EMC Europe 2022
International Symposium on Electromagnetic Compatibility
September 5-8, 2022, Gothenburg, Sweden

CONFERENCE PROGRAMME

www.emceurope2022.org
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Welcome from Jan Carlsson, Conference Chairman

LADIES AND GENTLEMEN, DEAR DELEGATES

After two years of EMC Europe events in the virtual domain, it is a great honour and pleasure for me to welcome you all to Gothenburg and EMC Europe 2022. I hope you will have a fruitful and successful conference and will enjoy your stay in our great city.

Gothenburg got its town privileges in 1621, so last year we celebrated Gothenburg’s 400th anniversary. The city’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 2022.

During the week, we look forward to the three keynote speeches given by Dr. Robert Kebel, Germany, Prof. Maria Feychting, Sweden, and Dr. 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 the 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, that make the event a success.

It should be remembered that a conference is not all about work, you must 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 of EMC Europe 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 the EMC Europe conference will be arranged in Krakow, Poland. Our colleagues there are already hard at work on this event, and I wish them all success. I am looking forward to meeting you all there again next year.

PROF. JAN CARLSSON
Conference Information/Social Events

General information/further information
EMC Europe 2022 website:
www.emceurope2022.org

EMC Europe 2022 Conference Venue
Svenska Mässan - The Swedish Exhibition and Congress Centre
Mässans Gata/Korsvägen
SE-412 94 Göteborg, Sweden
Phone: +46 31 708 8000
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 2022 has got a wireless network. For accessing this free of charge network, please use Network name: EMC2022 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 restaurant Seasons 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 Heaven 23, on floor 23. The bistro West Coast, and Corner.

There are several restaurants and cafes in the Swedish Exhibition & Congress Centre and Gothenburg 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 6
Time: 18:00–20:00

THE CITY OF GOTHENBURG sponsors a welcome reception on Tuesday September 6 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 7
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
General Information

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 Västrafik, 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, 200, 500 and 1000 Krona, and coins in denominations of 1, 5 and 10 Krona. The Krona is about ten Krona to a Euro or ten Krona to a Dollar. For an update on exchange rates please look up www.valuta.se.

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”. All 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 15°C (59°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 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 Vällgatan and Magasingsgatan 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

Jan Carlsson, Conference Chair
Torbjörn Persson, Conference Co-Chair
Kia Wiklundh, Technical Program Chair
Peter Stenumgaard, Technical Program Co-Chair
Dan Wallander, Exhibition & Sponsorship Chair
Björn Bergqvist, Tutorial & Workshop Chair
Tomas Bodeklint, Tutorial & Workshop Co-Chair
Outstanding perspectives

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www.rohde-schwarz.com/ad/emc
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Canavero F. G. (Italy)
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Deutschmann B. (Austria)
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Garbe H. (Germany)
Joskiewicz Z. (Poland)
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### Reviewers Board

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<td>Yamaguchi Masahirovi</td>
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<td>Sweden</td>
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<td>Zielinski, Ryszard J.</td>
<td>Poland</td>
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</table>
Vinn is a platform for starting up new, innovative service providers. We are a group of specialist companies and individuals with high-calibre expertise assembled in a creative environment. Through faster, better development, Vinn seeks to work alongside employees and customers to achieve success, and in the long-term, create a better world.
**Keynote Speakers**

**Dr. Robert Kebel**

ROBERT KEBEL was appointed Expert in EMC and lightning protection in 2008. He is leading industrial standardization in EMC and aviation (EUROCAE WG99/RTCA SC234 and WG58/SC202) and guided the first integration and certification of radio connectivity systems into the aircraft cabin. Since August 2001 Dr. Kebel is with Airbus in Hamburg, where he is in charge of electromagnetic compatibility and lightning protection. After his PhD in 1999 Dr. Kebel joined EADS Germany’s military aircraft section, where his responsibilities were in the field of signature technology. In 1997 he prepared an EMC test laboratories accreditation. From 1995 to 1998 he was research assistant at the university’s institute for basic electromagnetics in Hanover and the German army’s university in Hamburg. During this period he also lectured transmission line theory at the Hanover University of Applied Sciences. In parallel he was working as a consultant in EMC design of electronics. Born in 1967 in Hanover, he studied electrical engineering at Hanover University where he graduated 1995 in control systems engineering and specialized in electromagnetic compatibility. He is author of numerous publications in the field of electromagnetic compatibility and lightning protection. Dr. Kebel is an IEEE senior member and distinguished lecturer of the IEEE EMC society. He also is associate editor of the IEEE Letters on Electromagnetic Compatibility Practice and Applications.

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**Conducted EMI of an Inverter-Driven Electric Power Train**

**ABSTRACT:** Due to the electrification in mobility applications, electric (high) power trains become an increasingly important subject of investigating EMI. This talk provides an overview about the systematic root cause of electromagnetic conducted emissions of a power train. Direct current (DC) power sources such as batteries or fuel cells provide the energy for propulsion. Alternating current (AC) electric engines drive the vehicle, because AC engines have advantages in maintenance and reliability. Pulse-width modulating (PWM) inverters convert DC into AC voltages. PWM technology can lead to significant electromagnetic interference (EMI) issues pending e.g. on power level and more electric parameters, which should be chosen early for mitigating the EMI risk. A simple predictive simulation model supports taking integration decisions in view of the EMI risk. Typical power levels for smaller aircraft power trains start at 100 kW; levels up to some 10 MW are necessary for the propulsion of large transport aircraft. Fast switching inverters converting high power levels imply a high dV/dt and a significant EMI potential in common mode (CM). Besides filtering and shielding, a number of electric architecture decisions can mitigate EMI. This requires performing some basic predictive calculations

This talk will also show how the choice of the inverter and the choice of the power system (IT versus TN network) limits or exacerbates interference. Crosstalk to wiring looms routed adjacently to power train AC cables will further illustrate the effects and provide options for an optimization of a power train from an EMI point of view.
EMC EUROPE 2022 • GOTHENBURG, SWEDEN

Prof. Maria Feychting

**MARIA FEYCHTING** is Professor of Epidemiology at Karolinska Institutet, Institute of Environmental Medicine, and Head of the Unit of Epidemiology. Her research is focused on risk factors for chronic diseases, primarily cancer but also other chronic diseases. She has a specific interest in childhood cancer and adult brain tumors, both in terms of risk factors such as environmental and genetic factors. She has conducted research on potential health effects of non-ionizing radiation since the late 1980s, and she is the PI for the Swedish parts of the Interphone study, the Cefalo study, the Sotan study and the COSMOS study. She has published over 300 original articles, brief communications, review articles, editorials, letters, and book chapters, with ~ 250 listed in PubMed, and a WoS h-index of 59. She participates in the work of the WHO EMF programme and has been invited expert in several national and international health risk assessment expert groups. She was member of the International Commission on Non-Ionizing Radiation Protection (ICNIRP) during 2008 to 2020 and vice chairman 2012-2020. ICNIRP is an independent body suggesting science-based guidelines for non-ionizing radiation protection, which are used by many countries.

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**Radiofrequency Fields from Mobile Phone Technologies and Health**

**ABSTRACT:** The introduction of handheld mobile phones in the late 1980s has increased the exposure to radiofrequency fields (RF) in the general population. With each new generation of mobile phone technology, RF exposure levels from mobile phone handsets have become lower, and environmental levels from base stations only a fraction of that from handsets. Deployment of 5G at frequency levels used by older technologies is not expected to change this pattern; although exposure levels need to be continuously monitored as the technology develops. Each new generation of wireless technology has led to concern about potential health effects, and 5G is no exception. Most attention has been given to potential cancer risks and to health outcomes such as unspecific symptoms reported by persons who perceive themselves as hypersensitive to electromagnetic fields.

Overall, scientific research has not found support for a causal link between radiofrequency fields and the unspecific symptoms reported. For cancer outcomes, the evidence of an increased risk is also weak; however, in 2011 the International Agency for Research on Cancer (IARC) classified radiofrequency electromagnetic fields as possibly carcinogenic, mainly based on findings in a few epidemiological case-control studies on mobile phone use and brain tumor risk. Although time trend studies saw no increase in the occurrence of these tumors despite a considerable increase in the prevalence of RF exposure over a short time period, the IARC working group believed these studies covered a too short time period to be informative.

Since the IARC evaluation, additional case-control studies and prospective cohort studies have been published, as well as a considerable number of incidence time trend studies from different countries, covering a much longer time period. For 5G at frequency levels similar to earlier mobile phone generations, health risk assessment can learn from comprehensive research conducted over the past decades, whereas for higher frequency ranges, such as 26 GHz, fewer data are available. This presentation will summarize the evidence from epidemiological studies available to date.
The Quest for Fundamentally New SI-Traceable Measurement Techniques and the Development of New Sensing Capabilities

**ABSTRACT:** The quest of Christopher Holloway to understand and develop fundamentally new measurement methods started when he was pursuing his undergraduate degree and continues to this day.

One of the keys to developing new science and technologies is to have sound metrology tools (i.e., measurement tools) and techniques. A stated goal of international metrology organizations, including the National Institute of Standards and Technology (NIST), is to make all measurements traceable to the International System of Units (SI). The world of measurement science is changing rapidly with the SI redefinition that occurred in 2018. As a result of the shift towards fundamental physical constants, the role of primary standards and measurements must change. Atom-based measurements allow for direct SI-traceable measurements, and as a result, measurement standards have evolved towards atom-based measurements over the last few decades; most notably length (m), frequency (Hz), and time (s) standards. Recently, there has been a great interest in extending this to magnetic and electric (E) field sensors. Fundamental to all electromagnetic/communication measurements is having accurately calibrated probes, antennas, and power meters in order to measure either electric (E) fields or power.

In the past 10 years, we have made great progress in the development of a fundamentally new direct SI-traceable approach based on Rydberg atoms (traceable through Planck’s constant, which is now an SI defined constant). The Rydberg atom-based sensors now have the capability of measuring amplitude, polarization, and phase of the RF field. As such, various applications are beginning to emerge. These include SI-traceable E-field probes, power-sensors, voltage standards, receivers for communication signals (AM/FM modulated and digital phase modulation signals), and even the recording of musical instruments. In fact, this new atom-based technology has allowed for interesting and unforeseen applications. These new Rydberg atom-based sensors will be beneficial for 5G and beyond in that they will allow for the calibrations of both field strength and power for frequencies above 100 GHz. In this talk, I will lead us on a historical journey of the development of this approach, and in the process, I will summarize this work and discuss various applications.

In this talk, I will also introduce the National Institute of Standards and Technologies (NIST) and discuss what NIST does and discuss why international measurement standards are important.
Noise free e-mobility

E-Mobility is no longer a question of tomorrow and the number of e-vehicles is increasing day by day. Handling EMI noise is becoming more and more crucial, when it comes to design new electronic devices and systems. Würth Elektronik offers a wide range of EMC components, which support the best possible EMI suppression for all kinds of e-mobility applications. With an outstanding design-in support, catalogue products ex stock and samples free of charge, the time to market can significantly be accelerated. Besides ferrites for assembly into cables or harnesses, Würth Elektronik offers many PCB mounted ferrites and common mode chokes as well as EMI shielding products.

www.we-online.com/emobility

- Large portfolio of EMC components
- Design-in-support
- Samples free of charge
- Orders below MOQ
- Design kits with lifelong free refill

#EMCFOREMOBILITY
## Programme Overview EMC Europe 2022 – Gothenburg

**Date: Monday, 05/Sept/2022**

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Location</th>
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<tbody>
<tr>
<td>9:00am</td>
<td><strong>WS-01A: Automotive EMC</strong></td>
<td>G1</td>
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<tr>
<td>10:40am</td>
<td><strong>WS-04A: You had me at “Reverb”...!</strong></td>
<td>G2</td>
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<tr>
<td>10:40am</td>
<td><strong>WS-06A: Innovative Wireless Test Methodologies for 5G NR and mmWave Applications</strong></td>
<td>G3</td>
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<tr>
<td>10:40am</td>
<td><strong>WS-07A: EMC aspects of electrification of the society</strong></td>
<td>J1</td>
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<tr>
<td>10:40am</td>
<td><strong>WS-08: The art of filter design in EMC</strong></td>
<td>J2</td>
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<tr>
<td>10:40am</td>
<td><strong>WS-11: ANSI C63.25.3 EMC Test Site Validation in 18 to 40 GHz</strong></td>
<td>R5</td>
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<tr>
<td>10:40am</td>
<td><strong>WS-01B: Automotive EMC</strong></td>
<td>G1</td>
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<tr>
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<tr>
<td>11:10am</td>
<td><strong>WS-09A: Why are EM field emission/millimeter EMC tests so tricky?</strong></td>
<td>J2</td>
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<tr>
<td>11:10am</td>
<td><strong>WS-10A: Why are radiated emission/immittance EMC tests so tricky?</strong></td>
<td>J2</td>
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<tr>
<td>11:10am</td>
<td><strong>WS-12: Development of a GB-Ethernet Interface under EMC Aspects</strong></td>
<td>R5</td>
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<tr>
<td>11:10am</td>
<td><strong>WS-14: Spread Spectrum Clocking (SSC) to overcome EMI issues</strong></td>
<td>R6</td>
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<tr>
<td>12:50pm</td>
<td><strong>WS-02: Measurements on High Power Charging - Fast charging equipment for e-Cars</strong></td>
<td>G1</td>
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<tr>
<td>12:50pm</td>
<td><strong>WS-04C: You had me at “Reverb”...!</strong></td>
<td>G2</td>
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<tr>
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<td><strong>WS-06C: Innovative Wireless Test Methodologies for 5G NR and mmWave Applications</strong></td>
<td>G3</td>
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<tr>
<td>12:50pm</td>
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<td>J1</td>
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<td>J2</td>
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<tr>
<td>12:50pm</td>
<td><strong>WS-13A: EMC simulation workflow for Electrification Applications</strong></td>
<td>R5</td>
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<tr>
<td>12:50pm</td>
<td><strong>WS-15A: Risk-based EMC implementation with examples</strong></td>
<td>R6</td>
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<tr>
<td>3:40pm</td>
<td><strong>WS-03: EMC on humans</strong></td>
<td>G1</td>
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<tr>
<td>4:10pm</td>
<td><strong>WS-05: Device Measurements in Reverberation Chambers</strong></td>
<td>G2</td>
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<tr>
<td>4:10pm</td>
<td><strong>WS-07B: Innovative Wireless Test Methodologies for 5G NR and mmWave Applications</strong></td>
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<td>4:10pm</td>
<td><strong>WS-15B: Risk-based EMC implementation with examples</strong></td>
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<tr>
<td>6:00pm</td>
<td><strong>ME-01: ISC Meeting</strong></td>
<td>G1</td>
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<tr>
<td>6:00pm</td>
<td><strong>ME-02: IEEE EMC-Society Sweden Chapter Meeting</strong></td>
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<tr>
<td>6:00pm</td>
<td><strong>ME-03: IEEE EMC-Society Chairs Meeting</strong></td>
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</table>

