Preliminary CONFERENCE PROGRAM

Content
- Venue
- Schedule at a glance
- Social program
- Exhibition
- Technical program

Conference organized by: in cooperation with:

Barcelona, 2-6 September 2019 | www.emceurope2019.eu
CONFERENC E AT BARCELONA

Join us at the International Symposium on Electromagnetic Compatibility (EMCEurope 2019). EMC Europe 2019 conference focuses on the high quality of scientific and technical contributions giving the unique opportunity to present the progress and results of your work in any EMC topic.

EMC Europe 2019 Symposium will be organized by Universitat Politècnica de Catalunya located in Barcelona Campus Nord. Barcelona, the capital of Catalonia, is a Mediterranean and cosmopolitan city with Roman remains, medieval quarters and the most beautiful examples of Modernism and avant-garde. Pedestrian streets in the old quarter, green areas, and a splendid seafront with a range of modern facilities are a reflection of its multifaceted character.

VENUE LOCATION

EMC Europe 2019 Symposium will be organized by Universitat Politècnica de Catalunya located in Barcelona Campus Nord (click on the map!)
ACCOMMODATION

As a main touristic city, Barcelona has a wide variety of accommodations. Common touristic websites provide the best offers and availability. Because September is high season, we recommend booking your accommodation as soon as possible.

Barcelona offers hundreds of hotels and apartments to visitors. Best deals are obtained from websites like Booking, Trivago or Airbnb, among others.

The following hotels are located at a walking distance to the conference venue:

**Hotel Sansi Pedralbes**
Av. de Pearson, 1, 08034 Barcelona
sansihotels.com

**Hotel Upper Diagonal**
Passeig de Manuel Girona, 7, 08034 Barcelona
hotel-upperdiagonal.com

**Hotel SOFIA Barcelona**
Plaça de Pius XII, 4, 08028 Barcelona
sofiabarcelona.com

**Fairmont Rey Juan Carlos I**
Avinguda Diagonal, 661, 671, 08028 Barcelona
fairmont.com

**Hotel Bonanova Park**
Carrer del Capità Arenas, 51, 08034 Barcelona
hotelbonanovapark.com

**Arenas Atiram Hotel Barcelona**
Carrer del Capità Arenas, 20, 08034 Barcelona
atiramhotels.com

**Hotel Catalonia Rigoletto**
Carrer de Sabino Arana, 22, 24, 08028 Barcelona
cataloniahotels.com

Visit [https://goo.gl/maps/VuNE5XP6zRgWbo5d7](https://goo.gl/maps/VuNE5XP6zRgWbo5d7) and select hotels to see their location and the currently available fares.
This year, EMC Europe has a fantastic technical program that must not be missed. The conference comprises 5 days with state-of-the-art Technical Sessions, Workshops, and Tutorials on EMC. In summary,

As a novelty, each paper submitted to the EMC Europe 2019 was classified according to the scheme shown in the table below.

<table>
<thead>
<tr>
<th>Application Domains</th>
<th>Techniques</th>
<th>Methodologies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aerospace</td>
<td>Antennas and Co-site interference</td>
<td>Circuit modeling</td>
</tr>
<tr>
<td>Automotive</td>
<td>Calibration, proficiency tests and interlaboratory comparisons</td>
<td>Diagnosis, troubleshooting, and systems validation</td>
</tr>
<tr>
<td>Components, Semiconductors, and IC</td>
<td>Frequency domain techniques</td>
<td>EM simulation and validation methods</td>
</tr>
<tr>
<td>Communications</td>
<td>Instrumentation, virtual instruments, and measurement automation</td>
<td>Experiments, Measurements, and Testing</td>
</tr>
<tr>
<td>Education</td>
<td>Low frequency and power quality topics</td>
<td>On-site and study cases</td>
</tr>
<tr>
<td>Fundamental research</td>
<td>Near-field techniques</td>
<td>Software and algorithms</td>
</tr>
<tr>
<td>Human exposure &amp; Health</td>
<td>New materials: absorbers, composite, and metamaterials</td>
<td>Statistical modeling</td>
</tr>
<tr>
<td>protection</td>
<td></td>
<td>Theoretical analysis and/or bibliographical review</td>
</tr>
<tr>
<td>Industry</td>
<td>Power Integrity and Signal Integrity</td>
<td></td>
</tr>
<tr>
<td>Large systems &amp; Fixed</td>
<td>Radar systems</td>
<td></td>
</tr>
<tr>
<td>installations</td>
<td>Reverberation chambers</td>
<td></td>
</tr>
<tr>
<td>Management and Quality</td>
<td>Risk assessment</td>
<td></td>
</tr>
<tr>
<td>Metrology</td>
<td>Shielding &amp; grounding</td>
<td></td>
</tr>
<tr>
<td>Military and Defense</td>
<td>TEMPEST and Eavesdropping</td>
<td></td>
</tr>
<tr>
<td>Power electronics</td>
<td>Time-domain and Transient analysis</td>
<td></td>
</tr>
<tr>
<td>Railway</td>
<td>Transmission lines analysis</td>
<td></td>
</tr>
<tr>
<td>Security</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smart-grid</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standards &amp; Regulations</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Classifying the papers in terms of application domains, techniques, and methodologies allowed a program with coherent technical sessions, focused either on the (final) application or in a certain technique (Technical tracks).

Oral presentations were allocated in sequences intended to make sense for participants. In this manner, we aspire to maximize the interaction/involvement speaker-audience and the general enjoyment in benefit of all participants. This resulted in 20 oral sessions, 6 special sessions, and 3 poster sessions.

Moreover, in the technical program, you will find 9 Workshops and 9 Tutorials distributed along the whole symposium week. While Workshops are intended to be a period of discussion or practical work in which a group of people shares their knowledge or experience, Tutorials are meant as educational talks on specific topics.

In the next pages, you will find the detailed program. There is so much to see. It is about time to start planning your agenda!
<table>
<thead>
<tr>
<th>Time</th>
<th>Room 1</th>
<th>Room 2</th>
<th>Room 3</th>
<th>Room 4</th>
<th>Room 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>12:00</td>
<td>Advanced Graphene-based Nanomaterials for</td>
<td>Signal &amp; Power Integrity, EMI/EMC for</td>
<td>Analysis of Interference and Design</td>
<td>Understanding EMC / Radio / Automotive</td>
<td>Near Field Probes: Useful tools</td>
</tr>
<tr>
<td></td>
<td>Electromagnetic Shielding and Absorbing</td>
<td>PCB Design with ANSYS tools I</td>
<td>and Design Considerations in Internet of</td>
<td>Standards, Electromagnetic (EM)-Field-</td>
<td>for electronic engineers I</td>
</tr>
<tr>
<td></td>
<td>Applications: Towards 5G Technology I</td>
<td></td>
<td>Things Applications I</td>
<td>related Testing, update I</td>
<td></td>
</tr>
<tr>
<td>14:00</td>
<td>Advanced Graphene-based Nanomaterials for</td>
<td>Signal &amp; Power Integrity, EMI/EMC for</td>
<td>Analysis of Interference and Design</td>
<td>Understanding EMC / Radio / Automotive</td>
<td>Near Field Probes: Useful tools</td>
</tr>
<tr>
<td></td>
<td>Electromagnetic Shielding and Absorbing</td>
<td>PCB Design with ANSYS tools I</td>
<td>and Design Considerations in Internet of</td>
<td>Standards, Electromagnetic (EM)-Field-</td>
<td>for electronic engineers II</td>
</tr>
<tr>
<td></td>
<td>Applications: Towards 5G Technology II</td>
<td></td>
<td>Things Applications II</td>
<td>related Testing, update II</td>
<td></td>
</tr>
<tr>
<td>15:20</td>
<td>Coffee break</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16:00</td>
<td>Advanced Graphene-based Nanomaterials for</td>
<td>Signal &amp; Power Integrity, EMI/EMC for</td>
<td>Analysis of Interference and Design</td>
<td>Understanding EMC / Radio / Automotive</td>
<td>Near Field Probes: Useful tools</td>
</tr>
<tr>
<td></td>
<td>Electromagnetic Shielding and Absorbing</td>
<td>PCB Design with ANSYS tools II</td>
<td>and Design Considerations in Internet of</td>
<td>Standards, Electromagnetic (EM)-Field-</td>
<td>for electronic engineers II</td>
</tr>
<tr>
<td></td>
<td>Applications: Towards 5G Technology II</td>
<td></td>
<td>Things Applications II</td>
<td>related Testing, update II</td>
<td></td>
</tr>
<tr>
<td>18:00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Preliminary Program

