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EDITOR: ROBERT D. GOLDBLUM

KEYNOTE ADDRESS INTERNATIONAL SYMPOSIUM ON **ELECTROMAGNETIC COMPATIBILITY** DR. IRENE C. PEDEN, **PROFESSOR OF ELECTRICAL ENGINEERING** SEATTLE, WA, AUGUST 2, 1988

It is a pleasure to have this opportunity to spend a few minutes with you. We have much in common, those of you in EMC and those of us in my principal IEEE Societies-Antennas and Propagation, Geoscience and Remote Sensing, and Education. We have areas of common technical interest, and undoubtedly overlapping memberships as well, not to mention mutual concerns for the education of those individuals who will populate our fields in the next generation. I want to touch upon some of those common features in my brief time with you.

The Antennas and Propagation Society is my principal focus for the next few years. In AP-S, we think of ourselves as the "inhomogeneous wave equation people." Perhaps many of you do, too-indeed, from a reading of the Conference program, I deduce that it was a coin toss as to whether some of your papers would be submitted here or to the AP-S/URSI Symposium held in Syracuse earlier this summer. In a certain sense, perhaps, our visions of the world are complementary. We design antenna structures as if they were to be alone in the Universe. You know better than that, and deal with their effects on everything that is really there. When I think of EMC, I

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think of a cartoon I saw years ago. It showed a sea of rooftops all containing antennas, each of which was trying to be higher than all the rest. And all uncoupled, of course.

The next generation of electromagnetics-oriented electrical engineers is a topic of interest to us all. The IEEE Education Society is planning a special issue, due out next year, on electromagnetics education. It will be edited by Bob McIntosh, a former President of both AP-S and G-RS, and a faculty member at the University of Massachussetts, one of the academic institutions at which electromagnetics education has not been relegated to a back seat by the faculty. Some of the pressing problems of electromagnetics education are sure to be addressed in this issue, and I see resolution of these as crucial to the future of our fields-if we are to keep a talent pool of EE graduates who are qualified and interested in electromagnetic compatibility as well as in antennas, wave propagation, scattering, remote sensing, etc.

There has been a tendency on the part of electrical engineering faculties over too many recent years to de-empha-

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EDUCATION COMMITTEE NEWS

The following Education Committee report was presented to the Board of Directors at their August 1, 1988 meeting in Seattle, Washington.

The Distinguished Lecturer Program is in full operation with all four lecturers having been selected. They are Herb Mertel, Roger Southwick, Scott Bennett, and Don Heirman. Two lectures have been presented to date. An evaluation form, used to obtain feedback on the lecturer's performance, has been developed and will be used in the future.

An article by Kimball Williams "KEEPING THE PEACE: Insuring Compatibility between the Electromagnetic Environment and Electronic and Electrical Devices" will be published in the October issue of *Potentials*, the IEEE student magazine.

There has been no additional progress on the *Experiments Manual* or the *EMC Bibliography*.

In the future information on EMC courses and seminars will not be included in the Education Committee News column in the *NEWSLETTER*. This change is due to the large number of courses being presented, the limited information I receive about the courses, the difficulty in being fair to everyone, and the long lead time for editorial material in the *NEWSLETTER*.

Henry Ott Chairman, EMCS Education Committee Henry Ott Consultants 48 Baker Road Livingston, NJ 07039 (201) 992-1793

ISATA '89

The 20th International Symposium of Automotive Technology and Automation will be held in Florence, Italy from May 29 to June 2, 1989, and will concentrate on the topics of mechatronics—the use of electronics for product design, testing, engineering, and reliability. Authors wishing to give papers at the Symposium should submit the title and a short summary of 100–150 words before November 18, 1988. The final manuscript should be received by February 17, 1989. Topics of particular interest include:

- Electromagnetic interference testing
- Electromagnetic compatability testing
- Reliability

For further information, contact:

ISATA Secretariat 42 Lloyd Park Avenue Croydon CRO 5SB United Kingdom Telephone: 01-681 3069/01-686 1329 Telefax: 01-686 1490

NEWSLETTER STAFF

EDITOR

Robert D. Goldblum R&B Enterprises 20 Clipper Road W. Conshohocken, PA 19428

ASSOCIATE EDITORS

CHAPTER CHATTER	Charles F.W. Anderson 2302 Keener Road Hagerstown, MD 21740
BOOK REVIEWS	James S. Hill The EMXX Corporation 263 N. Main Street Hudson, OH 44236
EMC PERSONALITY PROFILES	William G. Duff Atlantic Research Corporation 5390 Cherokce Ave: Alexandria, VA 22314
ABSTRACTS	William H. McGinnis Southwest Research Institute P.O. Drawer 28510 San Antonio, TX 78284
PHOTOGRAPHER	Fred J. Nichols LectroMagnetics, Inc. 6056 W. Jefferson Boulevard Los Angeles, CA 90016
EMC STANDARDS ACTIVITIES	Herbert Mertel EMACO, Inc. P.O. Box 22066 San Diego, CA 92122
EMCS EDUCATION COMMITTEE	Henry Ott Henry Ott Consultants 48 Baker Road Livingston, NJ 07039
EMC-S BOD ACTIVITIES	Donald N. Heirman AT&T Information Systems Crawfords Corner Rd. Building 41–112 Holmdel, NJ 07733
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INTER-SOCIETY ACTIVITIES	Walt McKerchar Electromagnetic Engineering, Inc. P.O. Box 1888 Poulsbo, WA 98370-0269
PCs FOR EMC	Edmund K. Miller Rockwell Science Center P.O. Box 1085 1049 Camino dos Rios Thousand Oaks, CA 91360
EMC CERTIFICATION & ACCREDITATION	Russell V. Carstensen, P.E. Naval Air Systems Command AIR 5161 CG1, Room 940 Washington, DC 20361

size the core courses in our area in favor of more and more in computer engineering and other information-related topics. This is a response to the burgeoning amount of material that needs to be taught to undergraduates nowadays and to the fact that we have only four years. Five year programs have been tried by academic institutions in the past, and they have all failed. In the foreseeable future, we have to assume that we have just four years. At the University of Washington, we have just one core course in e-m, and we are not unusual. Students have flooded into computer-related courses, and they find them easier to digest in the introductory stages. The serious study of electromagnetics and its applications takes longer range goals and persistence. One introductory course is not sufficient in a mature field, in which to develop modern applications from the basics to the design level. It seems to the uninitiated that the basics ought to have been taken care of in the prerequisite physics courses, but we do not find this to be the case except with the unusually talented student. We have to put the concepts learned in introductory physics together with the mathematics that was (partially) learned out of context in the math department, and at the same time impart the engineering point of view that was missing in both. All this in ten weeks! The human mind needs integration time, and one course is not enough in which to capture the interest of the general student. We teach them the only 3-dimensional concepts they will get in the undergraduate curriculum, and the only material that involves quantities that have both magnitude and direction while also varying in time and space. Many of them find all this difficult to put together into a fabric that is well enough understood to permit appreciating what you can do with it. It is a mixed blessing that only the best students seem to get turned on by the core electromagnetics experience. We want the best students, as everyone does, but we do lose a share of them to other specialty areas! At the same time, there is room in the profession for many who could be very competent if they would just stick with it, even though they might not win any prizes. Our senior electives and graduate courses tend not to be heavily populated although the students in them are just great. We get top-notch research students, too, and have been enjoying a recent resurgence of interest from such students as well. But we still may not be getting enough in terms of numbers to satisfy the demands of industry for young engineers who are competent in electromagneticsrelated work, particularly design.

Interest in experimental work has fallen off among students in recent years. They all love to program and are anxious to do projects that involve computer simulations —a necessary but not sufficient art, in my view—not capable of describing all aspects of the real world. Model validation is a real showstopper in many contexts, and it is something AP-S is giving serious attention to right now. I'll come back to that. My immediate point is that there are very few academic departments left in which electromagnetics core coursework is sufficient in quantity, intellectual content, or excitement to draw students into more advanced work and thus to take care of the needs of our mutual professional endeavors.

There are relatively few EE departments now in which new young electromagnetics faculty are being hired to take the places of those of us of the retiring generationin spite of the success we have had in research and teaching. To those of you who employ our graduates, I would say that if you share this concern, there are several kinds of actions you might be able to take that would help to keep the pipeline full. Students vote with their feet, and they are sensitive to the job market. When there are good jobs in a particular field and when this is very visible, students want to know what they need to know to qualify for them. Electromagnetics education is still alive and well, though somewhat shrunken in size, because of this. If you or your company give money or equipment to academic institutions from which you hire, let them know with your gifts where your priorities lie. When you have good design problems that can be broken into chunks that students can handle (and when they can be stripped of proprietary aspects into generic problems that involve basic principles), get such problems to your friends on faculties. We welcome that kind of help, and it would be a significant pulse for progress in electromagnetics education.

It is not implied that all of our problems begin in the junior year when the engineering student reaches the point of choosing a major field. Students arrive at the universities with shortfalls that we cannot completely compensate. We hear much nowadays about how engineers should enter into the public/political arena and make their presence felt. Perhaps more of us should run for school boards or, at least, attend their meetings and bring our concerns to the attention of those responsible for curriculum in the public schools. That would be an important pulse for progress in pre-college education. Many of the basics seem to have gone by the boards in the public schools. They include spelling and grammar, math skills, and generalized attitudes toward working to achieve your long-range goals. Students will work-I sometimes hear it said that they won't, but this is not my sense of how they are. They will work, but for a short-term payoff. And as has been suggested before, the short-term payoffs are rarely seen as being in electromagnetics and its modern world applications. We try to transmit as much of the excitement as we can in the introductory course that they all take, but it does not "take" with as many as we would like. Perhaps the forthcoming issue of the Transactions on Education will contain articles that share the successes of others to the benefit of us all. If so, it will be a significant pulse for progress.

