IEEE EMC SOCIETY Newsletter

ISSUE NO. 150 SUMMER 1991 (ISSN 0164-7644) EDITOR: ROBERT D. GOLDBLUM

GERALD P. ROTHHAMMER (1930-1991)

Mr. Gerald Rothhammer, a founding member of the EMC Society, passed away on Monday, July 8, 1991. A graduate of the U.S. Naval Electronics School, Treasure Island, CA, Mr. Rothhammer served in the U.S. Navy from 1948 to 1953. Upon discharge, he joined Stoddart Aircraft Radio Company and advanced through various engineering and management levels to Engineering Section Chief in 1968. In that position he was responsible for many projects involving EMI, including the development of interference testing procedures and techniques for EMI transmitters and receivers and TEMPEST. During part of this period, a Systems Engineering Group was established under the management of Mr. Rothhammer with responsibility for the sale, design and construction of fixed and mobile systems for EMI management. In addition, Mr. Rothhammer was the supervisor of a special group which performed highly classified studies and equipment design for a U.S. Government agency. This project continued until the purchase of Stoddart by the Singer Corporation in 1970, at which time Mr. Rothhammer was named EMI Product Line Sales Manager. His responsibilities involved all EMI instrument sales world-wide including sales brochures, rep training, and sales calls. During this period the "Seven Series" EMI measuring system was successfully developed and marketed, and under Eaton management the company added turn-key EMS systems to the product base.

Mr. Rothhammer, known to his friends as Jerry, was appointed Director of Sales in 1986. He was responsible for all Eaton instrument sales in India, Korea, Japan, Mexico, Central America, South America and other countries not covered by Eaton's direct sales offices. As part of these travels he always sponsored the transnational activities of the EMC Society. He encouraged many non-U.S. engineers to join the EMC Society. In 1989, as a member of the EMCS transnational committee, he arranged for staffed EMC Society membership booths at the Zurich and Nagoya EMC Symposia, where over 40 non-U.S. engineers joined.

In 1989, Mr. Rothhammer was named head of a newly created EMC department at Eaton's Electronic Instrumentation Division. This department is responsible for all of EID's activities relating to EMC. As department manager, Mr. Rothhammer was responsible for managing the EMI products and accessories, EMS systems, accessories, and broadband power amplifiers. In all, Jerry Rothhammer had been with EID and its predecessor firms for 38 years.

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IEEE NEWSLETTER PUBLICATION SCHEDULE

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

Editorial contributions for the November 91 issue should be received by September 15.

BACK ISSUES OF THE EMC 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 post paid. 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.

EMCS BoD ACTIVITIES

DON HEIRMAN
ASSOCIATE EDITOR

BOD ACTIVITIES AT THE CHICAGO MEETING

The second EMC Society Board of Directors' meeting of 1991 was held on May 17, 1991 in Chicago at the Palmer House Hotel, which is the site of the 1994 EMCS Symposium. Board members present included Ed Bronaugh, Bob Hofmann, Dick Ford, Janet O'Neil, Don Heirman, Joe Butler, Dan Hoolihan, Warren Kesselman, Al Mills, Pat Coles, Hugh Denny, Herb Mertel, and Henry Ott. Members absent were Don Clark, Bob Haislmaier, Walt McKerchar, Dave Staggs, Don Weber, and Chet Smith. Guests were Martin Schneider, Division IV Director, Steve Berger, and Terry Cantine.

President Ed Bronaugh called the meeting to order at 10:15 a.m. The agenda and minutes were approved with minor additions and changes. Treasurer Ford presented his report which showed a current net worth as of 2/28/91 of $367.4K. Our long-term investments have grown to close to $218K of that total. The Board approved the Treasurer's report.

Gene Cory reported for Bob Haislmaier (Communications Services). He gave several reports. First, Chet Smith (History Committee) plans to have a microfiche viewer/projector available at the Cherry Hill Symposium booth. There he'll show back copies of the Society's Newsletters. Bob indicated that he is in need of a liaison chairman for the Press books of direct interest to the EMC Society. The Chairman would get reviewers and possible authors and help publicize books we sponsor. For further information, call Bob on (703) 692-8600. President Bronaugh will invite Dudley Kay, who heads the IEEE Press Book operation, to our Cherry Hill Symposium. Bob Goldblum (Newsletter Editor) pleaded for more reader feedback on the Newsletter information and articles. The Board suggested that the Society questionnaire planned for our Cherry Hill Symposium may be a vehicle to get member opinion on the Newsletter. Moto Kanda (TRANSACTIONS Editor) is preparing a special issue of the TRANSACTIONS for 1992 on High Power Microwaves. Dr. Giri and Bob Garver may be the associate editors of this issue. Gene Cory then presented his symposium committee report. Don Heirman, 1991 Symposium Steering Committee General Chairman, reported that they are on schedule in preparing for the 12-16 August symposium in Cherry Hill. One hundred nineteen papers were accepted, and 6 workshops and one poster session will be presented for the now full 5-day symposium. The advance program was mailed the week of 13 May. For further information, call the arrangements chairman, Henry Ott, on 201-992-1793. The Board approved reserving Washington, D.C. as the symposium location for the year 2000. The Board also approved co-sponsorship of the Israeli EMC Chapter's 1992 IEEE Region 8 Conference and Exhibition on EMC. Terry Cantine (1992 symposium) gave an oral report about the progress of her committee activities. The call for papers will be available for the Cherry Hill Symposium. Finally, Warren Kesselman, the 1991 Symposium Treasurer, presented his budget report. He particularly highlighted the expenses associated with marketing/publishing the conference proceedings for our EMCS membership. A motion was tabled to make sending the symposium record to the EMCS membership a permanent yearly event pending a review of the actual costs to do so. Estimates from the Washington and Cherry Hill Committees are that this expense is in excess of $30K or about $9 per member. The Board was asked to informally poll its EMCS colleagues about the subject of receiving free copies of the record in view of its costs to the Society.

Director Don Heirman (Technical Services) presented several reports. First, as chairman of the Society's Standards Committee, Don reported that his committee reaffirmed Standards 377 on Measurement of Spurious Emission from Land-Mobile Communication Transmitters and 473 on Electromagnetic Site Survey (10 kHz to 10 GHz). P626 on signal grounding practices was withdrawn since much of this work is already contained in existing documents. The disagreement on sponsorship of P1140 (Near-field E and H field Method of Measurement) between our Society and the Computer Society has been resolved. Our EMCS will finish its work in VDT application of near field measurements while the Computer Society will draw upon this work and extend it to entire desktop computing system applications. Next, Don discussed Clayton Paul's (Education Committee) report. Clayton reported that the Distinguished Lecturer Series is progressing well and that Lecturers are still available for bookings this year. He also indicated that there will be a final version of an information package available at the Cherry Hill Sympoium to help educators establish an undergraduate course in EMC. The Board approved expending $5000 to join the Computer-aided Electromagnetics Education (CAEME) group for a period of one year. After that time, the BoD will re-evaluate whether further support is warranted. The Board asked that Clayton write an article for the EMCS Newsletter

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INTER-SOCIETY ACTIVITIES

JOSEPH BUTLER
ASSOCIATE EDITOR

SAE AEROSPACE EMC STANDARDS ACTIVITY

SAE AE-4 Electromagnetic Compatibility. Work continues on proposed revisions to ARP 1705 on EMI gasket transfer impedance measurements. A new fixture for testing has been proposed and is now being reviewed by the working group. Other areas of work which are continuing are: ARP 958 for antenna calibration; ARP 4242 on system EMC: ARP 1972 on EMC testing; and AIR 1423 dealing with aircraft engine EMC. A systematic review of many SAE documents has begun as well. A recent ballot to the AE-4 committee identified the following documents needed for revision: ARP 935 EMI control plan; AIR 1147 EMI on aircraft from jet engine charging; ARP 1173 EMI gasket shielding effectiveness; AIR 1208 lightning/p-static bibliography; AIR 1209 parallel plate antenna; AIR 1221 EMC checklist; AIR 1255 spectrum analyzer; ARP 1267 impulse generator calibration; AIR 1394 cabling guidelines; AIR 1404 DC resistivity versus RF impedance for EMI gaskets; AIR 1406 lightning; AIR 1425 EMC on gas turbine engines; ARP 1481 corrosion control enclosure design; AIR 1500 lossy filters bibliography; AIR 1509 antenna factors; AIR 1700 shielding effectiveness upper frequency bound for cylindrical systems; ARP 1870 bonding and grounding; and ARP 4043 flight line bonding and grounding of aircraft. Chairman Dwayne Awercamp welcomes any interested parties who wish to work on these efforts.

SAE AE 4R Radiated Environments. The proposed FAA advisory circular, which is being drafted by this committee, will detail the electromagnetic environment for commercial aircraft as well as the methods of compliance to the High Intensity Radiated Field (HIRF) requirements. This document should be released for the full committee review sometime in August. Much discussion continues with regard to the high field levels specified in the HIRF environment.

SAE AE4L Lightning. This committee is actively involved with proposed revisions to DO-160C Part 22 on lightning requirements for commercial aircraft avionics. Work is also proceeding on a user's guide to accompany the FAA Advisory Circular AC-136 on lightning.

SAE SURFACE VEHICLE EMC STANDARDS ACTIVITY

SAE Automotive EMI Standards and Test Methods Committee. This committee continues its work on revisions to J1113 and J551, as well as its coordinating activities with ISO/TC22/SC3/WG3 on the European community EMC standards for automotive.

SAE Automotive EMR Standards Committee. This group is currently concentrating on activities with CISPR subcommittee D/WG2 with regard to revisions to CISPR 12.

AMERICAN NATIONAL STANDARDS INSTITUTE C63 STANDARDS COMMITTEE ON EMC

This committee, and in particular its five subcommittees, are involved in a large number of EMC standards activities. Subcommittee 1 on techniques and developments is involved with some 21 different projects covering the following areas: immunity test methods/instrumentation; ESD; C63.4 revisions on immunity, cable placement for emissions tests; frequency range extensions for emission testing to 20 Hz; medical device EMI standard; household appliance EMI standard; automatic instrumentation for EMI measurements; broadband emission measurements; open area test site issues - site attenuation, above 1 GHz issues, below 30 MHz issues, loop antenna size, international reference antenna, antenna positioner, use of LISN's down to 9 kHz and their location, antenna calibration, site attenuation errors and site construction. C63 is also working on product safety issues and their impact on EMC matters (unsafe operation of products since they are susceptible to RF) as well as coordination with the tri-service committee with regard to MIL-STD-461/462 revisions.

INTERNATIONAL ELECTROTECHNICAL COMMISSION CISPR SUBCOMMITTEES A & G

CISPR A is in the process of publishing a new version of CISPR 16. This subcommittee is also working on a new method of measurement of magnetic emissions using a Van Veen loop. In addition they are looking at a "standard" measurement antenna for emission measurements, possibly a fixed length dipole. CISPR G is working on updates to CISPR 22. They are also looking at finishing work on ESD as well as conducted and radiated immunity in support of EC 92 activities.