**TUESDAY, SEPT. 3**

<table>
<thead>
<tr>
<th>Time</th>
<th>ROOM 1</th>
<th>ROOM 2</th>
<th>ROOM 3</th>
<th>ROOM 4</th>
<th>ROOM 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9:00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10:40</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11:30</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12:35</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14:00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15:20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16:00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17:00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Opening: Plenary Opening Session (ROOM AUDITORI - VERTEX BUILDING)**

- **Reverberation chambers I**
- **EM Simulation**
- **Transient EMI**
- **Conducted EMI**
- **Protection of Civil Infrastructures against Intentional EMI I**

**Exhibition Inauguration**

**coffee break**

- **Reverberation chambers II**
- **EM Field Probes I**
- **Smart-grid & Power Quality I**
- **EMC Diagnostics of Complex Systems I**
- **Protection of Civil Infrastructures against Intentional EMI II**

**lunch**

**Exhibition**

- **Reverberation chambers II**
- **EM Field Probes II**
- **Smart-grid & Power Quality II**
- **EMC Diagnostics of Complex Systems II**
- **Protection of Civil Infrastructures against Intentional EMI III**

**coffee break**

**Registration**
## Preliminary Program

**WEDNESDAY, SEPT. 4**

<table>
<thead>
<tr>
<th>TIME</th>
<th>ROOM 1</th>
<th>ROOM 2</th>
<th>ROOM 3</th>
<th>ROOM 4</th>
<th>ROOM 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:00</td>
<td>Aeronautics</td>
<td>Power Electronics I</td>
<td>Electromagnetic Eavesdropping TEMPEST</td>
<td>New materials for EMC</td>
<td>Challenges in Special Applications of Electrically Small, HF Vehicular Antennas I</td>
</tr>
<tr>
<td>9:00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10:40</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11:15</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12:35</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14:00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15:20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16:00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17:00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Sessions**
- **Posters**
- **Workshops**
- **Special Sessions**

- Coffee break
- Exhibition
- Lunch
- Posters II (Poster's Area)
<table>
<thead>
<tr>
<th>Time</th>
<th>Room 1</th>
<th>Room 2</th>
<th>Room 3</th>
<th>Room 4</th>
<th>Room 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:00</td>
<td>Automotive I</td>
<td>Components, Semiconductors and IC I</td>
<td>EMC in Physics Experiments and Particle Accelerators</td>
<td>Numerical Simulation Techniques for EMC Problems I</td>
<td>Electromagnetic Interference on Static Electricity Meters I</td>
</tr>
<tr>
<td>9:00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10:40</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11:15</td>
<td>Automotive II</td>
<td>Components, Semiconductors and IC II</td>
<td>Communications I</td>
<td>Numerical Simulation Techniques for EMC Problems II</td>
<td>Electromagnetic Interference on Static Electricity Meters II</td>
</tr>
<tr>
<td>12:35</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14:00</td>
<td>Automotive III</td>
<td>Human Exposure &amp; Health Protection I</td>
<td>Communications II</td>
<td>Numerical Simulation Techniques for EMC Problems III</td>
<td>MIL-STD461 Military EMC Tests and Challenges/Pitfalls I</td>
</tr>
<tr>
<td>15:20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16:00</td>
<td>Automotive IV</td>
<td>Human Exposure &amp; Health Protection II</td>
<td>Intentional EMI</td>
<td>Education on EMC</td>
<td>MIL-STD461 Military EMC Tests and Challenges/Pitfalls I</td>
</tr>
<tr>
<td>17:00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### FRIDAY, SEPT. 6

<table>
<thead>
<tr>
<th>Time</th>
<th>Room 1</th>
<th>Room 2</th>
<th>Room 3</th>
<th>Room 4</th>
<th>Room 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9:00</td>
<td>Automotive EMC I</td>
<td>Measurements of conducted emissions in time domain and power-line filter design</td>
<td>Uncertainty about uncertainties along the EMC-compliance chain</td>
<td>Paper Preparation for the IEEE EMC Transactions</td>
<td>Ionizing Radiation &amp; Electromagnetic Interference on Integrated Circuits: from the need of combined tests to current solutions</td>
</tr>
<tr>
<td>10:40</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11:15</td>
<td>Automotive EMC II</td>
<td>Computational Electromagnetics and Multiphysics Methods for Simulating Complex Electromagnetic Environment Effects I</td>
<td>Protecting Against the Risks of Lightning and EMI in Systems and Components I</td>
<td>Components and topologies for passive EMI/EMC filters useful in conducted emissions: a practical approach I</td>
<td>EMI and power quality issues in Smart Cities and Transportation Systems I</td>
</tr>
<tr>
<td>12:35</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14:00</td>
<td>Automotive EMC III</td>
<td>Computational Electromagnetics and Multiphysics Methods for Simulating Complex Electromagnetic Environment Effects II</td>
<td>Protecting Against the Risks of Lightning and EMI in Systems and Components II</td>
<td>Components and topologies for passive EMI/EMC filters useful in conducted emissions: a practical approach II</td>
<td>EMI and power quality issues in Smart Cities and Transportation Systems II</td>
</tr>
<tr>
<td>15:20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16:00</td>
<td>Automotive EMC IV</td>
<td>Computational Electromagnetics and Multiphysics Methods for Simulating Complex Electromagnetic Environment Effects III</td>
<td>Protecting Against the Risks of Lightning and EMI in Systems and Components III</td>
<td>Components and topologies for passive EMI/EMC filters useful in conducted emissions: a practical approach III</td>
<td>EMI and power quality issues in Smart Cities and Transportation Systems III</td>
</tr>
<tr>
<td>18:00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
SOCIAL PROGRAM

Welcome reception | Sant Pau World Heritage by UNESCO

The Welcome Reception will take place on September 3rd

The Art Nouveau hospital pavilions were declared World Heritage by UNESCO in 1997. After more than a century as the home of the Hospital de la Santa Creu i Sant Pau, an ambitious restoration project following the transfer of all healthcare activities to the new Hospital has restored the cultural and artistic glories of the Sant Pau Art Nouveau Site, the most important work of Catalan architect Lluís Domènech i Montaner. With this transformation, the Sant Pau Art Nouveau Site, in which history and innovation go hand in hand, has become a new point of reference in the city of Barcelona. See more at Youtube

Gala dinner | Les Drassanes Medieval royal shipyards of Barcelona

Symposium Banquet will take place on September 4th

Les Drassanes were the medieval shipyards of Barcelona, which now house the Barcelona Maritime Museum. Built in the fourteenth century, Les Drassanes is perhaps the most stirring ancient industrial space of any kind and certainly the most complete shipyard that has survived from the Middle Ages.