The Education Committee of AP-S does interesting and relevant things, too. It organizes and offers short courses and workshops at symposia, including a special session on software validation at the last one. This reflects the priority given to current concern for the proliferation of computational work. The focus now is on developing some protocols for validating and comparing numerical results. It may be appropriate to select some benchmark problems for assessing errors in various numerical solutions and then to catalog those problems. Benchmarks would need to be solvable-i.e. the separable boundary value problems. The discussion also included the need to develop validation observables and procedures. The Education Committee also has interests in software relevant to engineering education and for application to areas of interest to AP-S members. "Reviews" of existing software have been proposed to save colleagues time and experimentation. Our Distinguished Lecturer Series has been the focus for some highly valued video tapes of these unique educational experiences. For example, a tape has just been completed on array design by Professor Bob Elliott of UCLA, our 1988 Distinguished Achievement Award recipient.

The AP Society has a great and growing interest in radar cross section theory and practice and has just established a technical committee on RCS that expects to continue holding sessions at the annual symposium and, possibly, to organize workshops or short courses as well. It will also solicit feature and/or designer corner articles for our very popular newsletter. We also see the coming need for new technical committees, such as electromagnetics software (beyond the purely educational), superconductive antennas, etc. These will be pulses for progress in our fields of professional interest.

We have had to cap our very excellent newsletter and are pushing at the seams of our *Transactions*; the possibility of starting a second has been proposed. Our historic name does not reflect areas of current intensive activity, and it has been suggested that it might be time to look for a new one. The time may be right for some combination of these accommodations to present research and development thrusts.

We maintain close ties with URSI, particularly Commission B, and with colleagues in the Antenna Measurement Techniques Association; and we participate in cooperation with organizers of other meetings—*i.e.* the Sixth World Telecommunications Forum (Geneva, 1991) and a March meeting of the Applied Computational Electromagnetics Society (Monterey, 1989). Perhaps we should be talking with you, too. Certainly our sense of collegiality includes EMC.

The work you do is terribly important. It is the kind of challenge that is often relegated to the "too hard" box. Getting together to share with each other the innovative ways you have found to approach and to solve problems is one of the premier ways we have to push the frontiers out a little farther. I certainly wish you a most productive and interesting Symposium. Seattle is proud to be your host, and I join the local Chapter and Section in hoping that you get a lot of good work done. May the Forces be with you, may the fog stay away, and may your Pulse for Progress create a step function that holds until you come together again.

About the Speaker

Irene C. Peden is a Professor of Electrical Engineering at the University of Washington, Seattle, where she teaches courses in electromagnetics, antennas and remote sensing and system theory. She received a B.S. degree from the University of Colorado, Boulder and M.S. and Ph.D. degrees from Stanford University, all in electrical engineering. An IEEE Fellow, Dr. Peden is 1988 Vice President and President-elect of the IEEE Antennas and Propagation Society and a former Vice President of the IEEE for Educational Activities.

1989 EMC SYMPOSIUM TRAVEL INFORMATION

The 1989 International Symposium on EMC is scheduled for September 8–10, 1989 in Nagoya, Japan. Nagoya is a city with a population of about two million, located an hour's travel south of Tokyo. This is the second international EMC Symposium to be held in Japan. As before, the official language will be English. There will be a technical exhibition held concurrently with the symposium technical sessions. A special program including sightseeing and shopping is planned for spouses. Technical visits are being arranged, and a post conference tour is planned.

International travelers reach Nagoya through Tokyo airport. Travelers will pass through customs there before flying on to the Nagoya airport. Limousines will then take them to the Nagoya Tokyu Hotel. To take advantage of low group fares, we are organizing a group for travel to and from Nagoya. The schedule will provide for arrival in Nagoya two days before the symposium opening. This arrangement will allow time to attend committee meetings, to set up exhibit booths, or to do a little sightseeing on September 7. Return travel will allow an optional return date to allow for additional business or sightseeing opportunities. Group members need not return as a group.

Travel to Japan will be from one or two international airports, possibly San Francisco and New York. Those requiring travel to one of these airports can take advantage of low "add-on" fares.

In Nagoya prices for food, lodging, and transportation are about the same as in other large cities around the world. In September the daily temperatures average a high of 81 and a low of 68 degrees Fahrenheit.

Arrangements will be made for U.S. carriers to provide transportation for government employees as required by government regulations. For more details on the EMC Group Travel Plan contact Jim Hill, 263 N. Main Street, Hudson, Ohio 44236, or telephone (216) 650-6230.

PRESIDENT'S MESSAGE

The EMC symposium held in Seattle this past August was a rousing success. General Chairman Don Weber and his committee are to be congratulated on a well-planned and well-executed symposium. At the symposium, our Society observed and celebrated its 30th anniversary. Chairman Weber reminded us how fast technology is changing these days. During his opening speech at the plenary session, he pointed out that in 1958 the laser concept was invented by Townes, the integrated circuit was invented by Kilby, and the Van Allen belts were discovered. He also noted that during the latter part of 1957 the Soviet Union launched Sputnik, that the United States launched Explorer I in early 1958, and that the first domestic jet airline passenger service was inaugurated between New York and Miami on December 10, 1958. There truly has been tremendous progress over the last thirty years, and our Society has been a part of this progress. I would like to reflect on our Society's past and attempt to identify some of the issues we must address in the future.

For those of you who may not be aware, the August 1988 *EMC Transactions* is the Society's Silver Anniversary issue. This publication has a number of papers that record the history and progress of our Society. Dr. Andrew Farrar pointed out in his paper that EMC technology "is basically a combination of all the disciplines employed in the fields of communications and electronics (CE), taken in the broad sense of those terms." Because of its diversity and its derivation from other disciplines, the early practitioners of EMC technology were challenged to set forth a charter and to establish an awareness as to what EMC technology was all about. In my opinion, one of the greatest accomplishments over the past thirty years has been the establishment of EMC technology as a new and respected discipline.

EMC technology has moved from applications primarily in the aerospace and DoD-related disciplines to everyday applications in the industrial, commercial, and domestic fields. Of course, this accomplishment could not have been achieved without significant technical contributions and dedication on the part of people within our Society and within the EMC community at large. It is my observation that EMC engineers are very loyal and devoted to their discipline, and I think it is this loyalty and devotion that give our Society its high degree of professionalism and camaraderie. It is gratifying to see many of the Society's Founders still attending symposiums and taking part in the Society's activities.



by Donald E. Clark

What are the issues that will confront the EMC Society in the future? Everyone can probably identify a different set of issues depending on one's perspective. Here, I have identified three that I think would be near the top of everyone's list. The three issues are tests and measurements, education, and information exchange.

In the October 1984 issue, the periodical Microwaves & RF published the results of a poll of professionals within the EMC community. The poll identified the area of tests and measurements as one of the biggest challenges facing the EMC community. Specifically, the article stated that the poll respondents "cited a lack of test equipment and confusing or non-existent standards as their biggest problems." Test equipment problems still exist today, but overall we have made great strides in test instrumentation. We have moved from the AN/URM-3 and the Empire Devices NF-105 to field intensity meters which can be computer-controlled and to spectrum analyzers with built-in microprocessors. However, there is still a need to develop better test facilities and procedures which will yield repeatable test results. There has always been a controversy about measurements in shielded rooms; anechoic chambers have only recently been used widely for EMC measurements, and there are still disagreements about the best configuration and procedures for open-site measurements. Thus, in the future, I think we must continue to develop test and measurement technology and its associated methodology.

Another issue we must continue to pursue is education. In his article, Dr. Farrar stated that "the need for teaching EMC fundamentals to a large number of engineers is both technologically and economically expedient." For EMC technology to continue to mature, we must attract both student engineers who are acquiring the fundamentals in undergraduate courses and, most definitely, those students in graduate school. To my knowledge, there is no university or college which offers optional studies in EMC technology. Granted, EMC technology may be too specialized for an undergraduate curriculum, but the fundamentals could be introduced as part of circuit design and electromagnetic courses. However, a graduate curriculum in EMC technology does seem appropriate. I know of at least one university which offers a graduate program in electronic warfare, which is a highly specialized discipline. Should the EMC Society take the initiative in the future by developing a model EMC curriculum? Might we invite officials from "candidate" universities to discuss and to review a model EMC curriculum?

Information and the exchange of information has always been an important aspect of EMC technology. It has always been a challenge within the community to transfer technology to engineers in other disciplines and to the nontechnical managers charged with planning and developing systems. John Naisbitt in his book *Megatrends* states that "we are drowning in information but starved for knowledge." He contends that we are becoming overwhelmed by information pollution and that we don't necessarily need more information. Rather we need better means of selecting information. It has been my observation that EMC practitioners sometimes "reinvent the wheel" because of lack of information about past work. We need to find ways to make it easy for design and application engineers to select EMC information that is already available. Naisbitt also contends that society as a whole is moving from national economies to a world economy and that we will all become a part of a "global village" in the future. This global village will no doubt have to apply EMC technology to prevent "electronic pollution." The challenges for the EMC community will be how to exchange information within this village and how to make the needed information readily selectable.

I think we can look forward to the coming decades with optimism. We can be proud of our past accomplishments, but we must identify the challenges of the future. It is essential that we continue to develop our technology, that we attract young engineers schooled in EMC technology, and that we learn how to make pragmatic information, as opposed to mere facts, available on both national and international levels.

CHAPTER CHATTER

CENTRAL NEW ENGLAND

This Chapter has scheduled a meeting for October 18 at which Mike Hopkins of Keytek will give a talk on ESD. John Clarke promises to provide more information for the next issue.

SANTA CLARA VALLEY

The May meeting of the Santa Clara Valley Chapter featured Bob Steinfeld, Product Compliance Engineering Manager at Apple Computer. Bob's subject was "An EMC Guide for Computing Devices." He cited some *lessons learned* and reviewed ways to reduce EMI problems with minimum rework and expense.

TOKYO

On March 18 the Chapter meeting was attended by fiftyfive engineers, twenty-one of whom were IEEE members. Topics of papers presented included: use of absorbing materials in shielded rooms to improve measurement accuracy; transmission characteristics of building power lines is related to their use for intrabuilding communications; and studies of asymetrical magnetron spectra which indicate that such anomalies are due to frequency fluctuations during pulse rise/fall time, rather than to mode jumping.

