IEEE ELECTROMAGNETIC COMPATIBILITY SOCIETY NEWSLETTER

ISSUE NO. 160 WINTER 1994 (ISSN 0164-7644) ROBERT D. GOLDBLUM, *Editor*

MESSAGE FROM THE PRESIDENT

WARREN KESSELMAN
PRESIDENT, EMC SOCIETY

The first meeting of the Administrative Committee of the Professional Group on Radio Frequency Interference (PGRFI), Institute of Radio Engineers (IRE) was held on Wednesday evening, November 20, 1957, in Asbury Park, New Jersey. The elected officers were Harold Schwenk, Chairman; Leonard Milton, Vice-Chairman; Albert Kall, Secretary; and James McNaul, Treasurer. In the first PGRFI Newsletter (January 2, 1958) Chairman Schwenk wrote, "I would like to take this opportunity to thank everyone who helped make possible the formation of the new Professional Group on Radio Frequency Interference. I would like to specially thank the other members of the Administrative Committee who have given their time and effort in getting the group organized . . . and all the people who have offered their services and support (material and moral) to get the group organized. . . I cannot help feeling satisfied at the way things have turned out even though the hardest job is still ahead. The success of this group, like any other organization, depends on its members to pitch in and lend a hand. I am sure that you will. I know a lot of people in the RFI field and I'm positive that they realize the benefits that can be had from this group and won't let it fail from lack of effort."

Thirty-six years later on November 6, 1993, the Board of Directors (BoD) of the Electromagnetic Compatibility Society, IEEE elected its 1994 officers. I am honored to have been elected President and I am pleased to be supported by a fine team of dedicated officers, BoD members, standing committee appointees and chapter chairpersons. As Chairman Schwenk said, " . . . they realize the benefits that can be had from this group and won't let it fail from lack of effort."

Our society has been blessed, over the years, with many fine volunteers who have contributed unselfishly of their time and talent. I had the privilege to have been one of the founders of PGRFI and to have served through the years with the many dedicated people whose initiative and drive have given us a firm foundation for the future. Past-President Hofmann contributed much over the last two years and we all owe him a vote of thanks. A "thank you, well done," is in order for the entire 1993 BoD. Also, I'd like to give recognition to six persons who retired from leadership positions after many years of devoted service - Dick Ford, Treasurer; Walt McKerchar, Director Professional Services; Don Heirman, Director Technical Services; Gene Cory, Chair Symposia/Conferences Committee; Herb Mertel, Chair Transnational Committee; and Pat Coles, Chair Awards and Membership Committees. Your performance was exceptional. Thank you.

Your Society, in addition to a name change, has grown considerably over the years. There are approximately 4,000 members throughout the world, 38 chapters (worldwide), and approximately 50 volunteers actively serving on Society boards and committees, with strong standardization and educational efforts. To keep up the pace, however, we need a continuous

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Our thanks to Herb Mertel for his years of dedicated service as associate editor for EMC Standards Activities.

IEEE EMC SOCIETY NEWSLETTER PUBLICATION SCHEDULE

PUBLICATION DATES	EDITORIAL DEADLINES
May	March 15
August	June 15
November	September 15
February	December 15

BACK ISSUES OF THE EMC SOCIETY NEWSLETTERS ON MICROFICHE

We still have a few sets of the uFiche copies of the back issues of the IEEE EMC Society Newsletters from the present to 1955 when it was called "Quasies and Peaks." The price is $25.00 postpaid. If you would like to have one of these sets you can order it from: Dr. Chester L. Smith, EMC Society Historian, 2 Jonathan Lane, Bedford, MA 01730.

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influx of new talent to carry on as vacancies occur and to support new areas of concern. Please give serious consideration to becoming involved in our broad and challenging goals and objectives. Your local chapter is an excellent place to begin your EMCS career. If your interest and skills are focused on specific Society functions, please contact the appropriate "Service Director." Your 1994 Directors are: Len Carlson, Communications Services Director; Dan Hoolihan, Member Services Director; Joe Butler, Technical Services Director; and Norm Violette, Professional Services Director.

The 1993 BoD worked hard to achieve many of the objectives that they had set for themselves in their long range plan (summarized in the Winter '93 Newsletter). For example: significant accomplishments occurred in the standards area, promotional videos were produced and distributed, two new chapters were added and five more are pending, the second President's Memorial (Scholarship) Award was presented at the '93 Symposium, the EMC bibliography was published and is available via Internet, EMCS conference records were micro-filmed, updated operational guidelines/handbooks were drafted, and the Experiments Manual was published.

My purpose in devoting attention to the past is to focus our future thinking. Our Society's heritage drives us to continually strive for excellence in the pursuit of knowledge, especially to enhance the EMC field. Your 1994 BoD will strive to facilitate the close cooperation and exchange of technical information among its members and other professional societies. Also, it will continue to study and provide for the technical and professional needs of its members. Communications between members, standing committees, chapter chairs and BoD is essential. The Transactions, Newsletter and symposia offer major avenues of interchange. The EMCS publications schedule is the same as in the past. The 1994 EMCS Symposium is scheduled for August 22-26 in Chicago. Also, EMCS is cooperating in symposia scheduled in Sendai Japan (May 17 to 19) and Bordeaux, France (May 30 to June 3). Your BoD has tentatively scheduled three '94 meetings: the first in March in conjunction with the Santa Clara Chapter's colloquium (March 29 to 30), the second at the Chicago symposium and the third in November at an East Coast site. All are open meetings.

In summary, our Society is active, productive and still growing. With your participation and support, 1994 will become another year that enhances our heritage.

NEWLY ELECTED IEEE FELLOWS

Eight members of the IEEE EMC Society have been elected IEEE Fellows (as of January 1, 1994). Congratulations and best wishes to our esteemed colleagues.

Prof. Arlon T. Adams
Dept. of ECE, 111 Link Hall
Syracuse University
Syracuse, NY 13210
For contributins to the development and application of the method of moments to antenna theory.

Dr. Michael A. Morgan
1265 Surf Avenue
Pacific Grove, CA 93950
For theoretical contributions to finite element techniques applied to electromagnetic scattering, and for academic leadership.

Dr. Jose Perini
676 Dwyer Road
Virginia Beach, VA 23454
For contributions to the advancement of electromagnetic compatibility in the topside design of navy ships.

Prof. Peter H. Russer
Inst. fur Hochfrequenztechnik
Techn. Universitat Munchen
Arciss. 21
D80333 Munich 2, Germany
For fundamental contributions to noise analysis and low-noise optimization of linear electronic circuits with general topology.

Prof. Yasutaka Shimizu
Cradle Tokyo Inst. of Technology
2-12-1 O-Okayama Meguru-ku
Tokyo 152, Japan
For contributions to research and development in the field of educational technology, electromagnetic compatibility, and surface acoustic waves.

Dr. Tasuku Takagi
Nakayama 5-2-20
Aoba-ku
Sendai 981, Japan
For contributions in the field of electromagnetic compatibility, specifically electric contact phenomena.

Dr. Donald D. Weiner
3 Jamar Drive
Fayetteville, NY 13066
For contributions to the analysis of nonlinear effects in electromagnetic compatibility.

Dr. Chang-Yu Wu
48 Sherwood Heights
Wappingers Falls, NY 12590
For technical leadership in the design of an electromagnetic compatibility laboratory.

EMCS BoD ACTIVITIES

DON HEIRMAN
ASSOCIATE EDITOR

I want to take this opportunity to thank you — our readers — and Bob Goldblum, the Newsletter Editor, for all the support I have received in the past five or so years in writing this column. But it is time to move on. This will be my last BoD column since I have stepped down from the BoD as its Director for Technical Services, a post which I have served for over a decade. Dick Ford has agreed to take over this column and Joe Butler takes over my Directorship. I wish them success in meeting our Society's challenges as presented to us volunteers by you, our members. I have taken on a new role as associate editor for Standards Activity, a topic near and dear to my interests. I replace Herb Mertel who is relinquishing that post starting with the next issue of the Newsletter. In the meantime, here is a brief report of my last BoD meeting and the last of the Board for 1993.

New Orleans was the venue for the BoD meeting held on 6-7 November 1993. The meeting was called to order at 1 PM on Saturday, 6 November by President Bob Hofmann. All BoD members except Walt McKerchar, Janet O'Neil, Dave Staggs, and Professor Akao were present. Newly elected BoD members Bill McGinnis, Joe Butler and Norm Violette were also present. Jim Muccioli replaced Pat Coles who submitted her resignation. Ferdy Mayer was not present. Dave Traver was a guest.

The minutes of the August meeting were approved with minor modifications. Dan Hoolihan stood in for Secretary Janet O'Neil and kept track of the meeting's proceedings as of November 6, 1993. Treasurer Ford then indicated that the Society's net worth was $435K as of 6 November, 1993. His report was accepted by the Board.

Dan Hoolihan, Director for Member Services moved and the Board approved Andy Podgorski as a Distinguished Lecturer. He also indicated that Dave Hanttula volunteered to temporarily replace John Adams as chairman of the Distinguished Lecturer's Program. Pat Coles gave her awards report. After a thorough review of the 1993 activity, Dr. Zhang was voted a belated certificate of achievement. Under chapter activities, Dan indicated that there were thirty-five inquiries about EMC Society membership at our annual symposium in Dallas. These will be pursued. Dave Staggs' report on chapter activity showed that we now have thirty-eight EMC chapters worldwide. Paperwork for chapter formation is moving forward for chapters in Boca Raton, FL, Oak Ridge, TN, Rochester, NY, and in the Carribbean. Ed Bronaugh reported on the results of the BoD elections for the three-year period ending December 31, 1996:

Dick Ford	Bill McGinnis
Henry Ott	Norm Violette
Ferdy Mayer	Joe Butler

He also led the final discussion for funding of Board members. The decision was that the bylaws were sufficiently flexible to allow specific requests for reimbursements or for other policies the Board may choice to propose. Next, Ed ran the elections of officers for 1994. This year, half of the positions were contested. The election results showed the following officers for 1994:

Warren Kesselman, President
Bill Gjertson, Vice President
Janet O'Neil, Secretary
Andy Podgorski, Treasurer

The service directors elected for 1994 were:

Communications:	Len Carlson
Member:	Dan Hoolihan
Professional:	Norm Violette
Technical:	Joe Butler

Congratulations to our officers and directors and good luck in 1994!