Les Drassanes were declared a Cultural Site of National Interest in 1976 because, despite renovation over the centuries, they remain true to their original design.
## Company information

<table>
<thead>
<tr>
<th>Company</th>
<th>Website</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advanced Test Equipment Rentals</td>
<td><a href="https://www.atecorp.com/">https://www.atecorp.com/</a></td>
</tr>
<tr>
<td>A Jin Electron</td>
<td><a href="http://www.ajinelectron.co.kr/">http://www.ajinelectron.co.kr/</a></td>
</tr>
<tr>
<td>Albatross</td>
<td><a href="https://www.albatross-projects.com/">https://www.albatross-projects.com/</a></td>
</tr>
<tr>
<td>ALTAIR</td>
<td><a href="https://www.altair.com/">https://www.altair.com/</a></td>
</tr>
<tr>
<td>AMETEK CTS GmbH</td>
<td><a href="https://www.ametek.com/">https://www.ametek.com/</a></td>
</tr>
<tr>
<td>ANSYS</td>
<td><a href="https://www.ansys.com/">https://www.ansys.com/</a></td>
</tr>
<tr>
<td>AR Europe Ltd.</td>
<td><a href="https://www.arworld.us/">https://www.arworld.us/</a></td>
</tr>
<tr>
<td>CADTECH</td>
<td><a href="https://cadtech.es/">https://cadtech.es/</a></td>
</tr>
<tr>
<td><strong>Company</strong></td>
<td><strong>Website</strong></td>
</tr>
<tr>
<td>-----------------------------------</td>
<td>------------------------------</td>
</tr>
<tr>
<td>Comtest Engineering</td>
<td><a href="https://www.comtest.eu/">https://www.comtest.eu/</a></td>
</tr>
<tr>
<td>DASSAULT SYSTÈMES</td>
<td><a href="https://www.3ds.com/">https://www.3ds.com/</a></td>
</tr>
<tr>
<td>Detectus</td>
<td><a href="http://www.detectus.se/">http://www.detectus.se/</a></td>
</tr>
<tr>
<td>EMCoS</td>
<td><a href="https://www.emcos.com/">https://www.emcos.com/</a></td>
</tr>
<tr>
<td>EMI Solutions PVT.LTD.</td>
<td><a href="http://www.emisindia.com/">http://www.emisindia.com/</a></td>
</tr>
<tr>
<td>ETS-Lindgren</td>
<td><a href="http://www.ets-lindgren.com/">http://www.ets-lindgren.com/</a></td>
</tr>
<tr>
<td>Freicomp GmbH</td>
<td><a href="http://www.freicomp.com">http://www.freicomp.com</a></td>
</tr>
<tr>
<td>Organization</td>
<td>Website Link</td>
</tr>
<tr>
<td>-----------------------------------</td>
<td>-----------------------------------</td>
</tr>
<tr>
<td>GCEM-UPC</td>
<td><a href="https://www.upc.edu/web/gcem/">https://www.upc.edu/web/gcem/</a></td>
</tr>
<tr>
<td>IEEE EMCS</td>
<td><a href="http://www.emcs.org/">http://www.emcs.org/</a></td>
</tr>
<tr>
<td>INTA</td>
<td><a href="http://www.inta.es/WEB/INTA/en/">http://www.inta.es/WEB/INTA/en/</a></td>
</tr>
<tr>
<td>ITAINNOVA</td>
<td><a href="https://www.itainnova.es/">https://www.itainnova.es/</a></td>
</tr>
<tr>
<td>KEMET</td>
<td><a href="http://www.kemet.com/">http://www.kemet.com/</a></td>
</tr>
<tr>
<td>Kitagawa GmbH</td>
<td><a href="https://www.kitagawa.de/en/">https://www.kitagawa.de/en/</a></td>
</tr>
<tr>
<td>LUMILOOP</td>
<td><a href="http://www.lumiloop.de/">http://www.lumiloop.de/</a></td>
</tr>
<tr>
<td>Company</td>
<td>Website</td>
</tr>
<tr>
<td>-------------------------</td>
<td>----------------------------------------------</td>
</tr>
<tr>
<td>MONTENA</td>
<td><a href="https://www.montena.com/system/home/">https://www.montena.com/system/home/</a></td>
</tr>
<tr>
<td>Oak-Mitsui Technologies</td>
<td><a href="https://www.faradflex.com/">https://www.faradflex.com/</a></td>
</tr>
<tr>
<td>Rohde &amp; Schwarz</td>
<td><a href="https://www.rohde-schwarz.com">https://www.rohde-schwarz.com</a></td>
</tr>
<tr>
<td>SOLIANI EMC CUSTOM SHIELDING SOLUTIONS</td>
<td><a href="https://www.solianiemc.com/">https://www.solianiemc.com/</a></td>
</tr>
<tr>
<td>WAVECONTROL</td>
<td><a href="https://www.wavecontrol.com">https://www.wavecontrol.com</a></td>
</tr>
<tr>
<td>Würth Elektronik eiSos GmbH &amp; Co. KG</td>
<td><a href="https://www.we-online.com">https://www.we-online.com</a></td>
</tr>
</tbody>
</table>
Advanced Graphene-based Nanomaterials for Electromagnetic Shielding and Absorbing Applications: Towards 5G Technology

**Time:** Monday, 02/Sep/2019: 2:00pm - 6:00pm  
**Location:** Room 1

**Session Chair:** Maria Dr. Sabrina Sarto, Sapienza University of Rome, Italy  
**Session Co-chair:** Dr. Alessio Tamburrano, Sapienza University of Rome, Italy

**Abstract** – The Workshop focuses on the development of new multifunctional graphene-based nanomaterials for electromagnetic shielding and radar absorption, such as graphene-nanocomposites or coatings and multilayer metal-free screens. Theoretical modelling approaches, simulation methods, production and experimental characterization techniques for the development of the EM screens are presented. Moreover, protection against electromagnetic interference (EMI) from the upcoming fifth-generation (5G) communication devices is discussed and new metal-free graphene-based absorbers above 24 GHz are proposed.

**Topics:**
- Innovative multifunctional shielding nanomaterials
- Radar absorbing graphene-based materials
- Graphene, graphene nanocomposites
- Modelling, fabrication, experimental testing
- 5G graphene-based absorbers

**Agenda:**
- Introduction to graphene-based nanomaterials for electromagnetic shielding and radar absorption. M.S. Sarto, Sapienza University of Rome, Rome, Italy.
- Production and electromagnetic characterization of graphene-based paint and thin coatings. A. Tamburrano, Sapienza University of Rome, Rome, Italy.
- Radar absorbing fiber-reinforced graphene-filled composites with enhanced mechanical properties. F. Marra, Sapienza University of Rome, Rome, Italy.
- Towards next generation wireless 5G technology. M. D’Amore, Sapienza University of Rome, Rome, Italy.
- New metal-free absorbers for 5G high-frequency bands. A.G. D’Aloia, Sapienza University of Rome, Rome, Italy.

---

Signal & Power Integrity, EMI/EMC for PCB Design with ANSYS tools

**Time:** Monday, 02/Sep/2019: 2:00pm - 6:00pm  
**Location:** Room 2

**Session Chair:** Dr. Flavio Calvano, ANSYS, Italy

**Abstract** – In this workshop, the typical Power and Signal integrity EMI/EMC issues on PCBs will be solved by a Full wave hybrid simulation approach coupled with the help of an advanced circuit simulator for the non-linear time transient analysis.

The PCB scattering parameter extraction provided by our full wave hybrid numerical code helps to identify issues on Power Delivery Network (PDN) and run a design of experiment genetic algorithm which can find the right decoupling capacitor strategy based on PDN noise and capacitor number minimization. Examples of this technique will be presented in this workshop.
The circuit simulator, with the PCB scattering parameter to steady-state space model conversion through advanced mathematical models, is used to build a full non-linear transient simulation to evaluate eye diagrams, voltage/currents transient diagrams and all the quantities useful for solving Signal Integrity issues, importing IBIS and Spice models for active devices in our environment. The time domain currents can be transformed in the frequency domain by a Fast Fourier Transform (FFT) and these can be analysed as a direct output for conductive emission problems, connecting circuit models for the Linear Impedance Stabilization Network (LISN). Examples of signal integrity and EMI/EMC will be presented in real cases.

The PCB and Circuit coupling are even important for evaluating the EMI/EMC issues. The Steady-state model is dynamically linked with the PCB project and the time domain current can be pushed back to the PCB as FFT to calculate the Near and Far-field by integrating the currents on the PCB. This helps designers to predict EMI/EMC issues and discover critical areas on the PCB.

Moreover, a novel Multiphysics approach has been developed to consider DC-Bias and temperature for the PCB capacitors. A DC solver can be used to evaluate the DC current and voltage distribution on the PCB and discover if there are traces or bias with a high current density, and at the same time, to evaluate the DC-Bias condition. The capacitor models have a DC-Bias and temperature dependence which can be automatically read by our internal code and the PCB can be simulated in the operative conditions which can have a significant impact on the EMI/EMC results in some cases. Examples of this new technique and the Multiphysics approach will be shown in the workshop.

