

Commission Report on GASS Commission Business Meetings

Commission E

prepared by Dave Giri (Chair 2014-2017)

1. Results of Election of Vice Chair

There were two candidates for the position of Vice Chair. They were Prof. F. Gronwald and Prof. Y. Hobara. 15 votes received from Canada, China (CIE), Germany, India, Ireland, Israel, Italy, Japan, Korea, Netherlands, Norway, Portugal, Switzerland, UK, and USA.

Dr. Frank Gronwald was declared elected as the Vice Chair of Commission E for the current triennium.

2. Results of Election of Early Career Representative

There were three candidates for the position of Early Career Representative. They were G. Gradoni, Ch. Kasmi, and N. Mora Parra. 17 votes were received from Brazil, China (CIE), Egypt, France, Germany, India, Japan, Korea, Netherlands, Norway, Portugal, Russia, S. Africa, Sweden, Switzerland, UK, and USA.

Dr. Gabriele Gradoni was declared elected as the Early Career Representative (ECR) of Commission E for the current triennium.

3. Appointment of Associate Editor for Radio Science Bulletin

Dr. F. Gronwald (Vice Chair elect) was appointed as the Associate Editor for the Radio Science Bulletin.

4. Updates/Status of Working Groups

A number of working groups have been established to provide focus for a number of activities relevant to the theme of Commission E. These are outlined below, together with the contact person and, where appropriate, a brief summary of the group's activities during the three-year period.

4.1 E1. Terrestrial and Planetary Electromagnetic Noise Environment

Co-Chairs: C. Price (Israel), Y. Hobara (Japan), A. P. Nickolaenko (Ukraine), and K. Hattori (Japan)

This working group deals with the study of the characteristics of electromagnetic noise taking place not only in the terrestrial but also in the planetary environment. The most well-known noise is the atmospheric radio noise from lightning discharges (the so-called sferics, in a wide frequency range from ULF to VHF). Some examples of topical subjects on sferics are (1)

monitoring of global lightning activity as studied by high-frequency noise and Shumann resonance phenomena in the ELF band, and (2) ELF transients related to the optical emissions in the mesosphere due to the lightning. Higher-frequency lightning emission provides us with the information on the fine structure of lightning electrical structure, while lower-frequency noise provides us with the macroscopic nature of lightning. The noise coming from the ionosphere/ magnetosphere will be discussed as well: micro-pulsations in the ULF range, VLF/ELF emissions and HF emissions due to the plasma instabilities in space. Also, our recent topic is radio emission from the lithosphere, which again covers a wide frequency range, from dc to VHF (or even more). The characteristics and generation mechanisms of those effects and also the seismic effect on the ionosphere will be discussed. Finally, the radio noise environment on other planets (such as Jupiter) will also be our topic. The interactions of these natural noises with artificial noises due to human activity is another subject. Power-line harmonic radiation penetrates into the ionosphere/magnetosphere and induces particle precipitation into the lower ionosphere (this is a kind of pollution of the natural environment by human activity). We also discuss the interaction of the natural environment with human activity.

4.2 E2. Intentional Electromagnetic Interference

Co-Chairs: M. Bäckström (Sweden) and W. Radasky (USA)

This working group studies the area of intentional electromagnetic interference (IEMI), which is defined by the IEC as the “Intentional malicious generation of electromagnetic energy introducing noise or signals into electric and electronic systems, thus disrupting, confusing, or damaging these systems for terrorist or criminal purposes.” In particular, this working group focuses on electromagnetic threat weapons, the coupling to electronic systems, the vulnerability of systems to these types of transients, and the protection of systems from the IEMI threat.

Over the 2011-2014 period, a large number of conferences dealt with IEMI, along with other aspects of HPEM:

Joint IEEE AP-S and URSI meeting in Spokane, Washington, July 3-8, 2011. Dr. Giri and Prof. Uslenghi organized an “In Memoriam” special session to remember Dr. Carl Baum (11 papers).

URSI General Meeting in Istanbul, Turkey, August 15-19, 2011. There was a session organized by Dr. Sabath and Dr. Radasky entitled “High Power EM and IEMI,” with 11 papers presented.