ELECTROSTATIC OVERSTRESS/ELECTRONIC DISCHARGE (EOS/ESD) ASSOCIATION

This organization, which has some 50 different standards activities underway, has recently applied for membership in the American National Standards Institute and its Standards Organization (STDCOM) is seeking accreditation as an ANSI standards producer. Areas of standardization work include: wrist straps; garments; ionization technology; work surfaces; device testing; grounding; floor materials; symbols; footwear; equipment; and packaging. Current advisory activities of the EOS/EOD include: glossary of terms; an ESD handbook; and coordination work on the new European ESD standard (CECC 0015).

TC-6 ON SPECTRUM MANAGEMENT

JOHN KELLAS
CHAIRMAN OF TC-6

The Technical Committee on Spectrum Management, TC-6, is concerned with the rules and regulations of the Spectrum Management Authorities in all countries, particularly the National Telecommunications and Information Administration (NTIA) and the Federal Communications Commission (FCC) in the U.S. We are concerned with how these rules and regulations apply to existing and new services which require the use of the electromagnetic spectrum. Information on national policies, spectrum conservation and modulation techniques which reduce the amount of required spectrum are of special interest. Not unlike other natural resources, the electromagnetic spectrum is extremely congested and suffers from the same negative environmental impact as our national forests, lakes and rivers. Spectrum users are constantly competing with each other for a portion of the radio frequency spectrum, whether existing or newly allocated. Unfortunately, shared spectrum has become the norm, and only conservation of this natural resource will ensure that the future needs of new radio services will be satisfied.

Several changes in the U.S. national policy in the area of Spectrum Management are being considered by the NTIA. Suggestions on ways to improve the management of the radio frequency spectrum are being gathered by the NTIA for later evaluation. Among the suggestions being considered are paying for spectrum availability and its access. Current trends in the use of low power output devices capable of operating simultaneously in spectrum occupied by high power devices are also creating electromagnetic compatibility problems. As the thirst for more convenience pushes demand for more and more wireless devices e.g., wireless local area networks, the proliferation of such devices could ultimately saturate the entire spectrum.

During conceptual and subsequent stages of evolution, equipment being proposed for operation by government agencies must be submitted for review by the NTIA. (The FCC has a similar process for nongovernment spectrum users.) This review results in an evaluation of the suitability of the proposed band and knowledge about systems that share or will share the same spectrum. In other words, the system is evaluated in terms of its compatibility with existing and planned uses of the spectrum. Review by the NTIA eventually results in certification of spectrum support for the equipment. Unfortunately, design engineers do not always have access to component spectrum management guidance and systems are sometimes developed without the benefit of this process. Failure to submit a system for review could result in a system that is not supportable by the spectrum management community.

The activities of TC-6 have focused primarily on presenting workshops on spectrum management topics, including the system review process. As mentioned above, the system review process certifies that spectrum support will be available for new equipment or systems.

CALL FOR VOLUNTEERS

IEEE-USA's Precollege Education Committee is in the process of establishing a discipline-based Volunteer Student Guidance Network and is looking for volunteers who are willing to serve as resource persons. If you enjoy counseling high school students and would be willing to answer an occasional request for career information in your particular field of experience, we need your help. For more information, contact A. Hartfiel, IEEE-USA, 1828 L Street NW, Suite 1202, Washington, DC 20036. (202)785-0017.

COMMSPHERE

The IEEE International Commsphere '91 Symposium will be held December 16-19, 1991 in Herzlia, Israel. The COMMSPHERE Symposium is intended to focus on ways to develop telecommunication and other electronic services into the next century, avoiding further saturation of the congested transmission medium.

The symposium is a gathering of leading scientists, industrialists and spectrum allocation specialists, aimed at interdisciplinary exposure and discussion of achievements, constraints, challenges and strategies. It is expected to breed better mutual interaction, trends of development of these services, and to support international cooperation. The symposium is supported by the International Union of Radio Sciences (URSI), by the CCIR and by the IEEE Communications and Antennas and Propagation Societies.

The symposium is structured into three days of plenary sessions. The presentations and discussions have been carefully selected by the team of session organizers to reflect the focus of the symposium and the quality of the discussion. Five workshops will then explore in depth different aspects on the fourth day, and re-assemble to a concluding plenary panel.

For further information, contact Symposium Secretariat, ORTRA Ltd., Kaufman 2, P.O. Box 50432, Tel Aviv 61500, Israel. Tel: 972-3-664825. Fax: 972-3-660952.

IEEE DIVISION IV DIRECTOR'S REPORT

MARTIN V. SCHNEIDER
ASSOCIATE EDITOR

MEMBERSHIP GROWTH & FORMATION OF NEW CHAPTERS

The 1990 annual report of the Secretary of the IEEE, Fumio Harashima, stated that the membership of the Electromagnetic Compatibility Society was growing at a rate of 4.9% and reached a total of 4,402 members at the end of the year. From the extensive data of the report, one can pinpoint the geographical areas where the membership remained constant or where it increased rapidly. It is interesting to note that the growth rate in the United States was 1.9% and outside the USA 12.4%. It is generally observed that both technical activities and membership growth are enhanced in the areas where a new chapter has been formed recently. A particularly fertile area for the formation of new chapters is the European Common Market with a total population of 330 million of which about 1 million are estimated to be electrical and electronics engineers.

HIGHLIGHTS FROM THE JUNE 1991 BOARD MEETINGS

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

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

Annual Dues	$73.00 per year
Assessment (Regions 1-6)	$22.00 per year
Student Dues (Regions 1-7)	$23.00 per year

3. The long term financial goals, as presented by the Treasurer, Ted Hissey, were approved and will be added as guidelines to the IEEE Policy and Procedures Manual, with the exact wording to be submitted for approval at the November 1991 meeting of the Board of Directors.
4. The 1992 basic operating budget was approved.
5. A number of other actions were taken covering a wide spectrum of topics including publications, committee appointments, delayed arrival of election ballots in Regions 8-10, and approval to continue the Engineering Skills and Assessment Program (ESAP) subject to a detailed follow-up report of the Educational Activities Board in 1992.

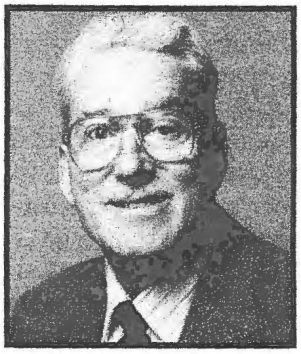
It is noted that while the IEEE General Fund is by now nearly depleted, the Societies have prospered financially through income derived from conference registration fees, and the "All Publications Package" sold to libraries. Three Societies in Division IV have become millionaires and may eventually have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

GERALD P. ROTHHAMMER *(Continued from page 1)*

Jerry authored and presented numerous papers at the IEEE EMC Symposium, the Environmental Engineers Symposia, the NATO EMC Conference, and the All-India EMC Conferences. Jerry also organized and presented numerous seminars on EMC Test Equipment and Measurements throughout India, Korea, Japan, Singapore, Australia, Indonesia, Taiwan, HongKong, Brazil and Colombia. Jerry was a founding member of the predecessor to the IEEE EMC Society, the P.G.R.F.I. (Professional Group on Radio Frequency Interference) in 1955. Jerry was also a founding member of the dB Society. All these activities necessitated such a great deal of travel that Jerry earned the nickname of "Road Runner." In 1978, Jerry was awarded the EMC Society "Certificate of Achievement for Technical Accomplishments in the Field of Electromagnetic Compatibility."

Jerry devoted his career and life to EMC. As a member of the National Committee for CISPR and several professional societies (IEEE EMC, Assistant Director of Professional Services; SAE AE4 Society, Vice Chairman; dB Society, Founding Member; and employment by Stoddart, Singer Ailtech and Eaton), Jerry is part of the foundation of the EMC community. To his friends, colleagues and clients, Jerry was known as a reliable person of note and a congenial friend to everyone. Many "deals" were ensured by his word and handshake. Every year, he sponsored several hospitality suites at symposia and meetings where the EMC industry met "after hours" for fellowship, food and drink. In 1986, besides being Exhibit Chairman for the EMC Symposium in San Diego, he was also a $30,000 fundraiser from U.S. industry for the 1986 CISPR meeting that was held in San Diego prior to the Symposium. Since the USA was host of the CISPR delegates from around the world, these funds were needed to ensure a successful meeting. Jerry's very special dedication before, during and after this CISPR meeting to make everyone feel at home is mentioned by Jerry's CISPR colleagues at every CISPR meeting.

Jerry's hobbies included the collection of novel electronic equipment from his world travels, postage stamp collection, and with his wife Barbara, the breeding and grooming of award-winning show cats (Lilac Point Siamese Cats). Jerry is survived by his wife, Barbara, and four children, Douglas, Susan, Craig and Brian, his mother, Buena Mae Rothhammer (91 yrs. of age), and his sister, Buena Marie Smith of Phoenix, AZ.



EDWIN L. BRONAUGH

The system of three large orthogonal loops, called the Loop Antenna System or LAS (and sometimes referred to as the "Van Veen Loop"), is a relatively recent development in Europe for making magnetic field measurements without special test sites and without being compromised by the local electromagnetic ambient. Dr. Jasper J. Goedbloed of Philips Research in the Netherlands has been kind enough to provide an introductory paper on this system. As Dr. Goedbloed says in his paper, this LAS appears to be on its way into CISPR 16, and probably into the CENELEC requirements. In this paper, Dr. Goedbloed describes the LAS, how it came about, and how it is calibrated and used. He also provides references for those who wish to go deeper into the technical details and the mathematical description of the LAS.

MAGNETIC-FIELD-INDUCED CURRENT MEASUREMENTS IN THE FREQUENCY RANGE 9 kHZ TO 30 MHz

Jaspar J. Goedbloed
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This brief report deals with a new measuring method to judge the interference capability of magnetic fields emitted by an equipment under test in the frequency range of 9 kHz to 30 MHz, in terms of the current induced in a particular loop-antenna system (See Figure 1). The new method has now entered the voting procedure in CISPR/A [1], and the application of this method is in the voting procedure of CISPR/F [2]. The application of the method is also being discussed in CISPR/B. In Europe in particular, there is clearly considerable interest in this method. It is therefore expected that CENELEC will include the method in the European Norms. The loop-antenna system, also known as the "Van Veen Antenna," is already commercially available (for example from Chase EMC Ltd. and from Rhode and Schwarz). However, its construction is fairly simple, as is its validation procedure, so a home-made system is an option.

An important drawback of the existing CISPR measuring method for magnetic fields in the frequency range 9 kHz to 30 MHz [3] is that at most of the open area test sites the ambient noise level is so high that compliance testing is almost impossible. In this context "high" means high compared to the emission limits for EUT which have been verified. A first step to improve this situation was to reduce the measurement distance d, so that the permissible emission level increased. However, even at d=10 m it is difficult to perform unambiguous measurements. Smaller distances are allowed, but only if one can prove that the results guarantee compliance with the limits associated with d=10 m. Unfortunately, a considerable amount of effort is required to obtain this proof, as the measurements are conducted in the so-called near-field zone of the EUT, where it is difficult to predict the field strength as a function of the distance from that EUT.

