



Commission E
on
Electromagnetic Environment and Interference
2014 - 2017 Triennium Report

Chair: Dr. Dave V. Giri

Vice Chair: Dr. Frank Gronwald

I. Terms of Reference

During the General Assembly in Beijing in 2014, the name of the Commission and its terms of reference were changed to better reflect current scientific and industrial practice.

Commission E promotes research and development in:

- ✓ Terrestrial and planetary noise of natural origin, seismo- electromagnetic fields;
- ✓ Man-made electromagnetic environment;
- ✓ The composite noise environment;
- ✓ The effects of noise on system performance;
- ✓ The effects of natural and intentional emissions on equipment performance;
- ✓ The scientific basis of noise and interference control, electromagnetic compatibility;
- ✓ Spectrum management

II. Commission E Working Groups

A number of Working Groups have been established to provide a 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 its activities during the three year period.



Commission E is Organized into following Working Groups

WG Name	Title	Co-Chairs
E1	Terrestrial and Planetary Electromagnetic Noise Environment and seismo-electromagnetic fields	C. Price (Israel), Y. Hobara (Japan), and K. Hattori (Japan)
E2	Intentional Electromagnetic Interference	M. Bäckström (Sweden), and W. Radasky (U.S.A)
E3	High-Power Electromagnetics	F. Sabath (Germany), and R.L. Gardner (U.S.A)
E4	Lightning Discharges and Related Phenomena	V. A. Rakov (USA) and S. Yoshida (Japan)
E5	Interaction with, and Protection of, Complex Electronic Systems	F. Gronwald (Germany), J-P. Parmantier (France)
E6	Spectrum Management	J. P. Borrego (Portugal), T. Tjelta (Norway) and R. Struzak (Poland)
E7	Geo-Electromagnetic Disturbances and their Effects on Technological Systems	A. Viljanen (Finland)
E8	Electromagnetic Compatibility in Wired and Wireless Systems	A. Zeddami (France), F. Rachidi (Switzerland)

E1. Terrestrial and Planetary Electromagnetic Noise Environment

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

This WG deals with the study on the characteristics of natural electromagnetic noise taking place not only in the terrestrial, but also in the planetary environment. The most well-known EM noise is the atmospheric radio noise from the lightning discharges (so-called sferics in a wide frequency range from DC to VHF). Some examples of topical subjects on sferics are (1) monitoring of global lightning activity as studied by high frequency noise and Schumann resonance phenomena in the ELF band and (2) ELF transients related with 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 the space. The radio noise environment on other planets is also of interest to this group. We are particularly interested in using natural EM observations in monitoring, detecting and forecasting natural hazards, such as thunderstorms, severe weather, space weather and seismic events.



E2. Intentional Electromagnetic Interference

Co-Chairs: M. Bäckström (Sweden), and W. Radasky (U.S.A)

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 the 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.

Between 2014-2017 (since the last URSI GA) a large number of conferences and important publications have dealt with IEMI, along with other aspects of HPEM:

The URSI General Assembly was held in Beijing, China from 16-23 August 2014. Commission E held two sessions covering HPEM and IEMI with a total of 11 papers. In addition there were several sessions on lightning and other EMC topics.

EMC Europe 2014 was held in Gothenburg, Sweden from 1-4 September 2014. The conference had around 520 participants and 250 papers. One tutorial was held on “The threat from HPM and HEMP”. There was one “Special session on Intentional EMI” (10 papers). Another session was held on “High Power Electromagnetics” (4 papers), and a separate session held on “Intentional EMI” (4 papers).

In September 2014 the IEEE Spectrum published an article dealing with the effects of IEMI on data networks. It is entitled, “Fear of Frying: Electromagnetic weapons threaten our data networks. Here’s how to stop them.”

Cigré Study Committee C4 published an article dealing with the threat of IEMI on the power grid. Its title is, “Protection of High Voltage Power Network Control Electronics Against Intentional Electromagnetic Interference (IEMI), Technical Brochure 600, November 2014.