Photo: DICK FORD

"New Blood" elected to the EMCS BoD: (l to r) Jim Muccioli, Bill McGinnis, and Dr. Norm Violette strategize for their first term.

Bill Gjertson, Director for Communication Services, gave his report. Chet Smith, History Committee, has completed the microfilming of our EMC conference/symposium records. A special thanks was extended to Gene Knowles who provided much help on the task. Bob Goldblum, Newsletter Editor, indicated that the Newsletter will reflect changes suggested by the annual symposium attendees, compiled by Bob Hofmann. Hugh Denny, IEEE Press Liaison, said EMC books were selling well and revenue from these sales will be substantial. Next, Gene Cory, Symposium Committee, noted that the books are now closed for the Anaheim symposium. Plans for Chicago are well under way with a full five-days of activity scheduled. With Montreal requesting the year 2001, we now have sites set for the next eight years. Gene noted that this will be his last meeting. We will miss his sage advice and "corporate memory."

Don Heirman, Director for Technical Services, gave his last series of reports as director. First his Standards Committee report showed that three projects had new chairs and that there were now 14 standards in effect or being planned. That is double the number when he took over the chair almost ten years ago. In particular he noted a new project on measuring interference to personal communications services (PCS) that was up for approval by the IEEE Standards Board at its December meeting. Finally, the number of Standards Committee meetings will be cut from 4 to 3 to parallel the reduced frequency of the BoD meetings. Next, Don discussed Kimball William's (Education Committee) report. Kim indicated that there will be an experiments booth at the Chicago symposium as well as a tutorial on basic EMC. Planning continues for placing the EMC abstracts on "INTERNET" for electronic access. Will Lauber (Technical Advisory Committee) said that the paper reviewers for Chicago are lined up in the TCs. He is looking for a TC-6 chair replacement. John Keller needs a relief chair for his committee on spectrum management. If interested call Wilf on 613-998-2377. Finally Joe Butler, Representative Advisory Committee, described two reports: one for the IEC/CISPR Subcommittees A and G and one for the SAE Automotive EMI and EMR Committees. For more information, call Joe on 617-935-4850.

Photo: DICK FORD

New EMCS BoD Officers elected (l to r): Dr. Andy Podgorski, Treasurer, Bill Gjertson, Vice President, and Warren Kesselman, President.

Don Weber, Director for Professional Services, resigned. Norm Violette will fill that position in 1994. Herb Mertel agreed to be interim director for the rest of 1993. A brief update on transnational activities was presented by Herb Mertel. Al Mills then presented his PACE report on the 1993 PACE Conference and Workshops. The workshop was held in Portland over Labor Day weekend with 220 attendees. Panels included presentations on "Jobs, Jobs, Jobs," "Government Policy," and "Benefits." For more information, call Al on 619-578-1480.

Warren Kesselman, Vice President, reviewed the EMCS long range planning guidelines. Both Dan Hoolihan and Don Heirman gave extensive inputs for their respective directorships. Bill Gjertson, Vice President for 1994 will brief all new officers on long range planning. A planning meeting will be held in New Jersey in the last week in January 1994. Warren Kesselman will preside.

With the reports filed, it was noted that the Board will have a new look in 1994. Many members will turn over the reigns to the new.
The list of those BoD members not continuing include:

Ed Bronaugh	Hugh Denny
Walt McKerchar	Gene Cory
Herb Mertel	Don Weber
Don Heirman	Pat Coles

We will miss all of them as Board members. We know that several will continue in various committee functions. With that President Hofmann closed the meeting in late morning, Sunday, November 7. The next BoD meeting is planned for the Santa Clara area in late March in conjunction with their colloquium. For further information call Janet O'Neil at 213-870-9383.

TODD HUBING
ASSOCIATE EDITOR

Franz Gisin did it! Franz is a Senior Engineer in the EMC Group at Rolm Corporation and Secretary of the Santa Clara Valley Chapter. He has worked in EMC for the past 15 years. Franz contacted the President of the local IEEE Antennas and Propagation Society and offered to give a presentation at one of their meetings. They quickly accepted his offer and in November, Franz gave a presentation describing the similarities and differences between the electromagnetic problems faced by EMC engineers and antenna engineers. There was a good turnout at the meeting and the audience was quite receptive to the things Franz had to say. Franz tells me that he had a good time and that the audience made him feel appreciated.

I hope that Franz's positive experience will encourage more EMC engineers to consider giving presentations to their local APS or MTT chapter. There are a lot of sharp electromagnetics engineers who would like to learn more about EMC and real-world EMC problems. Giving a talk to electromagnetics professionals in other organizations benefits the EMC Society, and can be personally and professionally rewarding as well.

For those of you who prefer to give talks where every member of the audience is sure to ask at least one question, I have another suggestion. Why not offer to give a one-hour presentation to your local elementary or middle school? Most teachers appreciate the opportunity to have an outside speaker come into their classroom, particularly when the topic illustrates the importance of education. Your presentation would give the children a chance to learn a little about EMC and at the same time show them that engineering can be interesting and fun.

Last year, I packed a portable TV, radio, hair dryer, some miscellaneous hardware, and a few laboratory supplies into a box and took it to my daughter's 6th grade class. It was the most fun I've ever had giving a presentation and I would have to rank it as one of the most worthwhile and rewarding things I did all year. The class particularly enjoyed the lightning demonstration. Next year, however, I must remember to bring along my fire extinguisher.

PHOENIX

The Phoenix Waves and Devices Chapter wins the award for the most meetings of any chapter in the October to December, 1993, time period. They had a total of 6 meetings in 8 weeks. At the October 14th meeting, Dr. Samir El-Ghazaly from Arizona State University spoke on the subject "Microwave Device Modeling: Time Domain Versus Frequency Domain." The following week, Dr. David Pozar from the University of Massachusetts at Amherst gave a presentation entitled "A Practical Guide to Microstrip Antenna Design." On November 5th, Dr. Roger Marks from NIST talked about "Water Electromagnetic Characterization of Microelectronic Circuits, Packages, and Interconnects." A presentation entitled "Development of a Dual-Reflector Feed for the Arecibo Radio Telescope, an Overview," was presented by Dr. Per-Simon Kidal from Chalmers University of Technology on November 17th. And finally on December 2nd, Dr. Dieter Schroder from Arizona State University spoke on the subject "Semiconductor Defects and their Characterization."

SEATTLE

Mark Herman from PACCAR was the featured speaker at the October meeting of the Seattle EMC Chapter. His topic was "Electromagnetic Compatibility in the Heavy Duty Truck Industry." The November meeting was a Forum on the European Norms for EMC hosted by Steve Stegner at Fluke Corporation. In December, Jerry Carter from Boeing spoke on "Variations in System Compatibility Testing."

DALLAS/FORT WORTH

Dr. Frederick Tesche gave a paper on the "Scattering Effect" at the September meeting of the Dallas/Fort Worth Chapter. Also, Ed Vance reported on the IEEE EMC Symposium that had been held in Dallas the previous month. In October, Mr. Ron Brewer, Vice President of Instrument Specialties Co., gave a presentation entitled "EMC Design of Modern Electronic Systems." The December meeting featured Mr. Henry Ott, whose talk was entitled "Effect of an Image Plane on Printed Circuit Board Radiation."

SANTA CLARA VALLEY

September's meeting of the Santa Clara Valley Chapter was their "Annual Social & Planning Session." The purpose of this event is to promote interaction and discussion about useful topics for the technical sessions to be held during the upcoming year. At the October meeting, Martin Green, the Managing Director for Interference Technology, gave a presentation on "Three Routes to Compliance with the European EMC Directive." The November meeting featured a talk by Ken Hall from HP entitled "Reproducible Normalized Site Attenuation from Site to Site (30 MHz - 300 MHz)." Carole U. Parker of Fair-Rite Products Corporation spoke at the December meeting. Her topic was "Basics of Soft Ferrites."

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TWIN CITIES
Jerry Becker, Vice Chairman of the Twin Cities EMC Chapter, reports that the September meeting featured two speakers. Jerry Anderson and Erik Borgstrom, both with Amador, presented talks on Computer-Aided Emission and Immunity Testing. The October meeting, which was held in conjunction with the 8th Annual Minnesota EMC Event, featured Dan McConnon speaking on "The EMF Issue - What is the Current Status? Where is it Going?"

CENTRAL NEW ENGLAND
John M. Clarke, Secretary/Treasurer of the Central New England Chapter, reports that Joe Butler of Chomerics presented a talk on "New Developments in Commercial EMI Standards" at the October meeting. His talk covered activities by organizations such as IEEE, SAE, RTCA, ANSI and CISPR as well as European and U.S. regulatory agencies. In November, Leo Makowski from Haefely Test Systems, Inc. presented an overview of the IEC Transient Immunity Standards that are proposed for adoption by the European Community as "Euronorms." He reviewed the status of 6 standards covering ESD, EFT, surge, power frequency magnetic fields, pulsed magnetic fields, and damped oscillatory magnetic fields. December's speaker was Bob Egan of Digital Equipment Corporation. His topic was "EMC and Wireless Communications."

