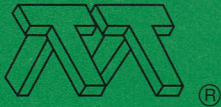


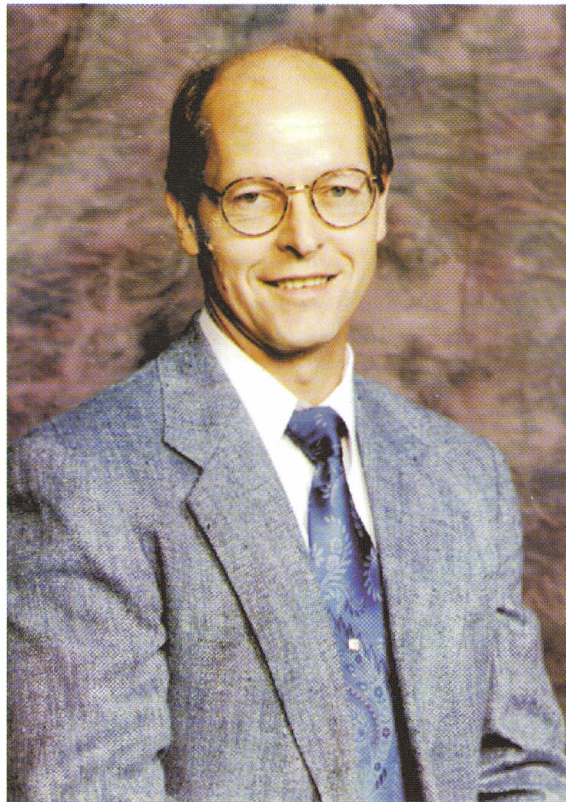
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# NEWSLETTER

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**for 1999-2000**

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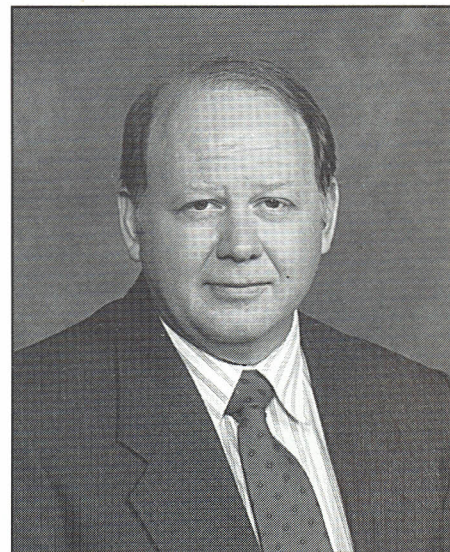
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## Editor's Message

The fall 1998 AdCom meeting was held September 13th and 14th in Seattle, Washington on the site of the 2002 International Microwave Symposium. The IMS 2002 chairman, Donn Harvey and the steering committee are planning a great symposium and Seattle is nice place to have it. This was my first visit to Seattle and I am looking forward to returning. Seattle is a coffee lover's dream, with the best cappuccino bars. The Pike street market is a pleasant walk from the Convention Center and has plenty of restaurants and shopping. My day trip to visit Mt. Rainier was an unforgettable experience and topped off wonderful weekend to Seattle.

Have Fun,

Aust'n



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Protocol: David F. Wait; University Relations: Dick Ehret; Publications Support: Charles M. Jackson, Don Huebner, Joseph Donovan; Publicity Support: George Rinard, Jeffrey Jargon; Signs: Christie Whitehead; MTT-S AdCom Liaison: Karl Varian; Industry Relations: Dick Loewecke, Robert O'Rourke; Historical Exhibit: Dave Russell

# President's Message



**Edward Rezek**  
**President**

I'm pleased to write to the MTT-S membership as the incoming Society president. I am honored to have this job and hope that I can contribute as much to the Society as my predecessors. The primary mission of the Society is to serve its membership. The Administrative Committee (AdCom) has been working vigorously in recent years to define and implement initiatives to execute the mission. 1999 will be an exciting year because some of these initiatives will begin to have an impact.

Perhaps the highlight of 1999 will be the completion of the CDROM Archival project, led by Charlie Jackson. Since 1997 our Society has been working on preparing a complete archive of all MTT-S publications since 1953. This is a completely searchable archive and will consist of nearly 20 CDROMs. The Archive will be sold for ~\$100 to Society members; the non-member cost will be substantially higher. It will not be made available at all to non-IEEE members. This CDROM archive is part of a larger MTT Digital Library project that also includes a Cumulative Abstract Index and an Annual CDROM. The Index is based on the Archive and will be updated yearly. The annual CDROM will be bundled with MTT membership and will include all of the society publications for the previous year including the IMS Digest for the previous

year. These will be offered to Society members only.

We have two developments coming in the area of publications that will better serve the needs of our members. A very exciting initiative that our Society has taken on is electronic publication. We are committed to the creation and operation of a refereed, all-electronic technical publication. This type of publication will enable rapid dissemination of topical information to our members. We will also soon be seeing some changes in the familiar MTT-S Newsletter. The Newsletter is being converted into a magazine that will include the content of the Newsletter but will also offer tutorials, articles on applications, and significantly higher technical content. The magazine will be distributed bi-monthly beginning in 2000 and will be included with Society membership. Our Society publications have always been first rate and we expect both of these publications to continue that trend.

Our Society is participating in a program of reciprocal electronic access to publications with EDS and other societies. An MTT-S member now has no-cost access to the EDS publications that are available on OPeRA. It is our intent to increase this reciprocal arrangement with other Societies whose publications are of interest to our members.

The Technical Committees, under the leadership of Frank Sullivan, have initiated a Speaker's Bureau. The intent is to make a wider variety of technical speakers available to local Chapters than is possible with the Microwave Distinguished Lecturer program. Right now we have commitments from roughly 20 speakers that are prepared to provide insight on topics from established technology to emerging and revolutionary technologies. Administration of the Speaker's Bureau will begin in 1999.

Our Education Committee is also involved in an initiative to sponsor and coordinate tutorials or short courses for the continuing education of our members. The committee is actively exploring opportunities for information generation, collection, and exchange in all relevant areas of microwave technology.

Beginning in 1998 our Society is offering a lifetime membership during the annual membership renewal drive. For the price of 5 years of membership dues a member can sign on for permanent membership. Permanent membership does require current IEEE membership.

For several years the Society has been focused on globalization. We have worked to expand our Society presence into Regions 8, 9, and 10. This effort is paying off. Our strongest growth in membership has occurred in Region 10 (Asia). Our strongest growth in chapters has occurred in Region 8 (Europe). Beginning in 1998 and continuing forward, our Society is a co-sponsor of the European Microwave Conference, the flagship technical microwave conference in Region 8. Our Society has long been a stakeholder in the largest microwave technical conferences in Region 10 (Asia Pacific Microwave Conference) and Region 9 (International Microwave and Optoelectronics Conference). Beyond this we have enjoyed a continued expansion of co-sponsorship of smaller topical conferences and workshops in Regions 8, 9, and 10. We are also continuing our financial support to Chapters in the Eastern Europe and Former Soviet Union areas of Region 8; the IEEE membership fee is reduced by 50%, Society membership dues are waived, and Society publications are made available at no cost.

In 1998 Roger Pollard initiated a Society internal review, lead by Barry Spielman. At our September AdCom meeting the initial recommendations were presented. The review committee recommended, among other items, expanding the size of the AdCom to bring more people into that governing body, a transition of the Newsletter into a magazine with a technical content consistent with continued education of our members, a Society electronic publication, and changes to the way that the AdCom approaches long range planning. The work of this review committee only scratched the surface of what we have to do. We will continue this activity into 1999 and hope to make some very positive changes to our Society in the very near future. As you can see from this communica-

tion, some of the ideas are already in implementation.


During 1998 Roger Pollard represented us at two critical IEEE TAB reviews: the 5 Year Society Review and the Publications Review. These are oversight reviews where the IEEE monitors the operation of the Society. We passed both reviews with flying colors and provided many measures that were perceived as "role model". In particular the review panel was impressed by the rapid time-to-publication metrics of both of our Society publications. Regarding the overall operation of the Society, the review panel saw great value in the internal Technical Committee review process that we perform; the panel was also quite pleased to hear about the various membership services initiatives which I have already highlighted.

For the past few years the Society has been working hard to take on a more active role

in the IEEE. Our Society has a single term president; this is a feature which opens the office to a larger number of members and we believe is one of our strengths. However as of this writing a seat on the management board of the IEEE is only available to Societies with two-term presidents. We have been working with the IEEE to change its policy to allow Societies with one-term presidents to have an equal opportunity for involvement. The IEEE appears ready to make this policy change in 1999.

As our Society enters 1999 it is enjoying its strongest financial position ever. Our net worth has shown a dramatic growth in the last few years due to a wise investment strategy by the IEEE and continued outstanding financial success of the International Microwave Symposium. The Society members who each year volunteer their time and talent to organize and

administer the world's most prestigious microwave event are to be congratulated. The Society net worth is now on the order of \$4M, putting your AdCom in position to focus on activities and services to help the members. This has given us the financial strength to bankroll new initiatives like the Digital Library project, the Speaker's Bureau, electronic publications, Former Soviet Union chapter support and others.

As your new president, I look forward to serving you in a way that meets your needs, increases your professional enthusiasm, aids your professional growth, and contributes to increased prosperity. 1999 will be an exciting year for our Society and the microwave engineering community. The technology that we have dedicated ourselves to continues to evolve and new applications are growing at a staggering rate. I hope you share my excitement. 

## MTT-2 Microwave Acoustics

by Robert Weigel,  
Chair MTT-2

**M**TT-2 is devoted to acoustic and surface wave components and their microwave and signal processing applications. Members of MTT-2 are Kimon Anemogiannis (SAWTEK, Orlando, Florida), Bruce McAvoy (Pittsburg, Pennsylvania), David Penunuri (Motorola, Scottsdale, Arizona), Don Malocha (University of Central Florida at Orlando), and Robert Weigel (University of Linz, Austria). Bruce McAvoy has chaired the MTT-2 subcommittee for many years. He retired from the chair in June 1998 but still serves as an active member allowing the committee to further have profit from his outstanding experience. As a new chair, Robert Weigel has been elected during the June 1998 meeting in Baltimore. Robert Weigel has been engaged with SAW technology since 1985 and has joined MTT-2 in 1993.

Surface acoustic wave (SAW) and bulk acoustic wave (BAW) devices are now finding application in many diverse electronic products. Many telecommunication systems – in particular satellite and mobile

radio systems – are dependent on extremely high performance SAW/BAW filters. Large, and to an increasing extend smaller radar systems utilize pulse compression SAW filters. One finds routinely SAW/BAW oscillators penetrating high frequency electronic systems. Every modern video receiving equipment contains several SAW IF filters. Fixed-code, chirped and even programmable matched filters have opened up a wide range of signal processing capabilities, e.g. in spread spectrum mobile radio and wireless LAN's. Acoustic sensors for many physical, chemical and biological quantities are now becoming mature and feasible. Wireless identification tagging and reading based on passive SAW tags has recently been introduced to the market. Radio SAW sensing is under investigation at many laboratories.

The 1997-98 activities of MTT-2 include the organization of a Focused Session at the 1997 IEEE International Microwave Symposium in Denver, Colorado entitled Acoustic Wave Devices for Portable Telecommunication. This session was devoted in particular to state-of-the-art

acoustic devices intended for ultracompact telecommunications. More than 300 participants showed great interest to the latest information on mobile radio acoustics given by Motorola, Hitachi, SAWTEK, Rockwell, and Siemens. MTT-2 also organized and sponsored both IEEE International Workshops on Commercial Radio Sensors and Communication Techniques held respectively in Sindelfingen, Germany in April 1997, and in Munich, Germany in September 1998. Both workshops included several high-caliber SAW papers attracting some 60 attendees.

The speaker of MTT-2 within the newly established MTT-S Speakers Bureau program is Don Malocha. His topic is "Surface Acoustic Wave Technology Applications"; the abstract is: "Surface acoustic wave (SAW) technology provides key devices for the diverse wireless market. Applications include both low loss RF filters, high performance IF filters, and resonators for both low-cost and high performance oscillators. New, emerging applications which can use SAW technology include identificationx

tags, wireless LAN's, sensors and spread spectrum communications. Current SAW devices and their applications, SAW technology challenges, and research opportunities are presented." Our speaker has already been invited by the IEEE German MTT/AP chapter and the Austrian Electronic Technology Society (ÖVE) to give presentations covering specific parts of his topic. During his June 1998 Guest

Professorship stay at the University of Linz, Austria he gave four talks in Linz and Vienna, Austria, and in Ilmenau and Munich, Germany.

**Linz, 13 October, 1998**  
**Professor Dr. Robert Weigel**

**MTT-2 Chair**

**Email:**

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## MTT-18 - Microwave

### Superconductivity: "Cold is Better"

**M. Nisenoff, MTT-18**  
**Co-Chair**  
**Naval Research Laboratory**

**Guo-Chun Liang,**  
**MTT-18 Co-Chair**  
**Conductus, Inc.**

The Technical Coordinating Committee MTT-18 Microwave Superconductivity was established in 1988 shortly after the discovery of superconductivity in materials with superconducting transition temperatures above 77 K, the boiling point of liquid nitrogen at atmospheric pressure. Prior to this discovery, it had been known for more than thirty years that the microwave surface resistance of then-known superconductors (the highest known superconducting transition temperature, at that time, was only 23 K) could be orders of magnitude lower than copper at the same temperature. This property had been used since the mid-1960's to fabricate very high Q-value cavities for accelerating atomic particles in high-energy particle accelerators in many high energy physics laboratories around the world. However, the requirement of cooling such devices to temperatures near 4 K precluded their use in other than very large installations. The advent of superconductivity above 77 K, with drastically reduced cryogenic refrigeration burden, opened the possibility of deploying very high Q-value, very low electrical loss RF, microwave and millimeter wave components on platforms such as cars, ships, airplanes and satellites.

In 1988, MTT-S established a TCC to address this new technology with Dr. Erwin Belohoubek, then at the David Sarnoff Re-

search Center, as the Chairman. In 1991, Dr. M. Nisenoff of the Naval Research Laboratory assumed the position of Chairman and in 1996, Dr. Guo-Chun Liang, of Conductus, Inc., Sunnyvale, CA. was elected as Co-Chairman of MTT-18. At the present time, there are 16 members on MTT-18 from the US, Japan, Germany and the United Kingdom representing research organizations in industry, government and academia.

