

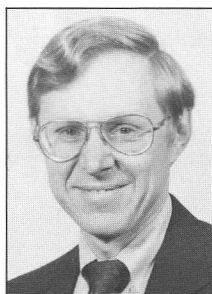


## Table of Contents

	PAGE
Editor's Notes.....	<i>P.W. Staecker</i> 2
Letters to the Editor.....	2
N.W. Cox, Jr., 1942-1988.....	3
N. Walter Cox, A Tribute.....	<i>C.T. Rucker</i> 3
TAB Highlights.....	<i>B.E. Spielman</i> 4
Division IV Director's Report.....	<i>G.A. Thiele</i> 4
AdCom Highlights.....	<i>V.G. Gelnovatch</i> 5
1988 MTT-S Symposium Review.....	<i>C. Buntschuh</i> 5
Reflections on the 1988 International Microwave Symposium Technical Program.....	<i>J. Taub &amp; J. Whelehan</i> 8
1988 Awards Banquet.....	<i>C.T. Rucker</i> 9
1988 MMWMC Symposium Review.....	<i>D. Hornbuckle</i> 12
Student MTT IMS Program.....	<i>N. Taub</i> 12
RadLab Celebration Update.....	<i>T.S. Saad</i> 13
Membership Services.....	<i>M.V. Schneider &amp; S.J. Temple</i> 14
MTT Speaker Bureau.....	14
Distinguished Microwave Lecturer '87-'88: Report.....	<i>R.H. Jansen</i> 18
Distinguished Microwave Lecturer '88-'89: Abstract/Biography.....	<i>R.H. Knerr</i> 18
Distinguished Microwave Lecturer '88-'89: Abstract/Biography.....	<i>A.H. Silver</i> 19
Zacharias Professorship.....	<i>J. Wiesner</i> 19
Membership Development.....	<i>A.L. Estes</i> 20
LA Chapter Chairmen's Reunion.....	<i>B. Aaron</i> 21
Barton Tours Australia.....	<i>D. Sinnott</i> 21
Chapter Meetings.....	<i>Z. Galani</i> 22
Announcement: Long Island MTT Workshop on Microwave Systems Design.....	25
7th Annual Benjamin Franklin Symposium.....	26
Technical Committee Reports.....	<i>R.S. Kagiwada</i> 27
MTT-17.....	<i>S.J. Temple</i> 27
1989 MTT-S Symposium Review.....	<i>C.W. Swift</i> 28
Special Articles.....	<i>Z. Galani</i> 27
PC Antenna Arrays.....	<i>R.J. Mailloux</i> 29
PCs for MTT.....	<i>E.K. Miller</i> 33
Secrets of Great Communicators: Part II.....	<i>C. Reimold</i> 36
Educational Committee.....	<i>K.K. Agarwal</i> 37
Scholarships, Fellowships and Grants-in-Aid.....	38
Student Paper Contest.....	<i>J.M. Owens</i> 36
ARFTG Highlights.....	<i>R.W. Tucker, Jr.</i> 37
ARFTG Meeting Call for Papers.....	39
Intersocietal Relations.....	<i>F. Ivanek</i> 40
Committee on Communications and Information Policy.....	<i>F. Ivanek</i> 41
TAB Periodicals Committee Report.....	<i>C.L. Smith</i> 41
PACE Report.....	<i>B.O. Weinschel</i> 43
Meetings of Interest.....	<i>F. Occhiuti</i> 43
International Space Year 1992.....	<i>W.C. Brown</i> 45
Book Review: <i>High Power Microwaves</i> .....	<i>R. Temkin</i> 45
Raytheon Excellence in Technology Recipient: Bob Pucel.....	46
Vote!.....	<i>G.A. Thiele</i> 46
Conference Announcements:	
US Conference on GaAs MANufacturing TECHNOlogy.....	47
Applied Computational Electromagnetics.....	48
Special Issues:	
FET Structures and Their Circuit Applications.....	49
Teaching Electromagnetics.....	50
Directory Changes.....	Back Cover

## Editor's Notes

## Letters



by Peter Staecker

The new look you see here is an attempt to save some money in printing and distribution costs of this newsletter. By a mere flip of a switch on the Compugraphic we can squish the type and make things look a bit more professional. My artist friend in M/A-COM's advertising department still has some problems with the front page banner—any suggestions?

A new section appears with this issue: **Intersociety News**. These articles and introducing information will be collected by Ferdo Ivanek, the MTT-S Intersocietal Relations Coordinator. Because of the increased interest by Chapter Officers in reporting Chapter activities, we will begin collecting these inputs in one location.

Attention **SCR-584 Technicians**: please identify yourselves. **NOVA** is filming the history of the **MIT Radiation Laboratory** and is restoring to operational condition an SCR-584 fire control radar, presently at the Historical Electronics Museum (Westinghouse Electric Corporation, Baltimore, MD). Ted Saad and I have been hearing bits and pieces of information that should make a great future article. Stay tuned. For more Rad Lab information, please see page 13.

In case you find you no longer can reach some of us in Massachusetts by telephone, you should know there is a new area code in our state. New **508 Area Code changes** for the MTT Committee Directory are listing on the back cover.

Shortly we will have two Tuckers appearing in these pages. Rodney S. Tucker has accepted a 3-year appointment as Transactions Editor. Don't confuse him with Ray Tucker, who contributes our ARFTG column.

One of the great gentlemen of our society has passed on. **Walter Cox** died early this summer of leukemia. Walter had emerged as a leader whose presence will be sorely missed, but will be remembered by us as an example by which to lead our lives.

### MTT-S NEWSLETTER COPY DEADLINE INFORMATION

Issue	Copy Deadline*
Spring	February 28
Summer/Fall	July 2
Winter	December 1

\* For special technical articles, submit 8 weeks earlier.

In your Winter 1988 issue, Dr. Seymour Solomon (*Bicycling can lead to temporary impotence*) has, I feel, exaggerated the situation. As a regular user of this admirable means of transport over some few decades, my personal experience does not support Dr. Solomon's statement. My advice to Dr. Solomon is:

- check that your saddle is ok,
- jump on your bicycle and ride home as fast as possible: you might be missing something!

Nigel Keen  
Max Planck Institut fuer Radioastronomie  
Bonn, West Germany

### OPEN QUESTION TO TIME-DOMAIN EXPERTS

Time-domain approaches to solve electromagnetic problems are becoming quite fashionable nowadays, competing with the more traditional frequency-domain techniques. It is true that, at least at first sight, the time-domain analysis of propagation in space or on lines follows more closely the physical reality than do frequency-domain developments, and thus permits one to better visualize propagating signals (it is also true that the concept of a steady-state periodic signal, which started at  $t = -\infty$  and will last until  $t = +\infty$ , is somewhat more difficult to comprehend). According to some particularly enthusiastic supporters, there is no problem whatsoever that time-domain techniques cannot solve just as well as (or better than) the corresponding frequency-domain methods do...

In this respect, I have one question to ask: how does one take into account, in the time-domain, the ohmic losses within metal boundaries, which typically exhibit a  $\sqrt{\omega}$  frequency-dependence? Pulses are distorted by frequency dispersion, losing their theoretical rectangular shape to take on a more rounded *erfc* behaviour. I raised the question several times at technical workshops recently, and received various conflicting answers, from a flat 'it just can't be done,' to a rather optimistic 'no problem!' It was suggested that time-derivatives of field or circuit quantities could be introduced as additional independent variables or, in the case of the TLM method, that the discretized mesh be extended within the metal itself. However, it was not clear whether the problem had really been addressed anywhere. This may sound somewhat surprising, since several active time domain proponents are simultaneously involved in the analysis of fin-lines for millimetre frequencies, where they cannot ignore metal losses.

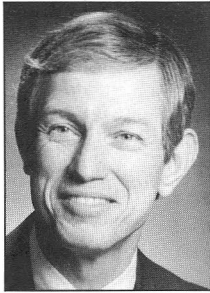
Up to now, my feeling is that the question is still open, but I would be pleased to revise my opinion if anyone could send me information, as to whether this problem was solved-and how- or whether people may be presently working on it. More generally, it would be interesting to know how time-domain techniques can cope with the distortion that appears whenever signals propagate within dispersive media or along dispersive transmission lines (such as waveguides, microstrips, finlines, optical fibres, and so on).

I look forward to receiving many answers and suggestions about this topic.

Fred Gardiol, Professor,  
LEMA-Ecole Polytechnique  
EL-Ecublens,  
CH-1015 LAUSANNE,  
Switzerland

## N. Walter Cox, Jr. A Tribute

by C.T. Rucker



### N. Walter Cox, Jr. 1942-1988

Dr. N. Walter Cox, Jr. of Dunwoody, Georgia, Director of the Microelectronics Research Center of Georgia Tech, died of leukemia on June 29, 1988. He was 45.

Cox was named Director of the Microelectronics Research Center in 1986 and had previously held positions as Director of the Electromagnetics Laboratory in 1985-86, Associate Director of the Electromagnetic Laboratory from 1982 until 1985 and Chief of the Physical Sciences Division from 1975 until 1985. Earlier, he had been a Senior Development Engineer with the Sperry Rand Electronic Tube Division in Gainesville, Florida, from 1971 until 1973 and an Engineering Staff Consultant with the Sperry Microwave Electronics Division in Clearwater, Florida, from 1969 until 1971.

The microwave and microelectronics community will remember Dr. Cox as an enthusiastic and vigorous proponent of our field. In addition to his direct technical contributions to solid state microwave components, he provided the leadership for significant research programs in unique materials, devices and circuits while at Georgia Tech. He was a member of the Advisory Group on Electron Devices (AGED) and routinely provided consulting assistance to the U.S. Air Force and other Department of Defense agencies in the development of effective research programs.

Walter Cox was a Senior Member of the Institute of Electrical and Electronic Engineers. He was a member of Sigma Xi, Eta Kappa Nu, Pi Kappa Phi and Tau Beta Pi. Within IEEE, he will be best remembered for his contributions while a member of the Administrative Committee of the Microwave Theory and Techniques Society since 1983. He became Chairman of the MTT-S Meetings and Symposia Committee in 1985 and was engaged in site selection for future symposia at the time of his death. He had served as member, organizer or chairman of numerous panels, symposia sessions and other related activities.

Walter Cox was born July 1, 1942 in Selma, Alabama. He was graduated from Messick High School in Memphis, Tennessee. Upon graduation he attended Chrisitan Brother College for his freshman year. He subsequently received his bachelor's, master's, and doctorate degrees in Electrical Engineering from the Georgia Institute of Technology.

He is survived by his wife, Mary Ann Blackstock Cox; daughters, Carolyn and Anna; his father, Noah W. Cox, Sr. of Memphis, Tennessee; a brother, Frankie L. Cox of Laurel, Mississippi; and several aunts, uncles and cousins.

Many of you will already know that the microwave and microelectronics community lost a valuable contributor and friend when, on June 29, 1988, leukemia claimed N. Walter Cox, Director of the Microelectronics Research Center at Georgia Tech. If not, it is my responsibility to tell you.

Obituaries, a necessary evil satisfied here by the column at left, are usually as lifeless as those they describe. They provide the facts but neglect the essence. I hope, here, to remind you of the essence of a contributor and friend to the microwave and microelectronics community. Perhaps, then, we will be reminded of the qualities that produce the leadership, friendship and trust we all look for in a friend or coworker.

**ATTITUDE:** Norman Vincent Peale had little to teach Walter Cox. I never knew him to approach any problem or person with a negative notion. You were, by definition, OK — even when, on occasion, you proved to the contrary.

**COURAGE:** His illness and its treatment were, at best, a most unpleasant experience. He considered this barrier to be just another to push down. He came no closer to complaining than to suggest one day, with a grin, that 'a new body might be helpful.'

**DIVERSITY:** Few subjects failed to excite his interest. He was conversant with almost every area of microwave and microelectronics technology. I thought this came easily, by osmosis, until I discovered his reading files.

**ROLE MODEL:** It is a rare thing when a hardheaded EE in his mid-fifties (your writer) adopts a younger (mid-forties) person for a role model. Your writer is just one of many.

**PEOPLE:** I know of a case where Walter Cox did the work of an inept employee and then got him a raise for doing a good job. The employee is now one of the best. Enough said.

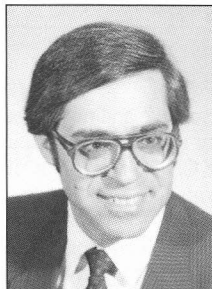
All obvious, you say. Perhaps. And, perhaps, I am a little bit presumptuous in pointing to the obvious in this particular way. If so, accept my apology. I submit, however, that the obvious is one of our most overlooked commodities, and that the rare individual described here would enjoy the opportunity to remind us of that fact. His reaction to this small tribute would likely be: 'Charlie, you didn't!' Yes, Walter, I did.

*Mr. Rucker is a Past President of the Microwave Theory and Techniques Society. He is a Principal Research Engineer at the Georgia Tech Research Institute and, since the death of N.W. Cox, is serving as Interim Director of the Georgia Tech Microelectronics Research Center. He and Dr. Cox were friends and coworkers since 1969.*

To perpetuate Walter Cox's memory, a scholarship fund has been established for Georgia Tech students in science and engineering. Persons wishing to contribute to the **N. Walter Cox Scholarship** fund should make a check payable to **The Georgia Tech Foundation, Inc.** and mail to:

The Georgia Tech Foundation, Inc.  
Office of Development  
Georgia Institute of Technology  
Atlanta, GA 30332-0180  
Attention: Charles Gearing (Walter Cox Fund)

## TAB Highlights



by Barry E. Spielman

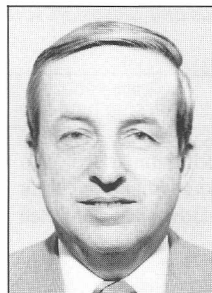
The TAB Finance Committee recommendations that **1989 Student Society** fees be continued at 50% of the higher grade member rate, and that optional publications continue to be made available to Students at 75% of the higher grade member rate were approved.

TAB OpCom approved the 1989 pricing of the **total periodicals package** at \$800 for Section Libraries and \$500 for Student Branch Libraries, as recommended by the TAB Finance Committee. The TAB Finance Committee recommendations for 1989 individual Non-Member rates and the rate of \$5500 for the **All-Transactions Package** were endorsed for approval by the Executive Committee.

TAB endorsed a Publications Board recommendation to clarify and strengthen the existing IEEE Policy to preclude preferential treatment based on an author's agreement to pay **page charges**.

TAB approved in principle the Charters for an **IEEE Superconductivity Committee** and an ASC/IEEE Coordinating Committee as the basis for negotiating an agreement with the Applied Superconductivity Conference Committee (ASC), and the formation of an IEEE Superconductivity Committee. Further, TAB OpCom passed a motion directing the TAB New Technology Directions Committee (NDTC) to report back to TAB OpCom in November with a proposal list of IEEE Society memberships in the IEEE Superconductivity Committee and a draft business plan. TAB OpCom endorsed the recommendation of NTDC that Dr. Theodore VanDuzer be the initial Chairman of the IEEE Superconductivity Committee. TAB OpCom also agreed that Dr. Henry Kressel, NTDC Chairman, and Dr. Irving Engelson, TAB Secretary, will form the nucleus of the TAB negotiating team with the ASC to implement this proposal.

## Division IV Director's Report



by Gary A. Thiele

One of the unsolicited 'benefits' of being a member of the IEEE Board of Directors is receiving letters from Mr. Irwin Feerst. Until recently, the major outward difference between these letters and most of the mail that arrives in my mail box was that his letters bore the full one ounce postage rate. Recently, that has changed as the copy of a recent envelope below shows. I can only con-

clude that since some of Mr. Irwin Feerst's letters attack the German heritage of some of the IEEE officers, he has seen fit to do the same to me, since my last name is of possible German origin. His act is an expression of prejudice of a kind which has no place in an America of any day and age, in my opinion.

I regularly receive his letters and also his newsletter at my home address. All my IEEE mail, my IEEE directory listing, and my published papers use my office address. IEEE headquarters had my home address as an alternate address for weekend express mail delivery. While there are various ways of getting a person's home address, I wonder if his "mole" supplied it to him. It is pretty clear to me that there is one (mole) who supports his less than 2300 (IEEE) member "Committee of Concerned EE's."

N. REX DIXON (R) (R)  
204 WINESAP ROAD  
STAMFORD, CT 06903

George Nazi Abbott  
8712 Westlake Court  
Raleigh, NC 27612

Gary (R) Thiele  
1001 Valley Vista Way  
Dayton, Ohio 45429

**These addresses are from envelopes stamped with the return address, "Committee of Concerned E.E.s." that were mailed to George Abbott, a former IEEE Board member, N. Rex Dixon, Vice President for Technical Activities, and Gary A. Thiele, Director of Division IV.**

Many of Mr. Irwin Feerst's letters enclose a copy of an editorial written

in support of him and published in a trade journal. See for example: Jon Titus, EDN, Feb. 4, 1988; John Miklosz, Computer Design, Jan. 1, 1988; Frank Burge, Electronic Engineering Times, Dec. 28, 1987; Girish Mhatre, Electronic Engineering Times, Dec. 21, 1987. I wonder if these editors could see the mail he sends, if they would then support him? I wonder if any IEEE member would sign his petitions, if they first saw his letters? I wonder if any of the IEEE's 280,000 members would vote for him, if they knew what these letters often contain?

Before any IEEE member considers supporting Mr. Irwin Feerst in the future, they should see these letters. To make that possible, my secretary has graciously agreed to send you the previous half dozen letters starting with the one that came in the envelope copied here, if you would send your name and address to me at: KL262, University of Dayton, Dayton, OH 45469.

We live in an imperfect world. There are problems. The IEEE has problems. The engineering profession has problems. We make the world a better place by attacking those problems in intelligent and rational ways. This is done by intelligent and rational people. We make the IEEE and the engineering profession better in the same way. If you'd like to make something better, to change something, get involved. There is ALWAYS the need for *a few good persons*. Changing long-established traditions and large institutions is a slow and often frustrating process. It is done a little bit at a time by many dedicated people. It is done not by tearing down that which has already been built, but by building upon the foundation already laid.

In defense of the recent change to approval voting, let this director speak to those few who attack it. Approval voting does *not* make it more difficult for any petition candidate to be elected. Indeed, it most likely makes it easier, *provided the candidate is acceptable to the majority!*

---

## ADCOM Highlights



by Vladimir G. Gelnovatch

The Spring 1988 MTT-S AdCom meeting was held in New York City, New York on 22-23 May 1988 in conjunction with the International Microwave Symposium.

The Standing Budget Committee presented their recommendations based on the tasking they received from the President at the 1988 January AdCom meeting. Their charter included both planning for the long- and short-term financial health of MTT-S and generation/implementation of current and new calendar year budget. Two of the recommendations were: (1) change the MTT-S financial cycle to match the IEEE Headquarters' milestones and, (2) construct a two-tier zero base budget for 1989 composed of a *core* and *discretionary* (nice-to-have) items. Also discussed were a number of tentative actions to deal with anticipated out-year deficit budgets. All of the above recommendations have already been adopted.

Bob Moore presented the financial picture of MTT-S in three parts. The first was a synopsis of the actual results of 1987 for which MTT-S had approximately a \$30K surplus. The second was a review of 1988 expenses to date. A major issue was the need for approval for additional page count for the Transactions. The Transactions editor requested initially 1500 pages for 1987 which proved too low. Increasing page count during the year is prohibitively expensive as the MTT-S must pay all the associated expenses while receiving no income on sales. After a comprehensive debate and careful consideration of membership benefits it was decided to raise the page count to 1750 pages, an increase of 250 pages over budget. The third part of the financial presentation was the presentation of the 1989 budget to AdCom for authorization. A core budget was presented on a Committee by Committee breakout and approved. The discretionary (above core) spending was approved item by item. The 1989 budget is a deficit budget necessitating the MTT-S to dip into reserves. The long-term goal of the Society will be to move away from deficit financing.

To meet the above goal a number of revenue producing actions were explored to increase income. As one result, the membership dues were increased to \$12.00. This is reasonable and commensurate with other Societies and more importantly, the actual services that a member receives. Additionally, the registration fee at the 1989 Long Beach Symposium will be raised by \$10.00 above the New York City cost.

A new Transactions editor was elected. He is Dr. Rodney Tucker. He will begin his three-year term in January 1988 and brings extensive expertise in this area from previous similar positions in Europe and Australia. Contact information:

Dr. Rodney S. Tucker  
AT&T Bell Laboratories  
P.O. Box 400  
Holmdel, NJ 07783  
(201) 888-7214  
FAX: (201) 949-8372

## Microwaves— Past, Present and Future The 1988 IEEE MTT-S International Microwave Symposium



by Chuck Buntschuh

May 1988 marked the first time since May 1964 that the International Microwave Symposium was held in New York. It was indeed a pleasure to host the Symposium again, after so many years, in the most exciting and fascinating city on earth. Judging from the compliments we have received, it was thoroughly enjoyed and appreciated by the worldwide microwave community.

The 1964 Symposium was the first International Microwave Symposium. It met in the International Hotel at the JFK International Airport. 657 people attended, including 24 from Canada and abroad; 45 papers were presented in 5 sessions over three days. In 1988, the 25th International Microwave Symposium was held in conjunction with the 7th Monolithic Circuits Symposium, the 31st Automatic RF Techniques Conference, and the Industry Exhibition. Over 8,000 people participated in the technical programs and exhibitions, which took place in the Marriott Marquis and New York Penta Hotels and the Jacob Javits Convention Center. Collectively, in the three meetings 258 papers in 51 sessions, plus 8 full-day workshops and 5 lunchtime panel sessions were presented over the 5-day period which has become known as Microwave Week.

Very roughly, this represents a twelvefold growth, or an average 10% per year, over a quarter-century.

### MICROWAVES—PAST, PRESENT, AND FUTURE

The theme of the '88 International Microwave Symposium celebrated the Hertz Centennial, recognized the advances of today, and looked ahead to the challenges of tomorrow.

### Microwaves—Past

In the spring of 1888, Heinrich Hertz published the fifth and sixth papers of a series begun in 1886 on his experiments demonstrating the validity of Maxwell's theory. These papers, on the velocity of propagation and reflection properties of the waves, were the first to attract international attention and stimulate duplication of the work by others. It was thus particularly appropriate that we celebrate Hertz's accomplishments and the birth of microwave science at the 1988 Symposium.

To honor the occasion we were especially fortunate to have an exhibit of replicas of Hertz's experimental apparatus, on loan from the Science Museum of London. This exhibit was the brainchild of Dr. John H. Bryant, who made the initial arrangements for the loan and the refurbishment of the pieces. John also wrote a

*continued on page 6*

## 1988 IEEE MTT-S SYMPOSIUM

(continued from page 5)

commemorative book, "Heinrich Hertz - The Beginning of Microwaves," to accompany the exhibit, summarizing Hertz's life and work and explaining the artifacts.

This extraordinary exhibition was made possible by the generous contributions of the MTT Society, the IEEE Life Fellows, and 28 microwave companies, as well as the organizational efforts of John Putnam, Ted Saad, and Mario Maury, Jr.

The Hertz Centennial also included two special technical sessions with five invited papers on Hertz and the history of electromagnetics. Prof. Robert S. Elliot, UCLA, presented "The History of Electromagnetics as Hertz Would Have Known It," and Prof. Charles Susskind, UC Berkeley, "Heinrich Hertz: A Short Life." Prof. J.D. Kraus, Ohio State, "Heinrich Hertz - Theorist and Experimenter." Prof. James Brittain, Georgia Tech, followed up with "The Legacy of Hertz: Some Highlights of Microwave History from 1889 to 1945."

These sessions, also organized by John Bryant, were videotaped. The tapes will be available for loan through the IEEE Service Center.

Bridging the gap from Hertz to the present was the MTT-S Historical Exhibit of Society's own collection. This collection was begun and has been nurtured and developed over the last decade by Ted Saad, who is the MTT Historical Committee. Just recently, the Historical Electronics Museum at Westinghouse, and the Historical Collection Committee of the Baltimore MTT Chapter have accepted curatorship of the collection.

Together, these two exhibits created the most comprehensive view of microwave and RF history ever assembled in one place.



Dr. Chuck Buntschuh opens the Symposium.

### Microwaves—Present

The microwave exhibition and most of the technical program symbolized 'Microwaves—Present,' by providing a report on the latest developments in technology and new product offerings.

### Attendance

A record total of 8081 people attended the Symposium, up significantly from the approximately 600 of the past two years. Of these, 2330 registered for the technical programs, just slightly more than the 2237 and 2240 in '86 and '87. The MTT-S

Symposium drew 1951, the Monolithic Symposium 800, and the ARFTG Conference 82 attendants; 350 were visitors from 26 foreign countries. These individual conference registrations were all off somewhat from last year, reflecting the present straitened circumstances of our industry. Workshop participation on the other hand, was up smartly: 948 attended 8 workshops, compared to 767 in Las Vegas.

### Opening Ceremony

The 1988 International Microwave Symposium was officially opened on Wednesday morning, following two days of workshops, and Monolithic Symposium and ARFTG Conference meetings. Chairman Chuck Buntschuh and Technical Program Co-Chairman Jesse Taub welcomed the attendees and gave an overview of the program.

IEEE President, Dr. Russel Drew, shared some of his thoughts on the role of the IEEE in the information age. He likened the IEEE to an information utility, fueled by ideas, generating information by the authors, and distributing it via conferences and publications. He described current efforts by the IEEE to do this more efficiently and economically.

MTT Society President, Dr. Barry Spielman also addressed the group, reflecting on the growth and increasing complexity of the Symposium.

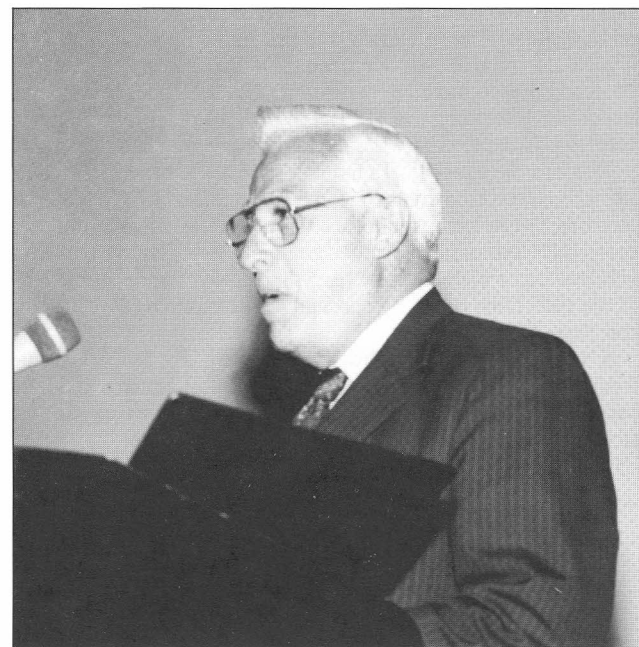
Ms. Alair Townsend, Deputy Mayor of New York City, welcomed the Symposium to New York with unparalleled sparkle and panache. She also described several high-tech projects of the city, and invited us not to wait another 24 years before returning to New York.

The keynote address, as well as several events on the technical program dealt with the future, so we'll come back to those in their proper place.

### Technical Program

From 394 papers submitted, the Technical Program Committee selected 100 regular length, 65 short length, and 49 open forum papers. In addition, 12 papers in the Monolithic Symposium were presented in joint sessions with the MTT Symposium, and 26 invited papers were read, for a total of 240, 100 of which were from 17 foreign countries.

*continued on page 7*



Dr. Frank Brand delivers his keynote address, "Tomorrow's Microwave Technology."

## 1988 IEEE MTT-S SYMPOSIUM

(continued from page 6)

This program consisted of 43 regular plus two Open Forum sessions. For the first time the technical program was expanded to four parallel sessions to accommodate the larger number of papers and to hold the Open Forums to a comfortable 25 papers each.

There were several special sessions and invited papers besides those commemorating Hertz and those with a 'future' flavor. A session on European Activities and a paper on Microwaves in Brazil provided excellent overviews on the international scene. A special session paid tribute to Professor Arthur Oliner, with three papers chronicling his contributions.

Monolithic circuits activity continues to expand. There were 35 papers in the Monolithic Circuits Symposium, including the 12 given in joint sessions. Moreover, there were three additional MMIC sessions in the MTT Symposium, including one invited paper, indicating this area has grown well beyond the bounds of its topical conference.

The 31st ARFTG Conference had 9 papers and 1 panel session on the topic "Innovations in Microwave Time-Domain Measurements," covering automated measurement techniques and applications.

### *Workshops and Panel Sessions*

The eight workshops were held on Monday and Tuesday, before the Symposium, in the Marriott Hotel. The topics and attendance figures were:

- M-1: Superconductivity and Microwaves. (179)
- M-2: MIC and MMIC FET High-Power Amplifier Design Techniques. (192)
- M-3: Designing MMICs Through Foundries. (82)
- M-4: Packaging Hybrid and Monolithic Microwave and Wave Components. (102)
- T-1: FET Structures and Their Modeling. (135)
- T-2: CAD Oriented Modeling of Discontinuities in Microwave and Millimeter Wave Transmission Structure. (157)
- T-3: High Volume Microwave Applications. (62)
- T-4: Developments in Linearizers for Microwave Power Amplifiers. (39)

There were 5 panel sessions on Wednesday through Friday. The lunchtime was lengthened to two hours to give them more time for discussion. Attendance at each session was estimated to be in the 120-170 range.

