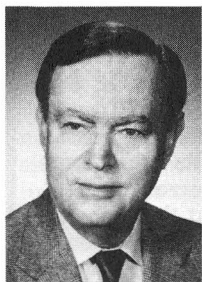




President's Column



by Ferdo Ivanek
1991 MTT-S President

According to the registration figures, one out of every 6 MTT-S members attended the 1991 International Microwave Symposium and the associated events of the "Microwave Week" in Boston. Those who made it to Boston will certainly agree with me that this was an exceptionally successful event. For all of us I would like to thank Peter Staecker and his Steering Committee for their exemplary organizational efforts. Those who were not fortunate enough to join us in Boston I refer to Peter's report in this *Newsletter* issue.

My brief welcoming address at the Plenary Session gave me the opportunity to point out a few basic facts about our Society that are worth repeating here. We have some 11,000 members worldwide, which places us among the top ten IEEE Societies. An even better measure of our activities is the number of MTT-S Chapters. With 70 Chapters worldwide we are among the top five of the 37 IEEE Societies. About one third of our membership is outside the United States (compared to one fourth for the entire IEEE), which exemplifies our highly successful transnational coverage.

The "Microwave Week" in Boston was especially busy for members of the various committees that met during that week. It started with the June 8 evening meetings of the AdCom Budget Committee chaired by Reynold Kagiwada, MTT-S Vice President, and the Long-Range Planning Committee chaired by Walt Gelnovatch, Past President. The AdCom meeting started the following morning (Sunday, June 9) and adjourned just before dinner. For the highlights of this meeting, please refer to the accompanying write-up by Dan Swanson, AdCom Secretary.

Tuesday evening, June 11, was reserved for the meetings of the Technical Coordinating Committee under Vice Chairman Eliot Cohen, and the Chapter Chairmen's meeting under Zvi Galani, Membership Services Chairman. The importance attributed to these meetings by the Technical Committee Chairmen and the Chapter Chairmen was perhaps best manifested by their high participation in spite of the highly

(Continued on page 4)

S. B. Cohn and A. A. Oliner Elected to National Academy of Engineering



Seymour B. Cohn



Arthur A. Oliner

Two prominent members of the microwave community, Dr. Seymour B. Cohn and Dr. Arthur A. Oliner, were elected in 1991 to the National Academy of Engineering. Their careers in microwave engineering intersected each other in various ways over the years, and the recognitions that the IEEE Microwave Theory and Techniques Society has accorded them have been remarkably parallel.

Both Drs. Cohn and Oliner are Honorary Life Members of the MTT Society, being two of the six living members in that distinguished category, and having both been elected in 1978. They have both been Presidents of the Society, in 1963 and 1960, respectively. They have both been recipients, in 1979 and 1981, of the Microwave Career Award, the MTT Society's highest award, and they have both received the Microwave Prize. They are also the only two people to have been selected by their peers for the unusual distinction of having a special retrospective session held in their honor at an International Microwave Symposium, in 1989 and 1988, respectively.

Although the main focus in each of their technical careers has been somewhat different, they have made basic contributions to many of the same topics, including strip lines and small aperture theory. Dr. Cohn has served mostly in industry and in consulting practice for industry, however, being concerned primarily with novel microwave devices and industrial applications, whereas Dr. Oliner has been affiliated with a university, and has concentrated on various fundamental guided wave effects in the microwave field.

Table of Contents

President's Column	1
S. B. Cohn and A. A. Oliner Elected to National Academy of Engineering	1
Editor's Comments	2
AdCom Meeting Reports and Summaries	
Summer MTT-S AdCom Meeting Highlights	3
Chapter Development	4
MTT-S Chapter One-Day Technical Activities	5
MTT-S Meetings & Symposia	5
MTT-S Ombudsman	7
Transnational Committee	7
The 1991 IEEE MTT-S International Microwave Symposium	
MMMWW	8
IMS Wrap-Up	9
ARFTG Highlights	11
University Activities at the 1991 IMS	12
The 1992 IEEE MTT-S IMS	12
Feature Articles	
Old-Fashioned Remedies for GaAs FET Power Amplifier Designers	13
Engineering Supply-Demand Bulletin	17
PCs for AF MTT-S	18
Division IV Reports	
Director's Report	21
Division IV Periodicals	22
TAB Highlights	23
Highlights of TAB Technical Meetings Council	23
Conference Reports	
Polish Microwave Conference—MIKON '91	24
Microwaves in Medicine '91	25
Calls and Announcements	27

MTT-S Newsletter Staff

Editor: John Wassel

Associate Editor: David Zimmermann

Feature Articles Editor: John Eisenberg

Region 8 Editor: Rolf Jansen

Addresses listed in 1991 MTT-S Committee Directory

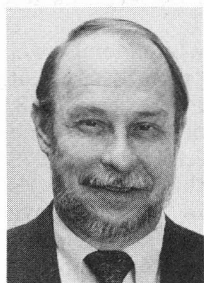
WANTED—Asia Pacific Editor/Correspondent.
Please Contact John Wassel.

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
(415) 941-7426

Editor's Comments



by John Wassel

The boy leaders of my former Boy Scout Troop had the responsibility to plan and execute all our campouts. I was the Scoutmaster of about eighty boys and we had four troop leaders who were assuming the tasks of leadership for the first time. The troop leaders undertook their planning with great enthusiasm and held several meetings to coordinate the logistics of getting the boys to a Boy Scout Camp for a two-day campout in the fall. They did a good job in getting everything organized, arranging for adults to drive the boys to the camp, and obtaining provisions, supplies, tents, etc. But, they forgot to bring the camp box with the pots, pans,

eating utensils, and condiments. It was a long weekend because we also had the tradition of not leaving camp except for real emergencies.

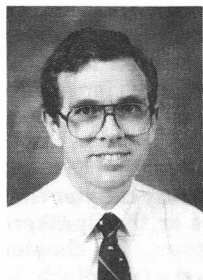
One of those leaders, a fine young man who has recently returned from Desert Storm, remembers that campout as the worst experience he ever had as a leader. The rest of the boys had little mercy for their collective embarrassment and, of course, the boy leaders worried about how the men would react. I recall that we had a lot of finger foods that weekend and learned to hard-boil an egg in a waxed paper cup. Everyone enjoyed the campout plus we had a chance to ponder the historical development of eating utensils. We also had a good unity of purpose in dealing with a common problem.

In retrospect, I imagine many of our conventions, symposia, conferences, and meetings are handled by people who had similar experiences in their youth. Otherwise, why would these events come off so well? The 1991 IMS is a fine case in point — very well organized and flawless in execution. Some of those highlights are covered within this issue. The Boston leaders are to be commended for a job well done. If they had problems, I don't think anyone noticed or, maybe, we just adapted to circumstances just as my boys did in the Boy Scout Troop.

Oh, by the way, the boys always loaded the camp box first on their subsequent campouts. Wouldn't you?

Summer MTT-S AdCom

Meeting Highlights



by Dan Swanson
MTT-S AdCom Secretary

The summer MTT-S AdCom meeting was held on June 9 at the Marriott Hotel, Boston, Massachusetts. The MTT AdCom is grateful to John Putnam and his Local Arrangements Committee for their excellent work.

The priority items for this meeting were the 1991 IMS Steering Committee Report, approval of the 1992 budget, 1998 IMS site selection, the Membership Services Committee and Intersocietal and Transnational Liaison.

Peter Staecker led off with the 1991 IMS Steering Committee Report. Peter reported that advance registration, workshop attendance and exhibitor registration were all approaching record numbers. Peter will give you the details elsewhere in this issue.

Skip Bryan was next up with a report on finances. The society generated a budget surplus in 1990 and our expenses for 1991 are on track. The budget committee has proposed a conservative budget for 1992 which assumes a modest surplus from the Albuquerque Symposium. There was some discussion on the fee structure for publications. The new *Microwave and Guided Wave Letters Journal* is being sent to each member at no charge in 1991. At one time it was thought that the *Letters Journal* would become the core publication for the society in 1992 and the *Transactions* would be optional. After further consideration AdCom felt it was important to include both the *Transactions* and the *Letters Journal* in the basic membership package. Therefore, the budget committee recommended that \$3 be added to the dues to help offset the costs of the *Letters Journal*. The 1992 budget was approved including the \$3 increase in dues.

Mario Maury next directed the 1998 IMS site selection process. The two candidates were the Boston Chapter and the Baltimore/Washington Chapters. Steve Stitzer presented the proposal by Baltimore/Washington with help from Craig Lyons of the Baltimore Convention Bureau. Glen Thoren and Steve Temple presented the proposal by the Boston Chapter. Both teams gave excellent presentations which made choosing one site over the other even more difficult. Baltimore/Washington was selected as the first choice site with Boston reserved as a second choice.

Under the Annual Agenda Framework each major committee is given extra time to report once each year. At the June meeting Membership Services, led by Zvi Galani, was in the spotlight. Membership Services includes Chapter Services, Membership Development, the Distinguished Lecturers and Speakers Bureau, the Newsletter and the Ombudsman. Mike Golio delivered the Chapter Records report for Joe Staudinger. Joe's challenge is to keep the chapter meeting records and chapter officer records up to date. As Chapter Services Chairman, Mike administers financial support for chapters and travel support for chapter chairmen.

Dan Swanson delivered the Membership Development report. Membership is holding steady in 1991 after a 5% decline in 1990. Membership fell 9.9% in Regions 1-7 and rose 5.4% in Regions 8-10 in 1990. Two new chapters in Hungary and Poland were added late last year. This is the first year we

have been able to analyze new member data by region on a week by week basis. In 1991 new members are being added in Regions 7-10 twice as fast as in Regions 1-6. It is also interesting to note that nearly 50% of new members are students.

The second committee in the spotlight was Intersocietal and Transnational Liaison headed by Dick Sparks. Dick reviewed our efforts toward closer cooperation with the European Microwave Conference, the SBMO Symposium in Brazil and the Asia Pacific Microwave Conference. He also reported on the chapter chairmen's meetings held in Region 8 and Region 10. Dick has been looking for additions to the Transnational Committee from Regions 7 thru 10. He also reported that currency conversion problems continue to hinder membership development in Eastern Europe.

Rolf Jansen summarized some of the MTT-S activities in Region 8. There is a new chapter being formed in Greece and a potential new chapter in Czechoslovakia. Martin Schneider reported that Austria is interested in forming an MTT chapter; it would be the first IEEE chapter in Austria. Branka Jokanovic reported on the Microwaves in Medicine Conference held in Belgrade, Yugoslavia. Attendance was only half the expected number due to the political situation in that country. The next conference is planned for Italy in 1993.

Next on the agenda were the President's Assigned Priority Items. Barry Spielman reported for the Ad Hoc Committee on MTT-S Week Structure. Their action plan includes gathering session attendance data at each IMS, surveying the exhibitors regarding a four-day exhibit, surveying attendees regarding the structure of workshops and reviewing the historical data on workshop attendance.

A proposal to form an Ad Hoc Technical Program Coordinating Committee in order to strengthen the TPC process did not receive sufficient support from the floor.

The last third of the meeting was devoted to action and information items which are beyond the scope of this summary. Thanks to all AdCom members, committee chairmen, committee members and guests for a successful meeting.

At the 1991 IMS



"Listen, Ferdo, the only way we can make budget is to move you to the Dedham Hilton."



Stitzer, Moore, and Jansen at AdCom Meeting.

Chapter Development

by Dan Swanson
Membership Development Chairman

Our Chapter Chairmen's Meeting in Boston provided an opportunity to exchange thoughts and ideas and to express a wide range of views and opinions. While some chapters are very successful, others are struggling and looking for guidance. I've had some time to collect my thoughts and would like to pass them on.

First, running a successful chapter involves a certain amount of effort on the part of the chapter officers. Even in large US chapters, the majority of the work is done by two or three dedicated volunteers. In new chapters, the creativity and problem solving skills of the chapter officers become even more important. Electing one new chapter officer each year is a good way to pass on your formula for success to those who follow. The *Chapter Officers' Handbook* was developed to guide the chapter officers. The Membership Services Committee would welcome ideas or suggestions that would improve the handbook.

Second, there never has been much money that flows directly from the MTT Society to the chapters and it is not likely to increase. In the IEEE the first source of funding for the chapters is the section. The system is designed to reward

the chapters via rebates based on meeting attendance. I realize that in some areas the section organization is very weak. But the chapters must properly report their meetings to be eligible for financial support. Some support is available from the MTT Society but time and distance make it a difficult program to administer. Again, the procedures for reporting meetings and applying for financial support are documented in the *Chapter Officers' Handbook*.

Third, speakers for meetings are normally found through the persistent efforts of the chapter officers. Any chapter that relies only on the Distinguished Lecturers or the Speakers Bureau will not develop a successful program. The chapter officers must use their industrial and university contacts to locate speakers. Inviting graduate students to speak would give them valuable exposure and strengthen our relations with our student members. If a speaker cannot be found, a discussion based on a published article or one of the MTT video tapes might be appropriate. The *Chapter Officers' Handbook* has some suggestions for organizing and publicizing a meeting.

Chapter meetings provide a vital forum for interaction between MTT Society members. The chapter officers must bear the burden of developing that forum for the benefit of all. The dedicated efforts of a few volunteers can make a tremendous difference in our society.

President's Column (Continued from page 1)

attractive social event taking place the same evening (a concert of the famous Boston Pops!).

The Technical Committees and the Chapters carry out the two basic but distinct activities of IEEE Societies: promoting technical excellence in the Society's field of interest, on the one hand, and promoting local membership activities, on the other. The two distinct organizational structures and their activities can be envisaged like the two sides of a coin, because they are different yet tied together by the Society's mission and by the individual members and volunteers who are involved in both activities.

In my Incoming President's Message (MTT-S Newsletter, No. 128, Spring 1991) I had focused on developing future activities of the Technical Committees (TC). This matter was discussed at the June 11 meeting of the Technical Coordinating Committee (TCC) which adopted a highly promising action plan. Progress will be reported in future Newsletter issues.

Focus on Chapter Activities

The annual Chapter Chairmen's meeting always reminds us that there is great variety among our chapters worldwide—even in the United States. They differ greatly by membership size and composition, educational and industrial base, business and social climate, organizational experience, leadership attitudes, etc. These and other factors affect chapter activities in various ways, and may require different approaches and solutions to encountered problems, and understandably produce uneven results.

Here I would like to focus on our chapter activities in response to reports, comments and criticism heard at the June 11 Chapter Chairmen's meeting. It was again a very good collective learning opportunity, and we are following up on the various subjects that have been brought up. After the meeting I had discussions with the Chapter Chairman whom I was able to personally meet in Boston, and later I reached some others over the phone. These discussions were very constructive and I passed on the specific information for use in the preparations for the forthcoming Region 8 Chapter Chairmen's meeting organized by Dick Sparks, Transnational

Liaison Chairman, in Stuttgart during the 1991 European Microwave Conference. My following remarks are necessarily limited to some broader aspects of chapter activities which are of more general interest.

The Chapter network represents the organizational infrastructure of our membership base. Taking into account that our 70 Chapters are spread out over all continents, and that their number continues to grow, it becomes obvious that just maintaining the two-way flow of information and coordination between the chapters and the MTT Membership Services Committee becomes more and more demanding. However, experience shows that the encountered problems in these volunteer activities are by no means more difficult to resolve than similar problems that most MTT-S members routinely encounter on their jobs. As usual, results depend on individual and collective initiatives.

Therefore, our main common goal in the area of chapter activities must be twofold. On one hand, we must help the chapters to make better use of local resources, to expand their intra-regional cooperation with other chapters, and to improve their working relationships with both the MTT-S Membership Services Committee and the IEEE Section. On the other hand, we must further develop our membership services to chapters in order to make better use of the affordable MTT-S support means, and to improve understanding of the specific local conditions in the different Chapters, especially in the newer ones and in those that seem to have a comparatively large share of difficulties. This is a two-way street and it will take determined efforts by the chapters, MTT-S Membership Services and the IEEE to sort out the encountered problems and to deal with them effectively.

This column alone cannot possibly address the subject of chapter activities in its entirety. However, each issue of the MTT-S Newsletter includes one or more write-ups on this subject. In this issue you will find the one written by Dan Swanson, Membership Development Chairman, who offers some of his thinking on issues that surfaced in the June 11 Chapter Chairmen's meeting. I invite further individual comments and suggestions because I find them most useful. Do not hesitate to write, fax or call anybody on the AdCom or on the Membership Services Committee!

MTT-S Chapter One-Day Technical Activities

by Ed Niehenke

Many of our MTT-S Chapters offer a one-day or half-day technical event (such as a symposium, seminar, industry night, workshop, or a course) on an annual basis to serve the local MTT-S membership. This event significantly benefits the chapter as well as the membership.