SINGAPORE
A joint MTT/AP/EMC chapter has been formed in Singapore. In September, the chapter committee sponsored a talk by Prof. C. B. Zhang from Tsinghua University entitled "Aspects of Microwave Imaging." In October, the committee sponsored another talk on "EMI Problems in Aircraft," which was given by Mr. M. F. Lim of Singapore Aerospace Ltd. The Singapore Chapter also sponsored special sessions on microwave components and systems, optical components and systems, radar, and antennas and propagation at the International Conference on Communication Systems (ICCS) held at the Westin Singapore in November. The Chairman of the Singapore Chapter is K. T. Leong. The Vice Chairmen are K. C. Chua and S. P. Yeo. Congratulations on a successful start and best wishes for the future!

LOS ANGELES
If the IEEE EMC Society has an award for the "Shake and Bake" Chapter of the Year, then the Los Angeles Chapter wishes to self-nominate! After summer break, the chapter reconvened innocently enough with Mike Bodeau of TRW speaking at the September meeting on Lightning and Launch Vehicles. October's meeting featured Hugh Hyatt of Hyger Physics who spoke on ESD Testing and Standards. Then in November, wild fires fueled by unseasonably warm and dry Santa Ana winds hit the Los Angeles area. Chapter members who lived in the few pockets of areas unaffected by the fire came to the November meeting featuring Bill Parker of Bill Parker Engineering. Bill is a Distinguished Lecturer of the EMC Society and the title of his presentation was "Solving Conducted Susceptibility and Emission Problems." Incidentally, Bill was a featured personality in the recent Los Angeles EMC Chapter newsletter "EMC Focus." Did you know Bill competes in marathons, including all eight 26.2 mile marathons held in Los Angeles? Chapter members took a break in December for the holiday season and were looking forward to having Ron Brewer of Instrument Specialties, Inc. as their January speaker. A popular member of the EMC industry as well as a Distinguished Lecturer of the EMC Society, Ron was sure to attract a good audience. Unfortunately, the meeting was canceled due to the 6.6 earthquake which struck the greater Los Angeles area on January 17. Many chapter members were affected by this devastating earthquake. Past chapter officer Gurdip Saran who lives in Northridge, the epicenter of the quake, was forced to find alternative housing (the night after the quake he and his wife slept in their car!) as his home was severely damaged. Several freeways were closed due to damage caused by the quake. Los Angeles is a geographically diverse city and chapter members rely on the freeway system to take them all over the city to and from the meetings. Without the freeways, authorities

Continued

BoD Secretary Janet O'Neil makes her own personal contribution to the growth of the IEEE family. Congratulations and best wishes.

Continued

suggested adding one to two hours to regular transportation time in light of the numerous detours required on surface streets. Also, a city imposed curfew restricted travel in the evening. Thus, chapter officers were forced to cancel Ron's presentation and certainly hope to woo him back in the fall.

There you have it for the "Shake and Bake" Chapter of the Year! (You get it, right?) What with the fires and earthquake, it's never a dull moment for the Los Angeles EMC Society Chapter. Fortunately, chapter members have an exciting program to look forward to in the coming months. Consultant Bernie Cooperstein will be speaking at the February meeting on increasing the EMC immunity of industrial data acquisition and control systems. Myron Crawford will speak at the March meeting on the weighty topic "Narrow Band White Gaussian Noise Excitation of Shielded Enclosures for Radiated Immunity and Shielding Effectiveness Testing." Myron spoke last year at one of the chapter meetings on reverberating TEM cells so this follow-up presentation is eagerly anticipated by all. April brings the industry's fabled Henry Ott, whose presentation at this time is still a mystery. Finally, in May, Dick Ford of the Naval Research Lab in Washington, DC will speak on a topic he calls "Bumpy Rooms," which has to do with a new type of shielded enclosure. Details on these presentations will follow in a later edition of the EMC Society Newsletter. You may even be treated to a photo or two. The "official" chapter photographer, Janet O'Neil, did not attend the fall meetings due to the birth of her first baby on October 1st, so no photos w re taken. Chapter chairman Ray A ams insists the fall meetings described herein really did take place, though. Look for photos of your favorite speakers Bernie, Myron, Henry and Dick in the next issue of the EMC Society Newsletter!

CALL FOR BoD NOMINATIONS

Nominations are now being accepted for candidates for the IEEE EMC Society Board of Directors. In accordance with the Bylaws, nominations may be made by petition or by the Nominations Committee. The petition shall carry a minimum of 15 names of Society members excluding those of students. Nominees should possess professional stature and significant technical skills in electromagnetic compatibility. They must have adequate financial support outside the Society and have the approval of their organizations or employers to actively participate. Duties will include attendance at three or four Board meetings a year and participation on committees, both of which assignments require telephone communications, correspondence, etc. Nominees must be full members of the IEEE and members of the EMC Society. Elected Directors must serve a three-year term starting January 1, 1995. No member can serve for more than six consecutive years, including partial terms. All nominees are required to submit a biographical summary to the Nominations Chairman. The summary must not exceed a one-half typewritten page and must be in the following format:

First paragraph	Name, title, place of employment, educational background.
Second paragraph	Technical and professional experience.
Third paragraph	IEEE service and activities including offices, committees, awards, etc.

Please submit petitions and biographical summaries to the Nominations Chairman. Submissions must be postmarked no later than May 30, 1994.

H. R. Hofmann
Nominations Chairman
AT&T Bell Labs - Room 2B-220
2000 N. Naperville Road
Naperville, IL 60566-7033
Telephone: 708-979-3627
Fax: 708-979-5755

Information can be obtained from the Nominations Chairman.

CHANGE TO EMC SOCIETY BYLAWS

In its last meeting on November 6, 1993, the EMC Society Board of Directors voted to move Bylaw 3.6 from section 3 to section 8, renumbering it to 8.5. In moving the Bylaw, the heading was removed to match the style of the other paragraphs in section 8. There is no other change.

8.5 The Board of Directors shall be able to provide monetary support for the services of outstanding individuals to serve in advisory or nonelective positions for a period to be specified in the appointment. Board of Directors approval by a 2/3 majority is needed.

NOMINATION PETITION
ELECTROMAGNETIC COMPATIBILITY SOCIETY
BOARD OF DIRECTORS

(Nomination guidelines given on facing page.)

I. NOMINEE'S NAME: _____

MEMBERSHIP NUMBER: _____

ADDRESS: _____

_____

_____

PHONE: _____

II. **BIOGRAPHICAL SUMMARY:** Attach Typed Copy

III. **SIGNATURES:** (Minimum of 15 names) We, the undersigned, all of whom are current IEEE Electromagnetic Compatibility Society (EMCS) members in good standing, nominate the above-mentioned person to serve on the EMCS BoD for a three-year term beginning January 1, 1995.

	MEMBER'S NAME (PRINT)	SIGNATURE	MEMBERSHIP NUMBER
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EMC CERTIFICATION & ACCREDITATION PROGRESS REPORT

RUSSELL V. CARSTENSEN
ASSOCIATE EDITOR

I recently elected to retire from federal service and re-entered private practice in November. The federal government is undergoing a significant and severe loss of experienced talent as it works through downsizing. I have always had a definite concern for the maintenance of professional expertise. Organizations are only as good as their people. One responsibility I have imposed on myself over the course of my career (and will continue even though I am no longer a civil servant) is to continue to support EMC certification and EMC test laboratory accreditation.

I have been probing into the certification process. NARTE currently has 1,010 certified EMC engineers and 330 certified EMC technicians on the rolls. The renewal rate is about 96%. To my amazement, thus far this year 60 people have applied for certification; 13 engineers sat for the examination, and of those, 8 have been certified. Certification is not automatic after successful completion of the examination. Candidates must also have a complete file of reference and peer endorsement documentation before their credentials are presented to the NARTE EMC certification board. However, of those who sat for the examination only one did not pass. It appears that that failure was occasioned by the candidate's neglecting to follow instructions, not because he was not competent. Similarly, seven technicians sat for the examination, and of those, six passed. Fourth (calendar, not fiscal) quarter statistics are even more impressive. There are seven engineers and two technicians currently slated to sit for the examination in that quarter alone.

The purpose of the examination is to confirm a working knowledge of EMC fundamentals. The EMC certification test is relatively easy. The examination is targeted to a generalized body of knowledge and is open-book. It is presumed that anyone with basic EMC engineering or (in the case of the technician examination) EMC technology education and a small amount of readily available reference materials can pass the examination.

The examination question base includes over 15,000 questions submitted by those who requested qualification by eminence. While the questions submitted were appreciated, they could not be used directly. Each question and solution must undergo a rigid psychometric review prior to release for the examination. The review is necessary to weed out ambiguous language, local terminology and errors. It was fascinating that in the initial submissions, questions did not match solutions; that solutions reflected the question asked, but could not be supported after the language was corrected.

The process for building a credible test file is complicated and thus very slow. For example, of the initial 15,000 questions, 938 have been through technical review and 913 of those have been through final review. The difference between technical and final review is that technical review is completed by a group while final review is conducted by two engineers only. The group explores subtle interpretations and nuances to assure that the technical issue is clear and distinct. After the group approves the completed question, it is sent simultaneously to two engineers for trial examination. Once their results are compiled, the final version is placed in the question pool. There are currently 367 questions in the examination database.

The examination staff is crying for volunteers to help with question review. They need reviewers for specialized questions in lightning and electrostatic discharge. The examination staff also needs help in developing a methodology and application for question-response timing. NARTE would like to conduct specialist examinations, tailored to specific fields within the EMC community. They would like to examine radar proficiency as a specialty in the afternoon. They have worked out response times for specialized questions but have not developed a methodology for inserting those specialized questions into the examination in a fashion that provides adequate challenge without jeopardizing the non-specialist taking the same examination. If you are interested in helping the examination staff, contact Ms. Clair Wyatt, SENTEL Corporation, at 703-413-1100 for information.