- P-1: U.S. Competitiveness—Some Views.
- P-2: The Business of Microwaves: The Better Mousetrap is No Longer Enough.
- P-3: Heterojunction Bipolar Transistor Circuits.
- P-4: Noise and its Measurement.
- P-5: Ferrites at Millimeter Frequencies.

### *Technical Program Committee*

The contributed papers were reviewed and selected by the 107 member Technical Program Committee under the superb leadership of Co-Chairmen Jesse Taub and Jim Whelehan. Additionally, Joe Levy organized the Open Forums, Don Neuf oversaw the invited papers efforts, John Pierro coordinated the workshops and panel sessions, and Paul Meier provided liaison with the MMIC and ARFTG conference committees. We can credit the overall success of the technical program to this team's outstanding work.

### *Microwave Exhibition*

This year, an even 300 companies staffed 482 booth spaces with 3824 people, covering about 3 acres of the Jacob Javits Convention Center. For the first time in many years the exhibition was located immediately adjacent to the technical meeting room rooms, making it especially convenient to visit whenever one had a few minutes to spare.

### **Microwaves—Future**

What's ahead for our microwave profession? We asked Dr. Frank Brand, VP and Chief Technical Officer of M/A-COM, Inc. to give us his view of the future of microwaves in the keynote address, "Tomorrow's Microwave Technology," delivered at the Opening Ceremony. Frank's basic message was that we must seek to find a balance between the states of the industry and the technology. He used the MMIC developments to illustrate how far and fast technology has progressed: industrial developments, however, are not keeping pace. He stressed that industry must be innovative in the way it conducts its business—we must seek more collaborative efforts and move beyond the destructive competitiveness in which no one wins.

Several events on the technical program pointed toward our future. Super-conductivity at microwave frequencies was the subject of an all day workshop on Monday and a regular Symposium session, which included an invited overview paper. The interest here is certainly sparked by the recent developments in high-temperature conductivity, but the presentations also included the conventional cryogenic regime.

Lightwave technology is rapidly gaining ground as a microwave engineering discipline, as lightwave modulation rates reach into the GHz region. Two focused sessions, with 8 invited papers, principally described applications in communications, radar, and military systems, and some of the associated microwave componentry. Also 8 papers in a regular session and the Open Forum reported on various aspects of optical techniques and components, while one session of the Monolithic Symposium was also devoted to fiber optic applications of MMICs.

### **Microwaves—After Hours**

Microwave Week was not all work and no play. The official social program began on Monday evening with the Monolithic Symposium's cocktail reception in the Astor Ballroom of the Marriott Marquis. On Tuesday evening over 1,000 people attended the Microwave Journal reception in the Roseland Ballroom, which featured music from the 40's and 50's, the heyday of Roseland. The ARFTG Conference reception and banquet also took place on Tuesday, in the N.Y. Penta.

Of course, the highlights of the social program are always the Industry-Hosted Cocktail Reception and the annual Awards Banquet. Both events were held in the Marriott. The reception, compliments of the exhibitors, was attended by well over 1,000, and 494 participated in the gala banquet. Charlie Rucker's article in this newsletter will give you the details on the many awards presented. The festivities concluded with 'A Bite of the Apple,' a delightful Broadway revue with popular show tunes from the turn of the century to the present.

New York offers a mind boggling array of attractions and activities for the visitor. The Guest Program, organized by John and Laurie Mruz, and Dick and Jo Kaminsky, offered six tours providing introductory and behind-the-scenes views of the Big Apple. The guests also made good use of the Hospitality Suite, where a continental breakfast was served and tourist information and assistance were provided by the N.Y. Convention Bureau.

## 1988 IEEE MTT-S SYMPOSIUM

(continued from page 7)

### 1988 SYMPOSIUM STEERING COMMITTEE

In the text above I mentioned the names of only a few of the many Committee members whose hard work and dedicated efforts made the 1988 International Microwave Symposium such an unqualified success. It has indeed been a privilege and pleasure to have worked with all of these wonderful friends:

#### Technical Program Committee

##### Co-Chairmen:

Jesse Taub                   Eaton-AIL, Melville, L.I., NY  
Jim Whelehan               Eaton-AIL, Melville, L.I., NY

##### Special Sessions

John Pierro                 Eaton-AIL, Melville, L.I., NY

##### Open Forum Chairman:

Joe Levy                    Eaton-AIL, Melville, L.I., NY

##### Invited Papers

Don Neuf                   Anzac-RHG, Deer Park, NY

#### Local Arrangements Committee

##### Chairman:

John Coppola              Narda Microwave, Hauppauge, NY

##### Operations:

Matt Jacobs                Narda Microwave, Hauppauge, NY  
Pari Boloori                Narda Microwave, Hauppauge, NY  
Bill Reich                  Narda Microwave, Hauppauge, NY

##### Catering:

Bob Koelzer                Narda Microwave, Hauppauge, NY  
Sid Wolin                   Anzac-RHG, Deer Park, NY

##### Local Transportation:

Joe Calviello              Eaton-AIL, Melville, L.I., NY

##### Airlines:

Jerry Hausner              R & D Associates, Albuquerque, NM

#### Guest Program Committee:

##### Co-Chairpersons:

Dick & Jo Kaminsky        Frequency Electronics, Mitchell  
                                  Field, NY  
John & Laurie Mruz        Micronics Technology, Glen Cove, NY

#### Finance Chairman:

Al Kelly                    Satellite Transmission Systems,  
                                  Hauppauge, NY

#### Publicity Committee:

##### Chairman:

Bert Aaron                 Bertram D. Aaron & Co.,  
                                  Plainview, NY

##### Advance Program:

Gerry Katz                 Eaton-AIL, Melville, L.I., NY

#### Publications Committee:

##### Chairman:

Ray Viola                  Unisys, Great Neck, NY

#### Registration Committee:

##### Chairman:

Klaus Breuer              Eaton-AIL, Melville, L.I., NY

##### Assistant:

Pete McVeigh              Eaton-AIL, Melville, L.I., NY

#### Awards Banquet Committee:

##### Chairman:

Joe Schindler              General Microwave, Amityville, NY

##### Assistant:

Georgette Baker            General Microwave, Amityville, NY

#### Chairman Emeritus & Historical Exhibits Liaison:

Saul Rosenthal             Polytechnic University, Brooklyn, NY

#### MMIC/ARFTG Liaison:

Paul Meier                 Eaton-AIL, Melville, L.I., NY

#### Student Program Chairman:

S.T. Peng                  N.Y. Inst. Tech.

#### Transactions Special Editor:

Hank Paczkowski           Eaton-AIL, Melville, L.I., NY

#### Exhibits Manager:

Howard Ellowitz            Horizon House, Norwood, MA

#### Conference Manager:

Larry & Margaret  
Whicker                    LRW Associates

#### Hertz Exhibit Manager:

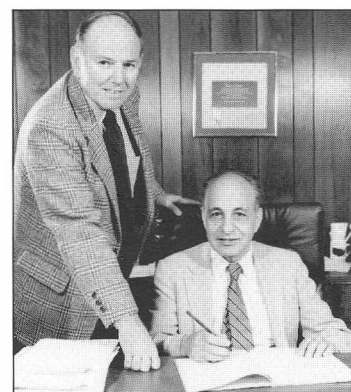
John Putnam                M/A-COM, Inc., Burlington, MA

#### Recording Secretary:

Naomi Taub

I can't thank them enough for the extraordinary job they did. And we're all looking forward to seeing you next June in Long Beach.

## Reflections on the 1988 International Microwave Symposium Technical Program



*by Jesse Taub and  
James Whelehan*

Looking back upon the Symposium, we were particularly pleased that we were able to assemble a broad-based Technical Program that demonstrated future trends as well as representing the diverse areas of current microwave technology. Sharp increases in papers on microwave optical interactions and microwave superconductivity are examples of this trend. Three contributed sessions on microwave monolithic integrated circuits, over and above the excellent papers given at the MMIC Symposium, suggest that this technology is now part of the mainstream of microwave engineering. We are particularly grateful for the deep commitment of our Steering Committee, the Technical Program Committee (TPC) and the Session Chairmen for helping to make this a successful

*continued on page 9*



## REFLECTIONS

(continued from page 8)

and informative Symposium. The TPC reviewed a record number of papers. Even with a 50% rejection rate, four parallel sessions were required.

A record registration of over 2300 attended the technical sessions. Eighteen countries were represented in the two hundred thirty papers that were given. The quality of the papers was high and the sessions were well attended. We made an effort to improve the quality of the slides used by each author. The benefits of their efforts were clearly evident. We hope that further improvement in the quality of slides continues in future Symposia.

The format of the Technical Program was similar to that used in 1987. The ninety minute sessions with long and short papers worked well. One out of three papers were in the short category; this appeared to satisfy the need, in some areas, for presenting new results and improvements without restating the prior art. Two hours were allotted for lunch rather than ninety minutes to permit the Panel Sessions to have more discussion. This extended the day by thirty minutes; it was felt to be a good trade-off.

Forty-nine Open Forum papers were given in two effective sessions. Joseph Levy, the Open Forum Coordinator, interacted with the TPC members to ensure the selection of strong papers that were well suited to this medium. Adequate space was provided to the presenters and the talks were well attended. We thank the authors for their efforts.

The Special Sessions (Panel Sessions and Workshops) had heavy registration, suggesting that the topics were timely. John Pierro did an excellent job in organizing and setting high standards for these sessions. His efforts towards having *hand-outs* available were appreciated by the attendees.

We continued to use Focused Sessions and invited papers to highlight selected areas. Don Neuf and John Pierro worked effectively with the session organizers. The areas covered were microwave/optical interactions, and microwave high power. The idea of focusing on microwave/optical interactions started in 1986. Evidence of the wisdom of that idea was that two sessions of contributed papers were also presented; it indicates that this area is now clearly within the field of interest of MTT-S members.

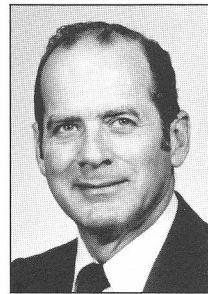
Our Symposium was particularly pleased to highlight the Hertz Centennial with two excellent sessions organized by John Bryant. A session honoring the many contributions to microwave theory of Arthur Oliner was well received. Three invited papers by eminent microwave engineers were presented at the European Microwave sessions. Their overviews of gallium arsenide device and IC technology, as well as millimeter waves, were most effective.

We believe that the format used in the 1988 Symposium should be continued. Future Symposia will be faced with an increasing number of quality papers. This may require a higher rejection rate, a fourth day and/or evening sessions.

We have received many favorable comments from the attendees about the quality of the Technical Program. The experience has been personally rewarding to us. Working with, and getting to know so many dedicated people on our Steering and Program Committees, will always be remembered.

Thanks again to all of the people that contributed to this successful program. We wish similar success to the 1989 Technical Program Committee. We hope to see many of you in Long Beach, California.

## 1988 Awards Banquet



by C.T. Rucker

Good friends—Good food—Good entertainment and the best opportunity each year to recognize some of those MTT-S members who have made special contributions to MTT-S or to our technical area during 1987—the Annual Awards Banquet.

It was most rewarding for me to have the privilege of assisting MTT-S President Barry Spielman in presenting the following major awards.

Microwave Career Award	Leo Young
Distinguished Service Award	Fred J. Rosenbaum
Microwave Applications Award	L.S. Napoli
	M. Fukuta
Microwave Prize	Kazuhiko Honjo
	Mohammad Madihian
Distinguished Microwave Lecturers	David K. Barton
	Rolf. H. Jansen

When one bears the responsibility for fellow evaluations, as I have for the past two years within MTT-S, it becomes evident that the MTT-S considers the IEEE grade of Fellow most seriously. An MTT-S Fellow Committee spends weeks to insure that every candidate is treated in detail and fairly. It is, therefore, quite significant that ten of those evaluated by MTT-S this year were elected IEEE Fellow. Seven of these were able to receive their Fellow certificates at the Symposium. They were:

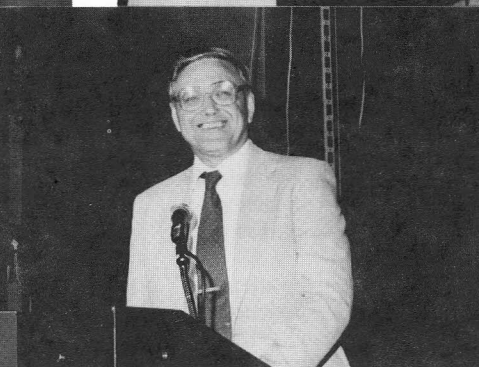
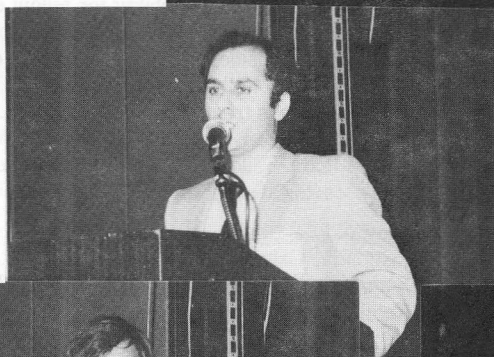
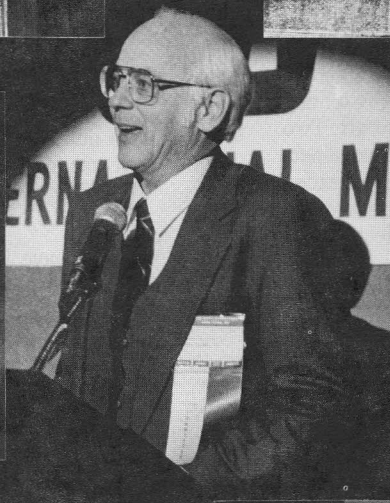
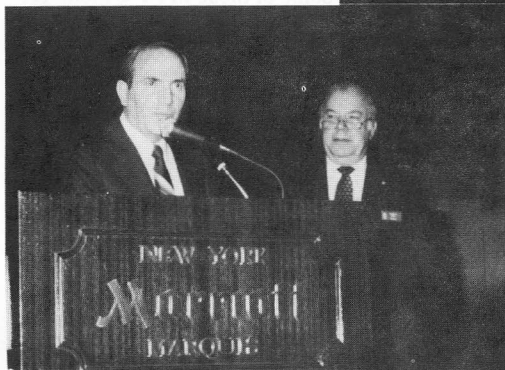
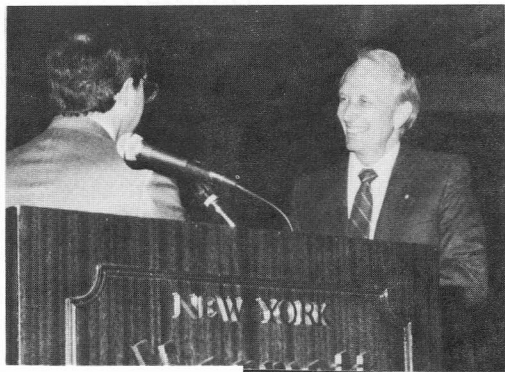
Berthold G. Bosch	Song-Tsuen Peng
Joseph A. Calviello	Saul W. Rosenthal
Walter R. Curtice	James J. Whelehan
Kuldip C. Gupta	

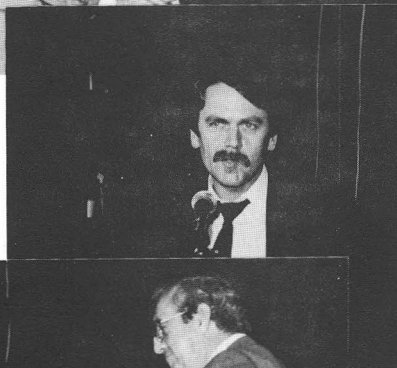
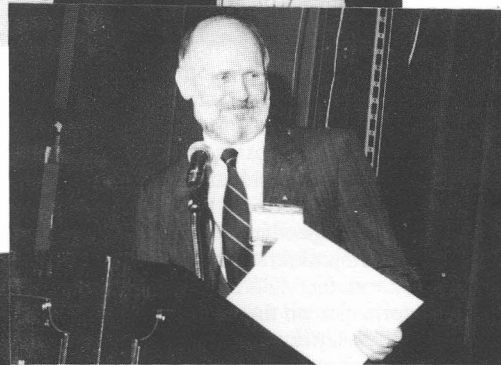
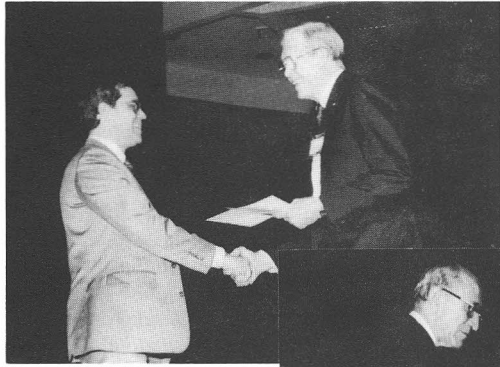
It is always rewarding to recognize some of those volunteers whose service and contribution to MTT-S have been special. This year, we were pleased to recognize:

David N. McQuiddy	1987 President
H. George Oltman, Jr.	Meritorious Service
Reynold S. Kagiwada	1987 TPC Chairman
Steven L. March	1987 Symposium

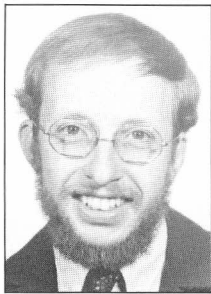
A surprise award was given this year to recognize the extraordinary efforts of John H. Bryant who led the highly successful effort that brought the Heinrich Hertz Exhibit to the Symposium in New York.

It is especially interesting that we have just finished recognizing Fred Rosenbaum for his many contributions to MTT-S by awarding him our Distinguished Service Award. Now, we plan to really put him to work—again. I am very pleased to announce that Fred will be your new Awards Chairman. I am confident that Fred will do an exemplary job—he always does. His official term begins in January, but we will begin transferring the responsibilities immediately.





# 1988 MMWMC Symposium



by *Derry Hornbuckle*

The 1988 IEEE Microwave and Millimeter-Wave Monolithic Circuits Symposium was held May 24 and 25 in conjunction with the 1988 MTT International Microwave Symposium at the Marriott Marquis Hotel and Jacob Javits Convention Center, New York, N.Y. Nearly 800 people attended the two days of technical sessions and related social activities.

This year's Monolithic Symposium activities began on Monday, May 23, with an evening reception in the Astor Ballroom of the Marriott Marquis. Piano music provided a backdrop suitable for conversation, and a variety of hors-d'oeuvres including salmon, roast beef, and ham encouraged lingering over drinks from the no-host bar. About 400 of the conference attendees and guests took advantage of this opportunity to socialize with others in the industry.

The Symposium proper began on Tuesday, May 24, in the Broadway Ballroom of the Marriott. Following the General Chairman's opening remarks, MTT-S AdCom President Barry Spielman presented a certificate of recognition to the preceding year's (1987) Monolithic Symposium Chairman, Yalcin Ayasli. Technical Chairman Reynold Kagiwada began the Symposium with an overview of the technical program, and served as chairman of the first session.

The technical program was the most extensive ever for the Monolithic Symposium, consisting of 35 papers, including three invited papers: The MIMIC Program, by Eliot D. Cohen; Microwaves vs. Fiber Optics, by Joseph Campanella and C. Mahle; and Commercial Applications of GaAs IC's, by Jerry Gladstone. The second day's program, on Wednesday, May 25, was jointly sponsored by the MTT Symposium, and was held at the Jacob Javits Convention Center with the MTT Exhibition and other MTT sessions. Additional information on the technical program can be found elsewhere in this Newsletter issue in the article by Reynold Kagiwada.

A number of related activities provided opportunities for the participants to socialize. Speaker breakfasts each morning brought together the speakers and session chairmen with time for discussing logistics and introductory information. A continental breakfast for all conference participants on Tuesday at the Marriott preceded the opening session. Beverage service at breaks encouraged participants to remain in the vicinity of the sessions and talk with each other. And all attendees, along with guests, were invited to the Microwave Journal reception on Tuesday. Local Arrangements Chairman Charlie Huang, and his counterparts on the MTT Symposium Committee, are to be commended for an excellent job on these activities. They provided for the guests of conference attendees as well, with a program which included a hospitality suite and local tours arranged by MTT, in addition to the two receptions.

Putting together a conference like the Monolithic Symposium requires the dedicated efforts of many people. I would particularly like to thank the Monolithic Symposium Steering Committee, Technical Chairman Reynold Kagiwada, Finance Chairman Alejandro Chu, Local Arrangements Chairman Charlie Huang, and all the members of the Technical Program Committee. Publicity Chairman Octavius Pitzalis got the word out on the Symposium,

and Digest Chairman Dale Dawson brought together the written information in the digest. Vice Chairman Roger Sudbury provided guidance from his experience as past chairman; Secretary William Perkins provided records of Steering Committee work; and Transactions Editor Russell Gilson handled reviewing and editing for the extended papers to be published in the December issues of both MTT and Electron Devices Transactions.

The Monolithic Symposium would not have been possible without the enthusiastic cooperation of the MTT Symposium Committee, particularly Chairman Charles Buntschuh, Monolithic Liaison Paul Meier, and the MTT Technical and Local Arrangements Chairmen: Jesse Taub, James Whelehan, John Coppola, and Jerry Hausner. The dedicated services of Larry and Margaret Whicker, of LRW Associates, were essential to almost every aspect of the conference organization.

Finally, special thanks are due to three members who are completing terms of service on the Monolithic Symposium Steering Committee this year:

Marvin Cohn, Westinghouse  
Russ Gilson, CECOM, Fort Monmouth  
Roger Sudbury, MIT Lincoln Laboratory

All three received plaques at our May Steering Committee Meeting honoring their service to the Monolithic Symposium, and we are grateful for their years of service.

## High School Students Attend the Symposium



by *Naomi Taub*

The 1988 Microwave Symposium Steering Committee asked the following question: Was it possible to introduce the concepts of microwave engineering to high school students? Traditionally, there has been a tendency to think that they do not have the background to understand microwaves and have not narrowed their science and math interests to engineering, let alone microwave engineering.

We ran an experiment. Under the general direction of Professor S.T. Peng, we invited high school students from New York City and Long Island to spend one day at the Microwave Symposium. It was a privilege to plan the program. It began with presentations by high school science teachers Richard Galati and Lydia Horowitz on the fundamentals of microwave technology and their applications. We arranged for Dr. John Bryant to guide the students through the Hertz Centennial Exhibit. Frances Peng organized college engineering students to conduct groups of 4 or 5 through the Commercial Exhibits. There was a surprise visit by William Brown who graciously showed his news broadcast video tapes of the Canadian's innovative microwave powered airplane, SHARP.

Occupational information was presented in several ways. The story of the development of the microwave oven was used. It

*continued on page 13*

---

## HIGH SCHOOL STUDENTS

(continued from page 12)

demonstrated that many types of engineers (research, development, marketing, etc.) were involved in the development of a successful product. The students had been invited to participate in an essay contest in which they had to explain why they might be interested in engineering as an occupation. Dr. Barry Spielman (MTT-S President) presented the winners with calculators at an Awards Luncheon and gave a brief address citing the excellent career opportunities in electronics engineering. Anthony Cappello, a young microwave engineer from Eaton/AIL, enthusiastically described the challenging work he is involved with.

When one student wrote that the day "opened my mind," and that "in some cases the information could have been at a higher level;" when students asked for *more time, more lectures and more interaction between lecturers, engineers and students*, we knew the experiment had been a success. It is a clear indication that these types of interactions create a positive attitude towards the profession and should serve to improve the quality of applicants who

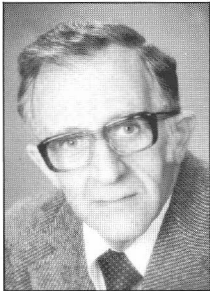
will be interested in microwave engineering. On behalf of our 1988 Symposium Steering Committee, we hope that similar programs become part of future MTT-S Symposia or Chapter activities.



Eaton/AIL engineer, Anthony Cappello is shown explaining Microwave Fundamentals as he conducts high school students through the MTT-S Historic Exhibit.

---

## The Radiation Laboratory 50th Anniversary Celebration: *An Update*



by T.S. Saad

In the fall 1987 issue of the MTT Newsletter, I wrote about the plans being formulated for a celebration of the 50th anniversary of the MIT Radiation Laboratory. In that report, I mentioned two activities that were being planned, one having to do with the activities that would take place in Boston at the MTT-S Symposium in June of 1991, the other, the video taping of interviews with surviving Rad Lab members. The report generated a great deal of interest, enabling us to both correct and augment our mailing list.

Activities planned for the Symposium are under no time pressure and have been set aside for the time being. The video taping project, however, has received our serious attention over the last several months.

Our Microwave Society Committee has been meeting regularly in our effort to set up a program to do the video taping properly. We had video taped our first meeting with the 14 Rad Lab members and felt that it was the technique to use. As a trial exercise, we taped a session, in which I interviewed Al Hill and Bob Pound. For that session, M/A-COM made available their facilities and some of their professional personnel. After reviewing the tape and what was required to make it, we decided that we would need professional help to do the project justice.

Our Committee continued to meet regularly over the next several months. We met and talked with professional video tape/movie making consultants. Our ambition was to prepare a

video tape or movie of such quality that it would serve two purposes, one to provide us with the historical archival material, the other to provide a movie on the history of the Rad Lab suitable for presentation as a NOVA film.

In the meantime, we had, from time to time, contacted the people at NOVA indicating our interest in recording the history of the Rad Lab.

At a meeting early this past spring, we decided to prepare a prospectus suitable for consideration by the producers of NOVA, and to solicit a favorable indication from them prior to seeking MTT-S approval. It involved retaining a professional film producer, soliciting funding, etc.

The prospectus was prepared and a phone call made to the NOVA office in Boston to set up an appointment. It was at that point we learned that a project - The History of Radar - had actually been approved and was to be NOVA sponsored.

The individual in charge of the project is Linda Garmon, a producer at NOVA. She was primarily responsible for the outstanding NOVA film on Superconductivity.

We have had two meetings with her. It is clear that she will focus, to a large extent, on the activities of Rad Lab. She has already begun interviewing ex Rad Lab members who are on our list. She has been searching the archives and libraries for movies, photos, etc. The project is well underway. In fact, at the time of this writing, a dedicated group of engineers in the Baltimore area are trying to make operational a vintage SCR 584 fire control radar. A film of this type usually takes about 8 months to complete, which means it could be shown as soon as early next spring.

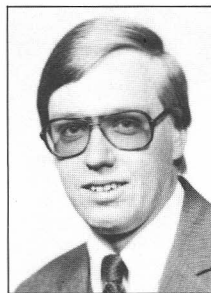
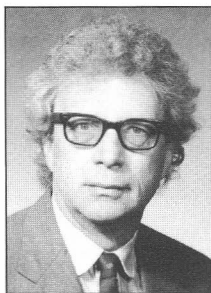
Although the major portion of the funding will come from the NOVA budget, some additional funding will be required. Our Committee is working to raise the remaining amount.

Another benefit of this project is that we have been told that the 'outtakes' (film not used in the final production) will be made available for our historical archives. Ex Rad Lab members who are on our mailing list may be contacted by Linda for an interview.

The film will be shown on national television. In addition, we will have copies of the film for our archives to show at the Symposium in 1991.

We will keep you posted.

## Membership Services



by Martin V. Schneider, Chairman  
and Steven J. Temple, Co-Chairman

### CHAPTER ACTIVITIES AND NEW CHAPTERS

The technical activities of the MTT-S chapters increased substantially in 1988. For the first six months of the year, 118 regular meetings were reported by the chapters. During the same period in 1987 only 84 meetings were held. The number of special meetings increased from 9 to 14 during these time periods.

Seven new chapters are currently being formed. They are: Ithaca, France, Galveston Bay, North Italy, Taipei, Virginia Mountain and Winnipeg. We expect to have a total of 66 chapters at the end of 1988, which will correspond to a growth rate of 12% per year.

### DISTINGUISHED LECTURES AND SPEAKERS' BUREAU

The 1988/1989 Distinguished Lecturers, Reinhard Knerr and Arnold Silver, have started their assignments by giving lectures on 'Lightwave Communications' and 'Superconductive Electronics' to Chapters in the United States. They are both planning to present talks in Europe this fall. By serving the needs of the European MTT community, we hope to maintain the high membership growth of 14% in this area.

On behalf of AdCom and our 60 chapters, we would like to thank our outgoing lecturers, David Barton and Rolf Jansen, for the excellent talks they presented to our members and to numerous other technical organizations. The continued vitality of our group and the Society depends on people like David and Rolf who visited most of our chapters and kept us informed on both the basic principles and developments in their field of expertise.