The MTT chapters have held many different types of events which have been very successful.

- Some chapters hold daylong events such as a one-day symposium, seminar, course, or workshop typically with 5 speakers and the event is generally held during the week or on Saturday.
- Other chapters have found a half-day event to be better suited to their needs, and the event is held on a weekday afternoon.
- Some chapters hold an Industry Night where companies present their products and pay for booth space. The Chapter provides the space and food.
- Some chapters combine the events in a Mini Exhibit/Mini Symposium. This event is held in the afternoon and evening, with two speakers. These may be the Distinguished Microwave Lecturers or Speakers from the Speakers Bureau. The program is combined with an exhibit where manufacturers present their products.
- Some chapters include the exhibits with the one-day technical event.

Each technical event offers the chapter's membership a comprehensive overview of a particular technology from the experts in the field as well as providing an open forum for speaker/attendee interaction.

For the event to be successful, selection of the subject matter is very important, and should be geared to the interest of the local membership. Examples of recent topics include: Multifunction MMICs, Receivers, Radar, Nonlinear Modeling, Electromagnetic Simulation, Trends and Applications—Microwaves in the 1990's, and Antennas. Invitations are generally sent to the local MTT-S membership and members of other societies who would have interest. These might include Antennas and Propagation, Electron Devices, and Aerospace and Electronic Systems.

For full-day or half-day events with invited speakers, a fee is charged and lecture notes are provided as well as food if appropriate. For exhibit events, the exhibitors are also charged a fee for participating.

These events, if run properly, can provide revenue to support chapter activities and other endeavors such as scholarships and sending students to the International Microwave Symposium. These events also provide the local membership an opportunity to develop their leadership and management skills in running a successful program.

For assistance, chapters should contact either Mike Golio of Membership Services Activities on (602) 897-5947, Zvi Galani, Chairman of Membership Services on (508) 858-5454, Steve Temple, Vice Chairman of Membership Services on (508) 858-5083, or your local AdCom liaison listed in the 1991 MTT-S Committee Directory. For topic ideas and speakers, you may also contact the chairman of one of the 18 technical committees also listed in the Directory.

Plan to include a special technical one-day event for your 1991-92 program!

MTT-S Meetings & Symposia Committee Report



by Mario A. Maury, Jr.
Chairman

1991 MTT-S Symposium—Boston

The 1991 IEEE/MTT-S International Microwave Symposium which was held in Boston, Massachusetts, from June 10-14 was a great success. As always, Boston is an outstanding site for our annual symposium with its large concentration of microwave activity in the area and a strong experienced local Steering Committee. The social events were outstanding and the Boston area offered a broad diversity of cultural activities and colonial sights plus the weather was delightful. As has been traditional in Boston-held symposiums, it again set a record for total attendance (estimated at 8,700). Peter Staecker, Symposium Chairman, and his dedicated Steering Committee (roughly 36 members) are to be congratulated for a job well done!

1992 MTT-S Symposium—Albuquerque

Well, now we are gearing up for the next symposium to be held in Albuquerque, New Mexico, June 1-5, 1992. By now you have seen the colorful letterhead for this symposium whose theme is "Discovering New Worlds Through Microwaves." Jerry Hausner, Symposium Chairman, and his Steering Committee are well underway in planning an outstanding technical and social program. You can bet it will be liberally laced with unique southwestern hospitality. We are all looking forward to another outstanding "Microwave Week" in Albuquerque in 1992. Call Jerry at (505) 842-8911 or any member of his Steering Committee if you need information.

Future Symposia—1993 thru 1997

The following is a listing of International Microwave Symposium sites through 1997 with their chairmen. If you are interested in participating, please contact the chairman directly; they can always use the help and this is a good way to actively support your society.

- 1992—Albuquerque, New Mexico/June 1-5, 1992
Jerry Hausner, Chairman
RDA Logicon
(505) 842-8911
- 1993—Atlanta, Georgia/June 14-18, 1993
Pete Rodrigue, Chairman
Georgia Institute of Technology, MRC
(404) 894-2944
- 1994—San Diego, California/May 23-27, 1994
Don Parker, Chairman
Hughes/RSR
(213) 344-8534

(Continued on next page)

MTT-S Meetings & Symposia

(Continued from previous page)

- 1995—Orlando, Florida/May 16-18, 1995
Keith Huddleston, Chairman
Martin Marietta
(407) 356-7201
- 1996—San Francisco, California/June 17-21, 1996
Jim Crescenzi, Chairman
Watkins-Johnson Company
(415) 493-4141, x2506
- 1997—Denver, Colorado/June 9-13, 1997
Hussain Haddad, Chairman
Ball Aerospace Systems
(303) 460-2114

1998 Symposium Site Selection

There were two contenders for the 1998 International Microwave symposium as follows:

- a) Baltimore, Maryland—Steve Stitzer, Chairman
- b) Boston, Massachusetts—Glenn Thoren and Steve Temple, Co-Chairmen

The Site Negotiations Committee (SNC), consisting of George Oltman (Chairman), Dave McQuiddy, Peter Staecker, Howard Ellowitz and Mario Maury, visited both sites on April 8 and 9, 1991. Both sites were found to be well qualified to host a symposium. At the June 10, 1991, AdCom meeting in Boston, a report was submitted by the SNC on both sites and a presentation was provided by each proposed site. AdCom then voted and Baltimore was selected as follows:

- 1998—Baltimore, Maryland/June 1-5, 1998
Steve Stitzer, Chairman
Westinghouse Electric Corp.
(301) 765-7348

1999-2000—MTT-S Symposium Site Proposals

We have received letter of intent from the following sites:

Year	Location	Deadline	Select By
1999	Portland, Oregon	V. Tripathi	June 1992
	Anaheim (LA), California	M. Maury	
2000	St. Louis, Missouri	B. Spielman	June 1993
	Dallas, Texas	K. Agarwal	

MTT-S Symposium Proposals Requested

The following is a list of future MTT-S International Microwave Symposia where we are requesting letters of intent by the deadlines noted:

Year	Location	Letter of Intent Deadline	Selected By
2000	Middle	June 30, 1992	June 1993
2001	East	June 30, 1993	June 1994
2002	West	June 30, 1994	June 1995

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

Mario A. Maury, Jr., Chairman
MTT-S Meetings & Symposia Committee
Maury Microwave Corporation
8610 Helms Avenue
Cucamonga, CA 91730
(714) 987-4715, x200

It is our current intent to plan symposiums seven (7) years out; this should provide adequate site selection options and

time for the SNC to properly evaluate the proposed sites. Starting in June 1991, site selection will be made on an annual basis.

MTT-S Sponsored Conferences

At the June 9, 1991, AdCom meeting, the following conferences were approved for sponsorship:

- Asia Pacific Microwave Conference (Co-Sponsorship)
August 11-13, 1992—Adelaide, Australia
- Measurement Science Conference (Cooperative)
January 30-31, 1992—Anaheim, California
- Topical Meeting on Electrical Performance of Electronic Packaging (Cooperative)
Spring 1992—Tucson, Arizona

In addition, AdCom approved the following conferences for Continuous cooperative sponsorship:

- European Microwave Conference (Annual)
- Asia Pacific Microwave Conference (Annual)
- International Microwave Conference/Brazil (Odd Years, 1991, etc.)

Also the following conference was approved for MTT-S Cooperative sponsorship:

- MM '92—Brighton, England, October 13-16, 1992

Meetings & Symposia Committee Members

The following are members of MSC:

Members	Responsibilities
Mario A. Maury, Jr. ¹	Chairman
P. Staecker ¹	Vice Chairman
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
R. Carter	University Exhibiting
H. Ellowitz ^{1,4}	Exhibit Management
L. Whicker ⁴	Conference Management

¹Members of Site Negotiating Committee.

²Will coordinate activities with Finance Committee.

³Will coordinate activities with Public and Public Relations Committee.

⁴These are advisory members of the committee since they provide services under contract.

At the 1991 IMS



Dr. Chuck Buntschuh (1988 IMS) and Capt. Chuck Swift (1989 IMS).

Transnational Committee



by Richard A. Sparks
International Conferences Chairman

The Transnational Committee was created in 1990 as the successor to the International Liaison Subcommittee originally formed in 1984 in recognition of the increasing technical activities, chapter formation and membership growth of the Society in the regions outside North America.

IEEE MTT Society Global Policy

Purpose—The IEEE Microwave Theory and Techniques Society is resolved to ensure an equitable participation of its international membership in all technical activities relevant to its field of interest. The purpose of this policy is to identify the management principles and practices for the Administrative Committee to follow in matters that primarily affect non-US members and issues that relate to their geographic separation from IEEE Headquarters.

Introduction—The Transnational Committee (TC), in formulating a global policy for the IEEE/MTT Society, takes the position that all non-US international activities are essentially an outreach and extension of the existing services and support provided to the domestic membership. It is recognized that the Chapter is the primary entity at the local level for coordinating and disseminating technical information to its members through the organization and scheduling of meetings, workshops, seminars, lecture series, etc.

There are many issues that arise in the conduct of IEEE business that become more complex to address or to answer when a non-US entity is involved because of poor communications and the distances involved. Establishment of the Transnational Office at IEEE Headquarters (effective 27 March 1989) is to help expedite situations that require special attention due to time constraints or complexity in response to the perception of non-US members, particularly in Regions 8, 9 and 10, that it is more difficult for them to get high quality service.

Policy—All MTT-S chapters, both domestic and overseas, have been assigned an AdCom member as a liaison person to communicate with on any and all issues that arise. In addition, the TC will foster communications between the members of overseas chapters and the Society by assigning regional correspondents to publicize local technical activities in each issue of the Newsletter.

Fostering and assisting in the establishment of chapters or joint chapters in every section of the world is a major function of the TC in concert with the Membership Services Committee. Providing recognized speakers on topics of timely importance will be implemented through the Speakers Bureau and the Distinguished Lecturer(s). In geographical areas where membership is more dispersed, it may be more appropriate to schedule periodic meetings or seminars at times and in locations that will appeal to a broader regional participation. In this aspect, the TC will coordinate with the Meetings and Symposia Committee to ensure minimum conflict in dates and topics.

It shall be the policy of the TC to identify and recognize the national microwave societies that exist in many countries of the world and cooperate with their leadership in all technical activities of mutual interest as well as serve as a liaison with the MTT Society Administrative Committee and its officers.

Cooperating sponsorship of the European Microwave Conference, SBMO Symposium in Brazil and more recently the Asia-Pacific Microwave Conference has established a basis for regional technical programs that can promote the goals and objectives of the Society. Together with the Meetings and Symposia Committee, the Transnational Committee will identify all worldwide microwave conferences of interest to Society members and explore the feasibility of establishing MTT Society regional conference sponsorship with existing executive committees. Through its overseas contacts, the Transnational Committee will help to develop recommendations and guidelines for the Administrative Committee to assist in the decision-making process of which overseas seminars, symposia and workshops to support financially or otherwise.

It shall be the policy of the TC to identify and recognize the national microwave societies that exist in many countries of the world and cooperate with their leadership in all technical activities of mutual interest as well as serve as a liaison with the MTT Society Administrative Committee and its officers.

Questions pertaining to the Transnational Committee should be addressed to:

Richard A. Sparks
M/S T2SH9
Raytheon Company
50 Apple Hill Drive
Tewksbury, MA 01875-0901
Tel: (508) 858-1355
Fax: (508) 858-1502



MTT Society Ombudsman

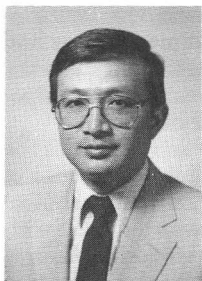
Ed Niehenke
Westinghouse Electric Corporation
P.O. Box 746, MS-75
Baltimore, MD 21203
(301) 765-4573
(301) 993-7432 (Fax)

I have been selected by the Microwave Theory and Techniques Society Administrative Committee (AdCom) to serve as your Ombudsman for 1991. The purpose of the Ombudsman is to receive complaints and assist members in solving problems encountered in obtaining membership services from IEEE and MTT-S.

My responsibilities include immediately acknowledging the member's complaint, investigating whatever action is necessary to rectify the problem, and responding to the member with details of the action taken and inviting the member to correspond further if either this action does not solve the problem or if the member still remains dissatisfied. I will provide a regular input to the *MTT-S Newsletter* concerning my activities as well as a year-end annual report to the MTT-S AdCom.

Please feel free to contact me by letter or telephone concerning your complaint. This action is another initiative of the

1991 Microwave and Millimeter-Wave Monolithic Circuits Symposium, Boston, Massachusetts, June 10-11, 1991



Charles Huang
1991 MMMW Chairman

The Technical Program Committee (TPC) met in Boston on Sunday, January 13, 1991, to select papers. The quality of papers submitted this year was uniformly higher than those of previous years. Notably, papers with higher levels of integration and careful attention to application details were reported. Finally, twenty-five (25) papers, out of sixty-five (65) submitted, were selected for presentation.

The TPC also decided on the following three invited papers:

- "Microwave and Millimeter-Wave Monolithic Circuit Technology, Its History and Future," by Roger Sudbury, MIT Lincoln Laboratory.
- "Military Applications of MMICs," by E. D. Cohen, DARPA/DMO.
- "Commercial Use of MMICs—Status and Future," by R. Rosenzweig, ANADIGICS, INC.

The first invited paper was chosen to celebrate the tenth anniversary of the symposium; while the second and third papers were chosen to address the entire spectrum of MMIC technology.

The 1991 program officially started at the reception held in the Grand Ballroom of the Marriott Hotel/Copley Place at 7:00 p.m. on Sunday, June 9, 1991. The Sunday reception is a symposium tradition. It is a one-time-a-year occasion for people to get together to check on how much older or wiser each other has become. Food, drink and music provided an informal and cozy environment for chatting. A total of three hundred and sixty (360) people attended the reception, and some complained that the music was too loud. It was suggested that we hire a string quartet in the future.

Roger Sudbury kicked off the symposium the morning of Monday, June 10, 1991. Roger reviewed the history of the Symposia with special attention paid to the technical breakthroughs reported at each symposium. Roger did an outstanding job and got the symposium off to a terrific start.

More than five hundred and sixty (560) people registered for the symposium. However, it seems that the attendance total for E. D. Cohen and R. Rosenzweig's invited talks clearly exceeded that total. Most of the talks were well presented and well attended. Conversations overheard in the hallways reinforced the impression that the symposium was a success.

Total attendance at the Monday evening panel sessions was less than one hundred (100). Attendance was not as large as expected, probably because people had a difficult time returning to the auditorium from the Microwave Journal reception held several miles away at the Boston Museum of Science. However, those who did attend the evening panel sessions were treated to many lively and insightful presentations and discussions.

Now that the symposium is completed, on behalf of the Steering Committee, I would like to extend my sincere appreciation to the Steering Committee of the International Microwave Symposium (IMS), MMWMC TPC members, authors, speakers and all attendants for making the symposium such a success.

We will see you in Albuquerque in 1992.

MTT-S Ombudsman



Ed Niehenke
Westinghouse Electric Corporation
Baltimore, MD

As your Ombudsman for 1991, I have received two inquiries from MTT-S members. The first was from an MTT-S member who is presently unemployed and requested members in his situation be granted the reduced registration rate of student, retiree, or life member for attending the MTT-S International Microwave Symposium (IMS). At the suggestion of our president Ferdo Ivanek, I called Peter Staecker, the 1991 IMS Chairman. His committee has already made a decision to offer the reduced rate to unemployed MTT-S members. I sent the unemployed member this information, so he could attend the IMS at a reduced rate. Continuing this policy for the 1992 IMS is under consideration.

The second inquiry was from an MTT-S member who noted two events enumerated below which he considered in error as listed in the 1991 MTT-S Calendar issued by the 1991 IMS Committee.

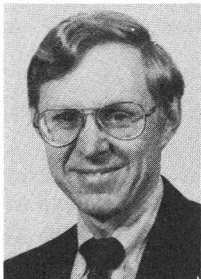
1. Dec. 11, 1941. US declares war on Germany and Italy.
2. Aug. 15, 1945. Japan Surrenders.

Concerning item 1, this fact is correct. Germany and Italy declared war on the US on Dec. 11, 1941, as noted by the MTT-S member. Congress replied with a declaration of war to Germany and Italy on the same day and notes that the US forces may be dispatched to any part of the world!