There are currently 12 EMC test laboratories accredited by the NIST-sponsored National Voluntary Laboratory Accreditation Program. MOTOROLA is the most recent laboratory to achieve accreditation.

For further information about accreditation or accredited laboratories, contact Mr. Jeff Horlick at NVLAP, 301-975-4020 or FAX 301-926-2884.

EMC certification will go a long way to preserve an essential skill base both within and outside the Government. The results of the August 1993 attendee survey were published in the last issue of this newsletter. Item 6 of that survey, "How can the EMC Society help you in your career?" was of particular interest to me. The leading response was "Espouse certification/ accreditation." It seems that this is not only an issue consistent with the Society's charter but is of concern to a large segment of the population as well. But more on this next time.

JOSEPH BUTLER
ASSOCIATE EDITOR

IEC/CISPR A&G
Don Heirman,
RAC Representative

The IEC CISPR annual meeting was held on 20-30 September, 1993 in Rotterdam, the Netherlands. Items of interest:

- Immunity: Radiated fields were discussed down to 27 MHz, and the use of pulse modulation where appropriate was also discussed. Conducted immunity on cables as a preferred substitute for the frequency range 30-80 MHz was argued. Performance degradation criteria are to be assembled for a host of ITE products from digital switching machines to LANs to radio links.

- Emissions: Controversy on the limits for signal port measurements under 30 MHz continues for those ports connected to long lines. The suggestion to add digital cellular radio spurious emissions under the ITE was debated.

The second edition of Publication 22 is to be released in October; it is not a very big change from the original version. Edition 3 in 1994 will have much of the intent of ANSI C63.4: the FCC adopted a provision allowing the manufacturer to choose either FCC Part 15/ANSI C63.4 or Publication 22 in showing conformance to emissions limits.

SAE AUTOMOTIVE EMI AND EMR
Ed Bronaugh,
RAC Representative

The EMR Committee has balloted J551/1. This will be essentially the same as J1113/1, an introduction to the remainder of the document and definition. Work continues on both documents.

SAE AE-4 ELECTROMAGNETIC COMPATIBILITY

Recent activity of this committee involves balloting on the cancellation of AIR 1509 - EMC Antennas and Antenna Factors: How to Use Them (the material has been included in the recent revision of ARP 958); and reballoting due to lack of a quorum on past ballots for ARP 4244 - Recommended Insertion Loss Test Methods for EMI Powerline Filters, and ARP 1972 - Recommended Measurement Practices and Procedures for EMC Testing. The results of the ballot on ARD 50040 - Certification of Aircraft - Electrical/ Electronic Systems for Operation in the High Intensity Radiated Fields (HIRF) are still being evaluated due to comments received.

RTCA SC-135 HIRF WORKING GROUP

Work continues on the proposed DO-160D Document with much activity going on in Section 20 of that document. Most of the activity is involved with modifying Section 20 to be in alignment with the HIRF Advisory Circular (ARD 50040 mentioned above).

RTCA SC-177 WORKING GROUP ON PORTABLE ELECTRONIC DEVICES (PEDS)

The activity of this group has been involved with investigating EMC problems deriving from operation of PEDs onboard commercial aircraft and the reported effects on navigation/communication systems. At present the group plans to develop an advisory circular which would mandate PEDs to meet either DO-199 or DO-160 emissions limits.

AMERICAN NATIONAL STANDARDS INSTITUTE C63 STANDARDS COMMITTEE ON ELECTROMAGNETIC COMPATIBILITY

The C63 committee is currently reviewing a draft revision of ANSI C63.12 - 1987 - Draft American National Standard for Electromagnetic Compatibility Limits - Recommended Practice. Discussions are under way among the FCC, Win Tech, and C63 concerning the possibility that C63 could participate in the review of methods of compliance measurement of Unlicensed Personal Communications Services (UPCS) devices. Preliminary work has been involved with analysis of C63.4 in terms of its adequacy in this area. ASC C63 Subcommittee 1, Techniques and Developments, recently balloted the radiated immunity portion of C63.15/Draft 3, Recommended Practice for the Method of Immunity Measurement of Electrical and Electronic Equipment. (Conducted immunity sections were balloted earlier in the year.) Draft 10 of the Methods of Measurement of Radio Frequency Interference from Appliances in the AM, FM, and VHF-TV Bands is currently being reviewed by the working group within C63.1. This document proposes adoption of the FCC Part 15 limits. C63.1 is also currently balloting Draft 2, November 1993 ANSI C63.5 - 19XX American National Standard for Electromagnetic Compatibility - Radiated Emission Measurements in Electromagnetic Interference (EMI) Control Calibration of Antennas, and Draft 2A, November 1993 ANSI C63.5 - 19XX American National Standard for Calibration of Antennas Used for Radiated Emission Measurements in Electromagnetic Interference (EMI) Control.

KIMBALL WILLIAMS
ASSOCIATE EDITOR

GROWING GRAY

At the last symposium in Dallas I remember having more fun than I can recall having since the previous symposium in Anaheim. I believe that a lot of that perception at each succeeding symposium has to do with meeting old friends and associates again and catching up on their news. Some old friends are absent at each symposium, never to be met again this side of the veil. Their work for the society, and the EMC community in general, must be taken up by someone else with the vision and persistence to carry on.

More and more I see the work in the Society being carried by the same aging shoulders year after year. I also notice that each year I meet fewer new, young members. Those of us who have been in the society for a time are getting gray, and there are too few new heads coming in to replace those that fade away. How do we let the young engineering students know about EMC? How can we let those now working in industry know about the Society and the benefits it offers?

WAVING THE FLAG

One of the front page stories in the *EE TIMES* for the week of December 6, 1993 began with the banner:

Regulations force electromagnetic compatibility issue
EMC SHOCKS BOARD DESIGNERS

Nowhere in this article is there any mention of the IEEE EMC Society. For many of us, the society and its meetings, symposiums and publications are a major source of new information on what is happening in the field of EMC. As Pat Coles said in the latest EMC Society video, "...This is where we learn our trade." The new engineer seeking information needs to know about the Society and what it has to offer to help him up the learning curve, as well as its resources for help and assistance.

It seems that with as much as we have been doing to spread the word about EMC and the Society, it has not been nearly enough. I took a look through the current listing of the standing committees to see if there was one committee in particular that might have the responsibility for carrying the message to the public at large, and it appears that, as Pogo said, "We have met the enemy, and he is us." The "Vision" statement in the proposed new charter for the EMC Society Education Committee reads, "To make everyone involved in appropriate technology aware of EMC at the level consistent with their needs." So... if there is any one group which is supposed to be waving the flag, at least some of the Education Committee think it should be us.

"ANOTHER" SUBCOMMITTEE

With all this in mind, I would like to propose a possible new sub-committee to the Education Committee. Let's give it a temporary name of the "Awareness" subcommittee. The express purpose of this subcommittee would be to find ways to fulfill the goals of the above vision statement. Some obvious methods might be:

- Writing at least one article each year for every relevant publication.
- Culling current publications for articles on EMC and writing replies and/or corrections and referring readers to the EMC Society for more information.
- Setting up liaisons with other related IEEE Societies and writing articles for their respective publications at least annually.

This is an "off the top-of-the-head" list, and I am sure that a brainstorming session of our members would suggest many more opportunities. I think we may have enough to get started with right now, and I don't want to wait until we have our next annual meeting in August before we get this ball rolling. So....

First, let me apologize if through ignorance we are intruding on some other committee's territory. Then let me suggest that if there is some other committee with the responsibilities that I have outlined, please let us know, for there are members of the Education Committee that would be glad to help you with your task.

If we don't hear from some other committee within a few weeks of this publication, I will contact the members of the Education Committee and begin the process of setting up this new sub-committee and getting it started on its task, so that by the time we hold our annual meeting at the symposium in Chicago, this new subcommittee may be able to report on some positive actions.

LOOKING BACKWARD, LOOKING FORWARD

Bellamy's novel *Looking Backward* concerned itself with all the changes that the novel's hero could see from a vantage point in the future, looking backward to the time he came from. We don't have the advantage of that long vision from the future, but we can see where we came from and the long strides that have been made in EMC technology and in the EMC Society over the years.

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IEEE EMC SOCIETY HISTORY

CHET SMITH
SOCIETY HISTORIAN

The IEEE EMC Society has as its charter the advancement of the theory and practice of electromagnetic compatibility. More than 4000 persons worldwide are active members of the Society. Although the majority of the members are from the United States, in keeping with its origins, an increasing percentage of the membership is from outside of the United States. There are currently 26 chapters in the United States, and international chapters in Austria, Canada (3), China, France, Israel, Japan, Singapore, Sweden, Switzerland and the United Kingdom, for a total of 38 chapters at the end of November, 1993.

The EMC Society had its start at the beginning of the 20th century when radio was in its infancy. Radio frequency interference (RFI) was noted as early as 1910 when the United States Navy petitioned to have about 4000 amateur radio stations shut down because of interference to the 1000 or so registered commercial and government radio stations. The Radio Act of 1912 did not put the amateurs off the air, but relegated them to the "useless wavelengths of 200 meters and shorter." It also limited their power to 1000 watts.

The American Institute of Electrical Engineers (AIEE) was organized in 1883. The AIEE concerned itself mainly with the technology of power generation and distribution, but it did have some early adventures with interference. The telephone and telegraph wired circuits were frequently in close proximity to the power lines. With the introduction of alternating current, the communications people began to experience ac hum. AC hum was controlled by systematically twisting the telephone and telegraph lines and through some early forms of filtering, the so-called "hum-bucking" coils.

