VDTs for more than 20 hours per week. The study did not show similar effects among other occupational groups. Although the authors were careful to point out flaws in their study and did not conclude that radiation from VDTs was causal, Brodeur claimed the association was with the ELF/VLF fields generated by the terminals. To further support his thesis, Brodeur describes the results of many unreplicated in vitro studies in which effects occur only at certain "intensity windows" and for which no biologically plausible interaction mechanism has been proposed.

There was general agreement that COMAR should respond to the "New Yorker" articles, but there was no consensus as to any definite and immediate action. (The "New Yorker" does not print letters.) Harold Goldberg, a member of the ad hoc committee that is reviewing COMAR for USAB, was present and strongly recommended preparing a rebuttal for possible inclusion as an editorial in "Spectrum." Dr. Adair volunteered to contact everyone mentioned in the articles and to act as a clearinghouse for all factual information for rebutting Brodeur. In addition, members were urged to respond to the articles as individuals through any avenue considered appropriate. Finally, there *was* a consensus that COMAR should review the forthcoming book "Deadly Currents" which will be based on the "New Yorker" series.

There was considerable further discussion as to the need for a mechanism to provide a quick and unequivocal response to rebut misinformation about radiation. The rapid and unambiguous response by the FDA to a recent Fox TV news special on cancer and exposure to magnetic fields from "killer electrical blankets" was cited as an example that COMAR should try to emulate. Many of us agreed that this definitely should be our objective, but, because of the large and diversified membership of the committee, this is an unlikely objective in a practical sense.

Further clarification of the objectives of COMAR were sought by several members. In particular, whether COMAR should respond not only to misinformation in the public arena but to poor-quality science or what in some cases can only be considered "junk science." Unfortunately, it is this type of science that has great public appeal. The concern is that other organizations apparently have difficulty separating hard science from "junk science" and there is a definite need for an organization, such as COMAR, to sort it all out. Two important examples were given, which some of us felt were flawed because the conclusions and recommendations were based on controversial reports from the scientific literature: the OTA Background Paper "Biological Effects of Power Frequency Electric and Magnetic Fields" and the

Continued on page 37

1989 National PACE Conference

by L.N. Medgyesi-Mitschang
Chairperson, MTT-S PACE Committee

"Engineering in the Public Eye" was the theme of the 1989 PACE conference, held in Burlington, Vermont, on September 1–4, 1989. Approximately 200 IEEE members attended the conference, representing chapters, societies, and regional entities of the Institute. The initiatives undertaken by the United States Activities Board (USAB) during the past year were summarized. Salient items of interest to our MTT-S membership were as follows.

Mandatory Uncompensated Overtime

IEEE Vice President Bertnolli, Leo Fanning, and Tom Suttle met with Acting Director of the Office of Federal Procurement Policy, Allan Burman, in September 1988 to discuss issues of mandatory uncompensated overtime. In subsequent action, the DOP advisory committee refused to recommend that the Pentagon ban bidding based on mandatory uncompensated overtime; therefore, IEEE-USA may join industry groups in asking Congress to amend Federal procurement law to ban the practice.

IEEE-USA Congressional Fellows

The Congressional Fellows Committee continues to select experienced engineers to serve for one year in Washington as science and technology advisors to members of the U.S. Congress. Sound technical knowledge is relatively scarce in the Congress and the aim of this committee is to increase its effect on legislative decision-making.

The 1988 IEEE-USA Executive Committee approved a request to initiate a solicitation for the Congressional Fellows Fund (CFF), and 1988 IEEE President Russell Drew mailed the letter to approximately 1,200 industry leaders at the end of December 1988. The CFF received almost $8,000 in contributions in 1989.

Washington Internship for Students of Engineering (WISE)

At the other end of the age spectrum from the Congressional Fellows Program, WISE seeks to expose engineers at the undergraduate level to public policy issues and their role in them as engineers. Two students are selected and brought to Washington for an intensive 10 weeks during the summer. Interacting with students sponsored by other engineering societies, they each examine a public policy issue in detail (generally by interviewing those directly involved in the issue), are briefed on the operation of the Congress, and write a report published in IEEE and other society publications.