Recently, Bergervoet and Van Veen [4] proposed a method in which they took the firm decision to reduce the measuring distance to zero, i.e., to place the equipment under test in the center of a loop-antenna system (LAS) consisting of three mutually perpendicular large-loop antennas (LLAs). With this LAS, the interference capability of the magnetic field of the EUT is then measured in terms of the currents induced in the LLAs by that magnetic field. More precisely, with this LAS the three orthogonal components of the effective dipole moment of the EUT are measured. A full account of this method can be found in [4]. An introduction of the LAS method for practitioners, including constructional details, can be found in [5]. The construction details, the validation procedure etc. can also be found in [1] (bilingual).

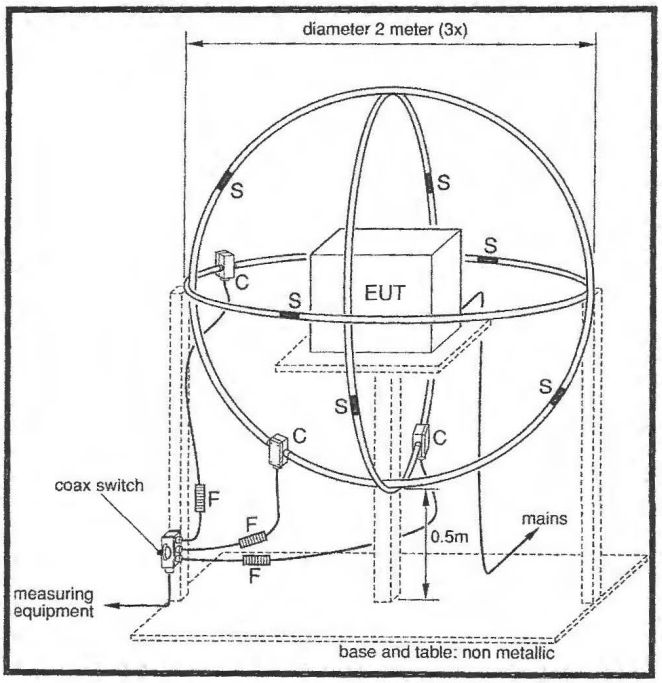

Figure 1. The Loop-Antenna System (LAS), Consisting of Three Mutually Perpendicular Large-Loop Antennas (LLAs). Each LLA contains two antenna slits (S), to ensure a good suppression of the response to electrical fields, and a current probe C, to measure the current induced by the magnetic field emitted by the EUT. The cables to the measuring equipment are loaded by ferrite absorbers to avoid resonances in the complete LAS.

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The LAS method has several advantages:

a) it is an indoor method;
b) it has a very good induced signal-to ambient-noise ratio;
c) the fields originating from the X, Y, and Z dipole moments are measured in an equal way;
d) it is a rapid method since neither the LAS nor the EUT has to be rotated during the measurements.

One disadvantage might be

e) for the standardized LAS, with LLAs having a diameter of 2 meters, the dimensions of the EUT are limited to 1.6 m, but a maximum dimension up to 3.2 m is possible in a nonstandardized LAS.

The items a) to e) will be discussed briefly below.

Indoor method

Since the EUT is placed in the center of the LAS and the current induced in the large-loop antennas is measured, there is no need for measurements at an open area test site (OATS). The system can be used efficiently indoors if there is at least 0.5 m between the LAS and a reflecting object. As the signal-to-ambient-noise ratio is very good, see below, there is no need to put the system in a Faraday cage nor in a (semi-) anechoic room. In fact, a "high-Q" Faraday cage may cause unwanted dominant resonances, which, if present, will be noted when carrying out the validation method.

Signal-to-ambient-noise method

Because of the close coupling between EUT and LAS, the ratio of the induced-signal and the ambient noise is very good. In fact, those who participated in the "Round Robin" test with the LAS, organized by Working Group 2 of CISPR/F [6], were very enthusiastic as now they were able to measure emissions which they had never been able to measure correctly at their OATS.

It can be shown that the improvement of the S/N ratio by using the LAS compared to that at the OATS is given by $8(d/D)^3$, in the case a simple model is applied to a situation in which the field measured at the OATS would have been dominated by the maximum radial magnetic field component [5]. For example, if at the OATS the measuring distance d=10 m and the LAS is constructed of LLAs having a diameter D=2 m, an S/N-ratio improvement of 60 dB will result.

More exact calculations [4] show that this improvement amounts to $(8\text{-}C_{dA})$dB, where C_{dA}(dB/m) is the conversion factor which related the induced current to the magnetic field strength which would have been measured at the OATS, see below. This means that in the above numerical example 54 dB would be found instead of 60 dB, so still a very noticeable improvement. Note that by increasing D, the signal-to-noise ratio decreases proportionally with D^3. Since the LAS method is an indoor method, the building attenuation might also contribute to an improved S/N ratio, in the case that the ambient noise stems from (legal) broadcasting transmitters.

X,Y and Z components

The current I_{ind} induced in the LAS is given by the simple relation [4]: $I_{ind}=\mu_o m_H/(DL_a)$, where m_H is the effective magnetic dipole moment on the EUT perpendicular to the LLA in which the current is measured. So the LAS essentially measures the effective dipole moments in three orthogonal directions, and does so for all three directions in exactly the same way. The latter is not the case in the OATS method as in that method the measuring antenna is always kept in a vertical plane and the EUT only rotated about its vertical axis. Consequently, in the OATS method the fields associated with the horizontal dipole moments (X and Y, parallel to the ground plane) are measured in a different way to that related to the vertical moment (Z), [5].

Rapid method

Since the LAS measures the three effective dipole moments in the same way, there is no need to rotate the EUT, nor to rotate the LAS to find a maximum reading. If the actual position of a disturbance source inside the EUT is at a distance of less than 0.5 m from the center of the LAS, the measuring results differ by less than 3 dB from those with that source in the center. Hence, the position of the EUT inside the LAS is not very critical. Moreover, the position of the mains lead of the EUT is not very critical, particularly when the EUT already complies with the conducted emission limit [3]. Hence, the new method is a rapid method: put the EUT in the center of the LAS and make three sweeps (one for each LLA) of the induced current as a function of frequency, and you are ready.

Non-standardized LLA diameters

In the case of a large EUT it is possible to use LLAs with a diameter D.2 m. A maximum of D=4 m is allowed [1,2], as larger diameters will give rise to standing wave effects along the perimeter of the LLA. If the extreme value D=4 m is used, it is advisable to use an LAS with only one LLA and to measure the EUT in the three orthogonal positions, as the large total structure with its "D=4 m LLAs" might give rise to uncontrollable resonances. Correction factors are available [1,2] to convert the measured current to a current value which would have been measured in the standardized LAS. To avoid unwanted capacitive coupling between the EUT and the LAS, the distance between an EUT and an LLA should be at least D/10 m.

Next some remarks about the emission limits associated with the LAS, about the conversion factors C_{dA} and C_{dV}, and about the method to validate the LAS.

Emission limits

As in this method the current is measured, the emission limit is given in dBμA, and not in the dBμV/m or in dBμA/m. This is in line with the decisions taken by CISPR/A and CISPR/F at the 1990 Meeting in York (UK): an emission limit will be

(Continued)

given in the same units in which the interference capability of the EUT is measured. Moreover, it was decided to stop using an electric field unit, such as dBμV/m, for the magnetic field component of the radiated field [7]. In the case of the magnetic field strength dBμA/m shall be used.

An example of the proposed emission limits is given in Table 1. The proposal has been made for luminaries and for self-ballasted lamps, both with lamp operating frequencies in excess of 100 Hz and luminaire dimensions smaller than 1.6 m. The limits given in Table 1 are proposed [2].

Conversion factor

The conversion factor C_d to convert induced current data to field-strength data can be easily calculated because in the LAS the characteristic parameters of the EUT are determined, i.e., the effective dipole moments. Among other things, this makes it possible to predict the fields in the vertical direction, as is necessary in the case of the protection of aeronautical services [8].

If the field strength data are obtained at an OATS, C_d has to be calculated for a source at a certain height h, above a reflecting ground plane at a certain distance from the magnetic field antenna used at the OATS. Results of this calculation, assuming h=1 m, and d values as indicated, are given in Figure 2, where it has also been assumed that the magnetic field antenna has been rotated to find the maximum reading.

To obtain the magnetic field strength value in dBμA/m, C_{dA}(dB/m) has to be added to the current in dBμA. When using the old unit dBμV/m, C_{dV}(dBΩ/m) has to be added to the current dBμA. To give an example: the current limit 88 dBμA on the first line of Table 1 converts to 88-47=41 dBμA/m or, using the old units, to 88+5=93 dBμV/m.

At low frequencies C_d is almost frequency-independent, as in that frequency range the dominant field contribution stems from the near-field radial component. At high frequencies C_d is roughly proportional to the frequency squared, as in that range the far-field tangential component is the dominant contributor. The cross-over is roughly at a frequency determined by f(MHz).d(m)=112, i.e., by the condition that the radial and the tangential components of the field of a magnetic dipole have equal magnitudes (using the full equations for the electrically small magnetic dipole).

FREQUENCY RANGE	LIMITS IN dBμA
9 kHz to 70 kHz	88
70 kHz to 150 kHz	88-58*
150 kHz to 1.605 MHz	58-32*
1.605 MHz to 3.95 MHz	58
3.95 MHz to 30 MHz	22

*decreasing linearly with the logarithm of the frequency

Table 1. Proposed limits [2] using an LLA with D=2m

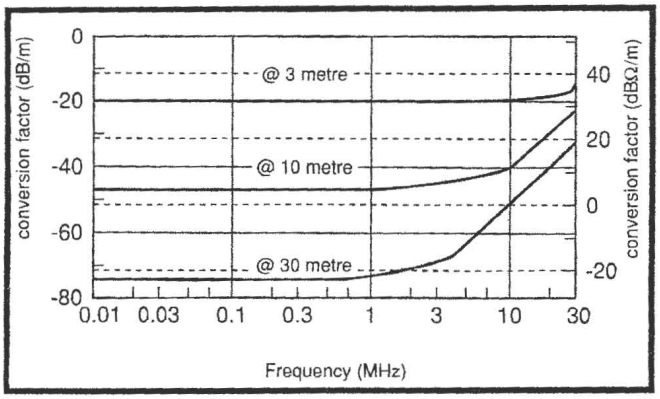

Figure 2. The Conversion Factor C_{dA} to Convert the Induced Current (in dBμA) into the Magnetic Field Strength H (in dBμA/m) for Three Standardized Values of the Measuring Distance d (in meter). C_{dV} may be used to convert the current into the old unit dBμV/m.

Validation

Finally, the validation of the large-loop antennas of the LAS. This is carried out by using a specially designed balun-dipole [1], connected to an RF generator. Then the current induced in an LLA is measured as a function of frequency for 8 prescribed positions of the balun-dipole. In each of the positions the validation factor, i.e., the ratio (expressed in dB) of the open-circuit voltage of the generator and the measured current, should not deviate by more than ±2 dB from a given validation factor.

