

EMC Europe 2014

International Symposium on Electromagnetic Compatibility September 1–4, 2014, Gothenburg, Sweden



CONFERENCE PROGRAMME

www.emceurope2014.org

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LADIES AND GENTLEMEN, DEAR PARTICIPANTS,

It is a great honour and pleasure for me to welcome you all to Gothenburg and EMC Europe 2014. I hope you will have a fruitful and successful conference and will enjoy your stay in our great city. The city is young compared to previous venues like Brugge, Rome and York since the city got its town privileges as late as 1621, but I'm sure you will enjoy it anyway.

Although EMC Europe 2014 is hosted in Gothenburg, it is a joint event organised by SP Technical Research Institute of Sweden in Borås located about 60 km east of Gothenburg who have been responsible for the technical program, and Just Event AB who have organised the exhibition and taken care of many practical details.

Gothenburg's location in the heart of a region that has the highest population density and strongest industry in Sweden makes the city an ideal choice for exhibitions, conferences and other events. Gothenburg has so many factors that make it an enjoyable place to be. The city is big enough and small enough at the same time. Swedes have voted Gothenburg as the friendliest city in Sweden, and a growing number of international visitors fully agree with them. Gothenburg offers a massive choice of first-class restaurants, cosy pubs, bargain shopping, theatres, museums and events to suit all tastes. The relaxing and friendly atmosphere is just part of the deal. Likewise the fact that all the best entertainment in central Gothenburg is within easy walking distance of the Swedish Exhibition & Congress Centre, the venue of EMC Europe 2014.

During the conference, we look forward to the three keynote speeches given by Karl-Gunnar Lövstrand, Sweden, Marco Klingler, France and Christopher Holloway, United States of America. It is a great honour to have such distinguished and respected colleagues to speak to us. Thank you to all authors, organisers of special sessions, workshops and tutorials who have contributed to our conference including those whose papers we are not able to present. Thank you also to those attending the conference who are not presenting. A special thanks goes to our sponsors and exhibitors who have supported us tremendously. As organisers we can only facilitate the conference. It is the participation of all of you, our guests, who make it a success.

A conference is not all about work, you have to enjoy yourself and spend time interacting with your colleagues as well. For that we have organised two social events. The Welcome Reception which is kindly sponsored by the City of Gothenburg will be held in the exhibition area at the conference venue. Our Conference Banquet will be held at Kajskjul 8 which is located close to the Gothenburg Opera House, located by the riverside. We look forward to meeting you at these events.

Personally, I would like to address a special thanks to my colleagues in the local organising committee for all efforts you have put into this. Thank you also to the members of the International Steering Committee and all others who have contributed to the almost 1000 reviews that were done during the peer review process, you are all acknowledged.

Next year EMC Europe conference in Dresden, Germany will be jointly organised with IEEE. Our colleagues there are already hard at work on this event and I wish them all success and I look forward to meeting you there again next year.

Ful-

PROF. JAN CARLSSON

General information/further information

EMC Europe 2014 website: www.emceurope2014.org

EMC Europe 2014 Conference Venue

Svenska Mässan – The Swedish Exhibition and Congress Centre Mässans Gata/Korsvägen SE-412 94 Göteborg, Sweden Phone: +46 31 708 8000 Fax: +46 31 160 330 E-mail for general information: infomaster@ svenskamassan.se Website: www.svenskamassan.se/en

Badges

All delegates will receive a badge and tickets for lunches and included social events. Participants are kindly requested to wear their badges throughout the conference, even at the social events. The replacement of lost or forgotten badge carries a & 25 charge. In order to facilitate the duplication of the badge, please present a copy of your registration confirmation as proof.

Wireless Access

EMC Europe 2014 has got a wireless network. For accessing this free of charge network, please use Network name: EMC2014 Password: EMCEurope

Official Language

All sessions will be held in English only. No translation will be provided.

Lunches, Coffee Breaks, Dining

The lunches are served in Estrad during Monday to Thursday for those who have them included in the registration or who have paid separately for them. The coffee breaks are in the exhibition/conference area.

There are a few dining restaurants in the buildings, such as Incontro near entrance 5. The bistro West Coast is located in the Gothia Towers lobby, entrance 4.

There are several restaurants and cafes in the Swedish Exhibition & Congress Centre and Gothia Towers. If you want to explore Gothenburg by eating, Gothenburg has a vibrant restaurant scene ranging from Michelin-starred gourmet and trendy eateries to classic neighbourhood institutions and street food. Check out www. goteborg.com/en/eat for more information and guides.

Welcome Reception

Venue: Exhibition area Date: Tuesday, September 2 Time: 18:00-20:00

THE CITY OF GOTHENBURG sponsors a

welcome reception on Tuesday September 2 in the Exhibition area in the Convention Center. Use this opportunity to mingle with your colleagues and exhibitors in an informal atmosphere.

Symposium Banquet

Venue: Kajskjul 8, Packhusplatsen 11, Date: Wednesday, September 3 Time: 19:00–23:00

WE HOPE THAT many of you will attend the banquet this year. Whilst we'll be sitting eating, the best paper and student travel grants will be awarded. There will also be some surprises.

The Kajskjul 8 is close to the Gothenburg Opera house, 2.7 km from the Convention Center, about 30 minutes by foot. You can take the tram or the bus to Lilla Bommen or to Brunnsparken. Then it's a short walk down to the Gothenburg Opera House by the water, when you take your left along the quayside towards Kajskjul 8.

Plan your trip with Västtrafik: www.vasttrafik.se/en

Medical Information/In case of an emergency

You may contact "Sjukvårdsupplysningen" 24 hours-a-day, 7 days a week. Here you will find registered nurses who can give you medical advice, answer your questions on self-care and provide you with information as to what to do should your condition require medical treatment. Telephone: 1177

In case of an emergency, use the main national emergency number: 112

Identity papers

Should you require treatment at a public healthcare centre or at a hospital, please remember to bring your identity papers and health insurance documents with you. If you are an EU citizen you should bring your European Insurance Card or Certificate E111. These papers entitle you to emergency medical treatment at the same rates as Swedish residents.

Pharmacy

Nearest pharmacy: Apoteket Korsvägen, Korsvägen 1, (About 100 meters from the conference venue)

Police

To call the Police, use the main national emergency number: 112 Nearest Police Office: Ernst Fontells plats, + 46 77 114 14 00 (About 400 meters from the conference venue)

Taxi

There are several companies to choose from. You can phone for a taxi or hail one on the street. The driver should have a taxi ID card clearly displayed in the vehicle. Service is included in the price.

- Taxi Göteborg: + 46 31 650 000
- Taxi Kurir: + 46 31 27 27 27
- Mini Taxi: + 46 31 140 140
- Taxi 020: +46 20 20 20 20

Getting Around

To travel across Gothenburg is easy and you have several options to choose from. A walk is a great idea in Gothenburg because mostly is in walking distance. But despite the short walking distances in Gothenburg sore knees and tired feet might need some help by public transport from time to time. In Gothenburg it's easy to get around by tram, boat, bus and bicycle.See more and plan your trip with Västtrafik, www.vasttrafik.se/en and read more about travelling in Gothenburg at; www.goteborg.com/en/Travel/

Tourist Centres

Gothenburg Tourist Centres are located on Kungsportsplatsen and in the shopping centre Nordstan. Here you can book accommodation, buy Gothenburg City Card, souvenirs, books, maps and tickets for excursions. The Tourist Centres have details of what's happening in Gothenburg during your visit and offer expert advice on various events. You can also book a sightseeing tour with one of the qualified City guides.

Tourist Information Contact Centre Telephone: +46 31 368 42 00 Fax: +46 31 368 42 38 E-mail: turistinfo@goteborg.com www.goteborg.com/en www.facebook.com/goteborgcom

Map and Cityguide

Cityguide Gothenburg is your perfect guide to the city. You will find information about restaurants, hotels, shopping, activities, sightseeing, events and more. The guide, including a city map, is available for offline use. You can download it from both App Store and Google Play.

Telephone code

The International country calling code of Sweden is +46. Please dial this number before a local Swedish number. Each city in Sweden has its own city code. The city code of Gothenburg is 31. So when you make a call from another country than Sweden to Gothenburg dial 0046 + 31 + the phone number.

Time Zone

The time zone in Sweden is UTC/GMT +2 hour.

Currency

The official Swedish currency is the Swedish Krona (SEK) which is divided into 100 öre. Bank notes are available in denominations of 20, 50, 100, 500 and 1000 Krona, and coins in denominations of 1, 5 and 10 Krona.

The Krona is about nine Krona to a Euro or seven Krona to a Dollar. For an update on exchange rates please look up www.oanda.com.

Banks, Credit and Debit Cards

Banks are usually open from 10:00 to 15:00. Some days banks may stay open until 18:00. All banks are closed on weekends and on public holidays. Banks at airports, ports and main railway stations are generally open longer.

Exchange offices usually have longer opening hours. Exchange service are available from

Forex Bank and X-Change with offices located at the Gothenburg-Landvetter Airport, the Avenue, Kungsportsplatsen and the Central Station.

All major credit cards are accepted in Sweden. ATM's are located at the airports and all over the city including the venue for the EMC conference. Look for "Bankomat" or "Uttag".

Most hotels, shops, restaurants and usually taxis accept VISA and MasterCard. American Express may not be accepted in some cases.

Safety and Insurance

As in all major cities, people should be aware of safety risks. You are advised not to wear your conference badge outside congress activities. It is highly recommended that all participants carry adequate personal travel and health insurance. The organisers do not accept responsibility for individual medical, travel or personal insurance. All participants are strongly advised to take out their own personal insurance before travelling to the Convention.

Post Offices

In general Monday-Friday 8:00–19:00 Saturday 8:00–14:00

Weather

In September, the average daytime temperature is around 10°C (50°F).

Destination Gothenburg

Situated on the beautiful west coast of Sweden, Gothenburg lies right in the heart of Scandinavia. The strategic location between the Swedish, Danish and Norwegian capitals makes it a true gateway. Gothenburg is a world-class meeting and events city, it is easily accessible from around the world, close to the sea with a stunning archipelago and, outstanding restaurants. Gothenburg is characterized by international style, local creativity and a natural, relaxed charm. A wide selection of meeting venues. accommodating efficient friendly service and care are other qualities that make Gothenburg the perfect venue for work and play. Meeting venues, hotels, restaurants and shops are all located within easy walking distance.

Gothenburg is a quite valuable destination with a lot of touristic sites. It is actually rated as the 2nd "Best value destination in 2013" by Lonely Planet, next after Rio de Janeiro.

Gothenburg has a long and successful tradition of trade and industry. Ever since the city was founded in 1621, it has been characterized by trade, shipping and international contacts. Already in 1731, the Swedish East India Company began trading with China and the East.

In the 19th century, the city became industrialized, largely thanks to the arrival of Scottish and English businessmen. Many of them donated fortunes which founded a hospital, library and university. A significant proportion of Sweden's exports and imports pass through the Gothenburg port and cutting-edge industries and worldrenowned brands, such as Volvo, SKF and Hasselblad have their origins and head offices here.

Gothenburg today, is a city of industry and expertise, with two universities and many service companies. New city districts are also emerging with offices, university grounds and residential areas.

Shopping

Most shops normally are open between 10:00 and 18:00, and weekends until 14:00. Food stores, department stores and shopping centres are usually open longer. Many grocery stores are open until 21:00 or 22:00. For example, next to the main convention centre, there is ICA Focus that is open between 7:00 and 23:00.

Gothenburg is a lively city for shopping, where delegates can find just about everything within an easy walk from the convention centre. Located in the heart of the city is everything from fashionable boutiques and department stores, to picturesque markets selling crafts, souvenirs and antiquities.

The city offers an exciting mixture of modern warehouses and specialist shops, pedestrian areas, galleries and arcades. NK and Nordstan are the two most well-known indoor shopping malls in the city centre.

Nordstan, has 150 specialist shops and warehouses under one roof. Visitors also often find arts and crafts exhibitions, fashion shows and other activities. Immediately outside Nordstan is the start of a three kilometer-long shopping area with the pedestrian precincts of Fredsgatan, Kungsgatan and Korsgatan, several shopping galleries and arcades. Here, inside Vallgraven (the old moat), is the greatest concentration of shops in Gothenburg. Along Vallgatan and Magasinsgatan are several design, furniture and arts and crafts shops as well as restaurants and cafés. Kungstorget has a lively market square where delegates find Saluhallen. It was opened in 1889 and, with its architecture and variety of shellfish, fruit, vegetables, cheese and cooked meats, is a real experience.

For all permanent non-EU residents there is a VAT refund available on all purchases made in Sweden.

Local Organising Committee





Christer Karlsson



Peter Stenumgaard



Dan Wallander



Jenny Eriksson



Jan Welinder



Yngve Hamnerius



Mats Bäckström



Rajeev Thottappillil

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Keynote Speakers



Karl Gunnar Lövstrand

KARL GUNNAR LÖVSTRAND was born at Västerlövsta, Sweden in 1946. He passed his M.Sc. exam at the University of Uppsala in 1969.

In 1973 he received his PhD degree in Electricity at the High Voltage Research Institute, University of Uppsala.

His research work concerned Static Electricity, Lightning Protection and Bio-effects of EM fields. In 1974 he was elected member of the Swedish National Committee of Radio Science, section E.

He was Docent of Electricity at the High Voltage Research Institute 1974-1981. He joined SAAB Military Aircraft Co in 1981. There he was responsible for the overall EMC program of the JAS Gripen fighter aircraft.

In 1985 he moved to the Defence Materiel Administration Testing Directorate, where he was responsible for the foundation of the NEMP test centre.

He was co-founder of the Swedish chapter of IEEE-EMC. In 1992 he was elected senior member of IEEE-EMC and was appointed Strategic Specialist of EM Effects for the Defence Materiel Administration.

During 1989–2000 he was responsible for the HPM-protection R&D of the Swedish Defence.

In 2000 he was employed by FMV Joint Materiel Command for the position of FMV Chief Scientist and co-ordinator of the Swedish R&D activities within the West European Armaments Group and was from 2005–2011 Swedish delegate to the European Defence Agency T&E committee.

In 2003 he moved to Linköping to become Technical Director at the FMV Testing Directorate. He retired in 2011. He is a frequent lecturer and has published many papers on electrostatics, bio-effects, lightning protection, NEMP and HPM.



Marco Klingler

MARCO KLINGLER was born in Zurich, Switzerland, in 1963. He received his Engineer's degree in computer science from HEI, Lille (France) in 1989, his DEA (M.S.) degree in automatics / robotics and his Ph.D. in electronics in 1989 and 1992 respectively, both from the University of Lille.

He then joined the French National Institute for Transport and Safety Research (INRETS) in Villeneuve d'Ascq (France) as a researcher where he was in charge of the R&D activities in EMC of ground transportation systems.

His main interests were electromagnetic interferences on PCBs, behavior of electronic components in electromagnetic environments, coupling to wire structures, test methods, and test facilities. In 2002, he joined PSA Peugeot Citroen in Velizy-Villacoublay (France) in the Development Division where he was successively in charge of the EMC design activities, the EMC/antenna simulation activities, and finally the EMC full vehicle validation activities.