U.S. Technology Policy Conference

The Technology Policy Conference Committee conducted a survey of IEEE society presidents last summer to identify issues of particular concern. They selected the topic "Policy Imperative for Commercialization of U.S. Technology" as the theme of the 1989 conference. The 1989 Conference was held on February 21 in Washington, D.C., and was jointly sponsored by USAB and TAB.

National Government Activities

IEEE-USA participated in an American Association of Engineering Societies (AAES) presidential-appointment taskgroup (PAT) to promote the appointment of engineers and scientists to transition team and federal policy positions in the Bush Administration. A list of federally appointive positions that would benefit from an appointee with technical training was developed by the AAES constituent societies.

Employment Assistance

A committee continues to monitor legislation that affects the employment of IEEE members. It also continues to monitor the activities of Career Technologies Corporation, the contractor that operates the IEEE job registries. USAB has established a Non-Employed Engineers Employment Registry (NEER), which will be available to employers without charge.

Salary Survey

A salary survey was conducted of U.S. members and completed during the past year. The resulting publication, IEEE U.S. Membership Salary and Fringe Benefits Survey (1989) is available from the IEEE headquarters.

Age Discrimination

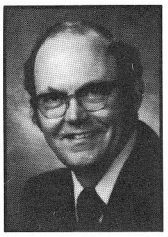
A committee is monitoring and supporting pending legislation on the Age Discrimination in Employment Act (ADEA) waivers. IEEE-USA questions the need for such waivers and recommends that they be permitted only under EEOC supervision and only when protections mandated by the Fair Labor Standards Act are guaranteed.

Career Maintenance

Activities summarized under this heading include workshops on career issues and development of study/training material on these issues available to the general membership.

Miscellaneous Topics

Other topics covered at the meeting encompassed ethics, intellectual property (patents, copyrights), licensure and registration, manpower, and pensions/retirement plans.



PCs for MTT

by E.K. Miller

Scientific Visualization, Visual Electromagnetics, and Visualization Software

Some of you are probably aware of growing activities in the general subject of "scientific visualization," terminology apparently first used in a report recently prepared under the auspices of the National Science Foundation ("Visualization in Scientific Computing," *ACM SIGGRAPH,* **21,** November 1987). While some of my colleagues and I have been talking about using graphics in EM since the early 1970s, only within the last two years or so have I begun to use the term "visual electromagnetics" as a way to emphasize the point. Actually, I adapted that name from Professor Ralph Abraham of UC Santa Cruz who published several books in a series called the *Visual Mathematics Library,* in which mathematical phenomena of various kinds are displayed graphically without a single equation. This idea is catching on in other areas of science, engineering, and mathematics, and in fields not normally associated with visualization, such as economics. There, the term "Visicon" is being used as a means of describing the increasing variety of graphical presentations being employed for economic data, which is often more abstract than the phenomena with which we deal.

For some time now, I have wanted to put together a book of EM graphics examples, for which the working title is (what else?) *"Visual Electromagnetics."* I mention this because, although I have many examples with which to develop such a book, its potential value could be greatly increased if it included problems representative of the entire electromagnetics community. This book would be most useful if designed to accompany literally any electromagnetics text, by following some generic sequence of topics. The book would present graphical depictions of sources, fields, and waves in a variety of formats to illustrate basic EM phenomena and thereby give students a "visual laboratory" from which they might develop a more intuitive sense of what Maxwell's equations are all about. If you have some graphics examples you might be willing to have included in such a book, please let me know. All contributions would, of course, receive full attribution. If you have any questions, suggestions, or comments, please contact me.

