IEEE | EMC SOCIETY

FINAL PROGRAM

EMC+SIPI 2025

RALEIGH, NC • AUGUST 18-22

KEYNOTE SPEAKER
Christian Schuster
Hamburg University of Technology
Germany (IEEE Fellow)

EXHIBIT HALL

TECHNICAL PROGRAM DETAILS

www.emc2025.org

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EMC+SIPI 2025

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1. DOWNLOAD EVENTSCRIBE APP:

Scan the QR Code or go to the Apple App Store or Google Play and search for **eventScribe.**

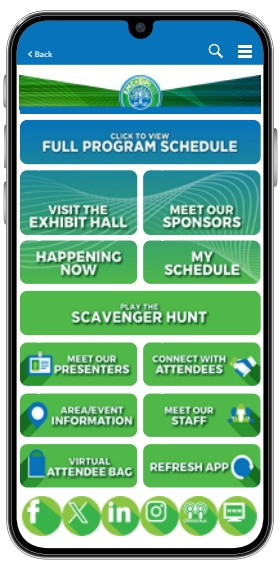
Install and **open** the eventScribe app. Find your event icon in the Upcoming Events (bottom row) or **search** for **EMC+SIPI 2025.**
Tap the event icon to launch your event's app.

2. LOGIN TO THE APP:

Tap **Create Account** and enter the event code emailed to the attendees. The event code will also be on signs at the Symposium.

3. APP TIPS:

Download the app before you go! Wi-Fi connection onsite can affect the functionality of the app. **Browse** the event information and create a personal schedule by tapping on the star next to presentation titles.



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WELCOME FROM BRUCE ARMCHAMBEAULT
THE 2025 EMC+SIPI GENERAL CHAIR

Friends and Colleagues,

Are y'all ready for something a little different? I would like to welcome you to the 2025 IEEE International Symposium on Electromagnetic Compatibility, Signal & Power Integrity in Raleigh, North Carolina. I would also like to extend a welcome to the Eastern NC Section of the IEEE and to our local Electromagnetic Compatibility Society Chapter. It has been 11 years since the 2014 EMC+SIPI Symposium! Time to have another great symposium

For 2025 we have many exciting events planned! The embedded Signal and Power Integrity Conference continues to bring in a record number of technical papers in this very timely subject area. Of course, there will be numerous technical papers on traditional EMC and new technologies, such as wireless power transfer, AI, biological EMC, nanotechnology, information security and others. In addition to the outstanding technical papers, we'll have the high quality workshops/tutorials and special sessions that you have come to expect over the years!

The Symposium Organizing Committee has planned and designed the 2025 EMC Symposium with the goal of ensuring the most enriching technical and professional networking opportunities possible through multiple vendor exhibits, technical programs, companion programs, and social events. We have prepared three days of top-rated, peer-reviewed technical papers presented by experts in multi-track sessions and two days of practical workshops and tutorials, experiments and demonstrations presented by industry professionals. Also included are collateral industry standards meetings and a full exhibit hall to learn about the latest offerings in EMC products and services. Make sure to visit the booths of our new exhibitors.

Please plan to join us for this world class symposium for EMC 2025 in Raleigh to enjoy the networking, education, special events, and hospitality of North Carolina at its finest!

Hope to see you there!
Bruce Archambeault
General Chair, 2025 IEEE International Symposium on Electromagnetic Compatibility, Signal & Power Integrity (EMC+SIPI)

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The R-Line Circulator bus is a free bus with stops around the downtown area. One stop is right at the Raleigh Convention Center!

FOR INFORMATION ON THE STOPS AND OPERATING TIMES CLICK HERE.

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GoRaleigh Station has served as Raleigh's downtown transit hub since 1988.

CLICK HERE FOR MORE INFORMATION

TRANSPORTATION TO & FROM RALEIGH-DURHAM AIRPORT

If you are flying into Raleigh-Durham International Airport and seeking transportation to RDU, then the Raleigh-Durham airport can offer you many ground transportation options. Providers pick up passengers outside bag claim at Terminal 1 and at Terminal 2, on the lower level.

CLICK HERE FOR MORE INFORMATION

TRAVEL INFORMATION

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Raleigh-Durham Airport
http://rdu.com

AIRPORT TRANSPORTATION
For transportation options to and from the Raleigh-Durham International Airport visit:
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DOWNTOWN RALEIGH MAP

ATTRACTIONS

1 Raleigh Convention Center
2 Sheraton Raleigh Hotel
3 Raleigh Marriott City Center
4 Red Hat Amphitheater
5 Kennedy Theatre
6 Martin Marietta Center for the Performing Arts
7 Lincoln Theatre
8 Artspace
9 Moore Square
10 Marbles Kids Museum
11 City of Raleigh Museum
12 Nash Square
13 State Capitol
14 NC Museum of Natural Sciences
15 NC Freedom Park
16 NC Executive Mansion
17 CAM - Contemporary Art Museum