In 2011, he moved to the Research Division where he is currently an EMC Expert and responsible of the EMC/antenna research activities.

His main interests include EMC modeling and simulation of automotive electric powertrains, multiconductor transmission lines, new materials, and specific vehicle antennas.



Christopher L. Holloway

CHRISTOPHER L. HOLLOWAY is a Fellow of the IEEE and received the B.S. degree from the University of Tennessee at Chattanooga, and the M.S. and Ph.D. degrees from the University of Colorado at Boulder, both in electrical engineering.

During 1992 he was a Research Scientist with Electro Magnetic Applications, Inc., in Lakewood, Co. From the fall of 1992 to 1994 he was with the National Center for Atmospheric Research (NCAR) in Boulder, Co. While at NCAR his duties included wave propagation modeling, signal processing studies, and radar systems design.

From 1994 to 2000 he was with the Institute for Telecommunication Sciences (ITS) at the U.S. Department of Commerce in Boulder, Co., where he was involved in wave propagation studies.

Since 2000 he has been with the National Institute of Standards and Technology (NIST), Boulder, CO, where he works on electromagnetic theory. He is also on the Graduate Faculty at the University of Colorado at Boulder.

Dr. Holloway received the 2013 IEEE APS Society Edward E. Altshuler Award, 2008 IEEE EMC Society Richard R. Stodart Award, the 2006 Department of Commerce Bronze Medal for his work on radio wave propagation, the 1999 Department of Commerce Silver Medal for his work in electromagnetic theory, and the 1998 Department of Commerce Bronze Medal for his work on printed circuit boards.

Dr. Holloway is currently serving as chair for US Commission A of the International Union of Radio Science and is an Associate Editor for the IEEE Transactions on Electromagnetic Compatibility.

He has published over 200 technical articles including: 92 refereed journal articles, 105 conference papers, 77 conference presentations without publications, 2 book chapters, and 35 technical reports.

Dr. Holloway's research interests include electromagnetic field theory, wave propagation, guided wave structures, remote sensing, numerical methods, metamaterials, measurement techniques, EMC/EMI issues, and atom based metrology.



Electronic devices must function effectively in their electromagnetic environment without having a negative impact on their surroundings.

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				Room F1	Room F2	Room F3	Room F4	Room F5
		09:00-10:40	WS/Tutorial	Tutorial 1A The Threat from HPM and HEMP	Workshop 1A Electromagnetic Reliability (EMR) of Electronic Systems for Electro Mobility	Workshop 2A Automotive EMC	Workshop 3A Modeling using MoM	Tutorial 3A Practical EMC Engineering
		10:40-11:10	Coffee break					
		11:10-12:50	WS/Tutorial	Tutorial 1B The Threat from HPM and HEMP	Workshop 1B Electromagnetic Reliability (EMR) of Electronic Systems for Electro Mobility	Workshop 2B Automotive EMC	Workshop 3B Modeling using MoM	Tutorial 3B Practical EMC Engineering
ay		12:50-14:00	Lunch					
Mond		14:00-15:40	WS/Tutorial	Special Session 1A Intentional EMI	Workshop 1C Electromagnetic Reliability (EMR) of Electronic Systems for Electro Mobility	Workshop 2C Automotive EMC	Tutorial 2A PEEC modeling	Tutorial 4A Board Level Shields
		15:40-16:10	Coffee break					
		16:10-17:50	WS/Tutorial	Special Session 1B Intentional EMI	Workshop 1D Electromagnetic Reliability (EMR) of Electronic Systems for Electro Mobility	Workshop 2D Automotive EMC	Tutorial 2B PEEC modeling	Tutorial 4B Board Level Shields
		18:00-20:00	Meetings	ISC	IEEE EMC Sweden			
		20:00-23.00	ISC dinner					
		09.00-09:40	Opening ceremony					
	20:00	09:40-10.20	Keynote1					K.G. Lövstrand
		10.20-10:50	Coffee break					
Tuesday		10:50-11:30	Keynote 2					M. Klingler
		11:30-12:10	Keynote 3					C. Holloway
	-00	12:10-13:30	Lunch					
);60	12:30-14:30	Poster session 1					
) nibition (14:30-15:50	Oral session	OS 1 Antennas	OS 3 Wireless Power Transfer	OS 5A Near-Field 1	OS 6 High Power Electromagnetics	Special Session 2A Models for System- Level EMC Analysis
	ExI	15:50-16:20	Coffee break					
		16:20-17:40	Oral session	OS2 Standards & Regulations	OS 4 Power electronics	OS 5B Near-Field 1	OS 7 Intentional EMI	Special Session 2B Models for System- Level EMC Analysis
		18:00-20:00	Welcome reception					

				Room F1	Room F2	Room F3	Room F4
Wednesday	Exhibition 09:00–17:00	09:00-10:20	Oral session	OS 8A Numerical EMC 1	OS 10A Human Exposure to EM Fields 1	OS 12A Shielding 1	OS 15A Wired & Wireless Communications 1
		10:20-10:50	Coffee break				
		10:50-12:10	Oral session	OS 8B Numerical EMC 2	OS 10B Human Exposure to EM Fields 2	OS 12B Shielding 2	OS 15B Wired & Wireless Communications 2
		12:10-13:30	Lunch	ISC meeting			
		12:30-14:30	Poster session 2				
		14:30-15:50	Oral session	OS 9A Reverberation Chambers 1	OS 11A Automotive 1	OS 13 Novel Materials	OS 16A Lightning 1
		15:50-16:20	Coffee break				
		16:20-17:40	Oral session	OS 9B Reverberation Chambers 2	OS 11B Automotive 2	OS 14 ESD	OS 16B Lightning 2
		19:00-23.00	Symposium banquet				
		09.00-10:20	Oral session	OS 8C Numerical EMC 3	OS 17A Low Frequency EMC 1	OS 19 Integrated Circuits	OS 21 Aircraft & Space Systems
		10.20-10:50	Coffee break				
sday		10:50-12:10	Oral session	OS 8D Numerical EMC 4	OS 17B Low Frequency EMC 2	OS 20A PCB 1	OS 22A EMC Measurements 1
hur		12:10-13:30	Lunch				
н		12:30-14:30	Poster session 3				
		14:30-15:50	Oral session	OS 9C Reverberation Chambers 3	OS 18A Transmission Lines 1	OS 20B PCB 2	OS 22B EMC Measurements 2
		15:50-16:20	Coffee break				
		16:20-17:40	Oral session	OS 9D Reverberation Chambers 4	OS 18B Transmission Lines 2	OS 20C PCB 3	OS 22C EMC Measurements 3

9:00–12:50 **T 1**

T 1A–1B: The Threat from HPM and HEMP

Session Chair: Mats Gösta Bäckström, Saab Aeronautics, Sweden Location: F1

The threat from High Power Microwave (HPM) weapons and from a High Altitude Electromagnetic Pulse (HEMP) constitute two extreme and severe threats against military systems as well against the society's technical infrastructure.

While HPM weapons are limited in range the footprint of a HEMP might cover a large part of a continent potentially creating huge problems with widespread damage. On the other hand, an HPM weapon can be used repeatedly and, due to its relatively small size, in many cases unnoticed and may easily be coordinated with other kinds of attack . Both HPM and HEMP may cause interference as well as permanent damage to electronic systems.

The tutorial will start with a brief introduction to electromagnetic threats in general whereupon HPM and HEMP will be treated separately.

In each case accounts will be given on general features of the threat, its effects on systems, protection methods and on methodologies for hardness verification.

Finally, special attention will be paid to the threat against critical infrastructures of the civil society.

9:00-17:50 WS 1A-1D: Electromagnetic Reliability of Electronic Systems for Electro Mobility

Session Chair: Werner John, SiL GmbH, Germany Location: F2

Electrically operated vehicles will imply huge design challenges for electric and electronic components. The close vicinity of high field strength from high power cables and electric motors and sensitive high density electronics requires a holistic approach concerning electromagnetic compatibility (EMC), respectively electromagnetic reliability (EMR). To make this more difficult the commonly used shielding effect of the car's metal case will disappear due to lightweight designs, using carbon fibre cabinets for examples.

The introduction of the electric power train establishes voltage and power levels

into the vehicles in terms of suitable EMC/EMR design and related measures; which were previously not dealt with in structured manner. The voltage increases, depending on the concept, by a factor of 10 (20 dB) up to approximately 100 (40 dB). The situation for power is similar. It must be concluded that future EMC/ EMR behavior of communication units (e.g. digital broadcast standard DVB-T) in electrically operated vehicles requires a significant reduction of electromagnetic emission generated by the electric power train components.

The project EM4EM aims to tackle these

EMC/EMR problems and works out their solutions from the perspective of noise immunity (EMR) of nano electronic components (IC – sensors – power devices) and electronic modules required for future developments in automotive and semiconductor industries.

New methodologies to reduce electromagnetic noise emission generated by power electronic components, modules and systems, and to increase vice versa the noise immunity of sensors systems will be developed.

Aspects of Time-To-Market and cost efficiency (lightweight design and appropriate package) will be taken into account as well. Therefore significant design flexibility can be achieved.

Finally the performance of the developed concepts will be presented on the basis of three demonstrators.

In order to validate the EM4EM project results three levels of demonstrators are foreseen (Level 1: low level demonstrator with simple cables and ground planes (Cable Harness + Power Modules + Control Units (IC/Sensors); Level 2: intermediate demonstrator with a real car body and EV subsystems; Level 3: complete demonstrator based on an electric eBuggy (test car).

This approach is unique and will be managed only in close cooperation with all EM4EM partners. The European CATRENE research project EM4EM is supported by the public authorities of Finland, Germany and Czech Republic.

The interdisciplinary collaboration in the EMC area is a key component of this project. The following industry and research partners are part of the EM4EM project: AUDI AG (project lead and coordination together with the EM4EM office)/ Daimler AG/Infineon Technologies AG/ Robert Bosch GmbH/Conti-Temic microelectronic GmbH/NXPSemiconductors Germany GmbH/ZUKEN GmbH/ELMOS Semiconductor AG/Leibniz Universitaet Hannover/Friedrich-Alexander-Universitaet Erlangen-Nuernberg Technische Universitaet Dortmund/University of Praha/ Institut of Microelectronic Applications Ltd. (CZ)/VTT Technical Research Centre (FIN)/Okmetic Oyj (FIN)/Murata Electronics Oy(FIN).

The following three reviewed papers are included in the session:

Measurement-Based Circuit Modeling of Conducted and Radiated Automotive Immunity Test Setups

Seyyed Ali Hassanpour Razavi, Sergey Miropolsky, Stephan Frei TU Dortmund, Germany

Analysis of two different Transmission-Line Holder Systems for Shielding Effectiveness Measurements of Conductive Material Samples Part I: Capacitive Coupled TLH

<u>Michael Kühn</u>¹, Werner John², Robert Weigel³ ¹AUDI AG, Germany ²SiL GmbH, Germany ³ Universität Erlangen-Nürnberg, Germany

Analysis of two different Transmission-Line Holder Systems for Shielding Effectiveness Measurements of Conductive Material Samples Part II: Capacitive and Galvanic Coupled TLH Michael Kühn¹, Werner John², Robert Weigel³ ¹AUDI AG, Germany ²SiL GmbH, Germany ³ Universität Erlangen-Nürnberg, Germany

10:00–17:50 WS 2A–2D: Automotive EMC

Session Chair: Marco Paolo Klingler, <code>Peugeot Citroen Automobiles</code>, <code>France Location: F3</code>

Automotive electric / electronic systems are endlessly growing in complexity with a permanent constraint of a constant or reduced time-to-market. Therefore, there is a strong need to constantly improve the efficiency of the EMC related tasks throughout the entire development process, starting from the design phase until the full-vehicle validation phase.

This workshop intends to present an overview of the most recent industrial advances in the field of automotive EMC design, modeling and simulation as well as in the field of automotive testing and measurements.

The presentations in this workshop will cover EMC issues at system, sub-system, equipment and component levels. In particular, topics addressed by the speakers will include hybrid power-train systems EMC analysis, antenna implementation, equipment design, printed-circuit-board optimization, and electronic component characterization.

10:00–10:15 **Opening and overview** of the workshop

- 10:15–10:40 Hybridization of time domain 3D solution with multitransmission line approach Roman Jobava¹, I.Badzagua¹, G.Chiqovani¹, E. Yavolovskaya¹, R.Bunger² ¹ EMCoS Ltd., Georgia ² Cassidian, Airbus Defense and Space, Germany
- 10:40–11:10 Coffee break
- 11:10–11:35 EM Simulation of RF Emissions from a Suspended Particle Device (SPD) System in Automotive Windscreens Peter Hahne¹. Markus Schick².

² EM Software & Systems GmbH, Germany

- 11:35 –12:00 **Investigating Cosite Interference** Effects on an Automobile Andreas Barchanski CST AG, Germany
- 12:00–12:25 Advanced Techniques for Efficient Automotive EMC/EMI Simulations J. F. Mologni¹, M. Kopp², F. Bocquet³, A. Colin⁴ ¹ ESSS, Brazil ² ANSYS, United States of America, ³ ANSYS, France, ⁴ FIAT, Brazil
- 12:25–12:50 Some examples of ongoing activities in Renault to try to get the best profit from EMC simulation Xavier Bunlon Renault S.A.S., Guyancourt, France

12:50–14:00 Lunch break

14:00–14:25 Evaluation of the EMC performances of a partial composite vehicle body depending on the type of material Ammar Kader^{1,2}, Marco Klingler¹, Tristan Dubois², Geneviève Duchamp² ¹ PSA Peugeot-Citroën, France ² Université de Bordeaux, France

- 14:25-14:50 Modeling the Sources of Common-Mode Current on Automotive Wiring Harnesses Todd Hubing Clemson University, United States of America
 14:50-15:15 Modeling of CAN Networks for EMI Susceptibility Prediction Michele Fontana¹, Flavio Canavero¹, Todd Hubing², Richard Perraud³
 - ¹ Politecnico di Torino, Italy ² Clemson University, United States of America
 - ³ Airbus Innovation Group, France
- 15:15–15:40 Low-frequency magnetic fields in electric vehicles – simulations and measurements from the DELIVER project Christer Karlsson, Peter Ankarson,

Jan Carlsson SP Technical Research Institute of Sweden, Sweden

- 15:40–16:10 Coffee break
- 16:10–16:35 Virtual EMC Testing In Automotive Industry Jan Hansen, Claus Schmiederer Robert Bosch GmbH, Germany
- 16:35–17:00 Power plan optimization using numerical simulation Madjid Mahmoudi¹, David Antonic¹, Christophe Morin² ¹ Johnson Controls Automotive Electronics, France ² CST France, France
- 17:00–17:25 Switching Signals as Safe Vehicle Applications and Handicaps for Automotive EMC Jean-Roger K. Kuvedu-Libla Delphi Electronics & Safety, Luxembourg
- 17:25–17:50 Predicting Radiated Emission of Automotive Systems with Current Scan Methods Jin Jia, Denis Rinas, Stephan Frei Technische Universität Dortmund, Germany

9:00-12:50 WS 3A-3B: Modeling using MoM

Session Chair: Heinz-D. Brüns, TUHH, Germany Location: F4

Nowadays, numerical simulations are common-place in the daily work of an EMC engineer. Among the various techniques available, the Method of Moments (MoM) has outstanding capabilities for a broad range of problems.