Fifty-six, including 19 IEEE members, attended the April meeting. As usual there was a wide diversity of topics covered. One of the papers presented dealt with antenna



by Charles F.W. Anderson

calibrations in the 1.0 to 2.5 GHz range. Additional subjects were the shielding characteristics of conductive plastic composite materials and the use of ferrite absorbers to reduce television *ghost images* caused by reflections from high-rise buildings.

On May 20 the Chapter held its monthly meeting with forty-three present. Twelve were IEEE members. Papers covered topics such as lightning channel computer simulation, ferrite absorbers, and chemical treatment for ground resistance reduction.

The June 24 meeting had a total attendance of fifty-one; sixteen were IEEE members. A wide range of topics presented included effects of through holes in PCB's, UHF bioeffects with the human skull modeled as a multilayered sphere, and a comparison of radiated noise measurements at the three and ten meter-distances. [Our thanks to Chapter Chairman Toshihiko Namekawa for the information.]

BOD ACTIVITIES



by Donald N. Heirman

BOARD OF DIRECTORS MEETING IN SEATTLE

The second Board meeting of 1988 was held on August 1, 1988 at the Westin hotel in Seattle the day before the EMC International Symposium at the same hotel. All Board members were present, as well as several EMC Society members and guests attending the symposium.

President Don Clark called the meeting to order and reviewed the agenda. Next, he sought and received Board approval to allow Dan Hoolihan to serve as a Board member to replace Gilda Haskins, who has resigned. Dan's term expires at the end of 1988. Don Clark then introduced Secretary Janet Nichols, who reviewed last meeting's minutes. The Board approved the minutes with minor modifications.

President Clark then moved to the treasurer's report. Treasurer Dick Ford indicated that the Society's networth as of April 30, 1988, was \$350.5 K. Dick indicated that we have virtually recovered from the October stock market decline, which had significantly affected our IEEE long-term savings investments. The Board approved Dick's report.

Next Vice President Ed Bronaugh presented a review of long-range planning for our Society. In particular, our Society has several representatives to external organizations and to committees of the IEEE Technical Activities Board (TAB). These representatives do not report to any of the four technical directors. A suggestion was made that these activities could be organized more effectively by instituting this direct reporting system. Ed has requested that the four directors consider which of these committees should report to them. Also they should consider appropriate goals and objectives. This work is an important first step in bringing into better focus the many liaison functions maintained by our Society with a myriad of both IEEE and external organizations. An ad hoc committee chaired by Ed and comprised of Board members Hoolihan and Knowles will prepare recommended actions in this area.

Past President Len Carlson stated that he is reviewing our Constitution and Bylaws with the intent of bringing them up-to-date with current activities. The last revision was in 1979. The deadline for proposed changes is October 1. However suggested changes may be sent to Len even after that "target" date. For more information and a copy of the latest Bylaws, call Len at (206) 773-6297. The remaining major items discussed were as follows:

1. Director Bob Haislmaier (Communications and Services) presented his reports. Moto Kanda, *Transactions* Editor, reviewed his future plans for the *Transactions* and the appointment of associate editors. Much of this material was covered in my last NEWSLETTER article.

2. Next, Gene Cory, Symposium Committee Chairman, reviewed all planned symposia activity. He reported that the Society Audit Committee, on which he serves with Don Clark and Bob Haislmaier, had met with Hugh Denny and Ernie Donaldson of the 1987 Symposium Steering Committee. They reported that proper accounting of the symposium financials had been followed. Gene then made several motions which were approved by the Board:

- The Annual International Symposium in Regions 1–7 will be held during the August-November period. International symposia in Regions 8–10 will be scheduled during the April-June period; in this case, the Region 1–6 National EMC Symposium will be scheduled in the August-November period.
- The request to hold an EMC Symposium in Japan in the period May-June, 1994 was approved.
- Assistance will be provided to the Beijing, China IEEE Section in preparing to host the 1992 International Symposium in Beijing.
- An advance loan of \$500 was approved for the 1991 Symposium to establish a bank account for expenses.
- The report of the 1987 IEEE International Symposium Audit Committee was accepted.

Gene Cory received approval to supplement the *IEEE Conference Organization Manual* with our EMC Symposia Policy, our statistical data, recent attendees list, and exhibitors list. Any inputs for the supplement should be relayed to Gene at (512) 522-2711.

3. Next Jim Hill presented his History Committee Report. The plan is to microfilm the minutes dating back to the first Board meeting on November 20, 1957. That meeting was held in Asbury Park, NJ, the site of our 1969 symposium. Jim then reported on activities of the International Affairs Committee. The primary activity is to exchange our conference proceedings with those from other international symposia. This arrangement is in effect for the Zurich symposium and for the IEEE conference in York, England.

4. Director Don Heirman (Technical Services) first presented his Standards Committee Chairman's Report. The IEEE Standards Board approved the revision of our Standard 139 at its June meeting. Standard 139 covers in-situ measurement of RF emissions from industrial, scientific, and medical equipment. Final galley proofs for the revision of Standards 213 and 214 are being reviewed. Standards 213/214 cover use and construction of line impedance stabilization networks (LISNs). Our Standards Committee sent a letter of appreciation to Paul Lange, secretary of the IEEE Standards Board Review Committee for his long-time help in processing our many standards revisions. Paul has now retired. We wish him the best.

5. Henry Ott, Education Committee Chairman, presented his report. The Committee is preparing an EMC bibliography; anyone interested in contributing to this project, call Henry at (201) 992-1793. Henry then led a discussion of whether EMC courses and seminars should continue to be inserted in his EMC NEWSLETTER column. In all candor, he felt that he could not cover all courses or ensure the timeliness of their announcement.

6. Subsequently Henry introduced Dave Hanttula, Distinguished Lecturers Program Chairman, who announced that there are now four EMCS Distinguished Lecturers:

Term

Roger A. Southwick	2/1/88 to 6/30/89
Herbert K. Mertel	2/1/88 to 6/30/89
W. Scott Bennett	7/1/88 to 6/30/90
Donald N. Heirman	7/1/88 to 6/30/90

Our thanks and appreciation to these folks who have agreed to provide up to four lectures a year on various EMC topics. These lectures are available to local chapters or other organizations, even non-IEEE. The lecturers are paid by the Society, which covers their expenses for each presentation. If you need such a service, call Dave Hanttula at (415) 656-1661 or call the lecturer directly; Dave has their numbers.

7. Wilf Lauber, Chairman of the Technical Advisory Committee, reported by correspondence that plans for the 1988–1989 programs for each of our seven technical committees are underway. The TC's are looking for increased membership. Those interested in such activity should contact Wilf at (613) 998-2377.

8. Director Hofmann (Member Services) gave his report.

9. Charlotte Tyson, Awards and Membership Chairperson, indicated that, as usual, awards will be given at the Awards Luncheon at the Westin. She noted that the Chapter-of-the-Year Award had been re-established this year and that the New Jersey Coast EMC Chapter (jointly with APS and VTS) was the recipient. Tony Noerpel of Bell Communications is the Chapter Chairman.

10. Dan Hoolihan, Chapter Activities Chairman, indi-

cated that the petition for the formation of the first French EMC chapter has been forwarded to IEEE Headquarters. Congratulations to our French colleagues! Dan indicated that the Chapter Chairman Breakfast would be held later in the week.

11. Bill Duff, Fellows Committee Chairman, again made a plea for additional potential Fellow nominees. For details, call Bill at (703) 642-4049.

12. Director McKerchar (Professional Services) reported the drafting of a booklet which will describe the Society's activities and how each member can join in serving the Society. The final version will be available for approval by the November 16, Board meeting. If you want to see and comment on the draft, call Herb Zajac at (503) 627-4759. Walt mentioned that this year the employment analysis form that is available to all symposium registrants will include questions on the NBS National Voluntary Laboratory Accreditation Program (NVLAP) on MIL-STD-462 EMC testing. For a copy of this *NVLAP Handbook*, contact Russ Carstensen at (202) 692-8600.

13. Herb Mertel, Transnational Committee Chairman, presented a review of EMC membership outside Regions 1-6. Countries with more than 15 members include: England, India, Korea, Spain, Sweden, Switzerland, and West Germany. These countries have the minimum number of members to petition for Chapter status. For more information on that process, call Herb at (619) 578-1480.

14. Under New Business, the Board approved the withdrawal of its position paper in support of HR 5008 (Legislation to Permit FCC to Set Minimum Performance Standards for Susceptibility to Interference of Audio/Video Electronic Equipments). According to Don Heirman, this bill (proposed in June, 1982) has been overtaken by events.

15. A letter from Charlie Seth, Chairman of SAE Committee AE4, was discussed. His concern is the immunity of aircraft to RF interference, and he hopes to organize a panel of EMC experts to examine this issue.

16. Rich Pescatore, Chairman of the Product Safety Society, which is a non-IEEE private organization concerned with the safety of electronic products, presented a case for affiliation with the EMC Society. After considerable discussion, the Board approved the formation of a Technical Committee on Product Safety. Its purpose will be to consider electrical safety and to examine the interplay between the electrical safety and EMC characteristics of products.

17. President Clark adjourned the meeting at 4:45 p.m. The next meeting will be in San Diego, CA, on November 16. An executive committee meeting will be held the day before. The EMCS Standards Committee will meet, in the same room, 90 minutes before the convening of the November 16 Board meeting. For information, call Janet Nichols at 1-(800) 325-9814.

Respectfully submitted, D.N. Heirman, Associate Editor

TECHNICAL ACTIVITIES BOARD

PERIODICALS COMMITTEE

The TAB Periodicals Committee held its second annual meeting of the year at IEEE Headquarters on Monday, June 20, 1988. Most of the problems of late issues have been cleared up. The *Transactions on Broadcasting* received favorable comment for the dramatic improvements which have been made. The request of the Lasers and Electro-Optics Society for a periodical called *Optical Letters* was approved, and publication should begin soon.