One problem is the preoccupation of computer scientists with the production of "pretty picture" graphics as opposed to the pictorial presentation of numerical data, whatever its origin. In the July 1989 issue of *Computer Graphics World,* the lead editorial, "Unscientific Software" by Phil LoPiccolo, laments: "Most current visualization tools that many claim are appropriate for scientific applications are light-years away from satisfying the needs of the vast majority of scientists and researchers." He quotes Robin McLeod, manager of visualization models and algorithms at Tektronix Labs in Wilsonville, Oregon, as saying that "if you are among the 85 percent of scientists who are not using specific tools and are not a graphics programmer, you can do absolutely nothing with visualization." The editorial continues, "We must make a radical and fundamental change in our processing paradigms. Continuing to quote McLeod, 'we don't need faster polygon blasters.' But what we do need are tools that show particle-path trajectories in a fluid-flow analysis, techniques that interactively present cross sections of complex volumetric data, and algorithms that display isopotential surfaces."

In the same issue, Charles Csuri, director of the Advanced Computing Center for the Arts and Design at Ohio State University, writes the *Output* column on the topic, "Visualization Tools." In it he observes that the computer graphics research community is "obsessed with the imitation of nature and focusing our research on realistic imaging, object synthesis, and animation." He also says, "Scientific visualization requires a radical shift in thinking. We must see graphics not as an end, but as a means to an end—that of information, understanding, and knowledge. We cannot simply paste our photorealistic computer graphics techniques onto the broad category of scientific visualization. *We must allow the requirements of scientists to drive new developments in our field* (my emphasis). Interactive computer graphics can be an important tool in the scientific process. Not only can it provide vital insight, but it can also allow the scientist to 'interact' with his computation, adjusting it in accordance with visual feedback. The kind of fast graphical interaction that is required does not demand high degrees of realism but *begs for images that carry information on a level commensurate with the researchers' knowledge of their data.* We must defer somewhat from our quest for realism, because our goal is not to synthesize reality but to provide visual inference. The graphics experts, artists, designers, and cognitive psychologists must work together to build systems that move the function of graphics from documentation of results to an integrated aspect of the scientific process. *These tools must be based not on the graphical primitives with which we are all familiar but on data structures from the scientific world.* We must realize that scientists do not typically build databases of polygonal objects for realistic rendering. Most often, their data is multivariate, defined on a nonuniform n-dimensional array and has no physical counterpart. The suggestion that workstations displaying thousands of polygonal surfaces per second address the 'scientific visualization problem' is tantamount to professional bigotry." To this I can only say "AMEN!" and thanks for reenforcing my own feelings about this topic.

Computational Physics

In his essay "Viewing the World Though a Computer," (*Computers in Physics,* Jul/Aug 1989), Barry Clark, member

of CIP's editorial board and a physicist at the National Radio Astronomy Observatory, also makes some trenchant observations concerning how computers are transforming the landscape of science and engineering. He observes that,

> "Increasingly, if one asks a physicist how he spends his research time, his answer, though he may hate to admit it, is that he spends it communing with a computer. There is no longer a call for physicists with skill in algebra—the symbol manipulation programs are as fast, and more accurate. And for the really hard theoretical problems, the theoretician stops trying for closed form answers, and settles for numerical solutions . . .
>
> "The massive computerization of research physics is a fact. It is right in line with the general trend of our society. The current phase of the industrial revolution is doing to clerical jobs what steam power did to manual ones. On the other hand, having the better part of a million lines of software between the scientist and nature is a pretty frightening thing. From statistical arguments, we know that this massive software system has literally hundreds of bugs. How can we be sure that what our computers are telling us is really the way that nature is and not some strange but subtle distortion induced by the some slip of logic deep within the system? Or, more frightening yet, is it not nature we see, but some distortion arising from the expectations in the software designer's mind?
>
> "And here is the physicist's dilemma: it is unthinkable that a modern large instrument should be built without software, and lots of it; but, on the other hand, because of the well-known fallibility of software, the physicist cannot afford to blindly assume that what the computers are telling him is really the way that nature is. A healthy dose of skepticism about the software must be part of the armamentum of the compleat physicist. This does not mean that the practitioner has to understand everything the software is doing. It is not possible to understand a system of a million lines of code and do anything else. Rather it consists of an awareness of the sorts of things that are likely to be human generated, rather than part of nature.
>
> "We learn some of the artifacts arising from the misuse of software at the same time we learn how to use the software itself. We had better or suffer the derision of those a little more familiar with the package. But this is only the easy part. The more difficult part—the subtle built-in biases of the algorithms or the codes—how do we keep that from devouring the physics? The answer is, 'Only with great difficulty.' This is the reason that we have many routes, many software paths, from data to conclusion. This is the reason that we have competent physicists sitting down to write code for a large system, and not only writing code, but writing code for functions that can already be done in other ways.
>
> "This is the price that we pay for the computerization of physics: multiple software systems for accomplishing the same aims, along with suspicion and partisanship among their users; in many cases a doubling of research effort to carry the data through two different software systems to compare answers; the loss of the time of talented physicists to the construction of software packages; and the inevitable, though sad, wrong conclusion drawn from the misinterpretation of what the software is doing."