The International Electrotechnical Commission (IEC) published a new standard dealing with the methods of testing equipment and systems to IEMI. It is IEC 61000-4-36, “IEMI immunity test methods for equipment and systems,” November 2014.

On 20 January 2015, the IEEE published a new standard IEEE Standard 1642 entitled, “IEEE Recommended Practice for Protecting Publicly Accessible Computer Systems from Intentional Electromagnetic Interference (IEMI).”

The first URSI Atlantic Radio Science Conference (URSI AT-RASC) was held in Gran Canaria from 18-22 May 2015. Dr. Dave Giri attended the conference and organized a session on high-power electromagnetics (HPEM).

EMC Europe 2015 and the IEEE EMC Symposium were jointly held in Dresden, Germany from 16-22 August 2015. The conference had 746 participants and 286 papers. One session was entitled “Intentional Electromagnetic Interference (IEMI) Protection of Critical Infrastructures” (8 papers). Another session was held on “IEMI



Pulsers and Effects Evaluation” (5 papers). Another session dealt with “HPEM Testing and Analysis” (4 papers). Also a workshop was held on “IEMI Effects on Critical Infrastructures - The European Project STRUCTURES” (7 presentations). Finally a tutorial covering the progress in HPEM standardization was also presented. In total 28 papers on Intentional EMI were discussed.

ASIAEM 2015 Symposium was held in Jeju, South Korea, 2-7 August 2015. This symposium is dedicated entirely to HPEM topics and had 164 participants and 180 papers. There were a significant number of papers (around 15) dealing with IEMI.

ICEAA 2015 was held in Torino, Italy from 7-11 September 2015, and there was a special session held on EM Shielding organized by Prof. Celozzi. Several papers dealing with the use of shielding to protect electronics from HPEM in general and IEMI in specific were presented.

The next conference to be mentioned was the Asia-Pacific Conference on Environmental Electromagnetics (CEEM) from 4-7 November 2015 in Hangzhou, China. Two keynote talks by Drs. Radasky and Giri emphasized HPEM/IEMI aspects, and there were several papers dealing with the subject during the conference itself.

Another conference of interest was the Asia-Pacific EMC (APEMC) Conference held in Shenzhen, China from 18-21 May 2016. This has become one of the largest EMC Conferences in the world with nearly 500 papers submitted. There was a special session organized on IEMI, and there were many submitted papers dealing with HPEM presented during the conference.

EUROEM 2016 Symposium was held in London, UK from 11-16 July 2016. This symposium is dedicated entirely to HPEM topics and had 214 participants and 125 papers. There were a significant number of papers dealing with IEMI.

IEEE EMC Symposium in Ottawa, Canada from 25-29 July 2016. There was a contributed session of 7 papers that included the topic of IEMI.

In the remainder of 2017 we expect papers dealing with IEMI to be presented at ASIAEM 2017 in Bangalore from 24-27 July 2017, the IEEE EMC Symposium in National Harbor, Maryland from 7-11 August 2017, and at the URSI General Assembly in Montreal from 19-26 August 2017.

E3. High Power Electromagnetics

Co-Chairs: F. Sabath (Germany), and R.L. Gardner (U.S.A)

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 meso-band 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.

E4. Lightning Discharges and Related Phenomena

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

The lightning discharge is one of the two natural sources of electromagnetic interference (EMI), the other one being the 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.

E5. Interaction with, and Protection of, Complex Electronic Systems

Co-Chairs: F. Gronwald (Germany), J-P. Parmantier (France)

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.

E6. Spectrum Management

Chair: J.P. Borrego (Portugal), Co-Chairs: 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 wireless communications service and radio sciences. The goal is to assure further development of radio sciences 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 co-existence 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.