During the intervening years, MTT-18 has been active at the IMS sponsoring one or, sometimes, two workshops each year and an occasional rump session. The workshops have covered a wide range of topics in microwave superconductivity from basic phenomena, CAD, high power device characterization, wireless communications applications and cryogenic measurements and packaging. For example, at the 1998 IMS held in Baltimore, MTT-18 co-sponsored workshops on "Cryogenics: A New Beginning" and on "Comparative Filter Technology for Communications Systems".

The Co-Chair of MTT-18, Dr. M. Nisenoff of the Naval Research Laboratory has been selected to be a Co-Director, along with Prof. Harold Weinstock of the US Air Force Office of Scientific Research, of a North Atlantic Treaty Organization (NATO) Advanced Summer Institute (ASI) on the topic of "Microwave Superconductivity". The Institute will be held in the Pyrenees Mountains in northern Spain from 29 August through 10 September 1999. Information about this ASI can be found on the World Wide Web at:

<http://www.geocities.com/Pentagon/Quarters/9088>.



## Chapter News

**Shyam Bajpai, Chapter News**  
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The Chapter News is a new service for the MTT-S members starting from this year. The mission of this service is to bring the chapters closer to the ADCOM/ MTT-S members. It became even more important because of the growth of the chapters specifically foreign chapters. As a start, we are reporting profiles/highlights of the chapters. The Chapter Chairs are requested to submit one page profile/highlights of their Chapter. I will also personally invite the chairs. The chapter profile may include: when it was started, number of members, typical number of meetings per year, typical attendance at each meetings, technical areas covered in last 5 years, do meetings have corporate sponsors?, how are the meetings conducted?, pictures, workshops, anniversary celebration, any interesting event, etc. I would like to thank Dr. Wolfgang Menzel (wolfgang.menzel@ieee.org), Chair of German Chapter and Dr. Roger Kaul (r.kaul@ieee.org), Chair of Washington D.C./ Northern Virginia chapter to respond to my request to provide us the following interesting material.

### German MTT/AP Chapter

The German joint IEEE MTT/AP Chapter was founded in 1985 as the first German IEEE chapter at all, starting as a MTT Chapter, but shortly after that it was extended as a joint MTT/AP Chapter. Its first chairman was Prof. Dr. Rolf Jansen. The chapter now has about 450 members, spread all over Germany. This, on the other hand, renders it difficult to meet very often, so meeting activities concentrate on a limited number of highly qualified and well attended workshops.



The photo shows 16 of the 40 W/NV Chapter Chairs. Seated, left to right, Ben Bernstein 60-61, Jim Shiue 78-79, Ed Wolff 58-59, Mrs. Wolff, Mrs. Garver, Bob Garver 65-66, Mrs. Cordero; and standing Roger Kaul 79-80, Shyam Bajpai 96-97, Ramesh Gupta 88-89, Greg Tait 91-92, Gus Bontzos 89-90, Art Sindoris 75-76, Saurabh Dalal 95-96, John Upshur 94-95, Zygmund Turski 83-84, Eric Funk 97-98, Pradeep Wahi 85-86, Jaime Cordero 87-88, and Leo Young, a long-time contributor to the chapter.

Some of these, like the International Workshop on Integrated Nonlinear Microwave and Millimeter Wave Circuits organized by University of Duisburg, are repeated regularly and have gained an international reputation. Most workshops include contributions from renowned international speakers. Participation at these workshop always is rather high, between 40 and 150. The topics of the workshops and their quality not only attract IEEE members, but also quite a number of non-members and thus helps to recruit new members for IEEE. In addition, the German MTT/AP Chapter is one of the scientific organizations (together with VDE/ITG) contributing to the national German microwave conference MIOP, taking place in a two years cycle.

**In 1997, the following workshops have been organized by the chapter:**

Commercial Radio Sensors and Communication Techniques, (in cooperation with the newly formed German UFFC-Chapter), Sindelfingen, 21.4.97;

Mobile Communications in the Millimeter-Wave Region, Dresden, 11-12.5.97;

Experimentally Based FET Device Modeling and Related Non-linear Circuit Design, Kassel, 17-18.7.97;

Int. Topical Meeting on Microwave Photonics, Duisburg, 3-5.9.97;

5th Int. Workshop on Terahertz Electronics, 18-19.9.97, IRAM, Grenoble, France (combined German and French MTT-Chapters)

2nd Int. Workshop on Transmission Line Matrix (TLM) Modeling: Theory and Applications, 29-31.10.97, Munich.

**In 1998, the following workshop are scheduled:**

Commercial Radio Sensor and Communication Techniques, Sept. 18, 1998, Munich

Scientific Computing in Electrical Engineering, Sept. 30 - Oct. 2, Berlin (together with the Weinstrass Institute for Applied Analysis and Stochastics, Berlin)

5th International Workshop on Integrated Non-linear Microwave and Millimeter Wave Circuits, Oct. 1-2, Duisburg

MMIC Design, Packaging, and System Applications, Oct. 22-23, Freiburg

Since last year, member information has been improved significantly by a Chapter Newsletter appearing twice a year (Con-

tact: [ulrich.kraft@dss.dornier.dasa.de](mailto:ulrich.kraft@dss.dornier.dasa.de)). In addition to general information for the members, each issue includes a feature article and an organizational profile. Furthermore, a web page has been established, providing actual information and links to the members


<http://mwt.e-technik.uni-ulm.de/world/IEEE> .

## Washington D.C./Northern Virginia Chapter Celebrates 40th Anniversary

As part of the 1998 International Microwave Symposium (IMS), the Washington DC/Northern Virginia (W/NV) Chapter of MTT-S celebrated its 40th anniversary. Actually the anniversary was a year late, but after 40 years, who's counting. The chapter was formed in 1957 with Gus Shapiro as the first Chair. Four years later the Chapter hosted the first Washington DC IMS with 27 papers. At the 1961 symposium the first digest of papers was published. The Chapter also hosted the IMS in 1971 and 1980, with 80 and 157 papers, respectively. In 1971 the first student paper competition at an IMS was held, and in 1980 the first historical exhibit at an IMS was included. In 1986 and 1998 the Chapter co-hosted the IMS in Baltimore.

In the accompanying photo taken at the 1998 IMS, sixteen Chairs are shown.

Warren Cooper, Barry Spielman, and Larry Whicker attended the symposium, but were not in the room at the time of the photo. Seventeen other former Chairs were unable to attend the symposium, while four are deceased.

The W/NV Chapter is proud of its continuing contributions to the technical and professional activities of MTT-S. The Chapter looks forward to working with the Baltimore Chapter to host another IMS in the first decade of the 21st century. 

## Report On ISSSE '98

As the wireless technology becomes increasingly more pervasive to our

lives, International Symposium on Signals, Systems and Electronics (ISSSE)

becomes one of the most important meetings for URSI that is emphasizing the

telecommunication. ISSSE series has been organized by Commissions C (Signals and Systems) and D (Electronics and Photonics). The first meeting was held in Erlangen, Germany in 1989, which was followed by Paris in 1992 and San Francisco in 1995. At Lille General Assembly, Commissions C and D formed the ISSSE Steering Committee to maintain continuity and to enhance visibility for the future ISSSE series as well as to assist organizers. One of the recommendations by this Steering Committee is that the meeting be held in close proximity (in time and space) of a major meeting of interest to either Commission. Another recommendation is to select a well-meaning theme to the meeting, rather than collection of papers.

ISSSE '98 was held on 29 September – 2 October, 1998 at Palazzo dei Congressi in Pisa, Italy. The dates fall in the week prior to the European Microwave Conference in Amsterdam to satisfy the recommendation of the Steering Committee as described above. The conference theme was **"Co-design of Radiocommunication Terminals: From Waves to Silicon through DSP."** General Chairman was Professor Marco Luise of University of Pisa who was assisted by Giorgio Vittetta for local arrangement and by Fillipo Giannetti for publication, both from University of Pisa. Technical Program Committee consists of three co-chairs, T. Itoh (UCLA), U. Mengali (University of Pisa) and C. Trullemans (Catholic University of Louvain, Belgium). The TPC Co-chairs were assisted by 6 Vice Co-chairs and 18 committee members from various parts of the world. The meeting was technically co-sponsored by IEEE Communications Society, Microwave Theory and Techniques Society and Electron Devices Society.

The conference theme **"Co-design of Radiocommunication Terminals: From Waves to Silicon through DSP"** is particularly timely. According to Professor Louise, "It is likely that by the year 2010 the number of wireless communication links for information transmission will exceed the number of *wired* ones. Each and every wireless communication application, be it high-speed point-to-point or switched cellular, terrestrial or satellite-based, UHF or

mm-wave, has benefited in terms of spectral and power efficiency by advances in VLSI, microwave and DSP components and techniques. The ultimate goal of the radiocommunication engineer is currently to exploit the *sinergy* of those advances through clever *co-design* of different, previously separately-designed subsystems. The Symposium will develop through parallel sessions in three main areas of *DSP-based Communication Equipment and Systems*, *VLSI design and Components*, and *Microwave Theory and Techniques*." All TPC shared his view in forming the technical program.

Following the reception in the evening of 29 September, the conference started on the morning of 30 September by a brief opening ceremony. Each morning of the following three days was started with an Invited Plenary Talk. These talks were:

"Microwave Power Amplifiers Fabricated from Wide Bandgap Semiconductor Transistors," by R. J. Trew, U. S. Department of Defense, on September 30,

"3G Wireless Communication System: The Design Challenge," by H. Meyr, RWTH Aachen, Germany, on October 1,

"Single-chip CMOS Wireless Transceivers: Current Status and Future Prospect," by A. Abidi, UCLA, USA, on October 2.

After the Plenary Talk, there were three parallel sessions, a total of 21, typically one for Microwaves, one for Telecommunications and one for VLSI.

#### **Microwave Sessions:**

WM1: Advances in Devices

WM2: New Materials and Architecture for Microwave and RF Circuits

TM 1: Progress of Numerical Characterization

TM 2: Millimeter Waves

TM 3: MW/Optical Interactions

FM 2: Nonlinear Circuit Design and Modeling

#### **Telecommunication Sessions:**

WT1: Broadband Wireless Access

WT2: Transmission Systems

WT3: Multiple Access

WT4: DSP for Telecommunications

TT 1: Signal Detection and Synchronization

TT 2: Wireless Transceivers

TT 3: Modulation, Coding and Compression

FT 1: Third-Generation Wireless Systems

FT 2: Wireless Channel Equalization

#### **VLSI Sessions:**

WV1: Wireless Transceivers

WV2: VLSI Technologies for RF Circuits

WV3: Broadband Techniques

TV 1: Data Communication/Processing Circuits

TV 2: Hardware/Software Co-Design of Telecommunication Systems

FV 1: Modeling and Design Techniques

The TPC received 57 submitted papers (including 37 in telecommunications) from 23 countries of which 41 papers were accepted. In addition, there are 53 invited papers. Therefore, 94 papers were given in 21 sessions. Essentially, no incidence of no-show was encountered. The number of participants was about 125 that includes 20 students and 8 Young Scientists who received full service at the registration fee identical to that for students.

The conference was very well organized and carried out in an relaxed and congenial atmosphere. There were ample occasions of technical exchange at coffee breaks and on-site luncheons for all participants. An excellent banquet was organized at a local restaurant with excellent Italian cuisine. On the afternoon of the third day, there was an optional excursion to a nearby town of Lucca.

During the conference, a meeting of the ISSSE Steering Committee was held including several guests and organizers and TPC members. The next venue was discussed. Recommended candidates are Japan and United States in that order. The final decision will take place in the near future.

T. Itoh,  
Chair ISSSE Steering Committee



# Microwave Theory of a Crumhorn



By Charlie Jackson

Applying microwave design techniques to renaissance woodwind musical instruments has been a lifelong passion for me. Ever since I first played a recorder, when I was 8 years old, I have been fascinated with transmission line theory. Years later I dog-eared my copy of "Horns, Strings, and Harmony" by Arthur Benade (now available from Dover). My

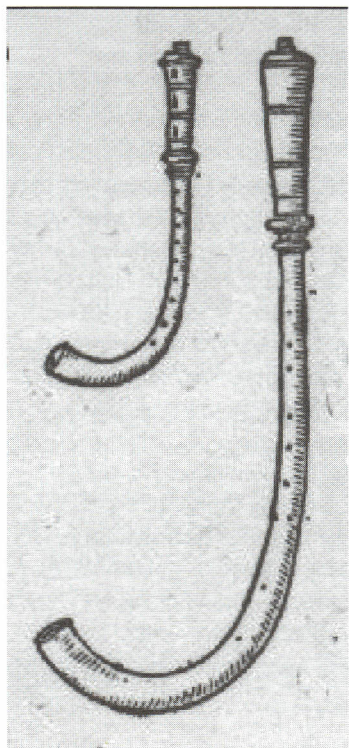


Figure 1: A pair of crumhorns from a renaissance woodcut.

first calculator was bought so that I could design a simple flute, rather than ace my homework. I started reading Ramo, Whinnery, and Van Duzer's book on electromagnetic theory because of the transmission line theory it contained, rather than its insights into Maxwell's equations.

It has a small diameter bore, with small diameter tone holes, and a reed that allows the pitch to be changed a bit more than some would like; all this makes it ideal to model with a simple transmission line theory. Basically, it sounds like a kazoo. To learn more about the Crumhorn, go to the Crumhorn Home Page at:

<http://www.iinet.net.au/%7Enick/crumhorn.htm>

This note describes how microwave design theory can be used to design a musical instrument that flourished in the renaissance called a Crumhorn, Figure 1. The Crumhorn is a capped double reed instrument that is more related to the bagpipe than the oboe.

Microwave design techniques include a bag of tricks and tools. The two most important tools for the design of a Crumhorn are transmission line theory, and a philosophy of modeling. The Microwave design community has employed a brute-force approach to design circuits, that the Acoustics community has not embraced. Microwave designers break a circuit up into little parts and cascade the circuit into one big circuit that models the complexity needed for an accurate model. Programs such as LIBRA are used pervasively throughout the microwave industry. A program called DELTAE is the only acoustical program that follows the same philosophy (see <http://rott.esa.lanl.gov>). There are no programs such as SONNET, or HFSS which solve the feild equations for arbitrary geometries. This is not surprising; I will be the first to point out that the market for designing renaissance musical instruments will not support the development of such tools.

Acoustical models of woodwinds using the method that I will present here were first described 20 years ago. Acoustical models used custom coded programs at about the time when a SPICE and COMPACT were in general use with elec-

trical engineers. The Acoustical community is now more concerned with economically viable programs using time domain models that approximate woodwinds, and capture the transients that make up the essence of a woodwinds sound.