VIEW, A No-Cost Image Analysis and Display Program

If you have a need for image analysis and display, then a program available at no cost from Lawrence Livermore National Laboratory might be of interest. The program, called VIEW, is supported on VAXes and Sun workstations as well as the MacII PC. Funded by LLNL, the Strategic Defense Initiative Organization, and the Rome Air Development Center, the program follows a predecessor for signal processing called SIG, which was also distributed free of charge by LLNL and whose design VIEW emulates. This brief account is *not* based on my own experience in using VIEW but is taken from the four-page brochure that describes it.

VIEW provides a window-based user interface that is menu or command driven. It also offers an online HELP and user manual. The program contains a variety of commands (more than 200) and functions in the following categories:

Data base
Input/output
Display
Arithmetic
Signal edit
Filter
Transform and window
Image enhancement
Signal manipulation
Simulation
System

The display commands include: **display** a 1, 2, or 3D signal; **magnify** and **zoom**; **pan**, **surface** for interactive 2D surface display; **plot2d** for perspective plot of 2D signals; **contour** for plotting 2D signals; and **relief** for calculating a reflectance map. Arithmetic commands make available operations such as **add**, **subtract**, . . ., **exponential** and **power**, through **differentiate** for computing the derivative of a 1D signal and **integrate** for computing the integral of a 1D signal. These 1D operations can be done on 2D signals which are made into a sequence of 1D signals through the database command **makeseq**, while the inverse operation of 1D back into 2D is made via the command **mergeseq**.

The numerous filter commands include **median, low-pass, high-pass, bandpass,** and **band-reject** Butterworth and Bessel filters. Various windows such as **Hanning, Hamming, Blackman,** and **Bartlett** can be created. Also included are **Radon** or **forward projection** and **back-projection** commands, iterative spectral **extrapolation,** and **Fraunhofer** and **Fresnel** for far- and near-field propagation. Many other operations can be selected for image enhancement and manipulation.

VIEW is written in C, for which source code is provided, and was designed for disparate applications involving multiple dimensions and data types. For further information about obtaining VIEW, contact Fran Karmitz, L-97, Lawrence Livermore National Laboratory, P.O. Box 5504, Livermore, CA 94550; (415) 422-5678.

Image Storage Technology

While on the topic of graphics, I will summarize a useful table from a recently published book, *Image Storage and Retrieval Systems* by M. D'Alleyrand (McGraw-Hill, July 1989). The table is a capacity and cost comparison for storage "media" ranging from typewritten documents to magnetic tape.

