EMC Europe 2022

International Symposium on Electromagnetic Compatibility

September 5-8, 2022, Gothenburg, Sweden

CONFERENCE PROGRAMME

EMC Europe 2022
September 5-8 Gothenburg Sweden

www.emceurope2022.org

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EMC EUROPE 2022

GOTHENBURG, SWEDEN

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Contents

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 Gothia Towers. If you want to explore Gothenburg by eating, Gothenburg has a vibrant restaurant scene ranging from Michelin-starred gourmet and trendy eateries to classic neighbourhood institutions and street food. Check out www.goteborg.com/en/eat for more information and guides.

Welcome Reception

Venue: Exhibition area
Date: Tuesday, September 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

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

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

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

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

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

Taxi
There are several companies to choose from. You can phone for a taxi or hail one on the street. The driver should have a taxi ID card clearly displayed in the vehicle. Service is included in the price.
- Taxi Göteborg: + 46 31 650 000
- Taxi Kurir: + 46 31 27 27 27
- Mini Taxi: + 46 31 140 140
- Taxi 020: +46 20 20 20 20

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

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

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

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

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

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

Currency
The official Swedish currency is the Swedish Krona (SEK) which is divided into 100 öre. Bank notes are available in denominations of 20, 50, 100, 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 Vallgatan and Magasinsgatan are several design, furniture and arts and crafts shops as well as restaurants and cafés. Kungstorget has a lively market square where delegates find Saluhallen. It was opened in 1889 and, with its architecture and variety of shellfish, fruit, vegetables, cheese and cooked meats, is a real experience.

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

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Peter Stenumgaard


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Tomas Bodeklint

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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.

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.

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.

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.

Dr. Christopher Holloway

DR. CHRISTOPHER HOLLOWAY is a Fellow of the IEEE and has been at NIST for over 25 years. He is also on the Graduate Faculty at the University of Colorado at Boulder. He received his B.S.E degree from the University of Tennessee, and his Master and PhD degrees from the University of Colorado at Boulder. His is an expert in electromagnetic theory and metrology, quantum-optics, Rydberg-atom systems, and atom-based sensors. He has a publication h-index of 57 with over 300 technical publications (including 143 refereed journal papers and 130 conference papers) and has over 12,000 citations of his papers. He also has 10 patents in various fields in engineering and physics. He is the Project Leader for the Rydberg-Atom-Sensor Project and is the Group Leader for the Electromagnetic Fields Group.

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 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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Date: Monday, 05/Sept/2022

9:00am - 10:40am	**WS-01A: Automotive EMC** Location: **G1** Chair: **Marco KLINGLER**, Stellantis, France	**WS-04A: You had me at "Reverb"…!** Location: **G2** Chair: **Vasiliki Gkatsi**, University of Twente, Netherlands, The	**WS-06A: Innovative Wireless Test Methodologies for 5G NR and mmWave Applications** Location: **G3** Chair: **Janet O'Neil**, ETS-Lindgren, United States of America Chair: **Aurelian Bria**, Ericsson AB, Sweden	**WS-07A: EMC aspects of electrification of the society** Location: **J1** Chair: **Urban Lundgren**, RISE, Sweden	**WS-09: The art of filter design in EMC** Location: **J2** Chair: **Heinz Zenkner**, Wurth Elektronik, Germany	**WS-11: ANSI C63.25.3 EMC Test Site Validation in 18 to 40 GHz** Location: **R5** Chair: **Nicholas Abbondante**, Intertek, Sweden	
10:40am - 11:10am	**F-01A: Coffe break** Location: **Exhibition Area**						
11:10am - 12:50pm	**WS-01B: Automotive EMC** Location: **G1** Chair: **Marco KLINGLER**, Stellantis, France	**WS-04B: You had me at "Reverb"…!** Location: **G2** Chair: **Vasiliki Gkatsi**, University of Twente, Netherlands, The	**WS-06B: Innovative Wireless Test Methodologies for 5G NR and mmWave Applications** Location: **G3** Chair: **Janet O'Neil**, ETS-Lindgren, United States of America Chair: **Aurelian Bria**, Ericsson AB, Sweden	**WS-07B: EMC aspects of electrification of the society** Location: **J1** Chair: **Urban Lundgren**, RISE, Sweden	**WS-10A: Why are radiated emission/immunity EMC tests so tricky?** Location: **J2** Chair: **Diethard Hansen**, Euro EMC Service, Switzerland	**WS-12: Development of a GB-Ethernet Interface under EMC Aspects** Location: **R5** Chair: **Heinz Zenkner**, Wurth Elektronik, Germany	**WS-14: Spread Spectrum Clocking (SSC) to overcome EMI issues** Location: **R6** Chair: **Bernd Deutschmann**, Graz University of Technology, Austria
12:50pm - 2:00pm	**L-01: Lunch break** Location: **Restaurant Area**						
2:00pm - 3:40pm	**WS-02: Measurements on High Power Charging - Fast charging equipment for e-Cars** Location: **G1** Chair: **Werner Grommes**, DGUV/IFA, Germany	**WS-04C: You had me at "Reverb"…!** Location: **G2** Chair: **Vasiliki Gkatsi**, University of Twente, Netherlands, The	**WS-06C: Innovative Wireless Test Methodologies for 5G NR and mmWave Applications** Location: **G3** Chair: **Janet O'Neil**, ETS-Lindgren, United States of America Chair: **Aurelian Bria**, Ericsson AB, Sweden	**WS-08A: LF EMC in power grid and transportation systems** Location: **J1** Chair: **Francinel L Vieira**, Leibniz Universität Hannover, Germany	**WS-10B: Why are radiated emission/immunity EMC tests so tricky?** Location: **J2** Chair: **Diethard Hansen**, Euro EMC Service, Switzerland	**WS-13A: EMC simulation workflow for Electrification Applications** Location: **R5** Chair: **Flavio Calvano**, Ansys, Italy	**WS-15A: Risk-based EMC implementation with examples** Location: **R6** Chair: **Nandun Senevirathna**, Eindhoven University of Technology and Philips Medical Systems Nederland B.V., Netherlands, The
3:40pm - 4:10pm	**F-01B: Coffe break** Location: **Exhibition Area**						
4:10pm - 5:50pm	**WS-03: EMC on humans** Location: **G1** Chair: **Jimmy Estenberg**, Scania Commercial Vehicles, Sweden	**WS-05: Device Measurements in Reverberation Chambers** Location: **G2** Chair: **Samar Hosseinzadegan**, Bluetest AB, Sweden	**WS-06D: Innovative Wireless Test Methodologies for 5G NR and mmWave Applications** Location: **G3** Chair: **Janet O'Neil**, ETS-Lindgren, United States of America Chair: **Aurelian Bria**, Ericsson AB, Sweden	**WS-08B: LF EMC in power grid and transportation systems** Location: **J1** Chair: **Francinel L Vieira**, Leibniz Universität Hannover, Germany	**WS-10C: Why are radiated emission/immunity EMC tests so tricky?** Location: **J2** Chair: **Diethard Hansen**, Euro EMC Service, Switzerland	**WS-13B: EMC simulation workflow for Electrification Applications** Location: **R5** Chair: **Flavio Calvano**, Ansys, Italy	**WS-15B: Risk-based EMC implementation with examples** Location: **R6** Chair: **Nandun Senevirathna**, Eindhoven University of Technology and Philips Medical Systems Nederland B.V., Netherlands, The
6:00pm - 8:00pm	**ME-01: ISC Meeting** Location: **G1**		**ME-02: IEEE EMC-Society Sweden Chapter Meeting** Location: **G2**		**ME-03: IEEE EMC-Society Chapter Chairs Meeting** Location: **G3**		

Date: Tuesday, 06/Sept/2022

9:00am - 9:40am	**OS-A: Opening ceremony** Location: **G3** Chair: **Jan Carlsson**, Provinn, Sweden		
9:40am - 10:20am	**OS-B: Keynote 1- Dr. Robert Kebel, Conducted EMI of an inverter-driven electric power train** Location: **G3** Chair: **Kia Wiklundh**, FOI, Sweden		
10:20am - 10:50am	**F-02A: Coffe break** Location: **Exhibition Area**		
10:50am - 11:30am	**OS-C: Keynote 2 - Prof. Maria Feychting, Radiofrequency fields from mobile phone technologies and health** Location: **G3** Chair: **Kia Wiklundh**, FOI, Sweden		
11:30am - 12:10pm	**OS-D: Keynote 3 - Dr. Christopher Holloway, The Quest for Fundamentally New SI-Traceable Measurement Techniques and the Development of New Sensing Capabilities** Location: **G3** Chair: **Kia Wiklundh**, FOI, Sweden		
12:30pm - 2:30pm	**Poster-1: Poster session 1** Location: **Exhibition Area** Chair: **Peter Stenumgaard**, FOI, Sweden	**L-02: Lunch break** Location: **Restaurant Area**	
2:30pm - 3:50pm	**SS-01A: Modelling and measurement of LF EMI** Location: **G1** Chair: **Amr Ibrahim Madi**, University of Zielona Gora, Poland Chair: **Iqra Aitbar**, UoN, Pakistan	**OS-01A: Wireless technologies** Location: **G2** Chair: **Marc Pous**, Universitat Politècnica de Catalunya, Spain	**OS-02A: Shielding and filtering** Location: **G3** Chair: **Valter Mariani Primiani**, Università Politecnica delle Marche, Italy
3:50pm - 4:20pm	**F-02B: Coffe break** Location: **Exhibition Area**		
4:20pm - 5:40pm	**SS-01B: Modelling and measurement of LF EMI** Location: **G1** Chair: **Amr Ibrahim Madi**, University of Zielona Gora, Poland Chair: **Iqra Aitbar**, UoN, Pakistan	**OS-01B: Wireless technologies** Location: **G2** Chair: **Zbigniew Joskiewicz**, Wroclaw University of Science and Technology, Poland	**OS-02B: Shielding and filtering** Location: **G3** Chair: **Philippe Besnier**, CNRS - UMR 6164 - IETR, France