RESTAURANTS & BARS

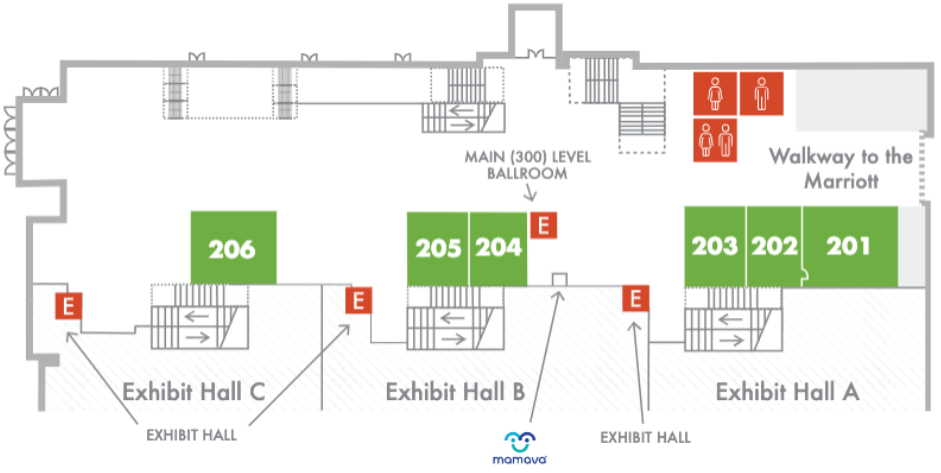
A Midwood Smokehouse
B Madre Restaurant
C Mulino Italian Kitchen & Bar
D The Daily Planet Cafe
E Second Empire Restaurant & Tavern
F Flying Saucer Draught Emporium
G Oak Steakhouse
H Parkside Restaurant
I Whiskey Kitchen
J Death and Taxes Fine Dining
K Subway
L The Raleigh Times
M Brewery Bhavana - Downtown
N Flavor Hills
O Chido Taco Mercado Style Tanqueria