As for item 2, the date is incorrect. The Japanese decision of unconditional surrender was transmitted to the Allies on Aug. 14, 1945, as noted by the MTT-S member. On Aug. 15, 1945, in an unprecedented broadcast to the Japanese people, Emperor Hirohito announced the terms of surrender. It was the first time that the Emperor, who is regarded as a living God, had ever addressed the Japanese people directly.

Please feel free to contact me by letter or telephone concerning any complaint you may have or any assistance you need in obtaining membership services from IEEE and MTT-S.

The 1991 IEEE MTT-S International Microwave Symposium: Wrap-up

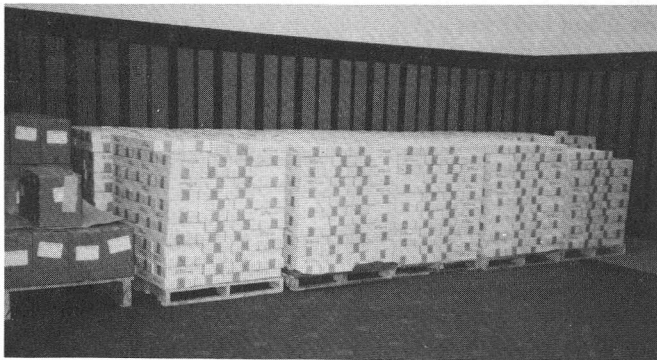


by Peter Staecker
1991 IEEE MTT-S Chairman

June 10th to 14th, 1991. Whoosh! After literally years of preparation, probably one of the fastest weeks on record, at least for the Boston Steering Committee. Even in the middle of a significant economic downturn, a record number of total attendees (estimated at greater than 8700, with duplicates still being removed) registered during the week. We can probably say also that the meeting generated a surplus for the MTT Society treasury, although the exact number is not yet available. In what follows are some of the behind-the-scenes activities which supplement the more conventional Symposium review which will appear in the December *Transactions* issue.

Miscellanea

If you are wondering how many pages of notes it takes to keep the attendees of the record 14 workshops happy, the answer is 287,630. On a similar note, the digests delivered to the Hynes Convention Center Saturday, June 8, weighed in at 22,000 pounds, an even one ton per pallet (Picture 1).



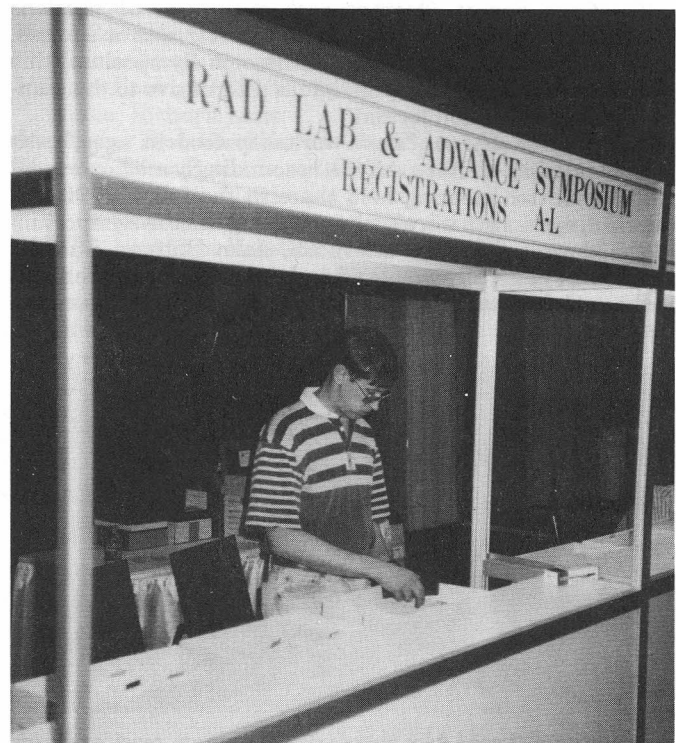
IMS Digests delivered to Hynes weighed 22,000 pounds.

The printing of the digests always goes right down to the last minute, and this year was no exception. The cover proofs, received with no time to spare, had enough errors to send the committee into fibrillation. Somehow, time was found to fix them all, however, and the finished product is testimony to the diligence of George Heiter and the Digest Committee.

The awards will be reviewed in the special *Transactions* issue in December. One award which will not be reported there is the special Rainbow Ribbon Manifold Prize, presented to Reynold Kagiwada for his conspicuous volunteerism in past Symposia (Picture 2). The rest of the ribbons were painstakingly distributed before the Symposium by Registration Chairman Cliff Drubin (Picture 3).



Special Rainbow Ribbon Manifold presented to Rey Kagiwada by Peter Staecker.



Ribbons distributed by Cliff Drubin before the IMS.

What Could Have Gone Better

The air conditioning in the Hynes: Monday and part of Tuesday. Didn't slow down the RadLab session one bit, however.

The harpsichordist never showed, but you probably didn't even notice.

The portable laser pointers. Frank Occhiuti, racing from room to room with a shopping bag full of batteries, could not keep up with the power requirements of these little devils.

The MTT Store: an innovation that needs a bit more hype. Did you know you could have bought an MTT tie for \$10?

The Chapter Chairman's Meeting. Already at a disadvantage in being placed in competition with the Boston Pops Tuesday evening, the meeting was slowed down significantly when the air conditioning was turned off at 9 p.m.

The handles on the shopping bags we provided for RadLab alumni had a half life of anywhere from 10 seconds to 3 minutes.

What Went Right

In short, most everything that we worried about. The price structure of advance vs. on-site registration pulled in many more advance registrants than previous years. As a result, lines in the registration area were quite manageable. It should be noted that new registration hardware and software helped smooth the registration process also.

The RadLab Celebration. From *Echoes of War*, the 60 minute NOVA documentary that was shown on PBS in October 1989, to the 1990-1991 commemorative calendar, the expanded, special Historical Exhibit, the Plenary Session, the RadLab reception and RadLab technical sessions at the meeting this year, the RadLab Committee, headed by Ted Saad, has given the 1991 Symposium special historical significance. You will be hearing more about the details of these events.

The Open Forum. Opening each of the two OF sessions with a topical introductory invited speaker was a success. Since its introduction at the 1983 Boston Symposium, this event has become a truly prestigious alternative to the standard technical session format.

Food in the Hynes. "Best workshop food in ages," was heard a number of times. After a resoundingly mediocre meal at a Committee meeting held there in the fall of 1990, the June dining reports were truly gratifying. As the Symposium wound down on Friday afternoon, John Putnam was the recipient of tastefully prepared and presented prune canapes by the catering staff of the Hynes. His reaction is captured in Picture 4.



John Putnam, Local Arrangements Chairman, receives Prune Canapes.

The Audio/Visual setups. Except for the inefficient laser pointers A/V went without a hitch.

The Student Paper Contest. With the organization of the event for the first time this year, the Symposium recognizes and supports the younger members or potential members of our profession. Professor Peter Rizzi has a number of suggestions for refining the process and logistics for following years, but the initial offering was an unqualified success.

University Booths in the Exhibition. Ditto, thanks again to Pete Rizzi.

The Guest Program. The size, location, and staffing of the Hospitality Suite were perfectly chosen, and the tours well-attended. Volunteers consisting of committee spouses and daughters added a personal touch to the hospitality offered in the Straffordshire Room of the Westin.

The Workshops. With over 1100 participants (another record), Larry Kushner had his own symposium going on Monday and Friday.

Summary

One of the big problems we feared in the months before the meeting was the huge traffic delays caused by the Central Artery Project in downtown Boston. Luckily the delays in getting that project started rendered this a non-issue. A second concern, given the recent rash of bank closings in the Northeast, was where to put our cash during the Symposium so that the funds would not be caught in a freeze. With advice from some highly-placed financial experts, we selected properly and dodged that bullet.

In general, however, what makes the Symposium work is the attention to detail by the committee individuals who do not lose sight of the fact that it is a team effort. Each subcommittee had (or is, at this time, having) its turn in the barrel, and at the end of the Symposium it is sometimes easy to forget the contributions made by those early in the game, for example, the Publicity Committee, who pulled together the stationery and the Program, and the Technical Program Committee, whose constant efforts for the past year have been punctuated by frenzied periods in December and January preparing for and executing the TPC paper evaluation session. It's also easy to forget the people whose only gratification is in doing their job so well that nobody knows they exist. That dubious distinction each year goes to the Local Arrangements Committee.

Ted Saad is already planning for the 100th anniversary of the RadLab. See you there in 2041!

At the 1991 IMS



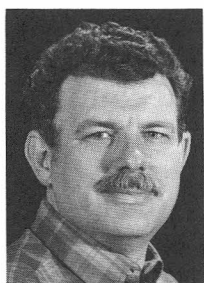
President Ivanek presents Past President Itoh with his recognition pin and plaque.



Fi Saad and Dottie Sparks getting ready to enjoy the banquet.

ARFTG Highlights

Summer 1991



by John T. Barr, IV

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

38th ARFTG Conference Announcement

The 38th ARFTG Conference will be held at the Sheraton Harbour Island Hotel in San Diego, CA, on December 5-6, 1991. The topic will be "On Wafer Measurement III," a follow-on to our previous conferences on the same subject. Recent advancements in on-wafer testing techniques will be presented including: establishment and verification of accurate on-wafer calibrations (including traceability paths), correlations between on-wafer and final packaged chip test results, reduction of measurement time and cost, and the development of improved or novel techniques (both invasive and non-invasive) techniques for S-Parameter, noise, power and temperature controlled measurements.

In addition to the technical presentations, the attendees will have ample time for informal discussion among themselves during the breaks and during the provided lunch and dinner (your spouse is invited to the banquet at no extra cost). There will be time for discussion with vendors and viewing of exhibits to see the latest in automation and measurement products. The registration fee includes technical sessions, exhibits, and all meals and break refreshments, one year membership in ARFTG and a post-conference digest of the presented papers.

Those interested in participating should contact the following:

Conference Chair: Allen Rosenzweig
Microwave Technology
4628 Solar Way
Fremont, CA 94538
(415) 651-6700

Conference TPC: Larry Dunleavy
Univ. of South Florida
Dept. of Electrical Engineering, ENG 118
Tampa, FL 33620
(813) 974-2574

Exhibits Chair: Jim Rautio
Sonnet Software
Suite 203, 135 Old Cove Road
Liverpool, NY 13090
(714) 987-4715

37th ARFTG Conference Wrapup

The 37th Conference was held in conjunction with the 1991 IEEE MTT-S Symposium in Boston, MA, and the topic was *Validation of Design by Measurement*. Papers were presented on: experimental validation by actual measurements of commercial design software, in other words, how "good" are design simulations and their models; new and/or improved measurement techniques of parameters needed for developing models; and other activities of interest to the RF and Microwave design and measurement community. The papers and presenters were:

Electromagnetic Simulation of Microwave Components, Dan Swanson

Simple Microstrip Structures Calculated vs. Measured, Bill Oldfield

A Resonant Mode Dielectrometer for Substrates, Gordon Kent
IEEE Standards Committees on Scattering Coefficients, Connectors: An Overview, Bill Oldfield

Modeling Precision Connectors with a High Frequency Structure Simulator, Joel Dunsmore

A Novel Technique for Vector Measurements of Microwave Networks, Somnath Mukherjee—**Selected "Best Paper"**

Modeling of Low Noise Millimeter-wave Amplifiers, Ulrich Rohde

A Gigahertz Test Fixture for Two-Port Passive Devices, Mark Cavin

Automated On-Wafer Noise and Load Pull Characterization Using Precision Computer Controller Electromechanical Tuners, Marcel Tutt

Pulsed Bias-RF Power GaAs MMIC Testing, W. Pribble
Error Correction and Power Calibration of Active Load Pull Measurements Systems, Douglas Teeter

Using a Packaged FET to Transform Between Measurement Media, Richard Lane

Measuring Resistive Sheets in Free Space, Harold Steinhelfer
Matched Filter Detection Adds Versatility to a Spectrum Analyzer, Somnath Mukherjee

A conference digest is available. Contact Henry Burger, ARFTG, 1008 East Baseline Road, No. 955, Tempe, AZ 85283-1314. Cost is \$20.00 for an ARFTG member and \$35.00 for a non-member. An additional \$9.00 is requested for airmail outside the USA.

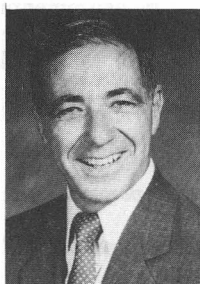
ARFTG Measurement Comparison Program

ARFTG conducts a continuous Measurement Comparison Program (MCP) for Vector Network Analyzers. Kits of test devices in numerous connector types, 7-, 3.5-, 2.92mm and Type-N, are circulated among ARFTG members for measurement. The results are collected and allow participants to compare the performance of their measurement process with a statistical "industry average." For more information, see "Measurement Program Compares Automatic Vector Analyzers" by Robert Judish and John G. Burns in *Microwaves & RF*, May 1991, or contact Robert Judish, ARFTG Standards Committee, NIST, Division 723.01, 325 Broadway, Boulder, CO 80301, (303) 497-3380.

Join ARFTG

We will be looking forward to discussing the latest in measurement automation and accuracy with you in San Diego. ARFTG brings you the latest in RF, Microwave and Millimeter Wave analysis, design and measurement. State-of-the-art papers are presented twice a year. If you are involved in automated techniques, come and join your peers and keep current with our ever-evolving technology. For more information on ARFTG or future conferences, write: John Barr, Network Measurements Division, Hewlett-Packard, 1400 Fountaingrove Parkway, Santa Rosa, CA 95403.

University Activities at the 1991 MTT-S IMS



by Peter A. Rizzi
Electrical Engineering Department
Southeastern Massachusetts University
North Dartmouth, MA 02747

This year's IEEE MTT-S Microwave Symposium provided opportunities for universities to highlight their microwave research. The activities included a student paper competition and several exhibits by universities engaged in microwave research and education.

Of thirty-two student papers submitted to the Technical Program Committee, thirteen were forwarded to the Student Papers Committee for consideration. After a careful review, eight papers were accepted for the competition. Because of travel problems, one of the papers was subsequently withdrawn. The remaining five papers were returned to the appropriate TPC group for possible inclusion in one of the regular symposium sessions.

The competition took place at a special session on Tuesday morning. Each student author was allotted fifteen minutes to present the paper and answer questions. As explained in the original announcement, papers were judged for content, presentation, and visual materials. The five judges were Dr. John Heaton of Lockheed/Sanders, Prof. Roger Pollard of the University of Leeds, Prof. Fred Rosenbaum of Washington University, Prof. Harold Sobol of the University of Texas at Arlington, and Prof. Arthur Uhlir, Jr. of Tufts University.

Prizes were awarded at the symposium banquet on Wednesday evening. The winners were:

First Prize: Gregory Johnson, University of Cincinnati

Second Prize: Andrew Engel, Jr., University of Michigan

Third Prize: Michael Frankel, University of Michigan

Honorable Mention: Lester Hall, North Carolina State University; Naftali Herscovici, University of Massachusetts; James McCleary, Texas A & M University; Michael Tobar, University of Western Australia

In addition to cash prizes for first, second, and third place, travel stipends and free registration were provided to all participants.

In order to encourage and promote productive interaction between academia and the microwave industry, the Steering Committee made available several booths in the exhibition hall for use by universities engaged in microwave research. Announcements describing the offer were mailed to over two hundred universities to which approximately twenty responded. Because of fiscal constraints, only fourteen schools were able to take advantage of the offer. With seven booths allotted, two universities were assigned to each. It was a "little tight", . . . but it worked out fine!

All in all, the comments expressed regarding both the student paper competition and the university exhibits were generally positive. As a result, the 1991 Steering Committee has recommended that these activities should be continued. Any comments and suggestions regarding these programs should be directed to either the author or the Steering Committee of the 1992 MTT-S Symposium.

1992 IEEE MATT-S International Microwave Symposium

June 1-5, Albuquerque,
New Mexico

1992—A Look to the
Future

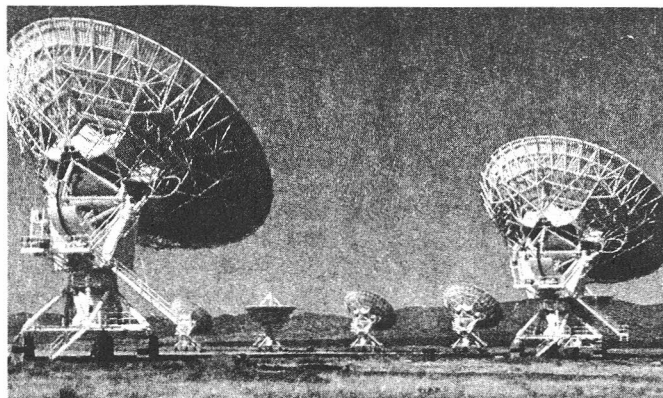
by Jerry Hausner
1992 IMS Chairman



An old adage tells us that it is necessary to reflect on our past to properly set goals for our future. Such reflection helps us to not lose sight of our roots and how far we have come. The recently held IMS in Boston served to let us catch our breath and reflect. Having done that, we can now look to our future in the State of the future, one of our few real frontiers, New Mexico. It is one of the fastest growing States in the union, but in a controlled manner, because of its greatest resource. That resource is not underground in the form of minerals, but in its laboratories in the form of Research and Development.