The Headquarters staff brought to the committee's attention the issue of using the Transactions for conference and symposia records. This practice is to be discouraged for several reasons. First, it has an adverse impact on the price of the All Transactions Package although this is an issue for the Finance Committee. Secondly, conference and symposia records are to be handled via the Open Order Plan by the Service Center. However, the major concern of the committee had to do with the disparity between the peer review policy for Transactions and the normally much-less-stringent review given conference papers. One comment was that a meritorious paper presented at a symposium could, indeed should, be submitted to Transactions for review and subsequent publication; but, in general, conference papers-worthwhile though they may be-are not suitable for Transactions. The final resolution of this question will be made by the General Board of IEEE, but the Periodicals Committee is on record as being opposed to using Transactions for conference/symposia records.

In previous notes we called attention to the Periodicals Committee's interest in a booklet for *Transactions* editors similar to the informational booklets available on finances and conferences. There was some staff opposition to this proposal on the grounds that the editors and staff already work closely on publication preparation. While this is true, most of the cases of late publications have involved special issues where a one-time guest editor was in charge. The discussions also brought out the fact that Associate Editors seldom see the material furnished to the principal editor from Headquarters. The Periodicals Committee intends to go ahead with the preparation of an Editor's



by Chester L. Smith

Booklet. Staff was instructed to supply the Committee (via Barbara Ettinger) with the papers and other documentation now being used. We have an outline, but it is subject to drastic revision. Thoughts, comments or observations would be most welcome!

Two technical areas were brought up for discussion— "neural networks" and "superconductivity." The problem here is not that these topics are out of the purview of IEEE, but rather that they cut across the interests of several Societies. The staff had hoped that the Periodicals Committee might suggest ways of bringing these subjects into focus. Ladies and gentlemen—help! Your insights are needed.

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

[Dr. Smith chaired the meeting as Prof. Tien was unable to attend. The next meeting of this committee is scheduled for October 10, 1988.]

POINT AND COUNTERPOINT

AN OBSERVATION

Invariably when I attend technical meetings, other participants tell me they have missed reading my column in recent newsletters, comment on issues discussed in previous columns, or ask me to write on matters bothering them. I remind these persons that this column was created to provide them with a "soapbox" from which their viewpoints could reach the membership and leaders of our Society. And, if they desire anonymity for fear their views may be misconstrued, their names can be withheld from publication.

THE EMC BANQUET

Robert Lucky (IEEE Spectrum, May, 1988) had it right when he wrote "when the dinner finishes, the program concludes with—nothing! Freedom!" Had the 1988 International EMC Symposium Committee ended the August 3, 1988 cookout Lucky's way, an event in extremely poor taste, one that transgressed the bounds of decorum for an international gathering of professionals, might have been avoided.

The announced guest speaker, supposedly a Soviet aerospace authority, told Russian ethnic jokes. I discreetly walked out as did a number of other attendees, who told me they considered the speech an affront to all the attendees and especially to those of Russian heritage. A further complication was the presence of two Soviet citizens.

The next day other EMC Society members expressed their dissatisfaction to me when I asked them to comment on the choice of ethnic humor for Society-sponsored occasions. We were dismayed that the Symposium Committee, in the name of our Society, had sponsored this entertainment. I related that a speaker's ethnic humor had caused problems at an earlier symposium, that the selection of speakers and their topics had been debated when I served on the Board, and that many years ago I had suggested that the Board develop policy guidelines for the selection of speakers and topics for Society-sponsored events. Again I recommend the development of guidelines, which should be furnished to the organizers of any event held under the sponsorship of the EMC Society. Perhaps readers would like to suggest standards and guidelines. If so, I would appreciate a copy. Conversely, if other readers feel that a Society-wide policy is not needed, I would appreciate letters explaining their reasoning.

PRIVATE ENDEAVORS OF PUBLIC OFFICIALS AND GOVERNMENT EMPLOYEES

This most interesting dilemma was discussed in a letter



by Anthony G. Zimbalatti

sent to me by a person who did not wish to be identified. Specifically when public officials or government employees participate as speakers, forum leaders, etc. in events sponsored by commercial enterprises which sell EMC products or which provide consultive or testing services, are these employees endorsing or apparently endorsing the product or service of the sponsoring business? Is there an ethical distinction depending upon whether the participant is paid or has expenses defrayed? The author has known of employees who do participate in such events. However I have also known of employees who decline to participate precisely because of the possible perception of an implied endorsement. Would issuing a disclaimer of endorsement or stating that one participated solely as a private citizen clarify this matter?

My opinion is that such an employee should decline even if he claims to speak as a private citizen or issues a disclaimer of endorsement. However if employees chose to appear, they should obtain prior documented permission from their employer, should identify all monies received, and should make clear that their participation is completely non-official and carries no endorsement. Similar conditions should apply to any employee who is recognized as working for a particular business enterprise. What is your opinion?

BLAZERS FOR EMC INTERNATIONAL SYMPOSIUM COMMITTEE MEMBERS

At the 1988 Symposium, committee members wore blue blazers. Many symposiums ago, committee members wore red blazers procured using symposium monies. Unfortunately that symposium suffered a big loss, and our Board of Directors stated that such procurements were inappropriate. Who paid for the 1988 blazers? If monies of the society were used, had such expenditures been identified in the symposium budget? If so, I believe the money could have been better spent. It appears that a guideline is needed to proclude such inappropriate purchases.

ACCREDITATION OF EMC PERSONNEL

Mr. Russ Carstensen has definitely taken a step in the right direction with the NAVAIR EMC Accreditation Program. So says Palmiro Campagna, P.E., an EMC engineer with the Canadian National Defense Organization. Palmiro feels that this program will impel the educational community to teach engineering students correct measurement procedures.

On the other hand, Mr. David Engle, Project Engineer, Grumman Melbourne Systems Divisions, feels that accreditation without corporate commitment will not necessarily be effective. David foresees an unstable situation since accredited personnel and laboratories may be in short supply and hence more costly, given the numbers of personnel and laboratories requiring accreditation. Also this scarcity could force costs upward because accredited personnel could demand more money or could change employers. Furthermore switching employers could jeopardize scheduled commitments or the survival of enterprises which must have accredited personnel in order to function. (David has over 20 years of EMC experience and is still active in EMC.)

Mr. Henry Burke, EMC Group Leader, Grumman Aircraft Systems Division, feels that NAVAIR accreditation will not necessarily yield better EMC products because equipment designers could ignore the recommendations of the accredited EMC engineer. Therefore corporate involvement may be necessary if accreditation is to be effective. Henry offers a possible solution. NAVAIR procurement documents could specify corporate penalties for inadequate compliance.

My latest thinking on accreditation leads me to conclude that organizations delivering products or services to NAVAIR should be accredited rather than accrediting only EMC laboratories or personnel. Organizations would continue accreditation as long as they met the established criteria which would include items such as: operational and relational features of EMC engineering to other project personnel, suitable number of accredited laboratories or engineers, or how accredited consultants or laboratories are to be procured, etc. In this way employers would have the responsibility of supplying accredited EMC engineering and would bear the penalty for having no accreditation. This should not be construed as an endorsement for or against accreditation, or the type of accreditation. Obviously, accreditation is desirable but there are problems like those identified above which will need to be solved. I urge that business enterprises be accredited as a part of the NAVAIR accreditation effort.

TEACHING ELECTROMAGNETICS

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

- Historical Perspectives
- Use of Laboratory Demonstrations in Classroom Lectures
- The Teaching of Optic Concepts in Undergraduate EM Courses
- Video Instruction-e.g. NTU
- Elective Microwave Courses
- Laboratory Courses
- Cooperative Educational Programs with Industry
- Teaching EM at the Graduate Levels
- Use of Computers in EM Instruction
- IEEE-Sponsored Instructional
- Approaches to EM Instruction outside the U.S.
- Curriculum Issues—e.g. Requiring One Course or Two?
- Reviews of EM Textbooks

Manuscripts should be submitted before December 1, 1988 to:

Bob McIntosh, Guest Co-editor Department of Electrical & Computer Engineering University of Massachusetts Amherst, MA 01003

EMC CERTIFICATION AND ACCREDITATION

PROGRESS REPORT

The workshop on certification and accreditation presented as part of the IEEE EMC Symposium in Seattle was well attended. Over a hundred people were there to participate and to raise questions. Two recurring concerns which continue to be raised at any public meeting are who needs to be certified and at what point. I will attempt to clarify these issues.

Certification deals with people. People who intend to offer their services directly (i.e. the product offered is the direct result of their intellectual labor) must be certified by NARTE as competent in the field of EMC engineering or EMC technology (in the case of technicians). The NAVAIR requirement will be that those persons in responsible charge of work must have certification.

Now for some examples of who is "in responsible charge" and therefore must be certified. It is intended that government employees and employees of engineering service firms functioning as work team leaders or section leaders (first line supervisors) must have certification. Also individual consultants considered to be in responsible charge fall into this category. The concept of responsible charge refers to that level at which technical decisions are made and implemented. Levels above first line supervisor tend to involve concurrence reviews i.e. not necessarily providing control.

Thus this requirement means that not all employees in a team need to be certified—only those in responsible charge. However, it means that to qualify, the parent organization must have on staff and available to the EMC task, a certified employee.

For manufacturers of products such an electronic systems or airframes, certification will not be required. This decision evolved from two thought lines. First, the product is tested for acceptance and stands alone, independent of the staff that produced it. Secondly, contracts for end products do not generally require specific labor categories for performance thus making enforcement impractical. If a prime item manufacturer were to offer the EMC portion of their staff directly (which is sometimes done for workload leveling), then those personnel offered directly would need to be certified as described above.

Accreditation applies to the laboratory as an entity in the holistic sense. Laboratories do not need to have certified people on staff to achieve accreditation. However, like the prime item vendor, if a laboratory were to offer a portion of their staff for direct EMC technical support (such as consultants), those personnel would need to meet the certification requirements.