In addition to providing the Distinguished Lecturers to our chapters, we have established an MTT Speaker Bureau to satisfy the growing need of MTT members to remain informed on a large number of technical subjects related to microwave devices, circuits and systems. Our new IEEE-MTT Speakers will give about six talks during the year and will accept your invitations if you can convince them that they will meet a lively and sizable audience. A list of the lecturers with the titles and abstracts of their talks appears in this Newsletter (see page 17).

### VIDEOTAPES OF DISTINGUISHED LECTURES

We have made tentative plans to produce videotapes of the Distinguished Lectures and some selected lectures from our Speakers' Bureau. The cost of creating the tapes in a professional studio will be shared equally by the IEEE Educational Activities Department, the MTT Society and AT&T. We expect that these videotapes will be available in 1989 for distribution to MTT chapters at a small cost. They can be shown to groups that are not included in the usual lecture circuit.

## MTT SPEAKER BUREAU

### Quasioptical System Design for Millimeter Wavelengths

by Paul F. Goldsmith  
Department of Physics and Astronomy  
University of Massachusetts  
Amherst, MA

Phone: (413) 545-0925 • FAX: (413) 253-5295

Millitech Corporation  
South Deerfield, MA

Phone: (413) 665-8551 • FAX: (413) 665-2536

### ABSTRACT

Quasioptical propagation is gaining increasing acceptance as a valuable transmission medium for millimeter wavelengths. The reasons for this include the low loss, broad bandwidth, multiple polarization handling, and large range of circuit functions that can be obtained. A wide variety of radar and radiometric systems and subsystems have been developed using quasioptical techniques. Quasioptical systems depend on availability of building blocks or components for carrying out particular functions. Some of these are quite similar to waveguide approaches used at longer wavelengths, and some derive from infrared and optical technology.

The relatively large (compared to optical) wavelength means that for compact systems, diffraction is an important consideration. Nevertheless, quasioptical techniques are continuously being extended to perform new tasks as well as being refined to occupy less volume. Recent developments include a system for high accuracy measurement of materials properties, quasioptical tuning elements for a frequency multiplier, and analysis of power combiners using a free space resonant cavity.

Quasioptical propagation using Gaussian beams (Gaussian optics) has been the basis of most system design employing free space transmission. The relative simplicity and comprehensiveness of the theory allows accurate and efficient calculations of the performance of many components.

Critical questions then are:

1. In what situations is Gaussian optics the optimal choice of propagation medium?
2. How is the Gaussian optics portion of a complete system interfaced to the parts using other transmission media?
3. How is system design using Gaussian optics carried out?

In this talk I review the basics of Gaussian beam propagation, and the Gaussian optics components which have proven especially useful. Guidelines for the use of different components and their integration into systems are also developed to aid the designer in assessing the utility of Gaussian optics and examples of quasioptical systems are also presented to illustrate the design principles.

### BIOGRAPHY

Paul F. Goldsmith was born in 1948 and received his undergraduate and graduate training at the University of California, Berkeley. His doctoral research involved the development and

*continued on page 14*

---

## SPEAKER BUREAU

(continued from page 14)

use of a 230 GHz radiometer for observation of emission from carbon monoxide molecules in interstellar clouds. After completing his PhD degree in 1975, he received an appointment as Member of the Technical Staff at Bell Telephone Laboratories, Holmdel, N.J., where he developed instrumentation for the 7m antenna used for radio astronomical observations. In 1977 he was appointed Assistant Professor at the University of Massachusetts at Amherst, in the departments of Physics and Astronomy and electrical and Computer Engineering. He has been actively concerned with the development of low noise receivers and other equipment for the 14m radome-enclosed radio telescope operated by the Five College Radio Astronomy Observatory, as well as using this instrument to study the composition and structure of molecular clouds in the interstellar medium of our Galaxy. His work in the area of receiver systems for millimeter and submillimeter wavelengths has led to ongoing interest in quasioptics-the application of optical techniques to these relatively low frequencies. Dr. Goldsmith is presently Professor of Physics and Astronomy at the University of Massachusetts, and Associate Director of the Five College Radio Astronomy Observatory. In 1982 he was one of the founders of the Millitech Corporation, a company dedicated to design and production of millimeter and submillimeter components and systems, where he is Vice President for Research and Development. Dr. Goldsmith is a member of the American Astronomical Society, Sigma Xi, URSI, SPIE, and a Senior Member of IEEE.

## Gallium Indium Arsenide Heterostructures for Low Noise Amplification, High Speed Logic Circuits, and Lightwave Detection

by Umesh K. Mishra and April S. Brown  
Hughes Research Laboratories  
3011 Malibu Canyon Dr.  
Malibu, CA 90265

Phone: (213) 317-5919 • FAX: (213) 317-5483

### ABSTRACT

Ga<sub>0.47</sub>In<sub>0.53</sub>As has long been recognized for its excellent electronic properties and its wavelength compatibility with low loss optical fibers. With the advent of advanced growth technologies such as MBE and MOCVD, heterostructures with InP and Al<sub>0.47</sub>In<sub>0.53</sub>As layers are now possible. This has led to the development of devices such as the AlInAs - GaInAs modulation doped field effect transistor (MODFET) and the heterojunction bipolar transistor (HBT) with AlInAs or InP wide gap emitters. The AlInAs - GaInAs MODFET has shown superior mm-wave noise performance compared to the GaAs based AlGaAs - GaAs and AlGaAs - InGaAs MODFETs. An extrinsic current gain cut-off frequency,  $f_t$ , of 170 GHz has been achieved for devices with a gate length of 0.1  $\mu$ m. Most of the work on InGaAs based HBTs was done with InP emitters. These MOCVD grown structures exhibited current gains of over 5000. In addition to high speed applications, HBTs are attractive as detectors and drivers for long wavelength optoelectronic circuits.

This talk will address the status of the materials, device properties, circuits and applications of heterostructures based on InGaAs.

## BIOGRAPHIES

Umesh K. Mishra received his Bachelor of Technology (B. Tech.) degree in 1979 in Electrical Engineering from the Indian Institute of Technology, Kanpur, India. His B. Tech. thesis dealt with oxide semiconductor on silicon solar cells. He received his M.S. degree in 1980 from Lehigh University, Bethlehem, PA. where he worked on metal-insulator-silicon-switching (MISS) devices. He obtained his Ph.D from Cornell University where his thesis addressed the fabrication and characterization of sub-micron vertical transistors in the AlGaAs - GaAs system. Umesh was at the Electronics Labs of General Electric in Syracuse, NY from 1983 to 1985 where, as Principal Staff Engineer, he was involved with the development of sub-micron AlGaAs - GaAs HEMTs or mm-wave low noise and power applications. He joined the faculty of Electrical Engineering at the University of Michigan, Ann Arbor, MI and became a Member of Technical Staff at the Hughes Research Laboratories in Malibu, CA. He is currently the Manager of Advanced Devices where he is responsible for the development of AlInAs - GaInAs HEMT and HBT devices for mm-wave analog and digital applications.

April S. Brown was born in Durham, North Carolina and obtained her B.S. degree in Electrical Engineering from North Carolina State University, Raleigh, NC in 1981. She received both her M.S. and Ph.D. degrees at Cornell University, Ithaca, NY in 1984 and 1985. Her graduate work was concerned with the understanding of substrate and kinetic effects on the growth of GaInAs and AlInAs by MBE. She studied the impact of these parameters on the performance of GaInAs planar doped barrier diodes and AlInAs-GaInAs MODFETs. On graduating from Cornell, April joined the faculty of Electrical Engineering at the University of Michigan, Ann Arbor, MI. In 1986 she became a Member of the Technical Staff at the Hughes Research Laboratories in Malibu, California. Her research has been primarily in the advancement of the AlInAs-GaInAs materials system for high speed devices. Devices made as a result of the effort have significantly advanced the state of the art for low noise millimeter wave operation. Digital circuits made with these high performance devices have yielded record divider performance. She has authored or co-authored over twenty papers on In-compound materials and devices. She has given three invited papers on the subject and contributed to several others. In 1987, April received an Outstanding Technical Achievement Award from Hughes Research Laboratories. She is a member of the IEEE, the American Physical Society, Tau Beta Pi and the Materials Research Society.

## Testing of High-Speed ICs with Ultrashort Optical Pulses

by Kurt J. Weingarten  
Lightwave Electronics  
897-5A Independence Ave.  
Mountain View, CA 94043

Phone: (415) 962-0755 • FAX: (415) 962-1661

### ABSTRACT

Gallium arsenide and related compounds have been the 'material of the future' for integrated circuit (IC) technology for the last decade. For microwave applications, such as broadband amplifiers, oscillators, diode switches, and mixers, compound semiconductor

*continued on page 16*

ICs and components clearly have outpaced competition from silicon ICs. For digital applications, such as fiber optic digital data transmission at gigahertz rates, high-speed data acquisition, and faster digital logic for computers and signal processors, these new ICs have a growing niche. New growth techniques promise much higher performance devices based on heterostructures and quantum-size effects, such as heterojunction bipolar transistors (HBTs) and high electron mobility transistors (HEMTs) or modulation-doped field effect transistors (MODFETs). These devices and ICs are creating new challenges for the high-speed test instrumentation used to characterize their electrical response.

One need is for increased time resolution or frequency bandwidth, with transistors showing a maximum frequency of oscillation,  $f_{max}$ , in excess of 100 GHz. Propagation delays and transition times of 1-10 ps, well below the resolution of conventional sampling oscilloscopes, are expected for switching circuits using these devices. In either the time or the frequency domain, the speed of the devices exceeds that of the measurement instrument. A second need is for a noninvasive probe of internal signals in the ICs. A test instrument with this feature would permit better characterization of complex high-speed ICs, improving models for devices at high frequencies and helping designers to optimize their circuit performance.

In the last decade, however, optical techniques for ultrashort pulse generation have outpaced electronic pulse generation techniques. Many research laboratories routinely generate picosecond pulses at a number of optical wavelengths, with the record of 6 fs (10<sup>-15</sup> seconds). This lecture will describe several methods of using these short optical pulses to make high speed electrical measurements on ICs. One method in particular will be emphasized, electrooptic sampling, which uses the linear electrooptic effect to allow for the detection of voltage signals with light and a high-repetition rate laser to repetitively sample the electrical waveforms. This approach allows direct probing of signals on the IC to allow in situ testing, and synchronization of the pulsed laser system to a microwave signal generator to allow testing of the IC with representative drive signals. The implementation of electrooptic sampling for at-speed testing of high-performance microwave and digital ICs will be described, and a number of measurement performed on microwave and digital circuits will be presented.

#### **BIOGRAPHY**

Kurt J. Weingarten was born January 30, 1961 in St. Petersburg, FL. He received the B.S. degree in electrical engineering from the Georgia Institute of Technology in 1983, and his M.S. in 1985 and the Ph.D. in December 1987 in electrical engineering from Stanford University, where he worked as a research assistant in the Edward L. Ginzton Laboratory. His thesis was 'Gallium Arsenide Integrated Circuit Testing using Electrooptic Sampling.' He has authored a number of papers on this topic and co-authored several papers on related topics such as the timing stabilization of modelocked lasers. In 1985 he received an IBM Predoctoral Fellowship and in 1986 and 1987 the Newport Research Award. He currently works for Lightwave Electronics developing a commercial version of an optical tester for GaAs ICs. His research interests are electrooptic sampling of GaAs ICs, high-speed electronic testing, and ultrafast optical pulse generation. He is a member of the IEEE and the Optical Society of America.

# Submillimeter Heterodyne Detection with Superconductive Electronics

by Michael J. Wengler

Department of Electrical Engineering

University of Rochester

Rochester, NY 14627

Phone: (716) 275-9402 • FAX: (716) 275-0135

#### **ABSTRACT**

A superconductive tunnel diode called an SIS is an extremely sensitive detector of signals at frequencies of 100 GHz and higher. In fact, it is capable of detecting every photon that it absorbs. For spectroscopy of signals from 100 to 760 GHz, heterodyne receivers using an SIS as the mixing element have demonstrated lower noise levels than any other technology. These receivers have been used for 100 to 260 GHz radio-astronomy at radio-telescopes around the world since about 1979, and have recently been used up to about 500 GHz.

This talk will describe these SIS mixers, including the underlying physical principles of the SIS diode and its interaction with radiation, the design of SIS mixers, and the fabrication and testing of these mixers.

The operation of the SIS tunnel diode detector has characteristics of both the semiconductor diode used for microwaves, and the photo-diode or photo-conductor used for infrared and higher frequencies. It is like the microwave diode in that its detection is essentially done by rectifying the incoming signal wave. It is like the photo-diode in that it absorbs energy from the incoming signal in units of  $h\nu$ , the energy of a photon. It is the second property that accounts for its incredibly high sensitivity.

Like the underlying physics, the design of submillimeter SIS receivers also draws from both microwave and optical techniques. For the longer wavelength end of this range, waveguide-mounted SIS's are used. For the shorter wavelengths, waveguides become very small and lossy. Instead, we use what we call the quasi-optic SIS. The SIS is integrated with a lithographically defined micro-antenna. The SIS-antenna is then placed on the back of a lens, which focuses the signal radiation into it. This system works well to as high a frequency as it has yet been tested, 760 GHz.

Various SIS receivers in use on radio telescopes will be shown. The progress of our work with the quasi-optic SIS will be reviewed. Fabrication techniques for SIS diodes will be described.

#### **BIOGRAPHY**

Michael J. Wengler was born on Long Island, in New York, in 1957. He received a B.A. in Physics from Swarthmore College in 1978, and a Ph.D. in Applied Physics from the California Institute of Technology in 1987.

His high frequency receiver career started in 1978 when he worked for Bell Telephone Laboratories in their Radio Physics Research Department. There, he worked on ultra-low-noise 100 GHz receivers, which were based on GaAs Schottky diodes operated at cryogenic temperatures.

In 1980, he hied himself to Caltech after discovering that he could only be promoted at Bell Labs with a Ph.D. At Caltech, he began working on 100 GHz receivers using the SIS superconductive tunnel diode. He extended the theory of the SIS mixer by treating the signal radiation quantum mechanically. He developed computer programs to aid in the design and analysis of SIS mixers. Finally,

*continued on page 17*



## MTT SPEAKER BUREAU

(continued from page 16)

he constructed the first quasi-optic SIS receiver, which showed record sensitivities for detection above 300 GHz.

On finishing his Ph.D. in 1987, he became an assistant professor of Electrical Engineering at the University of Rochester. He is investigating, both theoretically and experimentally, some of the quantum mechanical implications of the extremely high sensitivity

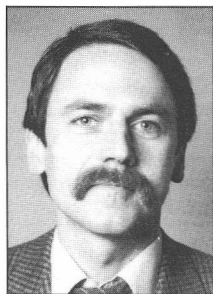
of the SIS. He is continuing to develop submillimeter receivers for radio-astronomy. He will also work with other superconductive circuits, in particular he is interested in oscillator circuits for the submillimeter frequency range.

Professor Wengler is an NSF 1988 Presidential Young Investigator. He is a member of the IEEE.

### MTT SPEAKER BUREAU: SUMMARY INFORMATION

Lecturer	Affiliation	Topic	Abstract & Biography Ref (Newsletter)
Heinrich Daembkes	AEG Research Center Sedanstrasse 10, D-7900 Ulm West Germany Phone: 49-731-392-4272	Microwave and Millimeter-Wave HEMT Devices and Circuits	Winter 1988
Pierre Encrenaz	Observatoire de Paris 92190 Meudon, France Phone: 33-14-077530 FAX: 33-14-5077893	The Impact of Coherent Detection Techniques on Terrestrial and Planetary Atmospheric Research, and on The Discovery of Interstellar Molecules	Spring 1988
Fred Gardiol	Ecole Polytechnique, Dept. D'Electricite El-Ecublens, CH-1015 Lausanne, Switzerland Phone: 41-2-472669 FAX: 41-21-4746600	Microstrip Circuit Analysis: The Integral Approach	Winter 1988
Paul Goldsmith	Millitech Corp. South Deerfield, MA Phone: (413) 665-8551 FAX: (413) 665-2536	Quasioptical System Design for Millimeter Wavelengths	Fall 1988
C. Holmes P. Parrish O. Pitzalis	EESof Incorporated 5795 Lindero Canyon Road Westlake Village, CA 91362 Phone: (818) 991-7530	GaAs FET and HEMT Modeling Circuit and System Simulation — State of the Art and Beyond	Spring 1988
U. Mishra A. Brown	Hughes Research Laboratories 3011 Malibu Canyon Drive Malibu, CA 90265 Phone: (213) 317-5919 FAX: (213) 317-5483	Gallium Indium Arsenide Heterostructures for Low Noise Amplification, High Speed Logic Circuits, and Lightwave Detection	Fall 1988
Erwin Schanda	Institute of Applied Physics University of Bern CH-3012 Bern, Switzerland Phone: 41-31-658910	Remote Sensing with Microwave and Millimeter Waves	Winter 1988
Kurt Weingarten	Lightwave Electronics 897-5A Independence Ave. Mountain View, CA 94043 Phone: (415) 962-0755 FAX: (415) 962-1661	Testing of High Speed ICs with Ultrashort Optical Pulses	Fall 1988
Michael Wengler	Dept. of Electrical Engineering University of Rochester Rochester, NY 14627 Phone: (716) 275-9402 FAX: (716) 275-0135	Submillimeter Heterodyne Detection with Superconductive Electronics	Fall 1988
Bernard Yurke	AT&T Bell Laboratories 600 Mountain Avenue Murray Hill, NJ 07974 Phone: (301) 582-4961	Quantum Noise in Microwave and Millimeter-Wave Electronics	Winter 1988

# CAD of Hybrid and Monolithic Microwave and Millimeter-Wave MICs



by *Rolf H. Jansen*  
*Industrial Microwave and RF*  
*Techniques, Inc.*  
*Neanderstrasse 5, D-4030 Ratingen 1*  
*West Germany*  
*Phone 49-2102-83095*

It is surprising how fast 12 months of lecturing pass by, packed full with new impressions and with meeting interesting people worldwide. It has been a workload in addition to my decent regular one but mostly a pleasure to present by now 40 lectures on the field of CAD of MICs and MMICs to an audience of about 1300-1400. I am now looking forward to complete my lecturing series with a few further presentations in Europe and Canada, but with a very much more relaxed schedule.

One of the highlights of the period reported here was a 1 1/2 day workshop on CAD of microwave circuits and antennas held by the West Germany MTT/AP chapter end of March at the University of Munich. With an attendance of about 80 microwave people and participation of CAD experts from our European neighbor countries and even from the US, the enthusiasm and motivation of the audience was extraordinary. My contribution was integrated into a sequence of high level presentations covering a wide range of topics like modeling, analysis of microstrip, coplanar and fin line components, linear and nonlinear simulation, time domain and frequency domain aspects as well as oscillator noise analysis.

In April I started for a condensed lecturing tour through the United States with a stop at the end in Ottawa. Starting with a talk and discussions deep into the night at Long Island, I went on to the University of Michigan where I was impressed by the size and professionalism of the gallium arsenide activities running there. In addition, I enjoyed the warm hospitality and sincere interest of the graduate students of this research center. The next station on my tour was the University of Colorado at Boulder combined with a visit to Ball Aerospace. This was similarly enjoyable from a professional and a social point of view. Dr. Haddad, the chairman of the local chapter, did his best to take care of me and satisfied my interest in the industrial microwave activities going on at Boulder while my colleague and well-known CAD specialist Dr. Gupta informed me about research at the University there and the beginning MIMICAD activities. From Colorado, I travelled on to participate in a one-day workshop on MIMICs which was sponsored by the Phoenix IEEE Waves and Devices Group in cooperation with Arizona State University. This gave me interesting insight into research and development work performed at Motorola and the opportunity to exchange ideas with MMIC experts and good old friends parallel to the sessions.

Certainly one of the most inspiring and best attended lecturing experiences I had during my period of service up to now was a visit to the Santa Clara Valley chapter where I spoke to about 80 people at the Hewlett Packard Corporate Auditorium in Palo Alto. Well organized and prepared by Dr. Holmes, (EESof), I had a great response and found a particularly vital and interested microwave community. Besides, Dr. Holmes who is himself one of the leading CAD contributors worldwide, did his best to make my stay at Palo

Alto pleasant and comfortable. When I hopped from Palo Alto to South Florida for 2 further talks the groups there were much smaller. However, the CAD topics I discussed there received similar attention and the hospitality of my colleague Prof. Henning of the University of South Florida who informed me about the technical activities in the Tampa bay area was excellent. A good conclusion to this North America lecturing tour was to make a jump to Ottawa, Canada, where again a larger audience waited for me after a morning talk still given in Florida. I found the Ottawa chapter expertly run by Irena Streibl of CRC and despite the short time I had for my visit, the schedule prepared by her gave room for exchange of valuable technical and background information. Thanks to all the hosts who have made this possible.

## Lightwave Communications



by *Reinhard H. Knerr*  
*AT&T Bell Laboratories*  
*555 Union Boulevard*  
*Allentown, PA 18103*  
*Phone (215) 439-7505*

### DISTINGUISHED MICROWAVE LECTURER (1988/1989)

#### Abstract

Lightwave communications technology has now reached a fairly sophisticated level of maturity. Applications range from multi-mode short wavelength LED systems, which can transmit at kilobits per second and are used primarily for short range applications, to long-haul single-mode laser systems, which can transmit at the rate of gigabits per second.

This talk will touch on the full range of lightwave communications applications. A short introduction to basic fiber technology will be given. Applications to optical data links and interfaces for point to point data networks, will be discussed as well as the extension of such technologies to lightwave local area networks (LANs). Different network architectures for lightwave LANs will be discussed, including the fiber distributed data interface (FDDI), and the manufacturing automatic protocol (MAP). Long haul digital systems will be mentioned, with special emphasis on the microwave aspects of gigabit systems, such as stripline and low noise GaAs preamplifier technology.

Coherent lightwave systems will be reviewed with emphasis on the equivalence between such systems and the older microwave technology. We will detail problems which have been addressed in microwave systems and which are now being encountered in coherent lightwave systems and being solved by analogy to the older microwave technology. These include techniques such as isolation, internal and external modulation schemes, low noise amplification and phase lock techniques. Emphasis will be placed on heterodyne rather than homodyne systems.

Because of the wide range of topics covered, the talk will be more in the nature of a review than an in-depth presentation of any given topic. Some theoretical discussion will be included, but

*continued on page 19*

## LIGHTWAVE COMMUNICATIONS

(continued from page 18)

hardware will be emphasized. We will conclude with a short look into the future, and a discussion of the fundamental problems that have yet to be solved in order to make certain exploratory systems practical.

### Biography

Reinhard H. Knerr is a native of Pirmasens, Germany. He received a PhD and an MS in EE from Lehigh University, Bethlehem, PA and Dipl. Ing. degree from the Ecole Nationale Supérieure d'Electrotechnique et d'Hydraulique in Toulouse, France and a BS degree from the Technical University of Aachen, Germany.

He joined AT&T Bell Laboratories as a Member of the Technical Staff in 1968. He was involved in R&D on circulators, IMPATT power amplifiers, low noise and power GaAs FET amplifiers and satellite receivers. He has published extensively in the field and holds six patents.

Knerr has supervised work in lightwave passive components, integrated optics, lightwave local area networks and lightwave data interfaces.

He is a Fellow of the IEEE and was editor of the Transactions on MTT from 1980 to 1982. He served as president of the MTT Society in 1986.

## Microwave and Gigabit Superconductivity Electronics



by *Arnold H. Silver*

*TRW Space and Technology Group  
One Space Park, MS R1//2170  
Redondo Beach, CA 90278  
(213) 812-0115*

### DISTINGUISHED MICROWAVE LECTURER 1988/89

Superconductive electronics is an integrated circuit technology which can provide the highest performance detection and signal processing circuits from dc to the submillimeter-wave region and the fastest digital logic and memory. This performance is achieved by combining the fundamental properties of superconductors, the superconducting Josephson tunneling diode, and the cryogenic environment required for superconductivity.

This lecture will review the fundamental and historical development of superconductive electronics. Its inception traces from the successive discoveries of flux quantization, the Josephson effect and the SQUID (Superconducting Quantum Interference Device) in the early 1960's; its application is a direct consequence of the development of a thin film integrated circuit technology for com-

puter applications. From a lead alloy technology in the 1970's, we now have a highly developed niobium circuit technology which is capable of operating at picosecond speeds and into the submillimeter-wave region.

We will discuss the performance and application of such components as quantum-noise limited microwave and millimeter-wave amplifiers, mixers, and video detectors, voltage-controlled oscillators, analog correlators and convolvers, and analog-to-digital converters. The recent discovery of superconductivity at temperatures as high as 95 kelvin may herald the widespread use of superconductive circuits. Prospects for development and application of high temperature superconductive electronics, and its possible impact on semiconductor devices will be explored.

### Biography

Arnold H. Silver joined TRW Space and Technology Group in 1981 after serving as Director of the Electronics Research Laboratory at the Aerospace Corporation for 10 years. Prior to that, he was with the Scientific Laboratory of the Ford Motor Company at Dearborn, MI for 12 years. He is a member of the IEEE, a Fellow of the APS, and has been active in the superconductive electronics community including service at Technical Program Chairman of the 1976 Applied Superconductivity Conference and a member of the Organizing Committees of the Workshop on Superconductive Electronics and the US - Japan Workshop on Josephson Electronics.

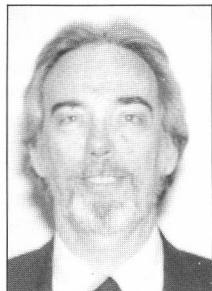
Silver has been active in the development and application of superconductive electronics since his invention of the SQUID at Ford in the early 1960's. At Aerospace, his laboratory pioneered the development of low noise millimeter wave mixers and detectors, including the superconducting-Schottky diode and the quantum theory of superconductive Electronics Research at TRW, his group has pioneered the development of low noise microwave amplifiers and oscillators, analog-to-digital converters, a niobium-based integrated circuit technology and now the development of a high temperature superconductive technology.

Silver received the BS, MS, and PhD degrees in Physics from Rensselaer Polytechnic Institute. His dissertation was on the application of nuclear magnetic and quadrupole resonance effects in the study of the structure of solids. He continued that research at Ford until his work on superconductive devices. He has authored more than 50 publications and numerous patents.

## Professorship to Honor Microwave Pioneer Jerrald Zacharias

Radiation Laboratory colleagues and other friends and admirers of the man who was an early leader in microwave plumbing, the developer of ultra high precision cesium frequency standards and who created the Physical Science Study Committee high school physics course, and stimulated many other educational reforms, have banded together to fund a professorship in his memory. Interested individuals can make contributions to M.I.T. or receive further information from Jerome Wiesner, M.I.T., Bldg. E15-207, 20 Ames Street, Cambridge, MA. 02139.

# Membership Development



by Alton L. Estes

## 1988 PROGRESS REPORT

### Growth Rate Continues Above 10 Percent

The current membership growth rate, 11.2 percent, and the continued growth momentum positions the MTT-S membership to achieve our Society's growth goal of 10 percent for 1988. The MTT-S membership growth rate (compared to the other 33 IEEE Societies) varied between first and fifth place for the first six months of 1988. At the end of June, the MTT-S membership grew 11.2% when compared to the June 1987 membership results. This growth compares favorably to the Institute Society membership growth rate of 7.9% for the same period. In addition, at the end of June the MTT-S continued to be the 6th largest IEEE Society with 9,732 active members. MTT-S was the 6th largest IEEE Society at the end of 1987.

### MTT-S IMS Membership Booth Enrolls 195 Members

The IEEE/MTT-S membership booth set up at the 1988 IEEE MTT-S IMS was a tremendous success. A record 195 new members enrolled with the Society. Of this total, 126 members joined the IEEE in addition to the MTT-S, and 69 current IEEE members took advantage of the free membership offer by the MTT-S. Also, adding to the booth success was the receiving and servicing of many inquiries concerning current IEEE or MTT-S members. At last year's MTT-S IMS, a total 167 new members were enrolled with our Society. Thanks to all who participated in making this year's booth such a tremendous success.

There will be a membership booth at the 1988 European Microwave Conference in Stockholm, Sweden. Please drop by and visit with the Membership Services Committee members, Adcom members, and Chapter Chairmen who will be contributing their time to increase membership and service members' questions at the booth. The booth is located in the Registration area.

### 1987 MTT-S Chapter Membership Report

Total MTT-S membership affiliated with chapters in 1987 increased 16.9 percent over 1986 chapter membership. This result was almost twice the 9.4 percent increase in numbers of chapters in 1987 over 1986. The average 1987 MTT-S chapter size increased by 6.8 percent over the 1986 average chapter size. The Society added 5 chapters during 1987. These statistics support the notion that our existing chapters are doing a good job in adding members.

Four chapters, Dallas, Portland, South Africa, and West Germany received Membership Development Recognition Awards at the 1988 International Microwave Symposium Chapter Chairperson's meeting. These awards, \$200 and a plaque, recognized the result of each chapter's outstanding efforts in promoting MTT-S membership in 1987. The West Germany chapter has won this membership recognition for three years in a row.

Fourteen chapters achieved membership growth for each of the past five years. This achievement included four more chapters than the ten chapters reported to have achieved the same significant membership result at the end of 1986. The fourteen chapters were Central Illinois, Central N.E., Chicago, Dallas, Denver, Milwaukee, Orlando, Ottawa, Philadelphia, Princeton, San Diego, Santa Clara

Valley/San Francisco, Sweden, and Syracuse. Two more chapters, Columbus and Tokyo, can join this list next year if they continue to increase membership in 1988.