To design a Crumhorn we need to have equations that model the:

- Condition for Resonance
- Impedance of the Tube
- Transmission Line
- Open Circuit Condition (Closed Hole)
- Short Circuit Condition (Open Hole)
- Parallel Impedances

We will ignore effects due to the:

- Losses in Propagation
- Open Hole Lattice
- Radiation Impedance
- Reed Input System

## Condition for Resonance

The condition for resonance is that the input impedance  $Z$  of the tube be maximum, or that the admittance  $Y=1/Z$  be a minimum (zero). To model the circuit (Crumhorn) all we need to do is find the peaks in the impedance as a function of frequency. To model a flute, the admittance should be maximum.

## Impedance of The tube

The impedance of the tube is given by

$$Z_o = \frac{\rho_o c}{S}$$

where  $\rho_o$  is the density of the gas,  $c$  is the speed of sound, and  $S$  is the cross sectional area. This equation is used the same way that the impedance of a microstrip line is used. For contrast, we can express the equation for the impedance of a wide microstrip line as:

$$Z_o = \frac{\mu_o c W}{d \sqrt{\epsilon_r}}$$

where  $\mu_o$  is the permeability of free space,  $c$  is the speed of light,  $W$  is the width of the

line,  $d$  is the substrate thickness, and  $\epsilon_r$  is the effective dielectric constant.

Very small diameter tubes exhibit effects due to the viscosity of the gas, so for frequencies of musical interest, a 1 mm hole is the smallest that we can use, without significant modifications to the equation for the impedance.

## Transmission Line

A key equation relates the input impedance  $Z_t$  and the impedance of a tube  $Z_o$ , the length of the tube  $l$ , the speed of light and the frequency  $k=\omega/c$ , and the terminating impedance  $Z_l$  by

$$Z_t = Z_o \frac{Z_l j Z_o \tan(kl)}{Z_o j Z_l \tan(kl)} \quad \text{equation 1}$$

Another key element of our model is that when the termination impedance is pure imaginary, then the total impedance is pure imaginary, and only one term of a complex pair needs to be tracked. To recap:  $Z_t$  is pure imaginary if  $Z_l$  is pure imaginary.

## Losses in Propagation

The transmission line equation shown above has already implicitly assumed that the losses are negligible.

## Open Circuit Condition (Closed Hole)

Figure 2 shows the cross section of a crumhorn. An open hole and a closed hole is shown. The open hole short circuits the pressure (hence it is short circuit), and a closed hole corresponds to an open circuit. When the terminating impedance is infi-

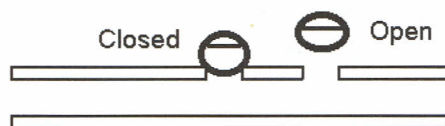


Figure 2: Cross section of a woodwind showing a closed and open hole.

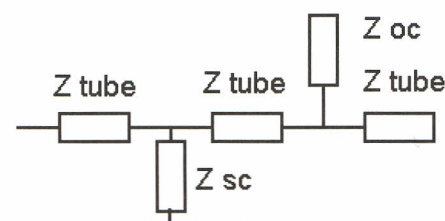


Figure 3: Circuit of the cross section of Figure 2.

nite, then the transmission line equation (1) reduces to

$$Z_t = -jZ_o \cot(kl)$$

## Short Circuit Condition (Open Hole)

When the terminating impedance is zero, then the transmission line equation (1) reduces to

$$Z_t = jZ_o \cot(kl)$$

## Parallel Impedances

The hole impedance is in parallel with the transmission line impedance. Both impedances are imaginary (no real part), so they are added with the standard equation

$$\frac{1}{Z_{tot}} = \frac{1}{Z_{hole}} + \frac{1}{Z_{tube}}$$

By starting at the far end of the crumhorn, where the open hole impedance is zero, and using the transmission line equation, the short circuit and open circuit equations and the parallel addition equations, it is possible to calculate the impedance of the instrument. Each fingering needs to be analyzed, and summarized.

## Reed Input System

How will we model the reed? Actually, we won't. It turns out that differences in reeds can be accounted for, to first order, by pushing the reed in, or pulling it out until the effective length of the reed equals the design length.

## Open Hole Lattice

It turns out that there are some holes at the end of a crumhorn that serve two purposes. First, they allow the lowest pitch to be tuned, and second, they provide a low pass filter that suppresses higher order modes. This low pass filter is called an open hole lattice by A. Benade.

## Radiation Impedance

The radiation impedance is ignored for the small diameter holes of the crumhorn. For a flute, the effects are large, and cannot be ig-

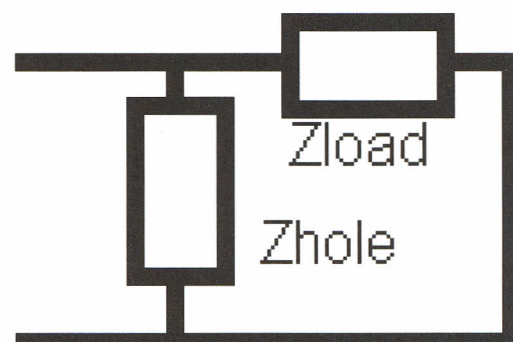


Figure 4: Parallel impedances

nored. This makes the crumhorn a great starting point for woodwind modeling.

## Brief Description of the Program

The program to model a crumhorn consists of many excel sheets in a workbook. First, there is a version page, with some cryptic comments to help the imagined user. Second is a shareware page to prevent rampant plagiarism. Next there are a lot of pages that calculate the impedance and resonance frequency of each fingering. Each note page has a plot of the impedance as a function of frequency (Fig. 5), and the peak frequency is calculated and passed to the summary sheet. Finally, there is a top level summary page containing a table of dimensions and physical constants, a table to enter pitches, a fingering chart, a calculation of each hole combinations resonant frequency (Fig. 6), along with the total deviation (Fig. 7), and a plot of the design and calculated frequencies. A fingering chart is used to check the individual pages of the excel program.

To reduce the size of the program so it is about the size of a floppy disk, the number of frequency points per note page is minimal. More points per note page will allow a more accurate determination of the resonance frequency.

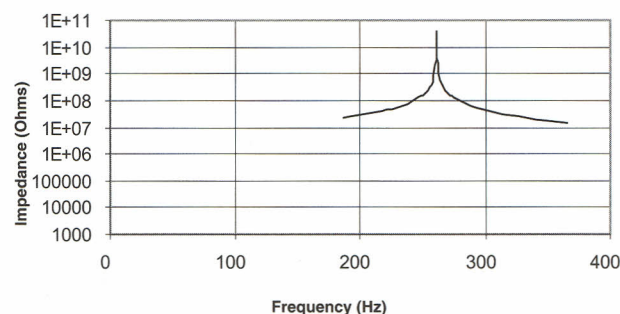


Figure 5: Plot of Impedance vs Frequency for "g" fingering.

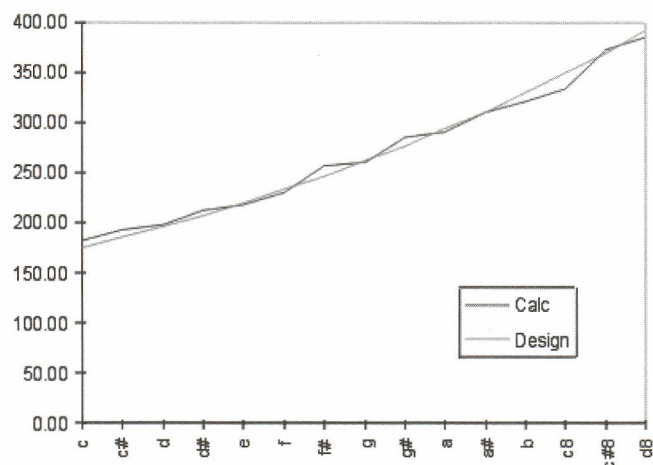


Figure 6: Plot of design and calculated frequency for each fingering.

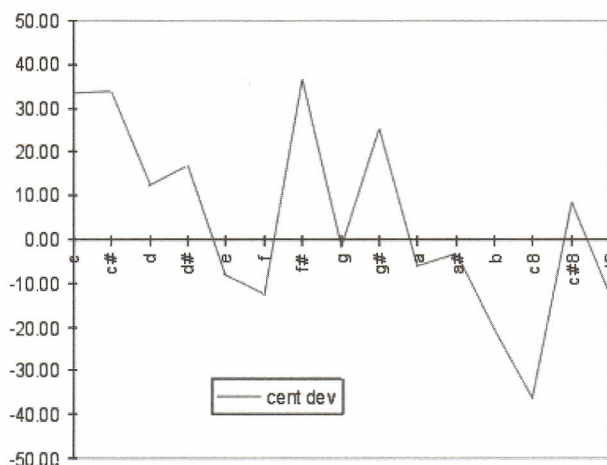


Figure 7: Plot of deviation from design for each fingering in cents.

Dimensions of the hole diameters, the wall thickness, the lengths of tubes, and the tube diameter can be changed to fine tune the instrument. Lucite tubing is commonly available in a number of different sizes, so now it is possible to design a crumhorn using these materials.


The dimensions of an alto crumhorn are from a book by Trevor Robinson called "The Amateur Wind Instrument Maker"

published by the University of Massachusetts Press. The name of the finger holes follows his convention.

The program is posted in a zip file on my web page <http://members.aol.com/cornetto45/>

### Conclusion

Microwave design techniques can be applied to the design of renaissance woodwind

instruments. The program described here shows that the dimension of a crumhorn provided in Trevor Robinson's book are pretty good, and certainly provide an excellent starting point for the fabrication of a crumhorn. The next step is to extend the program so that it can model other renaissance instruments including a cornetto, a lizzard, a serpent, and a shawm. 

## 1999 MTT-S Awards

by Peter Staecker  
Awards Committee Chair

At the September 1998 Administrative Committee meeting in Seattle, Washington, the following awards were unanimously approved and will be presented at the Awards Banquet of the 1999 International Microwave Symposium in Anaheim, California, the week of 12-19 June 1999:

### Microwave Career Award

William C. Brown, "For a Career of Leadership, Meritorious Achievements, Creativity and Outstanding Contributions in the Field of Microwave Theory and Techniques"

### Microwave<sup>1</sup> Pioneer Award

Robert L. Eisenhart and Peter J. Khan, "For applying a general formulation of

driving-point impedance to a device-mounting structure in rectangular waveguide and developing a validating measurement technique."

### Distinguished Educator Award

Peter Herczfeld, "For Outstanding Achievements as an Educator, Mentor and Role Model of Microwave Engineers and Engineering Students"

### Microwave Application Award

Christen Rauscher, "For Proposing and Demonstrating Innovative Approaches to the Design of Microwave Filters and Frequency Channelizers."

### Microwave Prize

Christopher M. Snowden – for his paper, "Large-Signal Microwave Characteriza-

tion of AlGaAs/GaAs HBT's Based on a Physics-Based Electrothermal Model," *IEEE Transactions on Microwave Theory and Techniques*, **MTT-45**, pp. 58-71 (1997)."

### Distinguished Service Award

H. Warren Cooper — "For His Outstanding and Dedicated Service to the Society"

### N. Walter Cox Award

Daniel Massé — "For Exemplary Service, Given in a Spirit of Selfless Dedication and Cooperation"

### 1999 IEEE Fellows Awards

(will not be known until December) 


<sup>1</sup>The modifier "Microwave" was unanimously approved by AdCOM during the September meeting, to distinguish the MTT-S award from those of other Societies, and to appropriately define the scope of this award.

# Report of ICMMT'98

**I**nternational Conference on Microwave and Millimeter Wave Technology (ICMMT'98) was held on August 18-20, 1998 at Media Center in Beijing China. This meeting was sponsored by Chinese Institute of Electronics and was technically co-sponsored by IEEE ED-S, AP-S and MTT-S (with E. Yamashita and T. Itoh as MTT Liaison and Co-chairs for the Conference Organizing Committee). Out of more than 400 submissions, 264 papers were presented of which 143 were authored by Chinese researchers and engineers. Papers came from 22 countries

with the largest number (31) from Japan and 15 from US. The papers were presented in 26 sessions. After the opening speech by Professor Zong Sha of Chinese Institute of Electronics, the first day had two plenary sessions, one in the morning for 6 invited papers and another in the afternoon for 8 invited papers. In the second and third days, there were 6 parallel sessions. Total attendance was 250 from China and 100 from abroad.

This conference originated from two meetings, one for microwaves and an-

other for submillimeter and infrared. They are now combined under the new series of ICMMT. Chinese organizers and technical program committee are very eager to enhance the quality of the conference. On the second day, there was an advisory meeting in which several issues and possible solutions toward such a goal were discussed, including the paper cancellation (no show) and the quality of presentations (format of transparencies). It is planned to have the next conference in two years. 

## 2000 MTT-S Awards: Call for Nominations

**By Peter Staecker**  
**Awards Committee Chair**

**N**omination forms are now available for the 2000 IEEE MTT-S Awards. We all know of deserving individuals who are recognized by their peers as being worthy candidates for the prestigious MTT-S Awards. Please take the time to nominate your deserving colleagues for a suitable MTT-S award or for the Fellow award so that others may be aware of their accomplishments. We will make sure that all nominations will be evaluated in a fair and professional manner. You may also note that the monetary level of the technical awards has been increased, as unanimously approved by AdCOM in their September meeting, and subject to TABARC approval in November 1998. These levels are consistent with interim increases for all IEEE awards approved by the IEEE Board of Directors.

**Fellow Award Nominations are due 15 March 1999!**

Fellow award kits may be obtained by contacting the IEEE Awards offices:

Ms. Sandy Schumacher  
Phone: (732) 562-3843  
Fax: (732) 981-9019  
e-mail: fellow-kit@ieee.org

**MTT-S Awards Nominations are due 1 July 1999!**

Nomination forms may be obtained by contacting:

Dr. Peter W. Staecker  
167 Cedar St.  
Lexington, MA 02421  
Phone: (781) 861-7643  
e-mail: p.staecker@ieee.org

or by immediate electronic download from <http://www.mtt.org/Awards/>. The MTT-S Awards are listed below with a description of the requirements for each award and the previous recipients by year:

### Microwave Career Award

*Prize: Certificate, a plaque and an honorarium of \$5,000*

This award is made to an individual (IEEE Member) for an outstanding career of achievement in the microwave field, and is the Society's most prestigious award.