The population of New Mexico is second in the country for higher level degrees, on a per capita basis. These people perform their duties in many world class laboratories. Some were established for the purpose of national security via defense, and have now branched out to national security via technology leadership. To permit capitalization of the billions invested in this R&D, the concept of tech transfer was created. This has become a modern buzz word, but New Mexico has an action program and a champion to achieve this. Examples of this are: the alliance of Photonics supported by Sandia and Los Alamos National Laboratories, HPM & accelerator technology, and the space technology of the Air Force Phillips Laboratory. In line with our theme and the efforts of the locale, we are planning a focus session on Tech Transfer. We are also cultivating special session speakers who can provide motivation for our future.

Our plan is that those who attend the 1992 IMS in Albuquerque (although they may not be able to spell where they have been) will leave with a feeling of exhilaration and ready to take on the future. If we can do this, we have done our job. Plan on attending the 1992 IMS and help us restore enthusiasm as to the future of the human race. That future is in the hands of the scientific community. It will happen in ABQ in '92. Don't miss it.



New Mexico's premier observatory in radio telescopes.

Old-Fashioned Remedies for GaAsFET Power Amplifier Designers



Steve C. Cripps

Introduction

Despite the many advances in solid state microwave device technology over the last 3 decades, vacuum electron devices still dominate high power microwave applications. There has therefore been an ongoing interest in microwave solid state power amplifiers which stretches back over many years as researchers, engineers, device technologists and venture capitalists have struggled to emulate the performance of devices such as the Traveling Wave Tube (TWT).

My own involvement in this perennial field of technical visibility started exactly ten years ago, when as a newly hired microwave design engineer starting a new job at a reputable defense electronics company, I was given the assignment of designing a new line of octave and multioctave 1 Watt GaAs FET power amplifiers. At that time, few if any broadband products were on the market above the 100 milliwatt level, and my assignment was a challenging one.

As with any new enterprise anywhere, there was no shortage of advice about how it wasn't going to work. Discussions with device vendors, colleagues, and literature surveys showed a fairly firm consensus about GaAs FET power amplifiers which could be summarized as follows:

- 1) Power GaAs FETs can't be matched over an octave band
- 2) Small signal s-parameters are useless for designing power amplifiers
- 3) Power amplifiers are inherently non-linear, so full characterization of non-linear properties is an essential first step in a design.

Over the next year, I was to disprove each of these assertions, and developed a method for designing GaAs FET power amplifiers which is simple-minded, approximate, but highly practical^{1,2}. This article is a summary of this design approach.

I cannot resist noting, in preface to this updated edition, that the aforementioned doubts and fears about the difficulties of designing GaAs FET power amplifiers seem to continue unabated to the present day. Whereas in 1980 the phobia was spread by theoretical papers full of tensor matrices, today it has been taken over largely by writers and vendors of non-linear simulators, who seem convinced that designing a power amplifier is close to impossible without using their particular product. I don't want to knock these people; as a matter of fact I admire them. What they don't seem to realize is that power amplifier design, in my own experience, is actually much easier than writing—or even using a non-linear simulator!

Some Practical Observations

An hour or so spent tuning a power device in a 50 Ohm test fixture with external tuners gives valuable insight into the power matching problem, and is recommended for anyone starting off on a microwave power amplifier design. (In accordance with the title, this is the "old-fashioned" approach; the computer will be used, but not yet!) Most GaAs FET devices, from small signal up to multiwatt types, can be summarized as showing the following general characteristics (see Fig. 1):

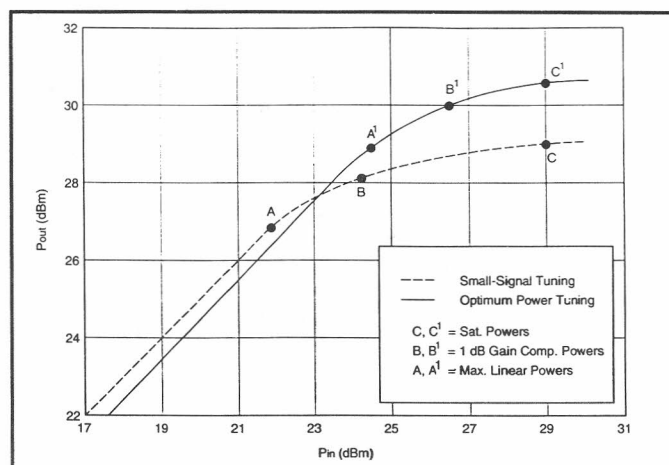


Figure 1. P_{IN} - P_{OUT} characteristics of a typical 1W GaAs FET.

1. Tuning the output for maximum gain results in significantly lower power output than the device specification (maybe 1-3 dB less, depending on the device)
- 2) Tuning for maximum power results in lower gain, but the decrease in gain is less than the increase in power.
- 3) Tuning for power is tricky, because the output tuner affects gain as well as power. A simple solution, a "trick of the trade", is to drive the device into saturation and tune for maximum power. There is usually a well defined optimum point. On reducing the drive level back into the linear range, the linear power can be observed to have increased as well, by about the same amount as the "saturated" power. (This is a critical observation, and will be discussed further shortly)
- 4) Output power performance is virtually independent of input tuning.

I well remember the anxious moment when I first performed the experiment (4). I deliberately mismatched the input, which caused a big drop in gain, then re-measured the power. It hardly changed. So the doomsayers were certainly wrong on this one; power performance seemed to be exclusively a function of output tuning, and the input could be safely matched or mismatched without affecting the power output. Even better, the input tuning hardly changed as the RF drive level as increased from small signal to saturated levels. This is of great importance in a broadband design, where the lower frequencies must be mismatched in order to obtain a flat gain response.

Observation (3) above is worthy of further discussion, since it forms the basis for the whole design technique to be described. Referring to Fig. 1 again, three points (A, B, C) have been identified on each curve. Each of these points represents a criterion for output power. Point B is the familiar 1 dB

compression point; C is the less-well defined "saturation" power level; A is termed the maximum linear power, corresponding to the maximum output power level at which no measurable compression has taken place. Note that the increase in power between the two experimental curves representing different output matching conditions is approximately the same, regardless of the power condition. In other words, the optimum load for the linear condition (A,A') is nearly the same as for the saturated case (C,C'). So to design our power amplifier, we only need to consider the linear case (A).

This is rather surprising. The assumption that matching a transistor for optimum power inevitably involves harmonic as well as fundamental impedances has a reasonable theoretical foundation, but experience and experiment reveal that these complications can be ignored, or certainly put on the "back burner". In any case, the basic premise in this design approach is to focus on the linear point A. At this point we can safely use linear s-parameters or models to determine the gain and VSWR of our design, since the device is still on its linear characteristic. The main task is to determine the optimum load for maximum power output.

Load-Pull Characterization

The observation that output power is a function of output impedance termination prompts further work on the test bench to determine the characteristics of this functional dependence. The results can be conveniently plotted on a Smith Chart and take the form of closed "contours" of constant power. A typical set of experimental contours is shown in Fig. 2.

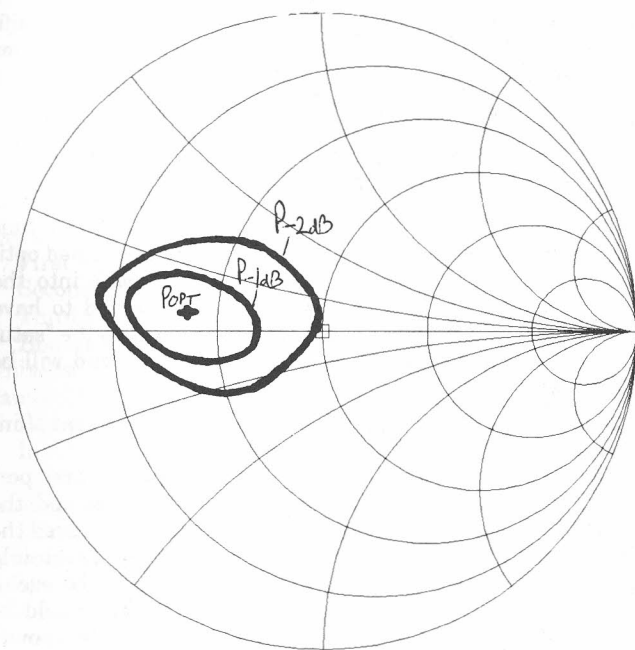


Figure 2. Typical load-pull curves.

These contour plots are valuable to the designer, since they give an immediate design target for a matching network. Unfortunately, a different set of contours is required for each frequency in the band of interest. Here the problem starts; generating these kinds of characteristic is very time consuming. Many attempts have been made to automate the process, and equipment to do so is commercially available, but this means more time and expense.

A disconcerting feature of the contours in Fig. 2 is their distinctive elliptical shape. Microwave engineers are accustomed to circles on Smith charts, and the assumption was always made that predicting an elliptical shape theoretically must involve some non-linear analysis. In a paper at the MTT Symposium in 1983¹, I showed that this was not the case; the elliptical load-pull contours were in fact formed by intersecting circles on the Smith chart, and could be predicted by elementary load-line principles.

Loadlines and Load-Pull Contours

The detailed derivation which starts off with the simplest possible linear model for a GaAs FET and ends with experimentally verified load-pull contours is not reproduced in detail here (see Ref 1, 2 for a detailed analysis). The key point in recognizing that a GaAs FET at microwave frequencies actually behaves in much the same way as a classical Class A audio tube amplifier is the "de-embedding" of the device from its parasitic elements. At microwave frequencies, the effects of package reactances, or even just the bondwire interconnects for a bare chip, plus the accurate setting of the measurement reference plane can jumble the measured data. In particular, the output capacitance of a power GaAs FET can be a dominant impedance element, and only when this is also de-embedded out of the measurement does an appealing and surprisingly simple picture emerge.

Fig. 3 shows an idealized model of a linear FET amplifier. The device is represented as a current generator which swings linearly from zero to I_{DSS} as the gate voltage is varied by the

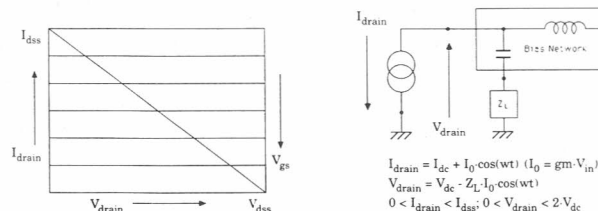


Figure 3. Large-signal FET model.

input signal. Assuming that the DC biasing elements and RF load are suitably separated, the RF voltage at the drain can swing to a maximum value of $2V_{DSS}$. It is an elementary and well-known result that for maximum linear power the RF load must be resistive and given by:

$$R_{OPT} = (V_{DSS}/I_{DSS}) \quad (1)$$

In this expression, an ideal device has been assumed, in which the maximum current is I_{DSS} and this current is sustained for all values of drain to source voltage down to zero. In practice this is taking ideality a little too far, and a more realistic version of equation (1) is:

$$R_{OPT} = (V_{DSS} - V_K)/I_{DC} \quad (2)$$

where I_{DC} is the DC bias current and V_K is the device knee voltage.

This simple result is widely used as a design parameter at lower frequencies. At microwave frequencies, as discussed above, impedance measurements become increasingly dominated by device and package reactances which distort the simple picture. However, detailed measurements on medium and higher power GaAs FETs show that provided the FET drain capacitance is de-embedded as part of the external load, the optimum output impedance is indeed still resistive, and is close to the low frequency value given in equation (1). Fig. 4 shows a plot of measured values of optimum load resistance

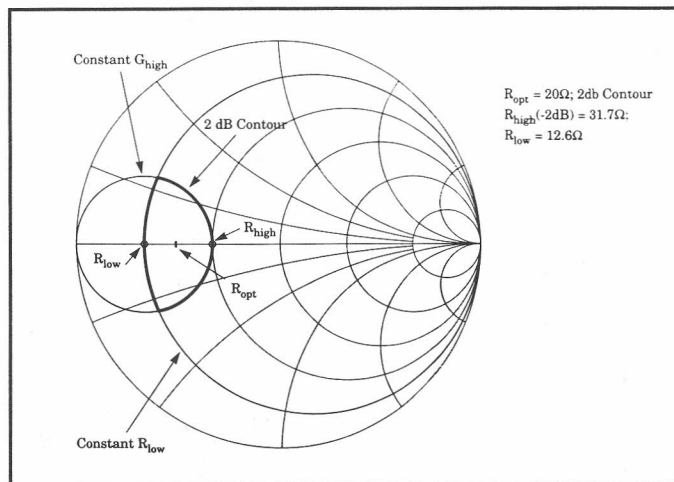


Figure 4. Measured values of R_{OPT} vs. theoretical prediction.

for a wide range of GaAs FET types, from which it can be seen that they fall closely on the line representing the ideal linear model.

Having established that the simple linear model of Fig.3 can predict the output load for optimum power with useful accuracy, the concept can be taken further by considering the values of maximum linear power for any general complex output load Z_L .

This analysis results in a simple set of equations which define the power for any value of output termination (see Appendix). The results can be plotted on the Smith Chart, as shown in Fig. 5. A given contour can be constructed using a simple set of rules:

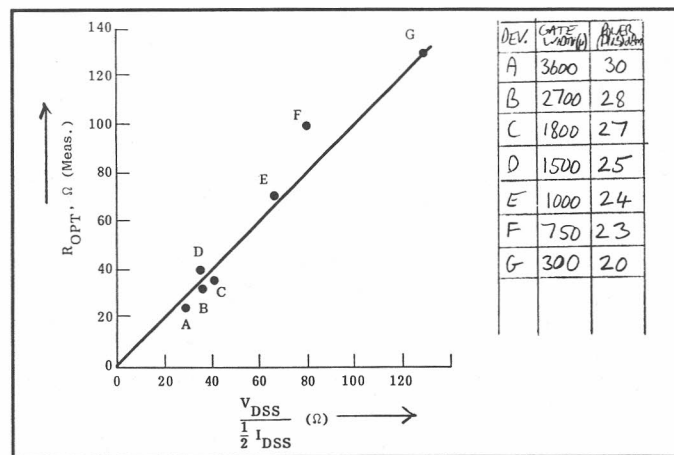


Figure 5. Load-pull contour construction.

- 1) Establish R_{OPT} (Equation (2), above)
- 2) Locate R_{OPT} on Smith Chart
- 3) For $-X_{DB}$ contour: $R_{HIGH} = R_{OPT} (10^{0.1X})$ $R_{LOW} = R_{OPT} (10^{-0.1X})$
- 4) Follow constant resistance line from R_{LOW} and constant conductance line from R_{HIGH} ; locate intersection
- 5) X db contour is defined by enclosed area.

Fig. 6 (a) shows a set of 1, 2, and 3 dB contours plotted by following the above procedure. It should be noted that so far the internal and external parasitic reactances have not been included. In order to compare the theoretical model with

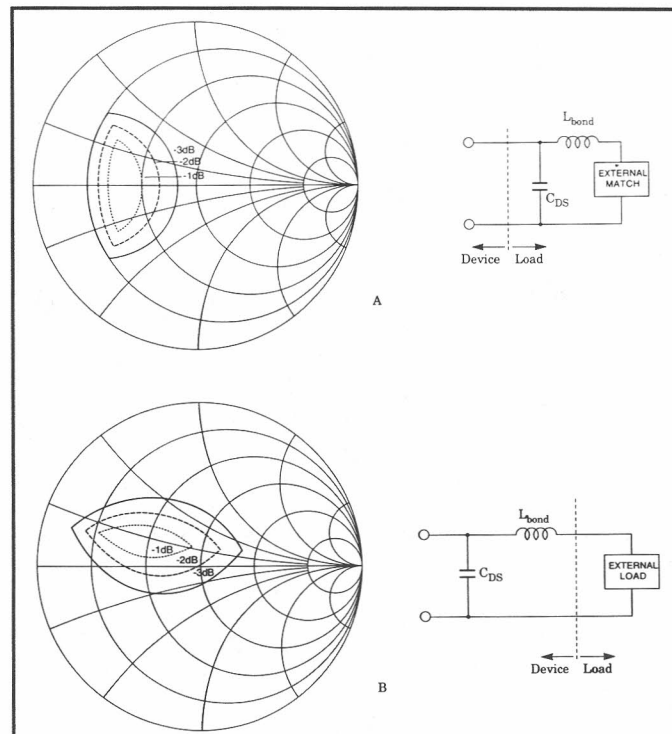


Figure 6. 1, 2, 3 dB Load-pull contours for a Toshiba 8855 chip; $R_{OPT} = 20\Omega$, $C_{DS} = 1pF$, $L_{BOND} = 0.25 nH$, $f = 10 GHz$.