E7. Geo-Electromagnetic Disturbances and their Effects on Technological Systems

Chair: A. Viljanen (Finland)

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 operating frequency of products and higher frequency sources of disturbances (such as Ultra-Wide Band systems) 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. Within the framework of this WG, we have regularly organized special sessions at URSI GASS This session focusing on theoretical and experimental EMC aspects in both wire and wireless communication systems. Potential remedies are also addressed.

1. Commission E: Joint Working groups

Inter-Commission working group on Solar Power Satellites

Chair: H. Matsumoto (Japan)

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

EGH. Seismo Electromagnetics (Lithosphere-Atmosphere-Ionosphere Coupling) Co-Chair for Commission E: M. Hayakawa (Japan)

EBK. Chaos and Complexity in EM

Co-Chairs: G. Gradoni (UK), A. Shivola (Finland), J. Wiart (France)

Note: Includes E9. Stochastic Techniques in EMC

Co-Chairs: L. Arnaut (UK), S. Pignari (Italy) and R. Serra (Netherlands)

Wave complexity underpinned by fully developed, partial and transient chaos is becoming permanent in multi-component electromagnetic systems operating at electrically large scales. Statistical methods have been developed to tackle those systems and their specific engineering structures occurring in electromagnetic compatibility, electronics circuits as complex sources of radiated emissions, wireless communications including massive MIMO systems, etc. Recent studies in wave chaos have attracted researchers in electromagnetic theory and universal statistical



properties have been used to study large electromagnetic systems without solving the full-wave problem. Hybrid methods combining full wave algorithms with newborn statistical methods are emerging in the EM wave modeling arena. System specific component need detailed treatment while deformed and irregular parts of EM environments can be treated statistically because of their mixing behaviour. Furthermore, statistical sources can be treated through semi-classical as well as random matrix theories. Novel theoretical models have been developed describing fields through complicated electromagnetic environments - including electromagnetic reverberation chambers - also accounting for coupling through apertures and including losses at both microwave and mmWave regimes, as well as complex placement of wires and cables within EM environments. Uncertainties arising within cabling and radiating systems can be described through the polynomial chaos method. Those topics have been the subjects of intense discussions stimulated by the Special Sessions organised at the URSI AT-RASC 2015 (Gran Canaria, Spain), at the URSI METS 2016 (Finland) and at the URSI GASS 2017 (Montreal Canada). A list of Special Sessions is reported here: "Wave Chaos and Complexity" (G. Gradoni – Nottingham UK, G. Tanner - Nottingham UK, A. Shivola - Aalto Finland, S. Anlage – Maryland USA) in cooperation with Commission E, "Stochastic Methods in EMC" (S. Pignari – Milano Italy, LR Arnaut – QMUL UK), "New Concepts in Wireless Communications" (G. Gradoni – Nottingham UK) where characterization of fading for multi-scale wireless systems is addressed with new energy-based approaches, and "Uncertainty Management and Stochastic Methods in Experimental and Numerical Electromagnetism, Environmental Exposure Assessment and Dosimetry" (G. Gradoni – Nottingham UK, Joe Wiart – Paristech France) in cooperation with Commission K. The organization of those sessions is kept more or less consistent at each major URSI event.

III. Commission E Related National Activities

During the triennial period a large number of events linked to Commission E took place in many cases directly sponsored by URSI. Listed below is a selection of national activities to show the breadth of Commission E-based events:

Canada:

Prepared by: Prof. Lot Shafai

ANTEM 2016 was organized jointly with other Commissions, and IEEE Waves Chapter. It was held in Montreal, on July 10-13, 2016, in Hotel Intercontinental.



Number of registrants was 144, 68 students and 76 full registrants. Three best paper awards were given to the students.

Czech Republic

Prepared by: Marek Svoboda, Ph.D., Head of Laboratory, CMI - Testcom Praha,

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The commission organizes biennial seminary called EMC 2015, EMC 2017 (autumn 2017) .