The basis for judging consists of publications in technical journals, presentation of lectures, contributions to the advancement of microwave technology, and other technical contributions considered in conjunc-

tion with any or all of these areas of contribution.

### Award Recipient:

1973 William Walden Mumford  
1974 Harold Alden Wheeler  
1974 Henry J. Riblet  
1976 John R. Whinnery  
1977 Ernst Weber  
1978 A. Gardener Fox  
1979 Seymour B. Cohn and  
Werner J. Kleen  
1980 Kiyo Tomiyasu  
1982<sup>1</sup> Akio Matsumoto and  
Arthur A. Oliner  
1983 Marion Ernest Hines  
1984 John Robinson Pierce  
1985 Harold M. Barlow and  
Nathan Marcuvitz  
1985 George L. Matthaei  
1987 Robert W. Beatty  
1988 Leo Young  
1989 Harry F. Cooke and  
Alexander L. Cullen  
1990 Robert A. Pucel  
1991 Sogo Okamura  
1992 Theodore S. Saad  
1993 Herbert Döring and  
Leonard Lewin  
1994 Yoshihiro Konishi

<sup>1</sup> Prior to 1982, the Career Application Awards were dated by their year of election. Starting 1982, these Awards are dated by year of presentation

1995 William J. Getsinger  
1996 John H. Bryant  
1997 Ralph Levy  
1998 Harold M. Sobol  
1999 William C. Brown

## Microwave Pioneer Award

*Prize: Plaque and an honorarium of \$2,500.*

This award recognizes a major, lasting contribution in the field of interest of MTT-S at least 20 years prior to the year of the award, by an individual or team of up to three (3).

The basis for judging consists of published contributions in an archival journal. Preference may be given to IEEE members.

### *Award Recipients*

1990 Hatsuaki Fukui  
1991 Robert H. Dicke  
1992 Robert M. Barrett  
1993 Claud E. Cleeton and  
C. Lester Hogan  
1994 Michiyuki Uenohara  
1995 William C. Brown  
1996 Kaneyuki Kurokawa  
1997 Ali E. Atia and Albert E. Williams  
1998 G. Ross Kilgore  
1999 Robert L. Eisenhart and  
Peter J. Khan

## Distinguished Educator Award

*Prize: Plaque and an honorarium of \$2,500*

This award recognizes a distinguished educator in the field of microwave engineering and science who exemplifies the special human qualities of the late Fred J. Rosenbaum, who considered teaching a high calling and demonstrated his dedication to MTT-S through tireless service.

The awardee must be a distinguished educator, recognized, in general, by an academic career. Additional attributes include documentation of having received other teaching awards; effectiveness as an educator supported by a list of graduates in the field of microwave science who have become recognized in the field; relevant letters of support; and an outstanding record of research contributions documented in archival publications. The candidate shall

have a record of many years of service to MTT-S, and must be a member of IEEE and MTT-S at the time of nomination.

### *Award Recipients*

1993 Arthur A. Oliner  
1994 Paul D. Coleman  
1995 George P. Rodrigue  
1996 George I. Haddad  
1997 David B. Rutledge  
1998 Robert J. Trew  
1999 Peter Herczfeld

## Microwave Application Award

*Prize: Certificate and an honorarium of \$1,500*

This award is given in recognition of the most outstanding application of microwave theory and techniques by an individual or team.

The basis for judging is the creation of a new device, component or technique; novel use of a device or component; or any combination of the above.

### *Award Recipients*

1973 Edward G. Cristal  
1974 Dean F. Peterson, III  
Phillip H. Smith ("special recognition")  
1975 Joseph F. White  
1976 Martin G. Walker  
1977 Stephen I. Long  
1978 Dale H. Claxton  
1979 Erwin F. Belohoubek  
1980 Julius Lange  
1982 Charles R. Boyd, Jr.  
1983 Les Besser  
1984 Paul Meier  
1985 James Cheal  
1986 Clarence Burke Swan  
1987 (No Award)  
1988 Masumi Fukuta and  
Louis S. Napoli  
1989 Kenneth L. Carr  
1990 Allen F. Podell  
1991 K. Reed Gleason and Eric W. Strid  
1992 Bernard Hershenov  
1993 John Carter and Irving Reingold  
1994 Martin V. Schneider  
1995 Cheng Paul Wen  
1996 Kikuo Wakino

1997 (No Award)  
1998 David D. Heston and  
Randall E. Lehmann  
1999 Christen Rauscher

## Distinguished Service Award

*Prize: Plaque and Certificate*

This award recognizes significant contributions and outstanding service to the Microwave Theory and Techniques Society and the microwave profession over a sustained period of time.

The basis for judging is service to MTT-S AdCom and IEEE.

### *Award Recipients*

1983 Theodore S. Saad  
1984 Alvin Clavin  
1985 George P. Rodrigue  
1986 Harold Sobol  
1987 Kiyo Tomiyasu  
1988 Fred J. Rosenbaum  
1989 Don Parker  
1990 H. George Oltman, Jr.  
1991 Charles T. Rucker  
1992 Richard A. Sparks  
1993 Stephen Adam  
1994 John B. Horton  
1995 Reinhard H. Knerr  
1996 Rudolf E. Henning  
1997 Vladimir G. Gelnovatch  
1998 Martin V. Schneider  
1999 Warren Cooper

## N. Walter Cox Award

*Prize: Plaque*

This award recognizes an individual who has given exemplary service to the Society in a spirit of selfless dedication and cooperation. The award is given in memory of N. Walter Cox, longstanding MTT-S volunteer.

The basis for judging includes service in one or more of the following areas: the Administrative Committee, Society publications, meetings and symposia, Chapter activities, committees, lectures, or other distinguished service. Factors which will be considered in evaluating an individual for the award shall include: maintaining a positive and enthusiastic attitude, demonstrating courage, exhibiting a diversity of interests and capabilities.

ties, serving as a role model, and motivating and inspiring others.

#### *Award Recipients*

1989 Richard A. Sparks  
1990 Peter W. Staecker  
1991 Helmut E. Schrank  
1992 Barry E. Spielman

1993 J. E. Degenford  
1994 Chuck W. Swift  
1995 Krishna K. Agarwal  
1996 (No Award)  
1997 Reynold S. Kagiwada  
1998 Roger Kaul  
1999 Daniel Massé



## MTT-S Elections and AdCom Nominations



**By Reynold S. Kagiwada**  
**Chairman Nominations**  
**and Appointments Committee**

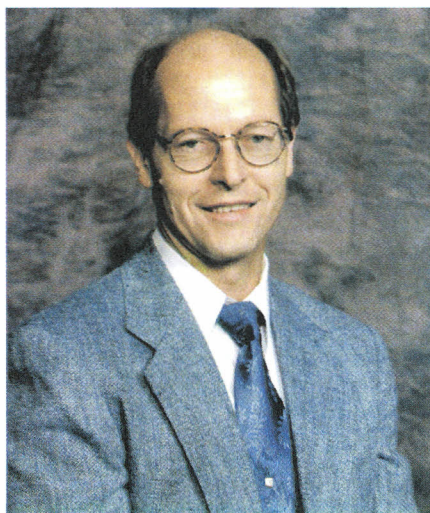
On September 13, 1998, MTT-S held their elections. There was an outstanding slate of candidates. Edward A. Rezek was elected president and Roger W. Sudbury was elected vice president. Michael P. DeLisio is the new secretary of AdCom. The following individuals were elected to AdCom:

- Roger B. Marks (newly elected to three-year term)
- Edward A. Rezek (reelected to third three-year term)
- Roger W. Sudbury (reelected to third three-year term)
- Frank J. Sullivan (newly elected to three-year term)
- Robert J. Trew (re-elected to second three-year term)

- Scott Wetenkamp (newly elected to three-year term)

Brief biographical sketches of Ed Rezek, Roger Sudbury, Mike DeLisio, and the newly elected AdCom officers are presented.

### New Officers



**Edward A. Rezek,**  
**President**

**Edward A. Rezek** is presently a Senior Staff Engineer in the Electronics Technology Division of TRW. His current responsibilities include development and productization of optoelectronic components and ICs as well as advanced photonics subsystems for space insertion. Dr. Rezek received his B.S.E.E. and A.B. Physics from Washington University in St. Louis, MO, and his M.S. and Ph.D. in Electrical Engineering from the University of Illinois. He is a member of Tau

Beta Pi, Eta Kappa Nu, Omicron Delta Kappa, and Sigma Xi. He has coauthored over 50 papers, holds four patents and has over 12 patent applications in review. He was the recipient of the 1992 TRW Chairman's Award for innovation and has received two TRW Gold Awards for his R&D activities. Dr. Rezek has been at TRW since 1980. He has been involved in advanced technology development; and manufacturing of optoelectronic components, optoelectronic ICs and RF and mmW microelectronics components for communication and electronic systems at TRW. His work at TRW has ranged from basic research and development to production insertion. He headed the development of Advanced RF Microelectronics Products and Technology for several years, being responsible for Advanced Microelectronics materials, GaAs and InP Devices/ICs, Heterojunction Bipolar Transistor Devices/ICs, Millimeter wave, and GaAs and InP Reliability and Commercial/Space Qualification. In 1996, he established the InP Microelectronics and Photonics Integrated Circuits Production Line at TRW.

Dr. Rezek became a student of IEEE in 1997. He is a member of the MTT, ED, LEO and CPMT Societies and the Intelligent Transportation System Council of the IEEE. He is also a member of the American Physical Society, the American Association for the Advancement of Science, the JEDEC (Electronic Industry Association) committees on GaAs Reliability and Microelectronics Devices, and the NASA/JPL GaAs Reliability Advisory Group.

Dr. Rezek has been very active in MTT-S AdCom from 1992-1999. Activities include: Secretary (1992); Vice-Chairman, Meetings and Symposium Committee (1993); Co-Chairman, Meetings and Symposium Committee (1994); Vice-Chairman, Membership Services Committee (1995); Chairman, Membership Services Committee (1996); Coordinator, Winter Technical Meeting (1994, 1995); Member, Long-Range Planning Committee (1993-1999); Review Committee Member, MTT-S Fellowships and Scholarships (1995-1997); Member, Budget Committee (1995-1999); Treasurer (1997); Vice-President (1998); and President (1999).

Other IEEE activities include: Member, TPC for the International Microwave Symposium (1991-1999); Member, TPC for MMWMC (1991); Reviewer, MTT-S Transactions special Issues on the International Microwave Symposium (1995-1999); Co-Chairman, Finance Committee for the MTT-S 1994 and 1999 International Microwave Symposia; and Vice-Chairman, 1997 Symposium on Technologies for Wireless Applications.



**Roger W. Sudbury,**  
Vice-President

**Roger W. Sudbury** is Executive Officer at the Massachusetts Institute of Technology Lincoln Laboratory. He is also Director of External Relations for the Laboratory and is responsible for the management of the Lincoln Laboratory Journal.

At Lincoln Laboratory, Mr. Sudbury led, for many years, the development of highfrequency, solid-state components for phased-array radars. This program involves the design, development, and fabrication of devices and monolithic GaAs circuits for microwave and millimeter transmit-receive modules. Mr. Sudbury served as Associate Manager of Lincoln Laboratory's Kiernan Reentry Measurements Site in the Marshall Islands, Kwajalein Atoll, where he managed the operation of radar and optical data collection experiments. Later, as Associate Leader of the System Engineering Group, he was responsible for field operations of the Optical Airborne Measurements Platform aboard the Cobra Eye reconnaissance aircraft.

Mr. Sudbury was one of the initial National Merit Scholars and is a member of Phi Kappa Phi, Phi Eta Sigma, Sigma Xi, Tau Beta Pi, and Eta Kappa Nu honor societies. He earned a B.E.E. degree with highest honors from Georgia Institute of Technology and received the S.M. and Engineer (E.E.) degrees from the Massachusetts Institute of Technology. As a Captain in the United States Army, he was program manager for a lightweight, solid-state avionics package in the OH-6A helicopter, receiving the Distinguished Service Medal.

Mr. Sudbury has authored and coauthored a number of technical papers and journal articles. He was a coauthor of "Millimeter-Wave Monolithic Circuits for Receiver and Transmitter Applications," which received the Government Microcircuits Applications Conference 1984 Outstanding Paper Award.

Mr. Sudbury's professional society involvement began as chair of the Georgia Tech Student Chapter of the IRE and he is currently an active member of IEEE's MTT-S and Solid State Circuits Society. He was instrumental in establishing the IEEE Microwave and MillimeterWave Monolithic Circuits (MMWMQ Symposium). He has served as Technical Program Chair and General Chair on the MMWMC Symposium's Steering Committee.

Working with the 1991 MTT-S International Microwave Symposium's Radiation Laboratory Celebration Committee, he oversaw MTT-S support for the NOVA production "Echoes of War." For this same symposium, he served as Edition Editor reissuing "Five Years at the Radiation Laboratory."

He has served on the IEEE MTT-S Administrative Committee since 1993. He is currently chair of the Meetings and Symposia Committee and previously chaired the Technical Coordination Committee. He has also chaired and served on the MTT-S Distinguished Lecture Selection Committee and acted as the MTT-S liaison to both the Solid State Circuit Council and the GaAs IC Symposium. Other MTT-S activities include serving a number of years as chair of the Monolithic Circuits Subcommittee of the IMS TPC.

**Michael P. DeLisio** (S'90, A'95, M'96) was born in Southfield, Michigan, on July

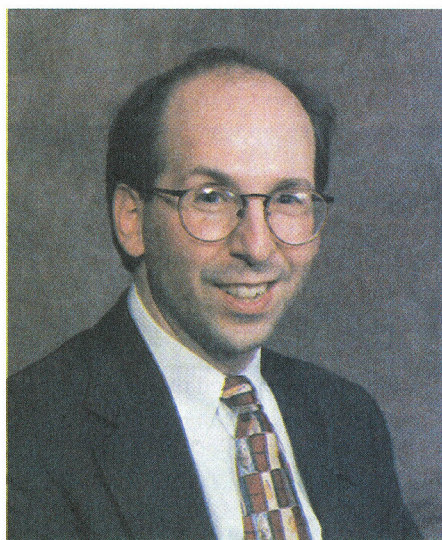


**Michael P. DeLisio,**  
Secretary

29, 1968. He received the B.S.E.E. degree from the University of Michigan, Ann Arbor, in 1990. In 1991, he obtained the M.S.E.E. degree from the California Institute of Technology in Pasadena. He received his Ph.D. degree in 1996 from Caltech. In January, 1996, he joined the Department of Electrical Engineering at the University of Hawai'i at Manoa, as an Assistant professor. His research interests include highfrequency, solid-state devices, microwave and millimeter-wave power combining, antennas, and monolithic quasi-optical devices. He has contributed to over 30 journal papers, conference presentations, and book chapters.