- (a) Load reference plane treating D_{CS} as part of external load.
- (b) D_{CS} and L_{BOND} included as part of device.

measured data, the drain capacitance and bondwire inductance needs to be included as part of the impedance presented to the active device terminals. Fig. 6 (b) shows how the contours shift to more familiar positions when the reference plane is shifted to include the drain capacitance and bondwire inductance.

A Design Example

An example will now be given of a design for a power-matched Toshiba JS-8851AS for the 2-6 GHz frequency band.

The data sheet shows this device operating typically at 90 mA and 10 V Vds for maximum power performance within its thermal ratings. So we can take the R_{opt} value to be $(10-1)/.09 = 100$ Ohms for this bias condition. Also, the small signal model gives a value for C_{ds} of 0.26 pF. The output matching design problem is summarized in Fig. 7. Treating the drain capacitance as an external element (whose value cannot be reduced), the matching network has to transform the 50 Ohm termination up to the optimum 100 Ohms and absorb the drain capacitance and bondwire inductance.

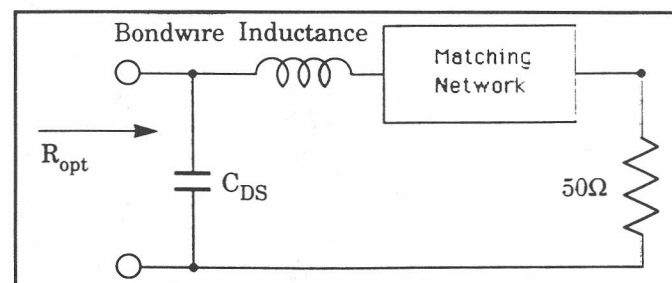


Figure 7. Power matching design problem.

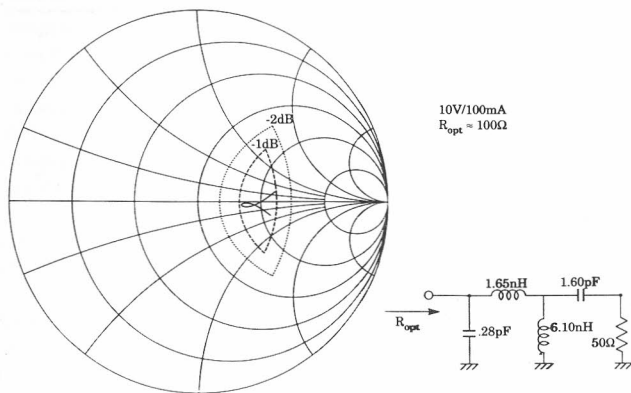


Figure 8. 2-6 GHz power match: JS8851-AS.

Formulated in this manner, the problem is a classical matching synthesis problem, and is best tackled that way. A possible circuit, using lumped elements, is shown in Fig. 9.

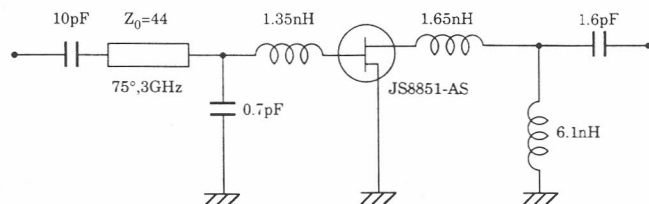


Figure 9. 2-6 GHz power-matched design.

The load-pull contours have been drawn on the Smith chart so that the degree of power match across the band can be tracked. It can be seen that the network is doing a fairly good job, keeping just inside the 1 dB contour. Note the advantage of keeping the drain capacitance as an external element; the optimum load is resistive and therefore constant with frequency, so that the power match can be tracked using a single set of contours.

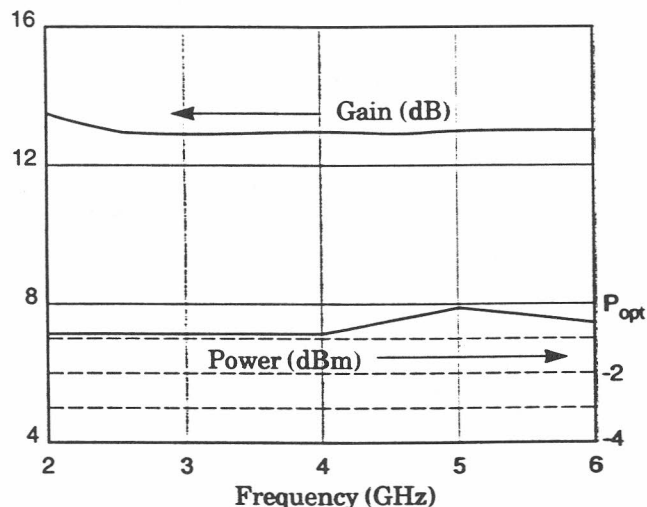


Figure 10. Amplifier gain and power response from 2-6 GHz.

The FET and output matching network can now be considered as a fixed block while the input match is designed. We can use linear s-parameters or a small-signal model for this, since we are designing a linear amplifier. Fig. 9 shows the final design, with its gain and power plotted versus fre-

quency. Note that the power is a relative plot; the power can be regarded as being measured relative to the optimum power for the device.

Does it Work?

Well, yes it does. There are of course some loose ends in the above discussion. I well remember a lecturer starting an undergraduate course in hydraulics by saying "OK, let's get the assumptions out of the way; they're the best laugh you'll have in this course." But he went on to expound a set of techniques and equations which have been successfully used by canal and pipeline designers for over a hundred years. Engineering is not a science, but a practice of the necessary to achieve a given goal. This is a circuit designer's model, not a physical one. It's not hard to shoot the present set of assumptions down, but the bullets can be dodged, for the most part:

- FETs don't always have 50% efficiency (true; a less efficient device cannot sustain the ideal current and voltage swing, but if both erode together the optimum impedance stays the same)
- Drain current does not have a hard limit at I_{dss} (true, although I'm always surprised how few microwave engineers understand the action of a diode clamp)
- Drain resistance is finite and voltage dependent (this is an interesting one, and will be addressed in a forthcoming paper)
- Large signal drain capacitance is different from the small signal value and is voltage dependent (true; but it's not enough to cause gain compression, remember we are still at point A in Fig. 1!)
- Drain voltage does not drop to zero (true; that's why equation (2) is recommended)

Some Wider Applications

The usefulness of this technique need not be confined to power amplifiers. The power performance of any amplifier over its specified frequency range is an important parameter to know for system analysis, but most designers still have to take a "what-it-does-is-what-you-get" approach to the power performance of their designs. Clearly, using the equations which are in the appendix, it is a fairly simple matter to analyze power performance. This becomes particularly desirable in the design of interstage matching networks, where the severe mismatch between the gate of the output FET and the drain of the driver is compounded by the need to maintain a good power match at the driver drain to obtain good overall gain compression performance.

The use of feedback, also, does not preclude the use of the technique; the driving point impedance at the drain can still be evaluated by some slightly innovative use of a good general purpose nodal analysis program, and the power performance can be predicted as previously described.

Conclusion

GaAs FET power amplifiers can be successfully designed using some old-fashioned concepts that have been widely used at lower frequencies. Non-linear simulators have their place and their uses, but they are only tools, like most CAE products. Use them by all means, but don't let them convince you that the job is too difficult. If you reach that point, it's time to build something.

(continued on next page)

Exports Now Employ Twice as Many Engineers as Defense

*Reprinted from
Engineering Supply-Demand Bulletin
Vol. 1, #1, May 15, 1991
Robert A. Rivers, Editor*

Declining defense employment is now more than compensated for by rapidly expanding real export volume. Recent declines in defense employment of 4 and 5 percent have resulted in an estimated employment of 222,000 in this first quarter of 1991 from a level of 244,000 in 1989. Export related engineering employment has been growing at a long term compounded rate of 6.2% per year but moderated by currency exchange rates in the short run. Exports presently account for employment of 456,000 engineers, or over twice the number employed as a result of current defense expenditures. Electrical and Electronics engineering employment supported by defense expenditures was approximately 86,000 in 1989. Subsequent reductions in defense expenditures have contracted that employment by 8000 to 78,000 while expansion of exports has resulted in expansion of export supported Electrical and Electronic Engineering employment to 175,000 in the first quarter of 1991, twice the defense employment.

The numbers of defense supported engineers and of export supported engineers were derived from a sensitivity analysis using a Data Resources economic forecasting model implemented to translate from the economic forecast by sectors to the utilization of engineers by sector and by specialty. The detailed sector demands are aggregated to produce the specialty and total engineering demands. In the case of exports, the sensitivity was determined by decreasing exports by increments from 1.9% to 14.3% and observing the decrease in engineering employment that in fact varied from 0.5% to 3.5%. The sensitivity of engineering employment to export volume when extrapolated from the 14.3% level to the 100% level was 24.5% and was linear over the range except for rounding variations. In the same manner, Electrical and Electronics Engineering employment sensitivity when extrapolated to the 100% level was 30.6% indicating a higher dependence on exports than engineers in general. **In the first quarter of 1991, 24.5% of engineers are supported by export sales and 30.5% of EE's are dependent on exports.**

A recent issue (Vol. 3, No. 3, Mar. 1991) of the Engineering Manpower Newsletter analyzed real export dollar volume and found a very solid exponential trend line compounding at a rate of 1.508% per quarter modified by an expansion contraction component highly correlated (-0.865) with the trade weighted dollar exchange rate. In addition, the trade dollar leads the export volume by 5 quarters. Because of the highly reliable trend and the dollar value correlation, export volume can be reliably forecast for 5 quarters. Forecasting beyond 5 quarters does not seem to be possible since the dollar value seems to be determined by the Group of Seven central banks.

In the first quarter of 1991, the real dollar value of exports needed to support one engineer was \$1,415,000. This is in between the values of GNP per engineer of \$2,330,000 from the general economy and defense expenditures per engineer of \$1,190,000 and establishes its reasonableness from a subjective point of view. In all of the above, engineer counts are based upon BLS Current Population Survey (a household

survey as contrasted with other counts that may be based upon a BLS occupational survey of employers).

Figure 1 shows variation in engineering employment as a result of the expansion trend of 1.508% per quarter modulated by the exchange rate controlled variation. The stagnation periods are associated with the rising and then high value of the dollar while the rapid expansion is associated with the falling and low value of the dollar. The values were derived from the 1991 measured value of \$1,415,000 of exports per engineer. That factor was used to determine all previous levels of engineering employment based upon the then current real dollar export volume. Other work has indicated that the real GNP per engineer increases at the rate of 1% per year. No early data is available to determine the productivity correction. On the basis of the other data, it is expected that in early years, employment may be understated by as much as 20%. The current levels are represented. Electrical and Electronics Engineers will have roughly the same kind of variation but with a present quarter peak of 175,000 supported by exports.



Figure 1. Engineering employment supported by exports.

Ed.—This article is republished at the request of Louis Medgyesi-Mitschang who serves as Chairman of the MTT-S PACE Committee.

Old-Fashioned Remedies

(Continued from previous page)

References

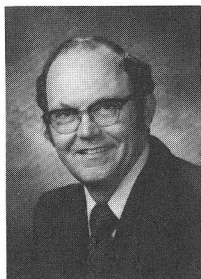
- ¹Cripps, S.C., "A Theory for the Prediction of GaAs FET Load-pull Power Contours", IEEE MTT-S Intl. Microwave Symposium Digest, 1983, pp221-223.
- ²Cripps, S.C., "GaAs FET Power Amplifier Design", Tech Note 3.2, Matcom Inc, ((415) 493 6127).

Dr. Steve Cripps is an independent consultant in microwave component design. He received his Master's and Ph.D. degrees in Electrical Engineering from Cambridge University, England, in 1974 and 1975, respectively. He has worked in engineering and management positions at Celeritek, Narda, Watkins Johnson, and Plessey Research (UK). In all of these positions he has specialized primarily in GaAs FETs and GaAs FET amplifier design.

This article was submitted through Feature Articles Editor, John Eisenberg, (415) 941-7426.

PCs for ~~AP~~ MTT

June, 1991



by E. K. Miller

The primary topic of this column will be brief reviews (they began as "mini-reviews," but the more I got into them the longer they became) of two books dealing with visualization. Also, starting in this column is something I plan to become a regular feature, samples of Visual ElectroMagnetics (VEM) applications provided by reader input, or from other sources. In past columns, I've suggested the possibility of publishing a book on VEM, and in that connection, solicited examples from readers interested in that topic. Because of the response to date, it seems to me that it would be a good idea to begin "previewing" these examples in this column. I welcome you again to send me any VEM examples that you might like to share with readers of the *AP-S Magazine* or *MTT-S Newsletter*.

Visualization Revisited

Some past columns were concerned partly or wholly with visualization and related topics. Scientific visualization is becoming recognized as a discipline in its own right that is increasingly important to scientists, engineers, and many other disciplines where abstract concepts and/or large amounts of data are encountered. Indeed, one of the major thrusts of the CAEME (Computer Applications in ElectroMagnetic Education) project is exploiting computer-based visualization technology for use by students and teachers alike. As electromagneticists, we should be able to "sell" our discipline better, to prospective students, our scientific non-EM colleagues, and to the public at large by more effective use of visual presentations. I have recently come across two more books that deal with visualization, whose contents are summarized and briefly reviewed below.

the SECOND computer revolution: VISUALIZATION,
by Richard M. Friedhoff and William Benzon, Harry
N. Abrams, Inc., New York, 1989, ISBN 0-8109-1709-2.

This is a marvelous book for anyone interested in visualization, whether from an interpretation and applications viewpoint, or computer-graphics and visualization-technology perspective, or for artistic exploration, or . . . There's something here for anyone who uses visualization for work or play, which must include just about everyone fortunate enough to be able to see. I would like to take you on a full tour of this book, but words can't do it justice considering that it is a large-format (8.5x11 in) book having over 200 illustrations, most in color, and you remember what Confucius said about a picture being worth 1,000 words. Actually, he was quite conservative considering that in even such a low-resolution image as a television picture, there are an equivalent of 250,000 words or so (based on 325x400 pixelsx1 byte/pixel and assuming 5 bytes per word).

As observed by Gregory in the foreword, "the central point that this book makes is that newly discovered *preconscious*

processes of human vision can be tapped and used to powerful effect by computer images—especially by computer graphics to suggest ideas. Perhaps its most powerful form is interactive graphics, where the hand can control and change the image, much as though it is a solid object lying in the familiar space of the object world. But the possibilities exceed the normal hand-eye interaction with objects, for the computer may display *abstractions* and even impossible *fantasies*, which can never exist as real objects. It has been claimed that computer interaction allows visualization to take off from our familiar world of objects, even to further dimensions of space. So a computer-generated four-dimensional hypercube, although at first a meaningless jumble of lines, becomes a richly meaningful object as it is explored by moving it around under the control of the viewer. A fascinating question is how powerful computer graphics will ultimately turn out to be for enhancing our visual awareness, and conceptual power to understand and invent."

For those of us interested in fields and waves, Gregory's observations are certainly relevant with respect to displaying *abstractions*, as we are unable to directly observe most aspects of the phenomena described by Maxwell's Equations. But it could be claimed that the word *fantasies* might also describe use of visualization in electromagnetics, since the phenomena with which we deal are not real objects that we can touch and handle. It's fairly obvious that much more use can be made of visualization for displaying the physics of EM fields. But perhaps other less obvious ways for developing a more intuitive understanding of the subject will be possible. An example was presented in *Smithsonian* magazine a while back, where the feasibility of being visually immersed in a relativistic world was being considered as a way not only of interesting students in the topic, but also of achieving a more basic feeling for, and discovering the ramifications of, relativity.