Last seminary EMC 2015 included following topics:

- Introducing the laboratory of Czech Metrology Institute
- Alternative methods of radiated EMI measurement (e.g. use of BCI clamp) and radiated EMS testing and their uncertainties compared to standard methods. Presented results were part of EMRP Project IND 60.
- Presentation of invited speaker from Rohde – Schwarz.
- Development in certification, preparation of the new RED Directive.

Annual lectures for university students (students from Czech Technical University and University of Pardubice) anechoic hall in the Czech Metrology Institute with topics :

- Anechoic chambers, their parameters, necessary equipment
- Antennas in EMC, types, advantages and disadvantages
- Uncertainties in EMC
- Software used in EMC measurement

Finland

Commission E is present in Finland, contributing to the active Finnish member committee with national networks and contributions to the national URSI Radio Days, and also giving input to the URSI flagship conferences (GASS, AT-RASC, AP-RASC), etc.

France

Prepared by: Virginie Deniau, Chaouki Ksmi, Sébastien Lalléchère

French Commission E is composed of 70 members, 37 of whom have made Com. E as a first choice (33 as a second or third choice). By essence, commission E is



interacting with all the others commissions, however with deeper interactions regarding Commission B (EM waves, fields, theory and applications).

During the past triennium, the activities of the commission E have been presented in 2014 and 2016, at the occasion of the 17th and 18th international symposiums on EMC which took place in Clermont-Ferrand (2014 June 30-july 3) and Rennes (2016 July 11-july 13).

For both symposiums, about 100 communications were presented during three sessions in parallel. In 2014, the organization committee of this symposium tried to increase the international participation in inviting the professor Christos Christopoulos to give an invited conference on the “challenges for experimenters and modelers in EMC analysis and design”. In 2016, a workshop was also organized during the symposium to identify new issues in EMC due to the evolution of the challenges for industrial partners.

The French Commission E also supported different conferences and workshop organized in France : UMEMA 2015 Clermont-Ferrand (around 50 attendants, EMC topics), UMEMA 2016, CEM 2014 (Clermont-Ferrand), CEM 2016 Rennes, General Assembly CNRS “GDR Ondes” (Lyon 2015)

French members of commission E were active during the last 3 years in different conferences:

- URSI GASS 2014 (with 1 french Young Scientist Chaouki Kasmi who was candidate for ECR)
- URSI AT-RASC 2015
- Int. Symp. on EMC (2014, 2016), EMC Europe (2014, 2016), Joint Int. Symp. on EMC and EMC Europe (2015 Dresden)
- ICEAA (2015, 2016)
- URSI APEMC (2016)
- EuroEM 2016 London, ASIAEM 2017 (Statistical methods in HPEM), AMEREM 2014
- EuCAP (2015, Organization of a special session « Deterministic & Stochastic Coupling Analysis for Antennas, Near-Field & EMC Applications”), (2017, Attendance to convened session « Advanced Statistical Methods and Tools in Applied Electromagnetism)”
- URSI GASS 2017, sessions and courses including French conveners:
 - o Com. EFGHJ : One-Day Workshop on RFI Mitigation and characterization (Virginie)



- Com. E : Short course on IEMI and Cyber threats for wireless communications (Virginie + Chaouki)
- Com E. : Time reversal in electromagnetics (Monsef, Derosny), Measurement techniques (Serra, Lemoine), EMC of Power Electronics (Lo, Kasmi), EMC in complex systems (Degauque, Silva),
- French Young Scientist Award (Grecia Romero)

Germany:

Prepared by: Frank Gronwald

The German URSI Commission E comprises about 15 active members. These are embedded in the German URSI community which annually meets for the traditional so-called “Kleinheubacher Tagung”, a meeting which has a long tradition and its roots in the 1960s. During this national meeting, the scientific sessions of Commission E are well-received and attract members of other Commissions as well, therefore strengthening the scope of URSI as an institution with a broad view on Radio Science as a whole.