Dr. DeLisio is a member of the Education, Antennas and Propagation, and Microwave Theory and Techniques societies of IEEE. He serves on the TPC for the MTT-S Microwave Symposium. He is also a member of ASEE, Tau Beta Pi, and Eta Kappa Nu.

**Roger B. Marks** joined the U.S. Commerce Department's National Institute of Standards and Technology (NIST) in 1989. He founded and currently directs the National Wireless Electronics Systems Testbed (N-WEST), which aims to coordinate standards for broadband wireless communications systems. Dr. Marks received his A.B. in Physics in 1980 from Princeton University and his Ph.D. in Applied Physics in 1988 from Yale University, which awarded him the Harding Bliss Prize for Excellence in Engineering and Applied



**Roger B. Marks,**  
newly elected to AdCom

Science. Following a post-doctoral appointment at the Delft University of Technology (The Netherlands), he has pursued a professional career with NIST's Radio Frequency Technology Division in Boulder, Colorado.

The author of 70 journal and conference publications, several of which have received awards, Dr. Marks has spent much of his career investigating the electrical characterization of high-speed micro-electronic circuits and MMICs. He developed both fundamental theory, including the General Waveguide Circuit Theory, and calibration methods, including the Multiline TRL Method. For this work, he received an IEEE Technical Field Award (the Morris E. Leeds Award) in 1995, as well as the 1994 Automated Measurements Technology Award (from the Automatic RF Techniques Group [ARFTGI]) and the U.S. Department of Commerce Silver and Bronze Medals. In 1996, he attended the highly selective Frontiers of Engineering program of the National Academy of Engineering. He has been selected as a Distinguished Microwave Lecturer for 1999-2001 by the IEEE MTT-S.

A Senior Member of the IEEE since 1991, Dr. Marks has served in several professional societies. In the MTT-S, he has been elected to serve on the Administrative Committee (AdCom) for 1999-2001. He has also chaired the Standards Coordinating Committee, acted as MTT-S Liaison to ARFTG, and served on the Microwave Prize Committee and as a member of MTT-11 and MTT-20. He has

been on the Editorial Review Board of the IEEE Transactions on MTT since 1990 and served as Associate Guest Editor of a 1997 special issue. Dr. Marks was an active member of the ARFTG Executive Committee from 1995-1998 as Technical Chairman, MTT-S Coordinator, and Webmaster. He has served on committees of the International Electrotechnical Committee and the National Electronics Manufacturing Initiative.

Dr. Marks developed the MTT-sponsored IEEE Radio and Wireless Conference (RAWCON) and chaired it in 1998 and 1999 as a followup to the Wireless Communications Conference that he chaired in 1996 and 1997. He served as Vice-Chair of the 1997 IEEE MTT-S International Microwave Symposium, organizing the Plenary Session, initiating the student travel grant program and implementing other innovations. He also chaired the 49th ARFTG Conference in 1997. He has been on the TPC of the International Microwave Symposium and several other conferences.

Dr. Marks lives in Denver, Colorado with his wife, Robbie, and their children, Daniel and Amy.



**Frank Sullivan,**  
newly elected to AdCom

**Frank J. Sullivan** is currently a Principal Staff Microwave Engineer in Raytheon's Electronic System Division. His main responsibilities include serving as lead engineer for various development programs within the Electronic Systems Laboratory. He is currently the lead engineer on an advanced T/R module development contract.

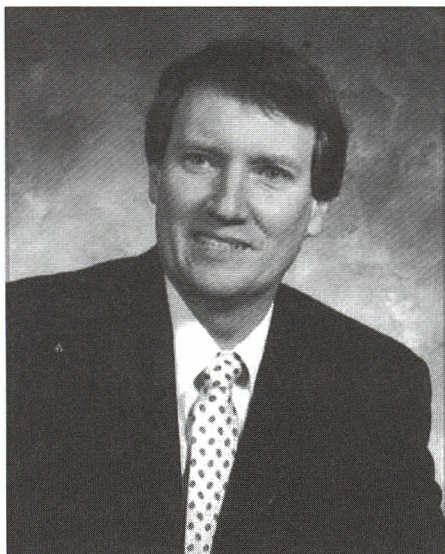
Mr. Sullivan received his B.S. degree in Physics from Manhattan College in 1962. He received his M.S.E.E. degree from the University of Connecticut in 1966.

Prior to joining Raytheon in 1984, Mr. Sullivan spent five years at M/A-COM, Inc. During this time, Mr. Sullivan managed the solid State Transmitter Business Center that was newly formed in 1978. His responsibilities included all technical development and business interaction with customers for solidstate transmitters. The technology focused on microwave transistor and IMPATT type amplifiers, sources and transmitters.

Mr. Sullivan was at Raytheon Company from 1966 through 1977 as a Senior Microwave Circuits Development Engineer. During this period, he was engaged in the development of various advanced microwave solid-state circuits for radar applications. The activity focused mainly on transistor, amplifiers, multipliers, oscillators, mixers, and subsystem integration. From 1963 to 1966, Mr. Sullivan was a Test Engineer at Hamilton Standard, Division of United Aircraft Corp. and was engaged in conducting various environmental tests for advanced aircraft and spacecraft components.

Mr. Sullivan has been an active member of the IEEE MTT-S since 1968. From 1972 through 1997, he served as a member of MTT-6 Technical Committee on Microwave and Millimeter Wave Integrated Circuits and as its chairman from 1991 through 1994. In 1995 and 1996, he was also a member of MTT-16 Technical Committee on Microwave Systems. He had helped organize many workshops and panel sessions that were held at MTT Symposiums. In 1997 he was TPC CoChairman for the "IEEE MTT-S International Topical Symposium on Technologies for Wireless Applications," which was held in Vancouver, B.C. Canada. He is currently serving as MTT Technical Coordinating Committee Co-Chairman and has held that position since 1995. He has also been a member of several IMS TPCs and for the past three years has served as the chairman for the TPC on Advanced Hybrid Technology.

Since 1970, Mr. Sullivan has been a part-time physics and mathematics instructor at Fitchburg State College. He has taught electronic circuits courses at Lowell University.



**Scott F. Wetenkamp,**  
newly elected to AdCom

Scott F. Wetenkamp is presently a consultant in the area of wireless data systems and subsystems. His development tasks have

included VCOs, synthesizers, power amplifiers, mixers, filters, microcontroller firmware, as well as system performance and system conceptual design. Prior to taking up consulting, Dr. Wetenkamp was a Senior Member of the Technical Staff at Pacific Monolithics, Director of Research and Development at Lucas Zeta, and Vice President of Engineering at Integra Microwave.

Dr. Wetenkamp received his BSEE, MSEE, and Ph.D. in electrical engineering from the University of Illinois in 1971, 1973, and 1975, respectively. His Ph.D. thesis, under the tutelage of Prof. Van Valkenburg, was in the field of active multiloop feedback audio filters but his first job was with WatkinsJohnson Company in the microwave synthesizer group. As a Member of the Technical Staff, he developed several broadband synthesizers from 100 MHz to 40 GHz. Later he transferred to the Solid State Di-

vision where he developed thin-film up/down converters. From WatkinsJohnson, he moved to Pacific Measurements to develop very wideband microwave power detectors, microwave sources and microprocessor-controlled instrumentation. He holds a patent on a broadband microwave power detector and has written several articles on that subject as well as synthesizer design.

Dr. Wetenkamp joined the IEEE as a student member but was not heavily involved until being elected to the position of Treasurer of the Santa Clara Valley MTT in 1992. This was followed by Secretary in 1993, Vice-Chair in 1994, and finally Chair in 1995. He was part of the 1996 International Microwave Symposium Steering Committee and the webmaster for the MTT AdCom's website in 1997.

He is presently the AdCom Secretary. 

## MTT-S AdCom Nominations

### Call for AdCom Nominations and Committee Appointment Suggestions

#### Reynold Kagiwada, Chairman Nominations and Appointments Committee

The MTT-S Nominations and Appointments Committee (N&A Committee) is actively soliciting candidates for the MTT-S Administrative Committee (AdCom). The N&A Committee consists of:

**Eliot Cohen**

(E-mail: e.cohen@ieee.org);

**Tatsuo Itoh**

(E-mail: t.itoh@ieee.org);

**Peter Staecker**

(E-mail: p.staecker@ieee.org);

**Reynold Kagiwada**

(E-mail: r.kagiwada@ieee.org);

**Kiyo Tomiyasu**

(E-mail: k.tomiyasu@ieee.org).

**The nominations for AdCom will be processed in accordance with the MTT-S Bylaws and Procedures Manual.**

*Nomination Procedure:* Obtain "suggested" nominees from each member of the N&A Committee. Process must ultimately

result in at least two nominees for each open slot.

Chapter nomination submitted prior to July, 1999.

Prepare a "Suggested Starting List of Candidates" of perhaps more than 40 names and solicit responses from AdCom.

Committee shall down select, and seek acceptance of nomination and commitment to perform as expected, if elected from this reduced list.

Assemble list of "suggested" nominees and prepare a "spread sheet" of biographical information emphasizing MTT-S, IEEE, and other activities. Compile results. Inform President of slate.

Prepare ballot for use at Annual Meeting. Petition candidates (signed by 25 MTT-S members, by July 1, 1999) are automatically included on the ballot.

All nominees will be contacted to ascertain that they will accept the nomination and will

commit themselves for active participation in at least two meetings a year, held in various locations in the United States.

The geographical and affiliation distributions of current AdCom members are given below:

#### **Present Elected Adcom (1998): Total = 18**

Mid-Atlantic/Eastern U.S. 4

Southeastern U.S. 1

Middle Region U.S. 3

Southwestern U.S. 1

Western U.S. 7

Europe 1

Asia-Pacific Region 1


Industry 11

Government 4

University 3

In addition to the elections, the N&A Committee seeks interested and qualified individuals who will be recommended to the president for his consideration to serve on various committees.

The N&A Committee is soliciting your help to suggest potential nominees to serve our membership as AdCom members. Please submit your suggestions to your local chapter chairman, N&A Committee

(by E-mail) and/or to R. Kagiwada, N&A Committee Chairman, TRW Inc., Mail Stop R6/2509, One Space Park, Redondo Beach, CA 90278 or FAX (310) 813-5923, by July 1, 1999. 

## MTT Society Ombudsman



**Ed Niehenke**  
**Niehenke Consulting**  
**5829 Bellanca Drive**  
**Elkridge, MD 21075**  
**(410) 796-5866**  
**FAX: (410) 796-5829**  
**E-mail: e.niehenke@ieee.org**

As your Ombudsman, I received 18 inquiries (8 non-US) from MTT-S members since the last newsletter report. All inquiries were typically acted upon within two weeks, and replies were sent to all MTT-S members. The ease and speed of response was due in a large part to the fact that the majority of inquiries were received by e-mail.

Four members (typically new ones) wanted to receive MTT-S Transactions and/or Microwave & Guided Wave Letters. When they joined MTT-S, they did not know that these publications were not included in the MTT-S membership dues. Information was given to them on how to obtain these periodicals.

Four members did not receive MTT-periodicals, which were sent to them. One of the previous members only received the

brown paper wrapper and not the periodical. I am happy to report that all new MTT-S periodicals are now being sent out in a plastic wrapper to solve this problem.

Members had the following requests: MTT-S Awards information, PACE meetings support request, technical information, ADCOM meeting dates, 1999 IMS exhibition booth request, MTT-S Transactions author information, information on the preparation of summary for IMS 99, MTT-S chapter chairmen and Distinguished Microwave Lecturers names and contact information, and life member information. All requests were acted upon and a reply was sent to all inquiries.


Many of the requested information can be found or was recently included on the MTT-S web page (<http://www.mtt.org>). This includes the awards information and how to nominate a person, chapter chairman and distinguished microwave lecturers names, lecture titles, and contact information. Plan to visit the MTT-S web page for the latest information. For those who need a booth at IMS-99 exhibition, please contact Harlan Howe at (781) 769-9750 or [hhowe@mwjournal.com](mailto:hhowe@mwjournal.com). Have you started writing your paper summary for the 99 IMS? Students should plan to enter the student paper competition. Visit the MTT web page for IMS 99 information ..

One life member requested free MTT-S Transactions and Microwave and Guided Wave Letters periodicals. When one becomes a life member, IEEE dues are free as well as any periodicals that are core (included in the basic membership dues). Members of a society for five years prior to life member also get free society membership plus their core periodicals. The MTT-S Transactions and Microwave and Guided Wave Letters are not core periodicals,

so if life members want to receive them, they must include payment for these with their dues. MTT-S gives their members a choice to select the periodicals they choose, with a low basic MTT-S membership. MTT-S periodical cost is separate, so the member can choose exactly what he wants. Unfortunately, this does not give free non-core periodicals to the life member according to the IEEE bylaws. This will be further investigated.

There is good news however. All MTT-S members will receive soon with their MTT-S newsletter a CD ROM that contains all MTT-S Transactions, Microwave and Guided Wave Letters, IMS digest as well as the RFIC digest material for 1997. This is planned to continue for 1998 and 1999. Mid 1999, MTT-S will be selling 20 CD's which contains the above-mentioned material from 1954 to 1997. The Microwave and Monolithic Integrated Circuits Symposium digests are also included. MTT-S members can also access the MTT-S Transactions, Microwave and Guided Wave Letters, Transactions of Electron Devices and Electron Devices Letters on the Webb through OPERA. Visit the web at <http://www.opera.ieee.org> to register and electronically view these periodicals.

The MTT-S dues as well as the cost of periodicals are the same for 1999 as for 1988. The annual MTT-S membership fee is \$8 (\$4 students) with a \$40 permanent fee good as long as you pay your IEEE dues. MTT-S Transactions are \$13 (\$10 students) while the Microwave and Guided Wave Letters are \$8 (\$6 students).

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

## Ground Rules For Meeting and Symposia Support

**M**TT-S is generally willing to provide support of technical meetings that would be of interest to its members. We have four levels of support:

**Cooperative Sponsorship** - general support with the use of MTT and IEEE logos, access to mailing lists, and etc. This is infrequently used, but is good for new meetings in remote locales.

**Technical Co-Sponsorship** - same as above, but MTT-S requires that it be proportionately represented on the Technical Program Committee. This is the most common form of support that MTT-S provides.