The Institute of Radio Engineers (IRE) was organized by Lee DeForest and others in 1912 to promote the science of radio. The IRE did, indeed, address the issue of interference from time to time, but the organization that took the issue most seriously was the American Radio Relay League (ARRL), an amateur radio society organized by Hiram Percy Maxim of Maxim machine gun fame. Maxim was an enthusiastic amateur scientist whose hobbies and professional activities tended to blur. After the amateurs were permitted back on the air, having been shut down during the 1918-1919 war, they (in the form of ARRL) were given a blunt ultimatum by the U.S. Department of Commerce: if the amateurs could not police themselves they would be shut down permanently. Self-policing has been one of the hallmarks of the amateur community ever since.

> *"The legal merger of the AIEE and the IRE took place in 1961 and the organization was named the IEEE."*

Radio broadcasting, however, still was chaotic; everyone did as they saw fit. In order to bring order, the Government appointed Herbert Hoover to chair a commission on the problem. Hoover was not an electrical engineer, but he was an engineer (mining) and he brought an engineering approach. The Hoover Commission report resulted in the Radio Act of 1927, which created the Federal Radio Commission (FRC). It established the policy of assigning discrete frequencies, power levels and modulation modes to individual stations, and established bands for the different types of radio services. The FRC had authority to license all radio stations except government stations. The appearance of vacuum tube technology at this time permitted much closer regulation of station emissions. Somewhere in this time period, Class B modulation (spark gap) was outlawed.

The FRC was replaced by the Federal Communications Commission (FCC) in the Communications Act of 1934. The FCC's role included not only radio, but all forms of electrical and electronic communication. The FCC consolidated the regulatory activities of the Department of Commerce, the U.S. Post Office, the Interstate Commerce Commission and of course, the Federal Radio Commission. The Communications Act of 1934 remains the law of the land to the present. It has been amended many times over the years, but one of the more recent changes was made by the Goldwater, Wirth, Vanek Bill of 1982. The original 1934 act and amendments up to 1982 did not address the issue of immunity. The only weapon the FCC had against interference was to control emissions. The Goldwater bill authorized, but did not mandate, that immunity be included in the FCC Rules and Regulations.

Electrical and electronic interference phenomena were known before World War II. However, the relative sparsity of the radio population and some simplistic methods used in wired communication had sufficed to control it. After the war, however, there was a sharp escalation in the use of the spectrum and more and different types of service were being

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introduced. The amateurs had their first experiences with television interference (TVI), both from harmonics of their HF operations and adjacent channel programs from 6-m (50 to 54 MHz) onto channel 2 (54 to 60 MHz). In the early 1950s, Rexford Daniels, Leonard Thomas, Eugene Knowles, and several others began to agitate for a formally recognized professional group to study interference phenomena in a scientific and systematic way. Mr. Daniels began publishing a quarterly newsletter, "Quasies and Peaks," in 1954. Efforts to obtain official recognition by the IRE were slow in coming. The IRE had no objectives, but merely wanted the scope of the proposed group defined.

In the same time period, a series of conferences (the "Armour" Conferences) were held in which papers on interference phenomena were presented. In the early 1950s, the IRE became officially active in interference control through the chartering of the Profession Group on Radio Frequency Interference (PG-RFI). The PG-RFI began publishing the Transactions on RFI and a newsletter, both quarterlies. Local chapters were authorized and Rex Daniels put together the Boston Section chapter. The PG-RFI also began holding annual Symposia and published the proceedings in a series of conference records.

The AIEE, in the meantime, had awakened to the fact that electronics was, indeed, a significant branch of electrical engineering and that many of its members were in both the AIEE and the IRE. The AIEE began organizing what were called Technical Interest Groups (TIG). A merger of the AIEE and the IRE had been talked up for some time and a formal vote was taken in 1959. The legal merger took place in 1961 and the organization was named the Institute of Electrical and Electronics Engineers (IEEE).

Since the interests of the various subsidiary groups involved significant areas of overlap, many of them were combined. In searching for a name for these merged groups, the term Professional Interest Groups was proposed. It was almost adopted when someone called attention to the fact that the abbreviation was PIG. The shortened form of G-XX was adopted, and the PG-RFI became the Group on Electromagnetic Compatibility (G-EMC). The scope of the charter of G-EMC was much broader in that all sorts of unwelcome electrical and electronic phenomena were included.

Although the old AIEE was strictly a U.S. and Canadian organization, the IRE was openly transnational from the beginning, and the G-EMC began holding IEEE international symposia on EMC at various locations around the United States, with a respectable number of foreign attendees and papers presented. The group encouraged its members to take part in EMC events in other countries and functioned as a participating, or sometimes as a sponsoring agency for the IEEE. There were several European EMC Conferences, notably the Geneva and Wroclaw meetings. In the late 1970s, the IEEE promoted all of its various subsidiary groups to the status of Societies.

Although the IEEE EMC Society had been labeling its Symposia as international for some time, the first off-shore international Symposium was held in Tokyo, Japan in 1984. During the same year a regional Symposium was held in San Antonio, Texas. Both programs were well attended and successful. In actual fact, however, both were "international" in that foreign and domestic participation was heavy in each. The term "regional" is somewhat of a misnomer in that these programs have never been strictly regional. In view of the experience that all IEEE EMC Symposia have been "international" and may be expected to remain so in the future, the Society may at some time in the future drop the terms "regional and "international" altogether.

WILLIAM H. PARKER

Bill was born on July 23, 1946, at Fort Dix, New Jersey, where his father, an Army master sergeant, was stationed right after World War II. Bill earned his Associate of Science Degree in Pre-Engineering at Chowan College in Murfreesboro, NC followed in 1973 by a BSEE from North Carolina State University in Raleigh. Since graduation he has taken additional undergraduate and graduate courses at USC, Northrop University and Western States College of Engineering.

For his initial involvement with EMC, Bill "blames" Steve Jensen, who took a hiring chance in August, 1973 at Genisco Technology Corporation on a recent college graduate with no experience and a lousy resume. Steve convinced Bill that striving to become an EMC consultant was an admirable and achievable goal and pointed out the number of former engineers at Genisco who had left to become consultants or otherwise open their own businesses: Fred Nichols, Joe Fischer, Chris Kendall, and eventually, Steve himself. Bill started at Genisco as a filter design engineer and was put in charge of the EMC Engineering Services Division in 1976. In 1988, he was promoted to Director of Engineering at Genisco, overseeing five engineering departments. In 1989, shortly after the sale of the EMC Engineering Services group to National Technical Systems, Bill resigned to begin his private consulting practice.

Bill has a background in military, aerospace, medical, and commercial/international EMI testing and he has helped provide filtering, shielding, and other EMC fixes in all those areas. He has taught EMC seminars for Don White Consultants (now Interference Control Technologies) since 1982. In his consulting practice and work for Genisco and Interference Control Technologies he has been fortunate in being able to travel widely and often and has visited 14 states and 7 countries.

Some of his most interesting and challenging work has been the on-site testing and EMI suppression of diesel engine generators at numerous military bases in the U.S., including remote radar sites in Alaska (during snowstorms).

During his 16 years at Genisco, he worked primarily with MIL-STD-461 and related military and aerospace specifications. Since beginning his consulting practice in 1989, the military/aerospace business opportunities have softened and he has found EMC needs in the computer, power quality, medical and international fields.

Recently he has worked on a number of medical instruments. EMI problems/challenges include the effective and economical suppression of conducted and radiated emissions from digital circuitry without violating stringent capacitive leakage current requirements, and without requiring major circuit or mechanical package re-design. The goal is to convince the clients to "design in," not "tack on" electromagnetic compatibility.

What Bill finds interesting about working with EMI is the exposure to many aspects, products, areas, and situations in the broad field of electrical technology. The field of EMC offers a vantage point from which the progress of technology can be viewed. What he finds frustrating

WILLIAM G. DUFF
ASSOCIATE EDITOR

is that the customer base for the EMC community seems exceedingly slow in learning the basics of EMI control, such as effective and efficient application of grounding, shielding, and filtering.

In the EMC seminars he teaches for Interference Control Technologies, he is somewhat disappointed by the low U.S. student count; foreign corporations and agencies are training heavily, while U.S. entities seem to be "waiting until things improve" before spending training funds. He is convinced that training is one of the factors that helps conditions improve, and is concerned that U.S. interests are practicing false economy and not preparing their technical personnel for the future. In his technical presentations as an EMC Society Distinguished Lecturer, he has been trying to remove some of the mystery surrounding effective, efficient application of EMI power line filters.

Bill is a registered professional engineer in California and is NARTE certified as an EMC engineer. He has served as Los Angeles chapter chairman (twice), vice chairman, secretary and treasurer, as well as serving on the EMC Society Board of Directors (1979-81 and 1983-85). He was EMC Society Vice President for 1982 and 1983. He has presented over two dozen technical papers or

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THE FINITE DIFFERENCE TIME DOMAIN METHOD FOR ELECTROMAGNETICS

By Karl S. Kunz and Raymond J. Luebbers
The Pennsylvania State University
CRC Press, Boca Raton, FL, 1993
448 pages $79.95

Reviewed by:
JAMES L. DREWNIAK
UNIVERSITY OF MISSOURI - ROLLA
GUEST EDITOR

The *Finite Difference Time Domain Method* is written by two of the leading contributors to the development and application of the finite-difference time-domain (FDTD) method for computational electromagnetics. With the advent of powerful and affordable desktop workstations, this computationally intensive numerical method is being widely applied in many areas of electromagnetics including EMC. This widespread activity is a result primarily of the increase in affordable computing power. Because of the great attention received by this method for application to electromagnetic interaction problems, this area is in a state of rapid development and application. The authors acknowledge in the preface that any text in this area is likely to be to some extent outdated as soon as it is published. However, while the FDTD method is theoretically quite straightforward, there are many details to successful application of this technique to any electromagnetic problem. Previously, these details were scattered throughout the literature. The authors have collected the central themes of these works, many of which are their own, and elaborate on some of the more subtle implementation details, recognizing that this is a rapidly advancing area.