SAE and EIA have both become involved in reviewing the technical requirements for accreditation. They have ac-



by Russell V. Carstensen, P.E.

cepted drafts of the critical elements for MIL-STD-462 testing and will be providing valuable insight from an industry perspective. At the EIA meeting on Friday following the symposium, an interesting point was raised. It was asked if the laboratory inspectors to be provided under NVLAP would be certified. Quite frankly, I had not given this issue much thought. We had circulated a request for volunteers amongst the Navy EMC community. In that request we had stressed concern about potential conflicts of interest from the standpoint of examining a competitor's facility. We have received offers from about ten possible participants. We are currently evaluating their resumes to confirm in-depth understanding and experience in MIL-STD 462 testing. Candidly the concept of certification was not included. We have since revised our standards to include certification as a requirement for laboratory examiners. NARTE is currently accepting applications and doing some internal processing, but they do not intend to award any certificates until October 1 (the "official" start date for the NAVAIR requirement). We have provided a list of the proposed NVLAP inspectors and have asked that NARTE review their credentials first so as to assure a credible cadre of laboratory examiners. NARTE has indicated that they can accomplish this task provided that they receive complete application packages from each of the applicants. NARTE will not release the laboratory examiners certification early so as to avoid inadvertently providing a competitive advantage to the individuals or to their sponsoring activity. NARTE will assure that candidates qualified as EMC laboratory examiners are also certified as EMC engineers or technicians.

The study guide pamphlet on the structure of the Certification Examination was not ready for the Seattle EMC Symposium as originally intended. We have had to reschedule release for about November.

A draft NVLAP EMC handbook for MIL-STD 462 accreditation was distributed for comment at the workshop. Additional copies can be obtained from NVLAP, National Bureau of Standards, Gaithersburg, MD 20899.

EMC PERSONALITY PROFILE





by William G. Duff

ROGER SOUTHWICK

Roger Southwick is one of four persons selected by the IEEE EMC Society as a distinguished lecturer. As a participant, he will give up to four lectures over a period of one year to EMC Chapters and to other EMC-related groups. The expense of these lectures will be paid by the Society. This program is intended to give local chapters the opportunity of having speakers from throughout the EMC community.

Roger recently left a staff engineering position at IBM Corporation to start his own business EMC Consulting. During the last six and a half years at IBM, he worked in the EMC department where FCC Part 15, Subpart J and "VDE-type" testing were performed. His specific assignments were to develop measurement methodology and automation for the type of measurement being performed in the laboratory. One assignment involved the evaluation of open field sites and an RF anechoic chamber. Roger published two papers on this topic. One dealt with site attenuation measurements, and the other concerned the comparison of open field sites. There was also an antenna project in which an ultra broadband antenna called the BOWTOP was built and successfully tested. A great deal of his time at IBM was spent in developing automated measurement techniques. This project resulted in a paper on the theory of the measurement of EMI signals, which will soon be published in EMC Transactions.

Roger was born on St. Patrick's Day, 1932, in New York. During the Korean War he served in the U.S. Navy as an electronics technician. With the G.I. bill, he attended the University of Denver where in 1960 he received a B.S. degree with a major in mathematics. He later took several graduate level courses in mathematics: His first EMCrelated position was with American World Airlines at Ft. Huachuca, AZ. Early in his career he held a number of positions in the EMC field including work for Frederick

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Research Corporation, Atlantic Research Corporation, and ECAC. Finally Roger took a position with the Department of the Army at Ft. Huachuca in the Spectrum Signature program. These experiences gave Roger a very comprehensive background in instrumentation and measurement methodology, and he has continued to pursue these topics.

Next Roger went to work for Southwest Research Instittute as a senior staff engineer. At SWRI he was initially a project leader involved in the development of a method to make power line impedance measurements with a highly sensitive current probe. A patent was issued on this current probe. His next project was the measurement of vehicle ignition noise and resulted in the design of an APD detector, which was also patented. Roger then moved back to Ft. Huachuca, AZ, where he worked for the Department of the Army once again. This time he worked on the measurement of degradation effects of multi-band receivers for ECAC. Then he accepted the staff engineering position at IBM. Now as a consultant, he advises in the area of EMC measurements, automation, training and site evaluation.

Roger has authored a long list of articles for EMC publications and holds two patents for EMC instruments. He is currently a senior IEEE member of the EMC Society and a member of USNC/URSI Commission E. His leisure activities include backpacking and hiking in Arizona and New Mexico. He combines these sports with trout fishing. For the past twenty years, he has practiced the martial arts; and for the past fourteen years, he has practiced Aikido. Last October he received his Shodan (black belt) certificate in Aikido. Presently he teaches Aikido classes to both adults and children. He is single with two grown sons from a previous marriage and lives in Tuscon, AZ.

PCs FOR EMC

This month we are pleased to present another guest columnist. The following reply was received soon after the appearance of the Summer 1988 column in which Dan Higgins lauded the attributes of FORTH as an alternative to FORTRAN. I introduced that column with the "tongue-in-check" comment that the subject of Dan's guest column "Alternatives to FORTRAN" was sure to be noncontroversial. As you'll see, Dr. Raines has some strong opinions of his own in this area.

IN DEFENSE OF FORTRAN

by Jerry Raines 13420 Cleveland Drive, Potomac, MD 20850

The Alternative to FORTRAN article by Daniel Higgins in the PCs for EMC Column struck a nerve of which I was heretofore unaware. This confirmed user of FORTRAN feels compelled to rise to the defense of a venerable tool.

FORTRAN has been serving the mathematically-oriented community for over 30 years. It is easy to learn, versatile, and probably the fastest number-crunching language generally available. Compilers are available for all types of computers ranging from the personal to the super so that any user has access to this language.

Despite its long term success as a science and engineering tool, FORTRAN has had detractors nearly every step of the way. Since its first appearance in 1954, countless novel languages have come and gone, each croaking the identical death rattle, "This language will make FORTRAN obsolete!" For example, remember ALGOL and PL/1? These were the trendy languages in my college years. In fact, FORTRAN has come nowhere near being osbolete because it has been systematically improved to keep pace with both advances in computer hardware and the desires of the user community. Thus, while I cut my programming teeth on FORTRAN IV, we now have FORTRAN 77; and a standards committee is working on FORTRAN 88. In view of this, Dan Higgins' stereotyping FORTRAN as the "QWERTY of computer languages" seem unfair.

Also, while we are speaking of old vs. new languages, note that Mr. Higgins includes BASIC and LISP in his list of "newer" ones together with ADA and Pascal. In fact, BASIC dates from 1956, and LISP also evolved in the late 1950's. Although one may argue technically that these languages are a few years younger than FORTRAN, one can hardly maintain that they were designed around today's generation of computer hardware. If FORTRAN is QWERTY, so must these be.



by Edmund K. Miller

Why does FORTRAN-bashing occur with almost seasonal regularity? Colleagues for whom FORTRAN is not the language of choice complain to me that is is "unstructured." What does this mean? As best as I can determine, they are objecting specifically to the careless use of the GO TO statement. This permits programs to leap suddenly across oceans of code and back again, leaving a tangled trail that is difficult to unravel or to understand. (From this behavior comes the uncomplimentary term "spaghetti code.") Granted, this occurs; however, it is an abuse of the language and does not occur in thoughtfully composed programs. Further, recent versions of FORTRAN feature END IF and related statements with a view towards reducing the temptation for such abuse. The revelation here, if any, is that FORTRAN can be abused. So can any language. So can any sophisticated tool. The remedy is not to throw out the tool. It is to educate the user. Good scientific programming, like good scientific writing, must be learned.

Now, this letter was not written to sing unconditional praises of FORTRAN. I am not a programmer by profession and have no more vested interest in this language than any other electromagnetics engineer (which, I hope to explain momentarily, is considerable!) I am convinced, however, that serious harm will come from unrestrained FORTRAN-bashing. To wit:

1. It promotes a computer software Tower of Babel. In an age when complicated software, especially in the electromagnetics and graphics disciplines, is proliferating like rabbits, the scientific community sorely needs a standard, portable, widely-understood language. FORTRAN has served that role admirably for over 30 years.

2. There will always be new and better (with respect to some particular attribute) languages coming along; however, to date, none have exhibited the staying power and adaptability of FORTRAN. To rush off in a burst of enthusiasm to embrace a new language every few years is at best a questionable use of intellectual energy. Remember, FORTRAN is a living, evolving language. That energy might be better deployed in contributing to its evolution.

3. Many great scientific thoughts and endeavors (for example, NEC) are implemented in existing libraries of FORTRAN programs. They will be underutilized or forgotten if no one but computer historians can read the language in which they are written. We will end up reinventing countless wheels for no good reason. Before abandoning a language because it may lack a few conveniences,

THE TRIENNIAL URSI INTERNATIONAL SYMPOSIUM ON ELECTROMAGNETIC THEORY

This symposium will take place at the Royal Institute of Technology, Stockholm, Sweden, August 14–17, 1989. It is an activity of Commission B "Fields and Waves," of the International Union of Radio Science (URSI) and will cover progress in all areas of electromagnetic theory. It is organized in cooperation with the Swedish National Committee of URSI (SNRV) and the Royal Institute of Technology. Contributions which describe recent and original results concerning new methods and/or applications are invited in all areas of electromagnetic theory. Authors are requested to submit a title and a full page abstract in English before November 15, 1888. Possible topics include:

- General scattering and diffraction
- Inverse scattering
- Numerical techniques
- Transient fields
- High frequency techniques
- Guided waves
- Antennas and arrays
- Propagation in random, inhomogeneous and nonlinear media

For further information, contact:

Prof. S. Strom Organizing Committee Chairman Dept. of Electromagnetic Theory S-100 44 Stockholm Sweden think of the rich body of knowledge it embraces.

The fact that FORTRAN is still with us after more than 30 years does not bespeak simple resistance to change. Rather, it speaks well of a language brilliantly and carefully conceived and ever adaptable to changing computer technology. Think carefully before jettisoning such a time-tested tool.