Especially for large and radiating structures the MoM out-performs most other numerical approaches. Unfortunately, the approach is quite sensitive to an adequate discretization regrading the electrical size and complexity of the object under considertion. Hence the user should have a good knowledge of the underlying principles to obtain fast, accurate and efficient results.

This workshop introduces the fundamentals of the Method of Moments as far as required for practitioners in EMC. Emphasis is put upon modeling of large and complex geometries and the discretization thereof.

Fast solving techniques are introduced and validation methods are outlined. The CONCEPT-II framework is chosen for solving numerous example problems as it is free for educational purposes. Interaction with external software is demonstrated.

1) Introduction into the Method of Moments with examples

- The fundamentals of MoM
- Treatment of metallic structures that are composed of wires and surfaces
- Extension to homogenous (lossy) materials
- Special aspects considering aperture problems
- Solving shielding problems based on a hybrid approach
- Modeling and validation aspects

2) Solving challenging real-world problems

Pre-processing

- Modeling of arbitrary geometries
- Import from CAD tools and meshingFast approximative methods (MLFMA, ACA)

Post-Processing

- MoM and network parameters
- Advanced post-processing and export to external tools (Matlab. Octave)

9:00-12:50 T 3A-3B: Practical EMC Engineering

Session Chair: Frits J.K. Buesink, University of Twente, The Netherlands Location: F5

Noticing that starting EMC engineers often do not know where to begin, a practical introduction to this discipline is appropriate.

This tutorial explains the essential steps:

1. Understanding the physics of electromagnetic effects.

2. Thinking in environments with an overview of the important phenomena in those environments: conducted and radiated electromagnetic effects, impulsive disturbances as lightning, inductive switching and ESD.

3. Separating environments using current boundaries in their various appearances to "short-circuit" common-mode current loops: connector plates, cable trays and finally shielding.

4.Creating electromagnetic environments, using the measures shown before with reference to standards.

This is the "bottom up" approach that works best for beginning EMC engineers.

The motto is "seeing is believing" based on many practical experiments that will be done.

There will be two calculation examples because these are used often to estimate the magnitude of effects: the basic mechanisms of induction of voltages by changing magnetic fields in circuit loops and currents due to electric field changes around surfaces.But the focus is on demonstrating effects using experiments that can be easily copied using simple tools as a generator and an oscilloscope and some "home-made" probes.

14:00-17:50 SS 1A-1B: Intentional EMI

Session Chair: Heyno Garbe, Leibniz Universitaet Hannover, Germany Location: F1

SS 1A

Reference Configurations for the Characterization of Critical Infrastructures

Benjamin Menssen¹, Kai-Uwe Rathjen², Stefan van de Beek³, Mleczko Marcin¹, Heyno Garbe¹, Stefan Dickmann², Frank Leferink³

¹Leibniz Universität Hannover, Germany ²Helmut-Schmidt-University, Germany ³University of Twente, The Netherlands

Parametric Interpolation of IEMI Effects in a Simplified Scenario Matteo Alessandro Francavilla¹,

Giorgio Giordanengo¹, <u>Marco Righero</u>¹, Giuseppe Vecchi², Francesca Vipiana² ¹Istituto Superiore Mario Boella, Italy ²Politecnico di Torino, Italy

On Dealing with Low Frequency Problems Using MoM and Dielectrics in a Simplified IEMI Scenario

Matteo Alessandro Francavilla¹, <u>Marco Righero¹</u>, Giuseppe Vecchi², Francesca Vipiana² ¹Istituto Superiore Mario Boella, Italy ²Politecnico di Torino, Italy

A Methodology for Modeling IEMI Problems on Complex Scenarios

<u>Mario Antonelli</u>, Fabio Milani, Mauro Bandinalli IDS – Ingegneria Dei Sistemi, Italy

IEMI Analysis of Critical Infrastructures by Simulations using a Multi-Method Coupling Strategy

Simon Runke¹, Volkert Hansen¹, Joachim Streckert¹, Markus Clemens¹, Kai-Uwe Rathjen², Stefan Dickmann² ¹Bergische Universität Wuppertal, Germany ²Helmut Schmidt University, Germany

SS 1B

Robustness of Remote Keyless Entry Systems to Intentional Electromagnetic Interference

<u>Stefan van de Beek</u>¹, Robert Vogt-Ardatjew¹, Frank Leferink^{1,2} ¹University of Twente, The Netherlands ²Thales Nederland B.V., The Netherlands

Susceptibility of a Tetra Station to Electromagnetic Field Threats and Determination of Failure Effects Michael Camp, Jürgen Schmitz, Markus Jung

<u>Michael Camp</u>, Jurgen Schmitz, Markus Jung Rheinmetall Defence, Germany

A Cost-Efficient System for Detecting an Intentional Electromagnetic Interference (IEMI) Attack

John Dawson¹, Ian Flintoft¹, Andrew Marvin¹, Pranvera Kortoci¹, Martin Robinson¹, Mirjana Stojilović², Marcos Rubinstein², Benjamin Menssen³, Heyno Garbe³, Werner Hirschi⁴, Loubna Rouiller⁴ ¹University of York, United Kingdom ²University of Applied Sciences and Arts Western Switzerland, Switzerland ³Leibniz Universität Hannover, Germany ⁴Montena Technology SA, Switzerland

A Comparator-Based Technique for the Identification of Intentional Electromagnetic Interference Attacks

David Recordon¹, <u>Marcos Rubinstein</u>¹, Mirjana Stojilovic¹, Sana Sliman¹, Nicolas Mora², Farhad Rachidi², Werner Hirschi³ ¹HES-SO, Switzerland ²EPFL, Switzerland ³Montena, Switzerland

TDoA-Based Localisation of Radiated IEMI Sources

<u>Mirjana Stojilović</u>¹, Benjamin Menssen², Ian Flintoft³, Heyno Garbe², John Dawson³, Marcos Rubinstein¹ ¹University of Applied Sciences Western Switzerland (HES-SO), Switzerland ²Leibniz Universität Hannover, Germany ³University of York, United Kingdom

14:00-17:50 T 2A-2B: PEEC Modeling

Session Chair: Jonas Ekman, Luleå tekniska universitet, Sweden and Giulio Antonini, Università degli Studi dell'Aquila, Italy Location: F4

As a tool for prediction of electromagnetic field phenomena in electric and electronics design, the Partial Element Equivalent Circuit (PEEC) method has received a great interest over the last years. Besides being a powerful full-wave 3-d numerical method which competes with other popular techniques (FDTD, FEM,MoM) it is especially suited for mixed electromagneticcircuit problems, in both the time and frequency domains.

The recent literature is confirming that the PEEC method is becoming more and more popular in EMC-EMI-Signal Integrity areas especially for its capability to combine electromagnetic fields and lumped elements in the same numerical framework [1]–[3]. Furthermore its recent extension to magnetic materials and the development of fast solvers have made it powerful and well tailored for a comprehensive treatment of EMC problems.

The aim of the tutorial is to present the basic theory of the method up to the most recent advancements of the technique. Furthermore, in order to make it easier for the audience, a step-by-step implementation of the method clarifying the key points to make it fast and efficient will be presented.

- 14:00–14:30 Introduction and the history of PEEC Jonas Ekman Luleå University of Technology
- 14:35–15:05 Recent progress - Acceleration techniques "Multiscale Decomposition Based Analysis of PEEC Models" Giulio Antonini, Daniele Romano, University of L'Aquila
- 15:10–15:40 Parameterized PEEC models Francesco Ferranti¹, Giulio Antonini² ¹Ghent University ²University of L'Aquila
- 15:40-16:10 Coffee
- 16:10–16:40 **Circuit and electromagnetic co-simulation for active, non-linear circuit systems** Sohrab Safavi & Jonas Ekman Luleå University of Technology

- 16:45–17:15 Industry view on PEEC for EMC simulations Didier Cottet ABB CRC
- 17:20–17:50 Application of PEEC formulation to analysis of electrical networks in aircraft Mauro Bandinelli, Alessandro Mori, Ingegneria dei Sistemi (IDS)

14:00-17:50 T 4A-4B: Board Level Shields

Session Chair: Gary Fenical, Laird Technologies, United States of America Location: F5

Board level shields are not just 5-sided metal boxes anymore. There is much mechanical engineering and considerations involved for:

- Space considerations
- Proper soldering
- Partitioning
- Circuit geometry
- Material selection
- Shock and vibration
- More

If properly done, PCB design control techniques can be the most cost effective means of resolving EMI issues.

- The techniques involve:
- Partitioning,
- Board stack-up,
- Use of isolating lines
- Routing
- Board Level Shields

The workshop will cover all aspects and design considerations of today's modern and improved board level shields.

9:00–9:40 **Opening Ceremony**

Session Chair: Jan Carlsson, SP Technical Research Institute of Sweden, Sweden Location: F5

Speakers:

Prof. Jan Carlsson, Chairman EMC Europe 2014 Prof. Mauro Feliziani, Chairman ISC EMC Europe Dr. Bob Scully, President IEEE EMC Society Prof. Hans Georg Krauthäuser, Chairman EMC Europe 2015

9:40-10:20 Keynote 1:

Dr. Karl-Gunnar Lövstrand, FMV Testing Directorate: "The EMC work of the JAS Gripen fighter aircraft project in the 1980's"

Session Chair: Peter Stenumgaard, Swedish Defence Research Agency, Sweden $\mbox{Location: F5}$

Background: The electronics technology saw a dramatic development during the 1970s' and 80s'. The EMC technology followed with new methods, instrumentation and tools. The first drawings of the JAS 39 Gripen fighter were made in 1979 and its first flight took place in 1988. The EME work of the Gripen project illustrates the EMC design challenges at the development of a new complex defence system 30 years ago.

Gripen was the first of a new generation of fighter aircraft. It was designed with extensive use of carbon fibre composites. The avionics included a digital fly-by-wire system. Old and new weapons and tactical systems should be integrated. Many companies were involved in the multi-national and multi-company project!

The SAAB EMC-group managed the EMC-design and coordinated the EMC work. Risk management has traditionally been in focus at aircraft design and the EMC work got a very high attention and support from the top management and the customer, FMV. The strong position of the EMC-group in the project was essential for the work.

One major challenge for the early aircraft design was the lagging status of several EMC technologies and standards needed for the work. The engineering tools, competences and standards were based on mechanical and analogue technologies of the 1960s' and 70s'. The computer power was inadequate for detailed EM calculations.

Several severe EMC-related accidents in western countries were related to effects from e.g. HIRF, HERO, and lightning. That indicated a need for better EME protection methods. Nuclear EMP interaction was a secret subject separated from regular EMC work. So was lightning protection that had its own community. An integrated EME system design including all effects was essential for the Gripen project.

A particular problem was the fast electronics evolution. E.g. the successive upgrading of equipment with C-MOS components and re-designed PCBs when compliance tests had been performed with first generation TTL-equipped functions.

The design concept: The design was based on the zoning concept in order to optimise the EMC integration and to control all EM effects. One zone defined CFC shielded compartments and one should provide extra good shielding. The zones were carefully realised and maintained by detailed design reviews and measurements. MIL-STD-461B was the EMC standard of the project. Standards for specifying EM point-of-entry limitations had to be defined. The MIL-STD-464 system standard was not yet published. Requirements as expressed in the customer's specifications and the equipment standards were based on the known character of the EM environment and the response to it by equipment of the 1970s'. Such specifications were not adequate for the Gripen technology. New parameters were needed. The early MIL-STD-1757 lightning test did not include repetitive current pulses. Such stress might impair digital signal sequences and had to be included. The US FAA summoned a meeting concerning the HIRF environment. The Gripen RS specification representing exposure to radar pulses then had to be increased by more

than 60 dB in some frequency bands! The improved HIRF specification also provided a basic HPM protection. This proved to be very valuable when the HPM vulnerability was later questioned in public media.

Detailed documents defined the work schedule, project events and equipment interfaces. High competence was needed at design reviews and the inspections of lab testing.

Testing. A general strategy was not to accept any requirements until realistic verification tools were identified. Three EM components, lightning, HIRF and NEMP required extra efforts. The stringent time schedule required an in-house full threat lightning test system and the testing was not allowed to impair the flight worthiness of the test aircraft.

The HIRF protection of the first prototype aircraft was demonstrated by illumination with mobile radar systems. This required unrealistic efforts and a Microwave Test Facility had to be acquired for repeated regular testing. The MTF was later frequently used at the Swedish HPM research work. The Nuclear EMP requirements included full system level testing. The Swedish NEMP Test Centre was not realised until too late for the project. The NEMP compliance had to be demonstrated by Skin Current Injection Testing supported by CEM analysis.

The early CEM analyses with primitive methods had poor time and spatial resolution. The NEMP community in USA supported the development of FDEM codes for our Cray-1 e.g. with sub-routines for CFC field penetration. This resulted in much better data. **Conclusions:** The very stringent methods used at the EMC design work proved to be successful. The technical integration work of the very complex aircraft system could be made without any severe EMC problems. The many challenges of the project resulted in a significant improvement of the Swedish EMC engineering competence including many technical and analytical tools.

10:50-11:30 Keynote 2 :

Dr. Marco Klingler and Ariel Lecca, PSA Peugeot Citroën: "The Backstage and Challenges of Automotive EMC"

Session Chair: Peter Stenumgaard, Swedish Defence Research Agency, Sweden Location: F5

Automotive EMC is often presented through a set of very technical and scientific topics, such as modeling and simulation, test and measurements, standardization, etc.

These topics are generally related to different type of electric / electronic systems, comprising well-known and/or new technologies, where EMC requirements and issues have to be addressed across each stage of the development and lifecycle of a vehicle.

This presentation will leave aside all these usual exciting engineering challen-

ges to focus on an EMC engineer's everyday real life in the automotive industry, where other critical, decisive and no less exciting challenges such as the optimization in delay, cost, client satisfaction and safety throughout the entire development process and product lifecycle have also to be overcome.

So what are the real EMC related questions that will be asked in this very competitive and cost-effective industry?

11:30-12:10 Keynote 3 :

Dr. Christopher Holloway, Electromagnetics Division, National Institute of Standards and Technology (NIST): "Rydberg Atom-Based Self-Calibrating Compact Electric-Field Probe"

Session Chair: Peter Stenumgaard, Swedish Defence Research Agency, Sweden Location: F5

We discuss a fundamentally new approach for the measurement of electric (E) fields that will lead to the development of a broadband, direct SI-traceable, compact, self-calibrating E-field probe (sensor). The approach is based on the interaction of RF-fields with Rydberg atoms, where alkali atoms are excited optically to Rydberg states and the applied RF-field alters the resonant state of the atoms. For this probe/ sensor, the Rydberg atoms are placed in a glass vapor cell. In effect, alkali atoms placed in a vapor cell act like an RF-tooptical transducer, converting an RF E-field strength measurement to an optical frequency measurement. The probe utilizes the concept of Electromagnetic Induced Transparency (EIT), where the RF transition in the four-level atomic system causes a split of the transition spectrum for the probe laser. This splitting is easily measured and is directly proportional to the applied RF field amplitude. Therefore, by measuring this splitting in the EIT signal a direct measurement of the RF Efield strength can be made. The significant dipole response of Rydberg atoms over the GHz regime suggests this technique could allow traceable measurements over a large frequency band including 1 GHz to 500 GHz.