Date: Wednesday, 07/Sept/2022

9:00am - 10:20am	**SS-02A: Risk-Based EMC** Location: **G1** Chair: **Davy Pissoort**, KU Leuven, Belgium Chair: **Mohammad Kameli**, KU Leuven, Belgium	**OS-03: Transmission lines** Location: **G2** Chair: **Francesca MARADEI**, Sapienza University of Rome, Italy	**OS-07A: Reverberation chambers** Location: **J1** Chair: **Frank Leferink**, University of Twente, Netherlands, The
10:20am - 10:50am	**F-03A: Coffe break** Location: **Exhibition Area**		
10:50am - 12:10pm	**SS-02B: Risk-Based EMC** Location: **G1** Chair: **Anne Roc'h**, Eindhoven University of Technology, Netherlands, The Chair: **Pejman Memar**, KU Leuven, Belgium	**OS-04: Immunity** Location: **G2** Chair: **Ramiro Serra**, Eindhoven University of Technology, Netherlands, The	**OS-07B: Reverberation chambers** Location: **J1** Chair: **Andy Marvin**, University of York, United Kingdom
12:30pm - 2:30pm	**Poster-2: Poster session 2** Location: **Exhibition Area** Chair: **Kia Wiklundh**, FOI, Sweden	**L-03: Lunch break** Location: **Restaurant Area**	
2:30pm - 3:50pm	**SS-04A: Stochastic Methods in EMC** Location: **G1** Chair: **Valter Mariani Primiani**, Università Politecnica delle Marche, Italy	**OS-05: Human exposure to EM field** Location: **G2** Chair: **MAURO FELIZIANI**, Università degli Studi dell'Aquila, Italy	**OS-08A: Measurements** Location: **J1** Chair: **Bernd Deutschmann**, Graz University of Technology, Austria
3:50pm - 4:20pm	**F-03B: Coffe break** Location: **Exhibition Area**		
4:20pm - 5:40pm	**SS-04B: Stochastic Methods in EMC** Location: **G1** Chair: **Valter Mariani Primiani**, Università Politecnica delle Marche, Italy	**OS-06: EMC in safety and security applications** Location: **G2** Chair: **Frank Sabath**, WIS, Germany	**OS-08B: Measurements** Location: **J1** Chair: **Mohamed Ramdani**, ESEO, France

Date: Thursday, 08/Sept/2022

9:00am - 10:20am	**OS-09: ESD** Location: **G1** Chair: **Diethard Hansen**, Euro EMC Service, Switzerland	**OS-13A: Computational electromagnetics** Location: **G2** Chair: **Christopher Holloway**, NIST, United States of America	**OS-15: Automotive** Location: **J1** Chair: **Marco KLINGLER**, Stellantis, France
10:20am - 10:50am	**F-04A: Coffe break** Location: **Exhibition Area**		
10:50am - 12:10pm	**OS-10: Lightning** Location: **G1** Chair: **Heyno Garbe**, Leibniz Universitaet Hannover, Germany	**OS-13B: Computational electromagnetics** Location: **G2** Chair: **Davy Pissoort**, KU Leuven, Belgium	**OS-16: Electric vehicles** Location: **J1** Chair: **Björn Bergqvist**, Volvo Cars, Sweden
12:30pm - 2:30pm	**L-04: Lunch break** Location: **Restaurant Area**		
2:30pm - 3:50pm	**OS-11: EMP** Location: **G1** Chair: **David Thomas**, The University of Nottingham, United Kingdom	**OS-13C: Computational electromagnetics** Location: **G2** Chair: **Markus Johansson**, Provinn AB, Sweden	**OS-17: EMC in automotive, aircraft and space applications** Location: **J1** Chair: **Ferran Silva**, UPC, Spain
3:50pm - 4:20pm	**F-04B: Coffe break** Location: **Exhibition Area**		
4:20pm - 5:40pm	**OS-12: Advanced materials and harmonic distortion** Location: **G1** Chair: **Jan Luiken ter Haseborg**, Technische Universit„ t Hamburg, Germany	**OS-14: Power Electronics** Location: **G2** Chair: **Stefan Dickmann**, Helmut Schmidt University, Germany	**OS-18: EMF, EMI and VSWR measurements** Location: **J1** Chair: **Alastair Ruddle**, HORIBA MIRA Limited, United Kingdom

9:00–12:50 **WS-01A + WS-01B: Automotive EMC**
Session Chair: **Marco Klingler,** Stellantis, France
Location: G1

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:

09:00 **Opening**

09:00 – 09:30
1 – Methods For Reducing Resonances Of Vehicle Electrical Architectures Due To The Network Of Shielded Links And OV Wires
Marco Klingler, Anass Samiri
Stellantis, France

09:30 – 10:00
2 – Methodology to Validate the Radiated Immunity of Very Complex Systems by a Succession of Simple Component Radiated Immunity Tests at System Level
Nadir Bedjiah[(1)(2)], Marco Klingler[(1)], Moncef Kadi[(2)], Romain Rossi[(2)]
[(1)] Stellantis, France
[(2)] ESIGELEC, France

10:00 – 10:30
3 – How to Measure the Test Level for ALSE Vehicle Testing
Dr. Martin Aidam
Mercedes-Benz, Germany

10:40 – 11:10 **Coffee break**

11:10 – 11:40
4 – All You Need for an EMC Inverter Simulation
Andreas Barchanski[(1)], Jan Hansen[(2)], Michael Wendl[(2)]
[(1)] Dassault Système, Germany
[(2)] Robert Bosch GmbH, Germany

11:40 – 12:10
5 – Leveraging Machine Learning and Design Exploration to Synthesize Cable Routing Design Rules
René Fiedler, Diana Mavrudieva
Altair, Germany

12:10 – 12:40
6 – Computational Estimation of Conducted and Radiated Emission in Battery Electric Vehicle
Ryota Morimoto, Akihiko Nojima
Toyota Motor Corporation, Japan

12:40 **Closing**

9:00–15:40 **WS-04A + WS-04B + WS-04C: You Had Me at "Reverb"...!**
Session Chair: **Vasiliki Gkatsi,** University of Twente, The Netherlands
Location: G2

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.

9:00–17:50 **WS-06A + WS-06B + WS-06C + WS-06D: Innovative Wireless Test Methodologies for 5G NR and mmWave Applications**

Session Chair: **Janet O'Neil,** ETS-Lindgren, United States of America,
Aurelian Bria, Ericsson AB, Sweden,
Location: G3

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

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 solcellsinstallationer"* 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 EV:s. 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.

9:00–10:40 **WS-09: The Art of Filter Design in EMC**
Session Chair: **Heinz Zenkner,** Wurth Elektronik, Germany
Location: J2

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

9:00–10:40 **WS-11: ANSI C63.25.3 EMC Test Site Validation in 18 to 40 GHz**
Session Chair: **Nicholas Abbondante,** Intertek, Sweden
Location: R5

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

11:10–15:40 **WS-10A + WS-10B: Why are Radiated Emission/Immunity EMC Tests so Tricky?**
Session Chair: **Diethard Hansen,** Euro EMC Service, Switzerland
Location: J2

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/Generic 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.

11:10–12:50

WS-12: Development of a GB-Ethernet Interface under EMC Aspects

Session Chair: **Heinz Zenkner,** Wurth Elektronik, Germany
Location: R5

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

11:10–12:50

WS-14: Spread Spectrum Clocking (SSC) to Overcome EMI Issues

Session Chair: **Bernd Deutschmann,** Graz University of Technology, Austria
Location: R6

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.

14:00–15:40 **WS-02: Measurements on High Power Charging – Fast Charging Equipment for E-Cars**
Session Chair: **Werner Grommes,** DGUV/IFA, Germany
Location: G1

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 magnetics fields H = I x N 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, icrease in body temperatur 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.

14:00–17:50

WS-08A + WS-08B: LF EMC in Power Grid and Transportation Systems

Session Chair: **Francinei L Vieira,** Leibniz Universität Hannover, Germany
Location: J1

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 supraharmonic 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:
Supraharmonics 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

14:00–17:50 **WS-13A + WS-13B: EMC Simulation Workflow for Electrification Applications**

Session Chair: **Flavio Calvano,** Ansys. Italy

Location: R5

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

14:00–17:50

WS-15A + WS-15B: Risk-Based EMC Implementation with Examples

Session Chair: **Nandun Senevirathna,** Eindhoven University of Technology and Philips Medical Systems Nederland B.V., The Netherlands

Location: R6

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)

16:10–17:50 **WS-03: EMC on Humans**
Session Chair: **Jimmy Estenberg,** Scania Commercial Vehicles, Sweden
Location: G1

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?