**Coffee Breaks:**
- 10:10am
- 11:30am
- 1:30pm
- 4:00pm
- 6:00pm

**Venue:**
- **Location:** Exhibition Area
- **Restaurant Area**
<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Location</th>
<th>Chair/Institution</th>
</tr>
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<tbody>
<tr>
<td>9:00am</td>
<td>OS-A: Opening ceremony</td>
<td>G3</td>
<td>Jan Carlsson, Provin, Sweden</td>
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<tr>
<td>9:40am</td>
<td>OS-B: Keynote 1 - Dr. Robert Keibel, Conducted EMI of an inverter-driven electric power train</td>
<td>G3</td>
<td>Kaj Wiklundh, FOI, Sweden</td>
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<tr>
<td>10:20am</td>
<td>F-02A: Coffee break</td>
<td>Exhibition Area</td>
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<tr>
<td>10:50am</td>
<td>OS-C: Keynote 2 - Prof. Maria Foychting, Radiofrequency fields from mobile phone technologies and health</td>
<td>G3</td>
<td>Mia Wiklundh, FOI, Sweden</td>
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<tr>
<td>11:30am</td>
<td>OS-D: Keynote 3 - Dr. Christopher Holloway, The Quest for Fundamentally New SI-Traceable Measurement Techniques and the Development of New Sensing Capabilities</td>
<td>G3</td>
<td>Christopher Holloway, FOI, Sweden</td>
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<tr>
<td>12:30pm</td>
<td>Poster: Poster session 1</td>
<td>Exhibition Area</td>
<td>Peter Strumpegaard, FOI, Sweden</td>
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<tr>
<td>2:30pm</td>
<td>SS-01A: Modelling and measurement of LF EMI</td>
<td>G1</td>
<td>Aram Ibrahim Madl, University of Zielona Gora, Poland</td>
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<tr>
<td>3:50pm</td>
<td>OS-01A: Wireless technologies</td>
<td>G2</td>
<td>Marc Pous, Universitat Politècnica de Catalunya, Spain</td>
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<tr>
<td>3:50pm</td>
<td>OS-02A: Shielding and filtering</td>
<td>G3</td>
<td>Valter Mariani Primiani, Università Politica Marche, Italy</td>
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<tr>
<td>4:20pm</td>
<td>F-02B: Coffee break</td>
<td>Exhibition Area</td>
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<tr>
<td>5:40pm</td>
<td>SS-01B: Modelling and measurement of LF EMI</td>
<td>G1</td>
<td>Aram Ibrahim Madl, University of Zielona Gora, Poland</td>
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<td>OS-01B: Wireless technologies</td>
<td>G2</td>
<td>Zbigniew Joklewicz, Wrocaw University of Science and Technology, Poland</td>
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<td></td>
<td>OS-02B: Shielding and filtering</td>
<td>G3</td>
<td>Philippe Bosnier, CNRS - UMR 6164 - IETR, France</td>
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## Programme Overview EMC Europe 2022 - Gothenburg

### Date: Wednesday, 07/Sept/2022

<table>
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<tbody>
<tr>
<td>9:00am</td>
<td>SS-02A: Risk-Based EMC</td>
<td>G1</td>
<td>Davy Pissaort, KU Leuven, Belgium</td>
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<td>Mohammad Kameli, KU Leuven, Belgium</td>
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<tr>
<td>10:20am</td>
<td>OS-03: Transmission lines</td>
<td>G2</td>
<td>Francesca Maradei, Sapienza University of Rome, Italy</td>
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<td>Frank Lelie UW, University of Twente, Netherlands, The</td>
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<td>10:20am</td>
<td>F-03A: Coffee break</td>
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<td>10:50am</td>
<td>SS-02B: Risk-Based EMC</td>
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<td>Anne Roch, Eindhoven University of Technology, The</td>
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<td>Pejman Mimar, KU Leuven, Belgium</td>
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<td>12:30pm</td>
<td>Poster-2: Poster session</td>
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<td>L-03: Lunch break</td>
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<tr>
<td>2:30pm</td>
<td>SS-04A: Stochastic Methods in EMC</td>
<td>G1</td>
<td>Vitor Mariani Primiani, Politecnica delle Marche, Italy</td>
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<td>3:00pm</td>
<td>F-03B: Coffee break</td>
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<td>5:00pm</td>
<td>OS-08: EMC in safety and security applications</td>
<td>G2</td>
<td>Frank Sabath, WIS, Germany</td>
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<td>5:00pm</td>
<td>OS-08B: Measurements</td>
<td>G1</td>
<td>Mohamed Ramdani, ESRO, France</td>
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<td>9:00am</td>
<td>OS-09: ESD</td>
<td>Diethard Hansen, Euro EMC Service, Switzerland</td>
<td>EMC: Electromagnetics</td>
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<td>10:20am</td>
<td>F-04A: Coffee break</td>
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<td>10:50am</td>
<td>OS-10: Lightning</td>
<td>Heyno Garbe, Leibniz Universität Hannover, Germany</td>
<td>Lightning</td>
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<td>12:30pm</td>
<td>L-04: Lunch break</td>
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<tr>
<td>2:30pm</td>
<td>OS-11: EMP</td>
<td>David Thomas, The University of Nottingham, United Kingdom</td>
<td>EMP: Electromagnetics</td>
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<td>3:30pm</td>
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<tr>
<td>3:50pm</td>
<td>OS-13B: Computational electromagnetics</td>
<td>Davy Plissou, KU Leuven, Belgium</td>
<td>Computer Electromagnetics</td>
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<td>4:20pm</td>
<td>F-04B: Coffee break</td>
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<td>Exhibition Area</td>
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<td>4:50pm</td>
<td>OS-12: Advanced materials and harmonic distortion</td>
<td>Jan Luiken, Technical University, Hamburg, Germany</td>
<td>Advanced Materials and Harmonic Distortion</td>
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<tr>
<td>5:40pm</td>
<td>OS-14: Power Electronics</td>
<td>Stefan Dickmann, Heimit Schmidt University, Germany</td>
<td>Power Electronics</td>
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<tr>
<td>6:40pm</td>
<td>OS-18: EMF, EMI and VSWR measurements</td>
<td>Alastair Ruddle, HORIBA MIRA Limited, United Kingdom</td>
<td>Electromagnetic Field and Exposure</td>
</tr>
</tbody>
</table>
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 improve constantly 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 standards, testing and measurements. The presentations in this workshop will cover EMC issues at system, subsystem, 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 electric/electronic component characterization.

**Agenda:**

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Chair(s)</th>
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<tbody>
<tr>
<td>09:00</td>
<td>Opening</td>
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<tr>
<td>09:00 - 09:30</td>
<td>1 - Methods For Reducing Resonances Of Vehicle Electrical Architectures Due To The Network Of Shielded Links And 0V Wires</td>
<td>Marco Klingler, Anass Samiri</td>
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<td>Stellantis, France</td>
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<td>09:30 - 10:00</td>
<td>2 - Methodology to Validate the Radiated Immunity of Very Complex Systems by a Succession of Simple Component Radiated Immunity Tests at System Level</td>
<td>Nadir Bedjiah, Marco Klingler, Moncef Kadi, Romain Rossi</td>
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<td>Stellantis, France, ESIGELEC, France</td>
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<td>10:00 - 10:30</td>
<td>3 - How to Measure the Test Level for ALSE Vehicle Testing</td>
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<td>Dr. Martin Aidam</td>
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<td>Mercedes-Benz, Germany</td>
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<td>10:40 - 11:10</td>
<td>Coffee break</td>
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<td>11:10 - 11:40</td>
<td>4 - All You Need for an EMC Inverter Simulation</td>
<td>Andreas Barchanski, Jan Hansen, Michael Wendl, Robert Bosch GmbH</td>
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<td>Dassault Système, Germany</td>
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<td>11:40 - 12:10</td>
<td>5 - Leveraging Machine Learning and Design Exploration to Synthesize Cable Routing Design Rules</td>
<td>René Fiedler, Diana Mavrudieva, Altair, Germany</td>
</tr>
<tr>
<td>12:10 - 12:40</td>
<td>6 - Computational Estimation of Conducted and Radiated Emission in Battery Electric Vehicle</td>
<td>Ryota Morimoto, Akihiko Nojima, Toyota Motor Corporation, Japan</td>
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<tr>
<td>12:40</td>
<td>Closing</td>
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**WS-01A + WS-01B: Automotive EMC**

Session Chair: Marco Klingler, Stellantis, France
Location: G1
This workshop will provide an introduction to recent applications of reverberation chambers (RCs). It is intended to provide EMC engineers who are interested in applying RCs to various measurement issues and the extension of RCs to solve a variety of EMC problems. The statistical methods used to evaluate the fields inside these chambers requires the collection of statistically independent samples. These samples can be generated by employing different stirring techniques such as mechanical mode stirring/tuning, spatial and frequency stirring. With the development of conductive fabric chambers and tents, another method of mechanical stirring is possible by movement of the fabric walls, or employing a fabric stirrer and is referred to in literature as a Vibrating Intrinsic Reverberation Chamber (VIRC).

This full-day workshop provides a brief overview of RC theory, followed by recent applications of RCs. The workshop material will be updated to reflect recent research results and implications. The format will be a conference presentation style (lecture) followed by a discussion moderated by the chairs. Furthermore, based on our successful RC workshop at EMC Europe 2013 in Brugge, a series of experiments aligned with the presentation topics will be demonstrated using a portable setup to clearly show the underlying principles of RCs and their applications in practice. The workshop attendees will have the opportunity to witness the presented theory in action, and even participate in performing some of the experiments themselves.

The workshop is designed for both academics and people from industry who will be involved in radiated emission or immunity testing of commercial or military systems using RCs, shielding effectiveness, or even communication channel. It will be valuable to personnel evaluating the use of RCs as a complement to or replacement for other types of radiated test facilities and for personnel who are trying to use statistical methods to characterize the electromagnetic environments.
As 5G begins to take center stage in the enterprise IOT and consumer markets, the wireless industry continues to develop the required test and measurement capabilities for the latest technologies to ensure that these products perform as intended. While considerable progress has been made, various industry organizations are still working on new test plans and test requirements that will be implemented throughout the industry. Although much of the low hanging fruit have been covered in test requirements to date, some of the toughest problems still remain to be solved.

For example, current wireless networks are relying on much more integrated end-to-end (E2E) system architecture than ever before. The base stations (gNB) and the user equipment (UE) must understand how the RF environment is constantly changing around them and they must be able to make decisions in a fraction of a second in order to maintain connectivity with the network. All this must be done while maintaining the adequate bi-directional data throughput with the network. The presentations in this tutorial will provide examples of the need for established industry metrics and test scenarios not only on the chip and module level, but for full scale implementation of a real life network in order to help designers to build fast and reliable networks for modern day requirements.

Attendees at the tutorial will learn about solutions to address the challenges generated by the 5G New Radio and mmWave applications through system planning and innovative wireless performance verification testing methodologies. Hands-on demonstrations are planned to complement the lecture material.

The workshop will conclude with a panel discussion including all speakers.

Planned Speakers and Topics:

**Wireless Interference/Immunity:**
**Product Quality as a Driver of Test Standards**
Harry Skinner, Intel, Hillsboro, Oregon, USA

**Use of Reverberation Chambers to Simplify EMC and RF Unwanted Emissions Measurements for 5G Base Stations: Experiences from Deployment and Use of RC in Ericsson Kista**
Ahmed Hussain, Ericsson AB, Kista, Sweden

**Emerging EMC Requirements for 5G mmWave Device Measurements**
Jari Vikstedt, ETS-Lindgren, Cedar Park, Texas, USA

**On the Definition of Incident Power Density for 5G mmWave Human Exposure Evaluation**
Walid El Hajj and Juan-Antonio Del Real Intel, France
Hybrid Testing Techniques for Advanced Communications
Aric Sanders, National Institute of Standards and Technology, Boulder, Colorado, USA

Addressing the Increasing Wireless Requirements for Commercial Aircraft and Aerospace Applications
Dennis Lewis, Boeing, Seattle, Washington, USA

Spurious Emissions up to 110 GHz in Reverberation Chambers
Lawrence Moore, Ericsson, Lund, Sweden

Recent Advances in C63.25.3: Qualifying Anechoic Chambers for Measurements of mmWave Devices
Zhong Chen, ETS-Lindgren, Cedar Park, Texas, USA

Definition of Far Field Measurement Distance for 5G mmWave Antenna Arrays: Application on N x M Patch Arrays
Walid El Hajj and Juan-Antonio Del Real, Intel, France

Potential of Edge Soldering in mmWave Antenna and EMC Design
Katerina Galitskaya, Radientum OY, Tampere, Finland
Monday September 5

9:00–12:50 WS-07A + WS-07B: EMC Aspects of Electrification of the Society
Session Chair: Urban Lundgren, RISE, Sweden
Location: J1

Part 1:
"Defending the electromagnetic spectrum"
Presenter: Sabine Alexandersson
Affiliation: FMV, Swedish Defence Materiel Administration

Abstract
In a world that is becoming more and more electrified and the air is filled with intentional and unintentional electromagnetic transmitted signals small signals may be hard to detect. During times of crises or war short wave communication is an efficient way to reach a receiver far away from the transmitter. It is therefore of importance to protect the spectrum below 30 MHz.

Part 2:
"EMC mitigation work at airports"
Presenter: Henry Heiman
Affiliation: SWEDAVIA

Abstract
Radio frequency interference can be harmful for critical aeronautical radio services. Swedavia is working proactive to protect these services. The presentation will cover both their general EMC mitigation work and the current on-going work to prevent potential interference issues from photovoltaic installations.

Part 3:
"Results from on-site EMC emission measurements on PV-installations with variations in inverters, optimizers, solar panels and cable routing"
Presenter: Urban Lundgren
Affiliation: RISE, Research Institutes of Sweden

Abstract
Presentation of work in the project “Metoder för att detektera och förebygga elektromagnetiska störningar från solcell-installationer” funded by Swedish Energimyndigheten (Swedish Energy Agency). The project is aiming at giving recommendations on how to perform on-site measurements of radiated emissions from photovoltaic installations. Part of the work is also to try to verify recommendations for system installation such as DC cable routing, potential equalisation and the use of solar panel optimisers.

Part 4:
"Solar power – a View from the regulatory plane"
Presenter: Martin Gustafsson
Affiliation: Elsäkerhetsverket

Abstract
A summary of reported events of electromagnetic disturbance from photovoltaic installations and related products subject to complaints. Examples of real-world cases of disturbance in more detail. Also, the view on standardisation will be covered from a regulatory perspective.

Part 5:
"Power quality and EMC issues related to electric vehicle charging"
Presenter: Math H. J. Bollen
Affiliation: Luleå University of Technology, Skellefteå, Sweden

Abstract
With the quick increase of electrical vehicles (EV) and the desire to replace internal combustion engine vehicles, the electrical infrastructure for charging need to be adapted to driving patterns and charging characteristics of the EVs. The hosting capacity for electric vehicles in a low-voltage distribution network can be analysed to estimate the impact on the power quality in the Swedish power grid. This presentation provides support for a discussion regarding the impacts of electromobility on the electrical system.
The tutorial introduces the participant step by step to the design of filters, independent of the application, independent of complex mathematical calculations, but practice-oriented with concrete examples and pointing out important points to pay attention to during the design. Numerous examples with clearly comprehensible results are presented; filters with and without transient protection. A realistic estimation of the required insertion loss quickly shows that filters do not need 90 dB insertion loss, it also quickly shows that the specifications of filters determined in the 50 ohm system do not have much to do with practice. The tutorial shows ways to quickly and effectively develop the right filter and what needs to be considered. In addition, influencing variables such as the parasitic capacitance of inductances, the impedance of peripheral cables, ground conditions at the filter, current and voltage bias of inductors and capacitors are shown and explained in concrete examples.