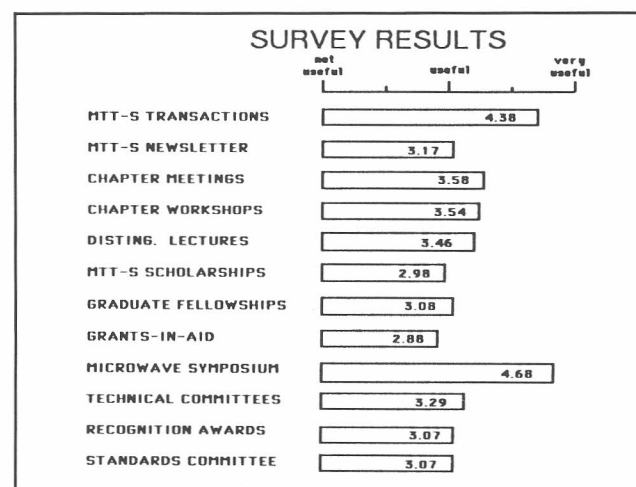
### Free MTT-S Membership Promotion Extended to 1990

The Societies membership goals for 1989 and 1990 were given quite a boost in the recent AdCom meeting. MTT-S AdCom voted to continue the FREE MTT-S membership promotion through February 28, 1990. This promotion enables colleagues to join MTT-S for FREE if they were not a MTT-S member in the year preceding the enrollment year.

A refinement made to the existing MTT-S Membership & Application pamphlets was printed and mailed in April to the chapters for their use in promoting membership. This pamphlet promoted both the "free" membership offer, the 50 percent reduction of IEEE dues effective March 1, 1988, and the extra "four months issues" promotion effective September 1988. An additional refinement will be made this July that will cover the enrollment period through February 28, 1990. This new MTT-S Membership Application & Information pamphlet will be mailed to all MTT-S chapters in August 1988 and will be used at the 1988 European Microwave Conference IEEE/MTT-S membership booth.

### MTT-S Services Survey

Over 800 persons attending the 1988 MTT-S IMS were asked to complete a survey about how they felt about membership services provided by the MTT-S. The survey asked the respondent to rank on a scale of 1 (not useful) to 5 (very useful) their opinion about twelve services MTT-S provides. A 3.0 rating indicates useful service. The lowest responses concerned MTT-S Scholarships and MTT-S Grants-In-Aid. The median response for these services were ranked 2.98 and 2.88 respectively. The highest rating was for the MTT-S Microwave Symposium and the MTT-S Transactions. The median response for these services were 4.68 and 4.38 respectively. The median response for all twelve services was 3.48, a response well above 'useful.' A bar chart follows that displays the median response of the 62 respondents for each of the twelve services. The Membership Services report in this newsletter outlines other new important services in the process of being provided the MTT-S Members by the Society.



## FUTURE 1988 MEMBERSHIP DEVELOPMENT ACTIONS

### 1988 Student Membership Drive

Membership development is initiating a MTT-S Student membership drive for the remainder of 1988 with the goal of increasing the MTT-S Student membership by at least 200 mem-

*continued on page 21*

## MEMBERSHIP DEVELOPMENT

(continued from page 20)

bers, a 14 percent increase, over the 1987 results of 1,534 student members. This goal is achievable, but is challenging since the USA student population is declining. With fewer students graduating, there is less upgrading to higher IEEE grades by students. Hence, a reduction in experienced (Senior) members could occur in future years if this trend continues. The goal was created in order to start to alleviate, somewhat, this trend in the short term. The future (ten to twenty years from now) health of our Society depends on the leadership derived from today's students who are next decade's experienced technical leaders.

A 1988 Student Information & Information pamphlet is being designed for printing and mailing in August to the IEEE Student Section Coordinators of target colleges and universities. The targets are those colleges and universities that have significant microwave programs as designated in John Owens' 1987 survey on Microwave Education.

### Membership Drive

A TIP (Technical Interest Profile) promotion similar to the one mailed last year is being readied for mailing in July 1988 to 4,447 IEEE members who are not currently MTT-S members and who were not MTT-S members in 1987. These IEEE members expressed a number one interest in their IEEE TIP concerning the following topics offered by the denoted Societies: AP-S; MM & sub MM Techniques, Electromagnetic Theory, Numerical Methods, Radar, Communication, CAS-S; Solid State & Microwave Circuits, AES-S; Radar Systems, MAG-S; Microwave Magnetics, LEO-S; Fiber Optics and Lightwave Technology, SS Circuits-S; Solid State Microwave Electronics, ED-S; Integrated Electronics, Optoelectronic Devices, and Superconductive Devices. A 40 percent promotion yield is expected based on the 1987 TIP promotion results.

### Other 1988 Plans

Advertisements promoting enrolling new members are being developed to be placed in the AP-S newsletter. AP-S will reciprocate in our Newsletter. A simplified form to upgrade to Senior member has been completed by IEEE. The use of this form by chapters will be encouraged in 1988.

## David Barton, MTT-S Distinguished Lecturer, Tours Australia

by Don Sinnott

During March David Barton, a MTT-S Distinguished Lecturer, visited Australia. There are no MTT-S Chapters in Australia but a number of the Australian IEEE Sections have a significant MTT-S component among their membership. David delivered his lecture to well-attended Section meetings in Queensland, New South Wales and Victoria and presented a two-day workshop "Microwave Radar for the 1990's" in Adelaide for the South Australia Section. Adelaide, the home of both the Australian Department of Defence's Microwave Radar Division and High Frequency Radar Division, is the center of most radar-related research and development in Australia. Dr. Barton's workshop drew a large and enthusiastic enrollment.

During the workshop, a presentation was made to David of an original mixer from the FPS-16 - a radar designed by David while at RCA. The photograph shows Dr. Don Sinnott, Chairman of the South Australia Section, presenting the mixer to David Barton. The inscription reads, "Presented to David K. Barton, to commemorate your visit to Australia, March 1988. Radar set

## LA Chapter Chairman's Reunion (1955-88)

by Bertram D. Aaron

On Tuesday, May 17, the Los Angeles Chapter of the MTT-Society held its past Chairmans night. Of the 26 past Chairmen, only seven were not present (away because of other business arrangements.)

The original Committee of eight who worked with Bert Aaron and Chuck Chandler to found this chapter were all present. In addition to Bert and Chuck there were Dean Anderson, Dick Jamison, George Underberger, Bob Hansen, Warren Perry and Al Clavin.

Missing from this evening were others who were active in the industry in the 1950's. To mention just one, Virginia Norwood who then was Manager of the RF and Microwave groups at Hughes Aircraft Company. Still with the Company and a senior person in Electro-Optics.

The Speaker of the evening was David Barton, the distinguished MTT Lecturer. His was a most interesting and provocative message.

Congratulations to the Los Angeles MTT Chapter.



Left to right: Dean Anderson, George Underberger, Dick Jamison, Chuck Chandler, Warren Perry, Al Clavin, Bert Aaron.

AN/FPS-16(V) serial no. 36 was the last of this series produced. It served at the Woomera Rocket Range in Central Australia and was then incorporated into a suite of radars at the Microwave Radar Experimental Facility of the Defence Science and Technology Microwave Radar Division at Salisbury, South Australia. This original mixer was replaced when the FPS-16 was integrated into the Microwave Radar Experimental Facility. Microwave Radar Division, Defence Science and Technology Organisation/South Australia Section IEEE."



Don Sinnott (L) presents FPS-16 mixer to Dave Barton (R).

## MTT-S Chapter Meetings (1986/1987/1988)

In the following citations, the final number in parentheses indicates attendance at the meeting.

MTT-S and AP-S Distinguished Lecturers appear below with abbreviated citations. Complete citations are as follows:

P.J.B. Clarricoats (AP), (Queen Mary College, University of London, London, England), "Reflector Antennas for Satellite Systems: Present Position and Future Prospects."

F.K. Schwering (AP), (US Army CECOM, Ft. Monmouth, NJ), "Millimeter-Wave Antennas."

E.C. Niehenke, (Westinghouse Electric Corp., Baltimore, MD), "GaAs—Key to Modern Microwave Technology."

J.H. Bryant (MTT), (University of Michigan, Ann Arbor, MI), "The First Century of Microwaves—1886 to 1986."

R.H. Jansen (MTT), (Industrial Microwave and RF Techniques, Ratingen, West Germany), "CAD of Hybrid and Monolithic and Millimeter Wave MICs."

D.K. Barton (MTT), (ANRO Engineering Consultants, Lexington, MA), "Technology Trends in Microwave Radar."

R.H. Knerr (MTT), (AT&T Bell Laboratories, Allentown, PA), "Lightwave Communications"

### ALBUQUERQUE (MTT/AP/EMC)

Dr. Venky Naravanamurti (Sandia National Laboratories), "Research and Research Management at Sandia National Laboratories," Nov. 5, 1987 (31).

### ATLANTA (MTT/AP)

Robert T. Hill (Naval Sea Systems Lab, Washington, D.C.), "Phased Array and Other Radar System Design Challenges," Oct. 6, 1987 (31).

David K. Barton, Feb. 2, 1988 (46)

William D. Hunt (Georgia Institute of Technology, Atlanta, GA), "GaAs Acoustic Charge Transport Devices - A High Speed Alternative to Charge Coupled Devices," Mar 15, 1988 (10).

### BALTIMORE (MTT/AP)

Dr. Rolf H. Jansen, Oct. 16, 1987 (34)

David K. Barton, Nov. 4, 1987 (20)

Prof. Satindar Bhagat (University of Maryland, College Park, MD), "Superconductors and High Temperatures," Feb. 9, 1988 (26).

Dr. S.A. Hovanessian (The Aerospace Corp., Los Angeles, CA), "Synthetic Aperture Radar (SAR)," Mar. 16, 1988

### BUFFALO (MTT/AP)

Dr. Yueh-Chi Chang (Bell Aerospace, Niagara Falls, N.Y.) "Dual-Band Dual Shaped Reflector Antennas," Oct. 1, 1987 (30).

### CENTRAL NEW ENGLAND/BOSTON (MTT)

Dr. R.H. Jansen, Oct. 22, 1987

Dr. J.M. Ballingall, (General Electric Electronics Laboratory, Syracuse, N. Y.), "High Electron Mobility Transistors (HEMTs) for Millimeter Wave Applications," Jan. 21, 1988

David K. Barton, Feb. 11, 1988

### CHICAGO (MTT/AP)

Dr. William A. Payne III, (A T & T Bell Laboratories, Naperville, IL.) "Photonic Switching Technology," June 30, 1987 (8).

Dr. Peter Clarricoats, (Queen Mary College, London University, London, England), "Satellite Systems and the Optical Fibre Challenge - A European View," Oct. 28, 1987 (18).

Dr. M.E. Brodwin, (Northwestern University, Evanston, IL) "Scientific and Engineering Applications of Microwaves," Nov. 16, 1987 (9).

### COLUMBUS (MTT/AP)

Roger F. Harrington, (Syracuse University, Syracuse, N.Y.) "Electromagnetic Analysis of Microwave IC's," May 26, 1987 (49).

Melvin J. Hinich, (University of Texas at Austin, Austin, TX.) "Bispectrum Based Nonlinear Time Series Analysis," June 22, 1987 (13).

Prof. Curt Levis, (The Ohio State Univ., Columbus, OH) "An Optical Radar for Mapping the Sea Floor," Oct. 5, 1987.

Prof. Peter Clarricoats, Oct. 27, 1987.

David K. Barton, Dec. 3, 1987 (33).

### DALLAS (MTT)

Ferenc Marki, (Western Microwave, Sunnyvale, CA.) "Microwave Mixers," November 19, 1987 (70).

Anthony M. Pavio, (Texas Instruments, Dallas TX.) "Nonlinear and Special Purpose Circuit Design," Dec. 8, 1987 (40).

Dr. R.H. Knerr, Jan. 26, 1988 (52).

David K. Barton, Feb. 25, 1988 (71).

Edward C. Cristal, (Hewlett-Packard Co., Palo Alto, CA) "Analysis of Coupled TEM Transmission Lines," Mar. 11, 1988 (53).

Dr. Samir Siliman, (Southern Methodist University), "Phase Locked Loops," Mar. 24, 1988 (65).

### DAYTON (MTT/AP)

Dr. Jonathan D. Young, (The Ohio State University, Columbus, OH) "Transient Polarimetric Diagnostic Measurements," Sept. 15, 1987 (32).

Prof. Peter Clarricoats, Oct. 26, 1987 (38).

Prof. P.L.E. Uslenghi (University of Illinois at Chicago, Chicago, IL.) "Electromagnetic Scattering from Anisotropic Structures," Nov. 20, 1987 (33).

David K. Barton, Dec. 2, 1987 (46).

Prof. Walter D. Burnside, (The Ohio State University, Columbus, OH., AP-S Distinguished Lecturer) "Compact Ranges and Radar Cross Section Measurement Techniques," Feb. 26, 1988 (49).

Dr. Robert Munson, (Ball Aerospace Corp., Boulder, CO) "Microstrip Antennas: Principles and Applications," April 1, 1988 (39).

### FINLAND (MTT)

Prof. Martti Tiuri, (Helsinki Univ. of Technology, Otakaari, Finland) "Prospects of Microwave Techniques in Finland," Jan. 27, 1988 (37).

### HOUSTON (MTT/AP/ED/MAG)

Dr. John H. Bryant, Nov. 18, 1986 (36).

N.G. Alexopoulos, "Material Layer Effects on Printed Circuit Antennas," Mar. 9, 1987 (46).

H.A. Peterson, "Superconductive Energy Storage for Power Systems," Mar. 30, 1987 (47).

*continued on page 23*

## CHAPTER MEETINGS

(continued from page 22)

### INDIA (MTT/ED)

Dr. Arthur D. Yaghjan, (Rome Air Development Center, Bedford, MA) "Overview of Near Field Antenna Measurements," Mar. 5, 1987 (15).

Prof. Jonas Grigas, (University of Vilnius, Lithuania, USSR) "Microwave Investigations on Ferroelectric Materials," April 20, 1987 (15).

Alakananda Paul, "Microstrip Antennas," July 6, 1987 (20).

Prof. Jonathan Allen, (Massachusetts Institute of Technology, Cambridge, MA) "Performance-Directed Synthesis of VLSI Systems," Dec. 9, 1987 (40).

Prof. A.H. Manshak, (Louisiana State University) "Transport in Heavily Doped Silicon"

Prof. S.C. Jain, (Wolfsar College, Oxford, England) "Transport in Inhomogeneous Weakly Inverted Layers," Jan. 16, 1987 (40).

Prof. C.R. Viswanathan, (University of California, Los Angeles, CA) "Sound Channel Effects," Dec. 17, 1987 (40).

Prof. John Prince, (University of Arizona, Tucson, AZ) "VLSI Packaging," Dec. 12, 1987 (40).

Prof. Robert Broderon, (University of California, Berkeley, CA) "VLSI Rapid Prototyping Project at Berkeley," Dec. 21, 1987 (40).

A.R. Jha, (Douglas Aircraft Co., CA) "High Power GaAs FET Devices for Radar Applications".

Prof. Robert Broderon, (University of California, Berkeley, CA) "Technology Requirements for Application Specific IC's".

Prof. Kenneth F. Galloway, (University of Arizona, Tucson, AZ) "Test and Measurement Structures for IC Technology," Dec. 24, 1987 (40).

Dr. A.P. Thakur, (C.I.T., CA) "Neural Networks," Jan. 1, 1988 (20).

### LOS ANGELES (MTT)

Donald Gartzke, (Dynawave Inc., Georgetown, MA) "Microwave Connectors," May 19, 1987 (30).

Michael G. Urban (Jet Propulsion Laboratory) "The Voyager Project: Results from Uranus, Plans for Neptune," June 23, 1987 (60).

Carlton B. Goss, (Gamma-F Corporation, Torrance, CA) "The Realization of Complex Waveguide Networks by Electroforming," Jan. 19, 1988 (55).

Octavious Pitzalis, Jr., (EESOF Inc., Westlake Village, CA) "Advances in Large Signal Analysis," Feb. 23, 1988 (75).

Dr. Walter H. Ku, (University of California, San Diego, CA) "Computer Aided Design and Synthesis of MMIC's," Mar. 23, 1988 (80).

### MIDDLE AND SOUTH ITALY (MTT/AP)

Dr. R.H. Jansen, Sept. 10, 1987 (25).

### MONTREAL (MTT/AP)

Prof. S.T. Peng, (New York Institute of Technology, New York) "Analysis and Design of Dielectric Waveguides - A Network Approach," Mar. 18, 1988 (10).

### NEW JERSEY COAST (MTT/ED/LEO)

Prof. Peter Clarricoats, Oct. 21, 1987 (28).

David K. Barton, Nov. 15, 1987 (16).

Dr. Gerald J. Iafate, (Fort Monmouth, NJ) "High Temperature Superconductivity - Novel Concepts and Fundamental Issues," Dec. 15, 1987 (40).

Dr. George I. Zysman, (AT&T Bell Laboratories) "A Digital Narrow-Band Cellular System," Jan. 19, 1988 (27).

Dr. Felix K. Schwering, Feb. 16, 1988 (42).

Dr. Walter D. Burnside, (The Ohio State University, Columbus, OH) "Compact Ranges and RCS Measurement Techniques," Mar. 15, 1988 (23).

Dr. Bernard Yurke, (AT&T Bell Laboratories, Murray Hill, NJ) "Quantum Noise in Microwave and Millimeter Wave Electronics," April 14, 1988 (22).

### NEW YORK/LONGISLAND (MTT)

Pradeep Wahi, (ATL, Baltimore, MD) "Optics for Microwave Applications," Sept. 30, 1986 (22).

David J. Fryklund, (M/A-COM Advanced Semiconductor Applications, Lowell, MA) "GaAs MMICs - New Frontier in Microwave Control Circuit Technology," Oct. 29, 1986 (35).

Dr. James D. Sullivan, (MIT Plasma Fusion Laboratory, Cambridge, MA) "Voyage to Uranus and Beyond," Dec. 3, 1986 (88).

Dr. John H. Bryant, Jan. 21, 1988 (42).

Dr. Brian J. Clifton, (MIT Lincoln Laboratory, Lexington, MA) "Receiver Technology for Millimeter and Submillimeter Wave Regions," Feb. 25, 1987 (27).

Edward C. Niehenke, (April 8, 1987) (43).

C.E. Soccolich, (AT&T Bell Laboratories) "High Speed, Long Wavelength Semiconductor Lasers," Oct. 22, 1987 (25).

S. Sridhar, (Northeastern University, Boston, MA) "AC Transport from RF to 100 GHz in Superconductors, Charge-Density Waves and Disordered Systems," Nov. 11, 1987 (28).

Masaki Surnaga, (Brookhaven National Laboratory) "High temperature Superconductors - Opportunities and Challenges," Dec. 9, 1987 (54).

G. Kanischak, (Eaton Corp.) "MMIC and MIMIC: Is it Time for the Old Dog (Microwave Designer) to Learn New Tricks?," Jan. 20, 1988 (50).

Dr. Rudi Handel, (Gain Electronics) "Status of SDHT Technology Development," Feb. 24, 1988 (19).

Dr. Rolf H. Jansen, April 6, 1988 (29).

### NORTH JERSEY (MTT/AP)

Dr. Rolf H. Jansen, Oct. 21, 1987 (87).

Ronald Schineller, (ITT Avionics, Nutley, NJ) "Microwave and Millimeter Wave Monolithic Integrated Circuits - Has Their Time Arrived?," Jan. 13, 1988 (50).

Dr. S.A. Hovanessian, (The Aerospace Corporation, Los Angeles, CA) "Radar Principles - Low, Medium and High PRF Radars," Feb. 24, 1988 (93).

Dr. Bernard Yurke, (AT&T Bell Laboratories, Murray Hill, NJ) "Quantum Noise in Microwave and Millimeter-Wave Electronics," Mar. 16, 1988

Raymond L. Ross, (USAETDL, Fort Monmouth, NJ) "MMIC Program Initiative," April 21, 1988 (32).

### OTTAWA (MTT/AP/AES)

M.G. Stubbs, M.Cuhaci, (Communications Research Center, Ottawa, Canada) Oct. 21, 1986 (48).

Dr. John H. Bryant - Dec. 9, 1986 (39).

*continued on page 24*

---

## CHAPTER MEETINGS

(continued from page 23)

Dr. W.W. Ward, (MIT Lincoln Laboratory, Lexington, MA) "In Celebration of the Pioneers and Voyagers: To Jupiter, Saturn, Uranus and Beyond," Jan. 26, 1987 (177).

Dr. J. Lee, (DREO, Ottawa, Canada) "Acusto-Optic Signal Processors for Frequency Spectrum Analysis and Direction of Arrival Determination of Radar Signals," May 12, 1987 (31).

P. Cowles, P. Strickland, (Canadian Astronautics, Ltd., Ottawa, Canada) "Microstrip Antennas and Patch Arrays: A New Technology for MLS Earth Terminals and Beyond," Nov. 24, 1987 (64).

David K. Barton - Feb. 16, 1988 (74).

### PHILADELPHIA (MTT/AP)

Dr. J. SooHoo, (General Electric Astro-Space Div., Valley Forge, PA.) "GaAs Applications in Satellite Communications," Oct. 29, 1987 (10).

Dr. Richard Knerr - Nov. 18, 1987 (8).

David K. Barton - Jan. 26, 1988 (38).

### PHOENIX (MTT/AP/ED/EMC)

Dr. Murray Woods, (Intel, Santa Clara, CA) "VLSI Reliability," Sept. 22, 1987 (21).

Dr. Constantine Balanis, (Arizona State University, Tempe, AZ) "Dispersion in Microstrip Transmission Lines," Oct. 22, 1987 (23).

Dr. Arnon Gat, (AG Associates, Santa Clara, CA) "The Application of Rapid Thermal Processing (RTP) to State-of-the-Art Integrated Circuit Fabrication," Nov. 9, 1987 (22).

Dr. Prabhakar H. Pathak, (The Ohio State University, Columbus, Ohio) "Geometrical Theory of Diffraction and its Applications," Nov. 19, 1987 (43).

David K. Barton, Jan. 20, 1988 (40).

Dr. Reinhard Knerr, Feb. 21, 1988 (21).

Al Gross, (GTE Communication Systems Corp., Phoenix, AZ) "Applied Technology - Applied and Contemporary," Mar. 24, 1988 (13).

Y.T. Lo, (University of Illinois, Urbana, IL) "Polart - The Magic of EM Waves," Mar. 29, 1988 (37).

Ralph V. Chamberlin, (Arizona State University, Tempe, AZ) "High Temperature Superconductors: Properties and Applications," April 20, 1988 (21).

### PRINCETON (MTT/AP/ED)

Robert Trew, "A Physical GaAs MESFET Model for Large-Signal Nonlinear CAD Applications," Nov. 12, 1987 (10).

David K. Barton, Jan. 27, 1988 (25).

Felix Schwing, Mar. 24, 1988 (8).

### SANTA CLARA VALLEY/SAN FRANCISCO (MTT)

Issy Kipnis, (Avantek, Inc., Newark, CA) "Silicon Bipolar MMIC's for Nonlinear Applications up to 20 GHz," June 25, 1987 (38).

Dr. Morton Maesel, (Time Microwave, San Jose, CA) "Microwave Diode Mixers," Sept. 10, 1987 (73).

Robert J. Wenzel, (Wenzel/Erlinger Associates, Agoura Hills, CA) "The Complexities of Microstrip Filter Design," Oct. 8, 1987 (67).

Dr. Alfred Riddle, (Avantek, Inc., Milpitas, CA) "Noise in Oscillators," Nov. 12, 1987 (79).

David K. Barton, Jan. 14, 1988 (72).

Dr. Rolf Jansen, April 14, 1988 (77).

### SPAIN (MTT/AP)

Miguel Calvo, "Distortion Analysis in Reflector Antennas," Feb. 20, 1986 (25).

Dr. Miguel Marin, "Hybrid MM/GTD Methods," Mar. 20, 1986 (27).

J.F. Hernandez, "The Finite Element Method of Microwave Circuit Analysis," April 10, 1986 (22).

Dr. Luis Vergara, "Adaptive Arrays," April 25, 1986 (25).

Dr. Manuel Sierra, "Theory of Linear Microwave Amplifiers," May 14, 1986 (26).

Prof. R.S. Elliott, "The Design of Antenna Arrays," June 23, 1986 (42).

E.C. Niehenke, Oct. 17, 1986 (23).

Dr. Felix Perez, "Analysis and Optimization of Monopulse Processors," Feb. 25, 1987 (21).

Dr. Jorge Perez, "Analysis of Nonlinear Microwave Systems," April 30, 1987 (10).

Dr. Yuen Y. Lo, "Microstrip Antennas: Theory, Experiments and Applications," June 4, 1987 (20).

Dr. Yuen Y. Lo, "What Random Arrays Can Do, Understanding and Misunderstanding," June 5, 1987 (9).

Dr. Peter Clarricoats, Nov. 23, 1987 (40+).

Dr. Peter Clarricoats, Nov. 24, 1987 (40+).

### ST. LOUIS (MTT/AP/ED)

Scott Jenkins, (Trammell Crow Co., St. Louis, Mo) "The Missouri Research Park," Mar. 24, 1988.

Dr. Jorg Raue, (TRW Electronic Systems Group, Redondo Beach, CA) "Millimeter Waves: Recent Progress and Current Applications," April 11, 1988.

### SWEDEN (MTT/AP)

Dr. Rolf H. Jansen, Mar. 22, 1988.

### SWITZERLAND (MTT/AP)

Dr. T. Weiland, (DESY, Hamburg, West Germany) "Die Gitter-Maxwell-Gleichungen. Ein Allgemeiner Ansatz Zur Numerischen Losung," June 3, 1987 (17).

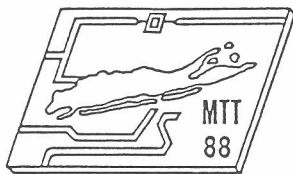
Prof. Y.T. Lo, (University of Illinois, Urbana, IL) "What a Random Array Can and Cannot Do - Understanding and Misunderstanding," June 16, 1987 (11).

### TOKYO (MTT)

E.C. Niehenke, Oct. 12, thru Oct. 15, 1987 (43).

Dr. Rolf H. Jansen, Feb. 15 thru Feb. 19, 1988 (166).





**IEEE Long Island MTT Workshop  
on  
MICROWAVE SYSTEM DESIGN**



**IEEE**

**DATE:** October 12, 1988  
**TIME:** 8:00 AM to 4:30 PM  
**LOCATION:** Crest Hollow Country Club  
 8325 Jericho Turnpike (Rte. 25)  
 Woodbury, New York  
 (516) 692-8000  
**FEES:** \$100 for IEEE Members  
 \$125 for Non-Members

**DIRECTIONS**  
 Eastbound from Brooklyn, Queens, Manhattan  
 Westbound from Eastern Long Island  
  
 Southern State Parkway - Exit 28A N  
 Northern State Parkway - Exit 36B N  
 L.I. Expressway (Rte. 495) - Exit 44 N  
 to  
 Seaford-Oyster Bay Expressway (Route 135)  
 Northbound to (Woodbury East) exit  
 leaves you on Jericho Tpke. going East  
 1 1/2 miles to Crest Hollow on  
 left hand side of road

**Payable to:** IEEE, Long Island Section  
 Fee includes Lunch, Refreshments and Textbook  
 "Microwave Receivers and Related Components" by J. B. Tsui.

**REGISTRATION:** Matt Jacobs  
 Narda Microwave Corp.  
 435 Moreland Road  
 Hauppauge, New York 11788  
 (516) 231-1700 Ext. 426

**Abstract**

Successful microwave system design is an interactive, iterative process that engages the system architect and component designer in a series of tradeoffs and compromises to arrive at an acceptable level of performance. This workshop will illustrate the dynamics of this process by using a case study approach to walk the participants through the design and development of the microwave portions of two major systems. The first case study will focus on a Low-Cost Packet Radio (LPR) communications system designed and built by Hazeltine Corp. The subject of the second case study will be an airborne Electronic Support Measures (ESM) system developed by Eaton Corp.

Present at the workshop will be the designers of the major microwave Line Replaceable Units (LRUs) of each system. They will take the participants through the design of the LRUs, how they evolved, and discuss the myriad tradeoffs that were made along the way. Juxtaposed to this will be presentations by the technologists who developed the microwave components and subsystems for the LRUs to discuss how they approached their tasks and the tradeoffs they had to make. By presenting both perspectives the organizers hope to illustrate how this dynamic process works in real life. This exchange should also provide the "grist" for audience participation and questions.

If you are from the systems or components side of this exciting business, plan to attend and learn what's happening "on the other side of the fence".