This new approach for E-field measurements has the following benefits: (1) it yields the field strength in SI units from a frequency measurement, fundamental constants, and known atomic parameters, (2) it is self-calibrating due to the invariance of the atomic parameters, (3) it will provide RF E-field measurements independent of current techniques, (4) since no metal is present in the probe, the probe will cause minimal perturbation of the field during the measurement, (5) it will measure both very weak and very strong fields over a large range of frequencies (field strengths as low as 0.8 mV/m have been measured, and below 0.01 mV/m may be possible), and (6) it allow for the construction of small, compact probes (optical fiber and chip-scale probes).

We demonstrate the broadband nature of this approach by showing that one small vapor cell can be used to measure E-field strengths over a wide range of frequencies: 1 GHz to 500 GHz. The technique is validated by comparing experimental data to both numerical simulations and far-field calculations for various frequencies. The chip-scale probe/sensor will be in a form factor, making it a transferable E-field standard. The probe would initially be used to perform a direct SI traceable calibration of existing probes and sensors, and calibrate electromagnetic test facilities. Other applications for this probe are numerous: ranging from sub-wavelength imaging and scanning, radio astronomy, security, to biomedical sensing and imaging.

12:30–14:30 Poster 1: Poster Session 1

Session Chair: Peter Stenumgaard, Swedish Defence Research Agency, Sweden Location: Exhibition Area

Sensitivity of a 1.5-T MRI system for electromagnetic fields

<u>Dirk W. Harberts</u>¹, Mark van Helvoort² ¹Philips Innovation Services, The Netherlands ²Philips Healthcare, The Netherlands

Compatible Susceptibility Measurements in Fully Anechoic Room and Reverberation Chamber

Emmanuel Amador, Céline Miry, Nicolas Bouyge EDF R&D, France

The Effects of Asymmetry on the Operation of the Van Veen Loop

James Stuart McLean TDK, United States of America

EMC Characterization of Implantable Cardiac Medical Devices in an Anechoic Chamber

Ivan Luigi Spano, Sara Sulis, Alessandro Serpi, Ignazio Marongiu, Gianluca Gatto University of Cagliari, Italy

Random Coupling Model for Wireless Communication Channels

<u>Gabriele Gradoni</u>¹, Xiaoming Chen², Thomas Antonsen³, Steven Anlage³, Edward Ott³ ¹University of Nottingham, United Kingdom ²Chalmers University of Technology, Sweden ³University of Maryland, United States of America

Analytical Modal Analysis to Evaluate the Contribution of Metamaterials to the Improvement of Reverberation Chambers

<u>Mihai lonut Andries</u>¹, Divitha Seetharamdoo¹, Philippe Besnier² ¹IFSTTAR, France ²IETR, France

Radiation of Complex Sources in Reflecting Environments: A Wigner Function Approach

<u>Gabriele Gradoni</u>, Stephen Creagh, Gregor Tanner University of Nottingham, United Kingdom

A Method of Defining Emission Limits Including the Gradient of an Amplitude-probability-distribution Curve Yasushi Matsumoto, Kaoru Gotoh

National Institute of Information and Communications Technology, Japan

A Breathing Detection Medical Device for Rescue of Buried People

<u>Alfredo De Leo</u>, Valerio Petrini, Paola Russo, Valter Mariani Primiani, Lorenzo Scalise, Graziano Cerri Università Politecnica delle Marche, Italy

A Hybrid Ewald-Spectral Representation of the Rectangular Cavity Green's Function

<u>Michael E. Gruber</u>, Thomas F. Eibert TU München, Germany

A new methodology of cranes modeling for ITER grounding safety assessment

François Grange¹, Thomas Gourdan², Pascal Blasquez², Didier Leschi2², Farid Paul Dawalibi³ ¹SES-EUROPE, France²EGIS, France ²Safe Engineering Services & Technologies Ltd, Canada

HF Analysis of Thin Horizontal Central-Fed Conductor above Lossy Homogeneous Soil

Farid Monsefi¹, Milica P. Rancic^{1,2}, Slavoljub Aleksic², Sergei Silvestrov¹ ¹Mälardalen University, Sweden ²University of Niš, Serbia

A novel connection approach based on development of the high permittivity materials for EMI filter design

Min Gong, Shishan Wang, Zheng Song, <u>Yidan Wang</u>, Xiaoli Meng Nanjing University of Aeronautics and Astronautics, People's Republic of China

Wideband impedance characterization and modeling of power electronic capacitors under high bias voltage variation

Fahim Hami^{1,2}, Habib Boulzazen², Fabrice Duval², Moncef Kadi² ¹VeDeCoM, France ²IRSEEM-ESIGELEC, France

A Study on the Characteristics of Semi-anechoic Chambers below 30 MHz

Masanori Ishii¹, Hideki Yoshida², Yasuyuki Danjo², Satoru Kurokawa¹, Katsumi Fujii³ ¹National Institute of Advanced Industrial Science and Technology, Japan ²Honda R&D Co., Ltd, Japan ³National Institute of Information and Communications Technology, Japan

Electromagnetic Interferences Suppresion in Planar Integrated Devices

<u>Nicoleta Adina Racasan</u>, Calin Munteanu, Vasile Topa, Claudia Pacurar, Claudia Hebedean Technical University of Cluj-Napoca, Romania

EMI reduction by

chip-package-board co-design Sho Kiyoshige, Wataru Ichimura, Masahiro Terasaki, Toshio Sudo Shibaura institute of technology, Japan

Circuit representation of coupled earthing grids

Gyorgy Varju1, Jozsef Ladanyi¹, Frans Sollerkvist² ¹Budapest University of Technology and Economics, Hungary ²Sweco Energuide AB, Sweden

Automatic Site-VSWR Measurement Using Mobile Robot Platform

<u>Michitaka Ameya,</u> Satoru Kurokawa AIST, Japan

Absorption Characteristics and SAR of a Lossy Sphere inside Reverberation Chamber

Damir Senic¹, <u>Christopher L. Holloway</u>², John M. Ladbury², Galen H. Koepke², Antonio Sarolic¹ ¹University of Split, Croatia ²National Institute of Standards and Technology (NIST), United States of America

Study of Backscattering from Small Wind Turbines Powering BTSs: RCS Simulations and Measurements

Tran Vu La¹, François Le Pennec¹, Fabrice Comblet², Serge Elenga³ ¹Telecom Bretagne, France ²ENSTA Bretagne, France ³IDSUD ENERGIES, France

Current Density and Internal Electric Field in a Model of the Human Body exposed to ELF Electric and Magnetic Fields

AbdelMalek Laissaoui', <u>Bachir Nekhoul</u>¹, Dragan Poljak², Kamal Kerroum³, Kamal EL Khamlichi Drissi³ ¹University of Jijel, Algeria ²University of Split, Croatia ³Blaise Pascal University, France

Study on Radio-frequency Damage Effects of Electro-explosive Device

Li Guilan, Zhang Feng, Ma Weiyu Beijing Institute of Radio Metrology and Measurement, People's Republic of China

14:30–15	 DS 1: Antennas Session Chair: Kristian Karlsson, SP Technical Research Institute of Sweden, Sweden Location: F1 	14:30–15:50	OS 3: Wireless Power Transfer Session Chair: Zbigniew M. Joskiewicz, Wroclaw, University of Technology, Poland Location: F2
14:30	EMC Characteristics of Open-end and Short-end Helical Antennas for Coupled-Resonant Wireless Power Transfer <u>Hiroshi Hirayama</u> , Shohei Fuka-	14:30	Shift of the Optimized Quality Factor Frequency for Inductive Wireless Power Applications Bart Thoen, <u>Nobby Stevens</u> KU Leuven, Belgium
	sawa, Hiroyuki Yamada, Nobuyoshi Kikuma, Kunio Sakakibara Nagoya Institute of Technology, Japan	14:50	Numerical Simulation of Wireless Power Transfer System to Recharge the Battery of an
14:50	Two New Types of Compact Ultra-wideband Antennas <u>Jian Yang</u> ¹ , Ahmed A. Kishk ² ¹ Chalmers University of Technology, Sweden		Silvano Cruciani ¹ , Tommaso Campi ¹ , Francesca Maradei ² , <u>Mauro Feliziani¹</u> 1University of L'Aquila, Italy ² Sapienza University of Rome, Italy
15:10	² Concordia University, Canada A Hybrid Technique for the Analysis of Antennas on an Electrically Large Platform Wei-Jiang Zhao, <u>Binfang Wang</u> Institute of High Performance Compu- tion Singapore	15:10	Transmitter with Cooperative Coils Matrix for Robust Wireless Power Transfer System <u>Wei Chen</u> , Zijian Bai, Sebastian Rickers, Guido.H Bruck, Peter Jung Duisburg-Essen University, Germany
15:30	Volume Self-complementary Radiators Boris Levin, Motti Haridim Holon Institute of Technology, Israel	15:30	Design of Magnetic Shielding for Reduction of Magnetic Near Field from Wireless Power Transfer System for Electric Vehicle <u>Hongseok Kim</u> ¹ , Chiuk Song ¹ , Jonghoon Kim ¹ , Daniel H. Jung ² , Eunseok Song ² , Sukjin Kim ² , Jiseong Kim ² , Joungho Kim ² ¹ Korea Advanced Institute of Science and Technology, Republic of Korea

(South Korea)

(South Korea)

²Korea Advanced Institute of Science and Technology, Republic of Korea
4:30-15:50	OS 5A: Near-Field 1 Session Chair: Davy Pissoort, KU Leuven – Kulab, Belgium and Wen-Yan Yin, Zhejiang University, People's Republic of China Location: F3
4:30	Sequential Sampling Algorithm for Simultaneous Near-Field Scanning of Amplitude and Phase <u>Tim Claeys</u> ¹ , Davy Pissoort ¹ , Dirk Deschrijver ² , Ivo Couckuyt ² , Tom Dhaene ² ¹ KU Leuven, Belgium ² Ghent University – iMinds, Belgium
4:50	Evaluation of the Near-Field Injection Method at Integrated Circuit Level Alexandre Boyer ¹ , Bertrand Vrignon ² , John Shepherd ² , Manuel Cavarroc ³ ¹ LAAS-CNRS, France ² Freescale Semiconductor, France ³ LAAS-CNRS, France
5:10	A Circuit Approach to Compute Near-field Interactions Based on an Efficient Implementation of the Spherical Wave Expansion Bart Boesman ¹ , Davy Pissoort ¹ , Georges Gielen ² , Guy Vandenbosch ² ¹ KU Leuven – Kulab, Belgium ² KU Leuven, Belgium
5:30	From Complex Near-Field Measurements to Radiated Emissions Modelling of Electronic Equipements <u>Abhishek Ramanujan</u> ¹ , Hanen Shall ² , Zouheir Riah ² , Frederic Lafon ¹ , Moncef Kadi ² ¹ Valeo, France ² IRSEEM-ESIGELEC, France

14:30–15:50 OS 6: High Power Electromagnetics

Session Chair: Mats Gösta Bäckström, Saab Aeronautics, Sweden Location: F4

14:30 Methodology and Equipment for Destructive High-Power Microwave Testing <u>Tomas Hurtig</u>, Mose Akyuz, Mattias Elfsberg, Sten E Nyholm, Anders Larsson Swedish Defence Research Agency, Sweden

14:50 Guideline for HPM Protection and Verification Based on the Method of Power Balance Mats Gösta Bäckström, Tony Bengt Nilsson, Lars Bengt Vallhagen Saab Aeronautics, Sweden

- 15:10 Equivalent Circuit/Transmission Line Model of Microwave Pulse-Compression Cavities Zisis Ioannidis, Stylianos Savaidis, Stelios Mitilinaios, Christina Tsitouri, Nikos Stathopoulos Technological Educational Institute of Piraeus, Greece
 - HPM detector system with frequency identification <u>Michael Suhrke</u>, Christian Adami, Christian Braun, Peter Clemens, Michael Joester, Sven Ruge, Hans-Ulrich Schmidt, Hans-Joachim Taenzer Fraunhofer Institute for Technological Trend Analysis INT, Germany

15:30

14:30–15:50	SS 2A: Models for System-Level EMC Analysis Session Chair: Kia Wiklundh, FOI, Sweden and Vladimir Mordachey, Belarusian		16:20–17:40	OS 2: Standards & Regulations Session Chair: Jan Welinder, SP Technical Research Institute of Sweden, Sweden Location: F1	
	and Radioelectronics, Belarus		16:20	Ten Years of Joint Cross-Border EMC Market Surveillance Nick Wainwright	
14:30	Scenario-Based Modeling for Electromagnetic Interference Analysis Kia Wiklundh ¹ , Peter Stenumgaard ¹ , Karina Fors ¹ , Sara Linder ¹ , Peter Holm ¹ , Leif Junholm ² ¹ FOI, Sweden ² FMV, Sweden		16:40	York EMC Services Ltd, United Kingdom The EMI Phantom of the Opera – Avoiding Interference During Performance Lennart Hasselgren EMC Services, Sweden	
14:50	Worst-Case Estimation of Electromagnetic Background Createded by Cellular Mobile Stations Near Ground Surface Vladimir Mordachev Belarusian State University of Informatics and Radioelectronics, Belarus		17:00 17:20	Invesigation on dispersions between CISPR25 chambers for radiated emissions below 100 MHz Frederic Lafon, Renaud Dupendant, Josselin Davalan Valeo, France	
15:10	Worst-Case Models of RF Front-End Nonlinearity for Discrete Nonlinear Analysis of Electromagnetic Compatibility Eugene Sinkevich Belarusian State University of Informatics and Radioelectronics, Belarus				Nick Wainwright York EMC Services Ltd, United Kingdom
15:30	Computationally-Effective Ultra-Wideband Worst-Case Model of Electromagnetic Wave Diffraction by Aperture in Conducting Screen Dmitry Tsionenko ¹ , Sergey Maly ² , Eugene Sinkevich ¹ ¹ Belarusian State University of Infor- matics and Radioelectronics, Belarus; ² Belarusian State University, Belarus				

Tuesday September 2

16:20-17:40 OS 4: Power Electronics

Session Chair: Frank Sabath, Bundeswehr Research Institute for Protective Technologies and NBC Protection (WIS), Germany Location: F2

- 16:20 Effect of diode characteristics on conducted noise spectrum in CCM boost converter Takaaki Ibuchi, Tsuyoshi Funaki Osaka University, Japan
- 16:40 Method of Efficiently Predicting the Conducted Emissions of Multiple VSCs Preye Milton Ivry, Oluwabukola Oke, Dave W.P. Thomas, Mark Sumner University of Nottingham, United Kingdom
- 17:00 **EM emissions induced by a DC/DC power converter Experiments on a laboratory system** Guido Chiappori¹, <u>Sylvie Baranowski²</u>, Ouafae Cohin³ ¹Ecole centrale de Lille, France ²Lille1 University, France ³ICAM Lille, France
- 17:20 In situ measurement of photo voltaic inverters <u>Cees Keyer</u>^{1,2}, Roelof Timens², Frits Buesink², Frank Leferink^{2,3} ¹Amsterdam University of applied Sceinces, The Netherlands ²University of Twente, The Netherlands. ³Thales Nederland, The Netherlands.