Product	Relative Capacity	Relative Cost/MBit
8½- by 11-inch typewritten page	0.02	1,000
8½- by 11-inch page with line work at 100 dpi	1	20
8½- by 11-inch photograph at 200 dpi, 4 bpp	16	5
Source microfiche at 24 by 98 frames	1,600	0.05
COM microfiche at 24 by 208 frames	5	1
5¼-inch floppy disks	1	200
10MB hard disk	10	5,000
6250 bpi tape	140	10
5¼-inch optical disk	2,000	5
5¼-inch digital paper	1,600	3
Digital tape	1,000,000	0.01

MININEC in Fortran

There was a minireview of the MININEC system in a past "PCs for MTT," in which I suggested that it would be helpful if the next release of the MININEC code were to be in Fortran. There have been various efforts made along that line by people other than the MININEC authors over the years, including Don Barrick, who got both BASIC and Fortran versions running on the Macintosh. In response to the column, Professor Jovan Lebaric [Rose-Hulman Institute of Technology, Department of Electrical & Computer Engineering, 5500 Wabash Avenue, Terre Haute, IN 47803-3999, (812) 877-8228] wrote to say that two students recently converted MININEC 3.12 to Fortran. He will have VAX and PC versions for use in his E&M classes and has also submitted a copy to ACES for distribution through its software library.

In a short note submitted to ACES with the code, Professor Lebaric says that "the main goal of the translation was to produce a Fortran version that mirrored the BASIC version of the code, both in the internal structure of the code and in its user interface."

He reports that this included the following major steps:

- All unnecessary labels were purged from the code.
- Looping and control statements were manually transformed from the BASIC syntax to Fortran syntax.
- The BASIC input and output statements were replaced by properly formatted Fortran equivalents.
- Translation of the BASIC READ-DATA statements to Fortran DATA statements.
- Implementation of BASIC functions not available in Fortran, e.g., SGN.

He further notes that,

"Since a BASIC program consists of a monolithic section of code in which all variables are global, it would have been very difficult to convert the GOSUB statements and routines into Fortran subroutines. We chose, instead, to implement GOSUBs and RETURNs using ASSIGNed GOTOs. The labels to return to are stored on a stack. Hence, the code for GOSUBs and RETURNs was replaced by the following:

```
"GOSUB 65 →  ASSIGN 54000 TO RETMP
             RETSTK(RETNDX) = RETMP
             RETNDX = RETNDX + 1
             GO TO 66
             5000 CONTINUE

"RETURN →    RETNDX = RETNDX - 1
             RETTMP = RETSTK(RETNDX)
             GO TO RETTMP
```

"The other major difficulty encountered in this translation was that BASIC is very relaxed in its handling of variable types. BASIC allows real expressions to index arrays and integer expressions to be the parameter of a subroutine that expects a real argument. Standard Fortran, however, requires that only integer expressions index array elements. It also does not perform compile-time checking on the type of arguments to a subroutine."

Continued on page 38

The translated MININEC was run on an IBM clone (using compiled Microsoft Fortran version 4.1, running at 8 MHz with an 8088 CPU and an 8087 math coprocessor) and a VAX 6320. For the test case of the L-wire antenna modeled with 20 pulses on the vertical segment and 30 pulses on the horizontal, the following timing results were obtained:

Code Version	CPU time (seconds)
PC BASIC	1191
PC Fortran	197
VAX Fortran	6
NEC2 on VAX	4.7

EDITOR's NOTES

Continued from page 3

In addition to the transnational activities news, there are nine other sections in this issue that contain groupings of similar articles. Recognizing that we are all very, very busy, our hope is that grouping articles by sections will allow you to identify those areas in the newsletter that are of most interest.

The MTT-S Newsletter is intended to be a service to MTT-S members. Our mission is to communicate the administrative news of the society and to provide a forum for technical articles that are not appropriate for the MTT-S Transactions. To this end, the Society spends approximately $60,000 publishing three issues of the newsletter each year. (This cost does not include the authors' or editors' time writing and editing the content of the newsletter, which is all donated.) Is this a good value? How can we improve the newsletter to better meet your needs? Only you, the reader, can answer these questions.