A brief preview of the topics to be covered in more depth is given in the introductory chapter, where the idea that visual thinking is real is reinforced, referring to Friedrich Kekule's insight in 1865 concerning the molecular structure of the chemical benzene having the form of a snake biting its own tail, and also to Albert Einstein's comments on visualization. This leads to a discussion of left-brain, right-brain thinking, where the latter is identified as the visual component. The chapter concludes by repeating the central premise of the book which is that because of the computer, visualization is emerging as a distinctive new discipline. It is emphasized that if visualization is to realize its full potential, it will have to borrow ideas from those areas traditionally concerned with imagery such as art history and perceptual and cognitive psychology. The remainder of the book attempts "to create a framework, borrowing from many fields, which will be useful to everyone who visualizes whether in art, science, medicine, entertainment, design, or any of the disciplines that every day are being irrevocably changed by the computer."

In the chapter "We Create the World We See," the various components of vision are discussed, including the color sense, stereopsis (two-eyed depth perception), and form perception. Isaac Newton began the science of modern color theory with his discovery of the light color spectrum using a prism. This result, Newton's discovery that the separated colors could be recombined into white light, and the further result that three colors can be mixed to make the other principal colors of the spectrum whether using light or colored pigments, produced the ideal of trivariance as proposed by Thomas Young. This is the theory that the eye has three separate sensitivities to "primary" colors, an idea later refined by Herman von Helmholtz who developed the Helmholtz equation. The Young-Helmholtz theory has been shown in recent years to be inad-

equate for explaining certain aspects of real-world color perception. Edwin Land, inventor of the Polaroid camera, proposed a radical new theory of color perception, finding that only two wavelengths are needed to produce a full-color scene, one relatively longer and one shorter wavelength, an idea embodied in the Land retinex theory. Land concluded that *the eye is able to see color independently of wavelength*, and he devised a series of experiments to illustrate this idea using a collage of colored papers now called a Mondrian after a Dutch artist Piet Mondrian whose paintings they resemble. The chapter concludes with discussions of how the visual system creates a three-dimensional world using stereopsis, the physiological mechanisms of vision, and conscious vs. preconscious visual processing.

The chapter "Images from Energy" discusses the various ways by which visual images can be formed and processed, including forming an image of non-visual or visually inaccessible phenomena. This process is referred to by the authors as capturing or transducing a pattern of energy. Transduction is defined as the transformation of energy from one form to another, the goal in this case being to make an image pattern. Much of what we do in electromagnetics might be said to deal with transduction, especially as we compute and measure more data such as surface or volume distributions of sources and fields whose patterns we wish to examine. This chapter, however, addresses visualizations that begin in the physical world, while the following chapter deals with computer graphics, and our EM applications encompass aspects of both. Some techniques of image processing are discussed, including one most of us have used or observed, the development of pseudo- or false-color images. Fourier analysis, computed tomography, holography and other techniques are summarized and illustrated with application examples.

The chapter on "Computer Graphics" discusses visualization that begins with a visual idea as opposed to imagery that represents a pattern of energy. The authors claim that "the real importance of computer graphics, its revolutionary significance, is as a tool for visual experimentation. Computer graphics provides a seamless fusion between the massive processing power of the visual system and the power of the digital computer." They further observe that "computer graphics, because it bonds mind and machine in a unique partnership, creates an entirely new way of thinking." Pixel-based and object-based graphics systems are discussed and illustrated. An intriguing example of the former is a series of variations of the well-known painting by Grant Wood *American Gothic* which shows a husband-wife farmer couple standing in front of their house. As this example shows, changing visual reality with computers requires the observer to suspend belief in what might be presented in an implausible photograph. Wire-frame development of solid models (akin to our use of wire meshes to approximate solid, conducting objects) is discussed and illustrated. Procedural graphics are discussed as a way to develop descriptions of complex objects and scenes from more basic building blocks, a problem that is closely related to the computational electromagnetics' task of building numerical models of geometrically complex antennas and scatterers.

In the chapter on "Visual Experiments" the authors begin with a quotation from a letter to Jacques Hadamard by Albert Einstein. It is "The words or the language, as they are written or spoken, do not seem to play any role in my mechanism of thought. The psychical entities which seem to serve as elements in thought are certain signs and more or less clear images which can be 'voluntarily' reproduced and combined. . . this combinatory play seems to be the essential future in productive thought before there is any connection with logical construction in words or other kinds of signs which can be

communicated to others." An interesting example of using images instead of calculations is presented in terms of "a game in which two players take turns choosing numbered chips from a hat. The chips are visibly numbered 1 through 9 and the goal of the game is to be the first to draw three chips that total 15. Each player must also keep in mind the need to block the opponent from arriving at the sum of 15 first." The preceding is a word description of a game known to all of us as tic-tac-toe. Once this is appreciated, playing the game becomes more intuitive than it first appeared to be where a set of calculations were needed at each step. An interesting example of visualizing the computer is given as color-coded matrices representing two sorting algorithms with the point that "it is easier to compare the operation of the algorithms with these visualizations than to compare the computer programs themselves." Other examples in this chapter include fractals, simulations of black holes and tornados and representing molecules.

The book's concluding chapter on "Emergent Technologies" summarizes some of the evolving applications that are being developed. An impressive example is that of the synthetic flyover, which combines image processing and computer graphics. One visual example presented is for the Los Angeles area where a satellite image is used together with topographic data to produce the view that would be seen by an airborne camera moving arbitrarily over the area. Another is a flyover of Miranda, a moon of the planet Uranus. Volume visualization adds tomography to the tool box, for which there are promising medical applications. Other topics discussed include combining computers with holography, parallel computing and artificial reality. The latter attempts to make the human/computer interface more intuitive and natural by replacing the keyboard with more realistic mechanisms. An example of artificial reality is the "data glove" where stereoptic images of a scene are presented visually working together with instrumented gloves to detect finger movements, to literally immerse the user in a computer-generated world. Such techniques are beginning to be used by surgeons in preparing for a complex operation, and for similar applications.

The book concludes with a listing of more than 50 resources for further reading. All in all, I found this to be an exciting, rewarding and stimulating book. If your interests include visualization, whether just in general or for specific uses in research, teaching, or application, I think you will find this book to be a useful resource.

Incidentally, you can expect to see an article based on this book appearing in a future issue of IEEE *POTENTIALS* magazine, the student publication. *POTENTIALS* is published four times per year, and as an associate editor, my job is to find authors for articles. If you are interested in contributing an article to the magazine, please contact me for an author's kit. Our circulation is over 50,000, so anything you might write could have a significant impact on the future careers of present students. Guidelines for *POTENTIALS* authors are fairly simple. Article length should not exceed 4,000 words less figures and illustrations. Since this is a student audience, mostly juniors, seniors and graduate students, the level should be appropriate for their background. We need an article about six months prior to publication, and it will be reviewed by student readers. I hope to hear from some of you.

Envisioning Information, by Edward R. Tufte, Graphics Press, P.O. Box 430, Cheshire, CT 06410, 1990.

This book is an impressive, even scrumptious, sequel to Tufte's (a professor of political science at Yale University) previous book on this topic: *The Visual Display of Quantita-*

time Information" (see PCs for AP, February 1988). It includes extensive use of color, and while emphasizing visualization as a way of dealing with complexity, is less technology and more history oriented than is "The Second Computer Revolution" reviewed above.

Envisioning Information is also a large-format, 8.5x11 in book, chock full of a wide sampling of graphical presentations. Tufte observes in the Introduction that "The world is complex, dynamic, multidimensional; the paper is static, flat. How are we to represent the rich visual world of experience and measurement on mere flatland?" The book includes several hundred displays of complex data to "celebrate escapes from flatland." The displays include samples from maps, "the manuscripts of Galileo, timetables, notation describing dance movements, aerial photographs, the Vietnam Veterans Memorial, electrocardiograms, drawings of Calder and Klee, computer visualizations, and a textbook of Euclid's geometry." Tufte suggests that "This book could serve as a partial catalog for . . . a Museum of Cognitive Art. . . . To envision information—and what bright and splendid visions can result—is to work at the intersection of image, word, number, art. The instruments are those of writing and typography, of managing large data sets and statistical analysis, of line and layout and color. And the standards of quality are those derived from visual principles that tell us how to put the right mark in the right place."

In chapter 1 on "Escaping Flatland," Tufte discusses the problem of presenting multivariate information not residing in three-space reality, one of which is to slice and project data from many angles onto, for example, the twelve surfaces of a pentagonal dodecahedron. Examples from astronomical observations of sunspot data are included together with railroad timetables, dance steps and atmospheric pollutants and weather conditions. Chapter 2 on "Micro/Macro Readings" discusses the transition from large-scale macro presentation to more finely-detailed micro visualization. A perhaps unexpected application of such principals is displayed in the decision of the designer of the Vietnam Veterans Memorial in Washington, D.C., to list the names by data of death rather than alphabetically. Graphical timetables are also used to illustrate this topic as well as the pattern of the growing number of objects in orbit around the earth.

Chapter 3 on "Layering and Separation" analyzes the need "to find design strategies that reveal detail and complexity." Tufte further notes that "Among the most powerful devices for reducing noise and enriching the content of displays is the technique of layering and separation, visually stratifying various aspects of the data." One obvious approach to layering and separation is the use of transparent overlays. The basic idea is that "the various elements of the graphical design collected together on flatland *interact*, creating non-information patterns and texture simply through their combined presence. Josef Albers described this visual effect as $1 + 1 = 3$ or more." Examples presented here are taken from timetables, hospital bills, maps, electrocardiogram tracings, music and marshalling signals. The idea of "Small Multiples" is the topic of Chapter 4. Tufte observes that "At the heart of quantitative reasoning is a single question: *Compared to what?* Small multiple designs, multivariate and data bountiful, answer directly by visually enforcing comparisons of changes, of the differences among objects, of the scope of alternatives. For a wide range of problems in data presentation, small multiples are the best design solution." These ideas are illustrated in several ways in this chapter, one of the more interesting being a 1659 drawing by Christiaan Huygens which depicts three ellipses. The inner traces the Earth's yearly journey around the sun, a second shows Saturn's orbit viewed from the heavens, and the third how Saturn

appears as viewed from Earth.

In Chapter 5 on "Color and Information," Tufte suggests that "Tying color to information is as elementary and straightforward as color technique in art . . ." He cites two principles for use of color (paraphrasing): 1) Confine use of pure, bright or very strong colors sparingly to small areas of extremes; 2) Avoid placing of light, bright colors mixed with white next to each other; 3) Large area background or base-colors should do their work most quietly, to allow smaller, bright areas to stand out most vividly; and 4) Do not present separate, large, enclosed areas in different colors, as they tend to fall apart. As evidence of the benefit of using color in a mathematical setting, several geometrical applications are shown. It is also recommended that information is best presented using colors found in nature, as these are "familiar and coherent." Tufte concludes his book with, in Chapter 6, "Narratives of Space and Time," where the examples include Galileo's observation of the satellites of Jupiter, and their modern portrayal via a corkscrew diagram that presents relative position versus time. Other examples are for railroad and airline schedules, musical scores and dance.

All in all, I think that you'll find this to be a fascinating, thought-provoking, stimulating book. It is a nice complement to *The Second Computer Revolution*, reflecting a more historical, graphics-design approach to visualization as opposed to the computer emphasis of the latter. Incidentally, the cover story of the April 29, 1991, issue of *Business Week* magazine titled "I Can't Work this Thing" addresses the issue of technological complexity. In a sidebar of this story, "The war on information clutter," Tufte is called "the guru of the information-design movement." You PC users might be interested to know that he was called in by IBM to help with the look of its Presentation Manager, a graphical program that employs colors. Tufte himself says that he likes the look of NeXT Computer Inc.'s black-and-white workstation because of its much higher resolution. His views on the Macintosh aren't mentioned.

This book is also reviewed in the Sep/Oct 1991 issue of *American Scientist*, where among other things it is mentioned that Tufte mortgaged his home to finance publication of his original book *The Visual Display of Quantitative Information*. More than 96,000 copies of that book have been sold, and since Graphics Press (i.e., E. R. Tufte) had room for storing a maximum of 12,000 copies, the book is now in its ninth printing. In both books, Tufte also eschews use of captions under figures, but instead includes the information that would be in a caption in the text itself.

Further Reader Input on Visualization

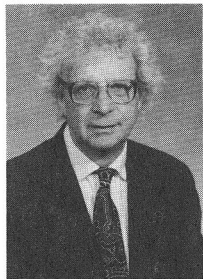
I am grateful to have received some additional VEM examples from readers. Assuming that further examples continue to be provided, I expect to make their presentation a regular feature of future columns. Results were received during the past two months from Professor David Pozar of the University of Massachusetts, Amherst, and a group at Clarkson University in Potsdam, New York. Dave's contributions are in color, and so may need some special handling if they are to be included in the Magazine, something I will check on. Some of the Clarkson results follow below.

A VEM Example from D. Q. Chowdhury, P. W. Barber and S. C. Hill of Clarkson University, 315-268-6511

In an article submitted to *Applied Optics* titled "Energy-Density Distribution Inside Large Nonabsorbing Spheres via Mie Theory and Geometrical Optics," the authors had included two surface graphs depicting the Mie and GO solu-

(continued on back cover)

Report From the Division IV Director



*Martin V. Schneider
AT&T Bell Laboratories
Holmdel, New Jersey*

A Sleeping Beauty for a Century, the Soliton Wave, Is Finally Awakened

Early this spring, IEEE members Linn Mollenauer and Akira Hasegawa flew to London to receive the Arthur Rank Prize for their work on soliton propagation. The banquet speech was given by Mrs. Margaret Thatcher who presented the awardees with a check of 45,000 pounds. In a subsequent congratulatory letter to the recipients, IEEE President Sumner wrote: "Your innovative research opens new opportunities in the field of ultra long distance fiber transmission and will accelerate the creation of global communication networks." Another kudo appeared on the front page of the Wall Street Journal on June 25, reporting that soliton pulses had been sent '6,000 miles through a glass cable without regeneration, 10 times the commercial distance record."

What are soliton waves and why are they excellent candidates for the transmission of lightwave pulses through optical fibers? The origin of the work on the solitary wave properties of a propagating field goes back to the mathematical treatment of nonlinear wave equations by D. G. Korteweg and G. DeVries in 1895. Starting with appropriate boundary conditions, it can be shown that stable waves may be launched in nonlinear media. They occur in nature as waves which propagate on the surface of oceans, oscillations transmitted through a one-dimensional nonlinear crystal lattice, and as optical envelope solitons in fibers. Soliton propagation has also been observed in periodic nonlinear transmission lines and applied to efficient broadband harmonic generation at microwave and millimeter-wave frequencies.

Soliton generation and propagation is particularly attractive for use in all-optical transmission systems in undersea applications. In this specific application the optical envelope soliton is a light pulse for which dispersion and nonlinearity can cancel each other. Thus transmission with minimum distortion ranging up to 10,000 kilometers can be achieved if sufficient optical power levels are maintained through periodic amplification. The production of a videotape of this new development is currently being planned by the IEEE Education Department in Piscataway, New Jersey.

Membership Growth and Formation of New Chapters

The 1990 annual report of the secretary of the IEEE, Fumio Harashima, shows that the membership of the Microwave Theory and Techniques Society declined by 4.5% to 11,597 members at the end of the year. From the extensive

data of the report, one can pinpoint the geographical areas where the membership changed most rapidly.

The highest decline of 10.8% occurred in the southeastern part of the USA (Region 3). This was partially compensated by a membership increase of 5.1% outside the USA. It is generally observed that both technical activities and membership growth are enhanced in areas where new chapters have been formed recently. A particularly fertile area for the formation of new chapters is the European Common Market with a total population of 330 million of which about 1 million are estimated to be electrical and electronics engineers.

Highlights From the Technical Activities Board Administration Council Meeting (TABAC)

The TABAC team met on April 6, 1991, at the Nashville Airport Marriott Hotel, Nashville, Tennessee. The main function of the council was to implement programs and oversee policies established by the IEEE Technical Activities Board. The highlights of the meeting are as follows:

1. The council endorsed the establishment of a Staff Conference Service to facilitate the planning and organization of technical conferences.
2. The Vice President of Technical Activities is currently elected by the IEEE Assembly. It was recommended that the VP be elected by TAB and that this procedure be discussed at the Society President's forum.
3. Larry Anderson, chairperson of the Society Review Committee, presented a schedule for the review of Societies on a five-year cycle. The review of the Societies in our Division will begin in 1992 with completion in early 1993.
4. Don Bolle, who is in charge of the Committee on Technical Excellence and Leadership, reported that his group had selected a number of technologies for reviews and will seek to identify internationally recognized experts who can evaluate IEEE's current standing and recommend actions to enhance IEEE's leadership in these areas.
5. Avrid Larson, chairperson of the USAB Technology Policy Council, requested Societies to identify technical experts to serve on the USAB Technology Policy Committees.