The balun-dipole serves two important aspects of the validation procedure: it makes it possible to verify whether the wanted signal is measured with sufficient accuracy and also to verify whether the influence of unwanted signals on the measuring results can be neglected. So the balun-dipole has a certain magnetic dipole moment, which is relevant when verifying the accuracy with which the wanted signal is measured. It also possesses an electric dipole moment, giving rise to a significant electric field strength. As the LLA is intended to measure only the effective magnetic dipole moment, the electric field should not influence the measuring results. If the electric fields do influence the results, one will generally notice resonance peaks in the experimental validation factor at the higher end of the frequency range [4]. Such peaks may also be observed when the LAS is used inside a "high-Q" Faraday cage.

In the validation procedure, both aspects are verified in one measurement. If the 2 dB criterion is then met, it automatically means that the influence of the electric field is negligibly small and the LLA is functioning correctly.

Continued on page 19

EMC PERSONALITY PROFILE

DARYL GERKE

Daryl Gerke, PE, is a principal in Kimmel Gerke Associates Ltd., an engineering consulting firm that specializes in EMI/EMC issues. He and his partner, Bill Kimmel, started the firm as a parttime enterprise in 1978, and moved into fulltime consulting in 1987. Since then, he has worked on dozens of EMC projects throughout the United States and around the world.

Daryl's formal EMC experience dates back to 1970, with the Sperry Univac Defense Systems Division in St. Paul, Minnesota. His informal EMC experience goes back another 10 years to 1960, when, as a teenage amateur radio operator, he quickly learned about TVI, BCI, and all those other forerunners of today's EMI.

Spurred by his interest in ham radio (but having only the vaguest notion what engineers really did for a living), Daryl received his BSEE from the University of Nebraska in 1968. His first job was with the Collins Radio Company in Cedar Rapids, Iowa, where he worked on VHF radios and digital communications systems.

In 1970, he joined Univac in what he thought was to be a digital design position. Instead, due to his RF experience he was offered a position in a newly formed group labeled "EMI, TEMPEST, and Grounding." This got him in on the ground floor of EMI and TEMPEST in high speed digital systems. Daryl claims that "most of us in the EMC business ended up here by fluke or accident... nobody grew up wanting to be an EMC engineer."

While with Univac, much of Daryl's time was spent working with digital designers and systems engineers on their EMI problems. He also spent a year doing EMP research, and in 1976, he helped launch a TEMPEST terminal product line based on an exciting "new" technology, the 8080 microprocessor. It was this project that brought Daryl and Bill Kimmel together, which resulted in forming Kimmel Gerke Associates, a parttime consulting firm. No, they didn't do EMC at first; that was too much like work.

WILLIAM G. DUFF
ASSOCIATE EDITOR

After eight years of EMI and TEMPEST, Daryl left Univac, seeking to broaden his horizons. For the next nine years he held a number of field engineering and product marketing positions with Tektronix, Micro Component Technology, and Intel. And although he thought he'd left EMI, very often the problems he helped solve as a field engineer were EMI related. More significant, however, was the international focus of Kimmel Gerke Associates on EMI/EMC in the early 1980s due to the emerging FCC/VDE regulations.

By the mid-1980s, the parttime consulting had grown, and the dream of an independent consulting company beckoned. Finally, in October 1987, the very day the stock market plunged, Daryl formally stepped out into private practice. (It's often said that timing is everything in business.) Fortunately, EMI problems were not plunging, but increasing, and the consulting practice slowly grew to where it is today.

In addition to consulting, Daryl has lectured and published widely on EMI/EMC issues. He has written numerous articles and papers on a broad range of EMC issues, such as digital design, software ("Designing Noise Tolerant Software" won an SAE award in 1987), electrostatic discharge, VHF radio/microprocessor interference, power disturbances, and power line magnetic fields. Daryl and Bill Kimmel also publish "Kimmel Gerke Bullets" (KGB), an EMC newsletter.

Daryl has been quite active in the IEEE at the local level. For three years, he was co-editor of the Twin Cities Section newsletter, the Radiator. For the past two years, he chaired the Twin Cities EMC Society Chapter. He also belongs to two other IEEE societies, the Power Engineering Society and the Industry Applications Society. Daryl is a Registered Professional Engineer, and of course, a NARTE Certified EMC Engineer.

Daryl and his wife, Mary Lou, live in St. Paul, Minnesota, with their two sons, Darren and Chris. He still pursues amateur radio as a hobby, which is where his EMI career really began over 30 years ago.

BOOK REVIEW

J.L. NORMAN VIOLETTE
ASSOCIATE EDITOR

CAPACITANCE, INDUCTANCE, AND CROSSTALK ANALYSIS

Charles S. Walker
Artech House, Inc.,
685 Canton Street,
Norwood, MA 02062.
1990.

The objectives of this book are to (1) provide relatively simple component and circuit models for the calculation of circuit performance, such as crosstalk determinations, principally at the printed circuit board (PCB) level. Equations and formulas are provided for calculating the values of inductance, capacitance, and characteristic impedance for a variety of conductor geometric configurations, including circular wires, microstrip, and stripline transmission lines. The absence and presence of ground planes are addressed. The values of the lumped parameters so determined, such as the mutual capacitance and inductance between parallel conductor pairs, can then be used to formulate and predict "first-order" crosstalk levels as long as lumped parameter component representation is valid. The author states his understanding of the complexity encountered whenever an attempt is made to obtain exact values of circuit parameters by field theory methods. The book provides "first-order," lumped parameter values usable within the range of frequencies when circuit dimensions are small compared to a wavelength. These are, then, essentially low-frequency models.

Chapter 1 presents general concepts and discusses electromagnetic field theory concepts in simplified, essential terms, with flux plots providing visual images of electric fields between conducting bodies and magnetic field lines. Basic models are developed for resistors, capacitors, and inductors from field concepts.

Chapter 2 provides formula sets that address circuit geometries commonly used in PCB and ceramic module design and other areas of electronic engineering. The capacitive and inductive formula sets are numbered consistent with the circuit geometry addressed. For example, the formula sets C-5 and L-5 pertain to equations for the respective capacitances and inductances associated with horizontal conductors so designated by the number "5". Typical parameters include the mutual capacitance and the self and mutual inductance for parallel long, circular inductors in free space; a long circular conductor above a ground place; parallel flat conductors; microstrip conductor configurations; striplines; four-conductor systems; etc.

Chapter 3 provides example calculations of capacitive and inductive crosstalk analysis on a PCB. Also included is a section on common ground coupling and another section on circuit crosstalk due to power supplies.

Chapter 4 describes the difference between the impedance of ideal discrete components and physically-realizable ("real") components.

A short review of ancillary circuit elements is the topic of Chapter 5, which includes the determination of PCB wiring conductor resistance, ground plane resistance, voltage and current source characteristics, and the characteristics of power supplies.

Chapter 6 describes experimental test data to determine the correlation between theoretical analyses (calculated, predicted values) and measured values. Circuit board photographs are presented of PCBs used for experimental measurements. Comparisons are made between the measured and calculated values for crosstalk. The range of accuracy (the degree of correlation) between the experimental and calculated values is provided for a number of cases.

An Appendix of field calculations for circular conductors is included. Also included are several references (bibliography) and an index.

The book is an excellent reference for performing manual crosstalk calculations of a "first-order," that is, for low frequency operations. It is understood that such calculations at high frequencies are much more involved. The numerous examples and experimental descriptions further enhance the book's usefulness. It is recommended as a valuable reference for electronic engineering students and practicing electronic design engineers.

FCC SUPPORTS C63 COMMITTEE IN C63.4 REVISION

The present revision of ANSI C63.4-1988, *American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 10 kHz to 1 GHz*, presented a major challenge to the Accredited Standards Committee on Electromagnetic Compatibility, C63, led by Dr. Ralph Showers, and C63 Committee members, including representatives from the Federal Communications Commission (FCC). The challenge was to produce a measurement procedure for testing most radio frequency devices (e.g., digital devices, also referred to as "information technology equipment") that would be acceptable to industry and to the Commission.

Now called ANSI C63.4-1991, *American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz*, this standard has had a long and active history, with early versions dating back to 1940. As the C63 Committee undertook the latest version, its primary concerns were to broaden the scope of the document to include details for testing digital devices and to extend the frequency range to cover 9 kHz to 40 GHz. But much of the impetus for the current revision came from a decision by the Commission to utilize the resources of the C63 Committee for the development of measurement procedures to replace MP-4, *FCC Methods of Measurement of Radio-Noise Emissions from Coupling Devices*, which is used for evaluating the compliance of digital devices with the FCC Rules. Before this decision, measurement procedures were primarily developed solely within the Commission, although there is a history of C63 documents being incorporated into the Rules.

The Commission decided that the ANSI standardization process could be a more effective means of developing a digital device measurement procedure, reaching an industry consensus on suitability, and communicating such a detailed test procedure to the public rather than revising MP-4 exclusively within the Commission. Since late in 1989, the Commission and C63 Committee members, using their considerable electromagnetic compatibility experience, have been working together to develop a test procedure to replace MP-4 as soon as possible. As a result, on January 2, 1991, the Commission adopted a *Further Notice of Proposed Rule Making in General Docket 89-44*, proposing to replace MP-4 with the test procedure in C63.4-1991.

The C63 Committee recognized the importance of including additional details on test procedures to provide proper evaluation of complex systems. Therefore, the scope of the document was broadened to include provisions for handling both table-top and floor-standing systems made up of many components with interconnecting cables. New appendixes provide, for the first time, step-by-step procedures for emission measurements, site attenuation guidance, and calibration of line-impedance stabilization networks (LISNs).

ANSI C63.4-1991 has undergone a number of reviews, and to that extent represents a near industry consensus. Its publication should provide the electromagnetic compatibility community with an almost universal measurement procedure for the evaluation of radio-frequency devices. This standard can be purchased from the IEEE by calling 1-800-678-IEEE.

(*Source*: The IEEE Standards Bearer, Kristen Dittman, author)

IEEE FELLOW HONORED

Robert D. Goldblum, editor of the IEEE EMCS Newsletter has received recognition as an IEEE Fellow. The honor was conferred upon Mr. Goldblum at the 1991 Awards Night Banquet of the Philadelphia section of the IEEE. The banquet was held at the Union League of Philadelphia on March 2, 1991. The title of Fellow recognizes unusual distinction in the profession and is conferred upon a person of outstanding and extraordinary qualifications and experience in IEEE designated fields who has made important individual contributions.

Photo: Dick Ford

IEEE Fellow Robert D. Goldblum (left) and Stanley B. Disson (right), Chair of the Philadelphia Section, display the Fellow Certificate.

Mr. Goldblum was cited "For contributions in electromagnetic compatibility testing and standards, and for promulgating increased awareness of EMC problems and their solutions.

THE APPLIED COMPUTATIONAL ELECTROMAGNETICS SOCIETY

DR. RICHARD W. ADLER
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ABSTRACT

This article briefly describes a relatively new and unique professional society, the Applied Computational Electromagnetics Society (ACES), which provides a forum for issues relevant to numerical modeling in applied electromagnetics. The primary focus of ACES is on computational techniques, electromagnetics modeling software, and applications. Included in this article is a description of the ACES annual symposia, publications, code user groups, benchmark problem solution workshops, short courses, software demonstrations, and other activities which serve the professional community. Finally the article describes how ACES can serve needs within the Electromagnetic Compatibility (EMC) community.