A weeklong short course, HPE 201-2011, was presented in Schloss Noer, Germany, September 18-24, 2011. Dr. Dave Giri served as lecturer and course director.

IEC SC 77C (High Power Transient Phenomena) Project and Plenary Meetings in Seoul, South Korea, October 19-21, 2011. Work continued on IEMI and HEMP standards for protecting civil systems from these threats. Dr. Radasky chairs IEC SC 77C and the Secretary is Dr. Hoad.

USNC-URSI conference in Boulder, Colorado, January 4-7, 2012. Several papers were presented dealing with IEMI.

APEMC in Singapore, May 21-24, 2012. A special session on HEMP and IEMI was organized by Dr. Radasky. Another regular session on HPEM was also held. A total of eight papers were presented.

EUROEM symposium held in Toulouse, France, from July 2-6, 2012. This symposium was dedicated entirely to HPEM topics, and had 218 papers and 312 participants. There was a significant number of papers dealing with IEMI.

IEEE EMC symposium held in Pittsburgh, Pennsylvania, from August 4-10, 2012. A workshop was held dealing with intentional EMI (IEMI), and 15 papers were submitted dealing with HPEM and also EM information leakage.

Joint ICEAA 2012 – IEEE APWC 2012 – EEIS 2012 (URSI Commission E) conference held in Cape Town, South Africa, September 2-7, 2012. Eleven papers were presented dealing with various aspects of HPEM, including IEMI.

Conference on Environmental Electromagnetics (CEEM) held in Shanghai, China (CIE), from November 6-9, 2012. Several sessions were organized with IEMI papers.

Directed Energy Professional Society (DEPS) Symposium held in Albuquerque, New Mexico, from November 26-30, 2012. While this conference was aimed mainly at source development, there was a session that included papers covering HEMP and IEMI.

National Radio Science Meeting sponsored by the USNC-URSI held in Boulder, Colorado, from January 9-12, 2012. There were a few papers dealing with HPEM and IEMI at this meeting.

An IET seminar entitled “Extreme Electromagnetics – The Triple Threat to Infrastructure,” held in London, England, on January 14, 2013. Ten papers were presented dealing with impacts of HPEM (HEMP, IEMI, and severe geomagnetic storms) on the critical infrastructures.

Asia-Pacific EMC (APEMC) symposium held in Melbourne, Australia, from May 18-23, 2013. There was a workshop on the protection of commercial facilities from HEMP and IEMI, and there was a special session on HPEM with eight papers presented.

IEEE EMC symposium held in Denver, Colorado, from August 4-8, 2013. There was a workshop on EM information leakage, and a special session on IEMI with six papers presented.

A session entitled “Intentional EMI (IEMI) and EMC” was organized at PIERS 2013, August 12-15, 2013, in Stockholm, with eight papers.

EMC Europe Symposium held in Brugge, Belgium, from September 2-6, 2013. There was a workshop presented on the impact of IEMI on the critical infrastructures in Europe, reviewing the work of three special EU-funded projects. A special session on EM information leakage was also held.

8th Future Security Research Conference in Berlin, September 17-19, 2013. There were session, “Electromagnetic Threats and Countermeasures,” consisting of seven papers, and a panel session with the same title.

IEC SC 77C (High Power Transient Phenomena) project and plenary meetings held in Ottawa, Canada, from September 23-27, 2013. Work continued on IEMI and HEMP standards for protecting civil systems from these threats. Dr. Radasky chairs IEC SC 77C, and the Secretary is Dr. Richard Hoad from the UK.

4.3 E3. High-Power Electromagnetics

Co-Chairs: F. Sabath (Germany) and R. L. Gardner (USA)

The objective is to encourage research in high-power electromagnetics (HPE). The technical area of HPE consists of the physics and engineering associated with electromagnetic sources, where nonlinear effects associated with high-field regions (and air breakdown) must be included in the analysis and design. This includes (but is not limited to) EMP simulators, high-power narrowband and mesoband sources and antennas, and hyperband (impulse) sources and antennas. It also includes the environment near lightning channels and in nuclear EMP source regions. In some cases, it includes the high field regions on or in targets, because of local field enhancement.