16:10–17:50

WS-05: Device Measurements in Reverberation Chambers

Session Chair: **Samar Hosseinzadegan,** Bluetest AB, Sweden
Location: G2

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

16:10–17:50 **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-, Genericand 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 ralidation (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 Cermony**
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

09:40–10:20

OS-B: Keynote 1
Dr. Robert Kebel, Conducted EMI of an Inverter-Driven Electric Power Train

Session Chair: **Kia Wiklundh,** FOI, Sweden
Location: G3

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.

10:50–11:30

OS-C: Keynote 2
Prof. Maria Feychting, Radiofrequency Fields from Mobile Phone Technologies and Health

Session Chair: **Kia Wiklundh,** FOI, Sweden
Location: G3

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.

11:30–12:10

OS-D: Keynote 3
Dr. Christopher Holloway, The Quest for Fundamentally New SI-Traceable Measurement Techniques and the Development of New Sensing Capabilities

Session Chair: **Kia Wiklundh,** FOI, Sweden
Location: G3

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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12:30–14:30 **Poster-1: Poster Session 1**
Session Chair: **Peter Stenumgaard,** FOI, Sweden
Location: Exhibition Area

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 Sinkevich[1], Yauheni Arlou[1], Natalia Sinyak[1], Ivan Shakinka[1], Xie Ma[2], Wen-Qing Guo[2]
[1]Belarusian State University of Informatics and Radioelectronics, Belarus; [2]China 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 Svistunou[1], Vladimir Mordachev[1], Eugene Sinkevich[1], Ming Ye[2], Arthur Dubovik[1], Ivan Shakinka[1]
[1]Belarusian State University of Informatics and Radioelectronics, Minsk, Belarus; [2]Huawei Technologies Sweden AB, Stockholm, Sweden

Estimation of effectiveness of EMI Gaskets by Using Results of Standardized Measurements
Dzmitry Tsuanenka[1], Eugene Sinkevich[1], Yauheni Arlou[1], Alexey Galenko1, Xie Ma[2], Wen-Qing Guo[2]
[1]Belarusian State University of Informatics and Radioelectronics, Belarus; [2]China 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 Karami[1], Marcos Rubinstein[2], Christophe Perrenoud[3], Emmanuel deRaemy[3], Pascal Kraehenbuehl[3]
[1]Electromagnetic Compatibility Laboratory, Ecole Polytechnique Fédérale de Lausanne (EPFL); [2]University of Applied Sciences and Arts Western Switzerland (HES-SO), Institute for Information and Communication Technologies; [3]Federal Office of Communications, Electromagnetic Compatibility Section, Biel/Bienne, Switzerland

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
Makarand Mukund Kane, Nathaniel Taylor, Daniel Månsson
KTH Royal Institute of Technology, Sweden

Time-domain Characterization of Reconfigurable Intelligent Surfaces for Wireless Communications
Giuseppe Pettanice, 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 Jose[1], Nathan Chopinet[2], Eric Pierre Simon[1,3], Alexandre Boé[1,3], Thomas Vantroys[1,4], Christophe Gransart[2], Virginie Deniau[2]
[1]Univ. Lille, CNRS, USR 3380-IRCICA; [2]Univ. Gustave Eiffel, COSYS-IFSTTAR; [3]Univ. Lille, CNRS, Centrale Lille, Univ. Polytechnique Hauts-de-France, UMR 8520-IEMN; 4Univ. Lille, CNRS, Centrale Lille, UMR 9189 CRIStAL

RF Coexistence Testing on Wireless Medical Patient Monitoring Device
Mahmud Naseef[1], Alen Moskofian[2], Pascal Hervé[2], Georgios Kokovidis3, Dennis Mendoza[3], Bill Dowd[3]
[1]Rohde & Schwarz, Germany; [2]CSA Group Bayern, Germany; [3]Dräger Medical Systems, Inc., USA

Electromagnetic Compatibility of Train Radio Communication with the Traction Systems
Tetiana Serdiuk, Botnarevscaia 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 Orvai[1], Márk Csörnyei[2]
[1]Óbuda University; [2]Robert 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 John[1], Julian Withöft[2], Emre Ecik[2], Ralf Brüning[3], Jürgen Götze[2]
[1]PYRAMIDE2525/TU Dortmund, Paderborn – Germany; [2]TU Dortmund/Information Processing Lab; [3]EMC 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 Martin[1], Ivan Herrero[1], Antonio Montesano[1], David Peña[1], Paula Sánchez[1], Ana Lopez[2]
[1]Airbus, Spain; [2]CT Ingenieros

Independent Component Analysis of the Cyclostationary Signals in the Transmission Line
Yury V. Kuznetsov[1], Andrey B. Baev[1], Maxim A. Konovalyuk[1], Anastasia A. Gorbunova[1], Johannes A. Russer[2]
[1]Moscow Aviation Institute, Russian Federation; [2]Technical University of Munich, Germany

Electromagnetic evaluation of UHF-RFID Smartshelf in Healthcare Environments
Pablo Marina[1], Samuel D. Suárez[2], Jose A. Hernández[2], Victor M. Febles[2], Luis E. Rabassa[2], Victoria Ramos[1]
[1]Instituto de Salud Carlos III; [2]Hospital Universitario de Canarias

Noise Source Modeling for Automotive Components Using a Wire-harness Bench
Noboru Maeda[1], Kengo Fukunaga[1], Keishi Miwa[2]
[1]SOKEN, INC.; [2]Toyota Motor Corporation

14:30–15:50 SS-01A: Modelling and Measurement of LF EMI

Session Chair: **Amr Ibrahim Madi,** University of Zielona Gora, Poland and **Iqra Aitbar,** UoN, Pakistan
Location: G1

14:30 **Un-terminated Black-Box EMI Models of Power Converters Driven by Random Modulation Strategies**
Lu Wan, Abduselam H. Beshir, Xinglong Wu, Xiaokang Liu, Flavia Grassi, Giordano Spadacini, Sergio A. Pignari
Dept. of Electronics, Information and Bioengineering (DEIB), Politecnico di Milano, Italy

14:50 **Versatile LabVIEW-FPGA-based Testbench for Electromagnetic Interference Evaluation in VSDs**
Douglas Aguiar do Nascimento[1,2], Robert Smoleński1, Piotr Leżyński[1], Alexander Matthee[2,1], Niek Moonen[2], Frank Leferink[2]
[1]University of Zielona Góra; [2]University of Twente

15:10 **Influence of Chaotic Spreading Factor Modulation Based Random Modulation on G3-PLC System**
Amr Madi[1,2], Waseem Elsayed[1,2], Douglas Nascimento[1,2], Abduselam Beshir[3], Piotr Lezynski[1], Robert Smolenski[1]
[1]University of Zielona Gora, Poland; [2]University of Twente, Netherlands; [3]Politecnico di Milano, Italy

15:30 **Mode Stirred Chamber Measurement of GHz Emissions of Wireless Power Transfer Systems**
Christoph Brillinger[2], Mehdi Gholizadeh[1], Ralph Prestos[2], David Pommerenke[1]
[1]Graz University of Technology IFE, Austria / Graz EMC lab; [2]Silocon Austria Labs

14:30–15:50 OS-01A: Wireless Technologies (I)

Session Chair:
Marc Pous,
Universitat Politècnica de Catalunya, Spain
Location: G2

14:30 **Interference Requirements at Vehicle Platforms to Protect UWB Communication**
Kia Wiklundh[1], Björn Bergqvist[2]
[1]Private; [2]Volvo Cars, Sweden

14:50 **A Study of Electromagnetic Robustness of IO-Link Wireless and SmartMesh IP for Applications on an Agricultural Vehicle**
Aleksandr Ovechkin[1], Brian Leeman[1], Dries Vanoost[1], Tim Claeys1, Marcel Verhoeven2, Davy Pissoort[1]
[1]KU Leuven, Belgium; [2]CNH Industrial

15:10 **On the Impact of Spread Spectrum EMI on Communication Performance**
Erik Axell[1], Thomas Ranström[1,2], Sara Linder[1], Kia Wiklundh[1], Karina Fors[1]
[1]Swedish Defence Research Agency, Sweden; [2]University of South Florida, FL

15:30 **EMC Challenges with 6G**
Kia Wiklundh, Peter Stenumgaard
FOI, Sweden

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 Claeys, Johan Catrysse, Davy Pissoort
KU Leuven, Belgium

15:10 **Shielding Effectiveness of Cabinets using IEEE 299 and 299.1 and Effect of Loading**
Hans Schipper[1], Chris Clemens[3], Frank Leferink[1,2]
[1]Thales, Hengelo, The Netherlands; [2]University of Twente, The Netherlands; [3]Ministry of the Interior and Kingdom Relations Zoetermeer, The Netherlands

15:30 **Auto-activated Electromagnetic Shield Upon High Intensity Radiated Field Illumination**
Quentin Tricas[1,2], Xavier Castel[2], Claire Le Paven[2], Thomas Eudes[1], Patrice Foutrel[1], Jérôme Sol[2], Philippe Besnier[2]
[1]Safran Electronics & Defense; [2]Univ 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, UoN, Pakistan
Location: G1

16:20 **Effects of the Switching Frequency of Random Modulated Power Converter on the G3 Power Line Communication System**
Abduselam Hamid Beshir[1], Waseem El Sayed[2], Amr Madi[2], Lu Wan1, Flavia Grassi[1], Paolo S. Crovetti[3], Xinglong Wu[1], Xiaokang Liu[1], Robert Smolenski[3], Sergio A. Pignari[1]
[1]Politecnico di milano; [2]University of Zielona Gora; [3]Politecnico di Torino