RALEIGH CONVENTION CENTER

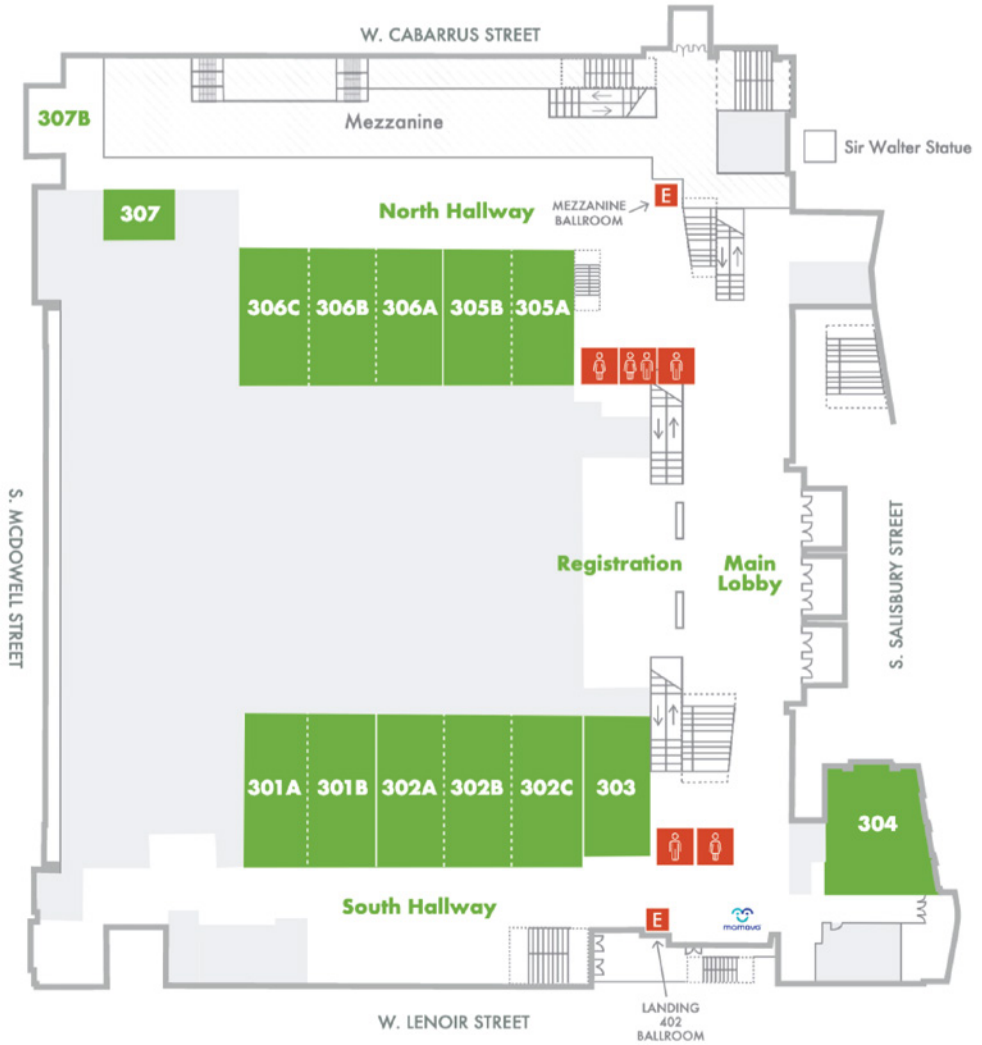
ROOMS MAPS

BALLROOM 400 LEVEL

MEZZANINE 200 LEVEL

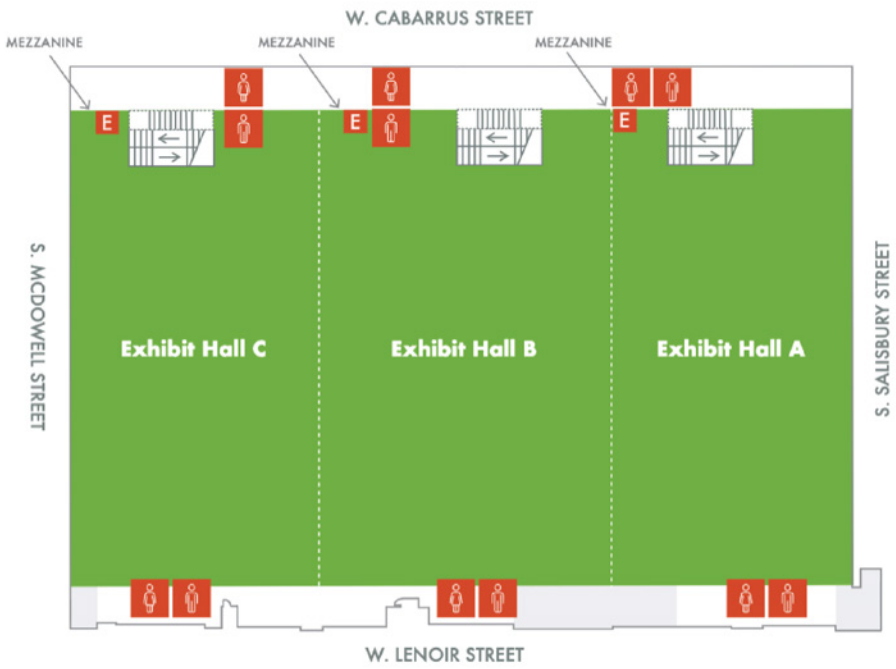


ROOM MAPS



MAIN 300 LEVEL

EXHIBIT HALL 100 LEVEL



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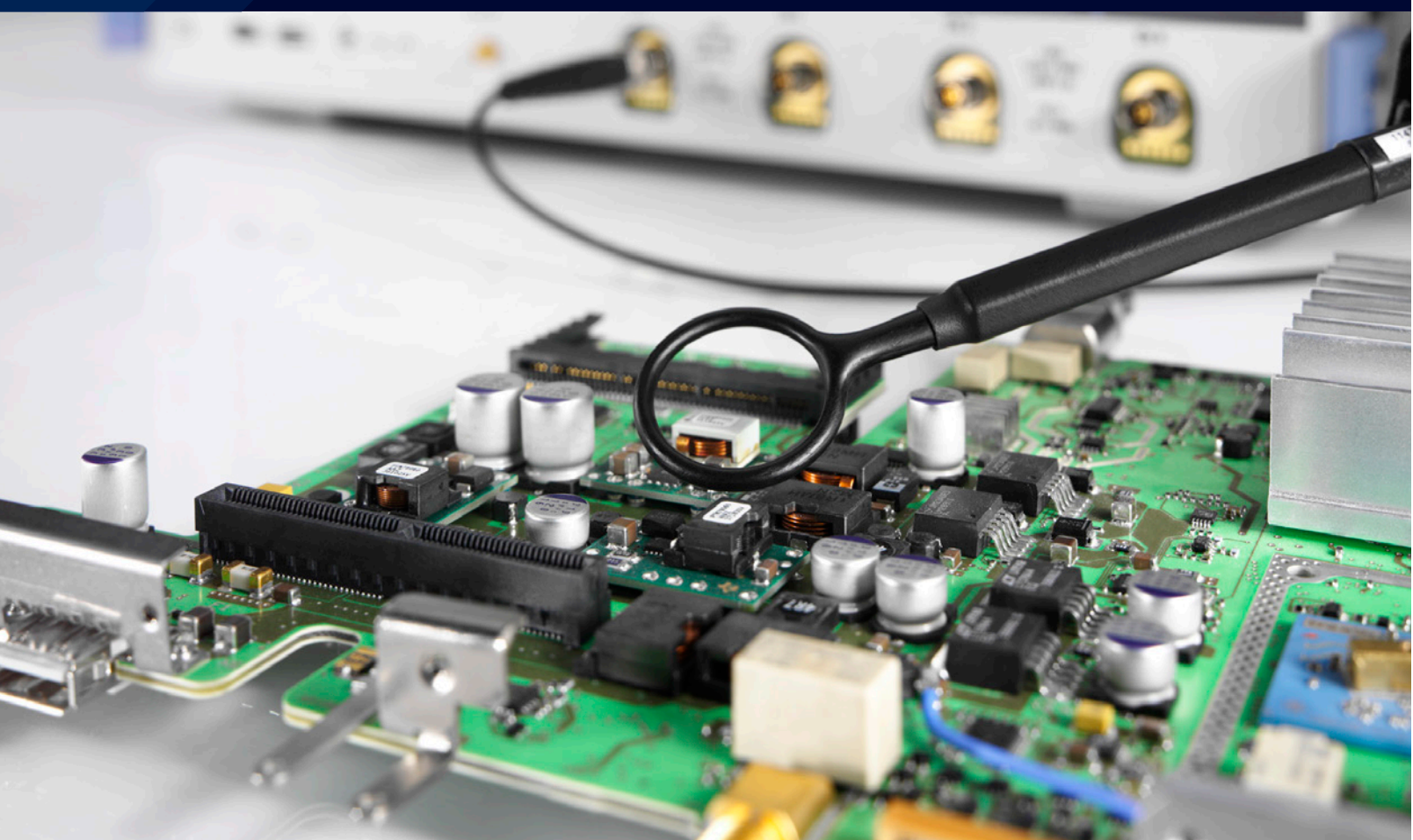
- ▶ Troubleshoot a power integrity issue