Summary of the content:
What is an EMC filter, which parameters have to be considered, where is the difference to a “signal filter”?
Filter components (inductance, capacitor, voltage-limiting components).
Different filter topologies, what are the differences, which ones are to be used where.
Source and load impedance and some terms according to CISPR 17.
Comparison of source and load behaviour of Pi- and T-filters.
Practical design of a filter (T and Pi).
Filter characteristics and their differences in behaviour.
Comparison between real set-up, LTspice® simulation and RedExpert® simulation, explanation of differences.

Examples of different filters (concrete set-ups with circuit and measurement results):
• Different filters without transient protection
• Filters with transient protection
• Band stop filter for 6.78 MHZ (ISM band)
• Elliptical filter with use of the parasitic capacitance of the inductance as an advantage
• Filter system for decoupling source and load impedances
• Interface filter under real electromagnetic load conditions
Today’s methods in the USA’s ANSI standards for test site validation stop at 18 GHz and in the past assumptions have been made that a test site which is validated below 18 GHz is also acceptable for measurements above 18 GHz. Given the proliferation of electronic devices operating at progressively higher frequencies, a suitable method for test site validation from 18 GHz to 40 GHz is needed.

Therefore, a new standard, ANSI C63.25.3 is being developed. Site validation methods for Open Area Test Sites (OATS) and Semi-Anechoic Chambers (SAC) with absorber on the ground plane as well as Fully Anechoic Rooms (FAR) are being explored using methods such as traditional s-VSWR, Time Domain s-VSWR, and Mode Filtered s-VSWR. Reverberation Chambers and Compact Antenna Test Ranges (CATRs) are also being examined to provide alternatives that address far-field considerations.

Presentations

Draft Standard ANSI C63.25.3
Nicholas Abbondante, Intertek, Boxborough MA, USA

Cylindrical Mode Filtered SVSWR – A New ANSI C63.25.3 Method Proposed for EMC Site Validation from 18 GHz to 40 GHz
Zhong Chen, ETS-Lindgren, Cedar Park, Texas, USA
Why is EMC getting ever more important? The vast proliferation of modern electronics in almost any area of product is accompanied, without effective mitigation, by unacceptable interference phenomena and lag of reliability. Regulations and technical standards try to control this. Here the radiated testing proves far more complex than conducted. Standards (STD) have inherent technical imperfections and are compromises in many ways. Understanding start with reviewing history background, physics and new game changing technologies like wireless 5G, medical devices and E-Mobility. In global markets international standards development (IEC/CISPR/ETSI/ISO/ SAE/ ANSI-IEEE) and harmonization eases trade. Focus: EU CE EMCD, RED, Automotive EMC. Testing acc. to STD is embedded in an overall product certification/qualification process. Therefore Product/Basic/Genric STD (limits) and the very important normative references (test methods) will be broadly technically analyzed. Product risk assessment/ EM-STDs get now more transparent.

Technical EMC Basics: EMC Units incl. dB, Constants in physics, frequency spectrum (to xx GHz), simple EM-radiators, near/far- field, basic test instrumentation, antennas, spectrum (FFT) and radiation efficiency of printed circuit boards and electronic components real world properties. We show typical cases for Pre/Compliance Testing Scenarios. Based on existing knowledge, clients improve their basic understanding of EMC testing and formal CE procedures.

Target Group
Parties benefiting from this specialized know-how are R&D/ QA/ corp. Standard-Compliance Department, Test Lab Organizations, Sales, Marketing, Legal Departments and Company Management up to CEO level. It does not stop here and incl. Investors and beyond. They certainly need to understand the risks involved in EM-Field related Product Compliance Testing. Seminar participants from management/sales/technical product R&D, QM or any other EMC concerned parties will greatly benefit. This is a specialized crash course with a safe 1-day guided Expert-Tour through one of the most challenging EMC areas (“el.-mag. fields”), a mine field!

We cover
EMC/Radio/Wireless/Automotive-EMC Testing per Norm and explain the background, for industry/government. We show winning EMC Testing strategies/CE compliance management. Real world cases “large/small Test Center” with planning from scratch to accreditation will be shown, fit for future.

Requirements
No special requirements. A general education background e.g., as technician / in engineering/physics or any similar level of expertise in electrical/electronic topics is beneficial. Parties responsible for EMC management (company internal and/or external services) or those who even need to decide on setting-up their own (“EM Field”) Test Facility/Test Center will surely enjoy details on planning, designing, specifying, quote evaluation, contracting, commissioning/accrediting.
The workshop describes what is necessary for the EMC-compliant development of a GB Ethernet interface, between Phy and Ethernet connector. It goes into detail about the circuit technology, the components and the layout. Using a practical example, points such as adaptation of the symmetrical signal paths, protection against transient overvoltages, selection of suitable components, construction of the ground system, placement of the components on the PCB and layout design are demonstrated. The topic of EMC is taken into account comprehensively. Using real measurement results, the influences of cables, ground systems and system set-up on the immunity to interference of various disciplines as well as on interference emission are clearly illustrated.

Summary of the content:
- 1 GB Ethernet front end design, overview
- Block diagram of a typical design
- Hardware design of a GB front end
- Schematic of the Ethernet interface
- Necessary key parameters of the components
- Some facts about signal integrity
- Layout considerations
- EMC requirements according to standards
- Measurement set-up for immunity and emission tests
- Aspects to consider for a proper set-up (cables, peripheral devices, power supply) Discussion of immunity tests and results
- Discussion of emission tests and results
- Discussion of emc behaviour of different shielding terminations
- Discussion of the emc behaviour of different Ethernet cable types
- Differences between integrated and discrete interface designs from the emc point of view

Conclusions and summary
A promising technique to improve the electromagnetic compatibility of electronic systems is based on spread spectrum clocking. Nowadays, this technique is widely used in modern electronic systems to reduce the electromagnetic emission by spreading the energy of a normally narrowband signal over a wider frequency range. Initially, such spread spectrum techniques were mainly used to make signal transmission systems more robust, avoid interference from RF signals, or to establish secure communications. Reducing the electromagnetic emission of an electronic system was less of a focus until the 1990s. Since then, many discussions have been held, e.g. on the question of legality under FCC regulations or the claim that spread spectrum is just a cheap trick to cheat an EMI receiver by actively shifting signals out of the receiver band while measuring at a certain frequency position.

In order to clear up these misunderstandings, this tutorial will provide a general overview of spread spectrum techniques, its history and applications, and an insight into the use of frequency modulation to reduce electromagnetic emission from electronic systems. Numerous practical examples of measurements of conducted electromagnetic emission from an electronic system are used to explain step-by-step how spread spectrum techniques actually work to reduce electromagnetic emissions. It is also shown how typical spread spectrum parameters such as frequency deviation, modulation frequency and modulation signal can be optimized accordingly to maximize emission reduction for the peak, average or quasi peak measurements in certain frequency ranges. In addition, the advantages and disadvantages of using spread spectrum techniques are explained and discussed.
Measurements regarding electromagnetic interference fields on installed high power chargers are new, recent and challenging. In this tutorial, the general interference fields inverter driven charging devices are examined, as they are currently found in private and industrial use (solar panels and motor drives). High Power Chargers operate with pulsating DC voltages up to 800 V with charging currents up to 500 A. By the well-known formula for magnetic fields $H = I \times N$, it becomes clear that the high charging currents must also produce high magnetic fields. In addition to the fundamental wave, many harmonics are also generated by the pulsation, which are known to cause stronger interference phenomena. The focus of the measurements is on the limit values of electromagnetic fields with an effect on humans. Here, different limit values were defined for the general population, for workers and for implant carriers. However, these limits are frequency-dependent and depend on the duration of exposure.

Therefore, the assignment of the interference levels is always necessary with reference to the frequency. The following limit values and guidelines are normatively compared:
- ICNIRP (international)
- EMF Directive 2013/EU (Europe)
- DGUV-Vorschrift 15 (Germany)
- BMAS Forschungsbericht 451 (Herzschrittmacher)
- DIN EN 45502-2-1 (active implants EMC immunity)

Typical, known Effects of Electromagnetic Fields on Humans as well as on Implant Carriers:
- tingling, relaxation, muscle twitching, fatigue, restlessness, headache, chest pain, drowsiness – nausea, metallic taste, palpitations, phospene effect of the eyes, increase in body temperature

What needs to be considered for the measurements:
- measurement technology used
- relevant directives on electromagnetic fields
- comparison of limits between ICNIRP, EMF-Directive and limits for pacemaker wearer
- measurements in time domain and frequency domain
- measurements related to the distance law: 0, 5, 10, 15 cm up to 50 cm
- the relevant area and measure point around the charging station, charging cable and charging plug

Measure method for detecting electrical and magnetic fields inside the e-Cars during driving: The strongest interference fields are generated during acceleration and deceleration. During constant travel the interference fields are low (as with high speed trains and railroads). The seats and the seats at buttock height and chest height are recommended as typical measuring points. The strongest fields are probably measured near the floor (inverter/harness). In addition to a small 3D field strength probe, an additional measurement with four mini 3D coils and a 4-channel oscilloscope is recommended.

The tutorial shows the theoretical basics as well as the field-tested measurement method in a practice-oriented manner.
As the electrification of vehicles and trains increases, the power grid is also being modernized to supply different load types and to support different renewable energy sources through power converters. This interconnection leads to huge and complex systems, not only providing energy between the many sources and loads but also a potential path of electromagnetic interference (EMI) in the suprathermal and RF conducted range (up to 30 MHz). A special focus is given to low frequencies (2-150 kHz) – a range lacking emission limits and analyses in the past. This tutorial session aims to provide a holistic overview of systems’ design techniques, the electric/electronic component characterization, the electric performance metrics and state-of-the-art solutions for EMI/EMC issues in power transmission and distribution grids, railways, electrical vehicles and wind turbines. In particular, the speakers will address time-frequency methods, degradation of cable insulation, stray currents in railways, modelling of power converters, EMC in energy storage systems and EMC testing in wind turbines, electric vehicles, and power grids.

Presentation Title 1: EMC Testing: From wind turbines, over the power grid to electrical vehicles (EVs)
Speaker’s Name: Sebastian Koj
Jade University of Applied Sciences, Germany

Presentation Title 2: Partial discharge location with time-reversal for the improvement of power transmission and distribution networks’ reliability
Speaker’s Name: Alistair Duffy (1) / Antonella Ragusa (1), (2)
(1) De Montfort University, United Kingdom
(2) The Institute of Marine Engineering of the Italian National Research Council (INM-CNR), Italy

Presentation Title 3: Supratherminals from switched-mode power supplies in low-voltage grids
Speaker’s Name: Leonardo Sandrolini (1) / Andrea Mariscotti (2)
(1) University of Bologna, Italy
(2) University of Genova, Italy

Presentation Title 4: Research of electromagnetic influence of traction supply systems on the railway automatics devices
Speaker’s Name: Tetiana Serdiuk,
Ukrainian State University of Science and Technologies, Ukraine

Presentation Title 5: Measurement and modelling of power inverter noise propagation on rolling stocks: practical examples
Speaker’s Name: Umberto Paoletti
Hitachi, Ltd., Japan

Presentation Title 6: EMC challenges for energy storage systems
Speaker’s Name: Bas ten Have
University of Twente, The Netherlands
In this tutorial we focus on the new EMC standard regulations for new hybrid and full electric vehicles which introduced the need to have a virtual modeling approach to reduce prototyping costs and time to market. We will present a simulation approach for IGBT/ SiC power modules parasitics extraction, PCBs, busbar, cables, magnetic components for power conversion, common mode chokes and EMI filters, electrical motor, and, thanks to advanced circuit simulation, at system level, we will show how to reproduce EMC normative curves for power electronics components through real simulation examples. In addition, in this tutorial we will present different solutions to perform EMC simulations of full vehicle considering cable routing, antennas, control units, and other components according to most common standards as CISPR12, CISPR25 and ISO 11451.

What you will learn
• How to estimate the electromagnetic compatibility performance of a complex product, including the enclosures and cables, building a 3D virtual model which is matching measurements
• How to model virtual models of common mode chokes and EMI filters
• How to extract power module parasitics power electronics printed circuit boards and study their effects on time domain signals, including the common mode noise in order to predict conducted emissions.
• Predict the dynamic breakdown of dielectrics when exposed to high electric fields.

Authors: Flavio Calvano, Giancarlo Guida, Ansys Italy, Marko Luukkainen and Bo Yang, Ansys Sweden
The recent European Blue Guide [1] (regarding the implementation of EU product rules) has stipulated a risk-based approach (rather than the conventional, rule-based approach) mandatory for the EMC compliance of any new piece of electronic equipment with applicable EU Directives – including the LVD and the EMCD [2], [3].

Many manufacturers in the industry as well as the users of electronic systems may not be familiarized with this novel risk-based EMC approach to the full extent, as there is a lack of understanding and no clearly prescribed risk-assessment methodologies available yet. Particularly, the small and medium scale enterprises (SMEs), may need assistance to adapt to this major shift in approach.

In this workshop, we will present the EMC risk-based approach, emphasizing its contrast to the traditional rule-based EMC approach. We will focus on two examples of implementation of risk-based EMC approach in both military and medical contexts. The workshop will also address an example of systematic analysis of EMI Risks.

There is not only a need for formalization, but also for trained specialists having the capability to deal with the complexity of systems, and all the stakeholders (individuals and institutions) involved. We will introduce two large European networks, ETERNITY - European Training Network on Electromagnetic Risks in Medical Technology, and PETER - Pan-European Training, research and education network on Electromagnetic Risk management that are currently training 29 Early-Stage Researchers focusing on the development and implementation of risk-based EMC methodologies [4], [5].

- Risk-based EMC (military application example) – Frank Leferink
- Systematic Analysis of EMI Risks – Prof. Dr.-Ing. Frank Sabath
- EMC Risk-based Approach within Philips Medical Systems – Rob Kleihorst
- Presentation of the European Training Network PETER – Davy Pissoort
- Presentation of the European Training Network ETERNITY – Anne Roc’h

**Hour 1:**

- (20 minutes) - Risk-based EMC – Frank Leferink  
- (Questions 10 min)
- (20 minutes) - Systematic Analysis of EMI Risks – Frank Sabath  
- (Questions and discussions 10 min)

**Hour 2**

- (20 minutes) - Risk-based EMC Approach within Philips Medical Systems – Rob Kleihorst  
- (Questions 10 min)
- Discussions on the last 3 ppts (30 min)

**Hour 3**

- (10 minutes) - Presentation of the European Training Network PETER (Pan-European Training Network on Electromagnetic Risks) – Davy Pissoort  
- (Questions 5 min)
- (10 minutes) - Presentation of the European Training Network ETERNITY (European Training Network on Electromagnetic Risks in Medical Technology) – Anne Roc’h  
- (Questions 5 min)
High exposure to electromagnetic fields is known to have adverse health effects on humans. Heating and nerve stimulation are well established effects and we know that foetuses and people with active or passive medical implants are considered to be extra sensitive to exposure and are therefore subject to stricter recommendations and exposure guidelines. But we also meet arising questions regarding oxidative stress and other exposure related biological effects found in recent research.