16:40 **Standardized Impedance: Microgrid Perspective for Inrush Current Compliance**
Alexander Matthee[1], Niek Moonen[1], Frank Leferink[1,2]
[1]University of Twente, Enschede, The Netherlands; [2]Thales, Hengelo, The Netherlands

17:00 **Influence of Impedance Interaction & Comparability on Spectral Aggregation (2-150 kHz) in DC Grids**
Arun Dilip Khilnani[1], Angel Eduardo Pena-Quintal[1], Erjon Ballukja[1], Mark Sumner[1], David William Prince Thomas[1], Leonardo Sandrolini[2], Andrea Mariscotti[3]
[1]The University of Nottingham, United Kingdom; [2]Università di Bologna, Italy; [3]University 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

16:20–17:40 **OS-01B: Wireless Technologies (II)**
Session Chair:
Zbigniew Joskiewicz,
Wroclaw University of Science and Technology, Poland
Location: G2

16:20 **Electromagnetic Noise as Entropy Source for Cryptographic System**
Jan Nemec, Stanislav Kovar, Iva Kavankova, Jan Valouch
Tomas Bata University in Zlin, Czech Republic

16:40 **Detailed Investigation of the Vulnerability of an OFDM Based WLAN Connection to CW Signal Interference**
Henrik Brech, Heyno Garbe
Leibniz University Hannover, Germany

17:00 **The Impact from Covid-19 Pandemic Lockdown on the Electromagnetic Interference in the GPS Frequency Band**
Karina Fors, Mikael Alexandersson, Peter Stenumgaard
Swedish Defense Research Agency FOI, Sweden

17:20 **Measuring Radiated Spurious Emissions from a 5G Device in a Reverberation Chamber**
Sara Nadine Catteau
Bluetest AB, Sweden

16:20–17:40 **OS-02B: Shielding and Filtering (II)**
Session Chair:
Philippe Besnier,
CNRS - UMR 6164 - IETR, France
Location: G3

16:20 **Multichannel EMI Filter Performance Assessment**
Daria Nemashkalo[1], Patrick Koch[1], Niek Moonen[1], Frank Leferink[1,2]
[1]University of Twente, The Netherlands; [2]Thales Nederland, B.V., Hengelo, The Netherlands

16:40 **Board-level Shielding with Magnetic Absorber Sheet**
Jorge Victoria[1], Adrian Suarez[2], Pedro A. Martinez[2], Antonio Alcarria[1], Andrea Amaro[1], Jose Torres[2]
[1]Würth Elektronik eiSos, Germany; [2]Department of Electronic Engineering, University of Valencia, Spain

17:00 **EMC Study On Aged Shielded Cables**
Henrik Wiebe[1], Matthias Spägele[2]
[1]Huber Automotive AG, Germany; [2]Huber Automotive AG, Germany

17:20 **Analysis of the PDN Induced Crosstalk Impacts on the High-Speed Signaling in Ultra-Thin and High Permittivity Substrates**
Taiki Kitazawa[1], Yuichi Hayashi[1], Yoshi Fukada[2], Yougwoo Kim[1]
[1]Nara Institute of Science and Technology, Nara, Japan; [2]TechDream, Inc, San Jose, CA, USA

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 Gkatsi[1], Ivan Struzhko[1], Robert Vogt-Ardatjew[1], Frank Leferink[1,2]
[1]University of Twente, The Netherlands, [2]Thales Nederland, The Netherlands

9:20 **Vulnerability of Smart Grid-Based Protection Systems to Ultra-Wide Band IEMI Sourcese**
Fernando Arduini[1], Thorsten Pusch[1], Michael Suhrke[1], Heyno Garbe[2]
[1]Fraunhofer INT, Germany; [2]Leibniz University Hannover, Germany

9:40 **Including Experimental Aging of Shielded Cables into Bulk Current Injection Simulations**
Oskari Leppäaho[1], Frédéric Lafon[1], Bruno Ferreri[1], Priscila Fernandez-Lopez[1], Marine Stojanovic[1], Richard Perdriau[2], Mohammed Ramdani[2]
[1]Valeo, France; [2]ESEO, France

10:00 **Effectiveness of Forward Error Corrections Over Different Wired Communication Channels in Harsh Electromagnetic Environments**
Pejman Memar[1], Hasan Habib[1], Zhao Chen[2], Dries Vanoost[1], Robert Vogt-Ardatjew[3], Bärbel van den Berg[4], Tom Holvoet[5], Davy Pissoort[1], Jeroen Boydens[1]
[1]KU Leuven, Bruges Campus, Bruges, Belgium; [2]Barco NV, Kortrijk, Belgium; [3]University of Twente, Enschede, The Netherlands; [4]Medisch Spectrum Twente Hospital, Enschede, The Netherlands; 5KU 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 Sajjad[1], John F Dawson[1], Ayhan Gunsaya[2], Andy C Marvin[1]
1University of York, United Kingdom; 2Ford Motor 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

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 Karlsson[1], Andreas Lundberg[1], Niklas Arabäck[1], Björn Bergqvist[2]
[1]RISE Research Institutes of Sweden, Sweden; [2]Volvo 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 Karlsson[1], Robert Moestam[2], Björn Bergqvist[3], Hans Kalaran[4], Åsa Rosdalen[3]
[1]RISE Research Institutes of Sweden, Sweden; [2]China-Euro Vehicle Technology; [3]Volvo Car Corporation; [4]Volvo 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 Claeys, 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 Senevirathna[1,2], Rob Kleihorst[1], Anne Roc'h[2]
[1]Philips Medical Systems Nederland B.V.; [2]Eindhoven University of Technology

10:00 **Combining Fast Field Probes with an EMI Detector to reveal Bit Errors induced by ElectroMagnetic Disturbances**
Hasan Habib[1], Tim Claeys1, Robert Vogt-Ardatjew[2], Bärbel van den Berg[3], Guy A. E. Vandenbosch[4], Davy Pissoort[1]
[1]KU Leuven, Bruges Campus; [2]University of Twente; [3]MST Hospital; [4]KU Leuven

10:50–12:10 OS-04: Immunity

Session Chair:
Ramiro Serra,
Eindhoven University of Technology, The Netherlands
Location: G2

9:00 **Testing Immunity of Active Implantable Medical Devices to Industrial Magnetic Field Environments**
Lucien Hammen[1,2,3], Lionel Pichon[2,3], Yann Le Bihan[2,3], Mohamed Bensetti[2,3], Gerard Fleury[1]
[1]Institut national de recherche et de sécurité (INRS), Vandoeuvre-lès-Nancy, France; [2]Université Paris-Saclay, CentraleSupelec, CNRS, Gif-sur-Yvette, France; [3]Sorbonne 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 Durier[1], Sonia Ben Dhia[2,3], Tristan Dubois[4], Alexandre Boyer[2,3]
[1]Continental Automotive FranceE, France; 2LAAS-CNRS, France; 3INSA Toulouse, France; 4IMS Bordeaux, France

10:50–12:10 OS-07B: Reverberation Chambers (II)

Session Chair:
Andy Marvin,
University of York, United Kingdom
Location: J1

9:00 **A Novel Hybrid Nested Reverberation Chamber Measurement Technique for Shielding Effectiveness of Conductive Fabrics**
Hakki Ekin Ozdemir[1], Muhammet Hilmi Nisanci[2], Fatih Ustuner[3], Ahmet Yasin Citkaya[1], Hamid Torpi[4], Mucahid Taha Mersin[1], Ridvan Aba1, Coskun Cosar[1]
[1]TUBITAK BILGEM, Turkey; [2]Sakarya University, Turkey; [3]Istanbul Ticaret University, Turkey; [4]Yildiz Technical University, Turkey

9:20 **On the Feasibility of the Three-Antenna Technique for Estimating Antenna Radiation Efficiency in Bluetest Reverberation Test Systems**
Samar Hosseinzadegan, Mats Kristoffersen, Patrik Svedjenäs, Sara Catteau, John Kvarnstrand
Bluetest AB, Sweden

9:40 **Eigenmodes of a Loaded Reverberation Chamber**
Hans Kalaran[1], Kristian Karlsson[2], Robert Moestam[3], Björn Bergqvist[4], Åsa Rosdalen[4]
[1]Volvo AB, Sweden; [2]RISE Research Institutes of Sweden; [3]China-Euro Vehicle Technology; [4]Volvo Car Corporation

10:00 **Comparison of Susceptibility Measurements on a Reference Test Setup in Two Reverberation Chambers Including Cabling Variations**
Thorsten Ragnar Pusch[1], Christian Adami[1], Tomas Hurtig[2], Mattias Elfsberg[2], Sven Fisahn[3], Martin Schaarschmidt[3]
[1]Fraunhofer INT, Germany; [2]FOI Swedish Defence Research Agency; [3]Bundeswehr Research Institute for Protective Technologies and CBRN Protection (WIS)