SCHEDULE AT A GLANCE

RALEIGH, NC
EMC+SIPI 2025

	MONDAY, AUGUST 18	TUESDAY, AUGUST 19	WEDNESDAY, AUGUST 20	THURSDAY, AUGUST 21	FRIDAY, AUGUST 22
7:00 AM	*Speaker Breakfast			Team EMC Bike Ride (6:45 AM) *Speaker Breakfast (7:00 AM)	*Speaker Breakfast
8:30 AM 9:00 AM	Workshops & Tutorials	Keynote	Technical Paper Sessions	Technical Paper Sessions	Workshops & Tutorials
10:00 AM	Break	Break	Break	Break	Break
11:00 AM	Workshops & Tutorials	Poster Session, Technical Paper Sessions	Technical Paper Sessions	Technical Paper Sessions	Workshops & Tutorials
12:00 PM 1:00 PM	Break Chapter Chair Training Session	Break	Past President's Luncheon Break	Awards Luncheon Break	Break
2:00 PM	Workshops & Tutorials	Technical Paper Sessions	Workshops & Tutorials	Technical Paper Sessions	Workshops & Tutorials
3:00 PM	Break	Break	Break	Break	Break
4:00 PM 5:00 PM	Workshops & Tutorials	Technical Paper Sessions Welcome Reception	Workshops & Tutorials Women in Engineering	Technical Paper Sessions	Workshops & Tutorials
6:00 PM 7:00 PM 8:00 PM 9:00 PM 10:00 PM	"Speed Networking" with EMC+SIPI Experts	"After the Welcome Reception" YP Event	Evening Gala		

Exhibit Hall Open: 9:30 AM - 6:30 PM

Exhibit Hall Open: 10:00 AM - 5:00 PM

Exhibit Hall

EXHIBIT HALL SCHEDULE:

TUESDAY, AUGUST 19
Exhibits Open: 9:30 AM – 6:30 PM
Welcome Reception: 5:00 PM – 6:30 PM

WEDNESDAY, AUGUST 20
Exhibits Open: 10:00 AM – 5:00 PM

THURSDAY, AUGUST 21
Exhibits Open: 10:00 AM – 12:00 PM

CLAYTON R. PAUL GLOBAL UNIVERSITY

(Pre-Registration Required)
Tuesday: 1:00PM - 5:00PM
Wednesday: 8:00AM - 5:30PM
Thursday: 8:00AM - 12:00PM

GLOBAL SIGNAL INTEGRITY AND POWER INTEGRITY (SIPI) UNIVERSITY

(Pre-Registration Required)
Tuesday: 1:00PM - 5:00PM
Wednesday: 8:30AM - 5:00PM
Thursday: 8:30AM - 12:00PM

EXHIBIT HALL ACTIVITIES

Ask the Experts Panel Discussions
Tuesday, August 19, 2025
10:00 AM - 11:30 AM, 2:00 PM - 3:30 PM
Thursday, August 21, 2025
10:00 AM - 11:30 AM

Poster Session
Tuesday, August 19, 2025
10:00 AM - 12:00 PM

Best Student Paper Poster Session
Tuesday, August 19, 2025
2:30 PM - 3:30 PM

Experiments and Demonstrations
Tuesday, August 19, 2025
9:30 AM – 11:30 AM
2:30 PM – 4:30 PM
Wednesday, August 20, 2025
9:30 AM – 11:30 AM
2:30 PM – 4:30 PM
Thursday, August 21, 2025
9:30 AM - 11:30 AM

YOUTH TECHNICAL PROGRAM

Wednesday, August 20, 2025
1:00 PM - 3:30 PM • ROOM 301B

***Speaker Breakfast is Only on the Day of the Presentation**

GENERAL INFORMATION

BRINGING COMPATIBILITY TO ENGINEERING INNOVATIONS SINCE 1957

The IEEE EMC Society has been at the pivot point of engineering technology for over a half-century. With a long history of developments in Electromagnetic Compatibility and Electromagnetic Environmental Effects, the Society brings sharp focus to methods and practices for proper performance of energy, electrical, communications, information technology and wireless systems. The Society promotes information sharing through regional chapters and international symposia. Collaboration across the research, design, test, regulatory and media industries has helped shape the world as we know it.

LEADING EDGE INFO

- EMC Measurements
- Signal & Power Integrity
- EMI Control
- EMC Management
- Low Frequency EMC
- Computational Electromagnetics
- High Power Electromagnetics
- Electromagnetic Environments
- Smart Grid EMC
- Regulatory Requirements for EMC, ESD, EMI, and SIPI

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WELCOME FROM SAM CONNOR

THE 2025 TECHNICAL PROGRAM COMMITTEE CHAIR

On behalf of the Technical Program Committee, welcome to the 2025 IEEE International Symposium on Electromagnetic Compatibility, Signal & Power Integrity (EMC+SIPI). I am excited to welcome the Symposium back to Raleigh, North Carolina, where we hosted a great conference back in 2014. I hope to meet you during this exciting week full of discussions, in which we will share insights, ask questions, learn from the experts and innovators, and evaluate new products.

I encourage you to attend the special sessions and traditional paper sessions - there is a lot to learn in the late-breaking developments of our colleagues. Attend and be challenged! We will have a poster session in the exhibit hall on Tuesday morning after the Keynote Speaker, so you can enjoy that one-on-one discussion format and visit our exhibitors before heading up to the classrooms for topically organized paper sessions.