4.4 E4. Lightning Discharges and Related Phenomena

Chair: V. A. Rakov (USA) and S. Yoshida (Japan)

Lightning discharges are one of the two natural sources of electromagnetic interference (EMI), the other being electrostatic discharge. Electric and magnetic fields generated by lightning represent a serious hazard to various systems, particularly those containing sensitive electronics. This WG focuses on the characterization of lightning and its interaction with engineering systems and with the environment, as well as on lightning detection and testing. It covers all aspects of lightning research, including observations, field and laboratory experiments, theoretical studies, and modeling.

Sessions on lightning discharges and related phenomena were organized at PIERS 2011 in Marrakesh, ICAE 2011 in Rio de Janeiro, ICLP 2012 in Vienna, GROUND/LPE 2012 in Bonito, SIPDA 2013 in Belo Horizonte, GROUND/LPE 2014 in Manaus, and ICAE 2014 in Norman, Oklahoma.

4.5 E5. Interaction With and Protection of Complex Electronic Systems

Co-Chairs: F. Gronwald (Germany), J-P. Parmentier (France), and H. Reader (South Africa)

This working group studies the various electronic and electromagnetic aspects related to the interaction with and protection of complex electronic systems. The focus is the analysis of the various coupling paths and their associated transfer functions into complex electronic systems, as formalized in the framework of electromagnetic topology. Analytical, numerical, and measurement techniques are used to characterize the electromagnetic fields and currents in a complex environment. In the analysis, special attention is placed on the emergence of new technologies, and the inclusion of advanced materials and communication systems. Functional safety is an integral part of the studies

4.6 E6. Spectrum Management

Chair: T. Tjelta (Norway) and R. Struzak (Poland)

The E6 focus is on sound scientific spectrum management for improved utilization of the radio frequencies for protection of wireless communications service and radio science. The goal is to assure further development of radio science and communication services, unobstructed by potential radio interference due to unwanted energy in the form of out-of-band and in-band encroaching and deleterious in-band and out-of-band emissions. The electromagnetic spectrum is treated as a limited natural resource, with a multitude of competing demands for access to it and use of it. Spectrum management seeks innovative means and technologies for adequate coexistence of all of them, taking into account the need of protection of new and incumbent wireless and wired communication services, systems, and equipment, with special focus on science services and those that use passive technologies.

Two of the papers presented at the previous GASS were revised and submitted to the Radio Science Bulletin, and were published in No. 340, on the topics

- Spectrum Management Overview
- Opportunistic Secondary Spectrum Access: Opportunities and Limitations

The WG planned a session at the first Commission E Electromagnetic Environment and Interference Symposium (EEIS 2012) in Cape Town, but there was very limited response and, in the end, no session on spectrum management. This was seen as a good opportunity to deal with the spectrum issues in between the General Assemblies.

A session on spectrum-management topics has been planned together with Commission J for the GASS 2014. Some papers were received, and the session will be held.

It appears difficult to engage the community in between General Assemblies to address spectrum-management topics: either to improve spectrum utilization, or to ensure an acceptable, “interference free” environment for radio science services.

4.7 E7. Geo-Electromagnetic Disturbances and Their Effects on Technological Systems

Chair: A. Viljanen (Finland)

4.8 E8. Electromagnetic Compatibility in Wired and Wireless Systems

Co-Chairs: A. Zeddani (France), F. Rachidi (Switzerland) and F. Gronwald (Germany)

The intensive use of the electromagnetic spectrum for communications has resulted in issues of compatibility and interoperability between different users. In addition, the continual increase in the operating frequencies of products and higher frequency sources of disturbances (such as ultra-wideband systems) has resulted in an increase of potential EMC problems in communication systems, and the use of power lines for carrying data is adding to interference problems. This session will focus on theoretical and experimental EMC aspects in both wired and wireless communication systems. Potential remedies will be also addressed.