The authors' stated goals are broad and ambitious, striving to provide a presentation of the FDTD method which will fit the needs of undergraduate and graduate level courses, as well as those of an applications engineer attempting to assimilate and apply the method. The book is well organized to meet these goals. Specifically, the approach taken in the organization of the material is applications oriented, and is divided into five parts: fundamental concepts, basic applications, special capabilities, advanced applications, and mathematical basis. Each section is divided into fairly short and concise chapters that treat a particular application or fundamental detail of the FDTD method.

The first section, Fundamental Concepts, devotes two chapters to the mechanics of the FDTD method. The authors primarily employ a scattered field formulation throughout the book. For many applications (in particular many EMC applications), a total field formulation is desired; however, this can be obtained in a straightforward manner from the treatment presented. Chapter 2 discusses the development of the FDTD equations from Maxwell's equations. Practical details of the implementation of the method in FORTRAN are also discussed for perfect conductors and lossy dielectrics. Other practical considerations for actually implementing the FDTD method are presented in Chapter 3 including cell size, time-step size, source excitations, filling the computational domain with Yee cells, truncating the computational domain with absorbing boundary conditions, and computational resource requirements related to problem size.

Basic applications of the FDTD method to shielding, waveguide aperture coupling, and dielectric and lossy dielectric scattering are presented in Part 2. The mechanics of the FDTD method given in Part 1 are applied in a straightforward manner to these problems. The application of the FDTD method to coupling effects of external fields to penetrable enclosures is discussed in Chapter 4. One of the author's early work in FDTD relating to the response of aircraft to EMP is described. Applying the FDTD method for investigation of the coupling of an external field to the interior of an enclosure with an aperture is presented for apertures on the order of resonant dimensions, and for apertures smaller than resonant dimensions. Details of the modeling and computational intensity of these types of problems are given, as well as results that are not intuitive, which illustrate the power of numerical methods for providing insight and guiding design approaches.

Part 3 discusses application of the FDTD method to more specific problems, including obtaining the far fields, FDTD for frequency-dependent materials, modeling impedance sheets, thin wires, voltage sources, lumped elements, nonlinear loads and materials, and visualization aspects. A method for obtaining the far electric and magnetic fields is developed in Chapter 7. The tangential electric and magnetic fields on a closed surface just inside the computational domain boundaries are related to the exterior fields, and a time-domain far-field extrapolation is developed from which the time-harmonic fields can be obtained by FFT.

An FDTD algorithm for linear, dispersive materials is presented in Chapter 8. The algorithm is convolution based (relating the electric flux density to the electric field). The modified FDTD updated equations are developed for first order Debye materials. A recursive evaluation of the resulting convolution integral is developed that renders the algorithm computationally efficient and can be realistically applied in three-dimensional problems with currently available workstations. Also given are algorithms for first order Drude

dispersion, as well as more general second order dispersive materials. These algorithms are a straightforward extension of the first order development.

An FDTD implementation of surface impedance boundary conditions for good conductors is given in Chapter 9. In these cases, a small mesh dimension would be required in the good conductor, and an inordinately large number of cells could result without some modification to the basic FDTD algorithm. Since in many cases only the fields external to the conductor are desired, a frequency domain surface impedance boundary condition can be employed to modify the FDTD equation for tangential magnetic field components adjacent (one-half cell) to the boundary. The procedure is applied to one and two dimensional problems.

Chapter 10 discusses special algorithms for incorporating thin wires and lumped elements into the FDTD method. When the scatterers or elements to be modeled are small relative to the wavelength, an inordinately small cell dimension would be required to model the geometry. This in turn decreases the maximum time step dictated by the Courant limit, and the solution time can grow prohibitively large. By introducing appropriate modifications to the FDTD equations for the cells through which the small geometries pass, a larger mesh dimension can be maintained while still being able to model the desired small elements. Such algorithms have been developed for thin wires, lumped loads, and impedance sheets. In preparation for developing the thin wire FDTD equations, the basic FDTD equations and distribution of the field components over the unit cell are related to the integral form of Maxwell's equations. This relationship can provide significant insight into the basic algorithm for newcomers to the FDTD method, and is useful to read with introductory material in Part 1.

Incorporation of simple nonlinear lumped loads and nonlinear materials into the FDTD method is discussed in Chapter 11. Modifications of the FDTD equations modeling a diode are presented. The voltage-current relation for a diode is combined with the finite-differenced form of Ampere's law to yield a nonlinear system of equations that must be solved at each timestep for any unit cells that incorporate a diode. Details for modeling a nonlinear magnetic sheet are also given and the results compared with previous studies. Since the magnetic material is nonlinear and has a large conductivity, the timestep to ensure stability of the algorithm is significantly affected. A helpful discussion as well as tabulated values of conductivity, mesh dimensions, and time increment are given for a linear medium to ensure stability.

Three chapters of more advanced applications of the FDTD method to scattering, antennas and gyrotropic media are given in Part 4. The material presented on scattering and antennas applies previously developed methods, while special techniques for handling gyrotropic media are given in the final chapter of the section. Calculations of the radar cross section (RCS) employing FDTD for impedance sheets and for a frequency dependent material are discussed in Chapter 13. Since the FDTD method is most typically applied using a rectangular mesh, the effects of approximating geometries that do not conform to rectangular boundaries, i.e. "star-casing" errors, are also discussed and demonstrated through RCS calculations for conducting plates and dielectric spheres. Examples are also given and discussed regarding the distance of the absorbing boundaries from the scatterer geometry via RCS calculations.

The FDTD method applied to antenna problems is presented in Chapter 14. Antenna input impedance, efficiency, power gain, and mutual impedance are calculated from FDTD results for a two-antenna array of dipoles, one of which is drive and the other a director. The accuracy of the FDTD method for these types of calculations is demonstrated by comparison with moment method results. Input impedance, radiation patterns and antenna gain are also computed for a monopole on a conducting box, and each is compared with experimental results. The good agreement demonstrates the power of the FDTD method for modeling complex geometries, and computing input impedance which is typically difficult and sensitive to feed-point modeling.

An FDTD formulation for application to gyrotropic media is presented in Chapter 15. Both a magnetized plasma in which the dispersion and anisotropies affect the update computations for the electric field, as well as a magnetized plasma in which the dispersion and anisotropies affect the magnetic field updates are considered. The recursive algorithms developed in Chapter 8 are applied for evaluating convolution integrals efficiently. The resulting algorithm is applied to normally incident plane wave scattering at the interface of free space and the gyrotropic medium.

Part 5, Mathematical Basis of FDTD and Alternate Methods, gives a brief presentation of the topics of finite-differencing schemes, stability, dispersion, and absorbing boundary conditions. The book is primarily applications oriented, and these developments are brief, but sufficient to give the reader an appreciation of the topics. A three-dimensional FDTD Fortran code is given in the appendix that is capable of handling perfect conductors and lossy dielectric materials. The code is liberally commented and easy to follow.

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Overall this book is a very nice contribution to the electromagnetics community. For an individual attempting to assimilate and apply the FDTD method to a specific problem, the book provides a good treatment of the method, and does a particularly good job of relating FDTD implementation to the applicable physics. The progression of topics throughout the book, from FDTD basics to application for modeling more complex media, structures, and loads is also very well suited for learning and assimilating the FDTD method quickly. Finally, the authors provide insight and a means for approximating the computational resources required for a given size of problem, which is very helpful for three-dimensional problems given the computational intensity of the FDTD method. My criticisms of the book are based primarily upon personal preference, and in general are minor. First, I found the references not entirely complete at points. Important or helpful references to direct the reader to more special topics or provide another perspective could have been provided in a few places. Second, no treatment of the FDTD method on unstructured meshes was given. However, even a brief but sufficient treatment would have added considerable length to the book. Finally, given the computational intensity of the FDTD method, a more detailed discussion of multigrid methods for reducing the number of cells in the computational domain would have been helpful.

James L. Drewniak received B.S., M.S. and Ph.D degrees in electrical engineering from the University of Illinois, Urbana-Champaign in 1985, 1987, and 1991, respectively. He was the recipient of several graduate fellowships and awards at the University of Illinois, and pursued graduate studies in wave propagation and interactions in the areas of electromagnetics, antennas, microwaves, and acoustics. In July, 1991 he joined the Electrical Engineering Department at the University of Missouri-Rolla as an assistant professor and has received campus Teaching Excellence Awards for 1991 and 1992. His research interests include the development and application of numerical methods for investigating electromagnetic compatibility problems, antenna analysis, and modeling of microwave components, as well as experimental studies in antenna and electromagnetic compatibility problems.

Dr. Drewniak is a member of the IEEE and is Secretary/Treasurer of the Rolla IEEE Subsection, and is also a member of the Acoustical Society of America, Eta Kappa Nu, Tau Beta Pi, and Phi Kappa Phi.

ELECTRICAL ENGINEERS SEEK FEDERAL COMMITMENT FOR SPACE COMMERCIALIZATION PROGRAM

"Today, the only way to realize the vaunted scientific and cultural missions of the U.S. space program is to hitch them to the powerful rocket of commercial development." This is the position of the United States Activities unit of The Institute of Electrical and Electronics Engineers Inc. (IEEE-USA), included in a report released last week and calling for a federal commitment to achieve the economic promise of space.

According to Charles K. Alexander, Jr., chairman of the IEEE-USA Board, "Just as we made space the arena of military competition during the Cold War, keen international economic competition compels us to make space the high frontier of commerce and industry. " Citing the successful $15 billion-per-year satellite communications industry, Dr. Alexander stressed that space commercialization can become profitable if the basic cost of space infrastructure is brought low enough. The IEEE-USA position listed several recommendations for an effective federal program to enable private commercialization of space.