FIFTH ANNUAL REVIEW OF PROGRESS IN APPLIED COMPUTATIONAL ELECTROMAGNETICS

The Applied Computational Electromagnetics Society will sponsor this unique forum for information exchange in Monterey, CA March 21–23, 1989. Contributions by both users and developers of electromagnetic computer modeling codes are solicited. Possible applications include antenna analysis, electromagnetic compatability and interference scattering, microwave components, and MMIC technology. Abstracts should be received by January 6, 1989. Suggested topics include:

- Codes, modifications, and applications—including moment methods, finite elements and finite differences, spectral domain techniques, and GTD and asymptotic techniques.
- Graphical input/output issues
- Code validation
- New mathematical algorithms

Send abstracts to:

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

BOOK REVIEW



by Jim Hill, The EMXX Corp.

In this issue we are reviewing two books; each is a symposium proceedings contained in two volumes. The first is from the recent 9th International Wroclaw Symposium on EMC held in Wroclaw, Poland from June 28 to June 30, 1988. Through an exchange agreement between the IEEE EMC Society and the organizing committee of the Association of Polish Electrical Engineers, we have copies for sale to U.S. members at the nominal price of \$30.00 postpaid. Orders from outside the U.S. should be sent directly to the Wroclaw organizing committee. The address is EMC Symposium, Box 2141, 51-645 Wroclaw 12, Poland.

The second symposium proceedings is from the URSI-sponsored International Symposium on Electromagnetic Theory held in Budapest, Hungary, August 25 through 29, 1986. While this was not strictly an EMC affair, it contained many papers of interest to the EMC community.

NINTH INTERNATIONAL SYMPOSIUM ON EMC

June 28 to 30, 1988 SYMPOSIUM RECORD PUBLICATION 906 pages, paperbound, \$30.00

This symposium, recently held in Poland, addressed many subjects rarely found in past EMC symposia, such as seismological effects and EMC, the EM environment of the earth, EMC and EMP in industrial gas discharge and plasma processing. Ball, bead, and anomalous lightning and EMC were covered as well. English and Russian were the official languages of this Polish symposium, with simultaneous translation provided in the lecture halls. The papers in the proceedings are in the original author's language. Of the 154 papers, 97 are in English and 57 are in Russian. An English synopsis is provided with each Russian paper, and each paper in English has a Russian synopsis.

To point out the focus of attention in Europe, we quote from the symposium chairman's opening address. "This event faces the problem of rapid changes in technology. Due to the proliferation of inexpensive microprocessors, we see all around us equipment and systems getting smarter and more foolproof. Human beings get rid of repetitious and boring tasks. More and more new systems for energy control and communications of great sophistication and energy appear. . . All the more, highly sensitive devices and systems are immersed in the electromagnetic noisy space. The latter is comprised of signals and transients, radiated and conducted, mostly from nearneighbors. Luckily some of the new technologies will greatly simplify, in fact banish, EMI; whereas, others will bring us new headaches."

To clarify the content of these volumes, we'll list the 23 technical sessions with a brief comment on each one:

1. Ball, Bead or Anomalous Lightning and EMC.—4 papers—Ball lightning remains one of the few phenomena on earth where the fundamental principles are not understood.

2. EMC and EMP in Industrial Gas Discharge and Plasma Processing.—4 papers—This is an increasingly important field, and comments on its relationship to automotive ignition systems are included. 3. EMC in Amateur Radio Service.—3 papers—Danish and Japanese authors make suggestions for standardization of immunity evaluation.

4. EMC in Wire Communication.—11 papers—A variety of approaches to the problem were presented in this very popular session.

5. ESD, Lightning, EMP.—6 papers—Subjects include spacecraft and high voltage power distribution stations.

6. EM Environment of the Earth—9 papers—The increase in annual electrical energy production leads to significant contributions to the formation of the Electron slot and may bring about an increase in thunderstorm activity.

7. Seismological Effects and EMC.—3 papers—EM emissions at 82 kHz may be a means of locating an earthquake epicenter.

8. Antennas.—This was the most popular session with 24 papers presented.—With the use of higher frequencies, the interest in microstrip and other small size antennas is increasing. A variety of antenna-related subjects are examined.

9. EM Radiation Hazards.—3 papers—A Chinese paper dealt with the corrosion effect of power line interference on buried pipeline.

10. EMC and Biological Risks.—5 papers—Many different effects of exposure to 6000 V/m or 120 A/m are found. Frequencies of 8 kHz, 41 kHz and 45 kHz are used on rats over 20 to 45-day exposure times.

11. EMC Education.—1 paper—A Bulgarian viewpoint with a plan for EMC training courses in universities. Thesis: EMC is a distinct scientific branch with its theories, peculiarities, and problems; it is not an accessory, "a service subject" as some people regrettably think.

12. EMC in Mobile Communications.—3 papers—These included two theoretical papers and one paper based on test and measurement in China.

13. EMI Coupling Paths.—4 papers—An impulse technique is suggested for measurement and electric coupling. Immunity design may be checked with this technique.

14. EMI Measurements.—11 papers—An intelligent automotive measuring system for CISPR Recommendation 22 is proposed.

15. EMI Predictions and Analysis.—7 papers—The only English-language paper dealt with the conflict between desirable simplicity of measurement and its theoretical optimum.

16. EMI Sources and Reduction Techniques.—7 papers— One paper discusses the reduction of radio noise from arc welders in the 10 kHz to 30 MHz range.

17. Filters and Filtering Techniques.—3 papers—All papers are in Russian. One proposes a method to design monolithic dielectric filters for improved performance in EMC applications.

18. Grounding and Shielding.—4 papers—These include an interesting paper on EMC problems associated with nuclear magnetic resonance imaging systems.

19. Immunity of Electronic Systems.—4 papers—Integrated circuits tend to have resonances in the range of 20 to 100 MHz. This can be the cause of low immunity in this frequency range.

20. Power Lines.—9 papers—In Poland 750 kV transmission lines were put into service in 1985. The World Health Organization reported that field strengths of 20kV/m are harmless to human health. The maximum values found in Poland were about 12 kV/m.

21. Propagation.—10 papers—These papers represent an interesting collection of theoretical and experimental contributions.

22. Spectrum Management and Monitoring.—11 papers—One paper describes computer-supported systems for radio communications frequency planning. Cellular systems are also discussed.

23. Susceptibility and Vulnerability.—5 papers—The increase in the number of communication and computer devices on board vehicles requires extra attention by EMC engineers. Radio astronomy with the most sensitive receivers will require further studies of immunity and adaptivity.

These Symposium Proceedings are in two volumes, paperbound with a "perfect" binding. Page size is $8\frac{1}{4}$ by $11\frac{1}{2}$. The quality of both paper and printing are very good and superior to any to come out of Poland previously.

RECORD OF THE NINTH INTERNATIONAL SYMPOSIUM ON EMC NOW AVAILABLE

The record of the Ninth International Wroclaw Symposium on EMC has just been received, and orders are being taken. The symposium held in Wroclaw, Poland from June 28 through June 30, 1988 was the most successful of the series. It was attended by almost 300 participants from 24 countries, an increase of 35% over the previous symposium. In addition to the technical sessions, there were workshops and exhibitions of technology and literature.

The Book Review section of this issue of the *EMC Newsletter* contains a review of the symposium record. Copies may be ordered from Jim Hill at the address shown under "Newsletter Staff" on page 2 of this issue. The price is \$30.00 postpaid to any address in the United States. Outside of the United States, orders should be sent directly to the Wroclaw Symposium office—i.e. EMC Symposium, 51-645 Wroclaw 12, Box 2141, Poland. Telex: 712118 ilw pl.

U.R.S.I. INTERNATIONAL SYMPOSIUM ON ELECTROMAGNETIC THEORY

Budapest, Hungary, August 25 to 29, 1986 SYMPOSIUM RECORD PUBLICATION Elsevier Science Publishing Co., Inc. P.O. Box 330, Grand Central Station 856 pages, two volumes clothbound, \$326.00

These two volumes contain the proceedings of the URSI (International Union of Radio Science) International Symposium on Electromagnetic Theory. The meeting was organized by the Scientific Society for Telecommunication and the Research Institute for Telecommunication and was sponsored by URSI and the Hungarian Academy of Sciences. It was held concurrently with the Eighth Colloquium on Microwave Communication; there was a joint plenary session. Prof. T. Bercelli has done an outstanding job as editor of these proceedings. The technical program consisted of 185 papers presented orally and an additional 109 poster papers. Authors from 36 different countries were represented. Together they presented a vast amount of interesting information on the latest results on electromagnetic theory and microwave techniques. The plenary session contained four papers dealing with wave propagation, waveguide leakage, and the status of research and development in Hungary.

The symposium was organized into eight sections. A review of these sessions will be helpful in determining the reader's potential interest in the symposium proceedings.

Section 1. Field Analysis and Numerical Methods.---33 papers, 6 posters.