4.9 Commission E Joint Working Groups

4.9.1 Inter-Commission Working Group on Solar Power Satellites

Chair: H. Matsumoto (Japan)

Co-Chair for Commission E: J. Gavan (Israel)

4.9.2 Inter-Commission Working Group on Natural and Human Induced Hazards and Disasters

Co-Chair for Commission E: W. A. Radasky (USA)

4.9.3 EGH. Seismo Electromagnetics (Lithosphere-Atmosphere-Ionosphere Coupling)

Co-Chair for Commission E: M. Hayakawa (Japan)

5. Updates to Terms of Reference of Commission

There were no updates to the Terms of Reference.

The current Terms of Reference are as follows:

Commission E promotes research and development in:

- a. Terrestrial and planetary noise of natural origin, seismic-associated electromagnetic fields;
- b. Man-made electromagnetic environment;
- c. The composite noise environment;
- d. The effects of noise on system performance;
- e. The effects of natural and intentional emissions on equipment performance;
- f. The scientific basis of noise and interference control, electromagnetic compatibility;
- g. Spectrum management.

6. Meetings Proposed to be Supported in the Coming Triennium

Commission E will support the following meetings in the current triennium:

- First URSI Atlantic Radio Science Conference (URSI AT-RASC), May 18-22, 2015, to be held in the ExpoMeloneras Convention Centre, Gran Canaria, Spain.
- Asia-Pacific Radio Science Conference (AP-RASC), August 21-25, 2016, to be held in the Convention Center, Seoul, South Korea.
- URSI General Assembly and Scientific Symposium, Montreal, Canada, to be held in 2017.

7. Report and Comments on the Scientific Program of the Commission for the Current GASS

Commission E offered 16 sessions at the URSI GASS in Beijing (2014). In addition, there were five more sessions co-organized with other Commissions. They were all well attended and, generally speaking, there were several lively discussions following the presentations.

In the URSI Questionnaire for Participants of the URSI GASS in Istanbul (2011), 22 (8.4%) of the 261 respondents chose Commission E as the Commission that best met their needs. Also, 51 (9.1%) of the respondents from the 2011 GASS said they attended Commission E sessions. We wish to get similar results if such a questionnaire was available at the GASS in Beijing.

8. Proposed Sessions for the Next GASS

Referring to the sessions listed under item 9 below, the planned sessions for the URSI GASS in Montreal 2017 are expected to be very similar. There is the possibility of adding some more special sessions on current topics.

9. Proposed Sessions for the AT-RASC

At the time of writing this report (February 12, 2015), the sessions planned at AT-RASC are as follows:

- E.1 Communication in the Presence of Noise
- E.2 Crosstalk
- E.3 Electromagnetic Compatibility Education
- E.4 Electromagnetic Compatibility Measurements and Standards
- E.5 Electromagnetic Noise of Natural Origin
- E.6 Electromagnetic Radiation Hazards

- E.7 High-Power Effects of Transients on Electronic Systems
- E.8 Spectrum Management and Utilization
- E.9 Other
- S-EB. High-Power Electromagnetics
- S-EC. Time Reversal in Electromagnetic Environments: Theory and Applications
- S-EF1. Understanding Microwave Processing of Materials
- S-EF2. Statistical Methods in Electromagnetics
- S-EAB. Chaos and Complexity in Electromagnetics
- E.10 Latest Results

We intend to combine papers into technical sessions with five or six papers or 10-12 papers in each session from the submitted papers.

10. Other Business

None.

Chair: Dr. D. V. Giri
Dept. of ECE, University of New Mexico
Pro-Tech
11-C Orchard Court
Alamo, CA 94507-1541 USA
Tel: 1 925 552 0510; Fax: 1 925 552 0532
E-mail: Giri@DVGiri.com
URL: www.dvgiri.com

Vice Chair: Frank Gronwald
Technische Universität Hamburg-Harburg Institut für Theoretische Elektrotechnik
Harburger Schloss Str. 20, 21079 Hamburg, Germany
Tel: +49 40 42878 2177; Fax: +49 40 42878 2385
E-mail: gronwald@tuhh.de
URL: <http://www.tet.tuhh.de/>

Early Career Representative: Gabriele Gradoni
Room B52 Mathematical Sciences Building
University of Nottingham
University Park, Nottingham, NG7 2RD, UK
Tel: 0115 9514923
E-mail: Gabriele.Gradoni@nottingham.ac.uk