INTRODUCTION AND BACKGROUND

During the past several years, computer modeling and numerical methods have matured as problem-solving tools in real-world electromagnetics applications. However, even in the mid-1980's, modeling and numerical methods were not being highlighted in various professional society meetings or most technical literature. As a result, information exchange among practitioners (both users and developers) was inhibited, thereby forcing many of the practitioners to "re-invent the wheel" to solve the same computational problem. Consequently, the need for an application forum, of sufficient scope to include all modeling techniques and commonly-used codes, became readily apparent. There was further consensus that both a regular meeting (with published proceedings) and an additional publication were appropriate. To these ends, ACES was organized in 1986.

Now formally chartered and incorporated as a non-profit organization, ACES is an international, interdisciplinary professional society with a wide range of activities and services. The interdisciplinary scope of ACES is pivotal to maintaining a "cross-pollination" between the high-frequency and low-frequency applications.

ACES activities and services have expanded to include canonical problem solution workshops (to "benchmark" the performance of codes and techniques) and code user groups, in addition to the newsletter, the journal, and the annual symposia. Furthermore, a Software Exchange Committee and a Software Performance Standards Committee provide a means to exchange information about electromagnetic computational codes and their performance in real-world applications. At the symposia, short courses and software demonstrations are offered. The ACES Journal is administered by an international editorial board, which presently represents nine nations.

GENERAL SCOPE OF ACES ACTIVITIES

Although the following list is not exhaustive, ACES activities and symposia or journal papers generally relate to at least one of these areas:

1) *Validation of codes and techniques.* This is done using internal checks and experimental, analytical or other computational data.

2) *Performance analysis of codes and techniques.* This usually involves identification of numerical accuracy or other limitation, solution convergence, numerical and physical modeling error, and parameter tradeoffs. However, it is also permissible to address issues such as ease-of-use, set up time, run time, special outputs, or other special features.

3) *Computational studies of basic physics.* This involves using a code, algorithm, or computational technique to simulate reality in such a way that better or new physical insight or understanding is achieved.

4) *New computational techniques,* or new applications for existing computational techniques or codes.

5) *"Tricks of the trade"* in selecting and applying codes and techniques.

6) *New codes, algorithms, code enhancements, and code fixes.* This category is self explanatory but includes significant changes to existing codes, such as applicability extensions, algorithm optimization, problem correction, limitation removal, or other performance improvement.

7) *Input/output issues.* This normally involves innovations in input (such as input geometry standardization, automatic mesh generation, or computer-aided design) or in output (whether it be tabular, graphical, statistical, fourier-transformed, or otherwise signal-processed), input/output data base management, output interpretation, or other input/output issues.

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8) *Computer hardware issues.* This is the category for analysis of hardware capabilities and limitations in meeting various types of electromagnetics computational requirements. Vector and parallel computational techniques and implementation are of particular interest.

Applications of interest include, but are not limited to, antennas (and their electromagnetic environments), networks, static fields, radar cross section, shielding, radiation hazards, biological effects, electromagnetic pulse (EMP), electromagnetic interference (EMI), EMC, power transmission, charge transport, dielectric and magnetic materials, microwave components, MMIC technology, remote sensing and geophysics, communications systems, fiber optics, plasmas, particle accelerators, generators and motors, electromagnetic wave propagation, non-destructive evaluation, eddy currents, and inverse scattering.

Techniques of interest include frequency-domain, time-domain techniques, integral and differential equation techniques, diffraction theories, physical optics, moment methods, finite differences and finite element techniques, model expansions, perturbation methods, and hybrid methods. This is not exhaustive.

CODE USER GROUPS

To provide needed links between developers and users of electromagnetics modeling codes and techniques, ACES is forming several code user groups. The following benefits to code developers and to code users are envisioned:

1) Distribution of developer communications (letters, bug reports, and upgrades) to the user group members, so as to provide the developer with a single point-of-contact for as many users as possible.

2) Collection and evaluation of user feedback, with subsequent forwarding to the developer (this includes the compilation of user comments as well as the verification of bug reports. User-proposed "work-arounds" and code modifications can be handled similarly).

3) Periodic survey of users, to determine the major actual applications of the code, with a survey report sent to the developer.

4) Assistance to inexperienced code users via publication of tutorials, user guidelines, and typical problems with solutions -- and also via increased access to experienced users (this will reduce the number of interruptions which a developer receives from beginners stuck on a problem. Furthermore, such assistance can indirectly enhance the code's marketability).

5) Some of these benefits to users are contingent upon the cooperation of the respective code developers (and will vary from code to code), whereas other benefits can be provided independently. However, in the interest of serving developers and users alike, ACES is seeking full cooperation from the developers, who are also being encouraged to maintain existing user-support arrangements for non-members of ACES.

BENCHMARK PROBLEM SOLUTION WORKSHOPS

An essential code and model validation task is the testing of the codes and computational models against benchmark problems which themselves require careful selection. This task is already underway with the publication of the ACES Collection of Canonical Problems-Set 1 in the Spring of 1990. With this set of problems, ACES offers the computational electromagnetics community a set of tools which can be used to help validate models and the codes that execute those models. With frequencies ranging from 900 Hz to 10 GHz, the problems in Set 1 include not only perfectly conducted bodies but also penetrable bodies. Transient as well as sinusoidal steady-state waveforms are represented in Set 1.

ACES will be publishing future collections of benchmark problems and will be convening international workshops at which problem solutions will be presented. Whenever possible, ACES will sponsor these workshops jointly with other groups of computational electromagnetics. To that end, ACES is collaborating with the TEAM (Testing Electromagnetics Analysis Methods) workshop to sponsor joint ACES/TEAM international workshops for solving canonical problems in computational electromagnetics. The first such joint meeting was held in October 1990 in Toronto. At that meeting solutions to problems in both TEAM collection and the ACES collection were presented, drawing upon the expertise within both groups. A similar joint ACES/TEAM international workshop is scheduled for July 1991 in Sorrento, Italy.

A parallel effort of the Software Performance Standards Committee is the development of code performance standards. Also under development are procedures and protocols for the validation performance analysis of codes and computational models. Performance assessments will be based on user community feedback, and the assessments will be updated periodically as the codes are modified, models are refined, and more test cases are investigated.

THE ACES NEWSLETTER

Several types of articles or columns appear in the ACES Newsletter, including:

1) Modeling Information
   - Writeups of EM computer modeling attempts (successful and unsuccessful which can save time and effort for others
   - Hints, shortcuts, observations, ideas or tips for EM modeling
   - Tutorial articles which give an introduction/overview of various modeling topics from an applications point of view, covering material likely to help the modeler do more accurate, efficient, and reliable modeling
   - New needs in EM modeling

2) Code Information
   - New or newly-available codes. These may be supplemented with listings of short codes and/or sample input/output
   - Code bugs, limitations, and other problems discovered by users
   - Code enhancements, improvements, and bug "fixes" or "work-arounds"
   - New innovative applications to particular codes

3) Pandora's Box: an in-depth, "blue-ribbon" analysis of specific computational electromagnetic problems

4) Computer graphics showing EM fields and currents

5) Special features

6) Other articles of interest to ACES members

7) A cumulative bibliography of measured EM data (to support code validation efforts)

8) Correspondence
   - Corrections/additions to previous ACES Newsletter articles
   - Suggestions as to how ACES can facilitate computational EM technique development and state-of-the-art advances
   - Letters to the Editor

9) News
   - ACES news and committee reports
   - Code user group news
   - Other news

THE ACES JOURNAL

The ACES Journal is devoted to the exchange of information in computational electromagnetics, to the advancement of the state-of-the-art, and to the promotion of related technical activities. A primary objective of the information exchange is the elimination of the need to solve a previously-solved computational problem in electrical engineering, physics, or related fields of study. The technical activities promoted by this publication include code validation, performance analysis, and input/output standardization; code or technique optimization and error minimization: innovations in solution technique or in data input/output; identification of new applications for electromagnetics modeling codes and techniques; integration of computational electromagnetics techniques with new computer architectures; and correlation computational parameters with physical mechanisms.

ACES Journal welcomes original, previously unpublished papers, relating to computational electromagnetics. Typical papers represent the computational electromagnetics aspects of research in electrical engineering, physics, or related disciplines. However, papers which represent research in applied computational electromagnetics itself are equally acceptable.

A unique feature of the ACES Journal is the publication of unsuccessful efforts in applied computational electromagnetics. Publication of such material provides a means to discuss problem areas in electromagnetic modeling. Material representing an unsuccessful application or negative results in computational electromagnetics is considered for publication only if a reasonable expectation of success (and a reasonable effort) are reflected.

OTHER ACES ACTIVITIES AND SERVICES

A data base is evolving out of the various ACES activities. It consists of computational data to be used for code (cross-) validation, performance analysis, and optimization as well as information about particular codes and techniques. Each data set will be documented to include the code and machine used, input variables (including numerical grids, where possible), a number of unknowns, basis and testing functions (where appropriate), a priori assumptions and simplifying approximations, computational method (e.g., finite difference, moment, perturbation, or hybrid methods), and solution technique (e.g., Gaussian elimination, LU factorization, single value decomposition). Also included will be the code memory requirements, typical run times, and maximum number of unknowns. A primary objective of this data is to baseline the capabilities and limitations of the various codes for different applications, so as to provide the best possible user guidelines. In addition, the data base provides an informal peer-review mechanism for codes and computational techniques -- to facilitate a rapid transfer of useful knowledge into the mainstream of the numerical electromagnetics community.

A small software library is maintained by the Software Committee. There are tentative plans for additional activity

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AN EMC TOUR OF THE PEOPLE'S REPUBLIC OF CHINA

GENE CORY

At the 1989 International Symposium on Electromagnetic Compatibility in Nagoya, Japan, I received an invitation to attend and present the keynote address at the Third National Symposium on Electromagnetic Compatibility which was held in Beijing on September 20-25, 1990. I accepted and offered to give EMC lectures if the organizers so desired.

On Wednesday, September 19, 1990, my wife Doris and I arrived in Beijing, after a brief business stop in Tokyo. We were met by Professor Gao You-gang and Professor Zhang Lin-chang, who were co-chairmen of the symposium, and Professor Zhang's wife, Professor Wang Ju-zhen. After a brief drive across the northern part of Beijing, we arrived at the University of Post and Telecommunications guest hotel, which was to be our home for the next two weeks.

The next morning, Professor Gao escorted us to breakfast to acquaint us with the system. After breakfast we were joined by Professor Li Yi-ming, who will be remembered by many of our EMCS members from the Seattle or the Atlanta symposia. Later we drove to the National Library of China, where I met with about 30 representatives from Chinese Ministries, professional societies and universities for the opening ceremony, exhibition ribbon cutting, and the keynote session. About 300 professionals from all over China attended these activities.