**Co-Sponsorship** - Financial responsibility shared with another organization. MTT will loan money up front, but requires a full budget to be submitted, with back up materials, and contingency plans. This in-

cludes general support with the use of MTT and IEEE logos, access to mailing lists, and etc. This is quite common for established meetings, but it is difficult to approve for new meetings.

**Sponsorship** - same as above, but MTT-S is solely financially responsible.

Whenever money is involved, since the IRS becomes involved, a preliminary and final budget must be prepared, and submitted to MTT-S and IEEE headquarters. There is material available from the IEEE web, and printed material can be requested from IEEE. Contact Charles Jackson at [c.jackson@ieee.org](mailto:c.jackson@ieee.org), or look at the IEEE website for more information.

All four levels of sponsorship can be approved for continuous sponsorship. This means that once continuous sponsorship

has been approved by MTT-S, and as long as budgets and reports are submitted, then the technical meeting does not have to be continuously re-approved every year. On one hand, continuous sponsorship saves work, but on the other hand, it causes a technical meeting to lose visibility. In the list of conferences, workshops, and technical meetings that follows, in my position as Meetings and Symposia Co-Chair, I have lost contact with the organizing committee. Over the next year we will be re-newing our contacts with these organizations.

Please note, for the list of meetings that follows, that meetings listed are those that have been officially sponsored by MTT-S (i.e., AdCom approved). There are many other microwave related meetings (chapter sponsored, commercial, etc.) that are not listed.

## MTT-S Speaker's Bureau Announcement

### Background

The MTT-S Society serves a wide range of technologies throughout the RF, Microwave, Millimeter-Wave, and Submillimeter-Wave areas. Some technical areas are mature while others are just emerging. Many of the emerging areas such as wireless communication are becoming important segments of the overall microwave industry. The "Technical Committees" within the MTT-Society have been organized into twenty (20) working committees to address advances in the various technologies. These 20 committees each have chairmen who report on technical activities at two (2) regularly scheduled meetings annually. The Technical Committees assist in the organization of the annual International Microwave Symposium, as well as organizing workshops, and sponsoring "Special Topical Meetings." The Technical Committee Chairmen report to the MTT-S Administrative Committee (ADCOM) through the Technical Coordinating Committee.

Throughout the world, MTT-S Chapters serve an important function of reaching out to the Society's membership. One

method of reaching out is to organize meetings that feature technical speakers.

### Speaker's Bureau Concept

A Speaker's Bureau is being set up to improve the communication link between the Local Chapters and the Technical Committees and to offer a wide variety of speakers to assist the Local Chapters in reaching the general membership.

Sometimes it is difficult to obtain outstanding speakers due to time and travel expense issues. Part of this problem is addressed through the ongoing "Distinguished Lecturer" program which has been set up by the MTT-S ADCOM. The Technical Committee's Speakers Bureau has been established to compliment the "Distinguished Lecturer" program and to serve as an additional link between the Local Chapters and the Technical Committees. The Speakers Bureau can provide technical speakers in the 20 technical areas which are represented.

The Speakers Bureau has identified highly qualified technical speakers who have

agreed to make time available to address local MTT-S Chapters. Travel expense funds (while not unlimited) are being provided to the speakers. Speakers have been identified in the US, Canada, Europe, and Asia. Some coordination of speakers travel with other business travel must occur to maximize success. For example, a speaker from Europe might give a presentation to one or more US Chapters while in the U.S. on other business. At the present time about half of the Technical Committees have identified speakers and have provided short abstracts of their presentations. The other Technical Committees are in the process of identifying speakers.

Chapter representatives may contact overall the Technical Coordinating Committee Chairmen directly or LRW Associates who is assisting with the administration of the program. *LRW Associates can provide a complete listing of speakers for interested Chapters.*

#### Please Contact:

Larry Whicker:  
Tel: 704-841-1915  
Fax: 704-845-3078  
e-mail: [lrw@aol.com](mailto:lrw@aol.com)



## Calendar MTT-S Sponsored Conferences

1999

Name	Date/Location	Involvement	
<b>Emerging Technology for Wireless Applications (INTERCOMM '99)</b>	21-24 February Vancouver, BC Canada	Co-Sponsor	Bernard D. Geller c/o LRW Associates 468 Walden Trail Waxhan, NC 28173 Tel: 704-848-1915 Fax: 704-848-3078 email: lrwassoc@aol.com
<b>10th Microcoll</b>	21-25 March Budapest Hungary	Co-Sponsor	G. Veszely Tech Univ Budapest Conference Secretariat Diamond Congress Ltd.- Microcoll H-1027 Budapest FO u. 68, Hungary Tel: +36-1-214-7701 Fax: +36-1-201-6383 email: diamond.eft@mtesz.hu <a href="http://www.mtesz.hu/tagegy/diamond">http://www.mtesz.hu/tagegy/diamond</a>
<b>IEEE Radio Frequency Integrated Circuits Symposium (RFIC'99)</b>	13-14 June Anaheim, CA USA	Co-Sponsor	Christian Kermarrec Analog Devices, Inc. 804 Woburn St. Wilmington, MA 01877 Tel: 617-937-1217 Fax: 617-937-1051 email: christian.kermarrec@analog.com <a href="http://www.mtt.org/ims1999">http://www.mtt.org/ims1999</a>
<b>MTT-S International Microwave Symposium</b>	13-19 June Anaheim, CA USA	Sponsor	Robert L. Eisenhart 3982 Ellenvue Ave, Woodland Hills, CA 91367 Tel: 818-716-1995 Fax: 818-713-1161 email: r.l.eisenhart@ieee.org
<b>53rd Automatic RF Techniques Group Conference (ARFTG)</b>	17-18 June Anaheim, CA USA	Affiliated	Gary Simpson Maury Microwave Corporation 2900 Inland Empire Blvd Ontario, CA 91764 Tel: 909-987-4715 Fax: 909-987-1112 email: gsimpson@maurymw.com <a href="http://www.arftg.org">http://www.arftg.org</a>
<b>1998 Radio &amp; Wireless Conference (RAWCON'99)</b>	4-7 August Denver, CO USA	Co-Sponsor	Roger B. Marks NIST 325 Broadway, 813.06 Boulder, CO 80303-3328  Tel: 303-497-3037 Fax: 303-497-7828 email: r.b.marks@ieee.org

## Calendar MTT-S Sponsored Conferences

## 1999

Name	Date/Location	Involvement
<b>29th European Microwave Conference</b>	4-8 October Munich Germany	Co-Sponsor Prof. Peter Russer Inst. for High-Frequency Engin. Technische Universität München Arcisstr. 21 D-80333 München, Germany Tel: +49-89-289-28390 Fax: +49-89-289-22265 email: eumw99@ei.tum.de
<b>MTT-S European Topical Congress on Technologies and Systems for Mobile and Wireless Applications (European Wireless '99)</b>	4-8 October Munich Germany	Co-Sponsor Prof. -Ing. Bernhard H. Walke RWTH Aachen Univ. of Technology Communications Networks Kopernikusstr. 16 D-52074 Aachen, Germany Tel: +49-241-80-7913 Fax: +49-241-8888-242 hfmwe001@hrz2.hrz.tu-darmstadt.de European.Wireless'99@ comnets.rwthaaachen.de
<b>European GaAs and Related III-V Compounds Application Symposium (GAAS'99)</b>	4-8 October Munich Germany	Cooperative Sponsorship Prof. Hans Hartnagel Technische Hochschule Darmstadt Merckstr. 25 D-64283 Darmstadt, Germany Tel: +49-6151-162162 Fax: +49-6151-164367 email: hfmwe001@hrz2.hrz.tu-darmstadt.de
<b>Topical Workshop on Power Amplifiers for Wireless Communications</b>	13-14 September San Diego, CA USA	Sponsor
<b>54th Automatic RF Techniques Group Conference (ARFTG)</b>	2-3 December Atlanta, GA USA	Affiliated Prof. Lawrence P. Dunleavy Univ. of South Florida Dept. of Electrical Engineering 4202 E. Fowler Ave., ENB 118 Tampa, FL 33620-5380 Tel: 813-974-2574 Fax: 813-974-5250 email: dunleavy@eng.usf.edu <a href="http://www.arftg.org">http://www.arftg.org</a>

## 2000

<b>Phased Arrays 2000</b>	20-26 May Dana Point, CA USA	Technical Co-Sponsor
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Notes: (1) Meetings listed are those that have been officially sponsored by MTT-S (i.e., AdCom approved).  
There are many other microwave related meetings (chapter sponsored, commercial, etc.) that are not listed.

## MTT-S Continuously Sponsored Conferences

MTT-S International Microwave Symposium (IMS)  
Annual (Sponsor)

Automatic RF Techniques Group (ARFTG)  
Semi-annual (Affiliated)

European Microwave Conference (EuMC)  
Annual (Cooperating)

Asia Pacific Microwave Conference (APMC)  
Annual (Cooperating)

MIOP  
Biennial - 1993, etc. (Cooperating)

MIKON  
Biennial - 1994, etc. (Cooperating)

Combined Optical and Microwave Earth and Atmospheric Sensing  
Biennial (1993, etc.) (with GRSS-S, LEO-S)

International Microwave Conference/Brazil (SMBO)  
Biennial - 1993, etc. (Cooperating; Co-Sponsor 1995)

IEEE GaAs IC Symposium  
Annual (Co-Sponsor)

IEEE Conference on the Computation of Electromagnetic Fields  
Biennial - 1992, etc. (Cooperating)

European GaAs Applications Symposium  
Biennial - 1992, etc. (Cooperating)

Topical Meeting on Electrical Performance of Electronic Packaging  
Annual (Sponsor)

19th International Conference on Infrared and Millimeter Waves  
Annual (Cooperating)

Microwaves in Medicine  
Triennial - 1993, etc. (Cooperating)

National Radio Science Meeting  
Annual (Cooperating) (with International Union of Radio Science)

Int'l Workshop on High Perf. Electron Devices for Microwave and Optoelectronic Applications (EDMO)  
Annual (Cooperating) (with UKRI MTT/AP/Leo Joint Chapter and King's College London)

Cornell University Conference on Advanced Concepts in High Speed Semiconductor Devices and Circuits  
Biennial (Technical Co-sponsor) (Sponsored by the IEEE Electron Device Society)

## MTT-S Meeting and Symposium Workshop

### Saturday 9 January 1999 Los Angeles Airport Marriott

On Saturday, January 1999, the MTT-S Meeting and Symposium Committee will be holding a "Best Practices" Workshop in conjunction with the Winter Technical Meeting and the 1999 IMS Technical Program Committee meeting. It will run from 5:00 pm to 7:30 pm with a buffet dinner. This is a new workshop intended to focus on the details of holding a technical meeting sponsored by the MTT-S.

This meeting is intended for individuals who have run meetings who can share their experiences and for individuals who are interested in holding an MTT-S sponsored meeting but have questions about the challenges they may face. Presentations will cover how to apply for sponsorship, budgeting, site selection and negotiation, resources available, registration, technical program planning, publications and closing the books. In the general discussion we will be able to share experiences and recognize "best practices".

This meeting offers the chance for meeting organizers to meet one another and the Society's ADCOM members who are involved in meeting planning.

If you are interested in attending this meeting, please contact Roger W. Sudbury at MIT Lincoln Laboratory.

Tel (781) 981 7024,  
FAX (781) 981 6098 or  
E mail: sudbury@ll.mit.edu



# The Fifth International Workshop on Integrated Nonlinear Microwave and Millimeter-Wave Circuits (INMMC)

**Steve Maas,  
Nonlinear Technologies, Inc.**

I was one of the invited speakers at the first INMMC in 1990. Immediately after our plane touched down in Dnsseldorf, I, my wife Julie, my co-author Dave Neilson, and his wife Sara piled into a little rented Opel and headed south toward Koblenz. The next morning we started a delightful tour along the Mosel, alternately visiting castles and wineries. Three days, five castles, and an uncounted number of *Moselblumchen* later, we staggered into Duisburg for the workshop, happy, relaxed, and ready for technology.

We weren't disappointed by the workshop any more than we were by the delights of the Mosel Valley. Most small technological workshops begin slowly and, after a number of years, finally become reasonably interesting. The INMMC hasn't followed this pattern; it has been a first-rate event right from the beginning. Part of the reason has been a number of excellent invited papers, but perhaps more importantly, the workshop has consistently attracted top-notch contributed papers, as well. The atmosphere has been moderately informal, with pleasant social events and plenty of opportunity for the attendees to discuss whatever interests them.

Like all subsequent workshops, the fifth INMMC workshop was held in Duisburg, Germany October 1-2, 1998. As in previous years, the workshop was hosted by

Gerhard-Mercator University and organized by Profs. Adalbert Beyer and Ingo Wolff. 87 attendees from 18 countries were treated to a fascinating collection of papers on the latest advances in nonlinear circuit-analysis and modeling technology. 25 papers were presented, of which six were invited. The workshop continued its tradition of excellence, and by now it has established itself as one of the most important for researchers in this field.


The workshop has traditionally been a mix of circuit-analysis papers, device modeling, and design of nonlinear circuits. The papers have covered frequency ranges from the RF bands to the millimeter-wave region. As one might expect, the subject matter of many papers has followed the strongest interests at the time of the workshop, but many papers on subjects that are not so thoroughly in vogue. For example, this workshop is one of the few places where researchers can learn about the latest advances in Volterra-based circuit analysis and modeling technologies, a subject almost as neglected (by the folks who set the styles) as it is promising.

This year's workshop introduced a number of new and fascinating subjects. In an invited paper, Jan Verspech and Patrick Van Esch of Hewlett-Packard, Brussels, introduced the concept of "nonlinear scattering functions," a new approach to the measurement-based characterization of nonlinear devices and components. I. Jäger and his colleagues from Gerhard-Mercator Univer-

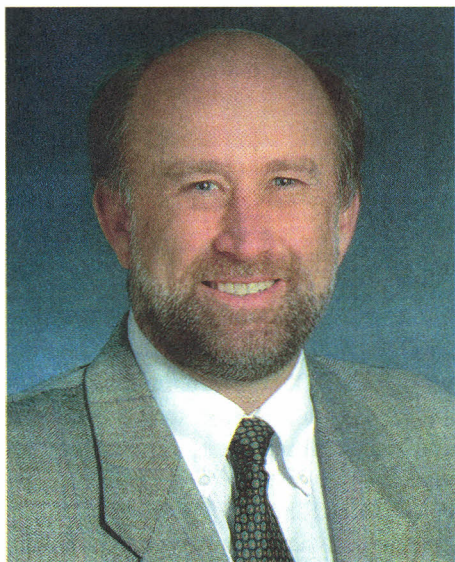
sity in Duisburg described a nonlinear transmission line using resonant tunneling diodes, and Robert Trew described microwave power amplifiers using wide-bandgap semiconductors, in particular, silicon carbide devices. (I've often thought that SiC FETs have an advantage that researchers have yet to recognize: the blown chips can be recycled as abrasive grit. Someday, your house may be sandblasted by blasted FETs!) Conversely, many papers considered such mainstream subjects as power FET modeling, parameter extraction, oscillator design, and planar monolithic mixers. There was something at the workshop for everyone.