16:20-17:40 OS 5B: Near-Field 2

Session Chair: Davy Pissoort, KU Leuven - Kulab, Belgium and Wen-Yan Yin, Zhejiang University, People's Republic of China Location: F3

 Parametric Reconstruction of Stochastic EMI Sources Based on Two-Point Planar Near-Field Scanning <u>Anastasia Gorbunova</u>, Andrey Baev, Maxim Konovalyuk, Yury Kuznetsov Moscow Aviation Institute (National Research University), Russian Federation
 Time-Frequency Modelling of Near-Zone EM Coupling with Planar Circuit with

NF/NF Transform Blaise Ravelo IRSEEM, France

- 17:00 Auxiliary Sources for the Near-to-Far-Field Transformation of Magnetic Near-Field Data Vladimir Volski, Guy Vandenbosch, Davy Pissoort KU Leuven, Belgium
- 17:20 A Differential Evolution Algorithm Based Source Reconstruction Technique Wei-Jiang Zhao, <u>Binfang Wang</u>, En-Xiao Liu Institute of High Performance Computing, Singapore

16:20- 17:40	OS 7: Intentional EMI Session Chair: Heyno Garbe, Leibniz Universitaet Hannover, Germany Location: F4	16:20–17:00	SS 2B: Models for System-Level EMC Analysis Session Chair: Kia Wiklundh, FOI, Sweden and Vladimir Mordachev,
16:20	Exact Discrete Electromagnetism for Electromagnetic System Security Fike Michael Scholz ¹		Belarusian State University of Informatics and Radioelectronics, Belarus Location: F5
	Sebastian Lange ² , Thomas Eibert ¹ ¹ Technische Universität München, Germany ² Bundeswehr Research Institute for Protective Technologies – NBC Protection, Germany	16:20	Computationally-Effective Worst-Case Model of Wire Radiation in the Frequency Range 1 Hz - 40 GHz Yauheni Arlou ¹ , Eugene Sinkevich ¹ , Sergey Maly ² , Gregory Slepyan ³
16:40	6:40 A Portable System for Autonomous Detection and Classification of Electromagnetic Interference in the GPS band Björn Gabrielsson, Karina Fors, Patrik Eliardsson, Mikael Alexan- dersson, Peter Stenumgaard Swedish Defence Research Agency, Sweden	16:40	¹ Belarusian State University of Informatics and Radioelectronics, Belarus ² Belarusian State University, Belarus ³ Tel-Aviv University, Israel SEAMCAT modeling system-level EMC Analysis <u>Stella Yriversity, Israel</u>
17:00	An analytical model for the analysis of propagation of IEMI in electrical networks <u>Bing Li</u> , Daniel Månsson KTH Royal Institute of Technology, Sweden		Stefan Hiensch ² , Karl Koch Koch ² ¹ European Communications Office, Denmark ² Federal Network Agency, Germany
17:20	Performance of the reception of DVB signals in the presence of a communication signal interferer <u>Alexandru Marius Silaghi</u> University of Oradea, Romania		

9:00-10:20 OS 8A: Numerical EMC 1

Session Chair: Heinz-D. Brüns, TUHH, Germany and Niklas Wellander, Swedish Defence Research Agency, Sweden Location: F1

9:00 Transmission cross section for apertures and arrays calculated using time-domain simulations Ronny Karl-Johan Gunnarsson, Mats Gösta Bäckström Saab Aeronautics, Sweden

9:20 Electromagnetic Field Coupling to an Electrically Small Axial Dipole Antenna in a Cylindrical Cavity Sergey Tkachenko¹, Juergen <u>Nitsch¹</u>, Ronald Rambousky² ¹Otto-von-Guericke University Magdeburg, Germany ²Bundeswehr Research Institute for Protective Technologies and NBS Protection (WIS), Germany

9:40 Time Domain Analysis of the Horizontal Grounding Electrode – Antenna theory approach versus transmission line approximation Dragan Poljak¹, Silvestar Sesnic¹, Sergey Tkachenko², Khalil El Khamlichi Drissi³, Kamal Kerroum³ ¹University of Split, Croatia ²Otto-von-Guericke University Magdeburg, Germany ³Universite Blaise Pascal, France

10:00 Time Domain Electromagnetic Inverse Method: Implementation and Validation for Simple Structures Bessem Zitouna, Jaleleddine Ben Hadj Slama National Engineering School of Sousse, Tunisia

9:00-10:20 OS 10A: Human Exposure to EM Fields 1

Session Chair: Yngve Hamnerius, Chalmers Tekniska Högskola, Sweden and Jan Welinder, SP Technical Research Institute of Sweden, Sweden Location: F2

9:00 Theoretical and Experimental Safety Aspects Evaluation of Induction Heating Cooking Systems Alfredo De Leo, Paola Russo, Graziano Cerri, Valter Mariani Primiani Università Politecnica delle Marche, Italy

9:20 Exposures Representative of Traction Current Magnetic Fields in Hybrid and Electric Vehicles – I: Simulation of Basic Restrictions in a Seated Human Alastair Ruddle, Lester Low MIRA Limited, United Kingdom

9:40 Exposures Representative of Traction Current Magnetic Fields in Hybrid and Electric Vehicles – II: Safety Factors Provided by Field Reference Levels Alastair Ruddle, Lester Low MIRA Limited, United Kingdom

10:00 Magnetic Field Generated by Short Circuit Current in the 110 kV Power System Tomasz Lisewski¹, Jaroslaw Luszcz² ¹Electrotechnical Institute, Poland ²Gdansk University of Technology, Poland

Wednesday September 3

9:00-10:20	OS 12A: Shielding 1 Session Chair: Andy Marvin, York EMC Services, United Kingdom and Maria Sabrina Sarto, Sapienza University of Rome, Italy Location: F3	9:00-10:20	OS 15A: Wired & Wireless Communications 1 Session Chair: Peter Stenumgaard, Swedish Defence Research Agency, Sweden and Yasushi Matsumoto,
9:00	A GHz-band Gasket-Free Electromagnetic Shielding Structure with Built-in Cascaded SIW Resonators		National Institute of Information and Communications Technology, Japan Location: F4
	<u>Satoshi Yoneda</u> , Yasuhiro Shiraki, Yuichi Sasaki, Naoto Oka, Hideyuki Oh-hashi Mitsubishi Electric Corp., Japan	9:00	Channel Selection that Considers the Impulse Characteristics of the Local Interference Patrik Eliardsson ¹ , Erik Axell ¹ , Kia C. Wiklundh ¹ , Peter F. Stenumgaard ¹
9:20	Sensitivity Analysis of Electromagnetic Transmission, Reflection and Absorption Coefficients for Biphasic		¹ Swedish Defence Research Agency (FOI), Sweden ² Linköping University, Sweden
	Composite Structures Muhammet Hilmi Nisanci ² , <u>Francesco De Paulis¹</u> , Danilo Di Febo ¹ , Antonio Orlandi ¹ ¹ University of L'Aquila, Italy ² Sakarya University, Turkey	9:20	Impulsive Noise Detection in OFDM Systems with PAPR Reduction Javier Ferrer Coll ^{1,2} , Ben Slimane ² , Jose Chilo ¹ , Peter Stenumgaard ³ ¹ University of Gävle, Sweden ² KTH Royal Institute of Technology, ² woden
9:40	Shielding Effectiveness Estimation in an Electrically Large Cavity using Power Balance		³ Swedish Defense Research Agency, Sweden
	Method and BLI Equatio IIn Hwan Jung ¹ , Jae W. Lee ¹ , Young Seung Lee ² , Jong Hwa Kwon ² ¹ Korea Aerospace University, Republic of Korea (South Korea) ² Electronics and Telecommunications Research Institute, Republic of Korea (South Korea)	9:40	On the Interference between Digital Terrestrial Television and Mobile Broadband in the Swedish 800 MHz band Carl Elofsson ² , Carl Karlsson ² , <u>Claes Beckman¹</u> ¹ Royal Institute of Technology KTH, Sweden ² Radiobustors: Sweden
10:00	Shielding Effectiveness Calculations for Cabinets in the Frequency Range 1 – 30 GHz Hanif Tavakoli ¹ , Bo Strand ¹ , Erik Abenius ¹ , Ming Ye ² , Ping-Fang Yu ³ ¹ ESI, Sweden ² Huawei Sweden, Sweden ³ Huawei China, People's Republic of China	10:00	Jamming and interference vulnerability of IEEE 802.11p Sara Örn Tengstrand ¹ , Karina Fors ¹ , Peter Stenumgaard ^{1,2} , Kia Wiklundh ¹ ¹ Swedish Defence Research Agency, Sweden ² Linköping University, Sweden

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10:50-12:10 **OS 8B:**

Numerical EMC 2

Session Chair: Heinz-D. Brüns, TUHH, Germany and Niklas Wellander, Swedish Defence Research Agency, Sweden Location: F1

10:50 Electrostatic Field Simulations of Curved Conductors by Using Method of Moments Based on Isogeometric Analysis Tadatoshi Sekine, Kenjiro T. Miura,

Hideki Asai Shizuoka University, Japan

11:10 Modeling of BCI Test Setup applied to Common Rail Pressure Control System

Anna Gheonjian^{1,2}, Xavier Bunlon³, Irina Oganezova^{1,2}, Imad Chahine¹, Badri Khvitia^{1,2}, Roman Jobava^{1,2} ¹EMCoS ltd., Georgia ²Tbilisi State University, Georgia ³Technocentre RENAULT, France

- 11:30 Calculating ElectroMagnetic Coupling Between Isolated Power Islands by 2D-FDTD with Equivalent Circuits Chun-Te Wu Da-Yeh University, Taiwan, Republic of China
- 11:50 Hybrid FDTD Method Based on Conformal Technique for Modeling Wedges Composed of Conductive and Dielectric Materials Xiang Yuan, Xiang-hua Wang, Jun Hu, Wen-Yan Yin Zhejiang University, People's Republic of China

10:50-12:10 OS 10B: Human Exposure to EM Fields 2

Session Chair: Yngve Hamnerius, Chalmers Tekniska Högskola, Sweden and Jan Welinder, SP Technical Research Institute of Sweden, Sweden Location: F2

- 10:50 Assessing Complex Low Frequency Magnetic Fields Against the EU Directive for Worker Protection Yngve Hamnerius, Tomas Nilsson Chalmers Tekniska Högskola, Sweden
- 11:10 Reference System for Basic-Restrictions Related Evaluation of Magnetic Field Exposure Reinhard Döbbelin¹, Stefan Förster², Andreas Lindemann¹ ¹Otto-von-Guericke-University Magdeburg, Germany ²formerly Otto-von-Guericke-University Magdeburg, Germany
- 11:30 An Efficient Integral Equation Based Dosimetry Model of the Human Brain Mario Cvetković, Dragan Poljak University of Split, Croatia
- 11:50 The frequency-selective evaluation of radiofrequency electromagnetic radiation in the public accessible indoor environment <u>Krzysztof Gryz</u>, Jolanta Karpowicz, Wiesław Leszko, Patryk Zradziński Central Institute for Labour Protection – National Research Institute. Poland

Wednesday September 3

10:50–12:10	OS 12B: Shielding 2 Session Chair: Andy Marvin, York EMC Services, United Kingdom and Maria Sabrina Sarto, Sapienza University of Rome, Italy Location: F3	2B: Shielding 2 10:50–12:1 Chair: Andy Marvin, 10:50–12:1 C Services, United Kingdom 10:50–12:1 Tia Sabrina Sarto, 10:50–12:1 a University of Rome, Italy 10:50–12:1 n: F3 10:50–12:1		OS 15B: Wired & Wireless Communications 2 Session Chair: Peter Stenumgaard, Swedish		
10:50	A Statistical Approach to Time-Domain Shielding Rodolfo Araneo, Salvatore Celozzi, Giampiero Lovat, Giuseppe Attolini			Defence Research Agency, Sweden and Yasushi Matsumoto , National Institute of Information and Communications Technology, Japan Location: F4		
11:10	Italy Prospective New PMC based Gap Waveguide Shielding for Microwave Modules <u>Ashraf Uz Zaman</u> , Eva Rajo-Iglesias, Per-Simon Kildal Chalmers University of Technology, Sweden		10:50	On Parameter-Reduced Models for Intersystem-Interference Analysis on Co-Located Frequency Hopping Systems Sara Linder ¹ , Peter Stenumgaard ^{1,2} ¹ Swedish Defence Research Agency, Sweden ² Linköping University, Sweden		
11:30	A fast method for estimating shielding effectiveness of an enclosure with apertures <u>Ali Shourvarzi</u> , Mojtaba Joodaki Ferdowsi University of Mashhad, Islamic Republic of Iran		11:10	The Use of Median Filters to Suppress Interference on Signal Lines Bruno Audone ¹ , <u>Michele Borsero</u> ² , Alessandro Tacchini ³ ¹ Reggio Emilia Innovazione, Italy ² INRIM, Italy; ³ Consultant		
11:50	Benchmark Calculations of Magnetic Shielding at Low Frequencies Fabian Happ, Heinz-D. Brüns, Frank Gronwald TUHH, Germany		11:30	Impact of Different Interference Types on an IEEE 802.11p Communication Link Using Conducted Measurement Peter Ankarson ¹ , Ulf Carlberg ¹ , Jan Carlsson ¹ , Stefan Larsson ² , Björn Bergqvist ³ ¹ SP Technical Research Institute of Sweden, Sweden ² Volvo Group Trucks Technology, Sweden ³ Volvo Car Corporation, Sweden		
			11:50	Radiated Interference of High Frequency Broadband Power Line Communications Tarmo Ronkainen, <u>Risto Vuohtoniemi</u> , Juha-Pekka Mäkelä University of Oulu, Finland		



Wednesday September 3

12:30–14:30 Poster 2: Poster Session 2

Session Chair: Urban Lundgren, SP Technical Research Institute of Sweden, Sweden Location: Exhibition Area

Irregular surfaces modelling for propagation analysis in the complex indoor environment

<u>Slawomir Kubal</u>, Michal Kowal, Piotr Piotrowski, Ryszard Zielinski Wroclaw University of Technology, Poland

Harmonic interaction between an electric vehicle and different domestic equipment

<u>Aurora Gil-de-Castro</u>¹, Sarah K. Rönnberg², Math H. J. Bollen² ¹University of Cordoba, Spain ²Luleå University of Technology, Sweden

Characterization of Anti-jamming Effect on the Joint Tactical Information Distribution System (JTIDS) Operating in Complicated Electromagnetic Environment