12:30–14:30

Poster-2: Poster Session 2

Session Chair: **Kia Wiklundh,** FOI, Sweden
Location: Exhibition Area

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 Pastukh[1], Valery Tikhvinskiy[1,2], Evgeny Devyatkin[1], Vadim Belyavskiy[3]
[1]Radio Research and Development Institute (NIIR), Russian Federation; [2]Bauman Moscow State Technical University, Russian Federation; [3]Spectrum 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 Claeys, 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 Claeys, Guy A. E. Vandenbosch, Davy Pissoort
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 Meng[1,2]
[1]CAEP Software Center for High Performance Numerical Simulation, China, People's Republic of; [2]institute 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 Huang[1], Liping Yan[1], Xiang Zhao[1], Ming Ye[2], Xian-Ke Gao[3]
[1]Sichuan University; [2]Huawei Technologies Sweden AB; [3]Electronics 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 Akpinar, 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
Osman Sen, Savas Acak, Soydan Cakir, Bahadir Tektas, Yasin Ozkan, Ali Karaali, Hulya Belirgen, Hakan Altun, Zeynep Sagir Sefer, Emre Camasırcioglu, Ali Ozturk, Merve Deniz Kozan, Burak Demirdogen
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 Miyake[1], Naoya Haraguchi[2], Fujio Amemiya[3], Nobuo Kuwabara[4], Hidenori Muramatsu[3]
[1]VCCI Council/ NEC Corporation, Japan; [2]FUJIFILM Business Innovation Corp., Japan; [3]VCCI Council, Japan; [4]Kyushu Institute of Technology, Japan

Current Distribution in Flat Transparent Antennas
Reuven Zemach[1], Zion Menachem[2], Jacob Assayag[1], Amir Gamliel[3], Motti Haridim[4]
[1]Merchavim Institute of R&D in Negev; [2]Shamoon College of Engineering, Beer Sheva, Israel; [3]Investigations and Intelligence Dept., Israel Police, Jerusalem, Israel; [4]HIT- Holon institute of Technology, Israel

Response of Muscle Tissue to Pulsed Elecromagnetic Fields: An Asymptotic Description
Constantinos Balictsis
Biosolutions Ltd., Greece

Novel 3D Printable Copper Twisted Pair Array Heatsink Design for EMI Mitigation
Darwin Zhang Li[1], Tetsumune Kuromura[2], Yoshi Fukawa[3]
[1]Good Simulations LLC, United States of America; [2]Mitsui Mining & Smelting CO., LTD.; [3]TechDream, Inc.

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. Baklezos[1,2], Christos D. Nikolopoulos[1], Panagiotis K. Papastamatis[2], Theodoros N. Kapetanakis[1], Ioannis O. Vardiambasis[1], Christos N. Capsalis[2]
[1]Hellenic Mediterranean University, Greece; [2]National Technical University of Athens, Greece

Intermodulation Distortion Characterization of RF Transceivers by Means of a Transverse Electromagnetic Cell
Alain Grèzes[1,2], Jérémy Raoult[2], Alexandre Martorell[1]
[1]Thales SIX GTS, Gennevilliers, France; [2]IES, University of Montpellier, CNRS

Impact of the Injection Point Selection During Indirect Application of ESD Pulses According to IEC 61000-4-2
Panagiotis K. Papastamatis[1], Theodosios K. Lamprinos[1], Christos D. Nikolopoulos[2], Anargyros T. Baklezos[1], Ioannis F. Gonos[1], Ioannis A. Stathopulos[1]
[1]School of Electrical and Computer Engineering, National Technical University of Athens, Greece; [2]School of Engineering, Dept. of Electronic Engineering, Hellenic Mediterranean University, Greece

14:30–15:50 SS-04A: Stochastic Methods in EMC

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

14:30 **Investigation of the Impact of Height Scans in Fully Anechoic Rooms on Detection of Maximal Radiated Field Strength Using Monte Carlo Simulation**
Jörg Petzold, Mathias Magdowski, Ralf Vick
Otto-von-Guericke Universtity, Germany

14:50 **Theoretical Analysis of a Wall-Mounted Broadband Antenna for Source Stirred Reverberation Chambers**
Alfredo De Leo, Paola Russo, Valter Mariani Primani
Universita Politecnica Marche, Italy

15:10 **A Source Stirred Vibrating Intrinsic Reverberation Chamber Using Two Antennas**
Danilo Izzo, Robert Vogt-Ardatjew, Georgios Erotas, Frank Leferink
University of Twente, The Netherlands

15:30 **Efficient EMC Risk Analysis of PCB Using Iterative Surrogate-Model Enrichment and Morris Sensitivity Analysis**
Alexandre Plot[1,2], Philippe Besnier[2], Béatrice Azanowsky[1]
[1]THALES SIX GTS, France; [2]Univ Rennes, INSA Rennes, CNRS, IETR – UMR 6164

14:30–15:50 OS-05: Human Exposure to EM Field

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

14:30 **Assessment of Exposure to Magnetic Field from Pulse Width Modulated Currents**
Markus Johansson, Jan Carlsson
Provinn AB, Sweden

14:50 **Time Reversal in Reverberating Structures for Deep Focusing in Human Bodies**
Emanuel Colella[2], Luca Bastianelli[2], Francesco Dragano[1], Valter Mariani Primiani[1,2], Franco Moglie[1,2]
[1]Università Politecnica delle Marche, Department of Information Engineering, Ancona, Italy; [2]Consorzio Nazionale Interuniversitario per le Telecomunicazioni (CNIT), Parma, Italy

15:10 **Comparison of Frequency and Code Selective Methods for Electromagnetic Exposure Measurement in the Vicinity of a LTE (4G) Base Station**
Bahadır Tektaş, Soydan Çakır
TÜBİTAK UME, Turkey

15:30 **SAR Computation Due to Wearable Devices by Using High-Resolution Body Models and FDTD Numerical Code**
Greta Silla[1], Luca Bastianelli[1,2], Emanuel Colella[2], Franco Moglie[1,2], Valter Mariani Primiani[1,2]
[1]Università Politecnica delle Marche, Italy; [2]Consorzio Nazionale Interuniversitario per le Telecomunicazioni (CNIT), Parma, Italy

14:30–15:50 OS-08A: Measurements (I)

Session Chair:
Bernd Deutschmann,
Graz University of Technology, Austria
Location: J1

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 Magentic 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 Pokotilov[1], Robert Vogt-Ardatjew[1], Frank Leferink[1,2]
[1]University of Twente, The Netherlands; [2]THALES, The Netherlands

16:20–17:40 SS-04B: Stochastic Methods in EMC

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

16:20 **Efficient Frequency-Domain Uncertainty Quantification Using Parameterized Model Order Reduction**
Francesco Ferranti[1], Daniele Romano[2], Luigi Lombardi[3], Giulio Antonini[2], Ye Tao[4], Michel Nakhla[4]
[1]Vrije Universiteit Brussel; [2]Università degli Studi dell'Aquila, Italy; [3]Micron Semiconductor; [4]Carleton University

16:40 **Polynomial Chaos Kriging Metamodel for Automotive EMC Simulations**
Arnold Bingler[1,2], Sándor Bilicz[1], Csörnyei Márk[2]
[1]Department of Broadband Infocommunications and Electromagnetic Theory, Faculty of Electrical Engineering and Informatics, Budapest University of Technology and Economics, Hungary; [2]Powertrain 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 Sekine[1], Shin Usuki[2], Kenjiro Miura[3]
[1]Department of Mechanical Engineering, Shizuoka University, Japan; [2]Research Institute of Electronics, Shizuoka University, Japan; [3]Graduate 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 Cabello[1], Enrique Pascual Gil[2], Guadalupe Gutierrez Gutierrez[2], Hirahi Galindo Perez[2], Luis Diaz Angulo[1], Alberto Gascon Bravo[1], Salvador Gonzalez Garcia[1]
[1]University of Granada, Spain; [2]Airbus, Spain

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 Tishehzan[1], Mark Nicholson[1], John F. Dawson[1], Davy Pissoort[2]
[1]University of York, United Kingdom; [2]KU Leuven, Belgium

17:00 **Board-Level Hardware Trojan Detection Using on-Chip Touch Sensor**
Masahiro Kinugawa[1], Yuichi Hayashi[2]
[1]The University of Fukuchiyama, Fukuchiyama, Japan; [2]Nara Institute of Science and Technology, Ikoma, Japan

17:20 **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

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 Petzel[1], David Pommerenke[1], Steffen Holland[2], Seyedmostafa Mousavi[1], Amin Pak[1]
[1]Graz University of Technology, Austria; [2]Nexperia Germany GmbH, Germany

16:40 **Time-domain Multitone Impedance Measurement System for Space Applications**
Marc Pous[1,2], Marco Azpurua[1], Dongsheng Zhao[2], Johannes Wolf[2], Ferran Silva[1]
[1]Universitat Politècnica de Catalunya, Spain; [2]European 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

17:20 **Influence of Radio Frequency Interference on the Electromagnetic Emission of Integrated Circuits**
Daniel Kircher, Bernd Deutschmann, Nikolaus Czepl
Graz University of Technology, Austria

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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 Ruffat[1], Fabrice Caignet[1], Alexandre Boyer[1], Fabien Escudié[2], Guillaume Mejecaze[2], Frédéric Puybaret[2]
[1]LAAS-CNRS, France; [2]CEA-Gramat, France

9:20 **Wearable ESD Occurrence Rate Detection with Voltage Level Estimation**
Gabriel Fellner[1], David Johannes Pommerenke[1,2], Seyed Mostafa Mousavi[1], Amin Pak[1,2], Matthias Wintersteller[1], Christoph Koger[1], Satyajeet Shinde[3], Michael Hillstrom[3]
[1]Graz University of Technology, Austria; [2]SAL GEMC lab, Austria; [3]Apple Inc., Cupertino, USA

9:40 **Quantification of ESD Pulses Caused by Collision of Objects**
Gabriel Fellner[1], Amin Pak[1,2], Seyed Mostafa Mousavi[1], Christoph Koger[1], Ali Khorrami[3], David Pommerenke[1,2]
[1]Graz University of Technology, Austria; [2]SAL, Austria; [3]Apple Inc.