**REGISTRATION FORM**

Registration for 1988 NY/LIMTT Chapter Workshop Wednesday, October 12, 1988 at the Crest Hollow Country Club, Woodbury, New York

Name \_\_\_\_\_ IEEE Number (if member) \_\_\_\_\_

Address \_\_\_\_\_

\_\_\_\_\_ Telephone Number \_\_\_\_\_

IEEE MEMBER (Includes Lunch, Refreshments, 1 Textbook) \$100.00 \_\_\_\_\_

Non Member (Includes Lunch, Refreshments, 1 Textbook) \$125.00 \_\_\_\_\_

Total Remittance: \_\_\_\_\_

MAIL TO: Matt Jacobs  
 Narda Microwave Corp.  
 435 Moreland Road  
 Hauppauge, New York 11788

**NOTE: REGISTRATION ENDS OCTOBER 1<sup>ST</sup>.**

**MAIL YOUR REGISTRATION FORM NOW!**

*Make Checks payable to: IEEE, Long Island Section*

**DO NOT SEND CASH**

---

---

# ANNOUNCEMENT AND CALL FOR PAPERS

IEEE AP/MTT-S  
Philadelphia Section

## SEVENTH ANNUAL BENJAMIN FRANKLIN SYMPOSIUM

### ADVANCES IN ANTENNA AND MICROWAVE TECHNOLOGY MARCH 11, 1989

The Philadelphia Chapter of the IEEE AP/MTT-S will hold its 7th Annual Benjamin Franklin Symposium on Saturday, March 11, 1989 from 8:30 AM to 5:00 PM. This one-day symposium will consist of:

Morning Session: Invited papers on Past, Present, and Future in Electromagnetics

Afternoon Session: Parallel Sessions of Contributed Papers, on:

- a. Antennas and Propagation: Phased Array Technology, Antenna Design, Radiating Elements and Phase Shifters, Antenna Applications, Imaging and Radiometry, Remote Sensing.
- b. Microwave Theory & Techniques: Microwave Networks and Filters, Solid State Devices and Circuits, Millimeter Waves and Monolithic Technology, Microwave Applications and History of Microwaves.

**PLACE:** Hyatt Cherry Hill  
State Highway No. 70 & Cuthbert Blvd.  
Cherry Hill, NJ

**PAPERS:** Authors are invited to submit papers in either field. Please send a camera-ready summary (one to four 8 1/2 x 11 pages with one inch margins) by December 15, 1988 to:

Dr. Nader Engheta,  
Moore School of Elec. Engineering/6390  
University of Pennsylvania  
Philadelphia, Pa. 19104  
Phone: 215-898-9777

**FURTHER INFORMATION:** Ms. Lori Hoffman 609-722-2877 or Mr. Ravi K. Moorthy GE-ESD 609-722-3886  
or Dr. Leonard Yorinks, GE-ESD 609-722-2257

## Technical Committees

by *Reynold S. Kagiwada*

This is the third of a series of reports by the Technical Committees of MTT-S. The purpose is to give the membership a better understanding of the role of the various committees and their activities.

Articles which have appeared so far include:

Committee	Author	Issue
MTT-3	Lee	119
MTT-6	Niehenke	119
MTT-15	Itoh	119
MTT-8	Williams	120
MTT-13	Hord	120
MTT-1	Berson	121
MTT-12	Perlman	121

This issue will feature a description of the Microwave Manufacturing Technology, MTT-17.

## MTT-17: Microwave Manufacturing Technology



by *Steve Temple*

As our microwave industry has matured, interest in the area of manufacturing technology has grown. Developments in rapidly emerging technologies such as Monolithic Microwave Integrated Circuits are shifting focus from feasibility demonstration to building a cost effective manufacturing capability. The Department of Defense has fueled efforts focused on MMIC manufacturing with the inception of the MIMIC program. In recent years, microwave manufacturing technology has also expanded its presence in leading universities.

In order to coordinate activities within the Microwave Theory and Techniques Society, and to stimulate timely discussion and exchange ideas, the Technical Committee on Microwave Manufacturing Technology was recently organized. The Committee Chairman is Steve Temple from Raytheon Company with Gary Lerude of Texas Instruments as Co-Chairman. Other members of the committee include Sanjay Moghe of Pacific Monolithics and Dick Kopeck from Avantek.

The Committee is interested in expanding its membership. Anyone interested in participating in the Committee's activities contact Steve Temple from Raytheon Company, Mail Stop M2-10, Hartwell Road, Bedford, MA. 01730, (617)274-4736.

The most recent meeting of the Committee was held at the Microwave Symposium in New York City. The Committee has chosen to focus on two projects over the next year. First, we encourage technical contributors within the microwave industry with

an interest in manufacturing technology submit papers to the 1989 Microwave Symposium in Long Beach, CA. The Committee would like to organize a focused session on manufacturing at the Symposium. Our second project includes plans to formulate and organize a panel session at the 1989 Symposium on the subject of Cost Effective Manufacturing of MMIC-Based Modules and Subsystems.

## Special Articles for the MTT Newsletter



by *Zvi Galani*

The MTT Newsletter staff is very interested in obtaining feature articles dealing with current topics in the technical and professional areas of interest to MTT members. The idea is to provide the 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 will cover topics in a broad, general sense. Specific design techniques and applications will be covered in 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:

Zvi Galani  
Raytheon Company  
Mail Stop M1-41  
Hartwell Road  
Bedford, MA 01730  
(617)274-4184

OR

Peter Staecker  
M/A-COM, Inc.  
52 South Avenue, Bldg. 7  
Burlington, MA 01803  
(617)272-3000, X1602

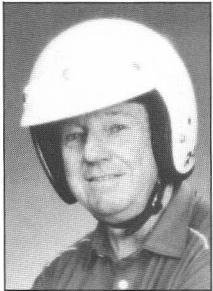
This issue features the article "Array Elements and Architecture of Printed Circuit Array Antennas," by Robert J. Mailloux. The article describes a variety of array elements and array configurations that use these elements.

Several feature articles are in the process of preparation for future issues of the Newsletter, dealing with the following topics:

- GaAs MMIC's
- Frequency synthesizers
- Beam power

The editorial staff of the Newsletter hopes that these articles will be informative and useful to the MTT-S community. Your comments and suggestions are welcome.

# 1989 MTT-S International Microwave Symposium



by C.W. Swift

Well, I've been to New York and back to attend the 1988 Symposium, and while I wasn't happy paying \$6.50 for a scotch and water, I do feel I put one over on the Big Apple. I went through the Lincoln tunnel three times, and only had to pay a toll once! Not a great victory, but one can't expect too much when jousting with our largest city. Frankly, if I were in charge, I'm sure more revenue could be generated by charging to get out of New York, rather than the present system where you pay toll to get in. Just think of the possibility if they had a toll gate in the Berlin wall, and it was free to get in, but \$50 to get out.

Next year, I'm hoping a number of you choose to come visit Long Beach and the 1989 MTT-S Symposium. The dates are Tuesday, June 13 through Thursday, June 15. The MMIC Symposium will start on June 12, and the ARFTG Conference will round out the week on June 16. It's a good idea to make note of these dates now. While the Committee plans on getting the advance program out early enough to give everyone plenty of notice, I've been told this promise is made every year, yet seldom achieved. If you've attended one of the last two Symposiums, you will automatically be placed on a priority list to receive the advance program by first class mail. If you'd like to be placed on this list, send your name and address to me at 15216 Burbank Blvd., Van Nuys, CA. 91411.

A word to the wise (are there any of you out there?). It's difficult to anticipate how many rooms will be needed in 1989. The Arrangements Committee has blocked accommodations for about the same number of rooms the Visitors Bureau reports were used in New York, but who knows what will happen in Long Beach? Will attendance be up? Will all those rich, Southern California engineers choose to drive from their Palos Verdes Estates, or take a room in a hotel? Are there a number of rooms used every year where reservations are made directly with the hotels, thereby making the number credited to the Symposium artificially low? So when you get your advance program, try to act as quickly as possible, insuring yourself of a room at the convention rate, at the same time getting an accurate count for future Symposia. In addition to hotel rooms, Long Beach can provide a convenient place close to our activities for either your motor home or boat.

I've attended practically every Symposium since 1960, and have seen a marked change in the tenor of the Awards banquet. This is the one time each year when the Society rightfully recognizes their outstanding members. But in addition to the honorees, there was a tendency to have a significant speaker address the group. Thankfully, speakers are out, and entertainment seems to be in. I would like to present a musical, and if I can get support from

the three guys who read this column, maybe I can then sell the idea to my Steering Committee. I don't want you to vote blindly, so here are some of the ideas I want to work into lyrics:

1. Microwave Theory
2. Equal Opportunity
3. Gallium Arsenide
4. DOD
5. MTT Symposium
6. Rep/Manufacturer Relationship
7. Sexual Harrassment

and here is my song on gallium arsenide, sung to 'My Funny Valentine.'

Gallium Arsenide  
From columns three and five  
You were a drain from the start  
Your yields are laughable  
Your sales deplorable  
One can't predict the state of art  
Lots of companies  
Large and small  
Have their backs against the wall  
Cause they heard your siren call  
Were they smart?  
So I got the gate today  
My lifes in Disarray  
Shame, Gallium Arsenide, Shame  
You were the source  
of all my blame

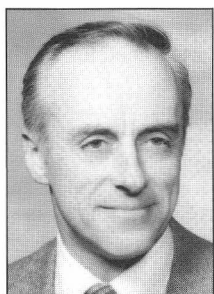
I was going to call it 'The Three Penny Opera,' but Marketing suggested 'Two Penny Opera' to meet competition. I'm resigned to the fact that after an audit, it will end up being 'The One Penny Opera.'

## 10 TIPS FOR A FEARLESS FLIGHT

1. Avoid coffee and sugary foods before your flight. They will only make you jittery.
2. Give yourself plenty of time to get to the airport. At check-in, opt for a seat in the front of the plane. It's smoother and quieter.
3. In the departure lounge, measure your anxiety level on a scale of one to 10. Don't deny your fear; instead control it. Take deep breaths, and hold for about three seconds. Then exhale completely. Shake arms and legs and shrug your shoulders to loosen up tense muscles.
4. Upon boarding the aircraft, tell the flight attendant you are a fearful flyer, and ask if he or she will let you meet the cockpit crew.
5. Slip a rubber band around your wrist. Give it a snap whenever you have a negative "what if" thought. That little sting will interrupt your negative projections.
6. In your seat, take deep breaths, wiggle into your seat, yawn, shake off tension. Don't be afraid of being conspicuous; it beats being afraid.
7. Lean back in your seat on takeoff. Don't hold onto anything or close your eyes. As the plane accelerates down the runway, wiggle your toes as quickly as you can.
8. Go with the movement of the plane. If it banks right, move with it. If the captain warns of turbulence, start bouncing in your seat before you feel it.
9. As soon as the seat belt sign is turned off, get up and move around the cabin, talk to other passengers, or at least stand and stretch. Don't remain in your seat.
10. Fly again as soon as possible. Each flight should get easier. Just as your fear was learned, it can also be unlearned.

For more information on programs to help the fearful flyer, contact: **The Institute for the Psychology of Air Travel**, Suite 300/25 Huntington Ave., Boston, MA 02116, (617) 437-1811.

# Array Elements and Architecture of Printed Circuit Array Antennas



by Robert J. Mailloux  
*Electromagnetics Directorate  
 Rome Air Development Center  
 Hanscom AFB, MA 01731*

## ABSTRACT

More than for any other antenna type, the design of printed circuit array antennas calls for an integrated effort between microwave circuit technology, antenna technology and mechanical design. This paper, which is an expansion of a paper presented at Military Microwaves '88, describes a variety of array elements and array configurations that use them. New EHF integrated circuit subarrays are discussed to emphasize required developments and the degree of integration necessary.

## INTRODUCTION

One of the most significant areas of current antenna research and development is the class of printed circuit antennas and arrays. This wide variety of antenna elements each have the common feature that they can be fabricated by lithography as components of printed circuits. Printed circuit antennas have assumed such importance because they are seen as the key to affordable phased array antennas at SHF frequencies (2-10 GHz), and they may be the only technology feasible for two dimensional arrays at frequencies above 20 or 40 GHz. This paper discusses recent progress in printed circuit antennas, and is organized by addressing technical issues in each of these two frequency ranges separately.

### Progress at SHF Frequencies

Most printed circuit antennas have been developed in the frequency range between 2 and 20 GHz. Within this range several kinds of printed antennas have found application to phased arrays, and selecting between them depends upon the array feed network and the required bandwidth.

A variety of dipole antennas can be fabricated by printed circuit technology. A folded stripline dipole element (Figure 1), printed in a single process on one side of a printed circuit board, has been reported by Hanley and Perini [1]. It is inexpensive to produce but since it is developed in stripline, as opposed to microstrip, it is not directly practical for monolithic circuit fabrication. Other dipole designs are however compatible with microstrip printed circuit device integration. These [2] have demonstrated 40% bandwidths and good scan characteristics.

These two printed circuit dipoles are fabricated on circuit boards that lie perpendicular to the array face. However, there is one dipole type excited using a circuit board parallel to the array face. However, there is one dipole type excited using a circuit board parallel to the array face. Figure 1C shows this microstrip dipole with an electromagnetically coupled feed. Although analytical tools [3] have been developed for probe feeding this element, it has been successfully implemented in an array with electromagnetically coupled feeds [4]. The invention of the electromagnetically coupled version is generally attributed to Oltman [5].

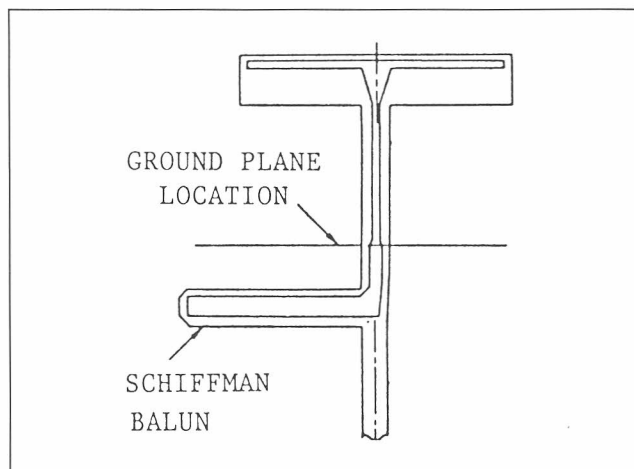


FIGURE 1. Printed Stripline Folded Dipole and Balun

Wide band arrays have used variations of printed circuit notch or Vivaldi elements. (Fig. 2). The early work reported by Lewis [6] described the flared notch in an array environment, and showed acceptable scan characteristics with a linearly polarized radiation pattern. Broadside arrays of the same elements had previously demonstrated greater than 6 to one bandwidth, but the scanned array bandwidth seems limited to about one octave. The flared notch element as it was first investigated, was excited by proximity coupling to the open-ended stripline center conductor. The Vivaldi element is a flared, truncated slot line. A paper by Gibson [7] popularized the name Vivaldi for this antenna and demonstrated

*continued on page 30*

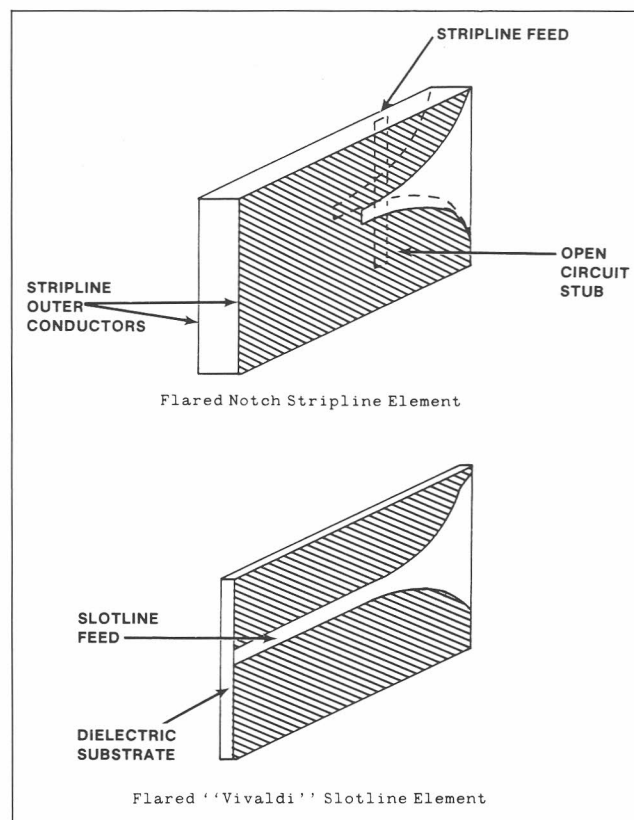


FIGURE 2. Flared Notch and Vivaldi Elements

## PC ARRAYS

(continued from page 29)

bandwidths of up to six to one. Franz and Mayes [8] present data describing the radiator length vs. reflection coefficient, and show that the length should exceed  $0.5\lambda$ , with  $0.9\lambda$  being nearly optimum. A recent investigation of abrupt transitions to notch antennas has also showed bandwidths (of the order of 6:1 [9]) and included some data on the strip line capacitively coupled feed that excites the notch. As with the flared notch antenna, the notch is etched into the outer conductors of the stripline antenna, and the feed is the center conductor.

The microstrip patch is a most interesting and useful element, and much of future array technology will be built around this element and its variations. It offers the promise of eventual production by monolithic integrated circuit techniques that will fabricate controls, phase shifters, amplifiers and other necessary devices, all on the same substrate, and all by automated processes. Three fundamental issues inhibit the use of patches for certain applications. First, the patch bandwidth has been limited to a few percent, with five percent bandwidth realizable using relatively thick substrates. Secondly, the desirable feature of having devices, patches and RF power distribution on the same radiating surface is very difficult to achieve for an array with full two-dimensional scan. Arrays designed with standard printed circuit board substrates ( $\epsilon=2.5$ ) lack room for the necessary circuitry, and this has led to the use of relatively complex and costly multilayer fabrication in order to integrate the required components. Thirdly, because microstrip feed and control circuits also radiate, there are fundamental limits to the ultimate sidelobe control possible with microstrip arrays.

At SHF frequencies, most microstrip patch array developments have been in "passive" arrays, using a single RF source, an RF power divider, and phase shifters at each element or row of elements. To reduce losses, several layers of power division are often accomplished using lower loss waveguide or stripline circuitry. Undoubtedly, the most significant progress in this frequency range has been the development of wideband electromagnetically coupled feeds for patch arrays.

Figure 3 shows several electromagnetically coupled patch antennas that illustrate the variety of configurations available. Studies of slot line and coplanar waveguide feeds (Fig. 3a, 3b) have been carried out for individual elements [10], while slot coupling [11] and parasitic patch coupling [12] have been the subject of large

array studies. The parasitic patch configuration seems to have extremely broadband characteristics, with bandwidths up to 17% already demonstrated in theoretical studies.

Several other examples of electromagnetically coupled patches will be shown in the section of EHF antennas.

### Progress Toward EHF Monolithic Subarrays:

There are a number of factors that dictate the need for an entirely new array technology at frequencies above 20 GHz and certainly above 40 GHz. At these frequencies circuit losses are considerable and mechanical tolerances very difficult to achieve with conventional assembly practices. Most importantly, the requirements for EHF arrays call for large arrays with thousands of elements. The cost of these arrays is prohibitive unless they can be assembled by the automated processes of monolithic microwave/millimeter wave integrated circuits.

The RADC we have been investing in an extremely high risk technology to develop monolithic or near-monolithic receive arrays at 20 and transmit arrays at 44 GHz. Developed for airborne satcom, both arrays need to have at least several thousand elements, weigh little, and be mounted essentially flush with the aircraft skin. Still other investigations have pushed EHF monolithic technology to 60 GHz, where applications for communication require large arrays, but do not emphasize flush mounted operation or a thin package. Though these are high risk developments, we feel that more conservative approaches will not lead to affordable arrays, and so not present viable system options. At these frequencies, passive arrays with corporate power dividers and phase shifters have excessive loss, and arrays of active elements assembled in hybrid combinations appear to be too costly.

Printed circuit arrays at these frequencies are usually assumed to be microstrip patches or dipoles, with a typical patch array mounted on multiple layers of a printed circuit board as shown in Figure 4. Multiple layers are required to perform the various RF power, DC bias, and logic distribution functions. Such arrays also require some form of heat removal incorporated into the layered structure, and heat removal can become so important as to dominate all other design considerations.

An alternative construction, shown in Figure 5 [13] has the printed circuit network boards mounted perpendicular to the array face, and in this orientation it is convenient to use dipole elements with their improved bandwidth. This configuration also uses the available array depth, and thus provides more volume for circuit layout and heat removal. It retains the primary advantage of fabricating groups of array elements using monolithic MMIC techniques, and should therefore offer the same economic advantages as the patch arrays.

*continued on page 31*

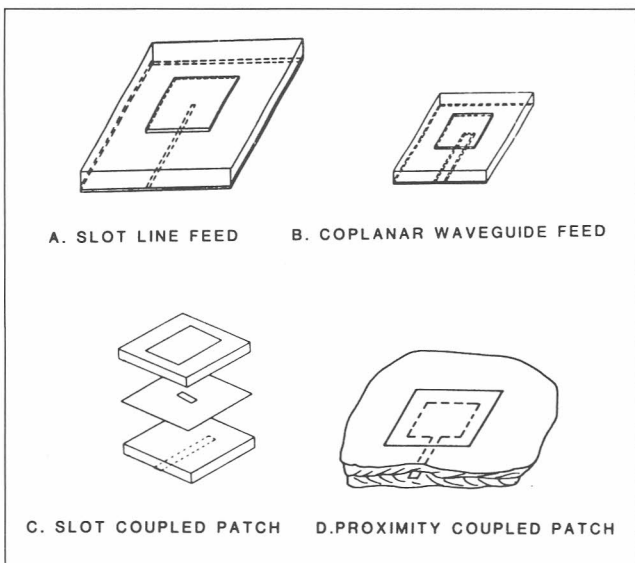


FIGURE 3. Electromagnetically Coupled Microstrip Patches

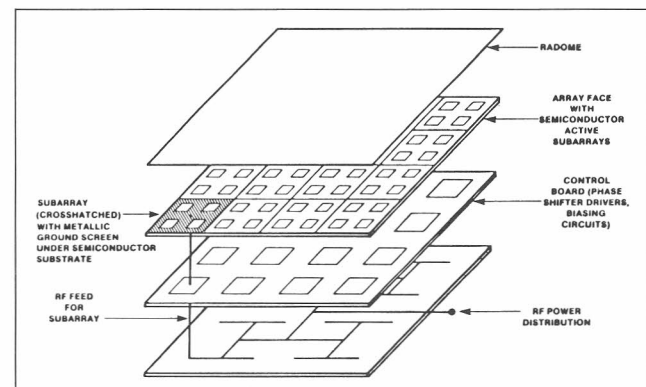


FIGURE 4. Multi Layer Construction of Printed Circuit Array

## PC ARRAYS

(continued from page 30)

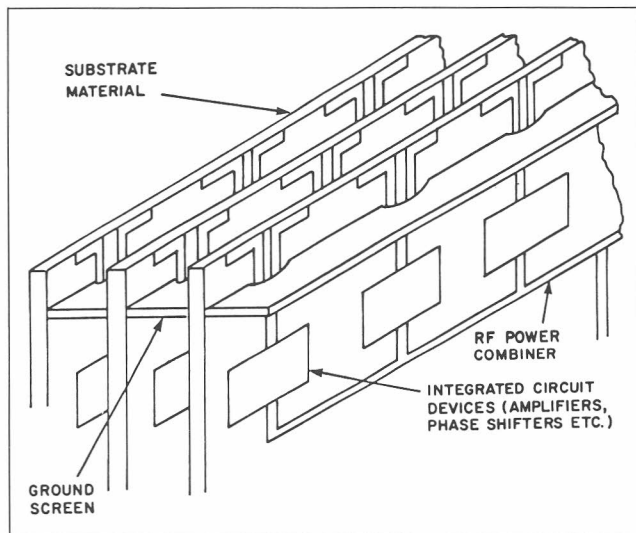


FIGURE 5. "Brick" Construction of Printed Circuit Array

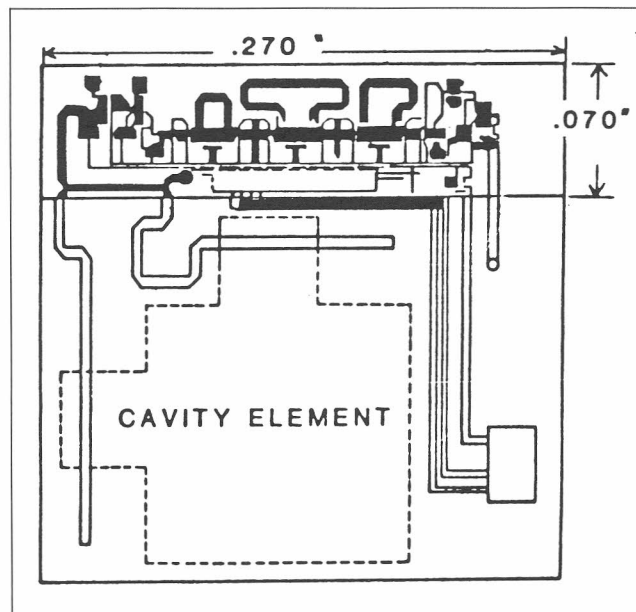


FIGURE 6. Basic Cell Configuration of 20 GHz Array

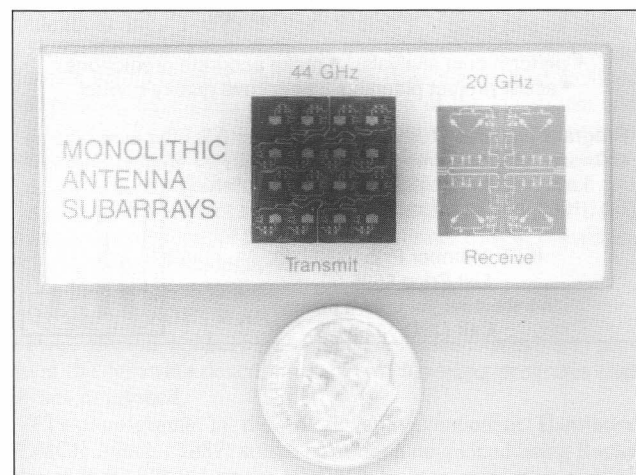


FIGURE 7. Monolithic Subarrays at 20 and 44 GHz

Figure 6 shows the basic cell configuration for an element of a subarray fabricated at 20 GHz by Rockwell Corporation. The array is not a printed circuit construction, but does incorporate monolithic GaAs integrated circuit low noise amplifier chips onto a 4-element subarray. The GaAs chip includes a low noise amplifier, a buffer amplifier and a three bit phase shifter. The overall noise figure is approximately 5dB. As shown, the basic subarray consists of four such cavity backed slot elements each excited by an integrated circuit GaAs chip. This hybrid packaged subarray has been demonstrated but its incorporation into an array is still a significant task. The subarray requires an RF input per element, and twelve control wires for each phase shifter. The vertical interconnect requirement is a major problem for this kind of fabrication.

Figure 7 shows several examples of more nearly monolithic subarrays. These developments by Ball Corporation show devices, circuits and array elements integrated onto the same GaAs chip, and represent a much higher degree of monolithic integration than the array described above. The GaAs chips are 0.5 inches on each side. The 20 GHz receive circuitry shown at right is actually one layer below the array face. A dielectric substrate with circular metallic patches (Fig 8) is bonded above the microstrip circuit layer so that the patches are excited with circular polarization by the probe feeds shown in the receive circuit photograph. The probe excitation was necessary to provide adequate bandwidth using the very thin (5 mil) GaAs chip.

Figure 7 also shows the most ambitious integration, a 16 element subarray with phase shifters and high power amplifiers at each element. Such extensive monolithic integration requires excellent chip yield in order to be economical, and requires good thermal control and excellent mechanical packaging to achieve reliability.

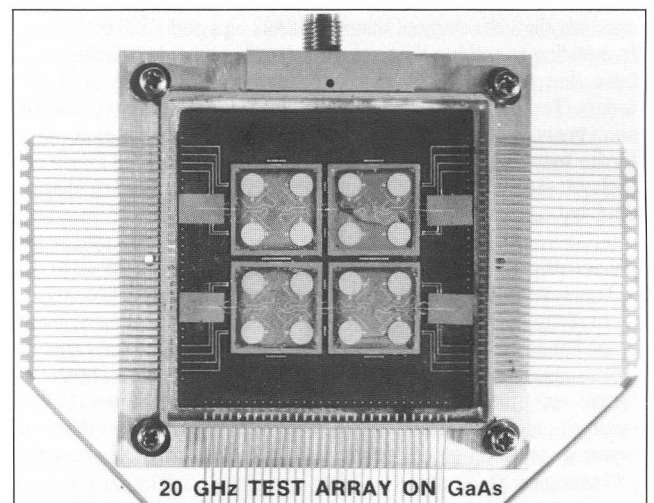


FIGURE 8. 10 GHz Test Array on GaAs

### Future Directions at EHF

When arrays are built using waveguide or coaxial power dividers, phase shifters and elements, the term "array architecture" is somewhat stilted. However, for the "monolithic" arrays described herein, it should be clear that there are substantial architectural issues even at the subarray level, that need to be settled in the development of EHF arrays. Subarray developments will continue to require new elements, new coupling mechanisms, improved techniques to accomplish or avoid vertical interconnects, and improved thermal control. All of these issues are interrelated, and the subarray architecture needs to consider them all together. The next step is to consider the array architecture needs to consider

*continued on page 32*

## PC ARRAYS

(continued from page 31)

them all together. The next step is to consider the array architecture, which involves a great deal more than simply mounting the subarrays. The multi-board array, whether mounted parallel or perpendicular to the array face, is where the heat removal, corporate power division and logic circuit distribution takes place.