Agenda:
- Introduction to Electromagnetic simulation for PCB design
- DC and thermal Multiphysics simulation for PCB
- Power Integrity Analysis and decoupling capacitor strategy and optimization
- Signal Integrity, Eye Diagrams, TDR and Z0 impedance scan
- EMI/EMC near and far field analysis

Speakers:
- Dr. Flavio Calvano (flavio.calvano@ansys.com) ANSYS Italy
- Dr. Frederic Bocquet (frederic.bocquet@ansys.com) ANSYS France
- Samuel Lopez (samuel.lopez@ansys.com) ANSYS Spain.

Challenges in Special Applications of Electrically Small, HF Vehicular Antennas

**Time:** Wednesday, 04/Sep/2019: 9:00am - 05:00pm  
**Location:** Room 5

**Session Chair:** Dr. Diethard E.A. Hansen, EURO EMC SERVICE, Switzerland  
**Session Co-Chair:** Ilona Danelyan, EMCoS Ltd. HQ, Georgia

**Abstract** - Vehicular, mobile HF (short wave 1.5/3 to 30 MHz, 200/100 to 10m) communication is up today still in beneficial use. Due to ionospheric propagation conditions, under presently low sunspot activities, only the lower spectrum part can mostly be used. Exactly this is a technical challenge, because here electrically short, vertical HF mobile antennas are known to be inefficient. There is however very little practical, experimental or simulation data available in the open literature. Aside from the military, emergency disaster relief organizations (humanitarian, medical, technical aid) depend on HF mobile on the go. In troubled areas communication infrastructure is mostly gone. Improved, quick, reliable, and still cost-effective deployment is vital. Sat-Com or 3 or 4G mobile phones are often no option. Our detailed experimental and EM-simulation investigations include Automotive EMC, analysis of electrically short HF Antennas, critical communications SNR-ratio, antenna performance impacting parameter studies, rubber tire impact, antenna input impedance, radiation pattern, the impact of soil/ground under the automobile, far-field simulations with absolute antenna efficiency, incl. vertical elevation angle. Validation measurements (groundwave, sky-wave) were performed in the critical low bands of shortwave spectrum around 1.8/3.5/7MHz and above. These representative bands were used base on existing government Amateur Radio transmitting licenses. Antenna efficiency tests by ground-wave propagation were conducted over 2.8 km flat farmland. Sky-wave antenna efficiency test lead to estimates, via statistics, from extended, real world, EU Ionospheric Propagation experiments. The only successful way to address antenna elevation patterns, without having H-field sensing drones available, was to use validated, professional EM-Simulation Codes. Agreement between tests and simulation results are very reasonable, given the many impacting parameters. Innovative antenna design concepts will be discussed.

The general content structure of the workshop is:
- Motivation, background, open literature, state of the art, interested users
- Basic technical challenges: Emergency Communication needs in remote disaster areas, Automotive EMC, electrically short HF Antennas, critical communications SNR on short wave low bands
- Test cars: Mainly Audi A6 Avant, similar in most results to the BMW 316i Touring
• R&D Antenna design and choice of tested frequency bands were based on an existing government transmission license as HAM radio operator. This allowed in principle use of HF spectrum bands from 1.8 to 29.7 MHz
• Antenna problem analysis by equivalent circuit/simulation model (car chassis, tires, short monopole, soil/ground)
• Efficiency impacting parameter studies (measured/simulated): Tire capacitance impact, Antenna Input Impedance, VSWR (S11), e.g. on 80m (ca. 3.5MHz, R&D Test Antenna, capacitive head, 1.88m long, vertical radiator, large XL resonance coil)
• Far Field Ant. Radiation Pattern (azimuth, elevation) impact for different soil/ground characteristic under the automobile, incl. simulated ant. efficiency
• Ant. efficiency-tests by a ground wave over 2.8 km flat farmland, efficiency estimates by statistics from extended EU Ionospheric Propagation experiments. Experimental dB (or %) efficiency => ranking of el. short HF mobile antennas for both R&D, as well as commercial, tested types.
• Skywave test: Comparing HF mobile to a fixed reference dipole type antenna with a simulated radiation pattern
• What makes a better radiator? Experiment / Simulation Comparison of two 80m R&D
• Antennas over PEC ground (efficiency, elevation angle)
• Discussion of assumptions/limits in the experiments and how well they fit simulations
• Outlook: Now we understand the underlying physics. Discussion of ideas to improve antenna principles by innovative procedures and design

Electromagnetic Interference on Static Electricity Meters

Time: Thursday, 05/Sep/2019: 9:00am - 12:40am
Location: Room 5
Session Chair: Dr. Paul Simon Wright, National Physical Laboratory - NPL, UK

Abstract - The workshop will present challenges and results from EU project on the EMI effects on static electricity revenue meters. The project was proposed in response to the findings by the University of Twente which reported some serious (>500%) meter errors induced by fast current changes. The project will further investigate these effects using waveforms captured from mass market electrical products and waveforms reordered on-site at meter connection points; examples of captured waveforms and associated meter errors will be presented. New waveform analysis techniques will be given which can be used to identify the types of signal that induce meter errors and in-turn unambiguously specify new testing signals that can be used in future type-approval testing. These waveforms will be applied using test-beds used in testing labs and the challenges for developing/retro-fitting suitable laboratory apparatus will be presented. The project findings are expected to influence future normative standards and testing procedures and the outlook for future standardisation will be given.

Topics:
• Capturing real-world waveforms for meter testing.
• Signal analysis techniques to unambiguously specify complex test waveforms.
• Testbeds for normative approval of static electricity meters.
• New type-tests and validated methods for determining electricity meter performance.
• Outlook for normative standards and testing procedures.

Agenda:
• Introduction to the problem (Paul Wright, NPL)
• Capturing real-world waveforms for meter testing. (Twente + VSL + UPC)
• Equipment to digitize waveforms (Marc Pous -UPC) demonstration of measurement equipment and data capture and analysis software
• Measurements of Appliances in the lab to capture waveforms (Helko van den Brom, VSL)
• Waveform capture on-site (Bas Ten Have, University of Twente)
• Signal analysis techniques to unambiguously specify complex test waveforms. (NPL)
• Triggering and Analysis (Paul Wright, NPL)
• Probability distributions (Marc Pous -UPC)
• Test Beds for approval of meters
• Testbed for normative approval of static electricity meters based on phantom power. (NPL/VSL)
• Testbed for normative approval of static electricity meters based on IEC61000-4-19 (Pavel Hamouz - CMI/ Jean-Pierre Braun - METAS)
• Future Type-tests and outlook for normative standards and testing procedures. (NPL)
• Latest findings on meter performance. (VSL/Twente Tom Hartman)
• Final discussions, feedback, and stakeholder needs
Abstract – Automotive electric / electronic systems are endlessly growing in complexity with 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:

Global Methodology for Electrical Component Tests to Reproduce Wideband Modulated Pulse Interferences on Vehicle
Thomas Picon (1,2), Marco Klingler (1), Tristan Dubois (2) & Geneviève Duchamp (2)
(1) PSA Group, France
(2) IMS, University of Bordeaux, France

Simulating and Resolving EMC/EMI Issues in Electric Vehicles
Matthias Troescher, Dassault Systèmes SIMULIA, Germany

PEEC Based Modeling of Inductive Components for Power Electronics Applications
Anna Gheonjian, Diana Eremyan, Zviad Kutchadze, Badri Khvitiia, Roman Jobava. EMCoS Ltd., Tbilisi, Georgia

Fast analysis of component and vehicle level conducted and radiated emissions on new electric powertrains
Jordi Soler, Philippe Le Marrec. Altair Engineering GmbH Böblingen, Germany

EMC simulation workflow for Power Electronics in the Automotive Industry
Flavio Calvano, Samuel Lopez, Frédéric Bocquet. ANSYS Inc, Italy

Modelling and simulation of a vehicle with an IPT (Inductive Power Transfer) system to see magnetic field inside and outside the vehicle for different chassis material etc.
Peter Ankarson and Urban Lundgren. Research Institutes of Sweden (RISE), Sweden

Noise Reduction in Stationary Operating Automotive Power Electronic Systems using Signal Synthesis
Stephan Frei, Andreas Bendicks, Tobias Dörlemann, Caroline Krause. TU Dortmund University, Germany