Gene and Doris Cory host luncheon for Beijing hosts. Left to right: Professor Gao You-gang, Beijing University of Post & Telecommunications and Mrs. Gao You-gang; Professor Zhu Xianghua, President of BUPT and Mrs. Zhu Xianghua; Professor Zhang Lin-chang, Northern Jiathong University and Mrs. Zhang Lin-chang; Gene and Doris Cory; Professor Li Yiming, President, First Academy, Ministry of Aerospace Industry and Mrs. Li Yiming.

The exhibition featured approximately 21 booths displaying Chinese EMC services, shielded enclosures, and test equipment. Several booths were from other countries.

The technical sessions included about 120 papers which were given in Chinese, but English abstracts were provided. The EMCS Newsletter abstracts have included some symposium abstracts. Arrangements had been made with Professor Sha Fei to assist in information transfer.

Several planning discussions were held on the 1992 International Symposium on Electromagnetic Compatibility scheduled to be held in Beijing on May 25-27, 1992. The Xiang Shan (Fragrant Hill) hotel, chosen to be the symposium site was toured. Designed by the world-renowned Chinese-American architect, I.M. Pei, this beautiful hotel will provide an outstanding location for the 1992 symposium.

Professor Sha Fei interprets for Gene Cory's EMC Measurements Technology lecture at Northern Jiaotong University.

My lectures included: EMC Concepts, Basic EMC Measurement Techniques, Advanced EMC Measurement Techniques, Designing for EMC Compliance, and Electromagnetic Bioeffects. They were presented in Beijing at the Beijing University of Post and Telecommunications, the Northern Jiao Tong University and Tsinghua University. In Chengdu and Nanjing, they were presented at the University of Electronic Science and Technology, and Southeast University, respectively. The lectures were also delivered at Shanghai Jiao Tong University and the Shanghai Electrical Apparatus Research Institute.

At these universities and research centers, I was briefed on many state-of-the-art and advanced-state-of-the-art programs. The EMC-related programs covered the entire range of EMC technology. These included the development of EMI noise collection and analysis systems; measurement and analysis of EMI for the city of Beijing; frequency management modeling; a study of the EMC impact on the National Electrified Railway system; a study of asymmetrical TEM cells, including filling factor and height to width ratio effects; applications of electro-optics; and a study of EMC materials, measurement techniques, and standards.

We were in China for four weeks and enjoyed all of it. Although we were busy with EMC activities, we did get to see some of China's wonders, including the Great Wall, Ming Tombs, the Forbidden City, The Summer Palace, Dujiargyan Dam and Irrigation system, and the Sun Yat Sen Mausoleum. We were also able to see the men's gymnastics event at the Asian Games, plus some of the marathon events. The people were wonderful, the food very good (although some items were very different from what we were accustomed to), and the shopping good (in terms of variety and price). We enthusiastically recommend your attending the 1992 International Symposium on Electromagnetic Compatibility in Beijing. Start making your plans now.

on his EMC talk at the Southeastern Michigan EMC Chapter meeting on "EMC as a Fundamental EE Discipline." The talk was given on April 11 at the University of Michigan. Next, Clayton presented the new slate of officers for TC-8 (Product Safety) for 1991-1992:

Chairman:	Brian Claes	(408) 258-4768
Vice-chairman:	Rich Pescatore	(408) 447-6607
Sec./Treasurer:	John McBain	(408) 447-0738

The Board then approved the slate. Congratulations to our new TC-8 officers. Joe Butler (Representative Advisory Committee) gave his report on the progress of his RAC activities. Two additional representatives were approved by the Board: The Electrical Overstress/Electrostatic Discharge Association representative is Bill Rittenour (Storage Technology Corp) and the Defense R&D TPC representative is Dick Ford, our Treasurer.

Dan Hoolihan, Director for Member Services, presented his committee review. First, Pat Coles (Awards) passed around a ballot for selecting awardees for our Awards luncheon on Wednesday, 14 August, at the Cherry Hill Symposium. A secret ballot was taken. Dan discussed a new award that is being proposed to honor those who were instrumental in founding the EMC Society. The so-called "PIONEERS Award," once approved by the Board, will be presented each year to selected society members who have been responsible for founding a local EMC Society Chapter. A decision of the particulars for awarding this honor will be made at the Board's Cherry Hill Symposium meeting.

Under chapter activities, Dan indicated that there are presently 33 active chapters (24 in the U.S. and now 9 outside the U.S. in Regions 7-10). The Boulder and Denver (Colorado) chapters have been combined and are now called the "Front Line Chapter" to cover the Denver, Littleton, and Boulder areas. Our newest chapter is the United Kingdom and Republic of Ireland Chapter as of March 1991. Finally, the Atlanta chapter is now a joint chapter with the Instrumentation and Measurement Society. Dan then requested that the President of the Society convene an ad hoc committee to pursue improved membership surveys. Dick Ford, Bob Haislmaier, Bob Hofmann and Dan Hoolihan were named to the group, with Dan as the chairman. Bob will prepare one version of a new questionnaire for the Cherry Hill symposium with inputs from Haislmaier and Walt McKerchar. Dick Ford was interested in a random sampling, more statistically-sound survey that would be mailed to the selected membership. President Bronaugh then sought and received approval from the Board to appoint Martin Schneider, Division IV Director, as an ex officio member of the Board.

Bob Hofmann presented Walt McKerchar's report for Professional Services. Bill Gjertson and Greg Abernathy have been working on several ideas for publicizing our EMCS work. These ideas include a longer video tape, listing our services in the yellow pages of the telephone directory under "Professional Services," and providing a job placement service for our membership. Herb Mertel (Transnational Committee) indicated that his committee enrolled 14 new EMCS members at the 9th Zurich Symposium and Technical Exhibition on EMC. His committee will staff the international EMC Symposium booth at the Cherry Hill Symposium. The intent is to foster worldwide recognition of EMC symposia. Al Mills (EMCS PACE Chairman) indicated that he is arranging for a national PACE representative to speak at the Chapter Chairmen's Luncheon on 13 August at the Cherry Hill Symposium. Bob Brook's (SSIT Liaison) report showed that a new IEEE ethics code has been released. For more information, call Bob on 516-595-3136 (USA).

Under new business, the Board approved a 20% increase in the non-member cost of our TRANSACTIONS. Dick Ford presented the 1992 budget proposal. Adjustments were made to include the surplus projected for the 1992 Annaheim Symposium and for supporting the CAEME group discussed earlier. Don Clark submitted suggested changes in the Bylaws. One suggestion was that the present designation of the four Technical Directors be changed to vice-presidents. The Board will review such proposals. Next, Martin Schneider, Division IV Director gave his report. He noted that TAB endorsed the establishment of a Staff Conference Management Service to facilitate the planning and organization of Technical Conferences. Also, our Society will be reviewed in 1992 to assess our strengths and identify opportunities for improvement. Finally, Martin is to identify which of the New Jersey based IEEE leadership should be invited to Cherry Hill to attend our various Society committee meetings.

The next Board meeting will be held on 17 August at the Hyatt Cherry Hill in Cherry Hill, New Jersey, the site of our 1991 EMCS Symposium. The EMCS Standards Committee will meet the same day between 8 and 10 a.m. with the Board meeting starting at 10:15 a.m. and extending the rest of the day. For more information, call Secretary Janet O'Neil on (213) 870-9383.

CROWDED AIRWAVES

Increasingly crowded airwaves are beginning to make it difficult for astronomers to "hear" certain celestial signals over background noise, a National Research Council committee has reported. Most radio astronomers believe this interfering noise is caused in part by the proliferation of electronic consumer devices such as cellular telephones and garage door openers, as well as the constantly growing number of active transmitting services.

The report, submitted for consideration by the Federal Communications Commission (FCC), is part of U.S. preparations for the upcoming 1992 World Administrative Radio Conference. This event is organized by the International Telecommunications Union, which establishes global frequency allocations. Many frequencies are protected for radio astronomers, the committee noted, but the total spectrum allocated for passive services is quite limited -- particularly when compared to bandwidths designated for active broadcasting services.

A form of electromagnetic radiation, many radio waves in space are produced by excited atoms and molecules, each of which emit a "signature" set of radio waves, that is, radio waves of specific wavelengths and frequencies. Of particular interest are spectral lines in the radio band which provide information on galaxy formation.

Astronomers detect cosmic radio signals with the use of radio telescopes, most of which consist of a curved reflector, like a satellite dish, which focuses and amplifies incoming radio signals. To collect the energy of the weak signals of distant objects, these instruments must be very large. In recent years, scientists have learned to surpass the acuity of the best optical telescopes by linking small dishes in an array. This new technology, known as very long baseline interferometry (VLBI), connects radio telescopes placed up to many thousands of kilometers apart. VLBI is sometimes difficult because frequencies are not consistently protected for passive users all over the world. For this reason, the committee recommended a consistent global allocation of these frequencies.

To study the rapidly rotating, highly magnetized neutron stars known as pulsars, scientists need access to new frequencies, particularly continuum bands below 3 GHz, the committee determined. The committee also urged protection of bands that could shed new light on distant galaxies. This would include the frequency range below 1400 MHz (the signature of hydrogen atoms), and an extension of frequencies relevant to the carbon-monoxide (CO) and hydroxyl (OH) molecules. Finally, the committee added, careful consideration should be given to the concept of a "Lunar Quiet Zone," recommended by the International Radio Consultative Committee, which would establish a protected-access region on the far side of the moon, thereby eliminating most forms of harmful terrestrial signal interference.

Entitled Views of the Committee on Radio Frequencies Concerning Frequency Allocations for the Passive Services in Preparation for the 1992 World Administrative Radio Conference, the report is available from the Board of Physics and Astronomy, (202)334-3520.

(*Source:* National Research Council News Report, Ginger Pinholster, author, March 1991.)

THE APPLIED COMPUTATIONAL EM SOCIETY
(Continued from page 15)

in artificial intelligence/expert systems and in computational electromagnetics education.

POTENTIAL BENEFITS TO THE EMC COMMUNITY

In EMC engineering, a major objective is to determine the effects of the electromagnetics environment, including stray signals, on susceptible electronic circuits and systems. For example, EMI occurs when unwanted signals (including noise) propagate through a medium and couple into a susceptible device. The levels of coupling are determined either by measurements or by prediction and analysis.

For several years, general agreement has existed regarding "standard" EMC tests for evaluating noise emission and device susceptibility; however, the same cannot be said about prediction and analysis methods. These latter methods have been less popular for two reasons: the difficulty in modeling main noise sources and their electromagnetic environments, and the number and complexity of coupling mechanisms. Although simpler analytical methods such as LRC network representations have been used in the past, they have not always proven effective.

For this reason, EMC engineers can benefit from participation in ACES activities, a primary focus on which is the interdisciplinary exchange of computational and modeling techniques in electromagnetics. Moreover, the need to cross-validate predicted and measured EMI data establishes scope for valuable collaboration between The IEEE EMC Society and ACES.

For more information, contact Dr. Richard W. Adler, Naval Post-Graduate School, Code EC/AB, Monterey, CA 93943.

Acknowledgement
The author wishes to acknowledge valuable discussions with Dr. J.R. Bergervoet and Mr. H. van Veen of Philips Lighting.