Jing Jin, Hao Xie, Jun Hu, Wen-Yan Yin Zhejiang University, People's Republic of China

Electric Field Calculation around of Overhead Transmission Lines in Bosnia and Herzegovina

<u>Adnan Mujezinović</u>¹, Adnan Čaršimamović², Salih Čaršimamović¹, Alija Muharemović¹, Irfan Turković¹

¹University of Sarajevo, Bosnia and Herzegovina ²Independent System Operator in B&H, Bosnia and Herzegovina

Method for determing statitistical mean and variance of electromagnetic energy transmission between coupled cavities

Louis Kovalevsky, Robin S. Langley, Andrea Barbarulo University of Cambridge, United Kingdom

A Method for Wi-Fi Radiation Performance System with a Non-signaling Mode Emulator

Yangwoon Roh, Keonyoung Seo, Nankyoung Kim, Jeongin Byun, Mihyun Lee, Hoyong Kim, Shinyoung Lee Samsung Electronics, Republic of Korea (South Korea)

Some cabling EMC issues inside the ITER cryostat

Alexander P.J. van Deursen¹, David Beltran², Piet van der Laan¹ ¹Eindhoven University of Technology, The Netherlands ²Iter Organization, France

A New 3D-PICS High Density Integrated Passive Device with Substrate Noise Reduction by localized P+ Guard Rings : Characterization and Modeling

<u>Miled Ben Salah</u>¹, Daniel Pasquet², Frédéric Voiron³, Philippe Descamps², Jean-Luc Lefebvre¹ ¹PRESTO ENGINEERING, France ²LaMIPS, CRISMAT Laboratory, France ³IPDIA, France

A Multipoint Method for the Locating of Radio Frequency Interference Sources in Power Stations and Substations

<u>Tomaž Živic</u>, Urban Metod Peterlin MILAN VIDMAR ELECTRIC POWER RESEARCH INSTITUTE, Slovenia

Use of reference limits in the Feature Selective Validation (FSV) method

Ricardo Jauregui, Marc Pous, <u>Ferran Silva</u> GCEM - UPC, Spain

Alternative Conducted Emission Measurements for Industry

Soydan Cakir, <u>Osman Sen</u>, Mehmet Cinar, Mustafa Cetintas TUBITAK-UME, Turkey

On the EMC of the propagation of 2.4 GHz ISM signals in environments with complex metallic structures – a cost-effective measurement setup <u>Helge Fielitz</u>, Jan Luiken ter Haseborg Hamburg University of Technology, Germany

Q Factor Damping of Anti-Resonance Peak

<u>Wataru Ichimura</u>, Sho Kiyoshige, Masahiro Terasaki, Hiroki Otsuka, Toshio Sudo Shibaura Institute of Technology, Japan

Model and Full-scale Study of Soil Berm for Karoo Array Telescope Shielding <u>Hardie Pienaar</u>, Howard Charles Reader Stellenbosch University, South Africa

An Analysis of the Performance of 245 kV Circuit Breakers Applying the Radiometric Monitoring and the Wavelet Transform

Thair Ibrahim Mustafa¹, Ciro Pitz¹, Hugo D. Almaguer¹, David W. P. Thomas², José Vicente Santos³, Fernando T. Flores⁴, José Eduardo Cereja⁴, Leandro B. Puchale⁴ ¹UNIVERSITY OF BLUMENAU, Brazil ²UNIVERSITY OF NOTTINGHAM, United Kingdom ³UNIVERSITY OF VALE DO RIO DOS SINOS, Brazil: 4CEEE-6T, Brazil

EMC analysis between Fixed Service and Broadcasting Satellite Service in the band 10.7 – 11.7 GHz

<u>Ryszard J. Zielinski</u> Wroclaw University of Technology, Poland

High performance shield room for intermediate frequency magnetic fields

<u>Takehiro Tsuruta</u>¹, Shigetaka Hirosato¹, Koji Fujiwara² ¹Takenaka Corporation, Japan ²Doshisya University, Japan

The methodology of estimation of Spectrum Monitoring System operating efficiency

Vadym Blagodarnyi¹, Pavlo Slobodianiuk¹, Mykola Kaliuzhnyi² 'State Enterprise Ukrainian State Centre of Radio Frequencies, Ukraine ²Kharkiv National University of Radio Electronics. Ukraine

Transient response of grounding systems of wind turbines under lightning strikes

Rodolfo Araneo, Salvatore Celozzi, Giampiero Lovat UNIVERSITY OF ROME LA SAPIENZA, Italy

Application of scattering parameters theory in planar EMI filter

Shishan Wang, Min Gong, <u>Yidan Wang</u>, Xiaoli Meng Nanjing University of Aeronautics and Astronautics, People's Republic of China

Protection of fixed monitoring station against interference from strong electromagnetic fields

<u>Georgij Leontjev</u> Communications Regulatory Authority of the Republic of Lithuania, Lithuania

Anti-jamming Performance Simulation and Analysis of Tactical Data Link Communication System

<u>Hao Xie</u>, Jun Hu, Wen-Yan Yin Zhejiang University, People's Republic of China

A Method Using an Open TEM Cell to Extract the Complex Permittivity of an Unknown Material

<u>Rémi Tumayan</u>^{1,2}, Xavier Bunlon¹, Alain Reineix², Guillaume Andrieu², Christophe Guiffaut² ¹Renault S.A.S, France ²XLIM, France

Surface roughness effects on corona-generated radio noise for long-term operating conductors

<u>Xingming Bian</u>1, Shunxu Zhuan², Shuwei Wan³, Liming Wang4, Bin Duan⁵, Kaifeng Qu⁵, Zhicheng Guan4

¹North China Electric Power University, People's Republic of China;

²State Grid Shaanxi Electric Power Corporation Economic Research Institute, People's Republic of China;

³State Grid Chongqing Nan'an Power Supply Company, People's Republic of China ⁴Tsinghua University, People's Republic of China ⁵Beijing Internet Aided Engineering (IAE), People's Republic of China

14:30–15:50	OS 9A: Reverberation Chambers 1 Session Chair: Frank Leferink, University of Twente/ THALES, The Netherlands and Philippe Besnier, IETR/INSA, France	14:30–15:50	OS 11A: Automotive 1 Session Chair: Marco Paolo Klingler, Peugeot Citroen Automobiles, France and Stephan Frei, TU Dortmund, Germany Location: F2
14:30	Location: F1 A Continued Evaluation of the General Method for Determining the Number of Independent Stirrer Positions in Reverberation Chambers Stephan Pfennig ¹ , Franco Moglie ² , <u>Hans Georg Krauthäsuer¹</u> ¹ Technical University Dresden, Ger- many; ² Università Politecnica delle	14:30	Analysis and Improvement of a Spark Plug for Less Radiated Electromagnetic Emissions Christoph Marczok ¹ , Uwe Maaß ¹ , Eckart Hoene ¹ , Ivan Ndip ¹ , Klaus- Dieter Lang ² , Dennis Hasselberg ³ ¹ Fraunhofer IZM, Germany ² TU Berlin, Germany ³ BMW Group, Germany
14:50	Marche, Italy Determining the Lowest Usable Frequency of a Frequency-Stirred Reverberation Chamber using Modal Density <u>Abdou Khadir Fall</u> ¹ , Philippe Besnier ¹ , Christophe Lemoine ¹ , Maxim Zhadobov ² , Ronan Sauleau ² ¹ Institute of Electronics and Telecom- munications of Rennes (IETR) / INSA of Rennes, France. ² Institute of Electronics and Telecom- munications of Rennes (IETR) / University of Rennes 1, France.	14:50 15:10	Investigation on the Propagation of Disturbing Pulses in Traction Batteries of Electric and Hybrid Vehicles Marc Maarleveld ¹ , Karsten Kreisch ¹ , Holger Kellerbauer ¹ , Kai Friedrich ² ¹ EMC Test NRW GmbH, Germany ² AUDI AG, Germany Evaluation of the Radiated Field by a Harness Above a Partial Composite Material Chassis Ammar Kader ^{1,2} , Marco Kling- ler ¹ , Tristan Dubois ² , Geneviève Duchamp ²
15:10	An Experimental Programme to Determine the Feasibility of Using a Reverberation Chamber to Measure the Total Power Radiated by an Arcing Pantograph Andy Marvin ² , Lan Ma ^{1,2} , Rob Armstrong ³ , Eva Karadimou ³ , Ying- hong Wen ¹ ¹ Beijing Jiaotong University, Beijing, People's Republic of China ² University of York, United Kingdom ³ York EMC Services Ltd, United Kingdom	15:30	¹ PSA Peugeot Citroën, France ² IMS Bordeaux, France Novel Ringing Suppression Circuit to Achieve Higher Data Rates in a Linear Passive Star CAN FD <u>Hiroyuki Mori</u> ¹ , Noboru Maeda ¹ , Yasuhiro Mori ² , Hiroyuki Obata ² , Yoshifumi Kaku ² , Syogo Akasaki ² ¹ NIPPON SOKEN, INC., Japan ² DENSO CORPORATION, Japan
15:30	Practical industrial EUT testing in reverb chamber <u>Per Thaastrup Jensen</u> , Anders Pilgaard Mynster, Rasmus Brun Behnke DELTA, Denmark		

14:30-15:50	OS 13: Novel Materials Session Chair: Mauro Feliziani, University of L'Aquila, Italy Location: F3	14:30–15:50	OS 16A: Lightning 1 Session Chair: Rajeev Thottappillil, Kungliga Tekniska Högskolan, Sweden and Farhad Rachidi, Swiss Federal Institute of Technology (EPFL), Switzgrland
14.00	and Mechanical Reliability of a LDMOS FET Using Graphene		Location: F4
	Shanghai Jiaotong University, People's Republic of China	14:30	A Semi-Analytical Formula for the Evaluation of the Indirect Lightning Performance
14:50	Convolution Perfectly Matched Layer (CPML) Implementation of the WCS-FDTD Method for Graphene Applications Meng-Lin Zhai ¹ , Wen-Yan Yin ^{1,2} , Zhizhang {David} Chen ³ , Xiang-Hua Wang ² ¹ Shanghai Jiao Tong University,		of Overhead Power Lines <u>Massimo Brignone</u> ¹ , Federico Delfino ¹ , Renato Procopio ¹ , Mansueto Rossi ¹ , Farhad Rachidi ² ¹ University of Genoa, Italy ² Swiss Federal Institute of Technology, Switzerland
45.40	People's Republic of China ² Zhejiang University,Hangzhou People's Republic of China ³ School of Electronic Engineering, School of Electronic Engineering,on leave from Dalhousie University, Canada	14:50	A Study of the Influence of Channel Resistance Parameters on Lightning-Induced Voltages on Overhead Lines <u>Alberto De Conti</u> , Silvério Visacro UFMG - Federal University of Minas Gerais, Brazil
15:10	and Optical Transmittance of Graphene Multilayer Thin Sheets Marcello D'Amore, Alessandro Giuseppe D'Aloia, Maria Sabrina Sarto Sapienza University of Rome, Italy	15:10	Estimation of Pulse Function Parameters for Approximating Measured Lightning Currents Using the Marquardt Least- Squares Method Karl Lundengård ¹ , Milica P. Rancic ^{1,2} ,
15:30	Graphene-based EMI shield obtained via spray deposition technique <u>Chiara Acquarelli</u> , Andrea Rinaldi, Alessio Tamburrano, Giovanni De		¹ Mälardalen University, Sweden ² University of Niš, Serbia Niš, Serbia, Sergei Silvestrov, UKK, Mälardalen University, MDH, Västerås, Sweden
	Bettis, Atessandro Giuseppe D'Aloia, Maria Sabrina Sarto Sapienza University of Rome, Italy	15:30	FDTD Analysis of 3D Lightning Problems with Material Uncertainties on GPU Architecture Georgios G. Pyrialakos ¹ , Theodoros T. Zygiridis ² , Nikolaos V. Kantartzis ¹ , Theodoros D. Tsiboukis ¹

¹Aristotle University of Thessaloniki, Greece ²University of Western Macedonia, Greece Wednesday September 3

16:20–17:40	OS 9B: Reverberation Chambers 2 Session Chair: Frank Leferink, University of Twente/THALES, The Netherlands and Philippe Besnier, IETR/INSA, France	16:20–17:40	OS 11B: Automotive 2 Session Chair: Marco Paolo Klingler, Peugeot Citroen Automobiles, France and Stephan Frei, TU Dortmund, Germany Location: F2
16:20	Average Attenuation supplemented by Maximum-to-Average Ratio in Reverberation Chamber Measurement of Transmission Functions Johannes Graenzer, Guido Rasek	16:20	Analysis of the Low Frequency Shielding Behavior of High Voltage Cables in Electric Vehicles Katharina Feldhues, Maja Diebig, Stephan Frei TU Dortmund University, Germany
16:40	EMCCons DR. RAŠEK GmbH & Co. KG, Germany 4G-LTE Base Station Output Power Estimation from Statistical Counters during Over-the-Air Tests in Reverberation Chamber Massimo Barazzetta ¹ , Davide Micheli ² , Paolo Gianola ² , Franco Moglie ³ , Valter Mariani Primiani ⁴	16:40	EMC mapping of a power train for fully electric 4-wheel drive vehicle Iván Echeverría ¹ , Mateo Iglesias ¹ , Fernando Arteche ¹ , Álvaro Pradas ¹ , Francisco Javier Piedrafita ¹ , John De Clercq ² ¹ Instituto Tecnológico de Aragon, Spain ² Inverto NV, Belgium
	¹ Nokia Solutions and Networks Italia, Italy ² Telecom Italia, Italy ³ Università Politecnica delle Marche, Italy	17:00	Investigations on the EMI of an Electric Vehicle Traction System in Dynamic Operation Sebastian Jeschke, Holger Hirsch University of Duisburg-Essen, Germany
17:00	Evaluation of Stirrer Efficiency by Means of First Reflection <u>André Manicke</u> , Konstantin Pasche, Hans Georg Krauthäuser Technical University Dresden, Germany	17:20	Automotive High Voltage Grid Simulation Soeren Schoerle ¹ , Eckart Hoene ¹ , Klaus-Dieter Lang ² ¹ Fraunhofer IZM, Germany
17:20	Characterization and Modeling of Measurement Uncertainty in a Reverberation Chamber with a Rotating Mode Stirrer Xiaoming Chen ¹ , Per-Simon Kildal ¹ , Jan Carlsson ² ¹ Chalmers University of Technology, Sweden ² SP Technical Research Institute of Sweden, Sweden		² University Berlin, Germany