EMC root causes and optimization of pressure sensors
Jan Benz, Jan Hansen (1), Stephan Frei (2)
(1) Robert Bosch GmbH, Germany
(2) TU Dortmund University, Germany
Switching Regulators in Automotive System Designs with Power and Data over Shared Cabling: Conducted and Radiated Emissions Prediction via Co-Simulation
Abhishek Ramanujan, Patrick DeRoy, Joseph Tarkoff. Analog Devices

Challenges for Automotive Electro Magnetic Compatibility Applications
Jean-Roger K. Kuvedu-Libla. Delphi Technologies, Bascharage, Luxembourg

Measurements of conducted emissions in time domain and power-line filter design

**Time:** Friday, 06/Sept/2019: 9:00am - 10:40am  
**Location:** Room 4  
**Session Chair:** Dr. Albert-Miquel Sánchez, Emzer Technological Solutions, Spain  
**Session Co-Chair:** Dr. F. Javier Pajares, Emzer Technological Solutions, Spain

**Abstract** – Electromagnetic compatibility (EMC) measurements usually consume a significant amount of time in any development project of electrical or electronic equipment, especially when problems arise, and the project enters in a redesign and retest loop not expected beforehand. Therefore, the EMC community devotes significant efforts to reduce the measurement time of regulated tests and to provide techniques that help on the solution design. This workshop has been focused on three techniques that can speed up the conducted-emission measurements and, eventually, can provide a solution. These techniques are:

- Measurements in the time domain.
- Measurements of CM and DM.
- Power-line filter design techniques.

When doing time-domain measurements, all frequencies are measured simultaneously. This is a very different situation with respect to traditional spectrum analyzers or electromagnetic interference (EMI) receivers, where the spectra are sequentially measured at several frequency steps. Thus, the reduction of measurement time in the first case with respect to the second one is significant. In this workshop, some technical issues that must be considered when performing time-domain measurements according to CISPR 16-1-1 will be covered, as for instance, the necessary dynamic range, the signal filtering, and the signal processing.

Every electric or electronic device needs a power-line filter to be compliant with any EMC regulation around the world. Knowing the modal nature of the conducted emissions (that is, knowing if the predominant mode is the CM, the DM, or a combination of both) becomes fundamental to improve the design of the power-line filter. In this workshop, different techniques to separate the CM and the DM will be analyzed, either by using analogic circuits or by signal processing in the digital domain.

For the optimal design of a power-line filter, the whole circuit information that intervenes in the system device-under-test (DUT), power-line filter and power-line network must be known. That means that the measurement of the input impedance of the DUT and the power-line network is needed. In this workshop, a measurement setup to measure the input impedance of DUTs connected to the power-line network, and the input impedance of the power-line network will be presented and used to develop a power-line filter design technique.

Actual measurements will be carried on supporting the explanation.

**Speakers:**
- Dr. Albert Miquel Sanchez, Emzer Technological Solutions, Spain
- Dr. Joan Ramon Requé, Emzer Technological Solutions, Spain
- Dr. Miquel Ribó, Emzer Technological Solutions, Spain
- Dr. F. Javier Pajares, Emzer Technological Solutions, Spain
- Dr. Arturo Mediano, Universidad de Zaragoza, Zaragoza, Spain

Components and topologies for passive EMI/EMC filters useful in conducted emissions: a practical approach

**Time:** Friday, 06/Sept/2019: 11:20am - 06:00pm  
**Location:** Room 4  
**Session Chair:** Ismael Molina Alba. WÜRTH ELEKTRONIK EISOS GMBH & CO. KG

**Abstract** – This workshop is intended to give a general view of the design and evaluation of passive filters to be used in EMC conducted emissions with a practical approach in mind. First, the problem of conducted-emissions is presented so attendees understand the problem to be solved including typical topologies. Then, the typical components used in
those filters are reviewed: capacitors, chokes, and ferrites. Different technologies and state of the art solutions will be introduced including strategies to choose practical components for specific cases. With the chosen components, a simple evaluation of the filter can be done with simulation including parasitic components affecting the behavior of the filter. Finally, a set of simple experiments to demonstrate those techniques will be presented.

**Agenda:**
- Introduction.
- The need for filters.
- Topologies for filters in conducted emissions.
- Components and technologies: chokes, capacitors, and ferrites.
- Choosing components for a filter.
- Design and simulation of filters.
- How to evaluate a filter in the laboratory.
- How to destroy a filter.
- Practical demonstrations.

**Speakers:**
- Ismael Molina, WÜRTH ELEKTRONIK EISOS GMBH & CO. KG,
- Dr. Arturo Mediano, Universidad de Zaragoza, Spain

---

**Computational Electromagnetics and Multiphysics Methods for Simulating Complex Electromagnetic Environment**

***Time***: Friday, 06/Sep/2019: 11:20am - 6:00pm  
***Location***: Room 2  
***Session Chair***: Prof. Wenyan Yin, Zhejiang University, Hangzhou, China

**Abstract** – Computational Electromagnetics (EM) and Multiphysics (MP) methods for simulating complex electromagnetic environment effects (E3) remain challenging tasks even nowadays. This workshop hosts a series of speakers that have made recent contributions to the field of computational EM/MP methods applied to problems relevant to various complex EMC/EMI/IEMI problems. The presentations will give both a review of the state of the art in the respective fields and show more recent progress. Topics that will be addressed include general computational EM/MP methods, numerical efficiency, and accuracy, handling of complex 3-D multiscale structures, validation of simulated results, and even high-performance computational EM/MP methods and their applications for characterizing complex E3 problems for further electromagnetic protection design. All these are important for the development of warship-, aircraft-, and aerospace-based platforms as well as communication and radar systems. The workshop is provided for both research engineers and scientists who are active in CEM and EMC/EMI/IEMI studies and applications.

**Speakers:**
- Prof. Liang Zhou (IEEE EMC-S DL), Shanghai Jiao Tong University, Shanghai, China
- Prof. Haijing Zhou, Institute of Applied Physics and Computational Mathematics, Beijing, China
- Martin Zang, Lehrstuhl für Theoretische Elektrotechnik, Bergische Universität Wuppertal, Germany
- Prof. Wen-Yan Yin (IEEE Fellow), Zhejiang University, Hangzhou, China

**Agenda:**
- Multiphysics (MP) Methods for Modeling and Simulating RF Devices/circuits Under Intentional Electromagnetic Interference (IEMI), Prof. Liang Zhou
- High-Performance Electromagnetic Simulation for Solving E3 Problems on a Supercomputer Platform, Prof. Haijing Zhou
- Determination and Assessment of the Human Exposure to Magneto-Quasistatic Fields of Wireless Power Transfer Systems in Electric Vehicles Using High-Resolution Two-Step Simulation Methods, Martin Zang
- Time-Domain Integral Equation Method for Simulating EMP Effects of Multiscale Complex Structures, Prof. Wen-Yan Yin
Protecting Against the Risks of Lightning and EMI in Systems and Component

**Time:** Friday, 06/Sep/2019: 11:20am - 6:00pm  
**Location:** Room 3  
**Session Chair:** Andy Plumber, NTS Lightning Technologies, USA

**Abstract** - Lightning and Electromagnetic Interference (EMI) are both a complex phenomenon. With the transfer of immense amounts of energy of short periods of time (microseconds), the “direct effects” of lightning can cause severe damage if not addressed. Fortunately, the effects of lightning on many common materials are well understood, and common protection strategies - terminals, diverters, expanded foils, proper bonding, and earthing can mitigate these physical damage effects.

The other and more complex consequence of lightning are the “indirect effects”. Due to the flow of current through structures that have been struck by lightning, transient currents and voltages are often conducted or induced into system cabling and components. These can cause system functional upsets, destroy system components, and produce other hazards that impact safety and operability of systems. In parallel, systems and components are also faced with tolerating EMI, which can be as harmful as the lightning transients. Protection design approaches of shielding, transient voltage suppression, filtering, and circuit architecture are presented.

Protecting against the effects of indirect effects of and other electromagnetic effects is a multi-stage process. The currents and voltages need to be quantified, protection needs to be designed, and then it needs to be verified that the system and components can tolerate these currents and voltages.