Most of the German URSI Commission E members are active in the IEEE as well. The URSI Commission E member Frank Sabath, for example, is the current president of the IEEE EMC Society. German URSI Commission E members take actively part in the various EMC conferences, as listed above by the French URSI Commission E. Currently, the German URSI Commission E, in particular, is strengthening its links to its French and Austrian counterparts by mutually visiting their national URSI meetings.

India

Report on RFI mitigation work done at GMRT centre in India.

Prepared by: Kaushal D. Buch, Swapnil Nalawade, Kishor Naik, Shruti Bhatporia, Yashwant Gupta, Ajithkumar B., Proceedings of the URSI-RCRS2017 conference, March 1-4, 2017, Tirupati, India.

Radio telescopes are wide-band radio receivers having almost 50 dB higher sensitivity than their terrestrial-communication counterparts. This increases their susceptibility towards man-made RFI which impairs the detection of weak radio sources and transient events. In the recent years, the overall levels of RFI have increased due to growing industrialization and extensive proliferation of communication devices. RFI adversely affects the signal-to-noise ratio (SNR) of a radio telescope receiver and is a major concern for the contemporary radio telescopes. This degradation in SNR can be



controlled by using RFI mitigation techniques. The GMRT(Giant Metrewave Radio Telescope) group in India has worked on a real-time technique for improving the SNR through RFI excision in the digital signal processing backend of a telescope receiver. (Buch et al., Proc. RCRS2017).

Real-time RFI mitigation techniques operate at a higher time-resolution resulting in lower loss of astronomical data and better improvement in SNR. Hence, these are implemented in real-time in the GMRT receiver. Median Absolute Deviation (MAD) method is used as a robust statistical estimator for computing signal dispersion. The threshold for excision is calculated using this robust signal dispersion. The samples outside the threshold are replaced by a fixed value or noise. This technique is implemented in time and frequency domain to excise broadband and narrowband RFI respectively.

Controlled test experiments are carried out by emulating RFI signal. A programmable analog instrument has been designed and developed at the GMRT to generate RFI with desired properties. This is used for subjecting the RFI filtering system to different types of RFI. Techniques have been developed for analyzing large volume of data and to understand the effects of RFI filtering.

The improvement in the SNR is calculated as the ratio of the signal after and before undergoing excision. Real-time RFI excision at various locations in the signal processing chain has shown improvement in the SNR up to 12 dB in temporal and spectral domains. The effect of real-time RFI excision on cross correlation and power spectrum of the signal is being studied. The technique can be used for other radio telescopes, passive microwave radiometers and communication receivers.) (Buch et al., Proc. RCRS2017).

Italy:

Prepared by: Carlo Carobbi (carlo.carobbi@unifi.it) and Sergio Pignari (sergio.pignari@polimi.it)

The 3rd edition of the IEEE International Workshop on “Metrology for Aerospace” (MAS 2016), held in Florence (Italy) from the 21st to the 23rd of June 2016, hosted the special session “URSI in Italy”. The special session was organized by Carlo Carobbi (vice-chair of Commission E in Italy and URSI representative at MAS 2016) and attended by some twenty researchers working in universities and research institutes. Three presentations were given after that the session chair, Roberto Sorrentino, President of the URSI Italian Member Committee, introduced URSI activity in Italy. The first presentation was a contribution from Commission J: “The clock-like nature of the radio pulsars”, from Andrea Possenti (INAF, Osservatorio Astronomico di Cagliari, Italy). The second presentation was a contribution from Commission F: “Use



of millimeter and optical wavelengths for next generation aerospace communication systems”, from Carlo Capsoni (Dipartimento di Elettronica, Informazione e Bioingegneria, Politecnico di Milano, Italy). The third and last presentation was the contribution from Commission E: “Proficiency testing in EMC”, from Carlo Carobbi (Dipartimento di Ingegneria dell’Informazione, Università degli Studi di Firenze, Italy). The abstract of the Commission E presentation is as follows:

“Achieving electromagnetic compatibility (EMC) for modern electrical and electronic equipment is not an easy task. This is mainly due the increasing need for efficient power conversion (high frequency switching power supply), connectivity (ubiquitous radiofrequency communication modules) and fast processing of relatively large amount of data (high speed digital circuits) within the same equipment. EMC is an even more critical issue in military, avionic and space applications where electrical and electronic equipment is subject to high power and broadband interference, must operate in close proximity and share the same ground and power supply. Further, in these contexts, consideration of the safety and economic consequences of a possible failure due to electromagnetic interference during a military or space mission or a regular flight is mandatory. Due to these reasons, not only EMC compliant design but also EMC testing require a high degree of specialization and competence, especially in high-frequency measurement techniques.”