If you are seeking in-depth discussions on a specific topic, consider participating in either a workshop or a tutorial. Tutorials are delivered lecture-style, with speakers presenting comprehensive information and guidance to the audience. In comparison, workshops offer a more interactive experience, fostering discussions and active engagement among participants. We have almost thirty sessions this year which will run all-day on Monday and Friday plus Wednesday afternoon, and they cover a broad range of important topics.

The popular experiments and demonstrations program offers hands-on learning opportunities to complement the technical presentations. These presentations often vividly demonstrate what makes the EMC/SIPI area so fascinating and provoke new ideas or ways of looking at a problem. Engage with the presenters and then reproduce the experiments for your colleagues when you get back home.

The "Ask the Expert" panel sessions add another dimension to the Symposium because you can hear experts share their points of view on best practices, challenges, and future directions in their industries. Attendees are encouraged to ask questions and steer the conversation into interesting areas. This year, we are excited to offer three panels focused on Automotive EMC, Design of Ultra-High-Speed SERDES Links, and EMC Lab Operations.

For attendees seeking a foundational education track in either EMC or SIPI that will help with your skill development and career advancement, we have two, two-day Global University programs this year. First is the Clayton R. Paul Global EMC University (CRPGU) which covers fundamental topics presented by expert instructors from universities and industries from around the globe. Second is the Global SIPI University which is expanded this year and will include more topics plus hands-on measurement demonstrations to reinforce key concepts.

I am confident that the breadth and depth of this year's technical program will provide a valuable experience for you regardless of where you are in your career and whether you are in academia or industry. It will also be a chance to build your professional network, to catch up with old friends, and to make new ones. See you in Raleigh!

Sincerely,
Sam Connor
IBM, EMC+SIPI 2025 Technical Program Chair

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KEYNOTE PRESENTATION

TUESDAY, AUGUST 19, 2025 • 8:30–9:30 AM • BALLROOM C

THE CONVERGENCE OF EMC AND SIGNAL/POWER INTEGRITY ENGINEERING

EMC engineering – the control of unwanted electromagnetic emissions and interference – and signal/power integrity (SIPI) engineering – the design of interconnects and packages that provide adequate signal transmission and power supply of electronic systems – seem to have a lot in common … or not, depending on how you look at it!

EMC engineering – seen from an exclusive SIPI perspective – is dealing with mostly regulatory compliance related, "low-frequency" problems such as ground loops and radiation from cables. Modeling and simulation are often difficult, test and measurement are paramount. In the end, "copper tape and ferrites" solve all problems.

SIPI engineering – seen from an exclusive EMC perspective – is dealing with mostly system performance related, "well-known" problems such as transmission line crosstalk and galvanic coupling. Modeling and simulation are paramount, test and measurement are often difficult. In the end, "equalization and integration" solve all problems.

Now, obviously, that's not how it really is!

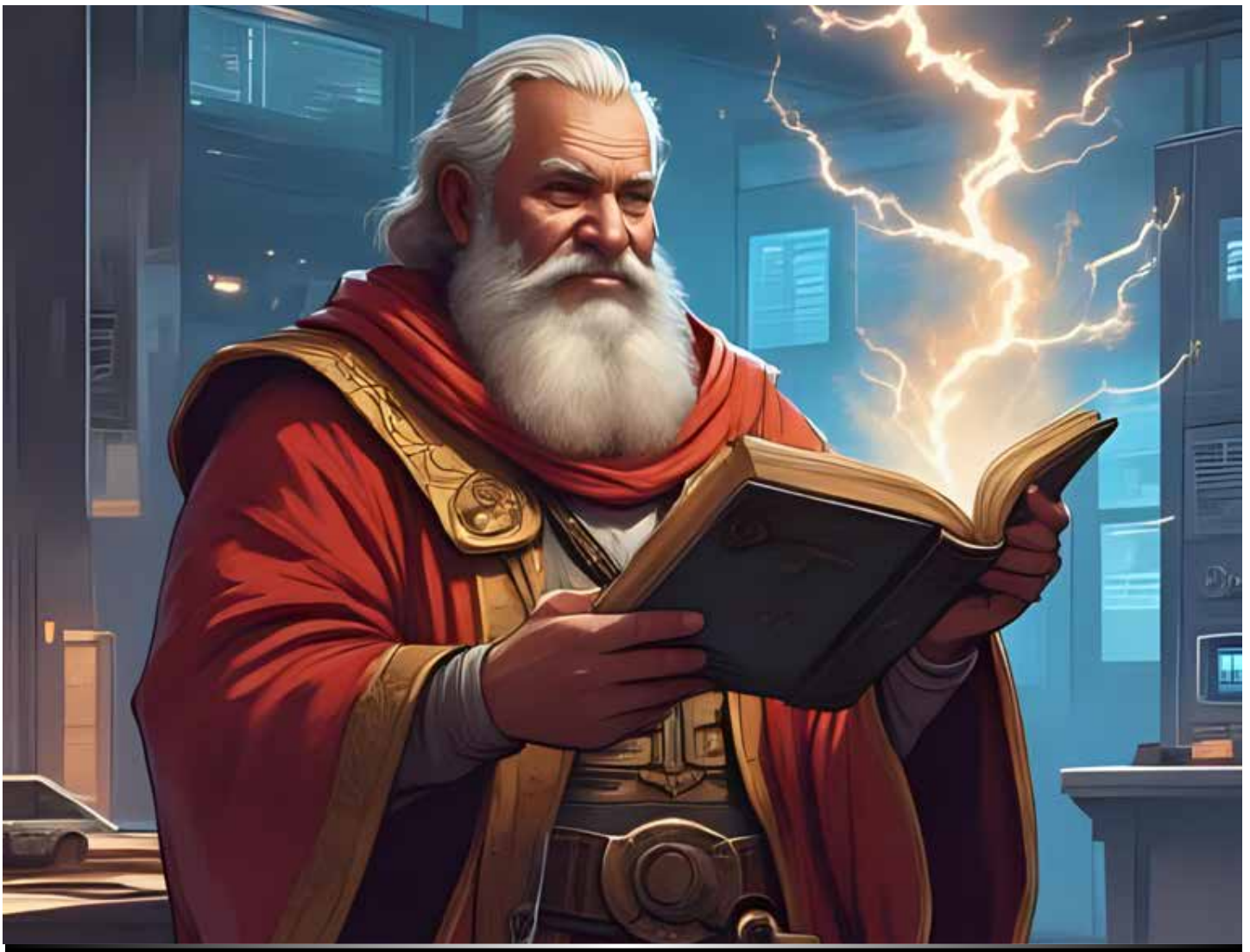
Drawing from personal experience and the experience of other professionals well known in industry and academia, I will try to show that EMC and SIPI engineering are two sides of the same problem (control of currents, if you will) and that both sides can benefit from each other by being aware of the concepts, methods, and solutions that exist in their respective domains. I will also try to make the point that due to ever increasing data rates and power levels of digital systems EMC and SIPI engineering are on a path of "convergence" – if we want it or not.