With the advent of modern numerical simulation techniques, these effects can accurately be quantified through simulation and analysis. This provides an opportunity to evaluate and understand multiple design iterations rapidly, explore various protection designs, and determine what the system and components need to tolerate. Once the environment is known, it simply becomes an exercise of evaluating the performance of the system in the presence of these transients.

This workshop will review the lightning environment, protection design, and methods. Examples will include wind turbines, aircraft, and commercial and industrial facilities.

Attendees are encouraged to bring real-life problems for consideration and resolution.

---

**Analysis of Interference and Design Considerations in Internet of Things Applications**

**Time:** Monday, 02/Sep/2019: 2:00pm - 6:00pm  
**Location:** Room 3  
**Session Chair:** Dr. Francisco Falcone, Universidad Pública de Navarra, Spain

**Abstract** - In this tutorial, we will provide an overview of the trends, limitations, and challenges in relation with communication system design, considering multiple systems and Heterogeneous Network operation, with special emphasis on interference conditions, characterization, and management. An overview of the wireless communication systems and related transceiver/devices will be given, as well as the specific characteristics of Quality of Service/Quality of Experience requirements. Different interference sources will be characterized to perform coverage/capacity estimations, as well as to analyze node density and node location variation impact in overall system performance. Interference estimation methods within the application scenarios will be described, based on analytical approximations, deterministic 3D ray launching, full-wave electromagnetic simulation, and hybrid simulation techniques. The challenges in terms of computational complexity will also be described. Co-location at device/sub-system level will be outlined, as well as the impact of multi-frequency operation in interference requirements, to provide an overview for the device as well as for system designers in relation with overall performance evaluation.

**Topics:**
- Introduction. Characteristics and Requirements of IoT communications
- Coverage/Capacity relations. Interference analysis and node location/density considerations
- Interference modelling and simulation
- Description of Use Cases within IoT application scenarios
## Near Field Probes: Useful tools for electronic engineers

**Time:** Monday, 02/Sep/2019: 2:00pm - 6:00pm  
**Location:** Room 5  

**Session Chair:** Dr. Arturo Mediano, Universidad de Zaragoza, Spain

**Abstract** - Main goal of the tutorial is to introduce knowledge on near field probes and to review the different techniques to use them in the RF/EMI/EMC practical design and troubleshooting work. The attendees will be able to know the basics of electric and magnetic near field probes, the principles of working with them including useful frequency range and shielded vs. non-shielded versions. Both homebrew and commercial near field probes are presented from the smaller models to test at the pin level to modern scanners to test complete boards. The attendees will understand how to use a near field probe with different instruments including oscilloscopes, spectrum analyzers (with and without tracking generator), Voltage Standing Wave (VSWR) Bridges, network analyzers and other special tools. Near field scanners are introduced. Once the combination of the probe and the instruments is understood they will be able to see how to apply those techniques to typical design and troubleshooting high-frequency systems from the component and material level, through the PCB design (including slots in ground planes), shielding and cable analysis and evaluation. They will be able to see some examples of probes, hardware demos and some real-world cases where the instructor found the probes useful.

## Understanding EMC / Radio / Automotive Standards  
Electromagnetic (EM)-Field-related Testing

**Time:** Monday, 02/Sep/2019: 2:00pm - 6:00pm  
**Location:** Room 4  

**Session Chair:**  Dr. Diethard E.A. Hansen, EURO EMC SERVICE, Switzerland

**Abstract** - Basic EMC/Radio/Wireless/Automotive lab testing background/knowledge. Focus on electromagnetic (EM) field related testing, mostly a less understood topic. Understanding physics/history/common principles in testing, incl. Mil-STD; calibration, instruments, sensors, antennas, and EM test sites (radiated emissions, immunity). Standard's limitations/agreed Tech-Compromises in CE product compliance testing is explained; formal procedures. Product risk assessment/EM test norms get now more transparent. CE Compliance (2016/17 enforced EU-EMC, RED directive), Quality of accredited ISO/EN 17025 (2017) test reports. Important topics: History, EMC Units including Decibels, Constants in physics, frequency spectrum (to GHz), simple EM -radiators, test antenna characteristics, near/far-field, spectrum and radiation efficiency of printed circuit boards, electronic components real-world properties, relevant EMC standards, EMF, legislation/ regulations, MRA, other EU Directives, Tech.-Doc., Notified Body vs. non/harmonized standards, typical EMC Tests for Pre/Compliance Testing. Based on existing knowledge, clients improve their basic understanding of EMC testing and formal CE procedures. We promote "help yourself" by understanding, rather than just blindly searching for 10 golden EMC design rules leading to successful product compliance.

## Protection of Civil Infrastructures against Intentional EMI

**Time:** Tuesday, 03/Sep/2019: 11:40am - 5:00pm  
**Location:** Room 5  

**Session Chair:** Dr. Martin Schaarschmidt, Bundeswehr Research Institute for Protective Technologies and CBRN Protection (WIS), Germany  
**Session Co-Chair:** Dr. Michael Suhrke, Fraunhofer Institute for Technological Trend Analysis (INT), Germany

**Abstract** - Intentional EMI is becoming more and more a threat to modern society because the availability of I-EMI is increasing, while modern electronic systems are becoming more vulnerable. Due to the widespread use of wireless systems this risk is increasingly important. Our civil infrastructures depend on the use of modern communication systems, and several research projects have been recently been carried out. In this tutorial we will give an overview of high-power and low-power I-EMI threats, the risks to civil infrastructures and preventive actions.

**Speakers:**
- Dr. Martin Schaarschmidt, Bundeswehr Research Institute for Protective Technologies and CBRN Protection (WIS), Germany
- Dr. Michael Suhrke, Fraunhofer Institute for Technological Trend Analysis (INT), Germany
- Dr. Robert Vogt-Ardatjew, University of Twente, Netherlands
- Dr. Frank Sabath, Bundeswehr Research Institute for Protective Technologies and CBRN Protection (WIS), Germany
- Dr. Isa Wegmann, Leibniz Universität Hannover
- Dr. Heyno Garbe, Leibniz Universität Hannover
MIL-STD461 Military EMC Tests and Challenges/Pitfalls

**Time:** Thursday, 05/Sep/2019: 2:00pm - 5:00pm

**Location:** Room 5

**Session Chair:** Osman Sen, TÜBİTAK UME, Turkish Metrology Institute, Turkey

**Session Co-Chair:** Soydan Cakir, TÜBİTAK UME, Turkish Metrology Institute, Turkey

**Abstract** – MIL STD-461 is a military standard that establishes interface and associated verification requirements for the control of the electromagnetic interference (EMI) emission and susceptibility characteristics of electronic, electrical, and electromechanical equipment and subsystems designed or procured for use by activities and agencies of the Department of Defense. Keeping EMI under control is critical for military applications. It can cause interference with other equipment and be detected by the enemy. The standard focuses on emissions generated by equipment as well as the susceptibility of equipment to degraded operation in the presence of external emissions. Tests procedures and limits are defined for EMI transferred via conducted and radiated means. The limits vary depending on the application (e.g. ground, air, ship, etc.) as well as the location of the equipment (e.g. above deck, below deck, flight-line, etc.). On the other hand, MIL-STD461 testing includes many challenges and pitfalls in the application and requires a good amount of experience and knowledge for correct testing.

This tutorial session intends to instructively present details of prominent military EMC tests and to inform the audience of potential challenges and pitfalls faced during military tests. This tutorial will also acquaint the audience with workable solutions to these challenges and insidious pitfalls of MIL-STD461.