10:00 **A Comparative Study of DPI Levels on BMS IC with an On-Hand Analytical Model to Predict Resonances**
Badr Guendouz[1,3], Kamel Abouda[2], Alexandre Boyer[3], Sonia Ben Dhia[3], Hiba Mediouni[2], Jérôme Dietsch[4]
[1]BMS/EMC-ESD Team, NXP Semiconductors, France, LAAS-CNRS, Univ. de Toulouse, INSA, UPS, LAAS; [2]BMS/EMC-ESD Teams, NXP Semiconductors, France; [3]LAAS-CNRS,Univ. de Toulouse, INSA, UPS, LAAS; [4]BMS/System Archi tecture team, NXP Semiconductors, France.

09:00–10:20 **OS-13A: Computational Electromagnetics (I)**
Session Chair:
Christopher Holloway,
NIST, United States of America
Location: G2

9:00 **Conformal FDTD Simulation of Vibrating Intrinsic Reverberation Chambers**
Florian Mahiddini, Guillaume Andreiu, Christophe Guiffaut, Nicolas Bui
Affiliation: Jade University of Applied XLIM, France

9:20 **Mixed Proper Orthogonal Decomposition with Harmonic Approximation for Parameterized Order Reduction of Electromagnetic Models**
Riccardo Torchio[1], Alessandro Zanco[2], Francesco Lucchini[3], Piergiorgio Alotto[1], Stefano Grivet-Talocia[2]
[1]Università degli Studi di Padova, Dept. of Industrial Engineering; [2]Politecnico di Torino, Dept. of Electronics and Tele communications; [3]Università degli Studi di Padova, Centro Ricerche Fusione

9:40 **On the Decoupling of Integrals in the Surface PEEC Method**
Maria De Lauretis[1], Elena Haller[2], Daniele Romano[3], Giulio Antonini[3], Jonas Ekman[1], Ivana Kovacevic-Badstubner[4], Ulrike Grossner[4]
[1]Luleå Univerisity of Technology, Sweden; [2]Halmstad University, Sweden; [3]University of L'Aquila, Italy; [4]ETH Zurich, Switzerland

10:00 **Suppression of Power-Bus Resonance and Unintentional Radiation by Lossy Resonator Filter**
Sho Kanao, Shuhei Kodama, Kengo Iokibe, Yoshitaka Toyota
Okayama University, Japan

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 Clovis[1,2], Klingler Marco[1], Pichom Lionel[2], Bensetti Mohamed[2]
[1]Stellantis, Centre technique de Vélizy, route de Gisy, 78943 Vélizy-Villacoublay; [2]Université Paris-Saclay, CentraleSupélec, CNRS, Laboratoire de Génie Electrique et Electronique de Paris, 91192, Gif-sur-Yvette, France. Sorbonne Université, CNRS, Laboratoire de Génie Electrique et Electronique de Paris, 75252, Paris, 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 Universitaet Hannover, Germany
Location: G1

10:50 **Distribution of the Current from Lightning in Sweden**
Florian Mahiddini, Guillaume Andreiu, Rebecca Persson1, Per Westerlund[2], Mahbubur Rahman[1], Milan Radosavljevic[3], Stefan Ståhl[4]
[1]Uppsala University; [2]Luleå University of Technology; [3]Svenska kraftnät; [4]SMHI

11:10 **Impact of IEMI Pulses on a Barometric Sensor**
Louis Cesbron Lavau[1], Michael Suhrke[1], Peter Knott[2,3]
[1]Fraunhofer INT, Germany; [2]Fraunhofer FHR, Germany; [3]RWTH Aachen, Germany

11:30 **Effects of EMC Filter Topologies on the Destruction Senarios of SMPS Under High Current Interference Pulses**
Laurine Curos[1,2], Guillaume Mejecaze[1], Tristan Dubois[2], Frédéric Puybaret[1], Jean-Michel Vinassa[2]
[1]CEA, DAM, CEA-Gramat; [2]Univ. Bordeaux, CNRS, Bordeaux INP, IMS UMR 5218

11:50 **New Probe Design for Hardware Characterization by Electro Magnetic Fault Injection**
Clément Gaine[1], Driss Aboulkassimi[1], Jean-Pierre Nikolovski[1], Jean-Max Dutertre[2]
[1]Univ. Grenoble Alpes, CEA, LETI, MINATEC Campus, F-38054 Grenoble, France; [2]Mines Saint-Etienne, CEA-Tech, Centre CMP, F-13541 Gardanne France

10:50–12:10 OS-13B: Computational Electromagnetics (II)

Session Chair:
Davy Pissoort,
KU Leuven, Belgium
Location: G2

10:50

Co-simulation of Circuit/Circuit Type Solvers for EMC Applications Using a New Relaxation Method
Amadou Bayaghiou Diallo[1,2], Christian Vollaire[1], Mohamed Bensetti[2], Lionel Pichon[2], Arnaud Breard[1]
[1]Univ Lyon, Ecole Centrale de Lyon, INSA Lyon, Université Claude Bernard Lyon 1, CNRS, Ampère, UMR 5005, Ecully, France; [2]GeePs – 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

11:10

Measurement-Based Modeling of PCB-to-Coaxial Cable Transition for 3D Electromagnetic Simulation by Equivalent Circuit Assisted De-Embedding
Herbert Hackl[1], Bernhard Auinger[1], Mate Kovacs[2], Andreas Wagner[2], Christian Stockreiter[2]
[1]Silicon Austria Labs GmbH, Austria; [2]ams osram group, Austria

11:30

Density-Based Topology Optimization for Conductor Pattern Design with Improved Impedance Boundary Condition
Katsuya Nomura
Kwansei Gakuin University, Japan

11:50

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

10:50–12:10 OS-16: Electric Vehicles

Session Chair:
Björn Bergqvist,
Volvo Cars, Sweden
Location: J1

10:50

Investigation of Ground Impedances Effecting EMC during Charging Operations of Electric Vehicless
Inti Runa Supa Stölben[1], Jonas Bertelmann[1], Michael Beltle[1], Stefan Tenbohlen[1], Christian Bersch[2], Konstantin Spanos[2]
[1]University of Stuttgart, Germany; [2]Robert Bosch GmbH, Germany

11:10

Experimental Investigation on Magnetic Field Emissions of Wireless Power Transfer Vehicle Charging Systems
Sebastian Jeschke, Michael Kleinen, Marcel Olbrich, Jörg Bärenfänger
EMC Test NRW GmbH, Germany

11:30

Flexible Numerical Evaluation of Human Head Exposure to a Transmitter Coil For Wireless Power Transfer at 13.56 MHz
Hamideh Esmaeili, Cheng Yang, Christian Schuster
Hamburg University of Technology, Germany

11:50

Inverter Interference on Charging Communication System during 400 V DC Charging of Vehicle
Lennart Hasselgren[1], Georgios Mademlis[2], Åke Lindbeck[2], Oskar Dahl[2]
[1]EMC Services, Sweden; 2Volvo Cars Corporation, Sweden

14:30–15:50 OS-11: EMP

Session Chair:
David Thomas,
The University of Nottingham, United Kingdom
Location: G1

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 Leferink[1,2], Chris Clemens[3], Hans Bergsma[1]
[1]THALES, Hengelo, the Netherlands; [2]University of Twente, Enschede, the Netherlands; [3]Ministry 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 Kawamata[1], Shinobu Ishigami[1], Osamu Fujiwara[2]
[1]Tohoku Gakuin University, Japan; [2]Nagoya Institute of Technology, Japan

14:30–15:50 OS-13C: Computational Electromagnetics (III)

Session Chair:
Markus Johansson,
Provinn AB, Sweden
Location: G2

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

14:50 **Modeling of a Litz Wire with Perfect Strand Pattern**
Silvano Cruciani[2], Tommaso Campi[1], Francesca Maradei[2], Mauro Feliziani[1]
[1]University of l'aquila, Italy; [2]La 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

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 Kasai[1], Toshio Onigata[2]
[1]Japan Aerospace Exploration Agency: JAXA; [2]e-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 Malburg[1], Niek Moonen[1], Jesper Lansink-Rotgerink[1,2], Frank Leferink[1,3]
[1]University of Twente, Enschede, the Netherlands; [2]NLR, Marknesse, the Netherlands; [3]THALES Nederland B.V., Hengelo, the Netherlands

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

Session Chair: **Jan Luiken ter Haseborg,** Technische Universitt 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 Sulaeman[1], Niek Moonen[1], Jelena Popovic[1,2], Frank Leferink1[3]
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. Azpurua[1,2], Marc Mateu-Mateus[1], Marc Pous[1,3], Marcos Quílez[1], Ferran Silva[1]
[1]Universitat Politécnica de Catalunya, Spain; [2]EMC Electromagnetic BCN, S.L. (EMC Barcelona), Spain; [3]European Space Agency, The Netherlands