The highest national space priority must be given to achieving improvements in basic space infrastructure by increasing the safety and reliability as well as decreasing the unit cost.

> The U.S. should develop a much safer, more reliable and less expensive alternative to the shuttle—a new passenger- and cargo-carrying vehicle. Large, economically-attractive, space-related markets must be created.

Dr. Alexander emphasized that such a space commercialization program would not exclude other important civil space activities. "By generating the required revenues for the large expenditures needed for solar system human activities, space industry would ensure the strong public support necessary for all other areas of the U.S. space program," he said.

For a copy of the IEEE-USA report, "What the United States Must Do to Realize the Economic Promise of Space," contact Sharon Richardson at (202) 785-0017 (voice) or (202)785-0835 (fax).

(Source: *IEEE NEWS*, Dec. 22)

EMCS EDUCATION COMMITTEE . . *Continued from page 12*

As I see the gray heads around me at EMC Society meetings, I want to bring young people into the Society and show them around and introduce them to these marvelous people that I have known and say, "See, they are real people!" I would like to look forward to the day when there is a large following of young engineers and technicians in the Society who can learn from these giants and grow to follow in their footsteps for a time, then break new ground on their own. I would like to look forward to that day coming soon.

EMC PERSONALITY PROFILE . . *Continued from page 15*

talks at various technical symposia and has chaired symposium sessions in the U.S. and abroad.

Bill served in the U.S. Army from 1965-1969, including tours in Korea and Vietnam. He has since served over 17 years in the U.S. Army Reserve. He is a private pilot with 500 hours flight experience, and owns a 1984 Piper Cherokee (Warrior II).

Bill is a (sometime) regular jogger, and has completed a dozen marathons, including all eight Los Angeles marathons. Bill has been married for 24 years to his wife Connie and they have a 16 year old daughter, Jennifer.

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EMCABS

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Following are abstracts of papers from previous EMC Symposia, other conferences, meetings and publications.

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Engineering College/University Libraries, Public Libraries, Company or Corporate Libraries, National Technical Information Services (NTIS), or the Defense Technical Information Center (DTIC) are all possible sources for copies of abstracted articles or papers. If the library you visit does not own the source document, the librarian can probably request the material or a copy from another library through interlibrary loan or, for a small fee, order it from NTIS or DTIC. Recently, it became clear that EMCABs were more timely than publications which were being listed in data files. Therefore, additional information will be included, when available, to assist in obtaining desired articles or papers. Examples are: IEEE, SAE, ISBN, and Library of Congress identification numbers.

Also, the steering staff of the Japan Technical Group and the EMC-J Tokyo chapter have offered to act as a central point for requests of papers abstracted here. Most of the papers will be available in Japanese only. The steering staff will assist in routing your request to the author(s) but will not do translating of the papers. The contact person is Prof. Yoshio Kami, the University of Electro-Communications, 1-5-1, Chofugaoka, Chofu-Shi, Tokyo 182, Japan. Abstracts of papers from EMC-J will be clearly identified.

Some of the Chinese papers are not available in English. Associate Professor Sha Fei, EMC Research Section, Northern Jiatong University has offered his time and assistance in routing requests for papers to the appropriate author(s). He is not furnishing a translation service.

As the EMC Society becomes more international, we will be adding additional worldwide abstractors who will be reviewing articles and papers in many languages. We will continue to set up these informal cooperation networks to assist requesters in getting the information or contacting the author(s). The library at Southwest Research Institute, 6220 Culebra Road, San Antonio, Texas, 78228-0510 has agreed to catalog, shelve, and have available for interlibrary loans proceedings from symposia and meetings which are donated to the library. Any such donations can be sent to me at the above address and I will review them for suitable articles and then forward them to the SWRI library. We are particularly interested in symposium proceedings which have not been available for review in the past. Neither the abstractors nor myself have a budget for acquiring proceedings; we rely on those we receive through attendance at symposia and from various subscriptions. Thank you for any assistance you can give in expanding the EMCS knowledge base.

THE ELECTRONIC PRODUCT DESIGNER'S VIEW OF EMC

EMCABS: 01-03-93

A. J. Maddocks
ERA Technology Limited, Cleeve Road Leatherhead, Surry, England
IEMCS-92, International EMC Symposium, Singapore, Republic of Singapore
7-9 December 1992, Pages 1-6

Abstract: The probability that any item of commercial electronic equipment will comply with the current range of European EMC standards is low if no consideration of EMC requirements has been given at the inception of the design. Fortunately, for many equipments the margins of non-compliance may not be excessive and it is often possible to make retrospective changes by using filters and improving bonding to bring the product into marginal conformity. However, retrospective remedial action is invariably expensive and inefficient because the product is infrequently designed to be receptive to such changes.

Index Terms: EMC design, EC Standards

SPEEDING UP QUASI PEAK WEIGHTING EMI TESTS

EMCABS: 02-03-93

Bartmut Schaefer
Rohde & Schwarz GmbH & Co. KG, Muehldorfstr. 15. Muenchen, Germany
IEMCS-92, International EMC Symposium, Singapore, Republic of Singapore
7-9 December 1992, Pages 46-54

Abstract: For maximum RFI emission in the commercial field, CISPR defines two different limits:
- Limits for quasi-peak weighted measurements
- Limits for average weighted measurements

Unfortunately, QP measurements are very time consuming due to the response time of the weighting circuit.
The time constants of the QP indication, which are defined in CISPR Publication 16, call for a measuring time of one second at each frequency.

Index Terms: CISPR requirements, Quasi-peak measurements

SIMPLE DIRECTED HORN AND ILLUMINATIVE WALL REFLECTION METHOD FOR CHAMBER ABSORBER CHARACTERIZATION

EMCABS: 03-03-93

K-T. Ting (1), and J. S. Fu, E.B.L. Choo, and Yiong Lu (2)
(1)0A Center, Chung Shan Inst. of Science and Tech, Taiwan 325, China, and (2) School of E&EE Nanyang Tech U., Singapore 2263
IEMCS-92, International EMC Symposium, Singapore, Republic of Singapore,7-9 Dec. 1992,pp. 72-77
Abstract: This paper describes a simple directed horn and illuminative wall reflection method to characterize the reflectivity of the absorber in a chamber environment. The method first chooses the cone angle of the horn and defines the illuminated wall area of reflection. It then measures the transmitted and reflected power at horn reference plane under the direct horn and back to reflecting wall sequence. The reflection coefficient of the absorbing material can be obtained from the ratio of the reflected power received from the absorbing wall to the direct power received, the testing range and the chosen cone angle. An experiment was performed using two identical pyramidal X-band horn antennas, one for transmission and the other for reception. The absorbing material under test was an Eccosorb H hair-type broadband microwave absorber. The reflectivity of around 20 dB down obtained at 8100 MHz up to a testing range of 90 inches conforms with data sheet specification. In comparison to the sample piece coaxial return loss and arch radiated reflectivity methods, the characterization approach presented here in simpler and accurate, and can be performed is a realistic chamber environment.
Index Terms: Absorber Evaluation, Anechoic Chamber

ANALYSIS OF EARTH POTENTIAL RISE INDUCED BY COMPLEX GROUNDING STRUCTURES

EMCABS: 04-03-93

Rui Wen
Physics Dept., Northen Jiatong University, Beijing 100044, China
IEMCS-92, Int'l EMC Sym., Singapore, Rep. of Singapore, 7-9 December 1992, Pages 101-105
Abstract: In this paper, finite element approach is used and a new algorithm is presented to calculate ground resistance and leakage currents. This algorithm could be applied to treat various kinds of complex grounding structure composed of conductive grids and rods. Furthermore, the distribution of the earth potential, touch voltage, and step voltage caused by exciting currents in the ground could be also calculated by the algorithm. In the algorithm, the image effects of the grounding structure and the ground itself are taken into account. For a complex grounding structure, the average current distribution could not be assumed because the leakage currents in all elements are not the same. In this paper, it is assumed that if the wavelength is much greater than maximum size of a complex grounding structure, the ground would be equi-potential, i.e., the potentials on all the elements segmented from the ground are the same with that of the entire grounding system. Furthermore, it is assumed that the potential in each element is equal to the potential at its central point, and that the leakage current is uniformly distributed in each element. For higher accuracy, each element could be further subsegmented into a number of subelements. However, such subsegmentation may lead to more complicated computation.
Index Terms: Grounding, Earth Potential, Finite Element Analysis

SIMULATION AND MEASUREMENT OF EMF AND EMI SCENARIOS IN HIGH VOLTAGE ENERGY SYSTEMS

EMCABS: 05-03-93

S. Shihab, G. Katrib, and Z. Gu
Dept. of EE, Royal Melbourne Inst. of Technology, GPO Box 2476V, Melbourne, Victoria, Australia
IEMCS-92, International EMC Symposium, Singapore, Republic of Singapore
7-9 December 1992, Pages 122-128
Abstract: Modern power systems operate at very high voltages for transmission and distribution of electrical energy in bulk quantities. This requires long runs of high voltage transmission lines, high voltage substations with large power transformers and switching equipments. Modern techniques in metering, protection and condition monitoring of these equipment require sophisticated digital and analog devices which are sensitive to electromagnetic fields (EMF) and electromagnetic transients (EMT). Their operation may be jeopardized or they may even be physically damaged due to intolerable magnitude of EMF levels and electromagnetic interference (EMI) generated in the high voltage equipment. Recently, there has been some work done on measuring the electromagnetic exposure from power systems, e.g., transmission lines, substations, etc. These field measurements led to a better understanding of the electromagnetic patterns of these areas.
Index Terms: HV Energy Systems, EMF measurements

THE IGNITION OF FLAMMABLE ATMOSPHERES BY RADIO FREQUENCY INITIATED SPARKS

EMCABS: 06-03-93

A. J. Maddocks
ERA, Tech. Ltd., Cleeve Road Leatherhead, Surry KT22 7SA, England
IEMCS-92, International EMC Symposium, Singapore, Republic of Singapore
7-9 December 1992, Pages 129-139

Abstract: In many cases where electromagnetic compatibility is not achieved the symptom is a loss of function or performance which can be life threatening if the system is safety critical. But unwanted induced currents due to electromagnetic radiation can cause sparks to occur and ignition of gases is possible. There is thus a potential incompatibility between radio transmitters and gas/petrochemical processing plant, an issue which has been addressed in detail in the UK over the last fifteen years.