One solution to the vertical interconnect problem is the use of parallel processing at the subarray level, in order to do all phase shifter logic and control at that level. This could eliminate dozens or even hundreds of vertical interconnects per subarray, but it also introduces additional complexities. "On Chip" processing implies combined GaAs digital and analog functions on the same chip, and this technology is not well-developed. In addition, there is little room on the existing chips, so integrating the logic functions would require major changes and some creativity in the architectural design of each of these subarrays. Elimination of the phase shifter control wires will alleviate, but not eliminate the vertical interconnect problem because of the need for bias lines, control lines, and RF feed interconnects. There remains a need for fabrication processes that produce inexpensive and reliable vertical interconnects.

Thermal issues now dominate array architectural decisions and require active cooling through the use of forced air or liquids, heat pipes, judicious placement of cold plates, etc. Many of these issues are not fully developed for high power arrays, but they do tend to favor those designs that have active circuitry on levels of substrate below the array face, where the cooling can be done directly without requiring the integration of massive cold plates. Thus thermal constraints, as well as vertical interconnect problems, tend to favor electromagnetic coupled geometries.

Finally, it should be emphasized that these "monolithic" arrays use today's technology of thinned GaAs chips and FET technology. In deciding to pursue these approaches we have to build upon the base that several years ago, appeared as though it would exist today. Technology is advancing so fast, however, that one may soon grow high quality GaAs islands on other substrates, or layer ferrite materials in thin films to produce phase shifters. These new technologies might bring about even more revolutionary changes than we have seen to date.

### Conclusion

This article has described developments in printed circuit array technology at SHF and EHF frequencies. At SHF frequencies the emphasis is on development of new, broadband elements that are still compatible with printed circuit fabrication. At EHF, however, arrays must include active devices, and so there is a need to consider the detailed architecture of the array and its subarrays. Several examples of subarrays are shown and illustrate technologies at 20 and 44 GHz.

### References:

1. G.R. Hanley and H.R. Perini, "Column-Network Study For A Planar Array Used With An Unattended Radar," RADC-TR-80-191, Final Report.
2. B. Edward and D. Rees, "A Broadband Printed Dipole With Integrated Balun," Microwave Journal, Vol 30, pp. 339-344, May 1987.
3. P.B. Katehi, N.G. Alexopoulos, "On the Modeling of Electromagnetically Coupled Microstrip Antennas-the Printed Strip Dipole," IEEE Trans. AP-32 No. 11, Nov 1984., pp. 1179-86.
4. I.E. Rana and N.G. Alexopoulos, "Current Distribution and Impedance of Printed Dipoles: IEEE Trans.," AP-29, Jan 1981., pp. 99-105.

5. H.G. Oltman, "Electromagnetically Coupled Dipole Antenna Element," 8th European Microwave Conference, Paris France, Sept 1978.
6. L.R. Lewis, J. Posgay, "Broadband Antenna Study: AFCRL-TR- 75-0178," Final Report F19628-72-C-0202.
7. P.J. Gibson, The Vivaldi Aerial. Presented at the Ninth European Microwave Conference (1979).
8. K.M. Franz and P.E. Mayes, "Broadband Feeds for Vivaldi Antennas" Antenna Applications Symposium, Univ. of Illinois, 1987.
9. G. Monser, "Performance Characteristics of Notch Array Elements over a 6/1 Frequency Band": 1987 Antenna Applications Symposium, 23-25 Sept 1987, Univ. of Illinois.
10. Y.T. Lo, RADC Technical Report (To be Published).
11. D.M. Pozar, "Microstrip Antenna Aperture-Coupled To A Microstrip Line," Electronics Letters, Vol 21, No. 2, pp. 49-50, January 1985.
12. J. Herd, "Moment Method Analysis of Infinite Arrays of EM-Coupled Rectangular Microstrip Antennas," IEEE Int'l Symposium on Antennas and Propagation, June 1988.
13. J.A. Kinzel, B.J. Edward, D. Rees, "V-band Space Based Phased Arrays," Microwave Journal, Vol. 30, No. 1, January 1987, pp. 89-102.

**Robert J. Mailloux** received the B.S. degree in Electrical Engineering from Northeastern University in 1961 and S.M. and Ph.D. degrees from Harvard University in 1962 and 1965, respectively.

He was with the NASA Electronics Research Center, Cambridge from 1965 to 1970, and with the Air Force Cambridge Research Laboratories from 1970 to 1976. He is presently Chief of the Antennas & Components Division, RADC, Electromagnetics Directorate. His research interests are in the area of periodic structures and antenna arrays.

Dr. Mailloux is a member of Tau Beta Pi, Eta Kappa Nu, Sigma Xi and Commission B of URSI. He is a Fellow of the IEEE, and has held offices in the IEEE Antenna and Propagation Society (AP-S) including the Presidency in 1983. He has also been a Distinguished Lecturer for AP-S and is now an Associate Editor of the Transactions. He is a part-time lecturer at Tufts University, and holds Adjunct Professorships at Northeastern University and the University of Massachusetts.

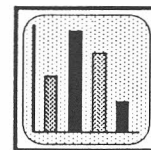
### Engineering Data Analysis Using the PC

An IEEE Individual Learning Program  
Developed by Dr. James Geer

- \* perform cost analysis
- \* make accurate predictions
- \* assist project planning
- \* improve quality control

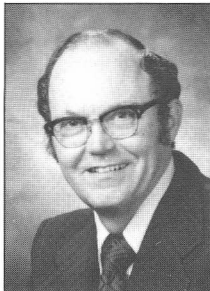
Program includes study guide and **user-friendly, menu-driven software**, textbook *Probability and Statistics for Modern Engineering*, Lawrence L. Lapin, PWS - Kent Publishing Co., 1983, and solutions manual.

IEEE Member Price \$398.00,  
List Price \$695.00  
Ask about our new training packages.  
Call (201) 562-5498





# PCs FOR MTT



by E.K. Miller  
Rockwell Science Center  
P.O. Box 1049  
Thousand Oaks, CA 91360  
(805) 373-4297

## PUFF

The account which follows describes *Puff*, a microstrip and stripline code for IBM PCs developed by Professors Richard Compton of Cornell University, and David Rutledge of Caltech, who provided the following write-up.

There are limitations in using commercial CAD packages, particularly in teaching and research. The programs are expensive, and they usually come with copy-protection devices that make it difficult to operate them on a large number of machines. The algorithms and models are often proprietary and this makes the program hard to understand. It tends to become a black box—providing answer but not insight.

To address these problems, we have written a new program in *Turbo Pascal*, named *Puff*, after the magic dragon in the song by the folk group Peter, Paul, and Mary. We have made *Puff* fast and easy to use. In the program the user lays out microstrip and stripline circuits on the screen with cursor keys. We have found it dramatically faster to lay out a circuit this way, instead of using the traditional circuit-description file. In addition, it is easy to catch errors, because you can see the circuit on the screen. One can analyze circuits with transmission lines, lumped elements, coupled lines, and arbitrary multi-ports. A frequency-domain analysis can be made at any time. *Puff* can also calculate voltage-transfer functions. Artwork correction can be included to compensate for discontinuities.

Several aspects of *Puff* invite new design approaches. We adjust the response curves directly instead of developing analytical expressions. This is healthy, because it stresses the physics of the circuits. In a traditional microwave class, a student often spends many hours deriving a complicated formula, and is then too exhausted to make much sense of it. The time-domain plots in *Puff* are also instructive. Even the experienced microwave engineer may never have considered the impulse response of a branch-line coupler, and he will find it a good puzzle to interpret the bumps in the plot *Puff* is also fun. We have overheard otherwise cynical students saying, 'You have to be careful; you could play all night.'

*Puff* is distributed free of charge. The program comes on a single diskette with a typeset, illustrated 36-page manual that includes instructions, examples, and a description of the algorithms and the models. *Puff* runs on an IBM-compatible computer with an Enhanced Graphics Adapter or a Color Graphics Adapter. An individual who would like a copy, or an instructor who would like a copy for each student in his class should write Professor David Rutledge Department of Electrical Engineering, California Institute of Technology, Pasadena, CA. 91125."

## MODELING SOFTWARE

M.C. Horton of MCH Associates, Thousand Oaks, CA. provided the following descriptions of two modeling programs that he has developed.

"Two programs in the Microwave Component Hardware (©MCH Assoc., 1987) series have been developed using Rocky Mountain BASIC 2.1 on the HP 9816 desktop computer, and can run on any HP 9000, series 200/300 machine. Each member of

the MCH series is similar; electrical and physical specifications are entered, the component is synthesized, all internal dimensions are determined, then the resulting physical component is analyzed and auto-scaled response plots, or tabular data, are presented on screen or dumped to a printer or plotter. These programs are available from MCH Associates, 1466 Oberlin Avenue, Thousand Oaks, CA. 91360, (805)495-7005.

**BEADLP**© first release in the MCH series, is used to design 'bead' type, coaxial lowpass filters. Chebyshev or Levy/Achieser/Zolotarev (LAZ) approximation can be used: LAZ is quasi-lowpass, with one large ripple near dc, but has the advantage of an extra parameter (determining lower equal ripple cutoff) useful in foreshortening filter length. After specifying cutoff, rejection, and ripple electrical specs, number of sections is calculated. Three diameters (inductive, capacitive, and coaxial bore) and dielectric properties are entered prior to calculating all internal lengths. All fringing capacities are accounted for in synthesis, and equal-ripple response is assured via optimization. Analysis of the resulting physical filter, including dissipation loss and fringing capacity, permits tabulation or auto-scaled plots of  $|S_{21}|$ , Ang (S221), RetLoss, passband InsLoss, and GrpDelay. Mr. Horton says that the program is very easy to use, and that 15 years of experience in design of filters using the program fully verifies the model. The price of BEADLP is \$499.00.

**COMBCLID**©, second program available in the MCH series, enables the complete internal dimensional design of both *COMB*line and *Capacitively Loaded Interdigital* (CLID) bandpass filters. Many options are available to the designer, such as COMB or CLID, double or single terminations, lumped or distributed capacitors, tapped or parallel-coupled inputs, and symmetric or asymmetric input parameters. Electrical specifications for loss breakpoints are entered, along with desired equal ripple cutoff frequencies and ripple level. Nominal default values are calculated for all subsequent electrical and physical numerical entries, and the filter is virtually auto-designed. Number of required sections is determined. Round rods or rectangular bars can be chosen, and capacitors may be placed within the resonators or in the housing/cover. The program contains a lookup table for all English and metric drills and all commonly-used fine-thread taps; reasonable, approximate values are calculated, whence the designer chooses from among five closest drills and two or three taps. Input lines, if tapped into the first resonator, can have round or rectangular center conductors. The program has been developed for extreme flexibility; yet very practical designs are achieved by one having almost no familiarity with microwave filters. After synthesis, gaps between adjacent resonators are determined so that all resonators have equal cross sections (end-most cross sections can differ from central ones), and all capacitor dimensions are determined, including fringing affects. An exact network is used for tapped input lines during synthesis. Analysis in COMBCLID allows the same plots as listed above for BEADLP; in addition,  $Re(Z)$ ,  $Im(Z)$ ,  $Re(Y)$ , and  $Im(Y)$ , can be plotted for use in interconnecting such filters in diplexers or multiplexers. COMBCLID has also been in practical use for design of combline filters for more than 15 years, and Mr. Horton says that the model is known to give excellent representation of the physical structure. The price of COMBCLID is \$749.00.'

## ENGINEERING-APPLICATIONS SOFTWARE

The ASYST package for the IBM PC and compatibles is reviewed in the 29 May 1987 issue of Science by D. Hary, K. Oshio, and S.D. Flanagan, pages 1128-1132, from which the remarks below were excerpted. It is also reviewed by Martin Heller in the April 1988 Engineering News, page 58. ASYST, from Adaptable Laboratory Software and published by Macmillan Software

continued on page 34

## PCs FOR MTT

(continued from page 33)

Company, New York, NY 10022, was developed expressly for the IBM PC. It furnishes comprehensive and powerful procedures for mathematics, statistics, and graphics (module 1); signal analysis and advanced mathematics and statistics (module 2); signal acquisition (module 3); and control and measurement (module 4). You should be aware of the fact that ASYST employs reverse Polish notation notation, and is implemented in Forth. Heller observes that 'I've seen PHDs throw up their hands and go back to FORTRAN after a week of trying to use ASYST, but have also seen students take to it in the first hour of going through the tutorial.'

ASYST's multiple applications 'are based on a comprehensive software algebra that not only facilitates programming but also provides a framework that preserves the parsimonious structure of mathematical formulas to ensure that algorithms are not only precise, coherent, and concise but also easy to test and correct.' A complete package sells for \$2195, but classroom prices are \$500 each for a minimum set of five. Upgrades have been released about twice per year to correct the many flaws and bugs contained in earlier versions. An extended support plan is also available which provides software upgrades as well as phone support by Adaptable Software Laboratories for one year, at a price of \$225.

ASYST requires most of the 640-kbyte program and system memory of the IBM PC. It is distributed on laser-hole-protected master and backup disks, a help disk, and two installation and demonstration diskettes. The master diskette is required every time ASYST is loaded because it is copy protected, an operation that takes about 15 seconds on the IBM PC-AT. Documentation includes three manuals for modules 1 and 2, and a manual for each additional module. The support plan is considered essential, since otherwise there is only a 60-day initial period of free support after purchase.

The reviewers conclude by noting that 'the acceptance of ASYST by the scientific community could dramatically change the way scientific data are handled and reduce the need for extensive in-house software development for many applications. However, there is no substitute for a well-conceived use of any software. We feel that the full acceptance of the ideas and concepts pioneered by Adaptable Laboratory Software and other software houses will depend on the ability of the scientific community to fully test and verify the procedures used by such products. Only then can the results produced by these software packages be subjected to confirmation which is crucial to rigorous scientific endeavor.' If any of you have had personal experience using ASYST or similar products which you are willing to share with others, please drop me a line or give me a telephone call.

Another similarly motivated product is CURVE, a 'full math analysis workbench and toolkit for the MS-DOS environment, including 80386 systems,' available from Curve Systems International, Inc., Department No. 288, Los Angeles, CA. 90097-4962 at a list price of \$495, but available at an introductory discount of \$99 to encourage individual purchase. According to Ed Kraut, a physicist here at the Science Center, at that price CURVE is a real bargain which will become indispensable to anyone who gets acquainted with it. Ed is considering the possibility of writing a review of this package for an upcoming column. The brief comments below are based primarily on CURVE documentation plus a review by Martin Heller in the April 1988 issue of *Engineering Tools*, pages 56-57.

CURVE is based on and computes with series representations (functions), manipulating the result with vectors of coefficients and the independent variable using what might be called a rational-approximation language. It can be used to solve linear and nonlinear differential equations as well as for fitting numerical data. The functional approximations built into CURVE include MacLaurin, Taylor, Bernoulli, Factorial, Hermite, Kitzelman, Legendre, Newtonian,

Tchebychef, continued fraction, rational fraction and Pade approximation. Program operations include differentiation, integration, logarithm generation, square root, function reversal (interchange of independent and dependent variables), curve plotting, root extraction, rounding and truncation, term display and definition, and origin specification.

My own description for CURVE would probably be 'model-based parameter estimation,' as one application of CURVE is to represent numbers obtained from other sources in a functionally convenient form for subsequent manipulation. If you are curious about whether CURVE might be useful for any of your work, two demonstration disks are available for \$9.95 from the above address, or by calling (213) 551-6695. The purchase price for the demonstration disks will apply to the \$99 individual cost of CURVE if you decide to buy it.

## COMPUTING ON THE HYPERCUBE

You may have seen something about the following news item, as reports about it have appeared in various places. The excerpt below appeared in the May 1988 issue of the IEEE monthly *The Institute*, and is included in case you might have missed it. Two years ago, Alan Karp, an IBM engineer, had offered a prize of \$100 to any software engineer who could speed up a problem's solution by at least 200 times with parallel processing. The winner would have to use a general-purpose parallel-processing system for scientific computing, and was to compare the results with a uniprocessor computer running identical problems.

A team at Sandia National Laboratories in Albuquerque, NM won the prize: R.E. Benner, J.L. Gustafson, and G.R. Montry. The three Sandia engineers demonstrated speedups of 1009 to 1020 times on three scientific problems that are computationally intensive: wave motion through deflectors, vortex motion in a fluid, and strain analysis of a cantilevered beam. Their algorithms were run on an Ncube/ten 10-dimensional hypercube having 1024 processors, from Ncube Corp., Beaverton, OR. Note that these speedup factors range from 98.5% to 99.6% of the theoretical maximum of 1024 times, an impressive accomplishment indeed!

They looked at each problem to identify potential bottlenecks to parallelism, and then developed mathematical methods and algorithms to minimize communications between processors, and to overlap communication and computation. The parallel solution to the fluid motion problem required, for example, 10 times less communications than the serial version. Also used was a logarithmic system-level algorithm to load a program into the hypercube in 11 steps, rather than inputting the same program serially into each of the 210 processors. Thus, after inputting the program into a single node, that node copied it to another, the pair then copied it to another pair, etc., cutting load time alone by a factor of almost 100.

## DISTRIBUTED COMPUTING

One aspect of supercomputing that can be overlooked in the quest for every-higher FLOP rates is the growing amount of computing power represented by the proliferating PC population. At Lawrence Livermore National Laboratory, for example, there are several thousand PCs (over 7,000 to be exact, including about 5,000 IBMs and 2,400 Macs) of various kinds distributed throughout the Lab. Thus, even if each PC has only a small fraction, 1 thousandth or so, of the computing power of a mainframe, the overall capability can nevertheless be equivalent in some ways to that of several mainframes. While the usage of the PCs is not as intensive as the mainframes in the computing center, their responsiveness for some applications can be substantially better than what the larger computers are able to provide. It's not likely that LLNL is unique in this regard, so that we might observe that one kind of distributed computing is increasing ubiquity of the PC and workstation.

*continued on page 35*

## PCs FOR MTT

(continued from page 34)

### SOFTWARE FOR TECHNICAL WORD PROCESSING

Many people have asked about comparisons of technical word-processors (TWP) to help in selecting one for their own use. A valuable series of articles on this topic has been published in the Notices of the American Mathematical Society. I list the titles and dates below for this work as follows:

Technical Wordprocessors for the IBM PC and Compatibles, Report by the Boston Computer Society, by Richard Goldstein, James Loomis, and Avram Tetewsky.

Part I — TWP Capabilities and People Needs, January 1987, pp. 15-32.

Part IIA — TWP Summary Tables, February 1987, pp. 262-281.

Part IIB — Reviews, April 1987, pp. 462-491.

Products reviewed were:

ChiWriter	Exact
EXP	The Egg
forMath	Manuscript
MASS-11	MicroTEX
PCTEX	PS
Samna IV	Spellbinder Scientific
SWP Enhancements	T3
to WorkPerfect	TechPrint II
TechWriter	TECH/STAR
TECH/WORD	TurboFonts
WordMarc Composer	

Even though these articles are a little over a year old, you might find them still to be helpful in choosing a TWP for your own use. In doing this study, the authors had two purposes, first to assist users in understanding their needs and how to fill those needs, and second to promote the establishment of high standards for TWP software on microcomputers through heightened user and vendor awareness. The authors considered four major aspects for consideration in selecting a TWP, as: 1) the capability to incorporate technical material (e.g., equations); 2) manuscript capabilities to organize the document; 3) Layout capabilities needed to control the exact look of the document; and 4) the user interface. Covering a total of 68 pages, these articles are chockfull of information.

I'm grateful to Ross Stone for sending me these articles, which he had discussed in his column in the December 1987 AP-S Newsletter, page 56. I thought they were worthwhile mentioning again here in case you had missed Ross' column.

Another TWP-related software review is included in the premiere issue of Computers in Physics (November/December 1987, see June 1988 PCs for AP column discussion), a new journal being published by the American Institute of Physics. Although a less detailed discussion than that just discussed, it might be accessible to more of you. Products reviewed in this issue include (computers for which they are designed are given in parentheses):

Alexander (IBM)	Exact (IBM)
Expressionist (Mac)	Finalword II (IBM)
Grafeas (IBM)	Laser Author (Mac)
Laserfonts (IBM)	Laser Wordix (IBM)
Mac QN (Mac)	Manuscript (IBM)
Mass-11, Version 7 (IBM, VAX)	Mathcad (IBM)
Nota Bene 2.0 (IBM)	Mathtype (Mac)
Samna Word IV (IBM)	Proofwriter (IBM)
Specific Fonts 4 (IBM)	Scifonts, Logifonts, & Electrofonts (Mac)
Spellbinder Sc. (IBM)	Techwriter (IBM)
Turbofonts (IBM)	Volkswriter Sc. (IBM)

### BENCHMARKS & PARALLEL PROCESSING

Benchmarks always seem to be of interest, and one that you might like to hear about is in the same Math Software Review of

Engineering News as that mentioned for CURVE above. In a review of PC-Matlab (3.2), results are given of running the PC-Matlab benchmark (Linpack) on computers ranging from the Macintosh to the Cray X-MP. The benchmark results are repeated below:

COMPUTER	PROCESSOR	KFLOPS
Macintosh	8MHz 68000	3
IBM PC/AT	6MHz 80286, 4MHz 80287	15
IBM PC/XT	4.7MHz 8087, 4.7MHz 8088	17
Compaq 386	16MHz 80386, 8MHz 80287	28
AT&T 6300	8MHz 8086, 8MHz 8087	29
ALR Dart	12MHz 80286, 12MHz 80287	30
Macintosh SE	with Radius Accelerator	64
Apollo Series 3000	Standard	72
Macintosh II	16MHz 68020 and 68881	73
Sun 3/50	15MHz with 68881	89
Sun 3/160	Standard	101
Microvax II	with FPA	140
ALR 386/20	20MHz 80386, 16MHz 80387	180
Compaq 386/20	20MHz 80386, 16MHz 80387	210
Sun 3/260	25MHz with FPA	404
Compaq 386/20	20MHz 80386/Weitek	450
Cray X-MP	Standard	33,000

Your first reaction might be that these numbers seem lower than you might have expected, since the Cray X-MP runs at about a GFLOP. The numbers above, however are the actual throughput provided by these computers, which typically are a tenth or less of the peak FLOP rate. What is interesting to see is that the newer PCs are overlapping low-end workstations. Since PC performance has typically lagged that of mainframes by about 10 years and a factor of 100 to 1,000, we might expect to see a few tens of thousands KFLOPs on PCs in the next 7-10 years.

### CDs FOR PCs

The introduction of compact-disc systems into personal computing seems to be picking up steam. Up until now, the reality of CD's for PCing seems to have been more appearance and promise than substance, but that may change. The AppleCD SC drive was introduced at the Third International Conference on CD-ROM in Seattle, WA in early March. The company, by declaring itself to be the first major PC manufacturer to commit to the CD-ROM market, hopes that third-party developers will follow suit.

The Apple drive is similar to others already available. Arc Laser Optical Technology of Santa Cruz, CA, has been shipping an \$1,100 CD-ROM player for the Mac since the Spring of 1987, along with a CD development system. The Apple drive, built by Sony, plays CD-ROM and CD-audio discs and connects to the Macintosh through the SCSI port. It can also be connected to the Apple II via a SCSI interface card, for which Apple will provide a free upgrade since early versions of the card will not work with the new drive. They are doing this partly to infiltrate the education market. The drive also includes a CD audio chip set, a Desk Accessory that allows the user to control audio discs, and headphone and RCA speaker jacks. The AppleCD, scheduled for first shipment in May 1988, will be priced at \$1,199. Storage capacity for the CD is approximately 200,000 pages of text, about 1,000 times the density of magnetic media.

Compact disc Products Inc. in New York is introducing a CD drive that can be used with any IBM PC or clone as well as any standard stereo system. Based on a Hitachi Limited drive, the \$729 unit will read a data disk and play music disks interchangeably. Optional software is also available, one package for \$95 enabling compiling personal catalogs of music CDs and to select particular tracks on these disks played in a predetermined order. Another \$100 program, intended for professional musicians, makes it possible to display CS music in its digitally coded form on the PC screen and rearrange it as desired (Business Week, January 25, 1988, page 821).

# Secrets of the Great Communicators

## Part 2: Finding the Gold



by Cheryl Reimold  
PERC Communications  
6A Dickel Road  
Scarsdale, NY 10583  
(914) 725-1024

Some years ago, I listened to a talk by a man called Danilo Dolci. He was one of those heroes who 'Take arms against a sea of troubles, and by opposing'...at least oppose them, at least take a human stand. Danilo Dolci led small bands of citizens in Sicily in open protests against the Mafia. Ghandi-like, he marched ahead of the townspeople and taught them to reject fear. He came to Columbia University to talk about his activities, and I went to hear him.

He was electric. We were all on the edges of our seats, marveling at his courage, enlivened by the light in his eyes. After the talk, I joined the line to shake his hand. When I finally reached him, I told him how wonderful I thought he was, how I admired his dedication, fearlessness, and energy.

Signor Dolci turned his shining gaze on me and gave me his full attention, as if I were the only other person in that full-to-bursting auditorium. He said we all had those qualities-or something to that effect. I do not recall his exact words.

What I do remember, and always will remember, is the way he looked at me as if I were someone who could do anything I wanted- anything at all. He seemed to see nothing but good in me, although he knew nothing about me and spend probably a total of two minutes with me. When I said goodbye, I felt empowered- that really is the word- to do anything worthwhile that I wanted to do. He saw a golden person in me who I didn't know was there, and he made me believe that person was my real self. Other people who had talked to him described his effect on them in similar terms.

Danilo Dolci saw the golden person in each of us- and we actually believed ourselves to be what he saw: a little better, a little stronger, a little more worthy than we had thought we were before we met him. Danilo Dolci was a 'Great Communicator.' He changed the people he met.

### THE GOLDEN SECRET

Today, if I am feeling defeated or overwhelmed, I can recall vividly the way he looked at me as someone who, just being human, had limitless potential and resurgent strength. Those two minutes have multiplied into hundreds of hours of hope, energy, and work as I remember his confidence in me and decide that, yes, I can do it, no matter what.

Since meeting Dolci, I have come across one or two people who knew the golden secret. One was a successful businessman, an agent for a book I was writing. The deadline for the book was impossibly tight; with my other commitments, there was no way I could finish it in the time specified. I told him so. He smiled and said to me, 'But I know you'll be able to do it. You're like me- you make things happen.' I finished that book on time.

The great communicator with the golden secret believes strongly in himself (herself), his work, and his ability to do whatever is re-

quired of him. He seems to draw this belief from the mere fact that he is a human being. He does not think he's unique; rather, he believes he can do great things because of certain human qualities that we all share. He has merely had the good sense or good fortune to recognize and use them.

Therefore, he sees these qualities- great reserves of strength, creativity, energy, and brainpower- in other human beings. He knows, perhaps only intuitively, that the way to activate these golden qualities is to concentrate on them and speak to them. So, he looks at them in you, and in so doing, he makes you aware of them in yourself.

When I have tried to apply Dolci's golden secret, the results have been consistently astounding. I become aware of abilities and energy I didn't think I had, and I use them. I feel good about each person with whom I'm talking. I don't see him as a barrier to something I want or a mass of potential objections to my ideas. Rather, I start to see him as someone full of interesting thoughts of his own. I listen more. I look forward to spending some time with this person, or working with him.

Of course, what we say or do depends on the situation, but I can tell you that when I look through the words and actions and roles to see the golden person inside, the person I'm talking to seems to begin to shine. Our time together is vibrant, positive, and often productive. We may not be fighting for freedom together, but our lives and work become more appealing, and we feel like giving more of ourselves.

Try to see the golden person in yourself and others. When you are with someone, believe that one shining human being is talking to another. See what happens, to both of you.

*Cheryl Reimold is author of more than 100 articles and several books, including How To Write a Million-Dollar Memo and Being a Boss. Her firm, PERC Communications, offers businesses in-house workshops and courses in communications, writing, negotiation, and creative problem solving. For information, please contact her at the address listed above.*

## IEEE MTT-S Student Paper Contest

The MTT Student Paper contest is open to all undergraduate student members of IEEE. Its objective is to increase awareness of undergraduate students of microwave subjects, and to enhance their communication skills. At the local level, the first prize is \$250.00. Local MTT Chapters are encouraged to use this activity for their members. Winners from local area contests will be entered in the national contest. The overall winner(s) will be invited to present his or her paper at the 1989 International Microwave Symposium, Long Beach, California. Limited travel expense money will be available. The national contest will be judged solely on the basis of the written material. Papers are due for judging at the local level by December 1, 1988.