Risk assessment in this area is based on two questions; “Which exposure will cause adverse effects in humans?” and “Which levels are we actually exposed to?”. The answers to these questions will guide us on how to perform a sound risk management: When do we need to limit exposure and how can it be done?

This workshop will deal with these questions and also give an overview of the guidelines from the International commission on non-ionizing radiation protection (ICNIRP), updated in 2020, as well as the European directive on the minimum health and safety requirements regarding the exposure of workers to the risks arising from electromagnetic fields. Another directive from the European Commission, relevant from this perspective, is the Radio equipment directive which states that radio equipment shall be constructed so as to ensure the protection of health and safety of persons and of domestic animals. What actions do we need to take to meet this requirement?
In this workshop we will cover various topics related to reverberation chamber test systems, including both theoretical and practical aspects. In this session, we will provide an overview of reverberation chambers and discuss their fundamentals and statistical properties. We will also compare this test facility with conventional anechoic chambers. In particular, we will focus on the practical aspects of reverberation chambers and discuss how measurements are performed and what parameters are measurable with this test facility. The workshop will conclude with a live demonstration of test measurements on-site or online, depending on the circumstances.

1. Basic Theory of Reverberation Chambers:
   - Contrast to Anechoic Chamber Measurements
   - Rich Isotropic Multipath (RIMP) Field
   - Rayleigh and Exponential Distributions

2. Performing Reference Measurements:
   - The significance of Gref (average chamber loss)
   - Properties of the reference antenna
   - Practical Do-s and Don’t-s
   - Handling of cable losses
   - Tradeoffs in settings
   - Number of samples, speed, sample correlation, frequency stirring, and etc.

3. Passive Measurements:
   - Antenna Efficiency Measurements
     - Reference antenna method
     - Brief overview of the three-antenna method
     - Diversity Gain Measurements
   - Correlation measurements

4. Active Measurements:
   - TRP measurements
   - TIS measurements
   - Throughput measurements

5. Directive Measurements:
   - Technical solutions that enable LoS measurements
   - Antenna Pattern measurements
   - Throughput measurements
   - EIRP
   - EIS
WS-10C: Why are Radiated Emission/Immunity EMC Tests so Tricky?

Session Chair: Diethard Hansen, Euro EMC Service, Switzerland
Location: J2

This WS builds on Part 1. Regulations/Tech-STD try to control EMI. Product Compliance assessment involves risks/measurement uncertainty. Here the radiated testing proves far more complex than conducted. Product-, Generic and Basic Standards are partly tricky and have all inherent technical imperfections/compromises in many ways. We shine light into the jungle. Analysis of test reports? Radiated testing starts with understanding correct selection/use/limits of test antennas and their normative calibration. Additional devices are e.g., Field Sensors and TEM Cells plus typical test instruments, incl. Hard/Software. We discuss in detail basically all types/sizes of Test/Site Facilities for radiated Emission and Immunity and their normative validation (IEC/CISPR/ETSI/SAE/ANSI IEEE) for applications in EMC, Wireless and automotive EMC. Test Sites incl. OATS, ALSE, ALC, FAR, RVC. GTEMs start from DC to GHz, they can be used for time domain/pulse testing.

Having assessed 400+ international test labs as tech-auditor (ISO EN 17025 accreditation) surely helps to sort things. Many Companies do “Conducted Tests” (R&D) inhouse and outsource “Field Testing”. When to use internal or external services is a technical as well as economic/management question. Sooner or later, depending on company size and market strategy, Lab Design (New EMC Test Center?): Planning, Quotation, Contract, Installation, Acceptance Test, Accreditation may become an issue. We present real world case studies.

**Target Group**
R&D, QM, QA, corp. Standard-Compliance Department, Test Lab Organizations, Sales, Marketing, Legal Departments and Company Management up to CEO level. It does not stop here and incl. Investors and beyond. They all certainly need to understand the risks involved in EM-Field related Product Compliance Testing. We demonstrate winning EMC Testing strategies/CE compliance management. Real world cases ”large/small Test Center” with planning from scratch to accreditation will be shown, fit for future.

**Requirements**
We recommend taking WS Part 1. Otherwise, no special requirements. A general education background e.g., as technician/in engineering/physics or any similar level of expertise in electrical/electronic topics is beneficial.
09:00–09:40 **OS-A: Opening Ceremony**  
**Session Chair:** Jan Carlsson, Provinn, Sweden  
**Location:** G3

**Speakers:**  
Prof. Jan Carlsson, Chairman EMC Europe 2022  
Anneli Rhedin, Lord Mayor and Chairman of the City Council, City of Gothenburg  
Prof. Ferran Silva, Chairman ISC EMC Europe  
Dr. Vignesh Rajamani, President IEEE EMC Society  
Prof. Zbigniew Joskiewicz, Chairman EMC Europe 2023
Due to the electrification in mobility applications, electric (high) power trains become an increasingly important subject of investigating EMI. This talk provides an overview about the systematic root cause of electromagnetic conducted emissions of a power train. Direct current (DC) power sources such as batteries or fuel cells provide the energy for propulsion. Alternating current (AC) electric engines drive the vehicle, because AC engines have advantages in maintenance and reliability. Pulse-width modulating (PWM) inverters convert DC into AC voltages. PWM technology can lead to significant electromagnetic interference (EMI) issues pending e.g. on power level and more electric parameters, which should be chosen early for mitigating the EMI risk. A simple predictive simulation model supports taking integration decisions in view of the EMI risk.

Typical power levels for smaller aircraft power trains start at 100 kW; levels up to some 10 MW are necessary for the propulsion of large transport aircraft. Fast switching inverters converting high power levels imply a high dV/dt and a significant EMI potential in common mode (CM). Besides filtering and shielding, a number of electric architecture decisions can mitigate EMI. This requires performing some basic predictive calculations.

This talk will also show how the choice of the inverter and the choice of the power system (IT versus TN network) limits or exacerbates interference. Crossstalk to wiring looms routed adjacent to power train AC cables will further illustrate the effects and provide options for an optimization of a power train from an EMI point of view.
The introduction of handheld mobile phones in the late 1980s has increased the exposure to radiofrequency fields (RF) in the general population. With each new generation of mobile phone technology, RF exposure levels from mobile phone handsets have become lower, and environmental levels from base stations only a fraction of that from handsets. Deployment of 5G at frequency levels used by older technologies is not expected to change this pattern, although exposure levels need to be continuously monitored as the technology develops. Each new generation of wireless technology has led to concern about potential health effects, and 5G is no exception. Most attention has been given to potential cancer risks and to health outcomes such as unspecific symptoms reported by persons who perceive themselves as hypersensitive to electromagnetic fields. Overall, scientific research has not found support for a causal link between radiofrequency fields and the unspecific symptoms reported. For cancer outcomes, the evidence of an increased risk is also weak; however, in 2011 the International Agency for Research on Cancer (IARC) classified radiofrequency electromagnetic fields as possibly carcinogenic, mainly based on findings in a few epidemiological case-control studies on mobile phone use and brain tumor risk. Although time trend studies saw no increase in the occurrence of these tumors despite a considerable increase in the prevalence of RF exposure over a short time period, the IARC working group believed these studies covered a too short time period to be informative. Since the IARC evaluation, additional case-control studies and prospective cohort studies have been published, as well as a considerable number of incidence time trend studies from different countries, covering a much longer time period. For 5G at frequency levels similar to earlier mobile phone generations, health risk assessment can learn from comprehensive research conducted over the past decades, whereas for higher frequency ranges, such as 26 GHz, fewer data are available. This presentation will summarize the evidence from epidemiological studies available to date.
The quest of Christopher Holloway to understand and develop fundamentally new measurement methods started when he was perusing his undergraduate degree and continues to this day.

One of the keys to developing new science and technologies is to have sound metrology tools (i.e., measurement tools) and techniques. A stated goal of international metrology organizations, including the National Institute of Standards and Technology (NIST), is to make all measurements traceable to the International System of Units (SI). The world of measurement science is changing rapidly with the SI redefinition that occurred in 2018. As a result of the shift towards fundamental physical constants, the role of primary standards and measurements must change. Atom-based measurements allow for direct SI-traceable measurements, and as a result, measurement standards have evolved towards atom-based measurements over the last few decades; most notably length (m), frequency (Hz), and time (s) standards. Recently, there has been a great interest in extending this to magnetic and electric (E) field sensors. Fundamental to all electromagnetic/communication measurements is having accurately calibrated probes, antennas, and power meters in order to measure either electric (E) fields or power.

In the past 10 years, we have made great progress in the development of a fundamentally new direct SI-traceable approach based on Rydberg atoms (traceable through Planck’s constant, which is now an SI defined constant). The Rydberg atom-based sensors now have the capability of measuring amplitude, polarization, and phase of the RF field. As such, various applications are beginning to emerge. These include SI-traceable E-field probes, power-sensors, voltage standards, receivers for communication signals (AM/FM modulated and digital phase modulation signals), and even the recording of musical instruments. In fact, this new atom-based technology has allowed for interesting and unforeseen applications. These new Rydberg atom-based sensors will be beneficial for 5G and beyond in that they will allow for the calibrations of both field strength and power for frequencies above 100 GHz. In this talk, I will lead us on a historical journey of the development of this approach, and in the process, I will summarize this work and discuss various applications.

In this talk, I will also introduce the National Institute of Standards and Technologies (NIST) and discuss what NIST does and discuss why international measurement standards are important.
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Tuesday September 6

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

**Session Chair:** Peter Stenumgaard, FOI, Sweden  
**Location:** Exhibition Area

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**System Analysis of Electromagnetic Environment Created by Radiating 4G/5G User Equipment Inside Buildings**  
Vladimir Mordachev  
Belarusian State University of Informatics and Radioelectronics, Belarus

**Worst-Case Adaptive Model of Field Penetration into Shielding Enclosure**  
Eugene Sinkevich1, Yauheni Arlou1, Natalia Sinyak1, Ivan Shakinka1, Xie Ma2, Wen-Qing Guo2  
1Belarusian State University of Informatics and Radioelectronics, Belarus; 2China Electronics Technology Cyber Security Co., Ltd., China

**Impact of Electromagnetic Radiation of 4G/5G Base Stations on Medical Short-Range Devices in Urban Area**  
Aliaksandr Sviystoun1, Vladimir Mordachev1, Eugene Sinkevich1, Ming Ye2, Arthur Dubovik1, Ivan Shakinka1  
1Belarusian State University of Informatics and Radioelectronics, Minsk, Belarus; 2Huawei Technologies Sweden AB, Stockholm, Sweden

**Estimation of effectiveness of EMI Gaskets by Using Results of Standardized Measurements**  
Dzmitry Tsuanenka1, Eugene Sinkevich1, Yauheni Arlou1, Alexey Galenko1, Xie Ma2, Wen-Qing Guo2  
1Belarusian State University of Informatics and Radioelectronics, Belarus; 2China Electronics Technology Cyber Security Co., Ltd., China

**Source Reconstruction Method Using Phase-Less Magnetic Near-Field Measurements: Application of the Method of Moment with Roof-Top Basis Functions**  
Hamidreza Karami1, Marcos Rubinstein2, Christophe Perrenoud3, Emmanuel deRaeamy1, Pascal Kraehenbuehl3  
1Electromagnetic Compatibility Laboratory, Ecole Polytechnique Fédérale de Lausanne (EPFL); 2University of Applied Sciences and Arts Western Switzerland (HES-SO), Institute for Information and Communication Technologies, Switzerland; 3Federal Office of Communications, Electromagnetic Compatibility Section, Biel/Bienne, Switzerland

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**Angular Spectrum for Wireless Over-the-Air Measurements in the Loaded Reveberation Chamber**  
Junhao Zheng, Xiaoming Chen  
Xi’an Jiaotong University, China

**Characterization of Parasitic Impedances of PV Panels from Common Mode Perspective**  
Makrand Mukund Kane, Nathaniel Taylor, Daniel Månsson  
KTH Royal Institute of Technology, Sweden

**Time-domain Characterization of Reconfigurable Intelligent Surfaces for Wireless Communications**  
Giuseppe Pettianice, Fabrizio Loreto, Daniele Romano, Fortunato Santucci, Piergiuseppe Di Marco, Giulio Antonini, Roberto Alesii  
Università degli Studi dell’Aquila, Italy

**Shielding Effectiveness Measurements DC to 40 GHz, draft IEEE 2855**  
Mart Coenen  
EMCMCC, The Netherlands

**Correlation Between HF Interference at Low and High Elevation Angle**  
Antonios Constantinides, Haris Haralambous  
Frederick Research Center (FRC), Cyprus

**Uncertainties and Limitations of Shielding Measurement with Two Antenna Method**  
Stefan Cecil, Kurt Lamedschwandner  
Seibersdorf Laboratories, Austria

**A Comparative Analysis of LoRa and LoRaWAN in the Presence of Jammers and Transient Interference**  
Artur N. de Sao Jose1, Nathan Chopinet2, Eric Pierre Simon1,2, Alexandre Boé1,3, Thomas Vantroux1,4, Christophe Gransart2, Virginie Deniau2  
1Université Lille, CNRS, UMR 9189 Cristal; 2University of Lille, CNRS, USR 3380-IRCICA; 3Université Gustave Eiffel, COSYS-IFSTTAR; 4Université Lille, CNRS, Centrale Lille, Univ. Polytechnique Hauts-de-France, UMR 8520-HEMIN; 4Université Lille, CNRS, Centrale Lille, UMR 9189 CRISTAL
RF Coexistence Testing on Wireless Medical Patient Monitoring Device
Mahmud Naseef¹, Alen Moskofian², Pascal Hervé³, Georgios Kokvidis³.
Dennis Mendoza³, Bill Dowd³
¹Rohde & Schwarz, Germany; ²CSA Group Bayern, Germany; ³Dräger Medical Systems, Inc., USA

Electromagnetic Compatibility of Train Radio Communication with the Traction Systems
Tetiana Serdiuk, Botnarevsca Rodica
Ukrainian State University of Science and Technologies, Ukraine

Measurement of Pulsed Aircraft Radio Altimeter In-Band and Out-band Interference Threshold Power Due to Sub-6 band 5G Mobile Communication Systems
Shunichi Futatsumori, Norihiko Miyazaki
Electronic Navigation Research Institute, National Institute of Maritime, Port and Aviation Technology, Japan

Study on Mitigating the Capacitive Noise Coupling Paths in Phase Shifted Full Bridge Converters
Róbert Orvai¹, Márk Csörsnyei²
¹Óbuda University; ²Robert Bosch Kft.