Some have suggested that MTT-S follow the lead of other societies and convert the newsletter to a magazine (like AP-S has done, for example). A survey on this topic was conducted at the 1990 MTT-S International Microwave Symposium (IMS), soliciting opinions from AdCom, the Technical Program Committee of the 1991 IMS, and chapter chairpersons and vice chairpersons. The results are currently being compiled and will be submitted to AdCom for consideration at the October meeting. However, we would like opinions from a larger cross-section of members. If you have an opinion and would like your voice to be heard, please contact Ferdo Ivanek, AdCom Vice President, at (415) 329-8716. Or you can FAX your comments to Ferdo in care of Jim Crescenzi, Watkins-Johnson, at (415) 493-1207.

THE ADVENT OF THE SIGNAL MICROPROCESSOR

Continued from page 10

The SMP presents an opportunity and a challenge to system designers, since it offers computation rates that are significantly higher than other approaches. The high speed of the SMP is accompanied by vector size and precision constraints that call for new approaches that optimally segment processing problems to achieve maximum computational efficiency. A growing library of applications software is being developed to aid systems designers in using the SMP to solve problems in the areas of realtime signal synthesis, waveform generation, target simulation, filtering, correlation, pattern matching, signal analysis, echo canceling, voice recognition, and distortion equalization.

COMAR ACTIVITIES

Continued from page 32

Departmemt of Engineering and Public Policy—Carnegie Mellon University Report, "Electric and Magnetic Fields from 60 Hertz Electric Power: What do we know about possible health risks?"

Dr. Osepchuk urged the committee to take a stand on this issue and, as a minimum, review and formally comment on the above publications. No agreement could be reached as to the action that should be taken.

This led to further discussions of the intent and purpose of COMAR. Harold Goldberg felt that rather than providing position statements, COMAR should provide only background information reports. Many of us felt that the preparation of such reports, while useful for supporting position statements, is definitely not the objective of COMAR. Further, when a consensus on a report is reached by a body as large and diversified as COMAR, the feeling was that the resulting reports would be completely ambiguous and, as in most cases, would conclude with the statement "more research is needed." Reports such as these would not serve any useful purpose when dealing with controversial issues and, in fact, are often misinterpreted to support any position on any side of any issue.

Finally, the issue of limited terms for members, in accordance with the new charter for COMAR, was discussed. The tenure for members shall normally be three years with eligibility to serve a second three year term, provided that no person serve more than two consecutive three-year terms. To comply with the new charter, members who will be leaving COMAR over the next two-and-a-half years were identified, and members who will serve one and two additional years were randomly selected.

COMAR met again on November 8, 1989 in Seattle, the day before the EMB Society Annual Meeting. Several entity position papers and/or background papers were discussed, and the following were approved by the members present: "Video Display Terminals," "Medical Applications of Electromagnetic Energy," and "RF/Microwave." A draft entity position on RF heat sealers was discussed, but the membership felt that a more solid rationale was needed before the draft could be accepted.

The COMAR Review Committee Report (requested by USAB) was discussed. The bottom line conclusions of COMAR are:

- Criticism of a lack of rapid response on key issues was unfair since USAB seems to be part of the delay.
- Agree than an AdCom or Steering Committee with one member from USAB and a member from Tom White's Public Relations staff would be useful. The overall purpose of the AdCom would be to provide a path of communications between COMAR, USAB, and the media.
- With reference to the preceding item, the other members of the AdCom should be the Ad Hoc Chairpersons of the COMAR Subcommittees.
- Two major meetings of COMAR per year should suffice if an increase in correspondence is carried out via FAX or E-Mail.

There was also discussion of proposed changes to the charter of COMAR. There was agreement that former members should be eligible for new terms after a 1 year absence from the committee. There was also agreement that two members of the AdCom would be appointed by USAB. Their abilities would be in marketing and promotion.

Finally, the book *Currents of Death* by Brodeur was discussed. Dr. Adair, who acted as a clearinghouse for factual rebuttal information on the series of "New Yorker" articles (upon which the book was based), summarized all information received to date. The members agreed to review the material and provide feedback to Dr. Adair after which an appropriate journal would be sought for publication. Suggestions included Spectrum and the Journal of the Health Physics Society.