**Agenda:**

- MIL-STD461G: Introduction and Differences from Previous Versions. Prof. Dr. Frank LEFERINK; University of Twente, The Netherlands
- Low Frequency Military Immunity Test: CS101 and Challenges & Pitfalls. Dr. Soydan ČAKIR; TÜBİTAK UME, Turkey
- Military Conducted Immunity Tests: CS114, CS115, CS116. Dr. Soydan ČAKIR; TÜBİTAK UME, Turkey

Ionizing Radiation and Electromagnetic Interference on Integrated Circuits: from the need of combined tests to current solutions

**Time:** Friday, 06/Sep/2019: 9:00am - 10:40am

**Location:** Room 5

**Session Chair:** Dr. Fabian Vargas, Catholic University - PUCRS, Brazil

**Abstract** – Technology scaling, which made electronics accessible and affordable for everyone on the globe, has advanced IC and electronics since the sixties. Nevertheless, it is well recognized that such scaling has introduced new (and major) reliability challenges to the semiconductor industry. This tutorial addresses the background mechanisms impacting the reliability of very deep submicron (VDSM) integrated circuits (ICs). In more detail, topics such as the basics about EMC and ionizing radiation, the mechanisms by which they affect ICs, the current standards and laboratory test setup for electromagnetic compatibility (EMC), total-ionizing dose (TID) and single-event effects (SEEs) on ICs are presented and their combined effects on the reliability of modern ICs are discussed. Moreover, reliability failure mechanisms for (ionizing and non-ionizing) radiation, the way they are modeled and how they are impacting IC
lifetime will be covered. Laboratory test setup and recent results from experimental measurements are described. Classic design solutions to counteract with TID, SEEs and EMI in VDSM ICs, as well as the recent achievements on the development of on-chip sensors to monitor EM conducted noise on IC power supply lines of ICs, are introduced. A YouTube video is presented to illustrate the effectiveness of such on-chip sensors. Finally, Spice simulations are used to demonstrate the combined effect of ionizing radiation with power supply noise on SRAM cells followed by the presentation of some measures to counteract with it.

Speakers:
- Dr. Fabian Vargas, Catholic University - PUCRS, Brazil
- Dr. Bernd Deutschmann, University of Technology, Austria
- Dr. Sonia Ben Dhia, Université de Toulouse, LAAS-CNRS, France

**Paper Preparation for the IEEE EMC Transactions**

**Time:** Friday, 06/Sep/2019: 9:00am - 10:40am  
**Location:** Room 2  
**Session Chair:** Dr. John Norgard, National Aeronautics and Space Administration – NASA, USA  
**Session Co-Chair:** Dr. Perry Wilson, National Institute of Standards and Technology – NIST, USA

**Abstract** – This tutorial is on the IEEE Transactions on Electromagnetic Compatibility (EMCT). Presentations on EMCT include

1. How to publish a paper in the EMCT.
2. How to prepare and write a good technical paper for the EMCT.

The presentation for part i), by Prof. Norgard, entitled “Publishing a Paper in the EMCT”, will cover the initial paper preparation process (topic & text), the submission process, the review cycle (Reviewers, Associate Editors, and the Editor-in-Chief), and final paper publication procedures for the IEEE Transactions on EMC. In addition, acceptance criteria are covered, along with style guides, online web support and help-aids, and proper paper organization.

The presentation for part ii), by Dr. Wilson, entitled “Writing a Good EMCT Paper: My Perspective” will cover aspects of writing a good paper for submission to the IEEE Transactions on EMC. Topics to be covered include goals, hints, and dos and don’ts for the abstract, index terms, main text, and conclusions of a paper. The material is very much from the personal perspective of the presenter based on his experience as both a reviewer and a former Editor-in-Chief of the Transactions.

This EMCT tutorial, which is sponsored by the IEEE EMC Society Board of Directors, is intended for anyone and everyone interested in publishing a paper in the EMCT, especially for the first time.

**Uncertainty about uncertainties along the EMC-compliance chain**

**Time:** Friday, 06/Sep/2019: 9:00am - 10:40am  
**Location:** Room 3  
**Session Chair:** Dr. Pierre Beeckman, Signify Netherlands B.V.

**Abstract** – Compliance with requirements for EMC is subject to many types and levels of uncertainty. In this tutorial, all categories of uncertainty that may be involved in compliance with EMC regulations and standards will be reviewed. The uncertainties that will be explained are due to measurement instrumentation and sites, product sampling but also because many standards allow alternative methods for the same requirement in a certain frequency region. Also, the significant level of intrinsic uncertainty resulting from limitations in standards specifications (e.g. the setup of units and routing and termination of cables) is addressed. Furthermore, the uncertainty (mismatch) between the compliance with a regulation or standard and the actual risk of interference will be discussed. Each category of uncertainty will be explained and supported by examples. The relevance and responsibilities of the distinct categories of uncertainty in different applications will be given.

**Learning objectives:**  
This tutorial will give better awareness on the many categories of uncertainties involved in standardized EMC testing, compliance demonstration with EMC regulations and the actual risk of interference in practice. Attendees will get a more balanced view of the uncertainty categories that really matter in practice.
EMI and power quality issues in Smart Cities and Transportation Systems

**Time:** Friday, 06/Sep/2019: 11:20am - 6:00pm  
**Location:** Room 5  

**Session Chair:** Dr. Flavia Grassi, Politecnico di Milano, Italy  
**Session Chair:** Dr. Petre-Marian Nicolae, University of Craiova, Romania

**Abstract:** The global vision of Smart and Sustainable Cities is restricted by the rapid increase of interference and interoperability problems, which occur through the interaction of electrical power with information technology and communications equipment. This tutorial aims at surveying technical challenges and recent findings in modelling, measurement, and mitigation of electromagnetic interference in modern power distribution networks in the Smart Grid context, including transportation systems. Related discussion includes the definition of proper emission limits in the related frequency range, adequate immunity of equipment to low-frequency disturbance, effective filter-design strategies, ad hoc measurement techniques and instrumentation, numerical modeling, and statistical techniques.

**Agenda:**
- Conducted EMI Research in Europe: Why, and How SCENT and ETOPIA projects. Dr. Frank Leferink, University of Twente, Enschede, The Netherlands  
- Interoperability of power electronic interfaces and advanced metering infrastructure - Selected EMC issues. Dr. Robert Smolenski, University of Zielona Góra, Poland  
- Multi-channel time-domain current and voltage measurements for EMI investigation Dr. Niek Moonen. University of Twente, Enschede, The Netherlands  
- Predicting conducted emissions in the presence of uncertainty, Dr. David Thomas, University of Nottingham, UK  
- EMI in a Smart Grid containing different power sources, Dr. Petre-Marian Nicolae, Ileana-Diana Nicolae, University of Craiova, Romania  
- EMC testing in automotive, Dr. Sebastian Koj, IAV GmbH, Germany  
- On the low frequency physical mechanism and modeling of cable common mode, current including skin effect, Dr. Umberto Paolletti, Hitachi, Ltd, Yokohama, Japan.  
- EM Interferences caused by power converting systems in automotive applications, Dr. Sven Fisahn, Leibniz Universität Hannover, Hannover, Germany

**EMC Diagnostics of Complex Systems**

**Time:** Tuesday, 03/Sep/2019: 2:00pm - 5:00pm  
**Location:** Room 4  

**Session Chair:** Dr. Vladimir Mordachev, Belarusian State University of Informatics and Radioelectronics, Belarus  
**Session Co-Chair:** Dr. Eugene Sinkevich, Belarusian State University of Informatics and Radioelectronics, Belarus

**Description**

EMC diagnostics is a detection of unintentional interference in complex systems containing an enormously large number of different spurious electromagnetic couplings and operating in a severe external electromagnetic environment. Such systems may be both on-board and ground-based.

Main features and main specificity of EMC analysis and design at this level are in the following:

- in high complexity and structural heterogeneity of the specified systems including radio equipment of various radio services, computers and equipment for information processing and display, the data communication networks, the developed subsystem of electric power supply, etc.;  
- in necessity of the simultaneous account of a considerable quantity of spurious electromagnetic couplings of various types, influences of interference on ports of all possible types (RF, signal, power supply, control, etc.);  
- in high complexity of external electromagnetic environment created by thousands of modulated pulse and continuous EM disturbances of extremely high dynamic a frequency range;  
- in joint presence and joint solving of EMC problems and problems of electromagnetic safety, electromagnetic ecology, and electromagnetic protection in some major cases.