More details about MAS 2016 and the special session “URSI in Italy” during MAS 2016 are reported in the December 2016 issue of the Radio Science Bulletin (No. 359, pp. 64-65).

Japan:

Japanese Committee for URSI, Activity Report for 2014-2017

Domestic academic activities:

The Technical Committee on Electromagnetic Compatibility (EMCJ) of the Institute of Electronics, Information and Communication Engineers (IEICE) had three regular technical meetings in September, October, and November 2014 where 39 regular reports and five special talks were presented. The September meeting was co-sponsored by the Technical Committee on Electronics Simulation Technology (EST), with the featuring technical topics “Biomedical EMC, Electromagnetic Analysis, EMC”. The October meeting was co-sponsored by Technical Committee on Microwave Engineering (MW), (EST), and the Technical Committee on EMC of the Institute of Electrical Engineers of Japan (IEEJ-EMC) with the featuring technical topics “Microwave, Electromagnetic Analysis, EMC”. The November meeting was co-sponsored by the Technical Committee on Photonics-applied Electromagnetic Measurement (PEM) with the featuring technical topics “Photonics-applied Electromagnetic Measurement, EMC”



<http://www.ieice.org/ken/program/index.php?instsoc=IEICE-B&tgid=IEICE-EMCJ>.

The Technical Committee on Electromagnetic Compatibility (EMCJ) of the Institute of Electronics, Information and Communication Engineers (IEICE) had three regular technical meetings in December 2014, January and March 2015 where 49 regular reports and three special talks were presented. The December meeting was co-sponsored by the Technical Committee on EMC of the Institute of Electrical Engineers of Japan (IEEEJ-EMC) with the featuring technical topics “Power electronics, EMC”, where nine reports were from EMCJ and five presentations were from IEEEJ-EMC. The January meeting was held in two days and co-sponsored by the Technical Committee on Wireless Power Transfer (WPT). The featuring technical topics were “Communication, Wireless Power Transmission, and EMC” and nine regular reports and a special talk were organized by WPT with 18 reports from EMCJ. In the March meeting eight regular reports and one special talk were presented.

<http://www.ieice.org/ken/program/index.php?instsoc=IEICE-B&tgid=IEICE-EMCJ>.

In conjunction with progress of power electronics devices and their application to automotive application such as electric vehicles (EV) and EV charging systems including WPT, it is essential to control electromagnetic disturbances generated by these systems to maintain electromagnetic environment and proper functionality of electronic systems. Applications of power electronics to commercial power supply sources such as grid connected power converters (GCPCs) applied to solar-photovoltaic (PV) power generating systems also generate EMC problems. Collaboration between power electronics engineers and EMC engineers is strongly expected. Domestic Conferences on EMC and Electromagnetic Characterization took place in March and April 2015.

Netherlands:

General activities:

- Three annual joint conferences with NERG (Dutch Institute of Electronic and Radio Engineers)
- A yearly joint symposium with the Belgian national URSI committee and Luxembourg URSI committee.
- Several PhD research programs on EMC topics.
- Currently organizing the International Symposium on EMC, to be held in Amsterdam in 2018.