Wednesday September 3

16:20–17:40	OS 14: ESD Session Chair: Ferran Silva, GCEM – UPC, Spain Location: F3	16:20–17:20	OS 16B: Lightning 2 Session Chair: Rajeev Thottappillil, Kungliga Tekniska Högskolan, Sweden and Farhad Rachidi, Swiss Federal
16:20	ESD performance analysis of automotive application based on improved Integrated Circuit		Institute of Technology (EPFL), Switzerland Location: F4
	ESD model <u>Frederic Lafon</u> , Priscila Fernandez Lopez, Abhishek Ramanujan Valeo, France	16:20	Lightning observations at Tokyo Skytree Takatoshi Shindo ¹ , Toru Miki ¹ , Daiki Tanaka ¹ Akira Asakawa ¹
16:40	A Methodology Towards the Establishment of a Statistically Credible Radiated Transient Immunity Level Sean Ngo, Barney James Petit, Richard Hoad QinetiQ, United Kingdom		Hideki Motoyama', Masaru Ishii ² , Mikihisa Saito ² , Takeo Sonehara ³ , Yusuke Suzuhigashi ⁴ , Hiroshi Taguchi ⁴ ¹ Central Research Institute of Electric Power Industry, Japan ² The University of Tokyo, Japan; ³ Shoden Co., Ltd., Japan ⁴ Tobu Tower Skytree Co., Ltd., Japan
17:00	Transient Characteristics and Polarization Effect of Electromagnetic Radiation Caused by Low Voltage ESD in Spherical Electrode Ken Kawamata ¹ , Shigeki Minegishi ¹ , Osamu Fujiwara ² ¹ Tohoku Gakuin University, Japan ² Nagoya Institute of Technology, Japan	16:40	In-flight Lightning Damage Assessment System (ILDAS): Diagnostic performance assess- ment with infight lightning data Alexandre Hervé ¹ , Gilles Peres ¹ , Alte De Boer ² , Michiel Bardet ² , Boissin Jean-François ³ , Flourens Franck ³
17:20	Electrostatic charging at petrol stations. Examination of electrostatic charging- and discharging mechanisms related		² National Aerospace Laboratory NLR, The Netherlands ³ Airbus, France
	with petrol filling operation and petrol filling stations. <u>Per Thaastrup Jensen</u> ¹ , Asbjørn Andersen ² ¹ DELTA, Denmark ² Force Technology, Denmark	17:00	A Simplified Apporoach to the Study of Electromagnetic Transients Generated by Lightning Stroke in Power Network Bachir Nekhoul ¹ , Basma Harrat ¹ , Lotfi Boufenneche ¹ , Makhlouf Chouki ¹ , Kamal Kerroum ² , D Poljak ¹ ¹ University of Jijel, Algeria ² Blaise Pascal University, France

9:00-10:20	OS 8C: Numerical EMC 3 Session Chair: Jonas Ekman, Luleå tekniska universitet, Sweden and Giulio Antonini, Università degli Studi dell'Aquila, Italy Location: F1	9:00–10:20	OS 17A: Low Frequency EMC 1 (Supported by IEEE EMCS TC 7) Session Chair: Magnus Olofsson, Elforsk – Swedish Electrical Utilities' R & D Company, Sweden and David William Philip Thomas, The University of Nottingham,
9:00	A Locally Implicit Leapforg Scheme for Fast Simulation of Triangle-Meshed PDN with		United Kingdom Location: F2
9:20	Nonlinear Circuit Shingo Okada, Hideki Asai 'Shizuoka University, Japan PEEC-based Solver Acceleration	9:00	Conducted mains test method in 2–150 kHz band Mart Coenen ¹ , Arthur Roermund van ² ¹ EMCMCC, The Netherlands ² Eindhoven University of Technology,
	Using Reluctance Method and Low Rank Compression Technique Danesh Daroui	9:20	The Netherlands Time domain methods for the
	SP Technical Research Institute of Sweden, Sweden		ce on the power supply network of complex installations
9:40	Predicting magnetic coupling of Power Inductors <u>Stefan Hoffmann</u> ¹ , Eckart Hoene ¹ , Lang Klaus-Dieter ² ¹ Fraunhofer IZM, Germany; ² Technical University Berlin, Germany		B.J.A.M. van Leersum ^{1,2} , R.B. Timens ¹ , F.J.K. Buesink ¹ , F.B.J. Leferink ^{1,2} ¹ University of Twente, The Netherlands ² Defence Materiel Organisation, The Netherlands ³ Thales Nederland B.V. The Netherlands
10:00	Massively Parallel FDTD Program JEMS-FDTD and Its Applications in Platform Coupling Simulatio Hanyu Li, <u>Haijing Zhou</u> Institute of Applied Physics and Computational Mathematics, People's Republic of China	9:40	Measuring of Voltages and ELF Electric Fields of High-Voltage Network in Bosnia and Herzegovina Adnan Carsimamovic ¹ , Adnan Mujezinovic ² , Salih Carsimamovic ² , Alija Muharemovic ² , Zijad Bajramovic ² ¹ Independent System Operator in Bosnia and Herzegovina, Bosnia and Herzegovina ² University of Sarajevo, Bosnia and Herzegovina
		10:00	Mitigation of Low and High Frequency Harmonics in Variable Speed AC Drives Used in Oil Rigs Djilali Hamza, Khalifa Hasan Al Hosani The Petroleum Institute, United Arab Emirates

Thursday September 4

OS 21: Aircraft OS 19: 9:00-10.20 9.00-10.20 **Integrated Circuits** & Space Systems Session Chair: John Dawson, Session Chair: Mohamed Ramdani, ESEO, France University of York, United Kingdom Location: F4 Location: F3 9.00 RFIP method: towards a better 9.00 Prediction of conformal antenna characterization of integrated coupling on aircraft circuits immunity Alexandre Piche, Gerard-Pascal Ala Ayed¹, Tristan Dubois¹, Jean-Luc Piau. Olivier Urrea. Gilles Peres. Levant², Geneviève Duchamp¹ Andrew Thain ¹IMS laboratory, France EADS France, France ²ATMEL Nantes SA, France 9.20 Time-domain Radiated 9:20 An EMI Resistant Integrated LVDS **Emissions Measurement of** Transmitter in 0.18?m CMOS Laboratory Simulated Spacecraft Gilbert Andrew Matiga, Jean-Michel On-Orbit Electrostatic Discharg Redoute. Mehmet Yuce Adrian G. Sun, Mark W. Crofton, Monash University, Australia Jason A. Young, William A Cox, Edward J. Beiting 9:40 The Aerospace Corporation, United Increasing the EMI Immunity of States of America CMOS Operational Amplifiers using an on-Chip Common-Mode 9.40 A Study of Evaluation Method Cancelation Circuit Anna Richelli¹, Jean-Michel Redouté² for Aeronautical L-band Signal Environment during Flight ¹University of Brescia, Italy: ²Monash Experiments University, Australia Takuya Otsuyama, Shiqeru Ozeki 10.00 A Balanced CMOS OpAmp with Electronic Navigation Research high EMI Immunity Institute, Japan Subrahmanyam Boyapati¹, Devarshi 10:00 High Speed Digital Lines Das², Maryam Shojaei Baghini², routed on not metallic Jean-Michel Redoute³ Spacecraft structures ¹IITB-MONASH RESEARCH ACADEMY. Marco Nicoletto¹, Demis Boschetti¹, India Patrizia Savi² ²Indian Institute of Technology, India ¹Thales Alenia Space Italia, Italy; ³Monash University, India

²Politecnico di Torino. Italy

10:50–12:10	OS 8D: Numerical EMC 4 Session Chair: Jonas Ekman, Luleå tekniska universitet, Sweden and Giulio Antonini, Università degli Studi dell'Aquila, Italy Location: F1	
10:50	Estimation of HIRF transfer functions by a leap-frog discontinuous Galerkin method Jesus Alvarez ² , Luis Angulo ¹ , Amelia Rubio-Bretones ¹ , Salvador Gonzalez Garcia ¹ ¹ Universidad de Granada, Spain ² Airbus Defense and Space, Spain	
11:10	An Approach on Quality Assurance in Computational Electromagnetics Sebastian Lange, Martin Schaar- schmidt, Frank Sabath Bundeswehr Research Center for Protective Technologies – NBC Protection, Germany	
11:30	Analytical Calculation of the Magnetic Field Radiated by A CM Coil Using Conformal Mapping Methods Pierre-Etienne Lévy, François Costa, Cyrille Gautier, Bertrand Revol SATIE, France	
11:50	Prediction of Near Field EMI Interference in Power Converters via the Induced EMF Method Leonardo Sandrolini, Ugo Reggiani, Marco Landini University of Bologna, Italy	

10:50-12:10 **OS 17B:**

Low Frequency EMC 2

(Supported by IEEE EMCS TC 7) Session Chair: Magnus Olofsson, Elforsk – Swedish Electrical Utilities' R & D Company, Sweden and David William Philip Thomas, The University of Nottingham, United Kingdom

Location: F2

10.50

Emission in the Frequency Range of 2kHz to 150kHz caused by electrical vehicle charging <u>Stefan Schoettke</u>¹, Jan Meyer¹, Peter Schegner¹, Sebastian Bachmann² ¹Technische Universitaet Dresden, Germany ²Belectric Drive, Germany

11:10 Background Voltage Distortion and Percentage of Nonlinear Load Impacts on the Harmonics Produced by a Group of Personal Computers Muhyaddin Jamal H Rawa, David W. P. Thomas, Mark Sumner

David W. P. Thomas, Mark Sumner The University Of Nottingham, United Kingdom

11:30 Experimental investigations of the input common mode impedance of a motor and its cable up to 1GHz <u>Anne Roc'h</u>¹, Frank Leferink^{2,3} ¹Technical University of Eindhoven, The Netherlands ²Thales Nederland, The Netherlands ³University of Twente, The Netherlands

11:50 PQ Versus EMC Problems at a Static Excitation System in a Power Group Petre-Marian Nicolae, Dinut-Lucian Popa, Marian-Stefan Nicolae University of Craiova, Romania

Thursday September 4

10:50–12:10 **OS 20A: PCB 1**

Session Chair: Pierre Degauque, University of Lille, France Location: F3

- 10:50 Radiated Emission from Signal Traces Changing Reference Planes Marcel Van Doorn Philips Innovation Services, The Netherlands
- 11:10 Asymmetrical PCB Interconnect Tree Modelling with Coupling Effect Blaise Ravelo IRSEEM, France
- 11:30 Forward Wave Analysis of Vertical Distribution of Power Supply Noise in Multilayer PCB <u>Umberto Paoletti</u>, Yasumaro Komiya, Takashi Suga, Hideki Osaka

Hitachi, Ltd., Japan Susceptibility Analysis of an

11:50 Susceptibility Analysis of an Operational Amplifier Using On-Chip Measurement He Huang¹, Alexandre Boyer1,

Sonia Ben Dhia¹, Bertrand Vrignon² ¹LAAS/CNRS & INSA Toulouse, France ²Freescale Semiconductor, Inc., FranceFreescale Semiconductor, Inc.

10:50-12:10 OS 22A: EMC Measurements 1

Session Chair: Christopher Holloway, NIST, United States of America Location: F4

10:50 **Reference test object for on site** HIRF test set up verification <u>Wilfrid Quenum</u>¹, Jean-Philippe Pamantier¹, Olivier Verstraete², Dominique Lemaire², Frédéric Therond² ¹ONERA, France ²AIRBUS Operations S.A.S, France

11:10 Electromagnetic Susceptibility Assessment of Controller Area Networks Michele Fontana¹, Flavio G.

Canavero¹, Richard Perraud² ¹Politecnico di Torino, Italy ²Airbus Group Innovation, France

11:30 Measurement Uncertainty and Cable Balance – with implications for the CDNE and CMAD <u>Richard Carlile Marshall¹</u>, David M Lauder² ¹Richard Marshall Limited, United Kingdom ²University of Hertfordshire, United Kingdom

11:50 Analysis of Termination Impedance Influence to Radiated Emission from AC Cable with CMAD Nobuo Kuwabara¹, Takuto Naka-

nishi¹, Kunihiro Osabe², Hidenori Muramatsu³

¹Kyushu Institute of Technology, Japan ²Voluntary EMC Laboratory Accreditation Center, Japan ³VCCI Council, Japan

12:30 -14:30 Poster 3: Poster Session 3

Session Chair: Christer Karlsson, SP Technical Research Institute of Sweden, Sweden Location: Exhibition Area

Theoretic and Experimental Analysis of a Reflector-backed Dipole Antenna for 1-3 GHz EMC Test

<u>Qi Wu</u>, Xiaojing Ding, Donglin Su Beihang University, People's Republic of China

The detection of counterfeit integrated circuit by the use of electromagnetic fingerprint <u>He Huang</u>, Alexandre Boyer, Sonia Ben Dhia LAAS/CNRS & INSA Toulouse, France

Improvement of Experimental System for Tracking the Threshold of Perception Currents

<u>Yoshitsugu Kamimura</u>¹, Akira Yamashita¹, Madoka Yamazaki², Setsu Enomoto²,-Yoshikazu Ugawa² ¹Utsunomiya Unversity, Japan ²Fukushima Medical University, Japan

Anechoic Chamber for Use in Frequency Range from MHz to GHz Constructed with Absorbers Featuring a New Design Concept

Atsuya Maeda¹, <u>Jongsoo Yoon²</u>, Sunghyuk Yoon², Hyungpyo Kim², Younggoo Lee² ¹A. Maeda Associates, Inc., Japan ²SK Tech Co., Ltd., Republic of Korea (South Korea)

Electromagnetic simulation to predict EMC immunity behavior of an aeronautic board

<u>Adil El abbazi</u>¹, Anas jaber¹, Vincent FON-TAINE², Christian Marot³ ¹SERMA, France ²Airbus, France ³Airbus GROUP-IW, France

Effect of High Temperature Ageing on Electromagnetic Emissions from a PIC Microcontroller

<u>John Dawson</u>¹, Ian Flintoft¹, Alistair Duffy², Andy Marvin¹, Martin Robinson¹ ¹University of York, United Kingdom ²De Montfort University, United Kingdom

Investigation of Low Repeatibility in Pamameters Measurement of Non-Conducted Electrostatic Discharge

<u>Fangming Ruan</u>¹, Wei Zhu¹, Guangcan Li², Xiangdong Yang¹ ¹Guizhou Normal University, People's Republic

of China

²Guizhou aerospace Institute of metrology and measurement, People's Republic of China

Cardiac pacemakers and electromagnetic fields: comparison of experimental results in France and Finland

<u>Isabelle Magne</u>¹, Leena Korpinen², Martine Souques³ ¹EDF R&D, France; ²Tampere University of Technology, Finland; ³EDF, France

Impedance Impact On Indoor Narrowband Power Line Channel

Anouar Achouri^{1,2}, Jean-Charles Lebunetel², Yves Raingeaud², Richard Nizigiyimana² 'Laboratoire des Applications Numèriques, France ²University of Tours, France

Study of Jamming Countermeasure

for Electromagnetically Leaked Digital Video Signals

<u>Tae-Lim Song</u>, Jong-Gwan Yook Yonsei University, Republic of Korea (South Korea)

Performance analysis of a power network Counter-TEMPEST filter in realistic cabling scenarios

<u>Chaouki Kasmi</u>^{1,2}, Damien Coiffard¹, Marc Hélier², Muriel Darces² ¹French Network and Information Security Agency - ANSSI, France ²Sorbonne Universités, France **Inductive Analysis of**