These features cause the specific requirements to the mathematical models, algorithms, and EMC criteria used for EMC diagnostics.
Topics

- Behavioral modeling of complex onboard and/or ground-based systems, as well as their elements and EM environment, for EMC diagnostics.
- Worst-case behavioral models of spurious electromagnetic couplings. Such models provide a high computational efficiency of EMC diagnostics of complex systems.
- High-efficiency techniques of measurement and computer modeling for the extraction of EMC characteristics of the system elements. The extracted information is then used for the development of adequate behavioral models of the system elements.
- Computer diagnostics and analysis of intrasystem and intersystem EMC problems jointly with the problems of electromagnetic protection, electromagnetic safety of on-board and ground-based systems and objects.
- Computer diagnostics, analysis and low-power testing of EMC characteristics jointly with characteristics of electromagnetic protection of local on-board and ground-based systems and objects.
- Computer diagnostics and analysis EMC problems of wireless communications of modern and future generations jointly with the problems of electromagnetic ecology and electromagnetic safety for the population.

Electromagnetic Eavesdropping TEMPEST

**Time:** Wednesday, 04/Sep/2019: 9:00am - 10:40am  
**Location:** Room 3  
**Session Chair:** Dr. Ireneusz Kubiak, Military Communication Institute, Poland

**Description**

different kind of electronic devices are used to process information. There are laser printers, laptop, computers with screens, scanners and so on. In this case, each device becomes a source of valuable emissions in electromagnetic infiltration process. We wonder very often how we can protect our information against electromagnetic leakage. There are used electromagnetic gaskets, electromagnetic shielding, zoning, power and signal filters, soft TEMPEST solutions. These methods limit levels of electromagnetic emissions or eliminate sources of these emissions. Whereas other people are searching new methods of noninvasive acquisition of classified information using unintentional emissions which are correlated with processed information.

**Topics**

Some of the topics within the scope of this special session are:

- Electromagnetic safety of video graphic standards and laser printers;
- Optical TEMPEST;
- Soft TEMPEST (e.g. special computer fonts);
- Protection of information against electromagnetic penetration;
- Noninvasive acquisition of information;
- Methods of measurement of sensitive emissions (conducted and radiated);
- Other topics can be considered. Please, contact the chairman for further information.

Electromagnetic Environmental Effects on Aircrafts

**Time:** Wednesday, 04/Sep/2019: 2:00pm - 3:20pm+  
**Location:** Room 1  
**Session Chair:** Manuel Añón Cancela, Instituto de Técnica Aeroespacial (INTA), Spain

**Description**

The impact of the electromagnetic environment upon the operational capability of aeronautic equipment, systems and platforms are known as electromagnetic environmental effects (E3) and their influence is becoming bigger in modern air platforms due to the increase of fly-by-wire systems in substitution of traditional mechanical options. Moreover, in the search of cost-effective approaches, notable parts of current aircraft are also being gradually made of non-metallic materials, such as composites (such as carbon fiber composite, aramid fibers, fiberglass, etc.) and this is also posing additional challenges to the manufacturers in terms of E3 compliance.

So, either coming from natural or artificial sources, electromagnetic interference on aircraft must be dealt with and manufacturers need to demonstrate compliance with E3 regulations, particularly in terms of certain threats, such as,
for instance, lightning indirect effects (LIE), precipitation static (P-static), electromagnetic discharge (ESD) or high intensity radiated fields (HIRF). To assess the impact of these effects both electromagnetic modeling and experimental testing are employed along different stages of the lifecycle of an aircraft, from the conception to the end of operation.

This special session aims at discussing these challenges and is intended for researchers able to present work on the state of the art of the different aspect of E3 issues on aircraft along their different stages: concept, mission definition, project development, system integration, airworthiness certification, in-service maintenance activities, fleet upgrades, etc.

**Topics**

- E3 tools for the aircraft design/development stages
- E3 modeling improvements at aircraft level
- E3 test methods at aircraft level
- The route to E3 airworthiness certification
- In service E3 issues

---

**Magnetometric Instruments and New Methodologies of Calibration and Testing**

**Time:** Wednesday, 04/Sep/2019: 4:00pm - 5:00pm  
**Location:** Room 1  
**Session Chair:** Dr. Marina Díaz Michelena, Instituto de Técnica Aeroespacial (INTA), Spain  
**Description**

Magnetometry is a powerful tool for the characterization of the Cosmos. In this regard, new planetary and space mission challenges impose serious magnetic cleanliness requirements to equipment, systems, and platforms. To meet such stringent requirements, novel or improved testing methods should be developed. Moreover, it is also necessary to develop magnetic models of equipment to characterize their magnetic behavior and to control the magnetic signature of the spacecraft.

Furthermore, a new generation of magnetic measuring instruments is now rising. They have high performances which require state-of-the-art calibration methods and test procedures. On the one hand, the abovementioned calibrations techniques require exhaustive characterization of the harsh and changing magnetic environment. On the other hand, they require controlling the unavoidable magnetic contamination.

The aim of this special session is to disseminate the current challenges and the different solutions in the field. In that sense, papers dealing with the topics below are very welcomed.

**Topics**

- Magnetic instrumentation
- Magnetic cleanliness
- Calibration techniques
- EMC testing for magnetometers

---

**EMC in Physics Experiments and Particle Accelerators**

**Time:** Thursday, 05/Sep/2019: 9:00am - 10:40am  
**Location:** Room 3  
**Session Chair:** Dr. Fernando Arteche, Instituto Tecnológico de Aragón (ITAINNOVA), Spain  
**Description**

The control of EMI phenomena in physics experiments and particle accelerators is a complex task due to the nature and rate of events (millions per second or one per year), the environment (very high currents/voltages, high magnetic field, high ionization radiation) and the low signal levels (picoamperes or nanoamperes). In order to ensure good performance of particle accelerators and physics experiments, techniques and studies are necessary covering areas outside the scope of EMC standards. For that purpose, EMC simulations, EMI characterization or EMC plans need to be developed beyond the actual state of the art. The session covers a large area of physics experiments and particle accelerators such as:

- Circular accelerators like Hadron Colliders, Synchrotrons, and associated experiments.
• Linear accelerators, light sources, and associated experiments.
• Laser pulsed facilities and associated experiments.
• Astrophysics experiments and facilities.

Cases of study are welcomed. In this regard, papers explaining how certain EMC/EMI problems were successfully handled in physics experiments and particle accelerators are appropriate. Likewise, papers highlighting the theoretical implications of the techniques used to control EMI in the experiments above and the empirical knowledge gained throughout the corresponding troubleshooting process are also suitable.

**Topics**

• EM characterization of high energy and astrophysics environments and experiments.
• EM control of pulsed laser, light sources, and synchrotron facilities as well as its associate experiments
• EMI control of radio frequency cavities and associated equipment in particle accelerators
• EMI control of high-power converters and amplifiers for magnets
• Susceptibility characterization of silicon detectors (pixel and strips), electromagnetic calorimeters and muon chambers
• Coordination between EMC requirements and electrical safety issues in physics experiments and particle accelerators.
• Innovative solutions for EMC based front-end electronics and low-level radio frequency designs.
• Simulation of complex cable bundles (LV, HV, signal and control)
• Simulation models of transient phenomena such as electromagnetic pulse (EMP) at laser pulsed facilities or quench associate to superconducting magnets
• Simulation models of coupling phenomena in physics experiments.

---

**Numerical Simulation Techniques for EMC Problems**

*Time:* Thursday, 05/Sep/2019: 9:00am - 3:20pm  
*Location:* Room 4

**Session Chair:** Dr. Luis Manuel Díaz Angulo, Universidad de Granada, Spain  
**Session Co-Chair:** Dr. Salvador Gonzalez Garcia, Universidad de Granada, Spain

**Description**

This special session will focus on especially complex simulation cases or new numerical techniques which may be useful in the context of EMC. Some examples of simulation scenarios are HIRF, indirect effects of lightning, cross-talking, PCB modeling. Progresses in new numerical techniques will also be very welcome: reduced models, acceleration techniques for electrically small problems, statistical computational electromagnetics, sub-cell models, etc.

**Topics**

• Numerical techniques applied to EMC problems.
• Computational Electromagnetics in time and frequency domains.
• Reduced complexity problems: reduced order models, sub-cell models.
• Numerical simulations applied to high intensity radiated fields (HIRF), lightning indirect effects (LIE).
• Statistical computational electromagnetics.
At the conference system website, you can find more information about the preliminary technical program:

https://www.conftool.org/emceurope2019/sessions.php
REGISTER NOW!

See you soon BARCELONA!