Particular activities:



- November 4th 2014. EMC-ESD in practice at the Amsterdam University of Applied Sciences. A one day symposium which is bi-annually organized, attendees approx. 150.
- Nov. 17th 2014 EMC knowledge market @ Eindhoven technical university.
- Nov. 26th 2014 ESD how to test clothing.
- Nov. 28th 2014 Market surveillance in the Netherlands
- April 23rd 2015 meeting @ imtech marine Rotterdam
- May 20th 2015 ESD How we should do measurements
- May 27th 2015 EMC Knowledge market @ Technical university Delft
- June 18th 2015 meeting @ BritNed (UK <-> NL) (380 kV ac to ± 450 kV DC station
1000 MW transport capacity)
- 27 November 2015: workshop ESD on ionization, FHI Leusden
- 2-3 December 2015: PCB Design and Layout Techniques for Cost-Effective SI, PI and EMC, Ostend
- 27 april 2016, Seminar Modeling and Simulation of Electromagnetic Compatibility Problems, Ostend, with 2 distinguished lecturers.
- 26 May 2016: ESD Seminar on ATEX, FHI, Leusden
- 3 June 2016: EMRP EMC project workshop, Delft
- 7 June 2016: EMC on Tour, University of Twente
- 22 June 2016: Meeting and tour, Space Expo, Noordwijk

Portugal:

In the last triennium (2014-17), the Portuguese Commission E has collaborated with the National Committee organising the URSI Annual Congress. During these events, significant scientific contributions, on the topics addressed by the Commission E, have been received, such as invited talks, papers or posters. The national congresses also intend to stimulate a close relationship between industry, academia and society, by promoting scientific exhibitions to show new projects, demonstrators, and industrial and commercial products, most of them related with the Commission E activities.

- **2014:** 8th Congress of the Portuguese Committee of URSI, devoted to the theme: “Drones and autonomous vehicles: present and future challenges”,
Programme:
<https://www.anacom.pt/render.jsp?contentId=1290312&languageId=1>



- **2015:** 9th Congress of the Portuguese Committee of URSI, theme: “5G and the Internet of the future”, Programme:
<https://www.anacom.pt/render.jsp?contentId=1363345&languageId=1>
- **2016:** 10th Congress of the Portuguese Committee of URSI, theme: “Communications in safety and emergency scenarios”, Programme:
<https://www.anacom.pt/render.jsp?contentId=1392453&languageId=1>

South Africa:

Chairperson – Dr P. Gideon Wiid – wiidg@sun.ac.za
Alternate Chair – Prof Ivan Hofsjajer - Ivan.Hofsajjer@wits.ac.za

The South African Commission E research and activities are closely linked to the South African IEEE combined Chapter on Antennas and Propagation, Microwave Theory & Techniques and Electromagnetic Compatibility. The biannual chapter conference was held in July 2016 in Stellenbosch with 135 attendees, 26 invited talks, 2 international presentations and 8 exhibitors.

The Inaugural Symposium on Earthing, EMC and Lightning Protection was held in June 2017 in Johannesburg and initiated by Terratech consulting company. Both the IEEE RADIO 2017 and IEEE Africon 2017 will be held in Cape Town during September.

The major research institutions have strong ties to the South African Square Kilometre Array, the national power utility Eskom, and the national space agency SANSA. Research is focused on interference modelling, measurement, characterisation and mitigation; power line interference and lightning protection of large photovoltaic plants; and space weather influences on power systems.

The South African SKA actively works on interference characterisation measurements with consulting companies ITC and MESA Solutions. A locally developed real-time transient analyser with 700 MHz bandwidth has successfully been used for various time-domain measurements. A recent measurement campaign included 800 km of GPS-logging drive-by propagation verification measurements on Digital Terrestrial Television signals to the SKA site, together with South African broadcasting signal distributor SENTECH.

Switzerland:

Recent activities of the Commission E (in cooperation with Commission C) in Switzerland include the design, test and installation of a lightning current



measurement system at the Säntis telecommunication tower in the Appenzell region of Switzerland. The site is operational since June 2010 and more than 400 flashes are successfully measured. The obtained data constitute the largest dataset available to this date for upward negative flashes.