Index Terms: Safety, Electromagnetic Hazard

ELECTROMAGNETIC IMPULSES IN HIGH VOLTAGE GIS-SUBSTATION DURING A DISCONNECTOR OPERATION

EMCABS: 07-03-93

K. Feser and R. Sun
University of Stuttgart and ELC/SISIR, Singapore
IEMCS-92, International EMC Symposium, Singapore, Republic of Singapore
7-9 December 1992, Pages 140-145

Abstract: In gas-insulated switchgear (GIS), very fast transients (VFT) can be observed during disconnecter switching. The overvoltages inside the enclosure have a very short rise time of some ns. The overvoltages are coupled out at the SF_6/Air bushings. A partial VFT can get back in the substation building, due to the traveling wave between the encapsulation and the earth, and can cause the unwanted electromagnetic interference in the secondary equipment. The paper presents the electromagnetic impulses from disconnector switching in the high voltage substation. The investigation of very fast transients caused during switching operation were carried out both inside and outside of the enclosure. The very fast transient voltages are calculated by proved models. The amplitude and waveshape of the transient voltages inside the enclosure on different points are presented in this paper.
Index Terms: Very Fast Transients (VFT), modeling, grounding

FINITE ELEMENT TIME DOMAIN APPLICATION TO RADIATED EMISSIONS FROM COMPONENTS ON PRINTED CIRCUIT BOARD

EMCABS: 08-03-93

H.O.Ali and G. Costache
EE Dept., University of Ottawa, 161 Louis Pasteur, Ottawa, Ontario, Canada K1N 6N5
IEMCS-92, International EMC Symposium, Singapore, Republic of Singapore
7-9 December 1992, 151-156

Abstract: A method of computing radiated field from axisymmetrical radiators, directly in the time domain using the finite element method (FEM) is presented. Starting with the time-dependent Maxwell's equations, the FEM is used to set up a system of linear second order differential equations. The system of differential equations is then solved for the sole, azimuthal component of magnetic field, using single-step differential equation solving techniques. The method can be used to compute near and far field radiated from unintentional antennas (assumed axisymmetrical) located on a printed circuit board, excited by sinusoidal and non-sinusoidal voltages. In this paper, a cylindrical monopole antenna above a perfect ground plane is analyzed using the method for sinusoidal and double exponential voltage excitations. The computed results compare well with the previously published results.
Index Terms: Maxwell's equations, Finite Element Method

APPLICATION OF THE TRANSMISSION-LINE MATRIX METHOD TO PREDICTION OF EM RADIATIVE EMISSIONS

EMCABS: 09-03-93

I. G. Gosling
School of EEE, Nanyang Tech. University, Nanyang Ave. Singapore 2263
IEMCS-92, International EMC Symposium, Singapore, Republic of Singapore
7-9 December 1992, Pages 163-166

Abstract: In this paper, the Transmission-Line Matrix (TLM) method of time domain analysis of physical structures will be reviewed. Special reference will be made to electronic equipment enclosures and printed circuit boards. Examples will be given of its application to the levels of radiation from printed circuit traces of different geometries propagating pulsed signals.

Index Terms: Transmission-Line Matrix (TLM), modeling

A NEW PROPAGATION MODEL FOR A STREET SCENE FOR MICROCELLULAR COMMUNICATIONS

EMCABS: 10-03-93

T. S. Yim and T. H. Siang
School of EEE, Nanyang Tech. University, Nanyang Ave., Singapore 2263
IEMCS-92, International EMC Symposium, Singapore, Republic of Singapore
7-9 December 1992, Pages 200-201

Abstract: This paper presents a new three-dimensional microwave propagation model for the signal path loss in an urban scene in which a transmitter is positioned in a main street while the receiver is in a side street. A combination of physical optics and uniform diffraction theory is used to calculate the field amplitude and phase, from which the signal power is obtained. To facilitate the complex calculations, image theory is applied to account for the wall-to-wall, wall-to-ground and ground-to-wall multiple reflections. The results show that diffraction components can be significant in cases where the reflections from the wall or the ground give rise to excessive losses. This can occur in the out-of-sight region even when the walls and ground are assumed to have high conductivity and permittivity values.
Index Terms: Modeling, Microcellular Communications

ANALYSIS AND SYNTHESIS OF MSM AND DSM LINES

EMCABS: 11-03-93

A. K. Verma, B. D. Raturi, and G. E. Sadar
Dept. of Elec. Science, U. of Delhi, S. Campus, New Delhi, 110 021, India
IEMCS-92, International EMC Symposium, Singapore, Republic of Singapore
7-9 December 1992, Pages 223-228

Abstract: A new algorithm is reported for the synthesis and analysis of a frequency dependent MSM and DSM lines. The algorithm is based upon the unified dispersion model and the techniques of non-linear optimization.

Index Terms: Metallic Shielded Microstrip Line (MSM), Dielectrically Shielded Microstrip (DSM)

SIMPLE EXAMPLES OF THE METHOD OF MOMENTS IN ELECTROMAGNETICS

EMCABS: 12-03-93

Edward H. Newman
ElectroScience Laboratory, Ohio State University, Columbus, OH
IEEE Transactions on Education
Vol. 31, August 1988, pp. 193-200

Abstract: This paper reports a pedagogical approach for introducing the method of moments (MM) to students using several relatively simple examples. The three examples used are the input impedance of a short dipole, plane wave scattering from a short dipole and two coupled short dipoles. Piecewise sinusoidal basis functions are used because they converge rapidly. Two-by-two matrices are adequate for the examples chosen. Simplifying assumptions permit the relatively easy evaluation of the integrals forming the elements of the impedance matrix. The equations can generally be solved using a pocket (scientific) calculator.

Index Terms: Method of moments, pedagogy for MM, integral equations, basis functions, electrically short dipoles, impedance matrix evaluation

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Please send all corrections and changes to Daniel D Hoolihan February 1994

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NINTH INTERNATIONAL CONFERENCE ON EMC'94

The Ninth International Conference on 'Electromagnetic Compatibility" will be held at the Armitage Centre, University of Manchester, United Kingdom from 5-7 September 1994.

The Conference provides an essential forum for the exchange of views on EMC problem areas, standards, methods of analysis and solutions through the medium of original technical papers and discussions. The conference will be supported by an exhibition of equipment and components related to the work of achieving electromagnetic compatibility. For more information, contact: Louise Bousfield, EMC'94 Secretariat, IEE Conference Services, Savoy Place, London WC2R OBL, UK. Fax: +44(0) 71 497 3633.

EMC ZURICH 1995 CALL FOR PAPERS

The 11th International Zurich Symposium and Technical Exhibition on Electromagnetic Compatibility will be held from March 7-9, 1995 in Zurich, Switzerland. Tutorials and joint events will be held on March 6. The Symposium is sponsored by the IEEE Switzerland Chapter on Electromagnetic Compatibility and organized by the Technology Laboratory of the Swiss Federal Institute of Technology Zurich.

Over the last 20 years, EMC Zurich has become one of the most important meeting places of the international EMC community. EMC Zurich offers the participants a large program of carefully selected papers covering virtually all current and foreseeable EMC issues on a high scientific and technical level, as well as a synopsis of the EMC products and services that are on the market.

Prospective authors are invited to submit 8 copies of the complete paper in English, including a 100-word abstract, to the Technical Program Committee EMC Zurich '95, ETH Zentrum-IKT, CH-8092 Zurich, Switzerland, so that they arrive not later than May 15, 1994.

Authors will be notified of acceptance by September 30, 1994. Camera-ready manuscripts will be due by November 28, 1994. All accepted papers will be published in a Symposium Record.

For more information contact Dr. Gabriel Meyer, Symposium Chairman, ETH Zentrum-IKT, CH-8092 Zurich, Switzerland.
Phone (411) 632 27 90,
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Tohoku University
Aoba Aramaki
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Bordeaux, France:
May 30 - June 3
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Louise Bousfield
FAX: (44) 71 497 3633

1995 Zurich, Switzerland
March 7-9
Dr. Gabriel Meyer
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1997 Shenzhen, China:
May 21-23

1999 Japan: May 15-17

U.K: Biannually, even years, in September.
Wroclaw: Biannually, even years, in June.
Zurich: Biannually, odd years, in March.

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Bob Hofmann
(708)979-3627

1995 Atlanta, GA: August 21-25
Marriott Marquis Hotel
John Rohbaugh
(404)894-8235

1996 Santa Clara, CA: August 19-23
Santa Clara Convention Center
Doubletree Hotel
David Hanttula
(415)335-1071

1997 Austin, TX: August 18-22
Austin Convention Center
Hyatt Hotel
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1998 Denver: August 9-14
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CALENDAR 1994

March 29-30
SVC EMC 94
Santa Clara Convention Center
Santa Clara, CA
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May 24-27
1994 INTERNATIONAL AEROSPACE AND GROUND CONFERENCE ON LIGHTNING AND STATIC ELECTRICITY
MESAGO
Messe & Kongress GmbH
Rotebuehistrasse 83-85
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June 27-July 1
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Boulder, CO 80303
(303)497-3295

July 11-15
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