For full information contact:

Dr. John M. Owens, Chairman  
Electrical Engineering Department  
University of Santa Clara  
Santa Clara, California 95053  
(408) 554-4482

## Education Committee Report



by Krishna K. Agarwal

The IEEE-MTT Society Merit Scholarships for 1988 were announced in March 1988 by Citizen's Scholarship Foundation of America, Inc., (CSFA). The recipients selected by CSFA for one year award, renewable for four years, are: Mr. Akihiro Itoh of Cupertino, California, Miss Lena Gandhi of Salt Lake City, Utah, and Mr. Harlan Howe III of Boxborough, Massachusetts.

In making the announcement, the CSFA noted that these exceptional recipients were chosen out of very impressive applicants. In addition to the scholarship money, the recipients receive a certificate in recognition of their award. The CSFA manages these awards for MTT-S and independently and confidentially collects information about all applicants on forms specially prepared for these awards. CSFA considers PSAT/SAT scores, class rank, academic record, GPA, leadership, career goals, community and extracurricular activities, teacher recommendation, etc., in making the selection. MTT-S verifies the eligibility of the parent in regard to the active membership. For the next school year beginning 1989-1990, the announcement for request of information appears in this issue of the MTT-S Newsletter.

Akihiro Itoh will be attending the University of California at Berkeley majoring in Electrical Engineering and wants to pursue a career in medicine with an engineering emphasis. 'I will cherish this scholarship as a reminder and further incentive to attain academic perfection,' says Akihiro.

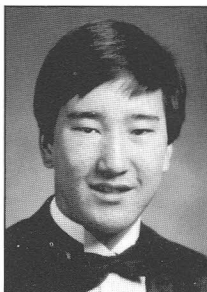
Lena Gandhi (photo not available) will be attending the University of Utah at Salt Lake City pursuing a career in Biology. She is the second in her family receiving the MTT-Merit Scholarship (her sister received the award two years ago when the National Merit Scholarship Corporation was managing the award for MTT-S.)



Harlan Howe III

The third recipient is Harlan Howe III who will be attending Rice University, Houston, Texas. 'I was very (pleasantly) surprised when I opened the letter,' says Harlan in accepting the award. Good Luck to you all in the pursuit of your career goals.

The 1988 Graduate Fellowships of \$5,000 each were presented to the four recipients at the MTT-S International Microwave Symposium in New York. The candidates are: Mark Sletten, University of Wisconsin, Patrick Heron, North Carolina State University, Raleigh, William Shillue, University of Massachusetts, Amherst, and Leon Hayden, Oregon State University. The presentation of certificate was made to the three recipients present (Patrick Heron could not attend) at the annual MTT-S Awards Banquet ceremony.



Akihiro Itoh

The air travel and complimentary banquet ticket were furnished by the 1988 MTT-S Symposium Steering Committee.



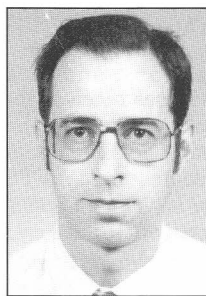
Kris Agarwal presenting certificates to recipients of 1988 Graduate Fellowships.

This year's \$10,000 Grant-in-Aid was awarded to Dr. Donald P. Butler, Assistant Professor in Electrical Engineering at Southern Methodist University, Dallas, Texas. The grant is provided to Dr. Butler to enhance Computer Aided Design facilities for the design of Microwave and Millimeter Wave Circuits and Devices. This grant would enable the EE department to purchase additional computer system and software tools for use by the students in microwave related courses.

For 1989-1990 Graduate Fellowships and Grants-in-Aid, an announcement is appearing in this issue (see page 38). Dr. Jorg Raue deserves much credit and thanks for managing these activities in a timely and excellent fashion.

The MTT-S Education Committee is soliciting applications for a Student Paper Contest for undergraduates in microwaves and related areas. The announcement appears in this Newsletter as well (see page 36). The activity can be used by MTT-Chapters to attract and encourage members to participate in MTT activities. Dr. John Owens and I would like the Chapter Chairmen to contact Universities in their local areas to give a push to this program. We need your ideas and help.

## ARFTG Highlights



by Raymond W. Tucker, Jr.

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, design and measurement. ARFTG holds two conferences each year, one in conjunction with the MTT-S International Microwave Symposium, and a second in the late Fall.

### 32nd ARFTG Conference Announcement

The Automatic Radio Frequency Techniques Group will hold its 32nd technical conference on December 1 and 2, 1988 in Phoenix, Arizona. This Conference's main topic will be *Non-Linear*

*continued on page 38*

## ARFTG UPDATE

(continued from page 37)

Measurements and Modeling Techniques. The conference hotel, Westcourt in the Buttes, is considered a resort hotel and will provide an excellent setting for the conference. For further information, see the Call For Papers elsewhere in this issue.

This ARFTG Conference promises to be outstanding, with an excellent Technical Program, Exhibits and Awards Banquet - plan to attend!!

### 31st ARFTG Conference

The Automatic Radio Frequency Techniques Group held its 31st technical conference on Tuesday, May 24, 1988 in conjunction with the International Microwave Symposium in New York City. Technical sessions, manufacturers exhibits and the Awards Banquet were the Penn Top and Sky Top areas of the 18th floor at the New York Penta Hotel.

The main topic for this conference was Innovations in Microwave Time-domain Measurements. Eight papers and a panel discussion were presented at this one day conference. The following papers were presented:

"Time-domain Metrology - Past, Present, and Future"  
Harold Stinehelfer, Sr., Raytheon

"Going from the Frequency to the Time-domain" J. Robert Ashley, Sanders Associates

"A New Time-domain Approach to Device Characterization" .M. Fidanboyly, N. Muthukrishnan, S.M. Riad, and A.Elshabini-Riad, Virginia Technical University.

"Time-domain Method for Measuring Non-Linear Effects of Active Microwave Devices" Andrew Landrie, Zhi-Yuan Shen, and Eric Hanson, Hypres, Inc.

"Error Corrected UHF Power Transistor Periodic Waveform Measurements" M. Sipila, K. Lehtinen, and V. Porra Helsinki University of Technology

"Analysis of Crosstalk on Printed Circuits" T.K. Sarkar, T. Rahal Arabi, and M. Manela, Syracuse University.

"Fault Location Using A Scalar System" Robert MacRae, George Hjiipieris, Marconi Instruments.

"Time Scale Calibration for Time-domain Measurements"  
Eric Hanson, Zhi-Yuan Shen, Hypres, Inc.

At the Awards Banquet, Dr. Charles E. Holmes received the ARFTG Automated Measurements Technology Award for his work in automated measurements and computer aided design software, and Dr. Glenn F. Engen was presented the ARFTG Automated Measurements Career Award for his numerous contributions to measurement metrology and six-port technology.

### JOIN ARFTG

ARFTG brings you the latest techniques in RF, Microwave and Millimeter wave Analysis, Design and Measurements. State-of-the-Art papers are presented twice a year. If you are involved in automated techniques, come and join your peers and keep current with our ever-evolving technology. For more information on ARFTG, write: ARFTG, Sly Hill Road, Ava, N.Y. 13303.

## 1988-1989 Scholarships, Fellowships and Grants-In-Aid

**UNDERGRADUATE MERIT SCHOLARSHIPS** — for children of MTT-S member (not limited to engineering), \$1,000-\$2,500 each, renewable for 4 years, given to meritorious students based on PSAT/SAT test scores, academic record, GPA, class rank, leadership, career goals, significant extracurricular and community activity, etc. Applications must be received by December 10, 1988.

**GRADUATE FELLOWSHIPS** — several \$5,000 fellowship awards each year for graduate research studies in microwave engineering on a full-time basis. Applicants must have attained high academic level in engineering or physics. Faculty Research Supervisor must be MTT-S member. Applications must be received by October 24, 1988.

**EDUCATIONAL GRANTS-IN-AID** — for individual members of MTT-S and for non-profit institutions, number and amount to be based on proposals submitted, proposed activity and financial justification. Applicant must be MTT-S member of 5 years standing. Applications must be received by November 7, 1988.

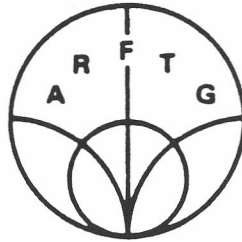
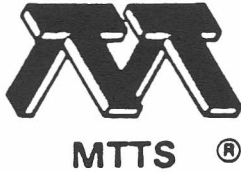
**For further information on the Merit Scholarships, contact:**

Dr. Krishna K. Agarwal  
3928 Wilshire Drive  
Plano, TX 75023  
(214) 867-3947

**For further information on the Fellowships and Grants-in-Aid, contact:**

Dr. Jorg E. Raue  
TRW ESG, R5/1291  
One Space Park  
Redondo Beach, CA 90278  
(213) 535-0160

Requests for applications and information on these awards must be made no later than October 30, 1988.



## AUTOMATIC RF TECHNIQUES GROUP

### FIRST CALL FOR PAPERS

Phoenix, Arizona  
December 1 and 2, 1988

The automatic RF Techniques Group will hold their 32nd Conference on Dec. 1 and 2, 1988 in Phoenix, Arizona, at the Westcourt in the Buttes Hotel.

The theme for this conference will be **Non-Linear Measurements and Modeling Techniques**. Appropriate topics for presentation would be automated methods and techniques for measuring and analyzing non-linear circuits and related topics. Papers are solicited on these topics as well as other areas involving computer aided RF/microwave measurement or design. Manufacturers are encouraged to discuss and exhibit new products in automated test and design areas.

Technical presentation shall be informal twenty-five minute talks using viewgraph or 35-mm slide illustrations. Authors are requested to submit a one-page abstract and a 500 to 1,000 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. Please refer to "ARFTG Instructions to Authors" for further information. All accepted papers will be published in the post-conference digest. Two copies of the abstract and summary should be sent by Oct. 14, 1988 to Dr. Jonathan Schepps, Technical Program Chairman.

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

Send papers to:  
Dr. Jonathan Schepps  
David Sarnoff Research Center  
201 Washington Road  
Princeton, NJ 08540  
(609)734-2185

For exhibit applications contact:  
William E. Pastori  
Eaton Corporation  
5340 Alla Road  
Los Angeles, CA 90066  
(213)822-3061

For further information, contact the ARFTG Conference Chairman:

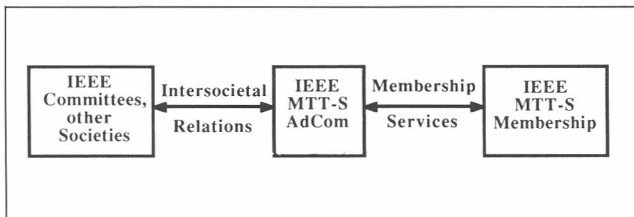
Gary Simpson  
Maury Microwave Corporation  
8610 Helms Avenue  
Rancho Cucamonga, CA 91730  
(714)987-4715

# Intersocietal Relations



by *Ferdo Ivanek*

The MTT-S AdCom has developed extensive relations within the IEEE and with some other Societies. The common objective of all these intersocietal relations is to better serve the MTT-S membership. The following diagram illustrates how this functions within the AdCom.



The MTT-S President appoints representatives to the various IEEE entities and to other Societies. The MTT-S representatives are expected to perform the following functions:

- participate in committee meetings as needed and otherwise monitor developments of interest to our Society
- participate in selected activities of common interest
- initiate new activities in the best interest of the MTT-S
- report to MTT-S President, to AdCom and to membership.

When Barry Spielman became MTT-S President, he found that the growth and increasing complexity of our intersocietal relations require systematic coordination. For this purpose he included in his AdCom organization the function of Coordinator, Intersocietal Relations, and appointed me to serve in this capacity.

The new coordinating function has three main objectives:

- simpler, more effective reporting to MTT-S President and to AdCom
- identify common or overlapping goals pursued in the different committees and Societies and coordinate our representatives' activities in the best overall interest of the MTT-S
- systematically disseminate key information to MTT-S membership.

Bob Moore, our PACE Representative, provided a shining example of how to keep the membership informed through the Newsletter. I proposed to follow his example and to introduce a regular column under the title 'Intersocietal Relations.'

The MTT-S is currently represented on the following IEEE Boards, Committees and Councils:

IEEE Board	Committee or Council	Representative
Educational Activities Board	Technical Activities Advisory Committee (EAB-TAAC)	K. Agarwal
Standards Board	Standards Coordinating Committee Standards Coordinating Committee on Non-Ionizing Radiation	E. Belohoubek S. Rosenthal
Technical Activities Board	Committee on Man and Radiation (COMAR) Solid-State Circuits Council (SSCC) Steering Committee of the Journal of Lightwave Technology (JLT)	B. Spielman (ex officio) J. Lin P. Greiling V. Gelnovatch N. Dietrich
United States Activities Board (USAB)	Aerospace R&D Committee Committee on Communications and Information Policy (CCIP) Defense R&D Committee Energy Committee Engineering R&D Committee Health Care Engineering Policy Committee Professional Activities Council for Engineers (PACE)	W. Brown F. Ivanek H. Howe, Jr. W. Brown J. Tancredi F. Rosenbaum K. Carr R. Moore L. Medgyesi-Mitschang

In addition, the MTT-S participates in the organization of two related IEEE conferences, and is represented at two Societies outside of the IEEE:

Conferences	GaAs Symposium Picosecond & Optoelectronics	P. Greiling P. Greiling
Other Societies	International Microwave Power Institute (IMPI) International Scientific Radio Union (URSI)	J. Osepchuk A. Oliner

This adds up to 18 entries in the above two tables and to as many MTT-S representatives or alternates. I shall continue reporting on the framework for our intersocietal relations in subsequent issues of the Newsletter.

I would like to conclude this introductory report with the invitation to all the MTT-S representatives to systematically contribute their own condensed reports. I also invite all other interested MTT-S members to contribute to our column with letters, comments and proposals. Please mail them to: Ferdo Ivanek, Communications Research, P.O. Box 60862, Palo Alto, CA 94306. For inquiries over the telephone please call (415) 329-8716.

**Stop secret snacking** by dealing with the underlying motive. *If your snack is a distraction:* Determine what's bothering you and either confront it or find a less caloric way to pass the time. *If your snack is an avoidance tactic:* Admit it. Then stop procrastinating and do the task. *If your snack is a substitute for something you can't have:* Think about why you feel this way, and figure out how to get what you want.

*Quick Fixes & Small Comforts* by Dr. Georgia Witkin, Villard Books, 201 E. 50 St., New York 10022. \$17.95.



## Committee on Communications and Information Policy (CCIP)



by Ferdo Ivanek

The interest of our Society in the CCIP is due to the fact that communications represent the major commercial microwave market segment.

For a one-sentence definition of objective and scope I quote the first paragraph of the corresponding section of the CCIP Charter: 'The overall objective of the IEEE Committee on Communications and Information Policy is to assist in the rational formulation of communications, computer and information technology legislation, regulation, and policy in the U.S. through the provision of sound counsel, based upon the best resources which the IEEE can bring to bear upon the issues.'

As of April 1988, the CCIP had 52 members, of which 17 represented 12 IEEE Societies. It consists of six subcommittees and an Executive Committee. Of primary interest to the MTT-S is the Technological Leadership Subcommittee, and next the Space and Spectrum Issues Subcommittee. I am active on the former and follow the activities of the latter.

The major recent output of the CCIP Technological Leadership subcommittee was the USAB Entity Position Statement 'Gallium Arsenide Technology,' issued in 1987. The following quotes provide the thrust of this document:

- 'Unfortunately, the U.S. electronics industry does not enjoy the dominant position in GaAs development and production that it did at the beginning of the silicon boom.'
- 'Current U.S. GaAs activity is concentrated mostly in small research and development companies or Defense Department supported contracts. By contrast, overseas investment in large-scale, high-speed GaAs chip development is conducted by vertically integrated, large systems corporations with established production facilities for silicon chips.'
- 'The future strength of the U.S. communications and electronics industry will depend in large part upon the competitiveness of its Gallium Arsenide (GaAs) components, ...'
- Therefore, it is imperative that both legislation and tax policy encourage the long-term investments in capital facilities and research and development that are necessary to ensure the competitiveness of U.S. GaAs technology in the marketplace, and to provide critical components for major systems.'

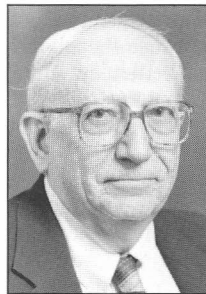
At our initiative the CCIP Technology Leadership Subcommittee is currently exploring the feasibility of cooperative industry efforts in communications. So far, four invited speakers addressed this subject:

- Harold Sobol, Past MTT-S President and Vice President, Engineering and Advanced Technology, Rockwell International Telecommunications Division, made on November 10, 1987 an opening presentation 'Cooperative Industry Research in Communications.'

- On March 22, 1988 Peter Panousis, Director, VLSI Technology Laboratory, AT&T Bell Laboratories, gave a presentation on Plans and Programs, Microelectronics and Computer Technology Corporation (MCC) described the MCC activities.
- Eric Sumner, Vice President, Operations Planning, AT&T Bell Laboratories, was the May 18, 1988 guest speaker on 'Industrial Cooperative Research for Communications System Development.'

The Technological Leadership Subcommittee and the CCIP found these invited presentations very useful in further pursuing the issue of cooperative industry efforts in communications.

## TAB Periodicals Committee Report



by Chester L. Smith

### March 28 Meeting

The Periodicals Committee held its first meeting of 1988 at IEEE Headquarters on Monday, March 28. The Committee "monitors" periodicals that are late and Division representatives are supposed to know why. Division IV has three on the "wanted" list, but none of these were serious. In each case, we expect to be on schedule by deadline times.

A Division representative has two responsibilities: (1) to keep things on time and (2) to monitor the technical quality of periodicals to assure that these are up to IEEE professional standards. So far Division IV is way ahead on technical quality and only minor glitches on timing.

The lateness issue is often the result of the guest editor. The Publications Committee has decided to prepare a manual for editors similar to those IEEE has for Conference Chairman and for Society Officers on budget and finance. The subcommittee appointed to prepare this booklet consists of Chester Smith Chairman, MITRE (617-271-7086), Alan Cookson (412-256-2160), Westinghouse and Anil Jain, Michigan State University (517-353-5150).

There was some discussion of electronic handling of IEEE publications. This would include electronic submission of manuscripts to publications, return of proofs and the like. The Computer Society is already doing much of their work via this route. Some problems brought up were not everyone is equipped to handle manuscripts electronically and mathematical text is not readily accommodated. Straight FAX is, of course, not so afflicted. 'Simple' text can be submitted on floppy disks.

Also this line was the question of whether or not IEEE has or is planning to publish transactions in Braille. So far, it is only an idea. With electronic processing it is possible. Any interest?

The question of mailing permits was brought up again. The new postal rates were also accompanied by some changes in the regulations which are too convoluted to go into here. The bottom line is that Society newsletters, Section publications and the like *must be* under IEEE 2nd Class permit in New York. Publications can be entered at any Post Office, however.

*continued on page 42*

## TAB REPORT

(continued from page 41)

### June 20 Meeting

The Transactions on Broadcasting was commented on favorably for the dramatic improvements that have been made. The request of the Lasers and Electro-Optics Society for a periodical called "Optical Letters" was approved and should begin publication soon.

An issue was brought to the Committee by the Headquarters Staff about using the Transactions as a vehicle for Conference and Symposia Records. This practice is to be discouraged for several reasons. It has an adverse impact on the price of the All Transactions Package, but that is an issue for the Finance Committee. Conference and Symposia Records are to be handled via the Open Order Plan by the Service Center. The major concern of the Committee, however, had to do with the disparity between the peer review policy for Transactions and the normally much less stringent review given Conference papers. One comment was that a meritorious paper presented at a Symposium could, indeed should, be submitted to a Transactions for review and subsequent publication, but, in general, conference papers worthwhile though they be are not suitable for Transactions. The final settlement of this question will be by the General Board of IEEE, but the Periodicals Committee is on record as being not in favor of using the Transactions for Conference/Symposium records.

Notes from the previous meeting we reported interest on the part of the Periodicals Committee in a manual for Transactions Editors similar to those on Finance and Conferences. There was some Staff opposition to this on the ground that the editors and staff work closely. While this is true, most of the lateness cases involve special issues where a on-time guest editor is in charge. The discussion also brought out the fact that Associate Editors seldom see the material furnished to the principal editor from Headquarters. The Periodicals Committee intends to go ahead with the preparation of an Editors Booklet. Staff was instructed to supply the subcommittee via Barbara Ettinger with the papers and other documentation now being used. We have an outline, but is in for a drastic revision. Thoughts, comments or observations would be most welcome!

Two technical areas were brought up for discussion: "Neural Networks" and "Superconductivity." The problem here is not that these are out of the purview of IEEE, but rather that these subjects cut across the interests of several Societies. The hope Headquarters Staff had in bringing these up was that the Periodicals Committee might suggest ways of bringing them into focus. Ladies and Gentlemen - Help!

A couple of minor points were raised near the end of the day. (1) There is no necessary reason why an aural presentation of a paper should be a prerequisite for consideration for publication in any Transactions. A nice idea but not necessary. (2) Page charges are *strictly* voluntary and no paper is to be refused for failure to provide page charges.

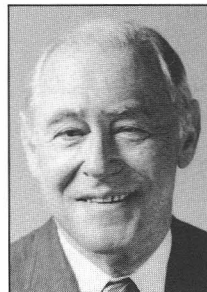
*Chester L. Smith is the Division IV Representative to the Periodicals Committee of the Technical Activities Board (TAB).*

**Frequent-flyer programs** are gradually being downgraded by the airlines. They may soon be eliminated altogether. *Advice:* Sell your mileage to anyone who will by it.

*Travel Smart, 40 Beechdale Rd., Dobbs Ferry, NY 10522. Monthly. \$44/yr.*

# Why Technology Alone Cannot Improve U.S. Competitiveness

— PACE REPORT —



by Bruno O. Weinschel

Editor's Note: *Dr. Weinschel is Chairman of the IEEE/USAB Committee on U.S. Competitiveness and a former president of the IEEE.*

### U.S. Discoveries

The IEEE publishes about 20% of the world's literature in Electro-Science. The success of our scientific publications was studied by the IEEE Publication Board. IEEE's "penetration" or percentage of total articles of the world's literature for 1981-87, in 26 sections of Electrical Computer and Control Engineering, exceeds 30 and 40% in many sections. These include circuit theory, electronic circuits, microwave technology, magnetic and superconducting materials and devices, electromagnetic waves/antennas and propagation, information and communication theory and measurement science.

### U.S. Commercialization

Their practical applications in the U.S. can be learned from patent activities.<sup>1</sup> While one cannot draw conclusions only from the increase in the *quantity* of U.S. patents granted to foreign inventors, Venture Economics, of Wellesley Hills, MA., using a data base of CHI Research, Haddon Heights, measured their *quality* by examining the frequency with which patents in electronics and computers were cited as prior art in subsequent patents. Their index measures the quality rather than the quantity of a company's patents. The ten highest range from 2.55 to 1.80 and include eight Japanese and two U.S.

### U.S. Neglect of the 'Middle Ground'

The U.S. often makes the basic invention and the Japanese, with many technical improvements, market a desirable product. An example is the video-cassette recorder. Ampex produced VCR's for broadcast studios. Sony invested in its commercial possibilities for consumers. It had to solve many engineering problems and had to create new magnetic material for a 1/2" video tape. The work resulted in thousands of patents demonstrating excellent product and process engineering.

In contrast to U.S. practice, Japanese industry uses in one team design, marketing, and product engineers. In order to reduce "Time-To-Market," production engineering proceeds simultaneously with process engineering.

Their most capable engineers, as in West Germany, are in production. Daily improvements of quality and cost are their responsibility. Engineering salaries are uniform throughout the various engineering sections of a Japanese company. In contrast, in the

*continued on page 43*

## PACE REPORT

(continued from page 42)

Anglo-Saxon culture, the R & D engineers are considered more important than manufacturing engineers.

The U.S. "manufacturing gap" between invention or discovery and commercialization is well described.<sup>2</sup>

Dr. R.M. White, president of the National Academy of Engineering,<sup>3</sup> makes these points: "The ability to translate scientific knowledge into useful products has to be a central focus of any nation that wants to have economic growth," He berates "the traditional low status of manufacturing. One of the things the Japanese have done very well and we have done poorly is to understand the concept of design for manufacturability...design (a product) so that you can produce it at low cost and (with) high quality. That's where we have been deficient." He also says, "There has been a paucity of courses in engineering schools on manufacturing engineering."

### Engineers and Philosophy of Management

The tasks of Engineers are controlled by Management. U.S. Management is principally guided by "Return on Investment" or ROI, not by growth of market share or expansion of capabilities. The Japanese emphasize those two factors in formulating their plans. As an example, in manufacturing of Japanese space probes, all important components were designed and manufactured in Japan, at many times the cost they could have been purchased from the U.S.

### The Macro-Economic Causes

Engineers cannot make a business policy decision independent of the top management. Two thirds of the U.S. top industrial management of the leading 100 industrial firms have a financial or legal background. Only one third are technologically *literate*. In Japan, two thirds have a technical or "hard science" *education*. The remaining one third come from export marketing which sensitizes them to the needs and desires of an end user. This background is responsible for a better understanding of the risks and potentials of new technologies, manufacturing processes and the need for total quality.

There is no capital gains tax in Japan, or in the major industrial countries for the sale of industrial equity. The U.S. manager lacks the financial incentive to take the risk his foreign counterpart can afford to take.

In Japan and West Germany the cost of capital is lower and its availability is better. The present prime rate in Japan is about 3 1/2 percent while the U.S. rate is 9%. A long-term development is a less desirable investment in the U.S. The availability of capital in Japan is enhanced by a savings rate of almost 20% relative to a U.S. rate below 4%.

These *macro-economic policies*, outside the influence of engineers, *determine the willingness of business management to take risks*. The short-range policies of the U.S. Treasury to optimize tax income, are decoupled from any considerations to enhance investment, improve our trade or strengthen U.S. industry. However, Industry is one of the major creators of wealth and of higher paying jobs. Industry is, the goose which can lay the golden eggs if properly encouraged by tax policy.

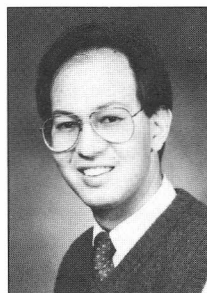
Our present Macro-economic policies and level of consumption mortgage the economic future of our children and grandchildren. Excessive consumer spending is encouraged by the 1986 U.S. tax reform and financed by the Federal Budget deficit. A Japanese business man subject to U.S. tax policies and capital costs, would make the same business decisions as his U.S. colleagues.

One of the most important contributions to an improvement of our competitiveness is not just more R&D, but the *improvement of the economic environment to stimulate the taking of business risks by U.S. industrial management*. Tax and monetary policies must

encourage increased savings and productive investments. These policies must lower the cost of capital for productive purposes while increasing its availability. They must be an incentive for management to take risks connected with investment in new designs, products, processes and improvement of human capital. The playing field for taking business risks in the U.S. must be levelled relative to Japan.

1. "Lookout, U.S.! The Japanese are Gaining in Patent activity," by Gary Stix, p. 4, June 1988, The Institute.
2. "Manufacturing, Innovation, and the American Industrial Competitiveness," by Stephen S. Cohen and John Zysman, pp. 1110- 1115, Science, Vol. 239, March 4, 1988.
3. "Competitiveness Starts on the Shop Floor," by Robert S. Cown, Staff Writer of the Christian Science Monitor, Christian Science Monitor, National Portion, Thursday, March 20, 1987.

## Meetings of Interest



by Frank Occhiuti

### GENERAL INTEREST

NORTHCON '88 Oct. 4-6, Seattle Convention Coliseum, Seattle, WA Contact: Ms. Alexes Razevich, Electronic Convention Mgmt., 8110 Airport Blvd., Los Angeles, CA. 90045, (800) 421-6816

WESCON '88 Nov. 15-17, Anaheim Convention Center, Anaheim, CA. Contact: Ms. Alexes Razevich, Electronic Convention Mgmt., 8110 Airport Blvd., Los Angeles, CA. 90045, (800) 421-6816

### COMMUNICATIONS

1988 4TH INTERNATIONAL CONFERENCE ON SATELLITE SYSTEMS FOR MOBILE COMMUNICATIONS AND NAVIGATION Oct. 17-19, Institution of Electrical Engineers, Savoy Place, London WC2R OBL. Contact: Conference Services, IEEE, Savoy Place, London WC2R OBL, U.K. 01- 240 1871

1988 MILITARY COMMUNICATIONS CONFERENCE—MILCOM '88 Oct. 23-26, San Diego Marriot, San Diego, CA. Contact: Ralph Osborne, TRW Electronic Systems Group, One Space Park, Bldg. 146, Rm. 1515, Redondo Beach, CA. 90270, (213) 535-5885.

GLOBAL TELECOMMUNICATIONS CONFERENCE—GLOBECOM '88 Nov. 28-Dec. 1, Diplomat Hotel, Ft. Luaderdale, FL. Contact: Richard Blake, Siemens Communications Systems, Inc., 5500 Broken Sound Blvd., Boca Raton, FL. 33487, (305) 994-7300.

continued on page 44

## MEETINGS OF INTEREST

(continued from page 43)

### COMPUTERS

INTERNATIONAL CONFERENCE ON COMPUTER DESIGN Oct. 2-6, Rye Town Hilton, Rye Brook, N.Y. Contact: ICCD 1988, 1730 Massachusetts Ave., N.W., Washington, D.C. 20036-1903. (202) 371-0101.