1991 IEEE MTT-S INTERNATIONAL MICROWAVE SYMPOSIUM

June 11-14, 1991 • Boston, Massachusetts

FINAL CALL FOR PAPERS

The 1991 IEEE-MTT-S International Microwave Symposium will be held in Boston, Massachusetts, on June 11 to 14, 1991. To allow the presentation of papers in the format best suited to each, the program will consist of three categories of papers: full length, for a 20 minute presentation, short, for 10 minutes, and open forum. Full length papers report results of significant advances in microwave technology. Short papers are typically a refinement in the state of the art. The open forum papers provide an opportunity for authors to present theoretical and experimental material in poster format, display hardware, perform demonstrations, and answer questions in an informal atmosphere without time limit.

The program committee will try to abide by the author's preference, but reserves the right to place the paper in the category it considers most appropriate.

Papers are solicited, which describe original work in the microwave field. A list of suggested topics is given below, but authors are encouraged to submit papers in any other or new aspect of microwave and millimeter wave technology.

- Biological Effects and Medical Applications
- Computer Aided Design Analysis and Synthesis
- Non Linear Modeling and Analysis (CAD)
- Solid State Devices and Circuits (Non FETs)
- Solid State Devices and Circuits (FETs)
- Microwave and Communication Systems
- Ferrite Devices and Microwave Acoustics
- Filters and Multiplexers
- Passive Components
- New Technologies
- Microwave Integrated Circuits
- Millimeter Wave and Submillimeter Wave Integrated Circuits and Technology
- Field Theory
- Guided Waves
- Phased and Active Array Techniques
- High Power Devices and Systems
- Measurement Theory and Techniques
- Manufacturing Methods and Packaging Techniques
- Microwave Superconductivity
- GaAs Monolithic Circuits
- Integrated Optics, Fiber Optics and Optical Techniques
- Receiver Technology

A prospective author is required to submit:

1. 15 copies of a 500-1000 word summary with supporting illustrations, which should include a concise statement of what is new and its potential application.
2. 10 copies of a 30-50 word abstract.
3. A separate sheet with the complete mailing address of the author and a statement categorizing the submitted paper as full length, short or open forum and specifying the topic area in which presentation is preferred.

All papers must be sent for review by December 14, 1990.
Submissions postmarked after that date will not be considered.

Mail submissions to:

MTT-SYMPOSIUM 1991
c/o LRW Associates
1218 Balfour Drive
Arnold, Maryland 21012
USA

Authors will be notified of the status of their submissions by February 15, 1991. Authors of accepted papers will receive copyright release forms and instructions for publication and presentation.

These final manuscripts will be required in early March 1991.

NOTE: Authors are cautioned to obtain all required company and government clearances prior to submittal. A statement signed by the authors stating that such clearances have been obtained must accompany the final manuscript of accepted papers to be published in the Symposium Digest.

MTT-S Newsletter Staff

Editor: Gary Lerude
Phone: (214) 995-5678
FAX: (214) 995-4288

Mailing Address
Texas Instruments
P.O. Box 655474
MS 402
Dallas, TX 75265

Overnight Delivery
Texas Instruments
13510 N. Central Expressway
MS 402
Dallas, TX 75243

Feature Articles Editor: John Eisenberg
Phone: (405) 941-7426

Mailing Address
25 Parsons Way
Los Altos, CA 94022

Region 8 Editor:
(Europe, Middle East, Africa)
Rolf Jansen
Phone: 49-2102-83095
FAX: 49-2102-842391

Mailing Address
Industrial Microwave and RF Techniques, Inc.
Neanderstrasse 5
D-4030 Ratingen
West Germany

Editor's Assistant: Mary Perez

Copy and Layout Editor: Gloria Beduhn

THE INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC.

445 Hoes Lane
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