Conducted EMI Emissions Investigation in SPWM based Control Modular Multilevel Converters
Djilali Hamza
University of Ottawa, Canada

ML Based SI-Design Support Outlook to AI enhanced PCB Design Processes – a Practical Approach
Werner John¹, Julian Withöft², Emre Ecik², Ralf Brüning¹, Jürgen Götte²
¹PYRAMIDE2525/TU Dortmund, Paderborn - Germany; ²TU Dortmund/Information Processing Lab; ³EMC Technology Center Paderborn Zuken GmbH

Electromagnetic Compatibility of Track Circuits with Parallel Traction Network
Volodymyr Havryliuk
Ukrainian State University of Science and Technology, Ukraine

Bias Network Noise effects modeling for RF amplifiers and MCM for Space Application
Adrian Martin¹, Ivan Herrero¹, Antonio Montesano¹, David Peña¹, Paula Sánchez¹, Ana Lopez²
¹Airbus, Spain; ²CT Ingenieros

Independent Component Analysis of the Cyclostationary Signals in the Transmission Line
Yury V. Kuznetsov¹, Andrey B. Baev¹, Maxim A. Konovalyuk¹, Anastasia A. Gorbunova¹, Johannes A. Russer²
¹Moscow Aviation Institute, Russian Federation; ²Technical University of Munich, Germany

Electromagnetic evaluation of UHF-RFID Smartshelf in Healthcare Environments
Pablo Marina¹, Samuel D. Suárez², Jose A. Hernández², Victor M. Febles², Luis E. Rabassa², Victoria Ramos¹
¹Instituto de Salud Carlos III; ²Hospital Universitario de Canarias

Noise Source Modeling for Automotive Components Using a Wire-harness Bench
Noboru Maeda¹, Kengo Fukunaga¹, Keishi Miwa²
¹SOKEN, INC.; ²Toyota Motor Corporation
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<th>Session</th>
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<tbody>
<tr>
<td>14:30-15:50</td>
<td><strong>SS-01A: Modelling and Measurement of LF EMI</strong> &lt;br&gt;<strong>Session Chair:</strong> Amr Ibrahim Madi, University of Zielona Gora, Poland and Iqra Aitbar, UoN, Pakistan &lt;br&gt;<strong>Location:</strong> G1</td>
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<tr>
<td>14:30</td>
<td>Un-terminated Black-Box EMI Models of Power Converters Driven by Random Modulation Strategies &lt;br&gt;Lu Wan, Abduselam H. Beshir, Xinglong Wu, Xiaokang Liu, Flavia Grassi, Giordano Spadacini, Sergio A. Pignari &lt;br&gt;Dept. of Electronics, Information and Bioengineering (DEIB), Politecnico di Milano, Italy</td>
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<td>14:50</td>
<td>Versatile LabVIEW-FPGA-based Testbench for Electromagnetic Interference Evaluation in VSDs &lt;br&gt;Douglas Aguiar do Nascimento, Robert Smolenski, Piotr Leżyński, Alexander Matthee, Niek Moonen, Frank Leferink &lt;br&gt;1University of Zielona Góra; 2University of Twente</td>
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<td>15:10</td>
<td>Influence of Chaotic Spreading Factor Modulation Based Random Modulation on G3-PLC System &lt;br&gt;Amr Madli, Waseem Elsayed, Douglas Nascimento, Abduselam Beshir, Piotr Lezynski, Robert Smolenski &lt;br&gt;1University of Zielona Gora, Poland; 2University of Twente, Netherlands; 3Politecnico di Milano, Italy</td>
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<td>15:30</td>
<td>Mode Stirred Chamber Measurement of Ghz Emissions of Wireless Power Transfer Systems &lt;br&gt;Christoph Brillinger, Mehdi Gholizadeh, Ralph Prestos, David Pommerenke &lt;br&gt;1Graz University of Technology IFE, Austria / Graz EMC lab; 2Silocon Austria Labs</td>
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<td>14:30-15:50</td>
<td><strong>OS-01A: Wireless Technologies (I)</strong> &lt;br&gt;<strong>Session Chair:</strong> Marc Pous, Universitat Politècnica de Catalunya, Spain &lt;br&gt;<strong>Location:</strong> G2</td>
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<td>14:30</td>
<td>Interference Requirements at Vehicle Platforms to Protect UWB Communication &lt;br&gt;Kia Wiklundh, Björn Bergqvist &lt;br&gt;1Private; 2Volvo Cars, Sweden</td>
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<td>14:50</td>
<td>A Study of Electromagnetic Robustness of IO-Link Wireless and SmartMesh IP for Applications on an Agricultural Vehicle &lt;br&gt;Aleksandr Ovechkin, Brian Leeman, Dries Vanoost, Tim Claeyaert, Marcel Verhoeven, Davy Pisoort &lt;br&gt;1KU Leuven, Belgium; 2CNH Industrial</td>
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<td>15:10</td>
<td>On the Impact of Spread Spectrum EMI on Communication Performance &lt;br&gt;Erik Axell, Thomas Ranström, Sara Linder, Kia Wiklundh, Karina Fors &lt;br&gt;1Swedish Defence Research Agency, Sweden; 2University of South Florida, FL</td>
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<td>15:30</td>
<td>EMC Challenges with 6G &lt;br&gt;Kia Wiklundh, Peter Stenumgaard &lt;br&gt;FOI, Sweden</td>
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14:30–15:50 **OS-02A: Shielding and Filtering (I)**

**Session Chair:** Valter Mariani Primiani, Università Politecnica delle Marche, Italy

**Location:** G3

14:30 Efficient Measurement Techniques and Modelling of Printed Circuit Board Shields
Andy Marvin, John Dawson
University of York, United Kingdom

14:50 Impact of the Bonding Design Parameters on the Shielding Effectiveness of Board-Level Shields at Microwave Frequencies
Pavithrakrishnan Radhakrishnan, Tim Claeyts, Johan Catrysse, Davy Pissoort
KU Leuven, Belgium

15:10 Shielding Effectiveness of Cabinets using IEEE 299 and 299.1 and Effect of Loading
Hans Schipper1, Chris Clemens2, Frank Leferink2
1Thales, Hengelo, The Netherlands; 2University of Twente, The Netherlands; 3Ministry of the Interior and Kingdom Relations Zoetermeer, The Netherlands

15:30 Auto-activated Electromagnetic Shield Upon High Intensity Radiated Field Illumination
Quentin Tricas1,2, Xavier Castel1, Francis Le Paven2, Thomas Eudes2, Patrice Foutrel2, Jérôme So1, Philippe Besnier
1Safran Electronics & Defense; 2Univ Rennes, INSA Rennes, CNRS, IETR – UMR 6164

16:20–17:40 **SS-01B: Modelling and Measurement of LF EMI**

**Session Chair:** Amr Ibrahim Madi, University of Zielona Gora, Poland and Iqra Aitbar, University of Nottingham, Pakistan

**Location:** G1

16:20 Effects of the Switching Frequency of Random Modulated Power Converter on the G3 Power Line Communication System
Abduselam Hamid Beshir1, Waseem El Sayed2, Amr Madi1, Lu Wan1, Flavia Grassi1, Paolo S. Crovetti1, Xinglong Wu1, Xiaokang Liu1, Robert Smolenski1, Sergio A. Pignari1
1Politecnico di Milano; 2Politecnico di Torino

16:40 Standardized Impedance: Microgrid Perspective for Inrush Current Compliance
Alexander Matthee1, Niek Moonen1, Frank Leferink2
1University of Twente, Enschede, The Netherlands; 2Thales, Hengelo, The Netherlands

17:00 Influence of Impedance Interaction & Comparability on Spectral Aggregation (2-150 kHz) in DC Grids
Arun Dilip Khilnani1, Angel Eduardo Pena-Quintal1, Erjon Ballukja1, Mark Sumner1, David William Prince Thomas1, Leonardo Sandrolini2, Andrea Mariscotti3
1The University of Nottingham, United Kingdom; 2Università di Bologna, Italy; 3University of Geneva, Italy

17:20 Measurement-Based Equivalent Circuit Model for Time-Domain Simulation of EMI Filters
Simone Negri, Giordano Spadacini, Flavia Grassi, Sergio Amedeo Pignari
Politecnico di Milano, Italy
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<td>OS-01B: Wireless Technologies (II)</td>
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<td><strong>Session Chair:</strong> Zbigniew Joskiewicz, Wroclaw University of Science and Technology, Poland</td>
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<td><strong>Location:</strong> G2</td>
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<td>16:20</td>
<td>Electromagnetic Noise as Entropy Source for Cryptographic System</td>
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<td>Jan Nemec, Stanislav Kovar, Iva Kavankova, Jan Valouch</td>
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<td>Tomas Bata University in Zlin, Czech Republic</td>
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<td>16:40</td>
<td>Detailed Investigation of the Vulnerability of an OFDM Based WLAN Connection to CW Signal Interference</td>
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<td>Henrik Brech, Heyno Garbe</td>
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<td>Leibniz University Hannover, Germany</td>
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<td>17:00</td>
<td>The Impact from Covid-19 Pandemic Lockdown on the Electromagnetic Interference in the GPS Frequency Band</td>
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<td>Karina Fors, Mikael Alexandersson, Peter Stenumgaard</td>
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<td>Swedish Defense Research Agency FOI, Sweden</td>
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<td>17:20</td>
<td>Measuring Radiated Spurious Emissions from a 5G Device in a Reverberation Chamber</td>
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<td>Sara Nadine Catteau</td>
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<td>Bluetest AB, Sweden</td>
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<td>16:20</td>
<td>OS-02B: Shielding and Filtering (II)</td>
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<td><strong>Session Chair:</strong> Philippe Besnier, CNRS - UMR 6164 - IETR, France</td>
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<td><strong>Location:</strong> G3</td>
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<td>16:20</td>
<td>Multichannel EMI Filter Performance Assessment</td>
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<td>Daria Nemashkalo¹, Patrick Koch¹, Niek Moonen¹, Frank Leferink¹²</td>
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<td>¹University of Twente, The Netherlands; ²Thales Nederland, BV, Hengelo, The Netherlands</td>
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<td>16:40</td>
<td>Board-level Shielding with Magnetic Absorber Sheet</td>
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<td>Jorge Victoria¹, Adrian Suarez², Pedro A. Martinez², Antonio Alcarria¹, Andrea Amaro¹, Jose Torres¹</td>
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<td>¹Würth Elektronik eSos, Germany; ²Department of Electronic Engineering, University of Valencia, Spain</td>
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<td>17:00</td>
<td>EMC Study On Aged Shielded Cables</td>
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<td>Henrik Wiebe¹, Matthias Spägele²</td>
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<td>¹Huber Automotive AG, Germany; ²Huber Automotive AG, Germany</td>
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<td>17:20</td>
<td>Analysis of the PDN Induced Crosstalk Impacts on the High-Speed Signaling in Ultra-Thin and High Permittivity Substrates</td>
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<td>Taiki Kitazawa¹, Yuichi Hayashi¹, Yoshi Fukada², Yougwoo Kim¹</td>
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<td></td>
<td>¹Nara Institute of Science and Technology, Nara, Japan; ²TechDream, Inc, San Jose, CA, USA</td>
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Wednesday September 7

9:00-10:20 SS-02A: Risk-Based EMC
Session Chair: Davy Pissoort, KU Leuven, Belgium and Mohammad Kameli, KU Leuven, Belgium
Location: G1

9:00 Study of Random Field Coupling onto a Scooter Following the Risk-Based EMC Approach
Vasiliki Gkatsi1, Ivan Struzhko1, Robert Vogt-Ardatjew2, Frank Leferink12
1University of Twente, The Netherlands, 2Thales Nederland, The Netherlands

9:20 Vulnerability of Smart Grid-Based Protection Systems to Ultra-Wide Band IEMI Sources
Fernando Arduini1, Thorsten Pusch1, Michael Suhrke2, Heyno Garbe2
1Fraunhofer INT, Germany; 2Leibniz University Hannover, Germany

9:40 Including Experimental Aging of Shielded Cables into Bulk Current Injection Simulations
Oskari Leppäaho1, Frédéric Lafon1, Bruno Ferreri1, Priscila Fernández Lopez1, Marine Stojanovic1, Richard Perdría1, Mohammed Ramdani2
1Valeo, France; 2ESEO, France

10:00 Effectiveness of Forward Error Corrections Over Different Wired Communication Channels in Harsh Electromagnetic Environments
Pejman Memari1, Hasan Habib1, Zhao Chen2, Dries Vanooost1, Robert Vogt-Ardatjew1, Bárbel van den Berg4, Tom Holvoet3, Davy Pissoort1, Jeroen Boydens1
1KU Leuven, Bruges Campus, Bruges, Belgium; 2Barco NV, Kortrijk, Belgium; 3University of Twente, Enschede, The Netherlands; 4Medisch Spectrum Twente Hospital, Enschede, The Netherlands; SKU Leuven, Leuven, Belgium

9:00-10:20 OS-03: Transmission Lines
Session Chair: Francesca Maradei, Sapienza University of Rome, Italy
Location: G2

9:00 Comparison of Emissions from a Transmission Line on a CISPR 25 Bench Setup and Test Vehicle
Ch Umer Sajjad1, John F Dawson1, Ayhan Gunsaya2, Andy C Marvin1
1University of York, United Kingdom; 2Motor Company, England

9:20 SPICE-Based Lumped Circuit Model of Multiconductor Lines Excited by an Incident Plane Wave
Moustafa Raya, Mathias Magdowski, Sergey Tkachenko, Ralf Vick
Otto von Guericke University Magdeburg, Germany

9:40 Characterization of Adhesive and Fastener Carbon Fiber Composite Joints Based on a Microstrip Transmission Line Method
David Ramos Somolinos, Borja Plaza Gallardo, Daniel López Sanz, José Cidrás Estévez, Víctor Díaz Mena, David Poyatos Martínez
Instituto Nacional De Técnica Aeroespacial, Spain

10:00 Multiconductor Transmission Line Approach to Model Common-Mode Currents in Motor-Drive Systems
Maryam Shokri, Ramiro Serra, Martijn C. van Beurden
Eindhoven University of Technology, The Netherlands
**Wednesday September 7**

### 9:00–10:20  
**OS-07A: Reverberation Chambers (I)**  
Session Chair:  
**Frank Leferink**,  
University of Twente, The Netherlands  
**Location: J1**

- **9:00**  
  Test level in Reverberation Chamber EMC Immunity Assessment Based on the Quantile to Average Ratio  
  Kristian Karlsson¹, Andreas Lundberg², Niklas Arabäck², Björn Bergqvist³  
  ¹RISE Research Institutes of Sweden, Sweden; ²Volvo Car Corporation

- **9:20**  
  An Experimental Study of the Signal to Noise Ratio of Radiated Emissions in the Presence of Thermal Noise in a Reverberation Chamber  
  Andy Marvin, Simon Bale  
  University of York, York, United Kingdom

- **9:40**  
  Electrical Fields in Vehicular Cavities During Reverberation Chamber EMC Immunity Test  
  Kristian Karlsson¹, Robert Moestam², Björn Bergqvist³, Hans Kalaran⁴, Åsa Rosdalen⁴  
  ¹RISE Research Institutes of Sweden, Sweden; ²China-Euro Vehicle Technology; ³Volvo Car Corporation; ⁴Volvo GTT

- **10:00**  
  On Excitation Periodicity in Continuously Stirred Reverberation Chambers  
  Lukas Oppermann, Lorenz Löser  
  TU Braunschweig, Germany

### 10:50–12:10  
**SS-02B: Risk-Based EMC**  
Session Chair:  
**Anne Roc'h**,  
Eindhoven University of Technology, The Netherlands and  
**Pejman Memar**, KU Leuven, Belgium  
**Location: G1**

- **9:00**  
  Combining 2oo3 Voting and Hamming Error Correction to Reduced the Occurrence of False Negatives in Wired Communication Lines under Continuous-Wave Electromagnetic Disturbances  
  Mohammad Kameli, Tim Claeyss, Davy Pissoort  
  KU Leuven, ESAT-WaveCore KU Leuven Bruges Campus Bruges, Belgium