### ELECTROMAGNETICS & OPTICS

1989 URSI INTERNATIONAL SYMPOSIUM ON ELECTROMAGNETIC THEORY Aug. 14-17, The Royal Institute of Technology, Stockholm, Sweden. Contact: Prof. S. Strom, Dept. of Electromagnetic Theory, Royal Institute of Technology, S-100 44 Stockholm, Sweden, Tel no. 46-8-790-81-95.

INTERNATIONAL CONFERENCE ON COATINGS AND SENSORS May 9-11, 1989, Penn State University, University Park, PA. Contact: Prof. Vijay K. Varadan, Dept. of Eng. Science & Mechanics, 227 Hammond Building, University Park, PA. 16802. (814) 865-2410.

### MICROWAVES & ANTENNAS

10TH ANNUAL ELECTRICAL OVERSTRESS/ELECTROSTATIC DISCHARGE SYMPOSIUM Sept. 27-29, Anaheim, CA. Contact: Jerry M. Soden, Sandia National Laboratories, Albuquerque, N.M. 87185, (505) 844-6812

IEEE ULTRASONICS SYMPOSIUM Oct. 2-5, McCormick Center Hotel, Chicago, IL. Contact: Prof. William D. O'Brien, Jr., General Chairman, Bioacoustics Research Lab, University of Illinois, 1406 West Green St., Urbana, IL. 61801, (217) 333-2407.

GOMAC '88 (GOVERNMENT MICROCIRCUIT APPLICATIONS CONFERENCE) Nov. 8-10, Las Vegas, NV. Contact: Jay Morreale (G-88), Palisades Institute for Research Services, Inc. 201 Varick St., Rm. 1140, New York, N.Y. 10014.

5TH INTERNATIONAL SYMPOSIUM ON ANTENNAS Nov. 8-10, Nice, France. Contact: M. Guiraud, CNET-PAB Centre de La Turbie, 06320 Cap D'Ail, France. Tel no. \*33 93 411530.

13TH INTERNATIONAL CONFERENCE ON INFRARED & MILLIMETER WAVES Dec. 5-9 Pacific Beach Hotel, Honolulu, HI. Contact: Kenneth J. Button, Program Chairman, Box 72, M.I.T. Branch, Cambridge, MA. 02139-0901, (617) 489-4343.

1989 IEEE MTT-S INTERNATIONAL MICROWAVE SYMPOSIUM June 14-16, 1989 Hyatt Regency Hotel, Long Beach, CA. Contact: C.E. Swift, C.W. Swift Associates, 15216 Burbank Blvd., Van Nuys, CA. 91411, (818) 873-4778.

IGARSS '89 URSI-F 12TH CANADIAN SYMPOSIUM ON REMOTE SENSING July 10-14, 1989, Vancouver, Canada. Contact: John S. MacDonald, MacDonald, Dettweiler & Associates, 3751 Shell Road, Richmond, B.C. Canada V6X 2Z9, (604) 278-3411.

SBMO INTERNATIONAL MICROWAVE SYMPOSIUM July 24-27, 1989 - Maksud Plaza, Sao Paulo, Brazil. Contact: Octavio M. Andrade, Chairman, Instituto Maua de Tecnologia, Escola de Engenharia Maua - Estrada da Lagrimas, 2035 - Sao Caetano do Sul, Sao Paulo, 09580, Brazil, Tel. no. (011) 4426944, Telex: 1145234 AUAT BR.

### SOLID STATE

2ND CONFERENCE ON CRYSTAL GROWTH Oct. 19-21, Atlantic City, N.J. Contact: G.M. Loiacono, Philips Laboratories, 345 Scarborough Road, Briarcliff Manor, N.Y. 10510, (914) 945-6075.

1988 GAAS REL WORKSHOP, Nov. 6, Nashville, TN. Contact: Anthony A. Immorlica, General Chairman, EIA/JEDEC, JC-50 Workshop, Washington, D.C., (315) 456-3514.

1988 IEEE GAAS IC SYMPOSIUM Nov. 6-9, Nashville, TN. Contact: Richard Y. Koyama, Symposium Chairman, TriQuint Semiconductor, Tektronix Industrial Park, Group 600, P.O. Box 4935, Beaverton, OR 97076, (503) 627-6773.

1988 U.S. GAAS MANTECH CONFERENCE Nov. 9-11, Nashville, TN. Contact: Wayne D. Moyers, Registration Chairman, Pacific Monolithics Inc., 245 Santa Ana Court, Sunnyvale, CA. 94086-4512, (408) 732-8000.

1988 IEEE INTERNATIONAL ELECTRON DEVICES MEETING Dec. 11-14, San Francisco Hilton, San Francisco, CA. Contact: Ms. Melissa Widekehr, c/o Courtesy Associates, Inc., 655 15th Street, N.W., Suite 3000, Washington, D.C. 20005, (202) 347-5900.

### MISCELLANEOUS

5TH INTERNATIONAL CONFERENCE ON FERRITES Jan. 10-13, 1989, Bombay, India. Contact: C.M. Srivastava, (convener, ICF5), Head, ACRE, I.I.T. Bombay, Bombay-400076, India.

SECOND INTERNATIONAL CONFERENCE ON ENGINEERING MANAGEMENT Sept. 10-13, 1989, Sheraton Centre Hotel, Toronto, Canada. Contact: Brian L.G. Lechem, Chairman, Conference Organizing Committee, 245 Fairview Mall Drive, Suite 600, Willowdale, Ontario, Canada M2J 4T1.

**Analyze your career path** to increase job satisfaction. Many people see particular positions as steppingstones to higher levels of responsibility. They believe that reaching those levels will bring them real satisfaction. But as they approach their goals, they see that people in those higher positions can be very unhappy—and that realization can undermine satisfaction in their current jobs. *If this happens to you:* Realize that happiness is different from success. Reconsider your objectives and the meaning of your work. This may be the time for a different career path...or a different career altogether.

*The Right Place at the Right Time* by employment consultant Dr. Robert Wegmann, Ten Speed Press, Box 7123, Berkeley, CA 94707. \$9.95.

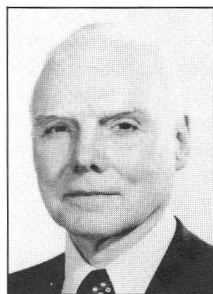
**Cut meeting time in half.** *Save time for all* participants by having the leader double his/her preparation time. Have a clear idea of the problems to be solved and be prepared with possible solutions. *Other time cutters:* Written agenda...scheduled time to end...stand-up meetings...informational reports distributed in advance.

*Time Power* by Charles R. Hobbs, Ed.D., Harper & Row, 10 E. 53 St., New York 10022. \$7.95.

**Men can take off their jackets** at 90% of all companies today (as long as they're not meeting visitors). But...95% of companies still demand a tie.

Runzheimer International, Runzheimer Park, Rochester, WI 53167.

# ISY-1992 International Space Year



by William C. Brown

The International Space Year is a global event scheduled for 1992, the 500th anniversary of Columbus's discovery of America and the 35th anniversary of the International Geo-physical year which ushered in the Space Age.

The first ISY planning conference took place in the summer of 1987 when 150 delegates from eight spacefaring countries and the European Space Agency met in Hawaii. They met again in Durham, New Hampshire in April to better organize and define their objectives.

The objectives of ISY 92 are to explore and expand the usefulness of space while at the same time promoting international cooperation. Examples of activities are the collection and sharing of information about the environment and the international aspect of planning for missions to the moon and to Mars.

In assessing the relationship of MTT-S to ISY 92, it is observed that the application of microwaves to space is all pervasive. Microwaves are essential to information collection and transfer, be it in the form of commercial communication enterprise, a connecting link to satellites exploring the planets and deep space, sensing the Earth's resources and conditions within its atmosphere, or determining the position of objects in space and sensing radiation from them. Add to this the potential for the use of microwaves to beam electric power to earth from geosynchronous satellites that collect energy from the sun around the clock, or to beam power to orbiting industrial parks, and we see the enormous present and future importance of microwaves to space activities.

What could MTT-S contribute to ISY 92? In this context IEEE President Dr. Russell Drew chaired a working group of professional society representatives that explored this issue at the first meeting in Hawaii. Drew's working group identified these appropriate activities of professional societies:

- Topical/Specialty Conference
- Publication of Newsletters
- Lectures, Displays
- Design Competitions
- Global ISY Communication Networks
- Educational Curriculums
- Briefings to Government Agencies

The MTT-S is already organized in such a manner that it could undertake some of the above activities within itself. There is also the possibility of joining with other Societies that have a mutual interest in microwave systems or components.

At the present time the Aerospace Electronic Systems Society is taking the lead role in ISY 92, but there is plenty of opportunity for other Societies to become involved and use ISY 92 as a focus for some of their activities.

*Bill Brown is MTT Representative to two IEEE TAB Technology Committees: Aerospace R&D, and Energy.*

## Book Review

**High-Power Microwave Sources** Victor L. Granatstein and Igor Alexeff, editors, published by Artech House, Boston and London, 1987, 564 pp. (\$77)

The field of high power microwave research has undergone tremendous growth in the last decade. Some examples of this growth include the commercialization of the gyrotron, the development of high power free electron lasers and the implementation of powerful new computer techniques for analyzing microwave devices. With these rapid developments occurring in the field, it is important to have reference works available to scientists, engineers and students entering the field. Professors Granatstein and Alexeff have done an excellent job of providing a major new book covering the field of "High-Power Microwave Sources." This book would represent a major advance even if the field already had an extensive literature. Since there is no such extensive literature at present, this book is particularly outstanding and significant.

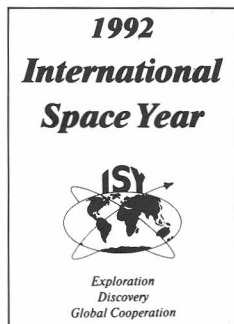
The book is an outgrowth of a course on the same subject held at the 1986 IEEE Plasma Science Conference. The chapters in the book cover a series of devices and theoretical topics and were written by the course lecturers. The lecturers are leaders in particular research areas and the material presented is very thorough and scholarly in approach.

The material covered includes an introduction and overview, discussing theoretical concepts of microwave devices (B. Levush, A. Drobot), technology (C.B. Wharton) and particle simulation (C.K. Birdsall). The remainder of the book covers specific microwave devices, dividing up into fast-wave devices and slow-wave devices. This division relates to whether the electromagnetic wave velocity is faster or slower than the speed of light in the device. Fast wave devices include the gyrotron (J.M. Baird and V.L. Granatstein), free-electron laser (J.A. Pasour) and orbitron (J.M. Burke, W.M. Manheimer, E. Ott and I. Alexeff). These chapters include excellent overviews of the device physics and summaries of the present day state of technology. There is some valuable new material about these devices that may interest even the experts in the field. The third part of the book covers slow-wave devices including crossed-field devices (Y.Y. Lau), the relativistic magnetron (J. Benford), Cerenkov sources (W. Case and J. Walsh) and a new device, the vircator (D.T. Sullivan, J.E. Walsh, E.A. Coutisas and L.E. Thode). Although these devices (except the vircator) have been operated for some time, there have been important advances in recent years. These advances include operation of the magnetron at high voltages (>500 kV) and powers, development of novel Cerenkov sources and the invention of the vircator (or virtual cathode oscillator). The recent work has led to many new insights into the operating characteristics of these devices.

"High-Power Microwave Sources" is an important book covering a rapidly developing field of microwave research. The book accomplishes what it intended to do, namely cover the field with both depth and breadth. Students and engineers new to the field should find this book extremely useful, while the more experienced should benefit from the review material and references. This book is a major contribution to our understanding of high-power microwave sources and is highly recommended to the reader.

### Reviewed by Richard J. Temkin

Dr. Temkin is a senior scientist in the M.I.T. Physics Department and is head of the Coherent Sources Division of the M.I.T. Plasma Fusion Center. His research interests include gyrotrons, free-electron lasers, the cyclotron autoresonance maser and the relativistic magnetron.



# Pucel Named First Raytheon Excellence in Technology Recipient

LEXINGTON, MASS.—Raytheon Company has honored Dr. Robert A. Pucel with an Excellence in Technology Award, the company's highest and most prestigious award for technical excellence.

Pucel, a staff member of Raytheon's Research Division in Lexington, Mass., received the award for pioneering the concept and technology of printing microwave circuits on tiny gallium arsenide chips. These advanced circuits have been demonstrated in uses ranging from military radar to cable television.

Pucel is an initial Excellence in Technology honoree. Raytheon began the awards program this year to recognize a select group of engineers and scientists for outstanding technical achievements.

Selection criteria include the significance of the innovation to Raytheon's continued success, to society at large and to the individual's own professional stature. Awards are to be presented once every two years.

Honorees receive a cash award of at least \$5,000, and Raytheon contributes an equal amount to the college or university of the honoree's choice.

Pucel joined Raytheon in 1951 as a microwave engineer and since 1974 has held the title of consulting scientist, the company's highest level scientific position. His academic credentials include bachelor's, master's and doctoral degrees in science from the Massachusetts Institute of Technology.

The Microwave Theory and Techniques society named Pucel as co-recipient of its Microwave Prize in 1976 and selected him as its national lecturer on microwave monolithic integrated circuits for the 1980-81 period. Since that time, he has delivered more than 80 lectures on the topic.

Pucel has authored or coauthored several books and dozens of technical papers and has been granted 21 patents in the field of solid state devices and circuits. He is a Fellow of the Institute of Electrical and Electronics Engineers and is a member of several of its Standards Committees. Pucel, his wife and family live in Needham, Mass. He is a native of Ely, Minn.



Raytheon President R. Gene Shelley (right) congratulates Dr. Robert A. Pucel, a consulting scientist at the company's Research Division, as a Raytheon Excellence in Technology Award recipient.

## VOTE!

by Gary A. Thiele

Vote!

This autumn you have the obligation to vote for officers of the IEEE, particularly the office of President-Elect. There are four candidates for President-Elect, two nominated by your Board of Directors, and two petition candidates. Three of these four persons have long records of positive service to the IEEE and are worthy of your serious consideration, in my opinion.

Vote!

This year for the first time we will be using 'approval voting' instead of simple plurality. That is, you may now vote for some or all of the candidates you approve of. This requires some strategic thinking on your part. For example, if you find all four candidates acceptable, but one is clearly your preference, then you would probably vote for that one only. On the other hand, if you found one candidate unacceptable, and three acceptable, you have a more complicated choice before you. Should you vote for the one you like the best, or should you vote for the three (or two) you find acceptable so as to make it less likely your unacceptable candidate makes a competitive showing?

Vote!

In my own case, I will probably vote for the three I approve of even though I have a 1-2-3 preference. Some of my colleagues on the Board feel they would vote only for the one candidate they like the best, arguing that a voter should place his weight behind the perceived best candidate. How will you vote?

Vote!

The IEEE Assembly is a body comprised of those members of the Board of Directors elected *directly* by the membership. Last November at a meeting of the Assembly, selection plurality voting was used, as it traditionally is, in electing persons for various offices such as secretary, treasurer, and the five vice-presidencies. In selection plurality, successive elimination of the weakest candidate on each ballot is used until one candidate has a majority. This should be contrasted with simple plurality wherein one ballot only is taken and the winner need only have the most votes. In addition to the selection plurality balloting at the Assembly meeting, and approval plurality ballot was also taken to see the correlation between the two systems, but the results were withheld from us by President Bachman until all the elections were concluded. In all cases but one, the same candidate emerged at the top under each balloting system including the two cases where there were four candidates. In the single case where the results were not the same, the winner under the selection plurality vote was, by a small margin, second in the approval plurality vote amongst three candidates. Had the Assembly used the simple plurality system, it is less likely that the correlation with either or the other two systems would have been as strong because the simple plurality system is not as likely to yield the candidate most acceptable to the most people when there are three or more candidates.

Vote!

I believe that with a strong voter turnout this autumn of informed IEEE members, an outcome truly representative of the will of the membership will result under the new approval voting system. I even believe the outcome will be the same as under the more familiar, and previously used, simple plurality system if the voter turnout is large. If the turnout is not large, the outcome is more difficult to predict; the potential for a poor result much greater. **Your vote is very important, especially this year.**

Vote!



**US CONFERENCE ON**

**GaAs**

**MANufacturing TECHNOlogy**

**1988 U.S. CONFERENCE ON  
GALLIUM ARSENIDE MAUFACTURING TECHNOLOGY**

The 1988 U.S. GaAs MANTECH will be held on November 9-11, 1988 in Nashville, TN in conjunction with the 1988 GaAs IC Symposium on November 6-9, 1988.

**CONFERENCE:**

The scope of the Conference embraces all manufacturing issues having to do with GaAs related (III-V compounds) and their applications in discrete devices, integrated circuits, integrated optoelectronics, etc. Based on last years attendance the MANTECH conference, in conjunction with the GaAs IC Symposium, is expected to attract over 1200 attendees.

**REGISTRATION INQUIRES:**

For information on conference registration and an advance program, please contact:

**Wayne D. Moyers**  
Registration Chairman  
Pacific Monolithics, Inc.  
245 Santa Ana Court  
Sunnyvale, CA 94086-4512  
(408) 732-8000

**EXHIBITS:**

Exhibits will be held November 9, 10, & 11. It is anticipated that, based on the success of exhibits at the 1987 Conference, upwards of 50 exhibitors will be present at the 1988 Conference which will be held at the Opryland Hotel. The Opryland Hotel has a large modern, dedicated exhibit hall with loading docks, truck access, and all utilities.

**EXHIBITOR INQUIRES**

For exhibitors who are interested in exhibit space, please send your inquires to or call:

**Anthony A. Immorlica**  
General Electric Corp.  
Electronics Park, EP3-155  
Syracuse, N.Y. 13221  
(315) 456-3514

**Diane Conti**  
VIP Meetings and Conventions  
17223 Palisades Circle  
Pacific Palisades, CA 90272  
(213) 459-4691

---

THE APPLIED COMPUTATIONAL ELECTROMAGNETICS SOCIETY

CALL FOR PAPERS  
FOR  
THE 5TH ANNUAL REVIEW OF PROGRESS  
IN  
APPLIED COMPUTATIONAL ELECTROMAGNETICS

March 21-23, 1989 in Monterey, California

- A unique forum for information exchange among practitioners of applied computational electromagnetics.
- Contributions by both users and developers of electromagnetic computer modeling codes are solicited.

SUGGESTED TOPICS INCLUDE:

Codes, Modifications, and Applications

- Moment Methods
- Finite Elements and Finite Differences
- Spectral Domain Techniques
- GTD and Asymptotic Techniques

Graphical Input/Output Issues

Code Validation

New Mathematical Algorithms

APPLICATIONS INCLUDE:

Antenna Analysis

Electromagnetic Compatibility and Interference

Scattering

Microwave Components

MMIC Technology

SEND ABSTRACTS TO:

Michael Thorburn  
Dept. of Electrical & Computer Engineering  
Oregon State University  
Corvallis, OR 97331-3202  
(503) 754-3617

Abstracts should be received by January 6, 1989

Camera Ready Summary/Manuscripts will be required later



---

**IEEE TRANSACTIONS ON MICROWAVE THEORY AND TECHNIQUES**  
**SPECIAL ISSUE ON**  
**FET STRUCTURES AND THEIR CIRCUIT APPLICATIONS**

Recent advances in GaAs compound semiconductor materials and improved processing technologies have resulted in several novel FET structures. Some of these structures are being extensively used in hybrid and monolithic integrated circuits at microwave and millimeter-wave frequencies. Others have been precluded from being used mainly due to lack of awareness and insufficient design information.

MTT-S Technical Committees MTT-6 on Microwave and Millimeter-wave Integrated Circuits is sponsoring a Special issue on "FET Structures and Their Circuit Applications" to be published in September 1989. The objective is to present different FET structures, their circuit modeling, state-of-the-art results, and future trends. Topics of particular interest include but are not limited to the following areas:

- Active three terminal devices, simulation, modeling and circuit application.
- Additional applications ( for example, mixers, oscillators, switches, multipliers, etc. ) of three terminal active devices such as MESFETs, MOSFETs, HEMTs, pseudo-morphic MODFETs, HBTs and PBTs.
- Device simulation and modeling.
- Computer-aided design of hybrid and monolithic integrated circuits at microwave and millimeter-wave frequencies.
- Novel device structures and innovative circuit concepts.
- Low noise and high power applications.
- Other related topics in state-of the-art solid state circuits.

Mr. Jitendra Goel of TRW, Electronics Systems Group will be guest editor of this special issue. Prospective authors are requested to submit five copies of the manuscript describing original work in the above areas by December 15, 1988 to:

Jitendra Goel  
Guest Editor, MTT Special Issue  
TRW Electronic Systems Group, M5/2459  
One Space Park,  
Redondo Beach, CA 90278  
U.S.A.

Tel: (213) 535-2605

---

---

**Call for Papers**  
**SPECIAL IEEE EDUCATION TRANSACTIONS ISSUE ON**  
**TEACHING ELECTROMAGNETICS**

**Scheduled for August 1989 Issue**

*Bob McIntosh and Fred Rosenbaum, Guest Coeditors*

The Education Society of the IEEE plans to publish a special Transactions issue that deals exclusively with the instruction of electromagnetic fields theory and related application areas of microwave engineering, antennas and propagation, electromagnetic compatibility and electro-optics. Papers will be considered for publication in this special issue only if they address educational activities in the above areas. Although papers that discuss conventional college/university classroom and laboratory curriculum will be included in this special issue, we especially encourage the submission of papers dealing with alternative approaches to electromagnetic instruction.

**Possible Topics Include (but are not limited to):**

- Historical Perspectives
- Use of Laboratory Demonstrations in Classroom Lectures
- The Teaching of Optics Concepts in Undergraduate EM courses
- Video Instruction such as NTU
- Elective Microwave Courses
- Laboratory Courses
- Cooperative Educational Programs with Industry
- Teaching EM at the Graduate Level
- Use of Computers in EM Instruction
- IEEE-sponsored Instructional Tools
- Approaches to EM Instruction Outside the U.S.
- Curriculum Issues (e.g., Requiring One Course or Two?)
- Reviews of EM Textbooks

**Manuscript Deadline: 1 December 1988**

Please submit manuscript to: Bob McIntosh, Guest Coeditor  
Department of Electrical & Computer Engineering  
University of Massachusetts  
Amherst, MA 01003  
(413)545-0709

The Microwave Theory and Techniques Society and the Antennas and Propagation Society are cooperating with the Education Society in this Special Issue.

## STEERING COMMITTEE

**Chairman**  
*Chuck Swift*  
C. W. Swift & Associates  
(818) 989-1133

**Vice-Chairman**  
*Don Parker*  
Hughes/RSG  
(213) 615-2576

**Secretary**  
*Irene Petroff*  
Rockwell International  
(714) 762-5794

**Technical Program**  
*Reynold Kagiwada* (Chairman)  
TRW/Systems  
(213) 535-5515

*Kenneth Yano* (Vice-Chairman)  
TRW/Systems  
(213) 297-4363

**Special Sessions**  
*Paul Greiling*  
Hughes - Research Lab  
(213) 317-5321

**Local Arrangements**  
*Pete Pusateri* (Chairman)  
Cain Technology  
(213) 326-5236

*Steve Swift* (Vice-Chairman)  
C. W. Swift & Associates  
(818) 989-1133

**Finance**  
*Eugene H. Gregory*  
Hughes RSG  
(213) 647-8897

**Publicity**  
*Mario A. Maury, Jr.*  
Maury Microwave Corp.  
(714) 987-4715

**Publications**  
*Kenneth Russell*  
JPL  
(818) 354-6080

**Transactions -  
Symposium Issue**  
*Frank Bayuk* (co-editor)  
*Jorg Raue* (co-editor)  
TRW/Systems  
(213) 535-7409

**Registration**  
*Harvey Endler*  
Systron Donner  
(818) 786-1760

**Guests Program**  
*Loretta Oltman*  
(818) 348-1697

**MMMC SYM. Liaison**  
*H. John Kuno*  
Hughes Aircraft  
(213) 617-6378

**ARFTG Conf. Liaison**  
*H. George Oltman, Jr.*  
Tecom Industries  
(818) 341-4010

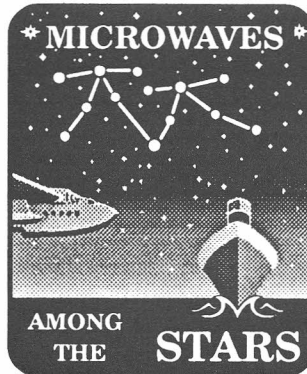
**Historical Exhibit**  
*Robert Eisenhart*  
Hughes/MSG  
(818) 702-1380

**Members-at-Large**  
*Alvin Clavin*  
(619) 755-2917

*John B. Horton*  
TRW/Systems  
(213) 535-4461

**Exhibition**  
*Howard Ellowitz* (Manager)  
Horizon House  
(617) 769-9750

FORM 89 IMS-7C (8/88)



# 1989 IEEE MTT-S International Microwave Symposium

June 13 - 15, 1989  
Long Beach, California

★ SYMPOSIUM HOTLINE 1-800-MICROWAVE ★

## ⇨ First Call for Papers ⇨

The 1989 IEEE-MTT-S International Microwave Symposium will be held in Long Beach, California, on June 13, 14, and 15, 1989. To allow the presentation of papers in the format best suited to each, the program will consist of three categories of papers: full length, short, and open forum. Full length papers report results of significant advances in microwave technology. Short papers are typically a refinement in the state of the art. The open forum provides an opportunity for authors to present theoretical and experimental material in poster format, display hardware, perform demonstrations, and answer questions in an informal atmosphere. The Technical Program Committee will try to abide by the preferences of authors but reserves the right to place the paper in the category it considers most appropriate.

Papers are solicited describing original work in the microwave field. A list of suggested topics is given below, but papers concerned with other aspects of microwave theory and techniques will be considered.

- Microwave Superconductivity
- Biological Effects and Medical Applications
- Computer Aided Design
- Solid State Devices and Circuits
- Microwave Systems
- Ferrite Devices
- Microwave Acoustics
- Microwave and Millimeter Wave Packaging
- Lightwave Technology
- Low Noise Techniques
- Microwave and Millimeter Wave Integrated Circuits
- Communication Systems
- Field and Network Theory
- Passive Components
- Phased and Active Array Techniques
- Submillimeter Wave Techniques and Devices
- High Power Devices and Systems
- Measurement Theory and Techniques
- Manufacturing Methods
- Opto-Electronics Technology

*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 open forum and specifying the topic area they wish to present their papers in. Submissions must be received by **December 12, 1988**. Late submissions will be returned unreviewed.

*Mail Submissions to:*

**Reynold Kagiwada**  
c/o LRW Associates  
1218 Balfour Drive  
Arnold, Maryland 21012

### NOTE

Authors are cautioned to obtain all required company and government clearances prior to submittal. A statement signed by the authors indicating this must accompany the final manuscripts.

Authors will be notified of the status of their submissions by February 3, 1989. Authors of accepted papers will receive copyright release forms and instructions for publication and presentation. Final manuscripts will be required in early March 1989.

## Directory Changes

J. Hausner  
 R & D Associates  
 2720 C Broadbent Parkway, N.E.  
 Albuquerque, NM 87107  
 (505) 345-8236  
**FAX: (505) 344-1661**

G. Jerinic  
 Raytheon Company  
 Equipment Division  
 430 Boston Post Road  
 Box E21  
 Wayland, MA 01778  
**(508) 440-6573**

J.E. Raue  
 TRW ESG  
 Mail Station R5/1291  
 One Space Park  
 Redondo Beach, CA 90278  
**(213) 535-016**

C.T. Rucker  
 Branch Head, Georgia Institute of  
 Technology  
 PSD/EML-GTRI  
 Atlanta, GA 30332  
 (404) 894-3420 (W), (404) 457-4651 (H)  
**FAX: (404) 894-3120**

T.S. Saad  
 Sage Laboratories, Inc.  
 11 Huron Drive  
 East Natick, MA 01760-1314  
**(508) 653-0844 (W), (617) 647-1243 (H)**  
**FAX: (508) 653-5671**

R.A. Sparks  
 Research Labs Raytheon Co.  
 50 Apple Hill Drive  
 Tewksbury, MA 01876-0901  
**(508) 858-1355 (W),**  
**(617) 274-2286 (W)**  
**(617) 275-1879 (H)**  
**FAX: (508) 858-1502**

S.J. Temple  
 Raytheon Company  
 Missile System Division  
 Mail Stop M1-16  
 Bedford, MA 01730  
**(617) 274-4736 (W), (508) 256-7652 (H)**

R.S. Tucker  
 AT&T Bell Laboratories  
 P.O. Box 400  
 Holmdel, NJ 07733  
**(201) 888-7214**  
**FAX: (201) 949-8372**



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

0176180 LF  
 THEODORE S SAAD  
 3 HURON DR  
 NATICK

17N \*\*\*  
 IEG15  
 MA 01760

Third Class