On the evening of October 1st, a dinner and reception for attendees was held at the *Schloss Oberhausen*, an old palace turned into a gourmet restaurant, just outside of Duisburg. The food was excellent and the company delightful. We all ate and drank too much and had a wonderful time.

The workshop was sponsored by the German government and by a number of German, American, and multinational companies. Many of these displayed their products at a small exhibit area adjacent to the auditorium in which the workshop papers were presented.

The workshop is held every two years; keep an eye on the notices in this newsletter and <http://www.nonlintec.com/meetings.htm> for announcements of the sixth INMMC in the year 2000. 

# Two New Distinguished Lecturers Elected

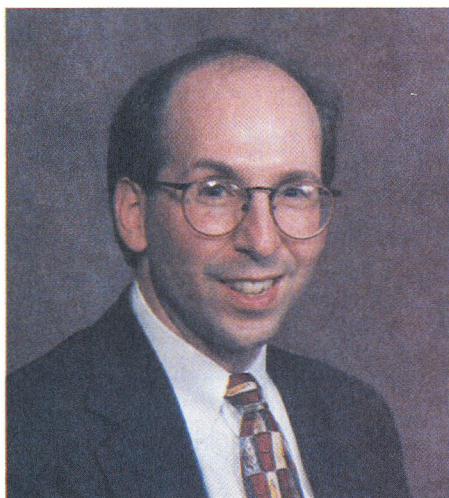


**Joseph F. Jensen** (S'81-M'83-SM-92) received the B.S. and M.S. degrees in electrical engineering from the University of California at Los Angeles in 1980 and 1983, respectively.

In January 1981 he joined Hughes Aircraft Company in El Segundo, CA, where his job assignments included work on high-speed A/D converters in silicon bipolar technology, VLSI design in CMOS/SOS technology, and testing methodology using electron-beam testing techniques. In August of 1983 he joined the staff of Hughes Research Laboratories in Malibu, CA, where he is currently a Principal Research Scientist and a Department Head of the Ultra-High Speed IC Department in the Microelectronics

Laboratory. As member of the Research Laboratories staff Mr. Jensen has been involved with the development of GaAs MESFET's, AlInAs/GaInAs HEMT's, and AlInAs/GaInAs HBT devices and circuits. Mr. Jensen is the author of over 70 papers in the area of high-speed integrated circuits and has 3 issued patents. Mr. Jensen has served on the ISSCC, IEDM, and IPRM conference program committees and has served as an associate editor for the Journal of Solid State Circuits.

## Standards for Broadband Wireless Access Systems



**Roger B. Marks**  
**Director, National Wireless Electronic Systems Testbed**  
**National Institute of Standards and Technology**  
 325 Broadway, Mail Code 813.01  
 Boulder, CO 80303-3328  
 303-497-3037 (tel)  
 303-497-7828 (fax)  
 marks@nist.gov  
 http://nwest.nist.gov

### Abstract

Broadband wireless access (BWA) systems are being developed worldwide to address the critical "last-mile" problem in telecommunications. The essence of the problem is that, while the world's data transmission capacities are growing at an enormous rate, few users have access to high-speed interconnections to fast networks. Both business and residential users are seeking alternatives to the conventional telephone-based network connections available to them.

Several wired alternatives for broadband access, including cable modems and digital subscriber lines, are being deployed. However, these deployments have limitations and often require tedious infrastructure reconstruction. Broadband wireless access (BWA) is an alternative that may offer quicker infrastructure build-out at a lower cost.

BWA systems are being developed worldwide in many areas of the spectrum. In many cases, large bandwidths, on the order of 1 GHz, are becoming available, typically at millimeter wavelengths. Following initial deployment of one-way video systems in the United States in the early 1990's, Canada in 1996 awarded nationwide licenses in the 28 GHz range. The U.S. followed with a nationwide auction of 1.3 GHz in the 28-31 GHz range in early

1998. Nations throughout the world are taking a similar approach. Many of the proposed systems are cellular, requiring elevated terrestrial base stations. Satellite-based systems are also well into development, and stratospheric systems using airplanes and dirigibles are underway.

A key issue for the success of these systems is standardization, which can bring down the cost and thereby extend the reach of these networks to lower-volume users. In the United States, auctions have put deregulated spectrum into private hands for mobile as well as BWA applications. In the mobile case, industry has not followed a coordinated path leading to national standards. The result has been frustrating for consumers as well as engineers and has kept equipment costs unnecessarily high.

Recently, U.S. National Institute of Standards and Technology and the U.S. National Telecommunications and Information Administration, both agencies of the U.S. Department of Commerce, have been developing the National Wireless Electronic Systems Testbed (N-WEST), an experimental facility for characterizing the performance of wireless

systems and the dependence of their performance on components, subsystems, modulation, propagation, interference, and other factors. N-WEST intends to distribute its data widely among its participants with the intention that they will come to compatible conclusions on technical grounds and thereby to consensus regarding appropriate operational standards and component specifications. N-WEST is focusing much of its early effort on millimeter-wave BWA. In order to accelerate the standardization process, N-WEST has enlisted nearly forty Supporting Companies and is coordinating standardization through two different standards bodies within the Institute of Electrical and Electronics Engineers (IEEE).

## Biography

Roger B. Marks joined the U.S. Commerce Department's National Institute of Standards and Technology (NIST) in 1989. He founded and currently directs the National Wireless Electronics Systems Testbed (N-WEST), which aims to coordinate standards for broadband wireless communications systems. Dr. Marks received his A.B. in Physics in 1980 from Princeton University and his Ph.D. in Applied Physics in 1988 from Yale University, which awarded him the Harding Bliss Prize for Excellence in Engineering and Applied Science. Following a postdoctoral


appointment at the Delft University of Technology (The Netherlands), he has pursued a professional career within NIST's Radio Frequency Technology Division in Boulder, Colorado.

The author of 67 journal and conference publications, several of which have received awards, Dr. Marks has investigated the electrical characterization of high-speed micro-electronic circuits and MMICs, developing fundamental theory and calibration methods including the multiline TRL method. For this work, he received an IEEE Technical Field Award (the Morris E. Leeds Award) in 1995, as well as the 1994 Automated Measurements Technology Award (from the Automatic RF Techniques Group [ARFTG]) and the U.S. Department of Commerce Silver and Bronze Medals. In 1996, he attended the highly selective Frontiers of Engineering program of the National Academy of Engineering. He has been selected as a Distinguished Microwave Lecturer for 1999-2001 by the IEEE Microwave Theory and Techniques Society (MTT-S).

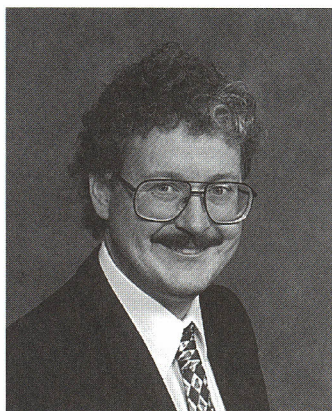
A Senior Member of the IEEE since 1991, Dr. Marks has served on numerous program committees and in professional societies. In the MTT-S, he has chaired the Standards Coordinating Committee and acted as MTT-S Liaison to ARFTG. He has served on the Microwave Prize Com-

mittee and as a member of MTT-11 and MTT-20. He has been on the Editorial Review Board of the IEEE Transactions on Microwave Theory and Techniques since 1990 and served as Associate Guest Editor of a 1997 special issue. Dr. Marks was an active member of the ARFTG Executive Committee from 1995-1998 as Technical Chairman, MTT-S Coordinator, and Webmaster. He has served on committees of the International Electrotechnical Committee and the National Electronics Manufacturing Initiative.

Dr. Marks developed the MTT-sponsored IEEE Radio and Wireless Conference (RAWCON) and chaired it in 1998 and 1999 as a followup to the Wireless Communications Conference that he chaired in 1996 and 1997. He served as Vice-Chair of the 1997 IEEE MTT-S International Microwave Symposium, organizing the Plenary Session, initiating the student travel grant program, and implementing other innovations. He also chaired the 49th ARFTG Conference in 1997. He has been on the Technical Program Committee of the International Microwave Symposium and several other conferences.

Dr. Marks lives in Denver, Colorado with his wife, Robbie, and their children, Daniel and Amy. 

## CDROM Archive Status



**Charlie Jackson**


The Microwave Digital Library is nearly complete. In your last

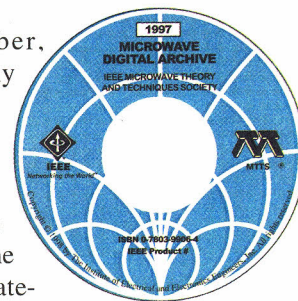
t newsletter, you received the 1997 Annual Archive CDROM, pictured above. The complete set of all MTT published material should be ready to publish by June 1999, with sale and delivery targeted for before the end of the year. The plan is to hold a demonstration of the CDROM at the TPC meeting in January, and at the International Microwave Symposium in June.

The initial pre-publication price will be \$50 for MTT members. The post publication price will be \$100 for MTT members, and \$200 for IEEE members (who are not MTT members). Remember, the CDROM set will not be sold to non-IEEE members. Pass the word to your colleagues and remind them that there are definite advantages to being an

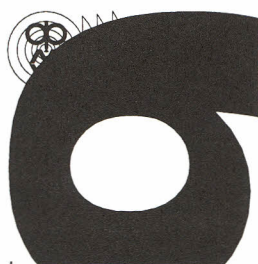
IEEE member, and especially and MTT member.

The first four CDROMs hold all of the published material from 1954 to 1974. It will take about 16 more CDROMs to complete the set.

Ted Saad deserves special credit and thanks for his help in this project. Ted offered his whole set of journals and digests, and they are being torn apart and scanned as you read this article. 



## 1999 ASIA PACIFIC MICROWAVE CONFERENCE

*Microwaves enter the 21st Century**Microwaves Enter the 21st Century***INTERNATIONAL ADVISORY COMMITTEE**

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**ORGANISED BY:**

Dept of Electrical Engineering  
 National University of Singapore  
 MTT/AP/EMC Chapter  
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Conference and Travel Management  
 Associates Pte Ltd  
 425A Race Course Road  
 Singapore 218671  
 Singapore  
 Tel : (65) 299 8992  
 Fax : (65) 299 8983

**Second Call for Papers**

The 1999 Asia-Pacific Microwave Conference (APMC '99) will be held in Singapore from 30 November to 3 December, 1999. The Organising Committee is inviting papers describing original work in all aspects of microwave theory and applications. Topics of interest include, but are not limited to the following areas:

- Solid State Devices and Circuits
- Low-noise Devices and Techniques
- High-power Devices and Techniques
- Monolithic Integrated Circuits
- Passive Devices and Circuits
- Packaging Techniques
- Ferrite and SAW Components
- Microwave Superconductivity
- Microwave-Optical Interactions
- Computer Aided Design
- Measurement Techniques
- Electromagnetic Field Theory
- Computational Electromagnetics
- Microwave Antennas
- Phased and Active Array Techniques
- Scattering and Propagation
- Microwave Remote Sensing and Sensors
- Microwave and Millimetre Wave Systems
- Communications Systems
- High Speed Digital Circuits
- Medical and Biological Applications
- Submillimetre Wave Techniques
- EMI and EMC
- Guided Waves

**SUBMISSION GUIDELINES**

Authors are invited to submit an abstract and an extended summary. Details as follow:

1. Four (4) copies of a 30-50 word abstract should be submitted. The abstract should be presented on a single separate sheet with a header bearing the paper title and author's name(s) together with complete mailing address, Fax number and Email address. A footnote specifying the most appropriate topic from the preceding list and the author's preference of oral or poster presentation should also be included.
2. Four (4) copies of a 500-1000 word extended summary of not more than four (4) pages including supporting illustrations should be submitted. The paper title and author's name(s) should appear on the front page of the extended summary.

Fax or Email submissions will not be accepted. All submissions must be in English and to be mailed directly to the APMC '99 secretariat. Submissions will be acknowledged via Email. Titles of accepted papers will be published on the APMC '99 website upon completion of review.

**SCHEDULE**

- Submission deadline for abstract & extended summary : 31 March 1999
- Notification of acceptance/rejection by mail : 30 June 1999
- Submission deadline for camera ready manuscript,  
 IEEE copyright form and author's advanced registration<sup>†</sup> : 29 August 1999

<sup>†</sup>Paper will only appear in Conference Proceedings on receipt of author's advanced registration.

## WORKSHOPS, SHORT COURSES AND TUTORIALS

The APMC '99 will provide stimulating workshops, short courses and tutorials conducted by a group of specialists in a wide range of interesting topical subjects.

## EXHIBITION

An International Microwave Exhibition in association with the conference will be held concurrently. Guidelines for potential exhibitors will be announced on the APMC '99 website in due course.

## APMC PRIZE

All accepted papers will be judged by the APMC '99 Award Committee for outstanding contributions to research in microwaves. The APMC Prize will be awarded to the author(s) of the selected best paper.

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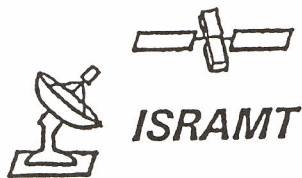
## SINGAPORE

**Climate:** Singapore has a mild tropical climate with abundant rainfall throughout the year. Temperatures reach a maximum of 31°C during the day, falling to a pleasant 25°C during evening hours. There are no distinct wet or dry seasons but the heaviest rainfall occurs between November and January. **Currency:** The unit of currency is the Singapore dollar (S\$). **Languages:** Singapore's population of 3 million people is cosmopolitan with the Chinese (78%), Malays (14%) and Indians (7%) forming the majority. There are four official languages: English, Malay, Mandarin and Tamil. English is the business language and it is widely spoken. **Food:** Eating out in Singapore offers the greatest feast in the east. From side-street hawker stalls to Cordon Bleu, the city is home to a mouth watering array of Chinese, Indian and Malay cuisines as well as culinary favourites from all over the world. There are eating places which suit every budget. **Shopping:** Truly a shopper's paradise, Singapore offers treasures from both the sophisticated West and the exotic East. Air-conditioned shopping centres and bazaars offer a wide variety of goods ranging from the latest electronic products to jewellery and souvenirs. The 3% Consumer Goods and Services Tax (GST) can be reclaimed on your departure at the airport. Duty-free shopping is also available for visitors to Singapore at selected stores both in the city and at the airport. **Public Transport:** Transportation is comprehensive, safe and inexpensive in Singapore. The Mass Rapid Transit (MRT) train system offers quick access to all parts of the island. An extensive network of buses also plies the entire island. Taxis are easily flagged from taxi stands or along the streets.