17:20 **Radiation Reduction from Heatsinks by a PMC Surface**
Muhammet Hilmi Nisanci[1], Francesco de Paulis[2]
[1]Sakarya University, Turkey; [2]University of L'Aquila, Italy

16:20–17:40 OS-14: Power Electronics

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

16:20

Deep-Learning Based Transient Identification in Switched-Mode Power Supplies Conducted Emissions

Mattia Simonazzi[1], Leonardo Sandrolini[1], Marcello Iotti[1], Andrea Mariscotti[2]
[1]University of Bologna, Italy; [2]University of Genova, Italy

16:40

Impact of Routing on the EMC Behavior of a GaN HEMT-Based Full Bridge DC-DC Converter

Ayawo Roger Ekon[1,4], Mickael Petit[1,3], François Costa[1,2], François Bouvet[4], Eric Dupuy[4]
[1]Université Paris-Saclay, ENS Paris-Saclay, CNRS, SATIE, 91190 Gif-sur-Yvette, France; [2]Université Paris Est Créteil, INSPE, 94000 Créteil, France; [3]Le CNAM, 75011 Paris, France; [4]Synchrotron SOLEIL, 91190 Gif-sur-Yvette, France

17:00

Lumped Circuit Model for Concentrically Arranged Conductors in Power Electronic Systems

Daniel Seyfried[1], Bednarz Christian[2], Matthias Friedrich[3]
[1]University of Applied Science Würzburg-Schweinfurt; [2]Siemens Mobility GmbH; [3]University of Applied Science Fulda

17:20

A Transfer Function Approach to Calculate the Radiation of a Three-Phase Inverter

Alexander Engeln, Kai-Uwe Rathjen, Eric Fritze, Klaus F. Hoffmann, Stefan Dickmann
Helmut Schmidt University Hamburg, Germany

16:20–17:40 OS-18: EMF, EMI and VSWR Measurements

Session Chair: **Alastair Ruddle,**
HORIBA MIRA Limited, United Kingdom
Location: J1

16:20

Extending Site VSWR to Millimeter Wave using Cylindrical Mode Filtering

Zhong Chen[1], Phil Miller[2]
[1]ETS-Lindgren, United States of America; [2]RATLR, Inc., United States of America

16:40

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

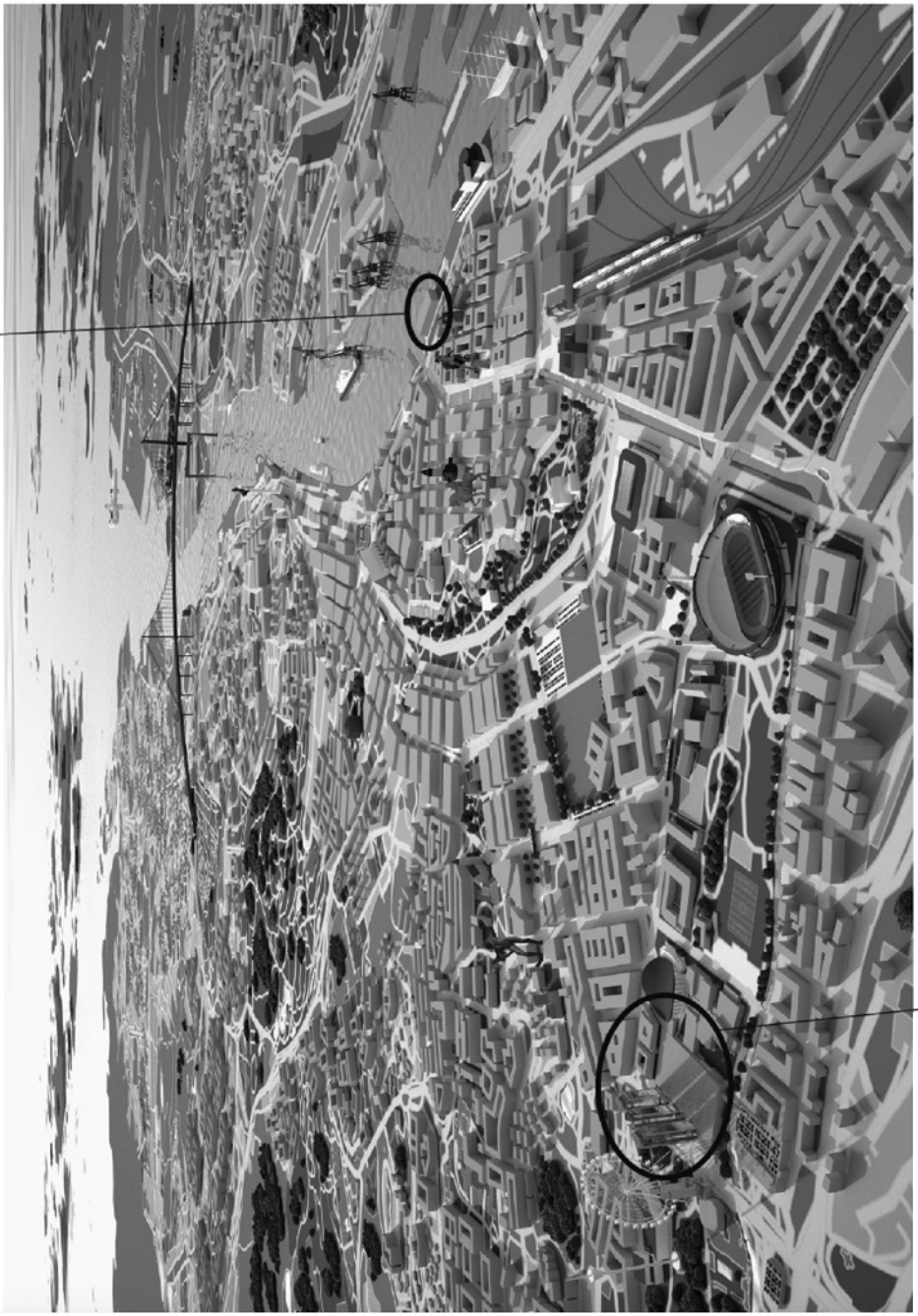
Cathrine E.S. Feloups[1,3], Niek Moonen[1], Frank Leferink[1,2]
[1]Electrical Engineering, Mathematics and Computer Science (EEMCS), University of Twente, Enschede, The Netherlands; [2]Thales Netherlands, 7554 RR, Hengelo, The Netherlands; [3]Department of Electrical Engineering, Faculty of Engineering, South Valley University, Qena, Egypt