Highlights From the June 1991 Board Meetings

The IEEE Assembly, Board of Directors and Executive Committee met in San Francisco from June 17 to June 20, 1991. The following activities took place:

1. The forecast for the deficit at the end of 1991 for the IEEE General Fund has climbed from 550 K to 828 K.
2. In order to prevent a financial crisis in 1992, the dues, fees and regional assessments will be increased. For example, the dues for grades other than students will increase from \$63.00 to \$73.00 per year. More specifically, the IEEE Bylaw 109.1 which covers dues, fees and regional assessments was amended as follows:

Annual dues	\$73.00 per year
Assessment (Regions 1-6)	\$22.00 per year
Student dues (Regions 1-7)	\$23.00 per year.
3. The long term financial goals, as presented by the treasurer, Ted Hissey, were approved and will be added as guidelines to the IEEE Policy and Procedures Manual,

(continued on next page)

Report of the Division IV Periodicals Council and Publications Board Representative

by Ronald Pogorzelski
General Research Corporation
Santa Barbara, CA

Having just returned from meetings of the TAB Periodicals Council and the Publications Board, both held in Chicago, I thought I would try to provide you with a few of the highlights of those meetings.

By design, a significant number of the issues on the PUBS Board agenda was first considered by the Periodicals Council the day before. This enabled the Council to provide the Board with a recommendation to aid it in its deliberations. Two such items concerned publication of a society magazine using outside vendors as opposed to the IEEE Magazines Department. In particular, the Antennas and Propagation Society (AP-S) (Division IV) and the Dielectrics and Electrical Insulation Society (DEIS) (Division II) both presented their cases for acquiring publication services for their respective magazines outside of IEEE. In each case the major incentive was financial. These Societies feel that they are able to avail themselves of a very significant amount of volunteer labor and are therefore paying for a good deal of IEEE service which they do not need. The IEEE Magazines Department for its part feels that it can provide a superior quality product at a competitive price. IEEE Staff and Society estimates of the financial impact to the societies of "going outside," not too surprisingly, differ. Both Societies argued that it is their firm belief that publication of their magazines will not be viable using the services of IEEE. After a lengthy discussion, the Periodicals Council endorsed both proposals conditioned on compliance with IEEE Policies and Procedures concerning quality, advertising revenues, cost advantage, payment of a share of IEEE fixed costs, etc. The PUBS Board, however, tabled the DEIS motion and passed the AP-S motion conditioned on verification of compliance issues prior to the next TAB meeting. A concern was also raised regarding compatibility of the *AP-S Magazine* with plans for future distribution via CD-ROM.

Several other proposals concerning Transactions and Magazines were endorsed by the Periodicals Council and approved by the PUBS Board without much argument. Two of these were a split of the *Circuits and Systems Transactions* into two Transactions and establishment of a new *Transactions on Micro Electro Mechanical Systems* (hyphenation and capitalization TBD!). Another was declaration of the *Circuits and Devices Magazine* and *Technology and Society Magazine* "general interest publications" which allows them to be sold to non-Society members at a non-institutional rate. (That is, if you are an IEEE member and want to receive an IEEE publication not so declared and you are not a member of the corresponding Society, you would have to pay the institutional rate!) Lastly, the Computer Society intends to take over publication of *Annals of the History of Computing* which was being discontinued by its present commercial publisher. It is believed that such historical records, analyses, and insights should be preserved.

Speaking of institutional subscription rates, there has been a concern that members are not aware that it is considered

not quite "cricket" of them to use their individual IEEE memberships to subscribe to IEEE publications for their institution. Thus, if you are a member of more than twenty Societies (!) you have probably noticed that a statement to this effect has been appearing on your dues bill. At this meeting the Periodicals Council reduced the threshold for appearance of the statement from twenty memberships to fifteen. My! What is the world coming to?

The next Panel of Editors meeting is planned for early in June in Piscataway and record attendance is anticipated. I must admit that, though I was Editor of the *AP Transactions* for three years, I never felt compelled to attend this Panel. However, looking over the agenda for this next meeting, I think that, were I still an Editor, I would certainly make an effort to go. It seems that the IEEE Staff has worked very hard to plan a meaningful gathering and the record number of reservations attests to their success. There is to be a general session with a number of presentations on various editorial concerns and there will also be "breakout sessions" on "tricks of the trade" and issues more specific to particular types of publications such as "incentives for reviewers" in the Transactions session. By the time you read this, your Editors will have attended this Panel (or not) and will no doubt have opinions as to its value. I would be interested in hearing from the Division IV Editors in this regard.

Incidentally, Richard Doviak's *Geoscience and Remote Sensing Transactions* has won an award of the Association of American Publishers for his September 1991 issue. You might want to check out that issue to see what constitutes an award winning publication. Congratulations, Richard and IEEE Staff!

Another news item is the transfer of the Broadcast Technology and Consumer Electronics Societies to Division IV effective January 1, 1992. The Division currently consists of the Antennas and Propagation Society, the Electromagnetic Compatibility Society, the Microwave Theory and Techniques Society, the Magnetics Society, the Nuclear and Plasma Sciences Society, and the Superconductivity Committee. To our new additions, "Welcome!"

Finally, a number of reports and discussion items were disposed of and I will report to you on those issues as they develop. Enough is enough!

Ed.—The Panel of Editors meeting in Piscataway was held the week of the 1991 MTT-S IMS. None of the MTT-S Newsletter Editors attended.

Report From the Division IV Director

(continued from previous page)

with the exact wording to be submitted for approval at the November 1991 meeting of the Board of Directors.

4. The 1992 basic operating budget was approved.
5. A number of other actions were taken covering a wide spectrum of topics including publications, committee appointments, delayed arrival of election ballots in Regions 8-10, and approval to continue the Engineering Skills and Assessment Program (ESAP) subject to a detailed follow-up report of the Educational Activities Board in 1992.

It is to be noted that while the IEEE General Fund is by now nearly depleted, the Societies have prospered financially through income derived from conference registration fees, and the "All Publications Package" sold to libraries. Three Societies in Division IV have become millionaires and may eventually have to decide how to return a good part of their savings to their members in the form of improved services.

TAB Highlights

by Ferdo Ivanek
1991 MTT-S President

The second meeting of the 1991 Technical Activities Board (TAB) was held on June 17 in San Francisco. It was, in fact, a four-day meeting sequence starting on June 14 with Division X Society Reviews. The morning of June 15 was reserved for TAB Committee meetings; I attended those of the Society Review Committee and of the Transnational Committee. In the afternoon we had the TAB Caucus which is intended for informal discussions and consensus building in preparation for the TAB Business Meeting. The all-day June 16 Society Presidents' Forum was another preparatory meeting; it concentrated on those items on the agenda of the TAB Business Meeting that are of special interest to the Societies.

For the benefit of new MTT-S members who lack the background information on the TAB, I am referring to the corresponding past write-ups in the *MTT-S Newsletter* Numbers 126 through 128. Those who are interested in more detail about the June 1991 meetings than I am able to provide here, I would like to refer to *Technical Activities Newsbriefs*, Vol. 10, No. 3, copies of which can be obtained by writing to the TAB Secretariat, 445 Hoes Lane, Piscataway, NJ 08855-1331, or calling them at (908) 562-3921.

The major categories of actions taken at the June 17, 1991, TAB Business meeting were: publications, Societies' Field of Interest changes, budget and miscellaneous housekeeping items.

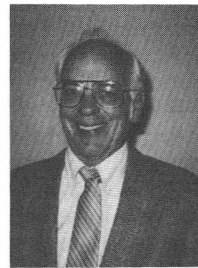
Three new periodicals have been approved: *Annals of the History of Computing*, *Transactions on Microelectromechanical Systems*, and *Transactions on Image Processing*. TAB also endorsed a proposal to split the *Transactions on Circuits and Systems* into two parts: I. *Fundamental Theory and Applications*, II. *Analog and Digital Signal Processing*. Four publications have been placed in the "general interest" category, which makes them available for subscription to all IEEE members (and not only to members of the publishing Societies): the *Circuits and Devices Magazine*, the *Technology and Society Magazine*, the *Annals of the History of Computing*, and the *Electrical Insulation Magazine*. The first one is of greatest interest to MTT-S members.

TAB endorsed the Engineering Management Society's revised Field of Interest which more accurately describes the Society's current focus. Based on experience with these matters, TAB approved a recommendation of the Society Presidents' Forum for a procedure that will provide all Societies an opportunity to review and, if needed, resolve problems before presentation to TAB for action. Also, TAB requested the Vice President—Technical Activities to devise a mechanism for resolving Field of Interest disputes between Societies which will provide for analysis and judgement of overlap and methods for ensuring compliance. As can be seen, the accelerating pace of technological development stimulates more frequent reviews and revisions of Society's Field of Interest. It would be in the best interest of our Society to revisit the subject and to monitor the changes proposed by other Societies.

The IEEE and TAB budget problems I reported in the Number 128 *MTT-S Newsletter* have not been satisfactorily resolved. The deficit is growing, and the actions taken to reverse this unsustainable trend are apparently insufficient and late. I therefore continue to be concerned about the persisting pressures to increase the various IEEE service fees

(continued on next page)

Highlights of TAB Technical Meetings Council



Chuck Buntschuh
Div. IV Representative
TAB Technical Meetings Council

Through the good offices of Martin Schneider, the Director of the IEEE Division IV (Electromagnetics and Radiation), I have recently been appointed the Division's representative to the Technical Meetings Council of TAB.

The Technical Meetings Council is the new name for the old Meetings Committee, under the new organization of TAB. The Council recommends technical meetings policy to the Technical Activities Board, and is responsible for overseeing all technical meeting activities involving TAB, and assists Societies and other TAB entities in development and organization of technical meetings by providing information and guidance regarding IEEE policies and procedures.

The Council is working on a number of projects for 1991. In this report I'll highlight several which should be of general interest to those involved in planning, administering, and managing technical conferences.

A new edition of the Conference Manual is into its second draft; the final document should be available to the Societies by the end of the year. Besides bringing the old edition up to date, the new one will be greatly expanded and so arranged that each Steering Committee member will find everything he or she needs in one chapter. Also it will contain a lot of checklists and blank forms to help make each committee member's job easier.

Last year a software package had been developed and introduced for Conference Registration. This year another package has been added for tracking of papers submitted to a conference. The program is now available for what might be considered alpha testing - I don't think it has been tested in action yet. Most of the larger Societies and Conferences already have well-developed systems, or let the jobs to outside contractors and thus may not have a need for these programs. However, if your Society or Conference is not so furnished, you may find one or the other of them a real boon.

What could be of considerable interest to all Societies is that the IEEE is getting into the conference management business. The Conference Management Services enterprise will be under the direction of the Technical Meetings Council and will offer a menu of services which ultimately will cover everything from site selection to all of the local arrangements functions. The program is being run by IEEE staffer Mr. Peter Sensi, who is quite experienced in conference management. Also it will not be financially underwritten by the IEEE and must stand on its own and compete in the open market. Phase I of their business plan, which is already underway, is to manage several small conferences which have been contracted by the Technical Activities Department for several years. Phase II, which is also off to a modest start, will be to offer a limited menu of services. Phase III will provide the entire smorgasbord. For more information, call

(continued on next page)

TAB Highlights

(continued from previous page)

incurred by the Societies, which would negatively affect MTT-S' finances. While our 1991 and 1992 budgets based on the current IEEE fees are sound, they provide very narrow margins for possible expense increases.

Among the housekeeping action items, I would like to draw attention to the TAB approval of delegating to the Field Services Department all paperwork and approval processing for the formation of new Society Chapters. Our Society has several new chapter initiatives pending or in process, which can be facilitated and accelerated by complying with the new approval procedure.

Among the other TAB activities there is currently one of special interest to the MTT-S, namely, the Society reviews. Division X reviews will be completed this year, and next year's program includes Division IV to which our Society belongs. I am quoting Larry Anderson, Chairman of the Society Review Committee: "The review will focus on the extent to which the Society/Council or Division is maintaining its vitality and technical leadership in its Field of Interest and is interacting appropriately with other entities." This calls for thorough and timely review preparations by the MTT-S AdCom.

At the 1991 IMS

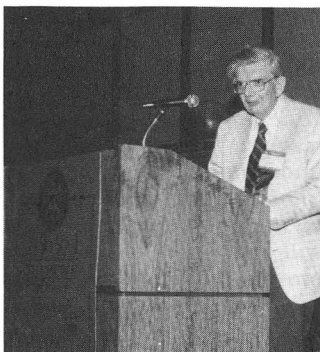


Past President Cooper and Division IV Director Schneider at the AdCom meeting.



At left, Professor Okamura accepting the Career Award at the banquet.

Below, Professor Dicke accepting the Pioneer Award at the banquet.



Polish Microwave Conference—MIKON '91 Microwaves at Rydzyna Castle

by Franco Giannini
University of Rome

The ninth edition of the Polish Microwave Conference, MIKON '91, had a real international flavour. Sponsored by the Telecommunications Research Institute (PIT) of the Polish Academy of Sciences and the AP/AES/MTT Joint Chapter of the IEEE Poland Section, the scientific event gathered more than 190 microwave specialists coming from 14 countries. Held since 1967 every three years, the MIKON conference represents the most important microwave event in Poland and it was already known for the particularly high scientific level of the accepted contributions. The '91 edition continued this tradition with its 123 papers given in 10 plenary sessions and 8 poster sessions, which demonstrated both the large attention paid to the event and the very interesting achievements in many of the fields related to the theory and the application of microwaves and millimeter waves.

Very well organized and located, MIKON '91 gave to all the participants the opportunity to enjoy the very beautiful castle of Rydzyna, a nice village close to the city of Poznan, and its gardens for a five-day conference. A small river and a deep green park became the right place to continue the after-session discussions or to develop new ideas coming from the hearing of the very interesting invited papers, that worldwide prominent microwave scientists were asked to give.

Furthermore the improvements in the results and the achievements presented by the Polish researchers were impressive, with respect for instance to the last two editions of the MIKON conference. The continuous presence of the Polish contribution into the international literature, already demonstrated the very good general level of their production. Nonetheless the variety of themes and the level of the results presented at MIKON '91 were really impressive and more evident than in the past.

The "birth" of the AP/AES/MTT Joint IEEE Chapter could not have a better celebration!

Finally, a special thanks has to be given to Professor B. Galwas, chairman of the scientific Programme Committee, for the one-day tour organized to give the invited speakers the opportunity to visit the wonderful city of Krakow in the South of Poland. A minibus trip to Rydzyna in a friendly atmosphere prepared the guests to take full profit of the incoming microwave week and represented a tasteful contact with the Polish reality.

This report was submitted at the request of MTT-S Past President Tatsuo Itoh.

Highlights of TAB Technical Meetings Council

(continued from previous page)

Peter Sensi or Suzanne DeFilippo at the IEEE Service Center, Piscataway, NJ, 908-562-3871. This office can also supply more information on the registration and paper-tracing software. In my next report, I'll go into more detail on the program and what it has to offer.

Microwaves in Medicine '91

by Branka Jokanovic
MTT-S AdCom

The 1st International Scientific Meeting: Microwaves in Medicine '91 was held on April 8-11 in Belgrade, Yugoslavia. The conference was conceived by Yugoslav MTT Chapter and organized jointly by the IEEE MTT-Society, the Scientific Committee of Serbia and the Institute of Microwave Technique and Electronics (IMTEL), Belgrade.

About 100 participants from Belgium, Bulgaria, Czechoslovakia, Hungary, Italy, Japan, Poland, South Africa, USA, USSR and Yugoslavia participated at the conference, which featured five invited presentations and 42 papers. They were sessions on medical applications of microwaves, dosimetry and instrumentation, biological effects, health hazards and safety standards, and the use of polarized light. The meeting also included a roundtable discussion on electromagnetic compatibility techniques led by Prof. R. De Leo of the University of Ancona, Italy, and review of potential medical applications of printed antenna structures led by Prof. A. Nesic of IMTEL in Belgrade. A small exhibition on microwave medical equipments was set up parallel to the conference.

The invited paper "Microwave Acupuncture as Stimulus for the Interaction Between Electromagnetic Fields (EMFs) and Nervous System," by Prof. A. Vander Vorst of Catholic University of Louvain in Louvain-la-Neuve, Belgium, as well as a series of papers from USSR, described the use of millimeter waves (40-80GHz) to stimulate acupuncture points, based on traditional Chinese medicine. According to M. Golant and V. Nadejeva from RPA "Istok," Moscow, this form of acupuncture is widely used in USSR, where 40,000 patients with conditions ranging from stomach polyps, duodenal ulcers, arterial hypertension, angina pectoris to traumas and advanced neoplasms have been treated using commercially available devices. More than 20 years of experience in USSR in theoretical and experimental research of non-thermal effects in millimeter waves action on living systems will be also presented at the International Scientific Meeting Millimeter Waves of Non-Thermal Intensity in Medicine which will be held 24-27 September 1991 in Moscow, USSR.