- **9:20**  
  Risk Management Plan For Hospital Environment  
  Mumpy Das, Robert Vogt-Ardatjew, (Barbel) van den Berg de Bakker, Frank Leferink  
  University of Twente, The Netherlands

- **9:40**  
  A Review On Links Between Different EMC Test Environments In Medical Technologies  
  Nandun Senevirathna¹,², Rob Kleihorst¹, Anne Roc'h²  
  ¹Philips Medical Systems Nederland B.V.; ²Eindhoven University of Technology

- **10:00**  
  Combining Fast Field Probes with an EMI Detector to reveal Bit Errors induced by ElectroMagnetic Disturbances  
  Hasan Habibi¹, Tim Claeyss, Robert Vogt-Ardatjew², Bärbel van den Berg³, Guy A. E. Vandenbosch⁴, Davy Pissoort⁴  
  ¹KU Leuven, Bruges Campus; ²University of Twente; ³MST Hospital; ⁴KU Leuven
9:00 Testing Immunity of Active Implantable Medical Devices to Industrial Magnetic Field Environments
Lucien Hammen1,2, Lionel Pichon2, Yann Le Bihan2,3, Mohamed Bensetti2,3, Gerard Fleury1
1Institut national de recherche et de sécurité (INRS), Vandoeuvre-lès-Nancy, France, 2Université Paris-Saclay, CentraleSupelec, CNRS, Gif-sur-Yvette, France, 3Sorbonne Université, CNRS, Paris, France

9:20 Correlation Between Near-Field Scan Immunity and Radiated Susceptibility at Integrated Circuit Level
Alexandre Boyer, Nicolas Nolhier, Fabrice Caignet, Sonia Ben Dhia
LAAS-CNRS, France

9:40 An Interlaboratory Comparison on Radiated Immunity IEC 61000-4-3
Emrah Tas, Frederic Pythoud
Federal Institute of Metrology METAS, Switzerland

10:00 An Investigation Methodology to Predict Far Field Radiated Immunity from Near Field Scan Immunity Measurements
Andre Durier1, Sonia Ben Dhia2,3, Tristan Dubois, Alexandre Boyer2,3
1Continental Automotive France E, France, 2LAAS-CNRS, France, 3INSA Toulouse, France, 4IMT Bordeaux, France

9:00 A Novel Hybrid Nested Reverberation Chamber Measurement Technique for Shielding Effectiveness of Conductive Fabrics
Hakki Ekin Özdemir1, Muhammet Hilmi Nisanci2, Fatih Üstüner3, Ahmet Yasin Ciktay1, Hamid Torpi4, Mucahid Taha Mersin1, Ridvan Abal, Coskun Cosar1
1TÜBITAK BILGEM, Turkey, 2 sakarya University, Turkey, 3Istanbul Ticaret University, Turkey, 4Yildiz Technical University, Turkey

Samar Hosseinzadegan, Mats Kristoffersen, Patrik Svedjenäs, Sara Catteau, John Kvarnstrand
Bluetest AB, Sweden

9:40 Eigenmodes of a Loaded Reverberation Chamber
Hans Kalaran1, Kristian Karlsson2, Robert Moeastam3, Björn Bergqvist1, Åsa Rosdalen4
1Volvo AB, Sweden, 2RISE Research Institutes of Sweden, 3China-Euro Vehicle Technology, 4Volvo Car Corporation

10:00 Comparison of Susceptibility Measurements on a Reference Test Setup in Two Reverberation Chambers Including Cabling Variations
Thorsten Ragnar Pusch1, Christian Adami1, Tomas Hurtig2, Mattias Elfsberg1, Sven Fisahn1, Martin Schaal Schmid1
1Fraunhofer INT, Germany, 2FOI Swedish Defence Research Agency, 3Bundeswehr Research Institute for Protective Technologies and CBRN Protection (WIS)
D.O.E. Method Application to Optimize System Level RF Signal Path with Antenna Design
Scott Lee, Tim Chen, Tyran Cho, Snake Chen, Weiting Liu
Ring, Taiwan

Sharing and Electromagnetic Compatibility Studies Between 5G Networks and Feeder Links for Mobile-Satellite Service in 6700-7075 MHz Band
Alexander Pastukh1, Valery Tikhvinskiy1,2, Evgeny Devyatkin1, Vadim Belyavskiy1
1Radio Research and Development Institute (NIIR), Russian Federation; 2Bauman Moscow State Technical University, Russian Federation; 3Spectrum Ltd

Detection of Fault Location in Branching Power Distribution Network Using Deep Learning Algorithm
Daiki Nagata, Shunya Fujioka, Tohlu Matshushima, Hideaki Kawano, Yuki Fukumoto
Kyushu Institute of Technology, Japan

An Exponential Back-off Algorithm Based Interference Avoidance Strategy for Bluetooth Low Energy against Wideband Interference
Bozheng Pang, Tim Claeyts, Hans Hallez, Jeroen Boydens
KU Leuven, Belgium

Influence of AWGN on the Possibility to Remove a Continuous Wave EM Disturbance in OFDM systems
Aleksandr Ovechkin, Brian Leeman, Dries Vanoost, Tim Claeyts, Guy A. E. Vandenbosch, Davy Pissort
KU Leuven, Belgium

A Computationally Efficient Hybrid FDTD Method for Solving Field-to-Wire Coupling Problems in Shielded Cables with Junctions Inside Electrically Large Objects
Xuesong Meng1,2 1CAEP Software Center for High Performance Numerical Simulation, China, People’s Republic of; 2Institute of Applied Physics and Computational Mathematics, People’s Republic of China

Out-of-the-Box Performance of Popular SDRs for EMC Pre-Compliance Measurements
Christian Spindelberger, Holger Arthaber
TU Wien, Austria

A Single-layer Dual-band Frequency Selective Surface for 5G Shielding
Yu Huang1, Liping Yan1, Xiang Zhao1, Ming Ye2, Xian-Ke Gao3 1Sichuan University; 2Huawei Technologies Sweden AB; 3Electronics and Photonics Department Institute of High Performance

Analysis and Design for Broadband Slot Transition from Microstrip to Rectangular Waveguide
Yen Ching Li, Cheng Wu Ting, Chung Yuan Liu, Tzong Lin Wu
National Taiwan University, Taiwan

The Effects of Shielded Room Power Line Filters on CE101, CE102 and CS101 Test Results
Ali Karaali, Erdem Akpınar, Osman Ozgur Gursahbaz, Bager Ozbey
Aselsan A.Ş., Turkey

Realistic Modeling for the Calculation of Transient Induced Currents in a Measurement Cable
Bachir Nekhoul
Jijel university, Algeria
Interlaboratory Comparison Measurements for Military Magnetic Emission Test
TUBITAK UME, Turkey

Experimental Prediction of the Radiated Emission and Final Measurement Process Optimization based on Deep Neural Networks According to EN 55032
Hussam Elias, Ninovic Perez, Holger Hirsch
Duisburg-Essen University, Germany

Verification of the Voltage/Current Conversion Factor of Transformer-type-AAN for Conducted Emissions on Unscreened Balanced Pairs
Nozomi Miyake¹, Naoya Haraguchi², Fujio Amemiya³, Nobuo Kuwabara⁴, Hidenori Muramatsu⁵
¹VCCI Council/ NEC Corporation, Japan; ²FUJIFILM Business Innovation Corp, Japan; ³VCCI Council, Japan; ⁴Kyushu Institute of Technology, Japan

Current Distribution in Flat Transparent Antennas
Reuven Zemach¹, Zion Menachem², Jacob Assayag³, Amir Gamliel⁴, Motti Haridim⁵
¹Merchavim Institute of R&D in Negev; ²Shamoon College of Engineering, Beer Sheva, Israel; ³Investigations and Intelligence Dept, Israel Police, Jerusalem, Israel; ⁴HIT-Holon institute of Technology, Israel

Response of Muscle Tissue to Pulsed Electromagnetic Fields: An Asymptotic Description
Constantinos Balicntsis
Biosolutions Ltd, Greece

Analytical Method to Check and Correct the TDR Impedance Profile of Low-Loss Transmission Lines
Matthias Hampe, Margarita Tetzlaff, Thomas Müller
Ostfalia University of Applied Sciences, Germany

Early Considerations for Unit’s Induced Electric Behaviour Characterization in the Extreme Low Frequency Domain
Anargyros T. Baklezos¹,², Christos D. Nikolopoulos¹, Panagiotis K. Papastamatis², Theodoros N. Kapetanakis¹, Ioannis O. Vardimbašis¹, Christos N. Capsalis²
¹Hellenic Mediterranean University, Greece; ²National Technical University of Athens, Greece

Intermodulation Distortion Characterization of RF Transceivers by Means of a Transverse Electromagnetic Cell
Alain Grèzes¹,², Jérémy Raoult², Alexandre Martorell¹
¹Thales SIX GTS, Gennevilliers, France; ²IES, University of Montpellier, CNRS

Impact of the Injection Point Selection During Indirect Application of ESD Pulses According to IEC 61000-4-2
Panagiotis K. Papastamatis¹, Theodosios K. Lamprinos¹, Christos D. Nikolopoulos², Anargyros T. Baklezos¹, Ioannis F. Gonos¹, Ioannis A. Stathopoulos¹
¹School of Electrical and Computer Engineering, National Technical University of Athens, Greece; ²School of Engineering, Dept. of Electronic Engineering, Hellenic Mediterranean University, Greece

Novel 3D Printable Copper Twisted Pair Array Heatsink Design for EMI Mitigation
Darwin Zhang Li¹, Tetsumune Kuromura², Yoshi Fukawa³
¹Good Simulations LLC, United States of America; ²Mitsui Mining & Smelting CO., LTD.; ³TechDream, Inc.
### SS-04A: Stochastic Methods in EMC

**Session Chair:**
Valter Mariani Primiani, Università Politecnica delle Marche, Italy  
**Location:** G1

<table>
<thead>
<tr>
<th>Time</th>
<th>Title</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>14:30</td>
<td>Investigation of the Impact of Height Scans in Fully Anechoic Rooms on Detection of Maximal Radiated Field Strength Using Monte Carlo Simulation</td>
<td>Jörg Petzold, Mathias Magdowski, Ralf Vick, Otto-von-Guericke Universität, Germany</td>
</tr>
<tr>
<td>14:50</td>
<td>Theoretical Analysis of a Wall-Mounted Broadband Antenna for Source Stirred Reverberation Chambers</td>
<td>Alfredo De Leo, Paola Russo, Valter Mariani Primani, Università Politecnica Marche, Italy</td>
</tr>
<tr>
<td>15:10</td>
<td>A Source Stirred Vibrating Intrinsic Reverberation Chamber Using Two Antennas</td>
<td>Danilo Izzo, Robert Vogt-Ardatjew, Georgios Erotas, Frank Leferink, University of Twente, The Netherlands</td>
</tr>
<tr>
<td>15:30</td>
<td>Efficient EMC Risk Analysis of PCB Using Iterative Surrogate-Model Enrichment and Morris Sensitivity Analysis</td>
<td>Alexandre Plot, Philippe Besnier, Béatrice Azanowsky, THALES SIX GTS, France; Université Rennes, CNRS, IETR - UMR 6164</td>
</tr>
</tbody>
</table>

### OS-05: Human Exposure to EM Field

**Session Chair:**
Mauro Feliziani, Università degli Studi dell’Aquila, Italy  
**Location:** G2

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<tr>
<th>Time</th>
<th>Title</th>
<th>Authors</th>
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<tbody>
<tr>
<td>14:30</td>
<td>Assessment of Exposure to Magnetic Field from Pulse Width Modulated Currents</td>
<td>Markus Johansson, Jan Carlsson, Provinn AB, Sweden</td>
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<tr>
<td>14:50</td>
<td>Time Reversal in Reverberating Structures for Deep Focusing in Human Bodies</td>
<td>Emanuel Colella, Luca Bastianelli, Francesco Dragano, Valter Mariani Primiani, Franco Moglie,Università Politecnica Marche, Department of Information Engineering, Ancona, Italy; Consorzio Nazionale Interuniversitario per le Telecomunicazioni (CNIT), Parma, Italy</td>
</tr>
<tr>
<td>15:10</td>
<td>Comparison of Frequency and Code Selective Methods for Electromagnetic Exposure Measurement in the Vicinity of a LTE (4G) Base Station</td>
<td>Bahadır Tektaş, Soydan Çakır, TÜBİTAK UME, Turkey</td>
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<tr>
<td>15:30</td>
<td>SAR Computation Due to Wearable Devices by Using High-Resolution Body Models and FDTD Numerical Code</td>
<td>Greta Silla, Luca Bastianelli, Emanuel Colella, Franco Moglie, Valter Mariani Primiani,Università Politecnica Marche, Italy; Consorzio Nazionale Interuniversitario per le Telecomunicazioni (CNIT), Parma, Italy</td>
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</table>
### OS-08A: Measurements (I)

#### Session Chair:
Bernd Deutschmann, 
Graz University of Technology, 
Austria

**Location:** J1

<table>
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<tr>
<th>Time</th>
<th>Title</th>
<th>Speakers</th>
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</table>
| 14:30 | Mono-Static Radar Cross-Section Measurement and Calibration for Complex Natural Resonance Extraction | Max Rosenthal, Felix Middelstaedt, Ralf Vick  
Otto von Guericke University, Germany |
| 14:50 | Measurement of the Unwanted Magnetic Field Emissions Along a Model of a Wind Turbine | Cornelia Reschka, Heyno Garbe  
Leibniz University Hannover, Germany |
| 15:10 | In-situ Measurements of Conducted and Radiated Emissions from Photovoltaic Installations | Sara Linder, Kia Wiklundh  
Swedish Defence Research Agency, Sweden |
| 15:30 | Estimation of the Highest Influence on the Measured Results of a Three-axis Shielded Loop Antenna Using Three Transmitting Antenna and Tilted Antenna Methods | Denys Pokotilov¹, Robert Vogt-Ardatjew¹, Frank Leferink¹²  
¹University of Twente, The Netherlands; ²THALES, The Netherlands |

### SS-04B: Stochastic Methods in EMC

#### Session Chair:
Valter Mariani Primiani, 
Università Politecnica delle Marche, Italy

**Location:** G1

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<tr>
<th>Time</th>
<th>Title</th>
<th>Speakers</th>
<th>Institutions</th>
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</table>
| 16:20 | Efficient Frequency-Domain Uncertainty Quantification Using Parameterized Model Order Reduction | Francesco Ferranti¹, Daniele Romano², Luigi Lombardi³, Giulio Antonini⁴, Ye Tao⁵, Michel Nakhla⁶  
¹Vrije Universiteit Brussel; ²Università degli Studi dell’Aquila, Italy; ³Micron Semiconductor; ⁴Carleton University |
| 16:40 | Polynomial Chaos Kriging Metamodel for Automotive EMC Simulations | Arnold Bingler¹², Sándor Bilicz¹, Csőrnyei Márk²  
¹Department of Broadband Infocommunications and Electromagnetic Theory, Faculty of Electrical Engineering and Informatics, Budapest University of Technology and Economics, Hungary; ²Powertrain Solution–Power Electronics, Robert Bosch Kft. |
| 17:00 | Stochastic Modeling and Analysis of Automotive Wire Harness Based on Machine Learning and Polynomial Chaos Method | Tadatoshi Sekine¹, Shin Usuki², Kenjiro Miura³  
¹Department of Mechanical Engineering, Shizuoka University, Japan; ²Research Institute of Electronics, Shizuoka University, Japan; ³Graduate School of Science and Technology, Shizuoka University, Japan |
| 17:20 | Analysis of Aircraft Shieldings for Lightning Indirect Effects by a Novel S-FDTD | Miguel Ruiz Cabello¹, Enrique Pascual Gil², Guadalupe Gutierrez Gutierrez², Hirahi Galindo Perez², Luis Diaz Angulo¹, Alberto Gascon Bravo¹  
¹University of Granada, Spain; ²Airbus, Spain |
**Wednesday September 7**