References

1. "Antennas for Measurement of Radiated Radio Disturbances," Draft Recommendation, Amendment to CISPR Publ. 16, Clause 15, CISPR/A (Central Office) 57, April 1991 (preceding document: CISPR/A (Secretariat) 104, April 1990).

2. "Radiated EM Disturbance Fields," Draft Modification of CISPR 15 (1985), Sub-clause 4.7, CISPR/F (Central Office) 66, March 1991 (preceding document CISPR/F (Secretariat) 139, February 1990).

3. "Limits and Methods of Measurement of Radio Interference Characteristics of Industrial, Scientific and Medical (ISM) Radio Frequency Equipment," IEC/CISPR Publ. 11, 1990, Geneva.

4. "A Large Loop Antenna for Magnetic Field Measurements," J.R. Bergervoet and H. Van Veen, Proc. International Symposium on EMC, pp. 29-34, Zurich, March 1989.

5. "Magnetic Field Measurements in the Frequency Range 9 kHz to 30 MHz," J.J. Goedbloed, EMC91, ERA Conference, Heathrow (UK), February 1991.

6. "Results Round Robin Test," CISPR/F/WG2 (Round Robin Test) 89-05, February 1989.

7. "Units of the Magnetic Field Strength," CISPR/A (Secretariat) 102, April 1990.

8. "Prediction of Radiation in Vertical Directions from Electrically Small Magnetic and Electric Dipoles Situated Close to a Real (lossy) Ground in the Frequency Ranges 100 kHz - 30 MHz," CISPR/A/WG3-(Macfarlane) 90-1, August 1990.

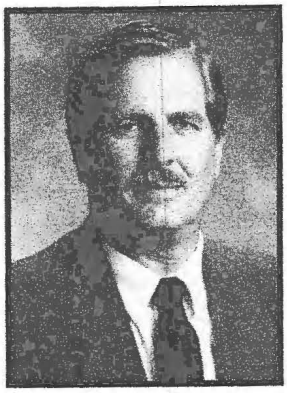
Jasper J. Goedbloed received an M.S. degree in experimental physics from the Municipal University of Amsterdam in 1967, and a Ph.D. degree from the Technical University of Eindhoven in 1973.

From 1954 to 1978 he was engaged in various studies at Philips Research Laboratories, such as electro-mechanical coupling systems, noise in IMPATT-diode microwave oscillators and amplifiers, and noise in avalanche photodiodes for optical communication systems. At the University of Amsterdam he investigated effects of gamma irradiation of lithium-drifted silicon. Since 1978 he has been supervisor of the EMC Department of Philips Research Laboratories.

Mr. Goedbloed contributes to the work of IEC/CISPR and IEC/TC77, is teaching EMC, and is a founder of the Post-Academic Course on EMC in the Netherlands. He is the author of a textbook on EMC which is used to introduce EMC at the Technical Colleges in the Netherlands.

He is a senior member of the IEEE, Member of the Dutch Physical Society and the Dutch Electronics and Radio Society.

EMCABS



WILLIAM H. McGINNIS
ASSOCIATE EDITOR

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

Mike Crawford, NBS
Bob Hunter, Texas Instruments
R. M. Showers, University of Pennsylvania
Yoshio Kami, University of Electro-Communications
Daniel Keneally, Rome Air Development Center
Sha Fei, EMC Research Section, Northern Jiatong Univ., Beijing, China 100044

"HOW CAN I GET A COPY OF AN ABSTRACTED ARTICLE?"

The answer to this frequently asked question follows:

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

NOTE: The steering staff of the EMC Japan Technical Group and the EMCS Tokyo Chapter have graciously offered to act as a central point for requests of papers abstracted. Most of the papers will be 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 Yoshio Kami, The University of Electro-Communications, 1-5-1, Chofugaoka, Chofu-Shi, Tokyo 182, Japan.

Readers should be aware that many of the Chinese papers are not available in English. Associate Professor Sah Fei, EMC Research Section, Northern Jiatong University has offered his time and assistance in routing requests for papers to the appropriate author(s). However, he cannot supply translations.

MEASUREMENT OF MAGNETIC FIELD DISTRIBUTION ADJACENT TO EXTENSION BOARDS FOR A PERSONAL COMPUTER

EMCABS: 01-08-91

T.Ikeda (1), R. Koga, O. Wada, M. Kosaka (2), and H. Sano (1)
(1)Fukuyama Univ. and (2)Okayama Univ.
IEEE EMCS Technical Chapter, January 1991

ABSTRACT: A two-dimensional distribution of RF magnetic field noise was measured for a four-layer printed circuit board with a small loop antenna on a plane 20 mm distant from the board as well as for a two-layer printed circuit board. As a result, a component perpendicular to the board is larger than a parallel component in the vicinity of PCBs. With respect to EMI, the perpendicular magnetic field is more hazardous than others because it causes larger induction on an adjacent PCB. An ad hoc induction-test board was prepared that comprises only a TTL NAND gate IC. RF voltage, which is caused by induction on a loop composed of the IC and a bypass capacitor, was measured at an output of a NAND through FET prove circuit. An induction noise was found to be large when the output level was II, whereas no significant noise was found at L level.
INDEX TERMS: Magnetic fields, susceptibility

METHOD TO ESTIMATE THE MECHANISM OF INDUCTION AND RADIATION FROM POWER LINES BY BALLOON OBSERVATIONS

EMCABS: 04-08-91

Ichiro Tomizawa, University of Electro-Communications
IEEE EMCS Technical Chapter, January 1991

ABSTRACT: Electromagnetic field at 50 or 60 Hz is induced and radiated from power transmission lines extended over Japan. The induction and radiation mechanisms can be modeled in two types of dipoles: vertical electric dipole and horizontal dipole. The type of induction and radiation depends on the operation of each power transmission system. The total or macroscopic induction and radiation mechanism of the Japanese power network can be estimated not by calculation but by observations. Observation on a large balloon is suitable to detect the electromagnetic field at the ELF range due to its low vibration and its good electrical noise condition. The induction and radiation mechanism can be estimated by fitting the attenuation against the distance, the wave impedance, and the field direction to the model calculation.
INDEX TERMS: ELF, Power line radiation

BASIC PROBLEMS IN EMC TEST SITE-ASSESSMENT & THEMES OF NEW CISPR RECOMMENDATION DRAFT

EMCABS: 02-08-91

Shigekazu Shibuya and Haruo Ishizuka
System consultant Shibuya's Office & Ishizuka Radio Wave Consulting Engineer's Office
IEEE EMCS Technical Chapter, January 1991

ABSTRACT: The CISPR draft has authorized the use of broadband antennas such as biconical antennas, log-periodic antennas, etc. and also theoretical values of NSA for transmitting antenna height of one meter and distance of 3/10/30m. An analysis of these theoretical values shows that the directivity (of antenna) is equal to that of short dipole, but it is not suitable for that of log-periodic antenna, though it may approximate the directivity of biconical antenna. This paper gives the theoretical values of site attenuation to medium height and medium range not specified (in the draft), and indicates combined effects of changing reflection coefficient of test site floor and directivity of antenna as well.
INDEX TERMS: CISPR, antennas, OATS

RF IMPEDANCE CHARACTERISTICS OF THE HUMAN BODY

EMCABS: 05-08-91

Tsuruo Shimayama
Fuji Electronic Ind., Co.
IEEE EMCS Technical Chapter
March 1991

ABSTRACT: There are many regulations and testing methods concerning human body, such as ESD from an electric charged body, body heating by electromagnetic waves and etc. In these cases, the most important factor is RF impedance characteristics of human body. Then, impedances between foot and earth were measured in several models.

INDEX TERMS: Bioeffects measurements

ELECTROMAGNETIC SHIELDING WORK METHOD AND PERFORMANCE NO. 3 - EXPERIMENT ON THE EFFECTIVENESS OF A WAVEGUIDE

EMCABS: 03-08-91

Tetsuzo Morita, Ryoji Yoshino, and Shinko Miyake, Taisei Corporation
IEEE EMCS Technical Chapter, January 1991

ABSTRACT: In factories and offices, it is required that the rooms be shielded from electromagnetic radiation. For this reason it is necessary to construct an electromagnetic shield spacer. In this area there are a number of electrical power lines and signal lines that penetrate the shield wall and it is very difficult to determine the effectiveness of this shield. Here a rectangular shaped iron duct with a cross section opening of dimension 30 cm x 50 cm was used, and the effectiveness of the electromagnetic shield was monitored by a waveguide. Changes in the effectiveness of the electromagnetic shield as a function of duct length and cable movement were experimentally determined by this company.
INDEX TERMS: Shielding, waveguide below cutoff

CHARACTERISTICS OF 10 METER ANECHOIC CHAMBER FOR EMI

EMCABS: 06-08-91

Yasuaki Saitoh and Tohra Harada
Murata Mfg. Co., Ltd.
IEEE EMCS Technical Chapter
March 1991

ABSTRACT: The anechoic chamber for the 10-meter method built in our Yokohama R&D center first did not achieve targeted performances. Our countermeasure to causes, however, made it possible for the site attenuation to satisfy the theoretical value with a tolerance of $\pm$3dB and the open site value with a tolerance of $\pm$1dB. From this we discovered that increasing the resistance value of the electromagnetic wave absorber, which lowers the resonance Q value by standing wave, brings about improvements of the site attenuation characteristic.
INDEX TERMS: Anechoic chamber, site attenuation

MEASUREMENT OF ELF FIELD STRENGTH USING TI : LI Nb 03 WAVEGUIDE MODULATOR — **EMCABS: 07-08-91**

H. Ito, T. Ichikawa, S. Kato, M. Matsuta, and N. Takaashi
Toyota Cent. Res. and Dev. Labs. Inc.
IEEE EMCS Technical Chapter
March 1991

ABSTRACT: The method of using a Ti : $LiNbO_3$ waveguide modulator for an electric field sensor has the advantages of small size, wide bandwidth, and less perturbation for the field to be measured. The application of the method to measure the ELF field has been investigated. As a result, the sensor with the ability to measure field strength under high voltage power lines has been developed to have 66 dB dynamic range and 0.01 $V^{-1}H_2^{-1/2}$ sensitivity.

INDEX TERMS: ELF, sensors

A STUDY ON THE SHIELDING EFFECTIVENESS MEASUREMENT BY DUAL-TEM CELL METHOD — **EMCABS: 08-08-91**

Atsuhiro Nishikata and Miyuki Ohtsubo
Communication Research Laboratory and Tokyo Gakugei Univ.
IEEE EMCS Technical Chapter
April 1991

ABSTRACT: The dual-TEM cell method, one of the common methods for testing shielding material, is investigated theoretically. The samples of finite area can be treated accurately, by considering every dipole source distributed over the sample surface. Highly conductive material is assumed as the sample and is analyzed based on a coupled parallel plate model. Experiment is performed on thin metal foils to verify this theory. As a result of the analysis, a very simple relationship between the dual-TEM cell method and plane wave method is found, and it enables us to convert one measurement value to the other.