At the 2015 URSI Atlantic Radio Science Conference organized in Gran Canaria, Farhad Rachidi (President of the Swiss National Committee and Chair of URSI Commission E) and Marcos Rubinstein (Chair of Commission C in Switzerland) organized a special session “Time reversal in electromagnetic environments: theory and applications” in which 6 papers involving researchers from France, Italy, Switzerland and then USA were presented.

At upcoming the URSI GASS in Montreal, Farhad Rachidi with Jacob Gavan, Moti Haridim and Frank Gronwald will organize a special session in relation to URSI WG E8 entitled “Electromagnetic Compatibility in Wired and Wireless Systems”.

United Kingdom:

Prepared on Jan 18, 2017, by Martin Fullekrug

The main aim of the URSI commission E is to join the scattered activities in the area of atmospheric electricity in the UK. This field of work is traditionally covered by the Institute of Physics, the Royal Meteorological Society and URSI commission E. The role of the commission E is to assist with the organisation of the ‘CTR Wilson Meetings on Atmospheric Electricity’ which are held on an annual basis at the University of Bath. The meetings are typically attended by ~30-40 representatives from a wide range of institutions in the UK. These meetings bring together experts that are working in the general area of atmospheric electricity and its applications in industry. For example, topics range from cosmic rays, cluster ions, charged aerosols and current flow in fair weather conditions, to disturbed weather electrification, rain electricity, thunderstorm electrification, lightning, corona discharges, transient luminous events and extend even to space weather and the impact of atmospheric electricity on the living world. The programme of the most recent Wilson meeting can be found in the attachment and it gives a good overview of the wide range of topics presented. In addition, it was decided to start a community website that promotes the full breadth of atmospheric electricity activities in the UK. The URSI commission E was heavily involved in the design and implementation of the website that was finally published at <http://www.ctrwiae.org/>. The website is effectively creating some kind of virtual institute that draws attention to the science of atmospheric electricity and the associated technology and innovation. The website also provides an overview of the numerous atmospheric electricity meetings that are organised throughout the year, includes job adverts, a scientific publications ticker that is updated every week, a twitter feed to promote public outreach, and hosts some information on the historical background of atmospheric electricity. It is planned to expand the website as the activities in the area of atmospheric electricity grow over time, in particular in



association with the three space missions that are planned to be launched in the coming years.

United States of America:

Prepared by: Charles Baylis, Ph.D.

Over the past triennium, the USNC-URSI Commission E has continued to encourage technical contributions in all areas of electromagnetic compatibility and interference. A particular thrust over this triennium has been to address issues with sharing the wireless spectrum. A special session on Spectrum Issues has been organized for both U.S. National Radio Science meetings that occurred during this triennium, and the organization of these sessions has provided a basis for collaborative, constructive discussions in the United States toward answering challenges in the shortage of the wireless spectrum. Commission E also sponsored a plenary talk on spectrum issues at the 2017 URSI National Radio Science Meeting in Boulder. As a result of this activity, the awareness of spectrum issues, challenges, and potential solutions has been raised within the United States. This thrust carries forward on an international level, as two sessions on spectrum issues have been separately organized for the URSI GASS 2017 in Montreal.

IV. Meetings

A large number of meetings took place in the review period as outlined in section III. In addition, Commission E sponsored a number of international meetings

V. Reviews of Radio Science

In the September 2015 issue of the Radio Science Bulletin, Commission E members Ryszard Struzak, Terje Tjelta, and José Borrego contributed the paper “On Radio-Frequency Spectrum Management”. It provides a comprehensive review of the concept of spectrum management, starting from its historical roots and explaining the evolution of global and regional spectrum management. Current trends in spectrum management are discussed as well. The article is written in a clear way and of interest to all Commission members.

VI. Website

Further information about Commission E may be found in the web links below:

<http://www.ursi.org/en/commission.asp?com=E>
<http://ursi-test.intec.ugent.be/files/E/Homepage.htm>