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### APMC '99 Secretariat

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425-A Race Course Road  
Singapore 218671  
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Tel: (65) 299-8992 Fax: (65) 299-8983  
Email: [ctmapl@singnet.com.sg](mailto:ctmapl@singnet.com.sg)



## Announcement and Call for Papers

# 7th International Symposium on Recent Advances in Microwave Technology (ISRAMT'99)

**December 13-17, 1999  
Malaga, Spain**

**Sponsored by:** University of Malaga, Malaga, SPAIN  
University of Nevada, Reno, NV, USA

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Universidad de Malaga, Spain  
Technical Program Co-Chair  
B. S. Rawat  
University of Nevada, USA

C. Camacho-Peñalosa  
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**In Cooperation With:** International Union of Radio Science (URSI)  
IEEE Northern Nevada Section

The 7th International Symposium on Recent Advances in Microwave Technology will be held in the attractive city of Malaga, Spain from December 13-17, 1999. The contributed as well as invited papers in any area of microwaves, electromagnetics, antenna and photonics; will be considered for this important international conference. Following is a partial list of some broad topics:

Microwave components and solid-state devices, antenna and radar technology, MICs/mm-Ics, remote sensing, biological effects and applications, communication systems, numerical methods and CAD techniques, propagation/scattering and measurements, electro-optics, optical communications/networks and sensors, microwave superconductivity applications, industry and environmental effects, signal processing, microwave photonics, microwave band gap crystals/materials, microwave education and all other topics of interest to microwave community. The working language of the symposium will be English. For detailed and the latest information, please visit the ISRAMT-99 web page:

<http://www.isramt99.ic.umaes>

Four half-day short courses on: (i) WDM/DWDM in optical communications; (ii) microwave photonics/band gap materials and applications; (iii) CAD of microstrip antennas; and (iv) design of GaAsFET devices are also being planned.

Prospective authors are invited to submit one original and three copies along with a diskette of a 4-page manuscript (in English only) prepared according to the instructions given below. The Technical Program Committee will select the papers for main sessions and poster sessions.

### Important Deadlines:

4-Page Paper Submission:	April 10, 1999
Acceptance Notification:	June 10, 1999
Paper Presentation Confirmation:	September 10, 1999
Pre-registration:	October 20, 1999

### Contributions and inquiries should be addressed to:

**(North/South America, Asia, & Pacific Region)**  
Prof. Banmali Rawat  
Technical Program Co-Chair  
Department of Electrical Engineering/260  
University of Nevada  
Reno, NV, 89557-0153, USA  
Telephone: (702) 784-6927  
Fax: (702) 784-6627  
E-mail: rawat@unr.edu

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Telephone: +34952131305  
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E-mail: isramt99@icumaes

### INSTRUCTIONS FOR PREPARING MANUSCRIPT

All papers must be written in English. Authors are requested to submit one original and three copies along with a diskette of a 4-page paper, including all the references, figures and photographs. The paper should be typed single-spaced in two columns on white paper 21.5 cm x 27.9 cm in dimensions. The title should be centered in capital letters 2.5 cm from the top of the first page. The author's name and complete organizational affiliation/address and e-mail address should be two lines below the title and the text should start three lines below this. Left and right hand margins should be 2.5 cm. A 2.5 cm margin should be left at the top and bottom of all pages. References should be cited according to IEEE MIT-S Transactions. Any contributed paper exceeding 4-pages will be rejected.

No paper will be published in the ISRAMT-99 Proceedings without Paper Presentation Confirmation from the author(s). A signed copyright form will be required for all the accepted papers. It is the responsibility of the author(s) to get necessary release from their company/organization.



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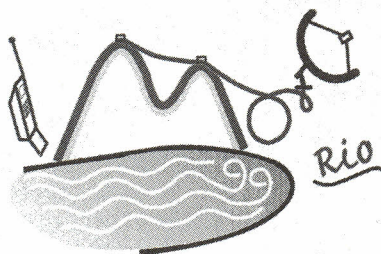
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UCSB, USA

# 1999 SBMO/IEEE MTT-S, AP-S and LEOS INTERNATIONAL MICROWAVE AND OPTOELECTRONICS CONFERENCE - IMOC'99

"Wireless and Photonics Building the Global Infoways"



Rio de Janeiro, Brazil, August 9-12, 1999

Hotel Sofitel Rio Palace, Copacabana Beach

## CALL FOR PAPERS

The SBMO/IEEE MTT-S, AP-S and LEOS 1999 International Microwave and Optoelectronics Conference (IMOC'99), is organized by the Brazilian Microwave and Optoelectronics Society (SBMO), co-sponsored by the IEEE Microwave Theory and Techniques Society (IEEE MTT-S), and technically co-sponsored by the IEEE Antennas and Propagation Society (IEEE AP-S) and the IEEE Lasers and Electro-Optics Society (IEEE LEOS). IMOC'99 will be held in the Hotel Sofitel Rio Palace, Rio de Janeiro, Brazil, in August 9-12, 1999.

This Conference will provide a major international forum for the exchange of information on research and recent developments in the field of RF, Microwaves, Millimetric Waves, Antennas, Radio Propagation, Optics and Optoelectronics.

Authors are invited to submit original work on the following suggested topics:

- |   |   |
|---|---|
| 1. Medical and Industrial Applications                | 12. Field Theory and Guided Waves         |
| 2. Microwave and Optical Materials                    | 13. Numerical Methods in Electromagnetics |
| 3. Microwave and Millimetric Wave Integrated Circuits | 14. Antennas and Arrays                   |
| 4. Monolithic Integrated Circuits                     | 15. Scattering and Diffraction            |
| 5. Optical and SAW Devices and Techniques             | 16. Radio Propagation and Remote Sensing  |
| 6. Active and Passive Devices and Components          | 17. Radio and Radar Meteorology           |
| 7. Microwave/Optical Integration                      | 18. Wireless and Mobile Communications    |
| 8. Packaging Techniques                               | 19. Digital and Radio Systems             |
| 9. Computer Aided Design and Modeling                 | 20. Optical and Satellite Communications  |
| 10. Microwave and Optical Measurements                | 21. Plasma Technology                     |
| 11. Microwave Techniques in Radar and ECM             | 22. Military Applications                 |
|   | 23. Others                                |

A selection of invited speakers will highlight important and developing areas.

The details for paper submission, including a template, are available in our home-page, <http://www.mc21.fee.unicamp.br/imoc99/>. Failure to submit a paper following our instructions may result in its rejection.

## DEADLINE FOR PAPER SUBMISSION: March 08, 1999

The papers will be assessed by an international review board. English will be the official language of the Conference. Extended versions of selected papers may be published in special issues of the IEEE MTT Transactions, IEEE AP Transactions and the IEEE/OSA Journal of Lightwave Technology.

Please, forward all submissions and inquiries to:

IMOC'99

UNICAMP-FEEC-DMO

PO Box 6161

13083-970 Campinas - SP, Brazil.

Tels.: +55-19-7883735, +55-19-7883704, Fax: +55-19-2891395

[imoc99@dmo.fee.unicamp.br](mailto:imoc99@dmo.fee.unicamp.br)



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Date of Birth DAY MONTH YEAR ☐ Male ☐ Female

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► A baccalaureate degree from an IEEE recognized educational program assures assignment of "Member" grade. Information regarding your initial technical degree is vital to proper grade assignment.

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Email Address

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GRADE

YEAR MEMBERSHIP EXPIRED

Please send all IEEE mail to my: ☐ Home Address ☐ Business Address  
If not indicated, mail will be sent to home address.

## 4 SIGNATURE OF APPLICANT

I hereby make application for IEEE membership and agree to be governed by IEEE's Constitution, Bylaws, Statements of Policies and Procedures and Code of Ethics.

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► Application must be signed.

Over Please

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A. What is your employer's primary line of business at your location? If you do not work for an employer, please identify your line of business.

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9. Industrial Equipment, Controls & Systems
10. IC's & Microprocessors
11. Semiconductors, Components, Sub-Assemblies, Materials & Supplies
12. Aircraft, Missiles, Space & Ground Support Equipment
13. Oceanography & Support Equipment
14. Medical Electronic Equipment
15. Original Equipment Manufacturers Incorporating electronics in their end product (not elsewhere classified)
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17. Government Agencies & Armed Forces
18. Companies Using &/or Incorporating any Electronic Products in their Manufacturing, Processing, Research or Development Activities
19. Telecommunications Services, Telephone (including) cellular
20. Broadcast Services (TV, Cable, Radio)
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24. Other commercial Users of Electrical/Electronic Equipment & Services (not elsewhere classified)
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26. University, College/Other Educational Institutions, Libraries
27. Other (please specify below)

B. What is your principal function?

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2. Engineering Management
3. Project Engineering Management
4. Research & Development Management
5. Design Engineering Management-Analog
6. Design Engineering Management-Digital
7. Research & Development Engineering
8. Design/Development Engineering-Analog
9. Design/Development Engineering-Digital
10. Hardware Engineering
11. Software Design/Development
12. Computer Science
13. Science/Physics/Mathematics
14. Engineering (not elsewhere specified)
15. Marketing/Sales & Purchasing
16. Consulting
17. Education/Teaching
18. Retired
19. Other (please specify below)

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2. Management other than Engineering
3. Engineering Design
4. Engineering
5. Software: Science/Management/Engineering
6. Education/Teaching
7. Consulting
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3. General Manager
4. VP Operations
5. VP Engineering/Dir. Engineering
6. Chief Engineer/Chief Scientist
7. Engineering Management
8. Scientific Management
9. Member of Technical Staff
10. Design Engineering Manager
11. Design Engineer
12. Hardware Engineer
13. Software Engineer
14. Computer Scientist
15. Dean/Professor/Instructor
16. Consultant
17. Other Professional/Technical (please specify below)

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	16 AUG. 98 - 28 FEB. 99 PAY FULL YEAR ONLY	1 MAR. 99 - 15 AUG. 99 PAY HALF YEAR ONLY
RESIDENCE		
United States.....	\$113.00	\$56.50
Canada (includes GST)*.....	\$107.00	\$53.50
Canada (includes HST)*.....	\$114.00	\$57.00
Africa, Europe, Middle East.....	\$ 97.00	\$48.50
Latin America.....	\$ 90.00	\$45.00
Asia, Pacific.....	\$ 91.00	\$45.50
Proceedings of the IEEE.....	\$ 23.00	N/A

\* IEEE Canadian Business No. 125634188

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To: First Union Bank, 550 Broad Street  
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Add \$15.00 for bank fees  
Send bank verification and transfer number, confirming fund transfer, with this application.

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Bermuda	Gibraltar	Malawi	Panama	Tunisia
Bolivia	Gilbert Isl.	Malaysia	Paraguay	Turkey
Burundi	Greece	Maldives Rep.	Peru	Zambia
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Cayman Isl.	Hong Kong	Mauritius	Portugal	
Chile	Iceland	Mexico	Singapore	
Columbia	Indonesia	Morocco	Solomon Isl.	

Your bank may charge a significant additional fee to your account at the time of collection of funds.

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Applicants who certify that their prior year's income did not exceed US \$8,600 or equivalent are granted a 50% reduction in: full year dues, regional assessment and fees for one IEEE Society. Please submit written certification with application and payment. Student members are not eligible. □ I certify I earned less than \$8,600 (US dollars) in 1998.

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Please check (✓) appropriate boxes

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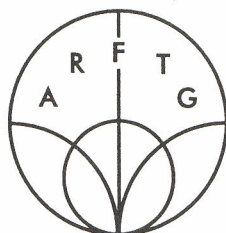
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## Advance Call for Papers

### 53rd Conference — Anaheim, California — June 18, 1999 *Nonlinearity Characterization*

In conjunction with the 1999 IEEE MTT-S International Microwave Symposium, the Automatic RF Techniques Group will hold its 53rd ARFTG Conference in Anaheim, Calif. on Friday, June 18, 1999. This conference will focus on the theme, *Nonlinearity Characterization*, featuring sessions on measurements and CAD methods for nonlinear radio-frequency devices.

Characterizing nonlinearity in radio-frequency devices and components is critical to a wide variety of communication systems, particularly in low-cost mobile digital communication systems. Device engineers require accurate large signal models with measurement techniques for verification, and system engineers demand device and circuit parameters to predict link performance. However, nonlinearity limits the application of parametric descriptions across the different stages of system development. The 53rd ARFTG Conference is devoted to advancing important methods for quantifying and describing nonlinear effects in RF devices, circuits, and systems.

We solicit original papers on nonlinearity characterization for:

- digital mobile communication
- wireless local loop
- LMDS and MMDS
- digital cable and broadcast television systems
- LEOS and other satellite communication systems
- wireless LAN
- other microwave and millimeter-wave communication links

We especially seek papers on measurement requirements and methods, instrumentation, model parameter extraction, model verification through measurements, performance results, and general nonlinear analysis in communication systems.

Papers are also invited in other areas of automated microwave and RF measurements, including network analysis, calibration techniques, on-wafer measurements, power, and noise.

Contributed papers will be presented as 20 minute talks or in an interactive poster session. Authors are requested to submit a one page abstract and a 500 to 1000 word summary, including illustrations, to allow evaluation with regard to the interests of the participants and the quality and novelty of the work. Please make your submission electronically to the Technical Program Chair no later than **March 19, 1999**. For further details, please see Instructions for Abstract/Summary Submission at our conference Web site ([www.arftg.org](http://www.arftg.org)).

Final deadline for full camera ready papers is **April 30, 1999**. Please see Instructions for Authors at [www.arftg.com](http://www.arftg.com) for submitting accepted papers. If your paper is accepted, you will also be invited to submit an extended version for publication in the Special Symposium Issue of the *IEEE Transactions on Microwave Theory and Techniques*.

Additional information can be obtained from the Conference Chair. For information on an outstanding exhibition opportunity, please contact our Exhibits Chair.

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