INDEX TERMS: TEM cell, shielding effectiveness

DEVELOPMENT OF WIDE-BAND AND HIGHLY SENSITIVE ELECTRIC FIELD SENSOR USING Li Nb 03 OPTICAL MODULATOR — **EMCABS: 09-08-91**

Nobuo Kuwabara (1), Kimihiro Tajima (2), and Fujio Amemiyta (1)
(1) NTT telecommunication Networks Laboratories, and (2) NTT Tech Assistance & Support Center
IEEE EMCS Technical Chapter, April 1991

ABSTRACT: Recent progress of electromagnetic compatibility (EMC) study has created a need for a small and wide-band electric field sensor to measure the electromagnetic pulses. An electric field sensor using $LiMbO_3$ has a good property to measure it, but the sensitivity of the sensor should be improved to apply the electromagnetic pulses measurement. The employment of driving power optical modulator and the high power optical source are effective to improve the sensitivity of the sensor. In this paper, a Mach-Zehnder interferometer whose half-voltage is about 4 V and a YAG laser pumped by laser diode whose output power is 25 mW, is used to improve the sensitivity.

INDEX TERMS: Electric field measurements, sensors

IMMUNITY CHARACTERISTIC MEASUREMENT AND EVALUATION FOR PERSONAL COMPUTERS BY USING TEM CELL DEVICE — **EMCABS: 10-08-91**

K. Tokushige, T. Shinozuka (1), K. Hirata, T. Takeuti, and M. Mituzuka
(1) Communications Research Laboratory, and (2) Institute of Radio Equipment, Inspection and Cert
IEEE EMCS Technical Chapter, May 1991

ABSTRACT: Immunity characteristics of the latest personal computers, including three desktop and laptop types, were examined by using a large TEM cell device, The impressed maximum electric field strength in the cell was approximately 30 to 60 V/m in 1 MHz and 5 to 230 MHz frequency range for the TEM mode. A subjective assessment of the personal-computer has been made by introducing an "immunity figure" defined as the ratio of the degradation degree to the impressed electric strength. It was found that no degradation appeared in the laptop type while serious one occurred in CRT display of the desktop type.
INDEX TERMS: TEM cell, Immunity

HIGH-SPEED SIGNAL PROPAGATION ON LOSSY TRANSMISSION LINES — **EMCABS: 11-08-91**

A. Deutsch et al.
International Business Machines, IBM Journal of Research and Development
Volume 34, No. 4, July 1990, pp. 601-615

ABSTRACT: Package interconnections in modern digital computers are inherently lossy due to small line widths and skin effects that are significant at high frequencies. The authors use a variety of classical techniques to analyze real examples of such lossy lines and the effects of line parameters, including dielectric dispersion, to characterize the lines with regard to reflections, rise-time slowdown, delay, attenuation and crosstalk. Methods for controlling these effects in order to maintain distortion-free propagation are investigated. The authors conclude that all the loss mechanisms must be included in such analyses and that unterminated transmission lines can be used in certain situations.

INDEX TERMS: Transmission lines, lossy lines, skin effects, cross talk, line terminations, distortionless transmission, attenuation, dielectric dispersion, high-speed signals

DESIGN FOR MULTINATIONAL EMC COMPLIANCE — **EMCABS: 12-08-91**

Donald N. Heirman, Robert C. Morris and Steven M. Crosby
AT&T Bell Laboratories
AT&T Technical Journal
Volume 69, No. 3, May/June 1990, pp. 28-45
ABSTRACT: International marketing of digital products requires compliance with several different EMC requirements. This paper focuses on a design process for achieving international compliance with a minimum of redesign and delay. Terms and acronyms are defined before comparing the emissions limits of several standards (FCC and CISPR). The whole process is managed by a defined series of steps including training, defining system requirements, design process (focus is on PWB layout and related topics), system design (including technology selection), determinants of emissions and "ground bounce," logic design to minimize emissions, and a number of techniques useful for EMC design.
INDEX TERMS: EMC training, EMC design, PWB layout, EMC requirements, EMC testing, IC, EMC quality metrics, international EMC requirements

1994 SYMPOSIUM

H.R. HOFMANN

The IEEE EMC Society Board of Directors meeting on May 16 and 17 was held at the Palmer House Hotel in Chicago, IL. The Palmer House, which will be the site of the 1994 EMC symposium, was chosen to give the Board an opportunity to preview the 1994 hotel facilities.

Located in the downtown loop area, the Palmer House was chosen by the 1994 organizing committee on the basis of its central location and excellent symposium facilities. Of course, the Palmer House will easily house the more than 1000 persons and 140 exhibit booths expected in 1994.

Quick and direct access to the exhibits and technical sessions is ensured by a bank of 11 elevators, all of which stop at the exhibit/meeting hall floors located just above the lobby. Ample space is also available in the hotel to allow adjunct symposium meetings.

The Palmer House has recently completed a $68 million dollar renovation program. Its Grand and State ballrooms, and the Empire and Red-Lacquer rooms are known world-wide. The Chicago lakefront and Grand Park are only two blocks from the hotel. Shopping along State Street starts when you step out the door of the hotel, and the Michigan Avenue shopping starts one block away. There are seven restaurants within the hotel, and dozens more within a couple of blocks.

Photo: Dick Ford

Bob Hoffman, EMCS Vice President (left), Ed Bronaugh, President (center), and Hilton Executive Bill Elges (right) tour the Palmer House, site of the 1994 EMC Symposium.

IRPA8

The Eighth World Congress of the International Radiation Protection Association will be held in Montreal from May 17-22, 1992. The Congress is expected to be the largest so far, and will focus on protection against ionizing and non-ionizing radiation, against a background of other public health and industrial hygiene experience. The health risks from radiation will be compared with those from other industrial and environmental hazards, and the perception by the public of those risks. All aspects of radiation protection will be explored during the Congress. Presenters of world stature will review important current topics in plenary sessions, workshops and scientific paper sessions. In addition, a major feature of the Congress will be training sessions aimed at providing a basic understanding of ionizing and non-ionizing radiation protection.

The International Radiation Protection Association (IRPA) is an association of 28 radiation protection societies.

For more information, contact IRPA8, 2155 Guy Street, Suite 820, Montreal, Quebec, Canada H3H 2R9. Fax:(514)932-9419.

INCEMIC

The Third International Conference on Electromagnetic Interference and Compatibility (INCEMIC) will be held in Calcutta from December 2-4, 1992. INCEMIC will focus on an evaluation of the progress on EMC Engineering in the commercial, industrial and consumer electronic fields. Research papers, case histories and application oriented EMC works may be submitted for oral presentation in the following areas:

EMI in Communication and Computing Systems
EMI Analysis, Design and Case Histories
EMI Coupling in Cables and Connectors
EMI MEasurements and Measuring Systems
EMI Design in Industrial Electronics
EMP, ESD, TEMPEST and other Related Transients
EMI Specifications and Standards
Spectrum Management

Prospective authors are requested to submit a 300-word summary by January 31, 1992. Summaries should be sent to Dr. G. K. Deb, Electronics Research and Development Centre, P-1, Taratala Road, Calcutta 700 088. Registration information is available from Shri V.R. Katti, Electrical Integration Group, Indian Space Application Centre, Vimanapura-Post, Bangalore 560 017.

CALENDAR 1991

1991

August 12-16	**IEEE 1991 EMC SYMPOSIUM** Hyatt Cherry Hill Cherry Hill, NJ	Contact: Ed Bronaugh IEEE 1991 Intl. Symposium on EMC P.O. Box 609 Lincroft, NJ 07738 (800) 253-3761
September 23-26	**13TH ANNUAL ELECTRICAL OVERSTRESS/ELECTROSTATIC DISCHARGE SYMPOSIUM** Riviera Hotel Las Vegas, NV	Contact: Terry Welsher AT&T Bell Laboratories 600 Mountain Avenue, Rm. 3B-321 Murray Hill, NJ 07974 (201) 582-5279
September 24-26	**DESIGN 91** Meadowlands Convention Center Secaucus, NJ	Contact: Kristen Lindberg Expocon Management Associates, Inc. 7 Cambridge Drive Trumbull, CT 06611 (203)374-1411, Ext. 105
October 2-4	**13TH PIEZOELECTRIC DEVICES CONFERENCE** Western Crown Center Kansas City, MI	Contact: Components Group, Electronic Industries Association, 2001 Pennsylvania Ave., N.W. Washington, D.C. 20006 (202)457-4930

1992

May 17-22	**EIGHTH WORLD CONGRESS OF THE INTERNATIONAL RADIATION PROTECTION ASSOCIATION** Montreal Convention Centre Montreal, Quebec Canada	Contact: IRPA8 2155 Grey Street, Suite 820 Montreal, Quebec Canada H3H 2R9 FAX:(514)932-9419
May 25-27	**URSI/IEEE/CIE INTERNATIONAL SYMPOSIUM ON EMC** Beijing, China	Contact: Prof. Zhanj Linchang EMC Research Section Northern Jiatong University Beijing, 100044, China
September 2-4	**11th INTERNATIONAL WROCLAW SYMPOSIUM ON EMC**	Contact: EMC Symposium Box 2141 51-645 Wroclaw, Poland
September 16-18	**14TH ANNUAL ELECTRICAL OVERSTRESS/ELESTROSTATIC DISCHARGE SYMPOSIUM** Loews Anatole	Contact: Charvaka Duvvury Texas Instruments, Inc. 12840 Hillcrest, Suite 200 Dallas, TX 75230 214-917-7969 FAX: 214-917-7487
November 2-5	**1992 SYMPOSIUM ON ELECTROMAGNETIC COMPATIBILITY** Tel-Aviv, Israel	Contact: Rafi Rubinstein, EMC 1992 Symposium Chairman Elisra Ltd. 48 Mivtza Kaddesh St. Benei-Beraq 51203 Israel Tel: (972-3)7545628 FAX: (972-3)7545468
December 2-4	**THIRD INTERNATIONAL CONFERENCE ON ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY (INCEMIC)** Calcutta, India	Contact: Shri V.R. Katti Electrical Integration Group Indian Space Application Centre Vimanapura - Post, Bangalore 560 017 India

INSTITUTIONAL LISTINGS

The IEEE Electromagnetic Compatibility is grateful for the assistance given by the firms listed below and invites application for Institutional Listings from other firms interested in the electromagnetic compatibility field.

PATTON & ASSOCIATES, 4718 West El Caminito Drive, Glendale, AZ 85302
Telephone: (602) 934-5458, FAX: (602) 242-7700
Worldwide Telecommunication design assistance, and agency submittal.

SPECTRUM CONTROL, INC., 2185 West 8th Street, Erie, PA 16505
Telephone: (814) 455-0966, FAX: (814) 455-2550
Complete EMC, FCC/MIL consulting, testing, repair, mfr. RFI filters, RFI gaskets, D-subminiature connectors.
Surface mounted devices: chip capacitors, capacitor networks, HIC and QUAD fastbus line drivers.

OMEGA SHIELDING PRODUCTS, 1384 Pompton Avenue, Cedar Grove, NJ 07009
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AMPLIFIER RESEARCH, 160 School House Road, Souderton, PA 18964-9990
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