PRESENTED BY:

Christian Schuster
Hamburg University of Technology, Germany (IEEE Fellow)

Christian Schuster received a Diploma degree in physics in 1996 and a Ph. D. degree in electrical engineering in 2000. Since 2006 he is a full professor at Hamburg University of Technology (TUHH), Germany. Prior to TUHH he was with the IBM T. J. Watson Research Center, Yorktown Heights, NY. His interests include signal and power integrity of digital systems, multiport measurement and calibration techniques, and development of physics-based as well as data-based modeling, simulation and optimization methods for EMC+SIPI. In the recent past, he has served as an Associate Editor for the IEEE Transactions on EMC, as an Adjunct Associate Professor at the School of Electrical and Computer Engineering of the Georgia Institute of Technology, and as the President of the NIT Northern School of Technology Management at TUHH.

UNLOCK THE ARCANE ARTS OF EMC+SIPI



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SCHEDULE AT A GLANCE

ROOM	302C	303	305A	305B	306A	306B	306C
8:30 AM	WORKSHOP WT_A1 ADVANCED MATERIALS FOR AEROSPACE EMC AND OTHER EMI/EMC APPLICATIONS	WORKSHOP WT_A2 MILITARY EMC	TUTORIAL WT_A3 INTRODUCTION TO MODELING TECHNIQUES FOR EMC+SIPI PROBLEMS	WORKSHOP WT_A4 WHEN OPEN SOURCE MEETS SIPI/EMC	TUTORIAL WT_A5 HENRY W. OTT FUNDAMENTALS OF EMC	TUTORIAL WT_A6 EMC IN POWER ELECTRONICS: PRINCIPLES OF EMI GENERATION AND MITIGATION FOR ELECTRICAL SYSTEMS AND ELECTRICAL TRANSPORT	WORKSHOP WT_A7 EMC REGULATIONS AND STANDARDS – PAST, PRESENT AND FUTURE
10:00 AM	REFRESHMENT BREAK						
10:30 AM		S					S
12:00 PM	LUNCH BREAK						
1:30 PM	WORKSHOP WT_B1 NEW EMC MEASUREMENT METHODS FROM 18-40 GHZ		TUTORIAL WT_B3 BASIC EMC MEASUREMENTS				
3:00 PM	REFRESHMENT BREAK						
3:30 PM	S						
5:00 PM							

ADDITIONAL STANDARDS SESSIONS, WORKING GROUPS AND TECHNICAL COMMITTEES
For Collateral Meetings, please see page 134

REGISTRATION/INFO DESK
7:00 AM - 5:00 PM

SPEAKERS BREAKFAST
Raleigh Convention Center, 301AB - 7:00 - 8:30 AM
(Breakfast Only on the Day of Presentation)

CHAPTER CHAIR TRAINING AND LUNCHEON
302A - 12:00 - 1:30 PM

"SPEED NETWORKING" WITH EMC+SIPI EXPERTS
Raleigh Marriott City Centre (Rye Bar and Southern Kitchen), 6:00 - 10:00 PM
(Pre-Registration Required)

S **STANDARDS WEEK**
For more information about Standards Week, please visit page 132

WT_A1 WORKSHOP

ADVANCED MATERIALS FOR AEROSPACE EMC AND OTHER EMI/EMC APPLICATIONS

8:30AM - 12:00PM

Room: 302C

Sponsored by TC-11 Nanotechnology and Advanced Materials

Chair:
Marina Koledintseva, *The Boeing Company, Saint Louis, MO*

In this workshop, presentations will focus on physics, technology, characterization, and EMC applications of new advanced materials, including nano-materials, metamaterials, and various composites. Such materials are used, in particular, for design of EMI shielding and filtering structures and various electromagnetic wave absorbers.