- 1A. Scattering-4 papers
- 1B. Miscellaneous Topics-2 papers
- 1C. Waveguides-9 papers
- 1D. Resonators-5 papers
- 1E. Numerical Methods-8 papers
- 1F. General Theorems-5 papers
- 1G. Poster Session-6 papers

Section 2. Scattering and Diffraction-43 papers, 10 posters

- 2A. Scattering Problems-35 papers
- 2B. Diffraction Problems-8 papers
- 2C. Poster Session-10 papers

Section 3. Antennas-33 papers, 42 posters

- 3A. Horn Antennas—4 papers
- 3B. Microstrip Antenna Analysis and Synthesis—4 papers
- 3C. Antenna Synthesis-5 papers
- 3D. Antennas and Systems-5 papers

- 3E. Coated Structures and Impedance Surfaces—5 papers
- 3F. Antenna Analysis—5 papers
- 3G. Reflector Antennas-5 papers
- 3H. Wire Antennas—4 papers
- 3I. Horn Antennas and Feeds—8 posters
- 3J. Microstrip and Millimeter Wave Antennas—10 posters
- 3K. Antennas in Plasma Media—3 posters
- 3L. Antenna Measurements and Experimental Techniques—3 posters
- 3M. Aperture Antenna-8 posters
- 3N. Miscellaneous Topics-6 posters

Section 4. Guided Waves-27 papers, 38 posters

- 4A. Wave Propagation—5 papers, 3 posters
- 4B. Waveguide Analysis-5 papers, 11 posters
- 4C. Planar Structures-5 papers
- 4D. Planar Optical Waveguides-4 papers
- 4E. Dielectric Waveguides-4 papers, 4 posters
- 4F. Anisotropic Waveguides-4 papers, 12 posters

Section 5. Transient Phenomena-5 papers

Section 6. Random Media—16 papers

- 6A. Scattering Effects-4 papers
- 6B. Tropospheric Wave Propagation-4 papers
- 6C. Ionospheric Wave Propagation-4 papers
- 6D. Irregular Surfaces and Media-4 papers

Section 7. Inverse Scattering-13 papers

Section 8. Fields in Biological Media-5 papers, 19 posters

- 8A. Biological Media-5 papers
- 8B. Biological Effects and Dosimetry-9 posters
- 8C. Hyperthermia-6 posters
- 8D. Tomographic Microwave Imaging-4 posters

Additionally there are three papers in a "Late Paper" section in the back of the second volume. All of the papers are in English. Orders from outside the United States and Canada should be sent to Elsevier Science Publishers, Sara Burgerhartstraat 25, P.O. Box 211, 1000 AE Amsterdam, the Netherlands.

EMI PUBLICATIONS AVAILABLE

The National Bureau of Standards and the National Engineering Laboratory have issued the *Center for Electronics and Electrical Engineering TECHNICAL PROG-RESS BULLETIN*. Included in this twenty-first edition are the abstracts of several papers of particular interest to the EMC community.

Adams, J.W., Ondrejka, A.R., and Medley, H.W., *A Time-Domain System for Identification of the Natural Resonant Frequencies of Aircraft Relevant to Electromagnetic Compatibility Testing*, to be published as NBSIR 87-3077.

A method of measuring the natural resonant frequencies of a structure is described. The measurement involves radiating an aircraft with an impulsive electromagnetic field and receiving the echo reflected from this aircraft. Resonances are identified by using a mathematical algorithm based on Prony's method to operate on the digitized reflected signal. The measurement system consists of special transverse electromagnetic horns, pulse generators, a time-domain system, and an implementation of Prony's algorithm. The frequency range covered is 5 to 250 MHz; this range is determined by antenna and circuit characteristics.

[Contact: John W. Adams, (303) 497-3328]

Vanzura, E., and Adams, J.W., Generating Constant Electromagnetic Fields Inside a Partially-Loaded Shielded Room.

This paper describes a computer-controlled feedback system that can maintain field strength levels within moderate bounds inside a partially-loaded shielded room. These levels are relatively uniform over a large enough volume to allow radiated immunity testing of moderate-sized objects. The frequency range depends on the characteristics of the transmit antenna; we use 50 to 200 MHz, which is usually a difficult range to cover because of limitations of other electromagnetic compatibility/susceptibility test facilities.

The measurement system consists of a computer, signal generator, amplifier, biconical antenna, and an isotropic probe system.

[Contact: Eric Vanzura, (303) 497-5752]

Jesch, R.L., Measurement of Shielding Effectiveness of Different Cable and Shielding Configurations by Mode-Stirred Techniques, NBSIR 87-3076 (October 1987).

The shielding effectiveness of cable configurations having different shielding arrangements and of shielding configurations used to terminate cable shields for helicopter wiring was measured by mode-stirred techniques. The mode-stirred measurements were taken at discrete frequencies between 200 MHz and 6 GHz. In addition, shielding effectiveness data on the shielding configurations were also obtained in a transverse electromagnetic cell down to 1 MHz. A description of the cable and shielding configurations is given along with plots of the measured shielding effectiveness data as a function of frequency.

[Contact: Ramon L. Jesch, (303) 497-3496]

Crawford, M.L., and Koepke, G.H. *Performing EM Susceptibility/Vulnerability Measurements Using a Reverberation Chamber*, Proceedings of the 7th International Symposium and Technical Exhibition on EMC, Zurich, Switzerland, March 3–5, 1987, pp. 121–126 (1987).

This paper discusses the design, evaluation, and use of a reverberation chamber for performing electromagnetic susceptibility (EMS) measurements of electronic equipment. Included are brief descriptions of the test procedures, application advantages and limitations, some EMS test results, interpretation of test results relative to freespace test methods, and an estimate of measurement uncertainties.

[Contact: Myron L. Crawford, (303) 497-5497]

Note: Center for Electronics and Electrical Engineering TECHNICAL PROGRESS BULLETIN 87-4 [NBSIR 88-3762] is available for \$11.95 from the National Technical Information Service (NTIS), Springfield, VA 22161.

IEEE AP-S INTERNATIONAL SYMPOSIUM & URSI RADIO SCIENCE MEETING '89

The 1989 International Symposium and Radio Science Meeting, sponsored jointly by the IEEE Antennas and Propagation Society and by USNC Commissions, A, B, E, F, H of the International Union of Radio Science (URSI), will be held at the Red Lion Inn, San Jose, CA, June 26–30, 1989. The technical sessions for IEEE AP-S and URSO will be coordinated to provide a comprehensive, well-balanced program. Authors are invited to submit papers on all topics of interest to the AP-S and URSI membership. Topics of particular interest to EMC Society members are listed below. A complete list of topics and other information on the technical program may be obtained from Professor Kenneth K. Mei.

- Electromagnetic theory
- Noise measurements and modeling
- Protection of electronic equipment
- · Spectrum measurements and modeling

For additional information, contact:

Dr. Ray King, General Chairman Lawrence Livermore National Laboratory, L-156 Livermore, CA 94550 (415) 423-2369

EMCABS

In this issue we continue publishing abstracts of papers from previous EMC Symposia, other conferences, meetings and publications. The EMCABS committee is composed of the members listed below. By way of introduction to the community, they are listed with their company affiliations:

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by William H. McGinnis

"HOW CAN I GET A COPY OF AN ABSTRACTED ARTICLE?" The answer to this frequently asked question follows.

Most large public-libraries, some small-public libraries; all engineering school libraries and most other college or university libraries have copies of publications in which articles appear. If they happen not to have the desired publication, such libraries usually can obtain it or a copy of the article from other libraries or sources. Many company libraries, both large and small, also have such arrangements. Many articles also are available from the National Technical Information Service (NTIS) and/or the Defense Technical Information Center (DTIC). To retrieve an article or publication containing an article abstracted in EMCABS, it is suggested that you contact your company library, a nearby engineering school library, a university library or your municipal public library. If the library does not have the publication, go to the librarian, explain what you need and he or she will help you get the publication on loan, perhaps from another library or, for a nominal charge, from NTIS. If you have a Department of Defense contract, the contracting officer or your company librarian can help you get publications from DTIC. The information needed is contained in the EMC abstract heading.

Propagation of Electromagnetic Waves in a Concrete Tunnel with Structures Originating From a Cross-Junction Kazunori Uchida, Toshiaki Matsunaga, Takeaki Noda Fukuoka Institute of Technology EMCJ87-15 Meeting, June 26, 1987	EMCABS: 01-10-88	Fourier Spectra of Positive Lightning Fields During Winter Thunderstorms Zen-Ichiro Kawasaki, Minoru Nakano, Tosio Takeuti Research Institute of Atmospherics, Nagoya University EMCJ87-12 Meeting, May 22, 1987	EMCABS: 04-10-88
ABSTRACT: This paper describes electromagnetic wave excitation and propagation in a two-dimensional concrete tunnel with complicated structures originating from a cross-junction such as cross-, T-or step-junction. The surface impedance boundary conditions are introduced to evaluate the dissipative property of the concrete walls, and the analytical expressions for the fields in each tunnel are shown. Numerical results are compared with the experimental ones based on the microwave simulation. It is demonstrated that the measured field distributions in the center of the tunnels are in substantial agreement with the calculated ones. INDEX TERMS: Tunnel, propagation, surface impedance, microwave simulation		ABSTRACT: During the winter of 1986, measurements of lightning and electric and magnetic fields were carried out at Inecho, Kyoto. Since the observation site faces the Sea of Japan, the observed results are not significantly affected by ground wave propagation. However, the 10-90% rise times of the fast transition of positive lightnings are slower than those of negative lightnings during summer thunderstorms. The average of rise times is found to be 570 ns, and the standard deviation is 130 ns. The average Fourier spectra is also estimated. INDEX TERMS: Positive lightning, fast transition, Fourier spectra	
 Estimation of Interference Reduction Effect By Selection Diversity On the Basis of Characteristic Function Shigehiko Okui¹, Norihiko Morinaga², Toshihiko Namekawa³ Suzuka College of Technology Osaka University Himeji Dokukyo University EMCJ87-8 Meeting, May 22, 1987 ABSTRACT: Diversity techniques are known as a practical and useful means to counteract interference occurring in microwave communication networks and mobile radio systems. This paper refers to statistical estimation of interference reduction effect by selection diversity in Nakagami m-fading environments. Characteristic functions derived in elegantly closed form are used to evaluate the average desired to interference power ratio, the probability of interference, and the reuse distance in cellular mobile radio systems. INDEX TERMS: Interference power ratio, Nakagami m-fading, probability of interference, reuse distance, selection diversity 		 Universal Characteristic Charts for Ferrite EM Absorbers Hajime Seki, Yoshiyuki Naitoh Faculty of Engineering, Tokyo Institute of Technology EMCJ88-12 Meeting, May 20, 1988 ABSTRACT: A novel method is proposed to determine matching frequenesses of a single-layered electromagnetic absorber with material dispersion ferrite absorbers, and all their characteristics are deduced systematically froferrite permeability. INDEX TERMS: Electromagnetic absorber, ferrite, dispersion, reflection 	EMCABS: 05-10-88
 Noise Problems in Measurements Using Laser Radar Tetsuo Kano, Akio Nomura, Yasunori Saito Faculty of Engineering Shinshu University EMCJ87-10 Meeting, May 22, 1987 ABSTRACT: The effects of noises are discussed, and the examples obtained represented. The electrical noises produced from lasers of sending systems constructions of systems although these are removable with usual methods filters. It is indicated that the minimum detectable property of the system is in of photomultipliers in the receiving system for the measurement of a short tized noise of A/D converters becomes the most significant in long range shown that our simultaneous two-wavelengths laser radar has a feasible ar INDEX TERMS: Laser radar, air pollution, remote sensing, differen method 	EMCABS: 03-10-88 d in laser radar systems are are significant in the trial s like a shielded room and nfluenced by the shot noise range. However the quan- e measurements. Also it is nd practical use. tial absorption, shielding	A Highly Lossy Material for EMC Applications Yoshiyuki Naitoh', Hajime Seki', Abdullah Mirtaheri', T. Mizumoto', Mikiya Ono ² 1. Tokyo Institute of Technology 2. Mitsubishi Mining & Cement Co., Lt. EMCJ88-13 Meeting, May 20, 1988 ABSTRACT: At high frequencies, existing materials correspond only to a s novel one is synthesized by resintering powder of Ni-Zn ferrite and BaTiC large ε and large μ and results in an EM absorber effective on both E and material may be conveniently used to protect computers from ESD hazar INDEX TERMS: Lossy material, Ferrite, BaTiO3, Electromagnetic ab	EMCABS: 06-10-88 mall portion of ε - μ plane. A)3. The compound has both H fields. This doubly lossy ds. psorber, ESD
			5