A Multiconductor System Prototype Fadi Abdallah Lund University, Sweden

Capacitors mutual inductance modeling and reduction

Gundars Asmanis, Deniss Stepins, <u>Aivis Asmanis</u>, Leonids Ribickis Riga Technical University, Latvia

Practical examples of underground mining equipment lack of electromagnetic compatibility

<u>Karolina Natalia Spalt</u>, Marek Kaluski, Marek Piotr Michalak, Monika Ewelina Szafranska National Institute of Telecommunications, Poland

New testing-method for smart sensors during design-process for EMC IC-Measurements

<u>Christian Spindler</u> Robert Bosch GmbH, Germany

Wireless Power Transmission Characteristics for Implantable Devices inside a Human Body

SangWook Park¹, HaeLyong Kim¹, JunHo Cho¹, EunHa Kim¹, SeoCheol Jung² ¹Korea Automotive Technology Institute, Republic of Korea (South Korea) ²Chungnam National University, Republic of Korea (South Korea)

Use of Independent Component Analysis to Separate Noise Sources in Emissions Radiated from LED Lamps

<u>Kaoru Gotoh</u>, Ifong Wu, Shinobu Ishigami, Yasushi Matsumoto NICT, Japan

The radiated EMI noise modeling and features analysis on the basis of Smart Grid Equipments

Yang Zhao¹, Yong Liu¹, Shijin Li¹, Wei Yan¹, Xiaohui Qiu², Xueli Chen¹, Jingrui Yan¹ ¹Nanjing Normal University, People's Republic of China

²Southeast University, People's Republic of China

Power quality and EMC solutions in micro grids with energy-trading capability

Vladimir Belov¹, Anna Butkina¹, Feodor Bolschikov², Peter Leisner^{3,4}, Ilja Belov⁴

¹Mordovian State University, Russian Federation ²Convertor Ltd., Russian Federation ³SP Technical Research Institute of Sweden, Sweden ⁴Use Vision University, Sweden

⁴Jönköping University, Sweden

The mobile experimental complex for study of electromagnetic fields generated in a wide frequency range in an industrial environment

Vasily Yu. Belashov^{1,2}, Artur I. Asadullin² ¹Kazan (Volga Region) Federal University, Russian Federation ²Kazan State Power Engineering University, Russian Federation

A Study of a Measuring Method for EMF Distributions Using the Kinect Sensor

<u>Ken Sato</u>¹, Yoshiyuki Takasu², Yoshitsugu Kamimura² ¹Tohoku Gakuin University, Japan ²Utsunomiya University, Japan

14:30–15:50	OS 9C: Reverberation Chambers 3 Session Chair: Perry F. Wilson, NIST, United States of America and Luk R. Arnaut, University of Nottingham, United Kingdom Location: F1	14:30–15:50	OS 18A: Transmission Lines 1 Session Chair: Alexander P.J. van Deursen, Eindhoven University of Technology, The Netherlands and Marcello D'Amore, Sapienza University of Rome, Italy
14:30	Overiew of State-of-the-Art OTA Measurements of Wireless Devices in Reverberation Chamber Xiaoming Chen ¹ , Per-Simon Kildal ¹ , Ahmed Hussian ¹ , Jan Carlsson ² ¹ Chalmers University of Technology, Sweden	14:30	Crosstalk modelling of unshielded wire pairs Jesper Lansink Rotgerink, Harmen Schippers National Aerospace Laboratory, The Netherlands
14:50	 ²SP Technical Research Institute of Sweden, Sweden Using the System Linearity of Reverberation Chambers to Derive an Equivalent Baseband Model in Time-Domain to Predict the Chamber Response to an Input Signal <u>Tim Artz</u>, Holger Hirsch University Duisburg-Essen, Germany 	14:50	Probability of Extreme Interference Levels Computed from Reliability Approaches: Application to Transmission Lines with Uncertain Parameters Mourad Larbi ^{1,2} , Philippe Besnier ¹ , Bernard Pecqueux ² ¹ Institute of Electronics and Telecom- munications of Rennes (IETR)/ INSA of Rennes, France ² CEA, France
15:10	Evaluation of Effects on Electro- magnetic Field Characteristics Inside Aircrafts Due to Phenol Internal Structures Using Reverberation Chamber Shunichi Futatsumori ¹ , Kazuyuki Morioka ¹ , Akiko Kohmura ¹ , Naruto Yonemoto ¹ , Masami Shirafune ² , Takashi Hikage ² , Toshio Nojima ² ¹ Electronic Navigation Research Institute, Japan ² Hokkaido University, Japan	15:10 15:30	Broadband Field Coupling Model of Transmission Lines based on Foster-Type Equivalent-Circuit Andreas Mantzke, Marco Leone University of Magdeburg, Germany Measurement of the Stochastic Electromagnetic Field Coupling to an Unshielded Twisted Pair Cable Mathias Magdowski ¹ , John Ladbury ² , Christopher Holloway ² , Ralf Vick ¹
15:30	Effect of losses on the maximum- to-mean value in a mode-stirred reverberation chamber <u>Gabriele Gradoni</u> ¹ , Franco Moglie ² , Valter Mariani Primiani ² ¹ University of Nottingham, United Kingdom; ² Università Politecnica delle Marche, Italy		¹ Otto-von-Guericke-University, Germany ² National Institute of Standards and Technology, United States of America

Thursday September 4

14:30–15:50 **OS 20B: PCB 2**

Session Chair: Flavio Canavero, Politecnico di Torino, Italy and Francescaromana Maradei, Sapienza University, Italy

Location: F3

 14:30 A Compact Common-Mode Suppression Filter Using Modified Ground Structure for High Speed Digital Interconnects on Multi-layered PCB Ho Seong Lee¹, Tae-Wan Koo¹, <u>Tae-Lim Song¹</u>, Jong-Gwan Yook¹, Kyungho Yoo², Jeongnam Cheon², Shinyoung LEE² ¹Yonsei University, Republic of Korea (South Korea) ²Samsung Electronics, Republic of Korea (South Korea)

14:50 Modeling of Differential Line Referenced to a Meshed Ground Plane

<u>Fengchao Xiao</u>¹, Kimitoshi Murano², Yoshio Kami¹ ¹University of Electro-Communications, Japan ²Tokai University, Japan

15:10 Effect of PDN variations of PCB with active components on unwanted emission <u>O Tereshchenko</u>¹, F.J.K. Buesink¹, F.B.J. Leferink^{1,2}

¹University of Twente, The Netherlands ²Thales Nederland B.V., The Netherlands

15:30 Circuit Modelling of Printed Circuit Boards for a DC-DC Converter Design

Raul Blecic^{1,2}, Renaud Gillon³, Bart Nauwelaers², Adrijan Baric¹ ¹University of Zagreb, Croatia ²KU Leuven, Belgium ³ON Semiconductor, Belgium

14:30–15:50 OS 22B: EMC Measurements 2

Session Chair:

Jan Luiken ter Haseborg, Hamburg University of Technology, Germany and Hans Georg Krauthäuser, Technische Universität, Dresden, Germany Location: F4

14:30 APD radiated transient measurements produced by electric sparks employing time-domain captures <u>Marc Pous</u>, Ferran Silva GCEM-UPC, Spain

14:50 Effectiveness Evaluation of Devices for AC Mains Cable Termination Control to Improve Reproducibility of Radiated Emission Measurement Shinichi Okuyama¹, Kunihiro Osabe², Katsuyuki Tanakajima³, Hidenori Muramatsu⁴ ¹NEC AccessTechnica, Ltd., Japan ²Voluntary EMC Laboratory Accreditation Center Inc., Japan ³Intertek Japan K.K., Japan ⁴VCCI Council, Japan

- 15:10 Estimating Maximum E-Field Values of Radiated Emission Measurements? Frank Schröder, Hans Georg Krauthäuser, Karl-Heinz Gonschorek TU Dresden, Germany
 - 15:30 Complex Principal and Independent Component Analyses of Radiated Emissions for the Time-Frequency Domain Luk R. Arnaut, Dave W. Thomas, Chijioke S. Obiekezie University of Nottingham, United Kingdom

16:20–17:40	OS 9D: Reverberation Chambers 4 Session Chair: Perry F. Wilson, NIST, United States of America and Luk R. Arnaut, University of Notting- ham, United Kingdom Location: F1	16:20–17:40	OS 18B: Transmission Lines 2 Session Chair: Alexander P.J. van Deursen, Eindhoven University of Technology, The Netherlands, and Marcello D'Amore, Sapienza University of Rome, Italy Location: E2
16:20	The Role of Random Wave Impedance in Electric Field Estimations Inside Reverberation Chambers Ramiro Serra, Rob Mestrom Technische Universiteit Eindhoven, The Netherlands	16:20	Statistical Investigation of a Field Coupling to Random Twisted Pair Using Design of Experiment Tarek Bdour, Alain Reineix, Christophe Guiffault XLIM, France
16:40	OTA Device Sensitivity in the Presence of Interference Measured in a Reverberation Chamber Patrik Svedjenäs ¹ , Klas Arvidsson ¹ , <u>Robert Rehammar¹</u> , Weiming Dong ² , Charlie Orlenius ¹ ¹ Bluetest, Sweden	16:40	Delayed Impedance Models of Two-Conductor Transmission Lines Maria De Lauretis ¹ , Jonas Ekman ¹ , Giulio Antonini ² ¹ Luleå tekniska universitet, Sweden; ² Università degli Studi dell'Aquila, Italy
17:00	² Chalmers University of Technology, Sweden Experimental Extreme Field Strength Investigation in Reverberant Enclosures	17.00	using perturbation theory <u>Fabian Ossevorth</u> , Hans Georg Krauthauser Technische Universität Dresden, Germany
	Robert Vogt-Ardatjew ¹ , Stefan van de Beek ¹ , Frank Leferink ^{1,2} ¹ University of Twente, The Netherlands ² Thales Nederland B.V., The Netherlands	17:20	Comparison of Simulation and Measurements of Time-Domain Field-to-Line Coupling in TEM Cell Tvrtko Mandic ¹ , Branimir Pejcino- vic ² Adriian Baric ¹
17:20	Measured Probability Distribution of the Quality Factor of a Reverberation Chamber Luk R. Arnaut ¹ , Mihai I. Andries ² , Jerome Sol ³ , Philippe Besnier ³ ¹ University of Nottingham, United Kingdom ² Institut Français des Sciences et Technologies des Transports, France ^a Institut d'électronique et de télécom- munications de Rennes, France		¹ University of Zagreb, Croatia; ² Port- land State University, United States of America

Thursday September 4

16:20–17:40	OS 20C: PCB 3 Session Chair: Flavio Canavero, Politecnico di Torino, Italy and Francescaromana Maradei, Sapienza University, Italy Location: F3	16:20–17:40
16:20	Development of Electronic Board Conducted Emissions Model EBEM-CE Using The Bottom-Up Approach Amine Hamouda ¹ , Zouheir Riah ¹ , Fabien Ndagijimana ² ¹ IRSEEM/ESIGELC, France ² IMEP-LAHC, France	16:20
16:40	An EMI Measurement Setup for Un-buffered DRAM PCBs <u>Mojtaba Joodaki</u> , Amir Attar Ferdowsi University of Mashhad, Islamic Republic of Iran	16:40
17:00	Radiated Spurious Emission Reduction Using Parasitic Element for Mobile Applications Tae-Wan Koo ¹ , Ho-Seong Lee ¹ , Jong-Gwan Yook ¹ , Kyungho Yoo ² , Jeongnam Cheon ² , ShinYoung LEE ² ¹ Yonsei university, Republic of Korea (South Korea) ² Samsung Electronics co., Republic of Korea (South Korea)	17:00
17:20	Ferrite-covered Open Stub as Lossy Resonator Filter for Suppressing Noise Propagation in Power Bus Yoshitaka Toyota ¹ , Kengo lokibe ¹ , Koichi Kondo ² , Shigeyoshi Yoshida ² ¹ Okayama University, Japan ² NEC TOKIN Corporation, Japan	17:20

:20-17:40 OS 22C: EMC Measurements 3 Session Chair:

> Jan Luiken ter Haseborg, Hamburg University of Technology, Germany and Hans Georg Krauthäuser, Technische Universität, Dresden, Germany

Location: F4

- 16:20 **Time-Domain Electromagnetic** Interference Measurement System for intermitent disturbances Gerard Costa, Marc Pous, Andreu Atienza, <u>Ferran Silva</u> GCEM-UPC, Spain
- 16:40 S-parameter Estimation for a Multiport Connection and a Multiport Device with Non-common Ground Noboru Maeda¹, Shinji Fukui¹, Toshikazu Sekine², Yasuhiro Takahashi² ¹Nippon Soken, Inc., Japan ²Gifu University, Japan
- 17:00 Development of measuring aparatus for conducted disturbance voltage by using TEM cell up to 1 GHz Shinobu Ishigami, Kaoru Gotoh, Ifong Wu, Yasushi Matsumoto National Institute of Information and Communications Technology, Japan
- 17:20 Transfer Impedance Measurements and Simulations on perforated Fully-Rigid Coaxial Cables with the Line Injection and the Triaxial Method Karsten Kreisch¹, Stephan Kubitzek¹,

Christian Hofmeister¹, Jörg Bärenfänger¹, Michael Schugt² ¹EMC Test NRW GmbH, Germany ²University of applied sciences of Bochum, Germany



Gothenburg City Map

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The Conference Venue



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Lunch Restaurant



Exhibition Plan



Entré 2

Exhibitor list

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Albatross Projects	Ex:02	
All-Russia Research Institute	Ex:12	
of Automatics – VNIIA		
Altair Engineering GmbH	Ex:22	
Amska	Ex:14	
Calcom ESI SA	Ex:04	
Ce-Bit Elektronik AB	Ex:26	
Combinova Marketing AB	Ex:24	
Compomill Nordic Components AB	Ex:09	
Comtest Engineering	Ex:25	
CST AG	Ex:19	
Detectus AB	Ex:27	
EG Electronics AB	Ex:35	
EM TEST GmbH	Ex:10	
EMC Hire	Ex:37	
EMCoS	Ex:06	
EMP-Tronic AB	Ex:33	
ETS Lindgren GmbH	Ex:32	
Flexitron AB	Ex:07	
Haefely Hipotronics	Ex:11	
IEEE EMC Society	Ex:31	
Ing.firman Gunnar Petterson Aktiebolag	Ex:03	
Jan Linders Ingenjörsfirma	Ex:36	
Jolex AB	Ex:05	
Jones Tech PLC	Ex:13	
Kamic	Ex:34	
Keysight Technologies	Ex:32	
Microwave Vision	Ex:28	
MTT Design & Verification AB	Ex:20	
Nolato Silikonteknik AB	Ex:30	
Ornatus AB	Ex:08	
Proxitron AB	Ex:10	
RF Partner AB	Ex:38	
Rohde & Schwarz Sverige AB	Ex:02	
Ronshield AB	Ex:21	
Roxtec International AB	Ex:29	
Saab AB	Ex:01	Last undated
SP Elektronik	Ex:23	August 13, 2014



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Ex:07

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Ex:34

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- 2015 Dresden, Germany
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- 2018 Beijing, China

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