Yugoslav, Czech and South African engineers have developed several interesting devices using microwave energy. For instance, Dr. B. Downing of the University of Cape Town, South Africa, has designed a low cost microwave system, operating at 2.45 GHz for deactivating HIV—the virus associated with AIDS—in breast milk collected to feed premature newborns. And S. Manola and co-workers at the Institute of Physics in Belgrade presented a way of using microwave-induced low energy gas plasmas for sterilization of medical instruments and plastic items at 75-80°C.

Prof. P. Walinsky of the Dept. of Medicine at Thomas Jefferson University Hospital in Philadelphia, reported that microwave balloon angioplasty of the coronary and peripheral blood vessels is a promising form of therapy for atherosclerotic vascular disease. In his invited talk, he concluded that microwave angioplasty was more effective than conventional angioplasty in maintaining vascular patency in the presence of thrombus.

The treatment of an enlarged prostate using microwave hyperthermia was addressed by Dr. H. Arastu and associates at the Albert Einstein Medical Center in Philadelphia, in their invited lecture on "The Efficiency of Transurethral Interstitial Microwave Hyperthermia in the Management of Benign Prostatic Hyperplasia (BPH)" and by Dr. B. Sawarz

and colleagues at MMA Postgraduate Medical School in Warsaw, in a paper on the treatment of BPH with intrarectal and intraurethral microwave applicators. The two presentations indicate that intraurethral microwave hyperthermia in advanced BPH is an efficient and safe alternative to surgery.

With respect to microwave hyperthermia, Dr. B. Kolundzija of the University of Belgrade presented a mathematical model for plotting energy deposition and temperature distributions, and Dr. Y. Nikawa and F. Okada of Japan's National Defense Academy in Yokosuka described an innovative applicator. In addition, Dr. E. Khizhnyak of the Institute of Cell Biophysics of the USSR Academy of Sciences in Pushchino and group led by Prof. F. Bardati of the University of Rome, Italy, described noninvasive techniques to map heating during hyperthermia. The dielectric properties of biological tissue were described from a theoretical point of view by Dr. S. Caorsi and co-workers at the University of Genoa in Italy and from an experimental point of view by IMTEL's V. Napijalo and B. Jokanovic.

In a series of three papers, Dr. Z. Stojanovic of the Institute of Aviation Medicine in Belgrade, Dr. Zoran and Milan Djordjevic of the Pacemaker Center at the University Clinical Center in Belgrade, and Dr. Z. Kelecevic, also of the Institute of Aviation Medicine, described their work on microwave-induced health effects and protective clothing. Z. Stojanovic, a medical doctor, presented the results of a clinical study of 253 radar operators which found an incidence of irregularities in the lymphocytes and the nervous system of the workers chronically exposed to microwaves.

In the review of the possible link between EMFs and cancer, Dr. S. Szmigielski of the Center for Radiobiology and Radiation Safety in Warsaw, Poland, concluded that EMFs should be classified as "possible" carcinogens.

The Belgrade meeting, the first conference of microwave applications in medicine, was an opportunity to introduce recent developments in this field. The organizers hope that it will stimulate further research, particularly because this field is potentially one of the most important non-military uses of microwave technology. Positive results of microwave applications in medicine both diagnostic and treatment as well as the current reduction of military projects give us a promise that the further explorations in this field would have a better financial support than earlier.

The 2nd International Scientific Meeting: Microwaves in Medicine '93 will be held in Italy. Those interested in attending should contact Professor Robert De Leo, University of Ancona, Via Brece Bianche, 60131 Ancona, Italy, Fax (071) 2204 835.

At the 1991 IMS



Europe: 1991: Sorrentino, Jansen, Jokanovic and Vander Vorst.

IEEE-USA Volunteer Student Guidance Network

Students regularly write to IEEE-United States Activities requesting career information. In most cases their needs can be met by sending them the IEEE guidance pamphlet, "Your Career in the Electrical, Electronics, and Computer Engineering Fields." A few, however, want information on specific fields, such as robotics, acoustics, aerospace, or biomedical engineering, to mention only a few. In these instances, we would like to be able to refer inquiries to volunteers who can respond with a letter, some printed materials, or even a phone call.

The IEEE-United States Activities Board actively promotes Career and Technology Policy Interests of Electrical, Electronics and Computer Engineers.

Call for Volunteers

IEEE-USA's Precollege Education Committee is in the process of establishing a discipline-based Volunteer Student Guidance Network and is looking for volunteers who are willing to serve as resource persons. If you enjoy counseling high school students and would be willing to answer an occasional request for career information in your particular area of experience, we need your help.

For more information, please complete the following and send it to: A. Hartfiel, IEEE-USA, 1828 L Street NW, Suite 1202, Washington, DC 20036 (telephone 202/785-0017.)

Name: _____

Address: _____

Phone: (work) _____ (home) _____

Employer: _____

Brief description of technical specialty/area of expertise: _____

Brief description of current job assignment: _____

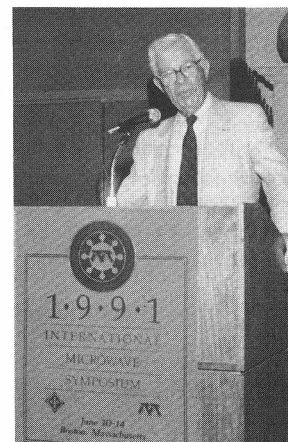
At the 1991 IMS



The AdCom eye test: Wassel passes, Belohoubek fails. Or is that backwards?



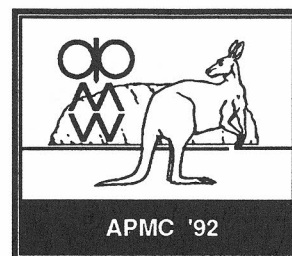
The quartet, uh, er, trio, at the banquet.



Above, the Donahues and John Putnam trying to sell one last banquet ticket to Chris Meyer, meeting coordinator at the Westin.

At left, banquet speaker Daniel Schorr.

THE 1992 ASIA-PACIFIC MICROWAVE CONFERENCE



in conjunction with
THE FIFTH AUSTRALIAN MILLIMETRE AND SUBMILLIMETRE WAVE SYMPOSIUM
AUGUST 11 - 13 1992 CONVENTION CENTRE, ADELAIDE, AUSTRALIA

Sponsored by IEEE South Australia Section: Co-sponsored by IEEE Microwave Theory and Techniques Society; URSI Commission B; The Institution of Radio and Electronics Engineers Australia; The Institution of Engineers Australia; and The Defence Science and Technology Organisation Australia.

CALL FOR PAPERS

Authors are invited to submit papers on topics of interest to either conference. Suggested topics are listed below but potential contributors should not feel constrained by these.

ASIA-PACIFIC MICROWAVE CONFERENCE

- Antennas and Propagation
- Biological Effects and Medical Applications
- CAD of Microwave Circuits
- Computational Electromagnetics
- Defence Applications
- Field Theory and Waveguides
- Filters, Multiplexers and Resonators
- High Power Devices and Applications
- High Temperature Superconductors
- Low Noise Receiver Technology
- Microwave Acoustics
- Microwave Industrial and Energy Applications
- Microwave Measurements and Instrumentation
- Microwave Polarimetry
- MMIC and GaAs Technology
- Optical Microwaves
- Passive Circuits
- Phased Arrays
- Remote Sensing and Measurements
- Semiconductor Devices and Measurements

MILLIMETRE AND SUBMILLIMETRE WAVE SYMPOSIUM

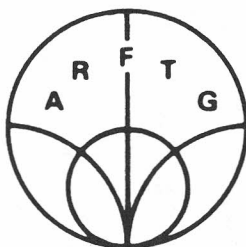
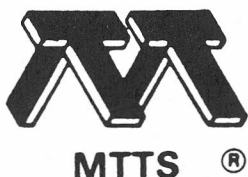
- Millimetre and Submillimetre Wave Technology
- Theoretical Studies and Models
- Applications and Systems
- Antennas and Arrays
- Astronomical Techniques and Observations
- Amplifiers and Down-converters
- Generation of mm and sub-mm Waves
- Detectors
- Components and Systems

SCHEDULE

Submission of Abstracts - December 6 1991
Notification of Acceptance - March 6 1992
Camera Ready Copy - May 8 1992
Conference - August 11-13 1992

Papers must be in English and of no more than four A4 pages in length. Abstracts should be submitted in the first instance to :

Professor Harry E. Green
Dean, Faculty of Engineering
University of Adelaide
GPO Box 498 Adelaide SA 5001
Australia



AUTOMATIC RF TECHNIQUES GROUP CALL FOR PAPERS

ARFTG 38th Conference - Fall 1991
FIRST CALL FOR PAPERS

San Diego, California
December 5-6, 1991

The Automatic RF Techniques Group will hold their 38th Conference at the Sheraton Harbor Island Hotel in San Diego, California on Thursday and Friday December 5-6, 1991. The conference theme is:

ON-WAFER MEASUREMENTS III

The growth in applications for RF and microwave MMICs in commercial markets will require continued innovation in testing on the wafer to reduce costs and insure high quality. The 38th conference will be ARFTG's third devoted to this increasingly important subject. Appropriate paper topics include those addressing the establishment and verification of accurate on-wafer calibrations (including traceability paths), correlations between on-wafer and final packaged chip test results, reduction of measurement time and cost, and development of improved or novel techniques (including non-invasive) for S-parameter, noise, power, and temperature controlled measurement applications. Papers on other RF measurement or computer-aided-design topics will also be considered.

Technical presentations shall be informal twenty-five minute talks using view-graphs or 35-mm slide illustrations. Authors are requested to submit a one-page abstract and a 500 to 1000 word summary with attachments containing illustrations, etc., providing sufficient technical content to enable proper evaluation and explaining the contribution's usefulness to the conference attendees. All accepted papers will be published in the post-conference digest. **Two copies of the abstract and summary should be received no later than September 20, 1991.**

Manufacturers interested in exhibiting at the conference should contact the Exhibit Coordinator for information and an application and agreement form.

Submit papers to:

For exhibit application contact:

Conference Chairman:

Larry Dunleavy
University of South Florida
Dept. of Elec. Engr., ENG118
Tampa, FL 33620
(813) 974-2574

James C. Rautio
Sonnet Software
135 Old Cove Road, Suite 203
Liverpool, NY 13090-3746
(714) 987-4715

Allen E. Rosenzweig
MicroWave Technology
4628 Solar Way
Fremont, CA 94538
(415) 651-6700



CALL FOR PAPERS

The 1992 IEEE-MTT-S International Microwave Symposium will be held in Albuquerque, New Mexico, on June 1 to 5, 1992. 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 interactive forum. Full length papers report results of significant advances in microwave technology. Short papers are typically a refinement in the state of art. The interactive 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. Use of computer and video displays is encouraged.

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

A prospective author is required to submit:

1. 15 copies of a 500-1,000 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 interactive forum and specifying the topic area in which presentation is preferred.

All papers must be sent for review by December 2, 1991.
Submissions postmarked after that date will not be considered.

Mail submissions to:

MTT-SYMPOSIUM 1992
c/o LRW Associates
1218 Balfour Drive
Arnold, Maryland 21012
USA

Authors will be notified of the status of their submissions by February 15, 1992. Authors of accepted papers will receive copyright release forms and instructions for publication and presentation.

These final manuscripts will be required in early March 1992.

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.

ANNOUNCEMENT OF STUDENT PAPER CONTEST

A student paper contest for full-time students (9 hours/semester graduate, 12 hours/semester undergraduate) will be held as part of the 1992 Symposium. To be considered, papers must be received by the Technical Program committee by December 2, 1991. A student must be the lead author, and the second author should attach a statement that his/her contribution is primarily advisory. There should be no more than two authors.

TRAVEL STIPENDS: Student authors of prize winning papers (as a result of this competition) may contact the Transportation Committee Chairman for travel expense assistance.

PRESENTATION AWARDS: All student papers accepted by the Technical Program Committee and presented by the student author at the 1992 MTT-S Symposium will be judged for content, presentation, and visual materials. First, second, and third prizes will be awarded.

Additional contest details will appear in the MTT-S Newsletter.

PCs for *AP* MTT

(continued from page 20)

tions that are of interest for at least two reasons. First, they demonstrate the physics of the fields in a visual way. And second, the two graphs provide a visually and easily interpretable way to compare the validity of the GO approximation with the rigorous Mie theory.

The results plotted in Figures 1 and 2 below are the source function S inside a dielectric sphere centered in the square plotting grid whose width equals the sphere's diameter, where S is given $\mathbf{E} \cdot \mathbf{E}^*$, with \mathbf{E} the internal electric field. The sphere has an index of refraction equal to 1.332 and is 500 free-space

wavelengths in circumference. The source function is plotted in the x - z plane for a TE plane-wave incident from the left parallel to the x axis which slants diagonally upward to the left. The fields were evaluated over a 200x200-point grid, having maximum values of 252.2 for the GO result and 253.7 for the Mie solution. Note that the Mie solution exhibits interference effects through the oscillations in the field, a feature missing from the GO result. For more details, contact the authors.

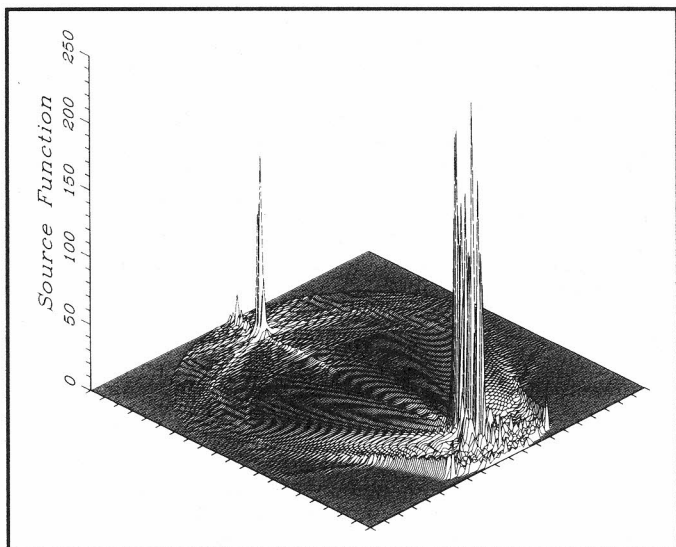


Figure 1. Surface graph of the Mie solution for the source function S [after Chowdhury, Barber and Hill (1991)].

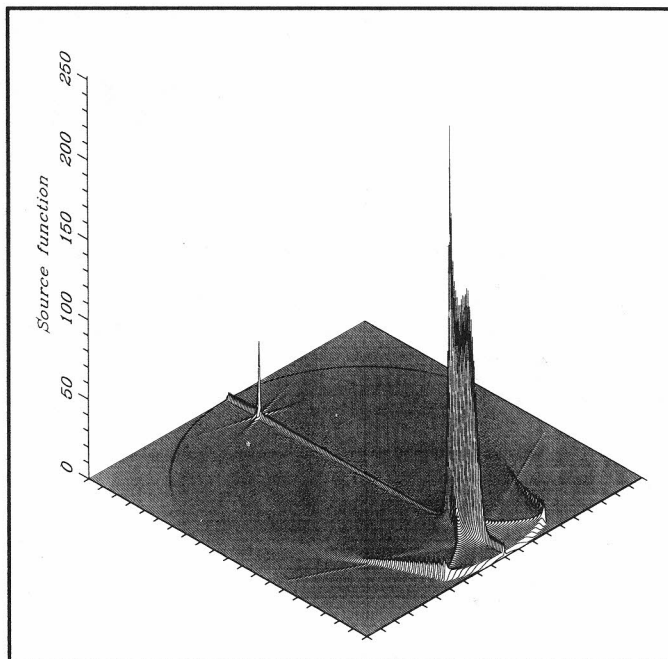


Figure 2. Surface graph of the geometrical optics solution for the source function S [after Chowdhury, Barber and Hill (1991)].



THE INSTITUTE OF
ELECTRICAL AND
ELECTRONICS
© ENGINEERS, INC.

445 Hoes Lane
P.O. Box 1331
Piscataway, NJ 08855-1331

Non-Profit Organization
U.S. Postage

PAID
PERMIT NO. 52
PISCATAWAY, NJ

Third Class