Polarization Characteristics for Thin Type Absorber by the Spatial Network Method Y. Kakimi, N. Yoshida, Ichiro Fukai Faculty of Engineering, Hokkaido University EMCJ88-15 Meeting, June 24, 1988	EMCABS: 07-10-88	Should Computer Clocks Be Allocated? Robert D. Hunter Texas Instruments, P.O. Box 2909, Austin, TX 78769-2909 1988 URSI Radio Science Meeting Program and Abstracts, Page 250	EMCABS: 10-10-88
ABSTRACT: An electromagnetic wave absorber is used to reduce the scattering. In order to design a good absorbing system, it is important to estimate the angle and polarization of the incident wave. We apply the numerical analysis to the abosrber using the Spatial Network Method. Also the thin type absorber is treated as the boundary condition. INDEX TERMS: Thin type absorber, scattering, polarization, oblique incidence, spatial network		ABSTRACT: It is well known that computer clock signals and their harmonics cause much of the elec- tromagnetic interference generated by modern computers (even those relatively low clock frequency personal computers). Since the frequencies of most computer clocks advance into the tens-of- megahertz range and since these clocks are usually crystal-controlled for technical reasons, an intriguing possibility exists for the mitigation of the effects of clock-generated emissions. INDEX TERMS: Spectrum management	
 Rapid Near-Field Antenna and RCS Measurement Via Probe Arrays B.J. Crown¹, J.P. Estrada¹ and M.E. Cram¹ J.C. Bolomey², D. Picard², G. Fine², M. Mostafavi² and L. Jofre² Georgia Institute of Technology, Atlanta, GA Groupe D'Electromagnetisme 1988 URSI Radio Science Meeting, June 6-10, 1988 ABSTRACT: The finite-difference time-domain (FD-TD) method is a di time dependent curl equations using a fully explicit numerical algorithm to propagation and scattering. Field boundary conditions at adjacent dissimil satisfied by the curl-equations analog. However, the radiation condition is formulated separately to work properly in the near field and in the time de INDEX TERMS: Wave modeling, FDLTD Method, absorbers 	EMCABS: 08-10-88 rect solution of Maxwell's to simulate real-time wave ar media are automatically s not inherent and must be omain.	 Improvements on RF Radiation Noise Testing Performance by RF Absorber Arrangements in Shielded Room T. Furuya, S. Okabe, A Matsunaga, K. Kato Yokogawa Electric Corp. EMCJ87-93 Meeting, March 18, 1988 ABSTRACT: This paper reports the improvements on radiated RF noise me room. RF absorber panels were arranged to diminish the standing waves. T measuring signal attenuation between two antennas. The reproducibility of ments were improved. INDEX TERMS: RF noise, RF absorber, noise measurements 	EMCABS: 11-10-88 asurements in the shielded he effect was evaluated by of radiated noise measure-
 The Effect of Field Scanning Probe on Test Range Evaluation A. Fer Purdue University School of Engineering and Technology, Indianapolis, IN 1988 URSI Radio Science Meeting, June 6-10, 1988 Program and Abstracts, Page 235 ABSTRACT: After all possible measures have been taken to minimize reflmust be calibrated by observation of the variation in amplitude of the indicating departure from plane wave conditions in horizontal and vertical the level of confidence over a given angular span is shown to be proportion probe. INDEX TERMS: Measurement, sensors, probe, test range 	EMCABS: 09-10-88 lection problems, the range field on the test aperture, polarizations. In this paper tal to the beam width of the	 A Numerical Method for Calculating Scattering from An Edge-Type Scatterer: H-Wave Incidence Yoichi Okuno and Hiroyuki Takahashi Kumamoto University EMCJ87-27 Meeting, June 26, 1987 ABSTRACT: A numerical method is presented for the solution of H-wa type scatterer. The basic method is the mode-matching one with a smoothi procedure has been known as a technique for the problems with smooth also to the edge-type problems when it is accompanied by an appropriate tr nate variables along the contour of the scatterer. Mathematical theory of t the numerical computations are given. Also included is a result of sample INDEX TERMS: Scattering problem, edge discontinuities, numerical theory 	EMCABS: 12-10-88 we scattering from an edge- ng procedure. Although the scatterers, it can be applied ansformation of the coordi- he method is presented, and e calculation. method

CALENDAR 1988

November 8-10

7th International Conference
Israel Society for Quality Assurance
Tel Aviv, Israel
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PRTA Ltd1, 2 Kaufman Street
P.O. Box 50432
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November 29-30

Seminar on Compliance Testing of Large Distributed Systems to Meet Class A FCC Limits New Jersey Coast EMC/AP/VT Chapter Auditorium—AT&T Bell Laboratories Middletown, NJ Contact: Michael Sly Honeywell, Inc. P.O. Box 54 Eatontown, NJ 07724 Telephone: (201) 542-1400

December 8-10

International Conference and Exhibition for Power Conversion and Intelligent Motion Harumi Grand Hotel and Tokyo Int'l. Fairgrounds Hall A Contact: Intertec Communications, Inc. 2472 Eastman Ave., #33–34

2472 Eastman Ave., #33-34 Ventura, CA 93003-5774 Telephone: (805) 658-0933

CALENDAR 1989

March 6-9 8th International Zurich Symposium and Technical Exhibition on EMC Swiss Federal Institute of Technology Zurich, Switzerland Dr. T. Dvorak Contact: ETH Zentrum-IKT 8092 Zurich, Switzerland Telephone: (+411) 256-2790 or Dr. R.M. Showers Moore School of Electrical Engineering D2 University of Pennsylvania Philadelphia, PA 19104 Telephone: (215) 898-8123

March 21–23	5th Annual Review of I The Applied Computat Monterey, CA Contact: Michael T Oregon S Corvallis, Telephon	Progress ional Electromagnetics Society Thorburn tate University , OR 97331-3202 e: (503) 754-3617
April 4–7	6th International Confe Propagation (ICAP 89) University of Warwick, Contact: ICAP 89 Conferen Institutio Savoy Pla London V United K	crence on Antennas and Coventry Secretariat ce Services n of Electrical Engineers ace WC2R OBL ingdom
April 17-21	Symposium on Corrosid EMI Shielding In Aeros (NACE Corrosion '89)	on and space Equipment
	Contact: Eric Carl Senior Re Chomeric 77 Drago Woburn, Telephon or Jack Gut 3370 Mira Anaheim,	son esearch Associate es, Inc. n Court MA 01888 e: (617) 935-4850 tenplan, M/S GA25 International Electronic Operations aloma , CA 92803
May 23-25	IEEE 1989 National Syn Compatibility Radisson Hotel Denver, CO Contact: John Tary Tri-State 12076 Gra Denver, C Telephone	mposium on Electromagnetic g Gen. & Trans. Assoc., Inc. ant Street CO 80233 e: (303) 452-6111
May 29–June 2	20th International Symp Automotive Technology Florence, Italy Contact: ISATA Se 42 Lloyd Croydon United Ki Telephone Telefax: 0	posium on y and Automation ecretariat Park Avenue CRO 5SB ngdom e: 01-681 3069/01-686 1329 01-686 1490

June 26–30	IEEE Antennas and Propagation Society International Symposium and URSI Radio Science Meeting Red Lion Inn San Jose, CA Contact: Dr. Ray King General Chairman, Lawrence Livermore National Laboratory L-156 Livermore, CA 94550 Telephone: (415) 423-2369
 August 14–17	Triennial URSI International Symposium on Electromagnetic Theory The Royal Institute of Technology Stockholm, Sweden Contact: Prof. S. Strom Organizing Committee Chairman Dept. of Electromagnetic Theory S-100 44 Stockholm Sweden
 August 22–25	1989 International Symposium on Antennas and Propagation (ISAP '89 Japan) Nippon Toshi Center Tokyo, Japan Contact: Dr. Takashi Katagi, Chairman ISAP '89 Publicity Committee Mitsubishi Electric Corporation 325 Kamimachiya, Kamakura, 247 Japan Telephone (0467) 44-8862, FAX (0467) 47-2005 Telex: 3862-165 MULCO J.
September 4–8	2nd International Conference and Workshop on Electromagnetic Compatibility (INCEMIC) Bangalore, India Contact: Col. (Dr.) G.K. Deb Electronics and Radar Development Establishment, C V Raman Nagar Bangalore 560 093 India
 September 8–10	IEEE International Symposium on EMC Trade and Industry Center Nagoya, Japan Contact: Prof. Y. Miyazaki Toyohashi Univ. of Technology Toyohashi, Japan 440 Telephone: 0532-47-0111, ext. 576 FAX: 0532-45-0480

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