PLANNED SPEAKERS & TOPICS

Silicones for Highly Demanding Applications in Aerospace, Aviation and Defense
Julia Sunderland
The Dow Chemical Company, USA

Graphene-Based Nanomaterials and Coatings for EMC Applications
Alessandro Giuseppe D'Aloia[1], Fabrizio Marra[2]
[1]DIAEE - Sapienza University of Rome, Italy; [2]Universita degli Studi di Roma La Sapienza, Italy

Advanced Electromagnetic Wave-absorbing Materials for Aerospace Application
Dandan Zhang
University of Michigan, USA

Characterization of Radar Absorber Materials and Coatings
Marina Y. Koledintseva
The Boeing Company, Saint Louis, MO, USA

Passive Intermodulation in the Contacts of Good Conductors at MHz and GHz Frequencies
Alexander Schuchinsky
University of Liverpool, United Kingdom

Vanadium and Other Redox Flow Batteries for Sophisticated Energy Storage for Aerospace Applications
Clifford M. Krowne [1,2]
[1]NRL, United States; [2]Ashlawn Energy LLC, United States

Photo by Karthik Vepuri

WT_A2 WORKSHOP

MILITARY EMC

8:30AM - 5:00PM

Room: 303

Sponsored by TC-3 Electromagnetic Environment & TC-6 Spectrum Engineering

STANDARDS WEEK

Co-Chairs:

Robert Davis, *Lockheed Martin, Retired*
Carl Hager, *NSWC Dahlgren*

Achieving electromagnetic compatibility with military equipment, systems, and platforms requires significant expertise and effort. EMC must be considered at all lifecycle stages and involves first characterizing the operational electromagnetic environment (EME), then design/testing military systems at various stages of production, assembly and integration and coordination of Spectrum in operational environments. This tutorial will cover a broad range of Military EMC topics.

PLANNED SPEAKERS & TOPICS

MIL-STD-461 Updates & Status
Finbarr O'Connor
Huntington Ingalls Industries Inc, USA

NATO Allied Environmental Conditions and Tests Publication (AECTP) 500 -Land Platform and System Test and Verification Procedure
AJM van Bladel
Dutch Ministry of Defense, Netherlands

E3 Aspects of MIL-HDBK-1763: Aircraft/Stores Compatibility
Joshua Ashley
United States Air Force, USA

HF Radio Noise Characterization Using an Active Short Vertical Monopole Antenna
Robert J. Achatz, Adam Hicks, Ryan S. McCullogh
NTIA Institute for Telecommunications Sciences, USA

The State of Clutter Modeling within the International Telecommunication Union (ITU)
William Kozma
NTIA Institute for Telecommunications Sciences, USA

Radar Spectrum Engineering Criteria (RSEC) and its Application to Federal Radar Regulations
Brian Nelson
NTIA Office of Spectrum Management, USA

Recent Results from a High Frequency Spectrum Survey Conducted In and Around McMurdo Station, Antarctica
Adam C. Hicks
NTIA Institute for Telecommunications Sciences, USA

Advanced Interference Analysis Measurements of Real-World Spectrum Sharing Environments
Todd Schumann
NTIA Institute for Telecommunications Sciences, USA

Overview of Regulatory Considerations with Respect to Receiver Immunity
Bruce D. Jacobs
NTIA Office of Spectrum Management, USA

Adjacent Band EMC and Coexistence Between 5G Base Station Transmitters And Radar Receivers
Brian Nelson
NTIA Office of Spectrum Management, USA

Near-Field Coupling Effects and Impact for HERO and External RF EME Testing
Mark Waller
U.S. Army Redstone Test Center, USA

EMC Testing Complexity and Potential Risks to Military Personnel and Operations Caused by the Integration of Systems Onto the Soldier Platform
Alejandro Rodriguez
US Army Test & Evaluation Command, USA

WT_A3 TUTORIAL

INTRODUCTION TO MODELING TECHNIQUES FOR EMC+SIPI PROBLEMS

8:30AM - 12:00PM

Room: 305A

Sponsored by TC-9 Computational Electromagnetics

Chair:
Giulio Antonini, *Universita degli Studi dell'Aquila, L'Aquila, Italy*

This tutorial will introduce commonly used numerical modeling techniques for EMC+SIPI problems without the need for detailed math. Practicing modelers will also benefit from learning the fundamentals of modeling techniques they are currently not using. Each technique will be presented with strengths and weaknesses so engineers can decide which techniques are appropriate for their problems.

PLANNED SPEAKERS & TOPICS

Introduction to the Finite Element Method
Chuck Bunting
Oklahoma State University, USA

Modeling with the Method of Moments
Lijun Jiang
Missouri University of Science and Technology, USA

Introduction to FDTD
Bruce Archambeault
Missouri University of Science and Technology, USA

Introduction to the Partial Element Equivalent Circuit (PEEC) Approach Applied to EMC+SI/PI Problems
Giulio Antonini[1], Daniele Romano[1], Jonas Ekman[2], Albert E. Ruehli[3]
[1]University of L'Aquila, Italy; [2]Luleå University of Technology, Sweden; [3]Missouri University of Science and Technology

RALEIGH FUN FACT

Raleigh, North Carolina is a city rich in American history and is the start to many traditions or "firsts." Raleigh is home to the first historically black university in the South (Shaw University-1865), the first public park in North Carolina named Pullen Park (1887), the first state-supported symphony in the USA (The North Carolina Symphony- 1932), the first Krispy Kreme in Winston-Salem located a few hours away (1937), the first state art museum in the U.S. (North Carolina Museum of Art- 1947), the first shopping center between Washington D.C and Atlanta (Village District- 1947), and the first and only major league pro sports franchise (Carolina Hurricanes- 1997). Don't forget about First Night Raleigh (1990), the city's New Years Eve party featuring the "Acorn Drop" to honor the city nickname, "City of Oaks."