17:20

Radio Frequency Interference Considerations in Large-Scale STATCOM Installations

Emil Mäki Eriksson, Jon Rasmussen, Mose Akyuz
Hitachi Energy, Sweden

Gothenburg City Map



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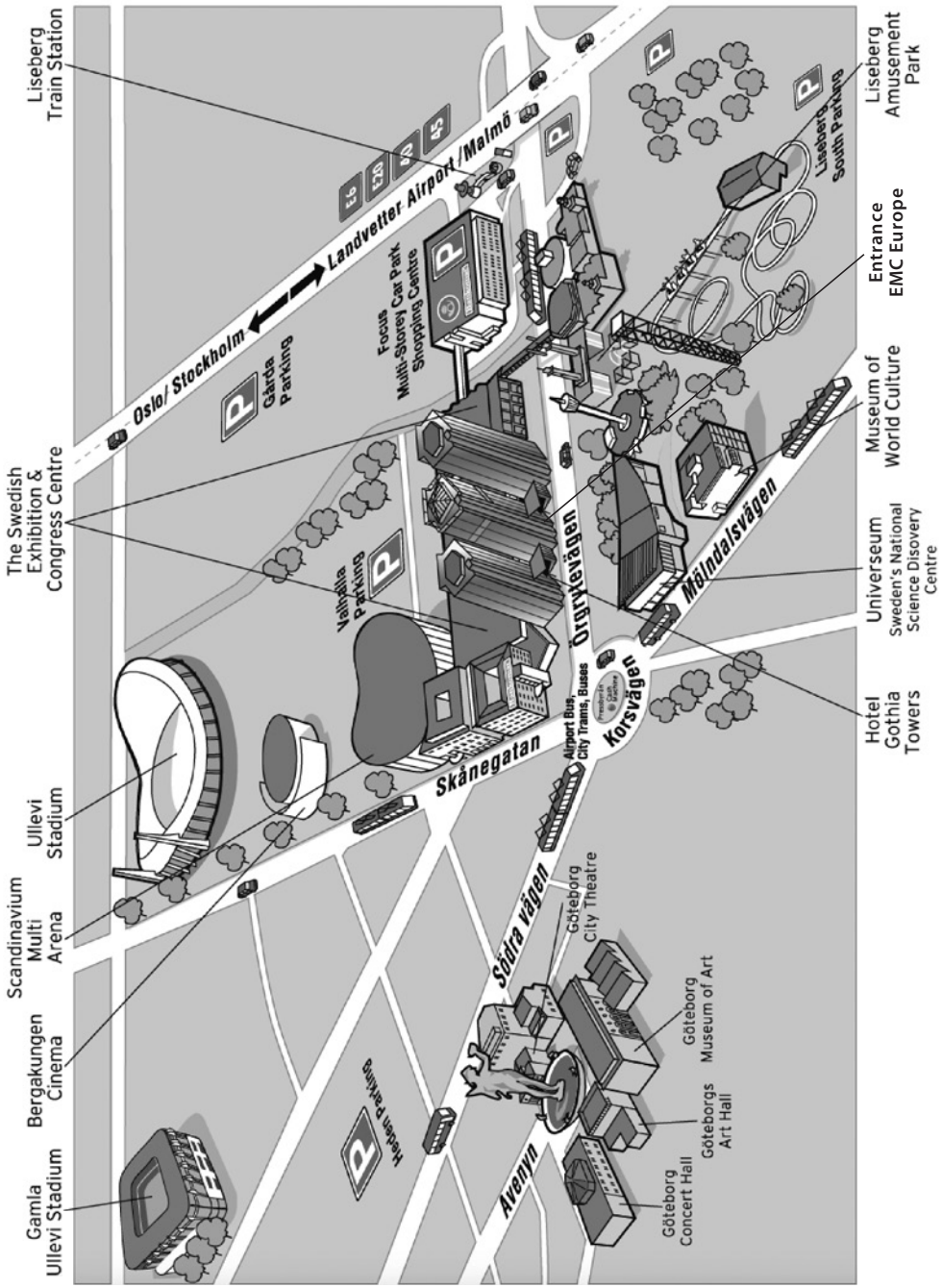
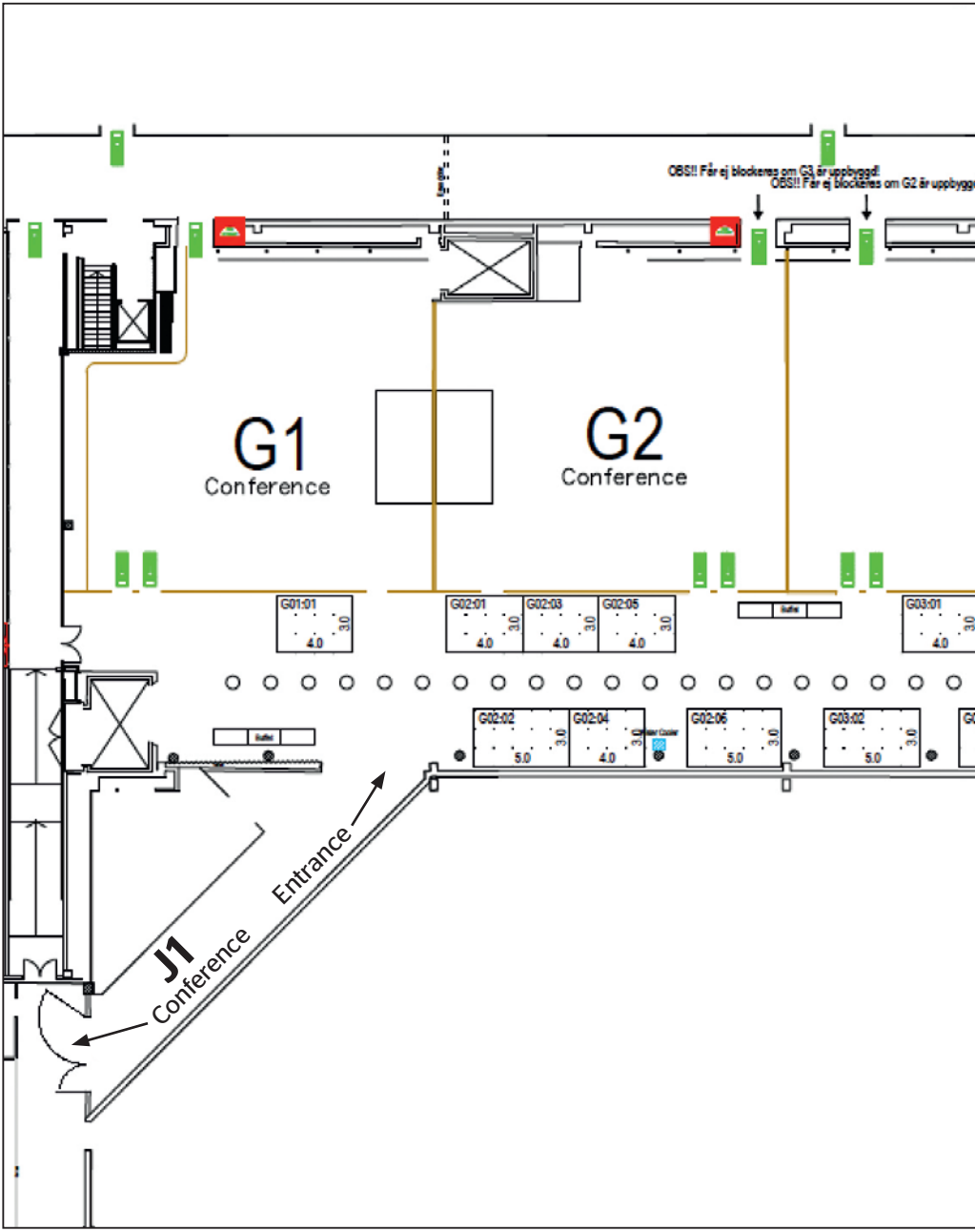


Floor Plan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EMC Europe 2023
September 4-8,
Krakow, Poland

EMC Europe 2024
September 2-5,
Bruges, Belguim

IEEE International Symposium on EMC+SIPI 2023
July 31- August 4,
Grand Rapids, Michigan

IEEE International Symposium on EMC+SIPI 2024
July 29- August 2,
Phoenix, Arizona

APEMC 2023
May 22-25,
Bangalore, India

APEMC 2024
May 20-24,
Okinawa, Japan

Exhibitor list

Exhibitor	Stand no.
Advanced Test Equipment Corp.	G02:04
Amska – Amerikanska Teleprodukter AB	G04:05
Ansys	G02:03
AR Europe	G02:02
Bluetest AB	G03:04
CE-BIT Elektronik AB	G04:12
Cergen GmbH	G04:08
Comsol AB	G05:05
Comtest Engineering BV	G02:02
Dassault Systems	G05:03
Dovitech A/S	G03:09
EMP-Tronic AB	G02:06
ETS Lindgren	G04:15
Freicomp GmbH	G03:09
Haefely AG	G04:03
IEEE EMC	G04:10
Intertek	G02:05
Jolex AB	G03:06
Kitagawa GmbH	G03:10
Kooma Engineering AB	G04:12
Lumiloop GmbH	G04:02
MVG Microwave Vision Group	G03:05
Narda Safety Test Solutions GmbH	G02:01
OEM Electronics AB	G03:03
Pendulum Instruments – Detectus	G03:01
Proxitron AB	G02:06
RanLOS AB	G03:08
RISE, Research Institutes of Sweden	G05:01
Rohde & Schwarz	G04:01
Seibersdorf Labor GmbH	G03:12
Spirent Communications	G03:02
Vinn Group	G04:07
Würth Elektronik	G03:07

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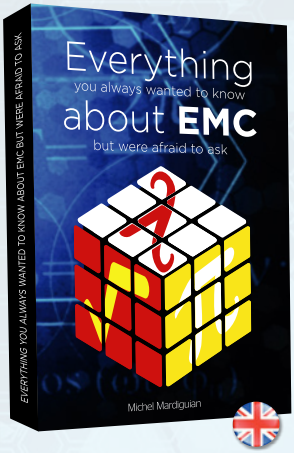

Michel Mardiguian, The complete EMC Handbook:

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"Everything you always wanted to know about EMC but were afraid to ask" is a must for anyone working with EMC. It presents all the basic principles and practices for successful EMC work with clear guidance and many examples, illustrations and guides. Each chapter ends with self-study questions..

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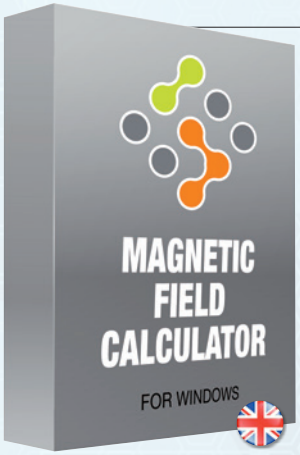

If you need to know the magnetic field in the vicinity of cables,

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

Influence of Radio Frequency Interference on the Electromagnetic Emission of Integrated Circuits
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 Hammen[1,2,3], Lionel Pichon[2,3], Yann Le Bihan[2,3], Mohamed Bensetti[2,3], Gerard Fleury[1]
[1]Institut national de recherche et de sécurité (INRS), Vandoeuvre-lès-Nancy, France; [2]Université Paris-Saclay, CentraleSupelec, CNRS, Gif-sur-Yvette, France; [3]Sorbonne 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 Clovis[1,2], Klinger Marco[1], Pichon Lionel[2], Bensetti Mohamed[2]
[1]Stellantis, Centre technique de Vélizy, route de Gisy, 78943 Vélizy-Villacoublay; [2]Université Paris-Saclay, CentraleSupélec, CNRS, Laboratoire de Génie Electrique et Electronique de Paris, 91192, Gif-sur-Yvette, France. Sorbonne Université, CNRS, Laboratoire de Génie Electrique 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 Claeys, Johan Catrysse, Davy Pissoort
KU Leuven, Belgium

Co-simulation of Circuit/Circuit type Solvers for EMC Applications Using a New Relaxation Method

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EMC Europe 2022
September 5-8 Gothenburg Sweden

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