**16:20–17:40  OS-06: EMC in Safety and Security Applications**
Session Chair: Frank Sabath, WIS, Germany
Location: G2

16:20  Time-Frequency Diagnosis of a Fault in a Network of Shielded Cable
Bachir Nekhoul
Jijel University, Algeria

16:40  Providing Assurance that Risks Associated with Electromagnetic Disturbances are Sufficiently Managed
Mohammad Tishehzan¹, Mark Nicholson¹, John F. Dawson¹, Davy Pissoort²
¹University of York, United Kingdom; ²KU Leuven, Belgium

**17:00  Board-Level Hardware Trojan Detection Using on-Chip Touch Sensor**
Masahiro Kinugawa¹, Yuichi Hayashi²
¹The University of Fukui, Japan; ²Nara Institute of Science and Technology, Ikoma, Japan

17:20  FPGA Switching Current Modeling Based on Register Transfer Logic Simulation for Power Side-Channel Attack Prediction
Masaki Himuro, Kengo Iokibe, Yoshitaka Toyota
Okayama University, Japan

**16:20–17:40  OS-08B: Measurements (II)**
Session Chair: Mohamed Ramdani, ESEO, France
Location: J1

16:20  Measurement of Steady-State and Transient Harmonics Caused by TVS
Leonhard Petzel¹, David Pommerenke¹, Steffen Holland², Seyedmostafa Mousavi¹, Amin Pak¹
¹Graz University of Technology, Austria; ²Nexperia Germany GmbH, Germany

16:40  Time-domain Multitone Impedance Measurement System for Space Applications
Marc Pous¹², Marco Azpurua¹, Dongsheng Zhao¹, Johannes Wolf², Ferran Silva¹
¹Universitat Politècnica de Catalunya, Spain; ²European Space Agency, The Netherlands

17:00  3D Printed Probe for Simultaneous E and H Fields Measurements
Marcos Quílez, Marc Pous, Marc Mateu-Mateus, Jordi Solé Lloberas, Ferran Silva
Universitat Politècnica de Catalunya, Spain

Daniel Kircher, Bernd Deutschmann, Nikolaus Czepl
Graz University of Technology, Austria
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<tbody>
<tr>
<td>09:00</td>
<td>OS-09: ESD</td>
<td>A Fast and Efficient Model Extraction Method to Predict the Transient Response of ESD Protection Devices</td>
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<td>François Ruffat¹, Fabrice Caignet¹, Alexandre Boyer¹, Fabien Escudié², Guillaume Mejecaze², Frédéric Puybaret³</td>
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<td>¹LAAS-CNRS, France; ²CEA-Gramat, France</td>
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<td>09:20</td>
<td>OS-13A: Computational Electromagnetics (I)</td>
<td>Conformal FDTD Simulation of Vibrating Intrinsic Reverberation Chambers</td>
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<td>Florian Mahiddini, Guillaume Andreiu, Christophe Guillfaut, Nicolas Bui</td>
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<td>Affiliation: Jade University of Applied XLIM, France</td>
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<td>09:40</td>
<td>OS-09: ESD</td>
<td>Wearable ESD Occurrence Rate Detection with Voltage Level Estimation</td>
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<td>Gabriel Fellner¹, David Johannes Pommerenke¹², Seyed Mostafa Mousavi¹, Amin Pak¹², Matthias Wintersteller¹, Christoph Koger¹, Satyajeet Shinde¹, Michael Hillstrom³</td>
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<td>¹Graz University of Technology, Austria; ²SAL GEMC lab, Austria; ³Apple Inc., Cupertino, USA</td>
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<tr>
<td>10:00</td>
<td>OS-13A: Computational Electromagnetics (I)</td>
<td>Mixed Proper Orthogonal Decomposition with Harmonic Approximation for Parameterized Order Reduction of Electromagnetic Models</td>
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<td>Riccardo Torchio¹, Alessandro Zanco², Francesco Lucchini³, Piergiorgio Alotto³, Stefano Grovet-Talocia³</td>
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<td>¹Università degli Studi di Padova, Dept. of Industrial Engineering; ²Politecnico di Torino, Dept. of Electronics and Telecommunications; ³Università degli Studi di Padova, Centro Ricerche Fusione</td>
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<tr>
<td>10:00</td>
<td>OS-09: ESD</td>
<td>Quantification of ESD Pulses Caused by Collision of Objects</td>
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<td>Gabriel Fellner¹, Amin Pak¹², Seyed Mostafa Mousavi¹, Christoph Koger¹, Ali Khorrami¹, David Pommerenke¹²</td>
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<td>¹Graz University of Technology, Austria; ²SAL, Austria; ³Apple Inc.</td>
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<tr>
<td>10:00</td>
<td>OS-13A: Computational Electromagnetics (I)</td>
<td>On the Decoupling of Integrals in the Surface PEEC Method</td>
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<td>Maria De Lauretši, Elena Haller⁷, Daniele Romano⁴, Giulio Antonini⁴, Jonas Ekman⁴, Ivana Kovacevic-Badstubner⁴, Ulrike Grossner⁴</td>
</tr>
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<td>¹Luleå University of Technology, Sweden; ²Halmstad University, Sweden; ³University of L’Aquila, Italy; ⁴ETH Zurich, Switzerland</td>
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</tbody>
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**Thursday September 8**

**09:00–10:20**

### OS-09: ESD

**Session Chair:** Diethard Hansen, Euro EMC Service, Switzerland  
**Location:** G1

- **9:00**
  - A Fast and Efficient Model Extraction Method to Predict the Transient Response of ESD Protection Devices  
    - François Ruffat¹, Fabrice Caignet¹, Alexandre Boyer¹, Fabien Escudié², Guillaume Mejecaze², Frédéric Puybaret³  
    - ¹LAAS-CNRS, France; ²CEA-Gramat, France

- **9:20**
  - Wearable ESD Occurrence Rate Detection with Voltage Level Estimation  
    - Gabriel Fellner¹, David Johannes Pommerenke¹², Seyed Mostafa Mousavi¹, Amin Pak¹², Matthias Wintersteller¹, Christoph Koger¹, Satyajeet Shinde¹, Michael Hillstrom³  
    - ¹Graz University of Technology, Austria; ²SAL GEMC lab, Austria; ³Apple Inc., Cupertino, USA

- **9:40**
  - Quantification of ESD Pulses Caused by Collision of Objects  
    - Gabriel Fellner¹, Amin Pak¹², Seyed Mostafa Mousavi¹, Christoph Koger¹, Ali Khorrami¹, David Pommerenke¹²  
    - ¹Graz University of Technology, Austria; ²SAL, Austria; ³Apple Inc.

- **10:00**
  - A Comparative Study of DPI Levels on BMS IC with an On-Hand Analytical Model to Predict Resonances  
    - Badr Guendouz¹²³, Kamel Abouda², Alexandre Boyer¹, Sonia Ben Dhia³, Hiba Mediouni², Jérôme Dietsch⁴  
    - ¹BMS/EMC-ESD Team, NXP Semiconductors, France; ²LAAS-CNRS, Univ de Toulouse, INSA, UPS, LAAS; ³BMS/EMC-ESD Teams, NXP Semiconductors, France; ⁴LAAS-CNRS, Univ de Toulouse, INSA, UPS, LAAS; ⁵BMS/System Architecture team, NXP Semiconductors, France.
09:00–10:20  **OS-15: Automotive**
Session Chair: Marco Klingler, Stellantis, France
Location: J1

9:00  Opportunities for Intentional Interference with Automotive Radars Using Commercial Sensors
Alastair Ruddle, Douglas Ruddle, Jaspal Singh, Richard Blachford
HORIBA MIRA Limited, United Kingdom

9:20  Analysis of the Power Coupling Between an Antenna and a Device Under Test in a MSRC to Replace On-board Immunity Tests of Automotive Equipment
Bule MBO Clovis¹,², Klingler Marco¹, Pichom Lionel², Bensetti Mohamed²
¹Stellantis, Centre technique de Vélizy, route de Gisy, 78943 Vélizy-Villacoublay, France.
²Université Paris-Saclay, CentraleSupélec, CNRS, Laboratoire de Génie Electrique et Electronique de Paris, 91192, Gif-sur-Yvette, France.

9:40  Analytical Method to Estimate Radiated Magnetic Field Emissions in Automotive Electric Drives
Madhavi Dhara, Guido A. Rasek
Valeo Siemens eAutomotive Germany GmbH, Germany

10:00  Integrated EMI Detector as Essential Safety Mechanism in Automotive Sensor Applications
Dieter Joos
ON Semi, Belgium

10:50–12:10  **OS-10: Lightning**
Session Chair: Heyno Garbe, Leibniz Universität Hannover, Germany
Location: G1

10:50  Distribution of the Current from Lightning in Sweden
Florian Mahiddini, Guillaume Andreiu, Rebecca Persson¹, Per Westerlund¹, Mahbubur Rahman¹, Milan Radosavljevic¹, Stefan Stähl¹
¹Uppsala University; ²Luleå University of Technology; ³Svenska Kraftnät; ⁴SMHI

11:10  Impact of IEMI Pulses on a Barometric Sensor
Louis Cesbron Lavau¹, Michael Suhrke¹, Peter Knott²³
¹Fraunhofer INT, Germany; ²Fraunhofer FHR, Germany; ³RWTH Aachen, Germany

11:30  Effects of EMC Filter Topologies on the Destruction Scenarios of SMPS Under High Current Interference Pulses
Laurine Curos¹², Guillaume Mejecaze¹, Tristan Dubois³, Frédéric Puybaret¹, Jean-Michel Vinassa³
¹CEA, DAM, CEA-Gramat; ²Univ. Bordeaux, CNRS, Bordeaux INP, IMS UMR 5218; ³Univ. Bordeaux

11:50  New Probe Design for Hardware Characterization by Electro Magnetic Fault Injection
Clément Gaine¹, Driss Aboulkassimi¹, Jean-Pierre Nikolovski¹, Jean-Max Dutertre²
¹Univ. Grenoble Alpes, CEA, LETI, MINATEC Campus, F-38054 Grenoble, France; ²Mines Saint-Etienne, CEA-Tech, Centre CMP, F-13541 Gardanne France
### Thursday September 8

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<th>Session</th>
<th>Description</th>
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<td>10:50–12:10</td>
<td><strong>OS-13B: Computational Electromagnetics (II)</strong>&lt;br&gt;Session Chair: Davy Pissoort, KU Leuven, Belgium&lt;br&gt;Location: G2</td>
<td>Co-simulation of Circuit/Circuit Type Solvers for EMC Applications Using a New Relaxation Method&lt;br&gt;Amadou Bayaghiou Diallo1,2, Christian Vollaire1, Mohamed Bensetti3, Lion Pichon3, Arnaud Breard3&lt;br&gt;1Univ Lyon, Ecole Centrale de Lyon, INSA Lyon, Université Claude Bernard Lyon 1, CNRS, Ampère, UMR 5005, Ecully, France; 2GeePs - Group of electrical engineering – Paris, UMR CNRS 8507, CentraleSupélec, Université Paris-Saclay, Sorbonne Université, 3 &amp; 11 rue Joliot-Curie, Plateau de Moulon 91192 Gif-sur-Yvette, France</td>
</tr>
<tr>
<td>10:50–12:10</td>
<td><strong>OS-16: Electric Vehicles</strong>&lt;br&gt;Session Chair: Björn Bergqvist, Volvo Cars, Sweden&lt;br&gt;Location: J1</td>
<td>Investigation of Ground Impedances Effecting EMC during Charging Operations of Electric Vehicles&lt;br&gt;Inti Runa Supa Stölen1, Jonas Bertelmann1, Michael Bettle1, Stefan Tenbohlen1, Christian Bersch2, Konstantin Spanos3&lt;br&gt;1University of Stuttgart, Germany; 2Robert Bosch GmbH, Germany</td>
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<tr>
<td>10:50</td>
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<td>Measurement-Based Modeling of PCB-to-Coaxial Cable Transition for 3D Electromagnetic Simulation by Equivalent Circuit Assisted De-Embedding&lt;br&gt;Herbert Hackl1, Bernhard Auinger1, Mate Kovacs2, Andreas Wagner2, Christian Stockreiter3&lt;br&gt;1Silicon Austria Labs GmbH, Austria; 2ams osram group, Austria</td>
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<tr>
<td>11:10</td>
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<td>Density-Based Topology Optimization for Conductor Pattern Design with Improved Impedance Boundary Condition&lt;br&gt;Katsuya Nomura&lt;br&gt;Kwansei Gakuin University, Japan</td>
</tr>
<tr>
<td>11:30</td>
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<td>Flexible Numerical Evaluation of Human Head Exposure to a Transmitter Coil For Wireless Power Transfer at 13.56 MHz&lt;br&gt;Hamideh Esmaeili, Cheng Yang, Christian Schuster&lt;br&gt;Hamburg University of Technology, Germany</td>
</tr>
<tr>
<td>11:50</td>
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<td>Inverter Interference on Charging Communication System during 400 V DC Charging of Vehicle&lt;br&gt;Lennart Hasselgren1, Georgios Mademlis2, Åke Lindbeck2, Oskar Dahl3&lt;br&gt;1EMC Services, Sweden; 2Volvo Cars Corporation, Sweden</td>
</tr>
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</table>
14:30–15:50 **OS-11: EMP**
Session Chair:
David Thomas,
The University of Nottingham,
United Kingdom
Location: G1

**OS-13C: Computational Electromagnetics (III)**
Session Chair:
Markus Johansson,
Provinn AB, Sweden
Location: G2

14:30 Uncertainty Propagation with an Asynchronous Temporal Co-Simulation Method Applied to a Transmission Line Network
Imane Massaoudi, Pierre Bonnet
Université Clermont Auvergne, Clermont Auvergne INP, CNRS, Institut Pascal, France

14:50 Effectiveness of Radiofrequency Field Exposure Assessment for Vehicle Occupants Based on Empty Vehicle Field Data and Field Reference Levels
Alastair Ruddle
HORIBA MIRA Limited, United Kingdom

15:10 TEMPEST Zoning for Complex Platforms
Frank Leferink¹,², Chris Clemens³, Hans Bergsma¹
¹THALES, Hengelo, the Netherlands; ²University of Twente, Enschede, the Netherlands; ³Ministry of the Interior and Kingdom Relations Zoetermeer, The Netherlands

15:30 Distance Characteristics of Field Peak Value of Transient Electric Field Caused by Sphere-Gap ESD Using a Optical E-Field Probe
Ken Kawamata¹, Shinobu Ishigami¹, Osamu Fujiwara²
¹Tohoku Gakuin University, Japan; ²Nagoya Institute of Technology, Japan

14:30 Exact-Kernel Thin-Wire MoM with Geometric Representation by Bézier Curves
Thomas Rylander¹, Matthys M. Botha²
¹Chalmers University of Technology, Sweden; ²Stellenbosch University

14:50 Modeling of a Litz Wire with Perfect Strand Pattern
Silvano Cruciani¹, Tommaso Campi¹, Francesca Maradei², Mauro Feliziani¹
¹University of f’aquila, Italy; ²La Spienza University of Rome, Italy

15:10 Numerical Simulation of Field Distribution Regarding Automotive Component EMC-testing According to ISO 11452-2
Andrea Hofer, Stefan Cecil
Seibersdorf Labor GmbH, Austria

15:30 Approach to S-Band Antenna Pattern Distortion Generated by Spacecraft Plasma Plume
Alessandro Giordani, Davide Morfei, Thales Alenia Space Italia s.p.a., Italy
Thursday September 8

14:30-15:50  **OS-17: EMC in Automotive, Aircraft and Space Applications**

Session Chair: Ferran Silva, UPC, Spain
Location: J1

14:30  **A Study on EMC Test Methods for ESD-Induced Conducted Noise through Space Structures**
Toru Kasai¹, Toshio Onigata²
¹Japan Aerospace Exploration Agency; ²e-OHTAMA, LTD.

14:50  **Design of EMI Optimized Isolated DC/DC Converter for Space-Based Applications**
Patrick Koch, Johan Dijkstra, Niek Moonen
University of Twente, The Netherlands

15:10  **Radiated Emissions from Power Feeders for Electric Propulsion in Aircraft**
Jesper Lansink Rotgerink
Royal Netherlands Aerospace Centre, The Netherlands

15:30  **Mitigating Radiated Emissions of Power Feeders On-board Electric Aircraft**
Leonardo Malburg¹, Niek Moonen¹, Jesper Lansink-Rotgerink¹², Frank Leferink¹³
¹University of Twente, Enschede, the Netherlands; ²NLR, Marknesse, the Netherlands; ³THALES Nederland B.V., Hengelo, the Netherlands

16:20-17:40  **OS-12: Advanced Materials and Harmonic Distortion**

Session Chair: Jan Luiken ter Haseborg, Technische Universiteit Hamburg, Germany
Location: G1

16:20  **Predicting the EMI Induced Offset of a Differential Amplifier Stage using a Neural Network Model**
Dominik Zupan, Daniel Kircher, Nikolaus Czepl
Graz University of Technology, Austria

16:40  **Impact of Long Distribution Cable to the Harmonic Distortion in Indonesia Remote Microgrids**
Ilman Sulaeman¹, Niek Moonen¹, Jelena Popovic¹², Frank Leferink¹³
¹University of Twente, Enschede, The Netherlands; ²Klimop Energy, Deventer, the Netherlands; ³Thales Nederland B.V., Hengelo, The Netherlands

17:00  **Broadband Effective Dielectric Permittivity of Heterogeneous 3D Printed PLA Structures**
Marco A. Azpurua¹², Marc Mateu-Mateus¹, Marc Pous¹³, Marcos Quílez¹, Ferran Silva¹
¹Universitat Politècnica de Catalunya, Spain; ²EMC Electromagnetic BCN, S.L. (EMC Barcelona), Spain; ³European Space Agency, The Netherlands

17:20  **Radiation Reduction from Heatsinks by a PMC Surface**
Muhammet Hilmi Nisanci¹, Francesco de Paulis²
¹Sakarya University, Turkey; ²University of L’Aquila, Italy
16:20-17:40 **OS-14: Power Electronics**

Session Chair: Stefan Dickmann, Helmut Schmidt University, Germany
Location: G2

**Deep-Learning Based Transient Identification in Switched-Mode Power Supplies Conducted Emissions**
Mattia Simonazzi¹, Leonardo Sandrolini¹, Marcello Iotti¹, Andrea Mariscotti¹
¹University of Bologna, Italy

**Impact of Routing on the EMC Behavior of a GaN HEMT-Based Full Bridge DC-DC Converter**
Ayawo Roger Ekon¹,², Mickael Petit¹,², François Costa¹,², François Bouvet¹,², Eric Dupuy¹
¹Université Paris-Saclay, ENS Paris-Saclay, CNRS, SATIE, 91190 Gif-sur-Yvette, France; ²Université Paris Est Créteil, INSPE, 94000 Créteil, France

**Lumped Circuit Model for Concentrically Arranged Conductors in Power Electronic Systems**
Daniel Seyfried¹, Bednarz Christian², Matthias Friedrich³
¹University of Applied Science Würzburg-Schweinfurt; ²Siemens Mobility GmbH; ³University of Applied Science Fulda

16:40

**Extending Site VSWR to Millimeter Wave using Cylindrical Mode Filtering**
Zhong Chen¹, Phil Miller²
¹ETS-Lindgren, United States of America; ²RATLR, Inc., United States of America

**Non-Linear Hybrid Filter for the DC-Side Ripple Current of Voltage Source Converters**
Sebastian Raab, Ansgar Ackva
University of Applied Sciences Wuerzburg-Schweinfurt, Germany

17:00

**Assessment of EMI and Power Quality in Mains Power Distribution Using a Low-Cost Breakout Box for EMC Education**
Cathrine E.S. Feloups¹,³, Niek Moonen¹, Frank Leferink²
¹Electrical Engineering, Mathematics and Computer Science (EEMCS), University of Twente, Enschede, The Netherlands; ²Thales Netherlands, 7554 RR, Hengelo, The Netherlands; ³Department of Electrical Engineering, Faculty of Engineering, South Valley University, Qena, Egypt

17:20

**Radio Frequency Interference Considerations in Large-Scale STATCOM Installations**
Emil Máki Eriksson, Jon Rasmussen, Mose Akyuz
Hitachi Energy, Sweden
Floor Plan

G1 Conference

G2 Conference

Entrance
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<td>Advanced Test Equipment Corp</td>
<td>G02:04</td>
<td>10401 Roselle St 92121 SAN DIEGO USA <a href="http://www.atecorp.com">www.atecorp.com</a></td>
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<tr>
<td>Amska</td>
<td>G04:05</td>
<td>Box 88 155 21 NYKVARN SWEDEN <a href="http://www.amska.se">www.amska.se</a></td>
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<td>AR Europe</td>
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<td>Ce-Bit Elektronik AB</td>
<td>G04:12</td>
<td>Box 7055 187 11 TÄBY SWEDEN <a href="http://www.cebith.se">www.cebith.se</a></td>
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<td>Cergen GmbH</td>
<td>G04:08</td>
<td>Olof Palme Str. 13 60439 FRANKFURT GERMANY <a href="http://www.cergen.de">www.cergen.de</a></td>
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<td>Comsol AB</td>
<td>G05:05</td>
<td>Tegnergatan 23 111 40 STOCKHOLM SWEDEN <a href="http://www.comsol.com">www.comsol.com</a></td>
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<td>Comtest Engineering BV</td>
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<td>Hoge Rijndijk 205 2382 AL, Zoeterwoude Netherlands <a href="http://www.comtest.eu">www.comtest.eu</a></td>
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<td>Dassault Systemes</td>
<td>G05:03</td>
<td>Klarabergsviadukten 90 111 52 STOCKHOLM SWEDEN <a href="http://www.3ds.com">www.3ds.com</a></td>
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<td>Dovitech A/S</td>
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<td>Blokken 59 3460 BIRKERØD DENMARK <a href="http://www.dovitech.dk">www.dovitech.dk</a></td>
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<td>Box 130 60 250 13 HELSINGBORG SWEDEN <a href="http://www.emp-tronic.se">www.emp-tronic.se</a></td>
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<td>ETS Lindgren</td>
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<td>Mekaanikontie 1 27510 EUPA FINLAND <a href="http://www.ets-lindgren.com">www.ets-lindgren.com</a></td>
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<td>Haefely AG</td>
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<td>Birrsstrasse 300 4052 BASEL SWITZERLAND <a href="http://www.pfiffner-group.com">www.pfiffner-group.com</a></td>
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<td>IEEE EMC Society</td>
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<td>Box 1103 164 22 KISTA SWEDEN <a href="http://www.intertek.se">www.intertek.se</a></td>
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<td>Västerviksv. 4 139 36 VÄRMDÖ SWEDEN <a href="http://www.jolex.se">www.jolex.se</a></td>
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<td>Kitagawa GmbH</td>
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<td>Birkenwaldstrasse 38 63179 OBERTSHAUSEN Germany <a href="http://www.kitagawa.de">www.kitagawa.de</a></td>
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<td>Kooma Engineering AB</td>
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<td>Box 10101 434 22 KUNGSBACKA SWEDEN <a href="http://www.kooma.se">www.kooma.se</a></td>
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<td>Lumiloop GmbH</td>
<td>G04:02</td>
<td>Gosstritzer Str. 63 1217 DRESDEN GERMANY <a href="http://www.lumiloop.de">www.lumiloop.de</a></td>
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<td>Microwave Vision SA</td>
<td>G03:05</td>
<td>13 rue du Zephyr 91140 VILLEJUST FRANCE <a href="http://www.mvg-world.com">www.mvg-world.com</a></td>
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<td>Narda Safety</td>
<td>G02:01</td>
<td>Test Solutions S.r.l Via Benessea 29/B 17035 CISANO SUL NEVA ITALY</td>
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</table>
OEM Electronics AB G03:03
Box 1025
573 29 TRANÅS
SWEDEN
www.oemelectronics.se

Pendulum Instruments G03:01
Lotnicza 37
80-297 BANINO
POLAND
www.pendulum-instruments.com

Proxitron AB G02:06
Box 324
591 62 MOTALA
SWEDEN
www.proxitron.se

RanLOS AB G03:08
Stora Åvägen 21
436 34 ASKIM
SWEDEN
www.ranlos.com

RISE G05:01
Box 857
501 15 BORÅS
SWEDEN
www.ri.se

Rohde & Schwarz G04:01
Sverigekon
Flygfältsgatan 15
128 30 SKARPANÄCK
SVIERGE
www.rohde-schwarz.com

Seibersdorf Labor GmbH G03:12
2444 SEIBERSDORF
AUSTRIA
seibersdorf-laboratories.at

Spirent Communications G03:02
Box 2220
403 14 GÖTEBORG
SWEDEN
www.spirent.com

VinnGroup AB G04:07
Box 2220
403 13 GÖTEBORG
SWEDEN
www.vinngroup.com

Würth Elektronik eiSos GmbH G03:07
Annelundsgatan 17C
749 40 ENKÖPING
SWEDEN
www.we-online.com

Upcoming EMC Events

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<td>September 4-8,</td>
<td>Krakow, Poland</td>
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<td>EMC Europe 2024</td>
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<td>IEEE International Symposium</td>
<td>July 31- August 4,</td>
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<td>APEMC 2023</td>
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<td>APEMC 2024</td>
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_Last updated
August, 2022_
The Environmental Engineering Handbook has undergone an extensive update and is the most complete handbook in environmental technology. The handbook covers the entire work area for environmental technology and is an invaluable tool for establishing environmental technical specifications, both national and international.

A comprehensive encyclopedia that provides guidance in correct methodology for environmental technology work, as well as basic rules and advice on how such work – correctly specified and verified – leads to a safe and reliable product. The handbook is published by the Swedish Environmental Engineering Society (SEES).

If you need to know the magnetic field in the vicinity of cables, this simple-to-use Windows simulation tool is for you!

Compute the magnetic field in any number of points due to currents in a complex cable layout in just seconds. Computed field strengths are listed in a table where points with a too high amplitude, compared to a user-defined limit, are highlighted. To get the complete picture, you can plot the field in various ways, e.g., as a color surface plot. Try different ways to reduce the field strength such as, e.g., rearranging cables or using a ground plane. Get the new results by a simple press on a button. The perfect tool for an EMC engineer!
Nominations for best paper award

Accelerated Modal Network Synthesis for Arbitrary Interconnection Structures Through a Model-Order Reduction by a Static-Mode Extraction
Hannes Schreiber, Marco Leone
Otto-von-Guericke University Magdeburg, Germany

Efficient Measurement Techniques and Modelling of Printed Circuit Board Shields
Andy Marvin, John Dawson
University of York, United Kingdom

Opportunities for Intentional Interference with Automotive Radars Using Commercial Sensors
Alastair Ruddle, Douglas Ruddle, Jaspal Singh, Richard Blachford
HORIBA MIRA Limited, United Kingdom

Uncertainty Propagation with an Asynchronous Temporal Co-simulation Method Applied to a Transmission Line Network
Imane Massaoudi, Pierre Bonnet
Université Clermont Auvergne, Clermont Auvergne INP, CNRS, Institut Pascal, France

Daniel Kircher, Bernd Deutschmann, Nikolaus Czep
Graz University of Technology
Nominations for best student paper award

FPGA Switching Current Modeling Based on Register Transfer Level Logic Simulation for Power Side-channel Attack Prediction
Masaki Himuro, Kengo Iokibe, Yoshitaka Toyota
Okayama University, Japan

Testing Immunity of Active Implantable Medical Devices to Industrial Magnetic Field Environments
Lucien Hammen1,2, Lionel Pichon2,3, Yann Le Bihan2,3, Mohamed Bensetti2,3, Gerard Fleury1
1Institut national de recherche et de sécurité (INRS), Vandoeuvre-lès-Nancy, France; 2Université Paris-Saclay, CentraleSupélec, CNRS, Gif-sur-Yvette, France; 3Sorbonne Université, CNRS, Paris, France

Analysis of the Power Coupling Between an Antenna and a Device Under Test in a MSRC to Replace On-board Immunity Tests of Automotive Equipment
BULE MBO Clovis1,2, Klinger Marco1, Pichon Lionel2, Bensetti Mohamed2
1Stellantis, Centre technique de Vélizy, route de Gisy, 78943 Vélizy-Villacoublay, France; 2Université Paris-Saclay, CentraleSupélec, CNRS, Laboratoire de Génie Électrique et Electronique de Paris, 91192, Gif-sur-Yvette, France; Sorbonne Université, CNRS, Laboratoire de Génie Électrique et Electronique de Paris, 75252, Paris, France.

Impact of the Bonding Design Parameters on the Shielding Effectiveness of Board-Level Shields at Microwave frequencies
Pavithrakrishnan Radhakrishnan, Tim Claeyts, Johan Catrysse, Davy Pissoort
KU Leuven, Belgium

Co-simulation of Circuit/Circuit type Solvers for EMC Applications Using a New Relaxation Method
Amadou Bayaghiou Diallo1,2, Christian Voltaire1, Mohamed Bensetti1, Lionel Pichon2, Arnaud Breard1
1Univ Lyon, Ecole Centrale de Lyon, INSA Lyon, Université Claude Bernard Lyon 1, CNRS, Ampère, UMR 5005, Ecully, France; 2GeePs – Group of electrical engineering - Paris, UMR CNRS 8507, CentraleSupélec, Université Paris-Saclay, Sorbonne Université, 3 & 11 rue Joliot-Curie, Plateau de Moulon 91192 Gif-sur-Yvette, France