WT_A4 WORKSHOP

WHEN OPEN SOURCE MEETS SIPI/EMC

8:30AM - 5:00PM

Room: 305B

Sponsored by TC-9 Computational Electromagnetics

Chair:
Yansheng Wang, *Rivos Inc., Santa Clara, CA, USA*

Co-Chair:
Giorgi Maghlakelidze, *NVIDIA Corp, Santa Clara, CA, USA*

Open source is gaining increasing attention these days, with well-known projects like Linux and RISC-V leading the way. But how can the SIPI/EMC community contribute to and benefit from this growing open-source movement? Join us for this workshop to find out. We'll introduce several open-source projects and tools specifically developed for the SIPI/EMC community. Our invited speakers, who are maintainers, contributors, and users of open-source projects, will share their valuable insights. By the end of the workshop, we hope to inspire and motivate attendees to get involved in open-source initiatives and explore the opportunities they offer.

PLANNED SPEAKERS & TOPICS

Deep Learning Based Modeling and Optimization for Signal and Power Integrity
Ling Zhang
Zhejiang University, China

Open Source De-Embedding Tutorial and Best Practices
Jason Ellison
TE Connectivity, USA

OpenSIPI: An Open Source Platform to Automate S-para Extraction and Post-Processing
Yansheng Wang[1], Yuchu He[2]
[1]Rivos Inc., USA; [2]Google Inc, USA

OpenParEM - A Free Open-Source 2D & 3D Full-Wave Electromagnetic Simulator
Brian Young
Independent Technology and Business Development, USA

From Toy to Tool, A Python Journey II
David Banas
Keysight Technologies Inc, USA

Free S-parameter Viewers Anyone Can Use
Eric Bogatin
University of Colorado Boulder, USA

Developing an Open S-parameter Visualiser With Assistance From AI
Giorgi Maghlakelidze
NVIDIA Corp, USA

Removing Communications Barriers between CAD and Instrumentation Companies with Open-Source PCB
Ken Willis
Cadence Design Systems, USA

When Open Source Meets SIPI/EMC Panel Discussions
Yansheng Wang
Rivos Inc., USA

WT_A5 TUTORIAL

HENRY W. OTT FUNDAMENTALS OF EMC

8:30AM - 5:00PM

Room: 306A

Sponsored by EdCom

Chair:
Jen Dimov, *NASA, Greenbelt, MD, USA*
Co-Chair:
Patrick DeRoy, *Analog Devices Inc, Norwood, MA, USA*

This tutorial is an overview of many of the major topics that need to be considered when designing an electronic product or system to meet signal and power integrity (SIPI) and electromagnetic compatibility (EMC) requirements. The tutorial will present the foundational ideas from physics and mathematics and will demonstrate the engineering approaches to help the attendees to successfully design, evaluate, diagnose, and/or solve EMI problems. The main objective of this tutorial is to provide a learning opportunity for those that are new to EMC as well as provide a review of the basics to those who already have some experience in this area.

PLANNED SPEAKERS & TOPICS

Electric Fields, Magnetic Fields, and Maxwell's Equations
John C. McCloskey
EMC-Closkey LLC, USA

Transmission Lines
Eric Bogatin
University of Colorado Boulder, USA

Antennas
Lee Hill
SILENT Solutions LLC & GmbH, USA

Coupling In Electrical Circuits and Systems
Christoper J. Semanson
Renesas Electronics America Inc, USA

Grounding
Todd Hubing
LearnEMC, USA

Board Level Design
Niek Moonen
Universiteit Twente, Netherlands

Noise Mitigation At System Level
Karen Burnham
EMC United Inc., USA

Electrostatic Discharge
Daryl Beetner
Missouri University of Science and Technology, USA

WT_A6 TUTORIAL

EMC IN POWER ELECTRONICS: PRINCIPLES OF EMI GENERATION AND MITIGATION FOR ELECTRICAL SYSTEMS AND ELECTRICAL TRANSPORT

8:30AM - 5:00PM

Room: 306B

Sponsored by TC-7 Electrical System and Power Electronics EMC (formerly Low Frequency EMC)

Co-Chairs:

Niek Moonen, *University of Twente, Enschede, Netherlands*
Daria Nemashkalo, *University of Twente, Enschede, Netherlands*

Power electronic (PE) devices are at the core of modern energy conversion, enabling efficient distribution, regulation, and utilization of electrical energy across various applications, including electric transport. As global energy consumption shifts toward electrification and digitalization, power electronics play an increasingly important role. However, these systems inherently generate electromagnetic interference (EMI), which can disrupt the performance of nearby electronic devices and/or compromise system reliability. Managing EMI, generated by PE devices effectively is crucial to achieving electromagnetic compatibility (EMC), ensuring reliability, interoperability and safety of electrical systems. In this tutorial, we discuss EMC challenges driven by PE devices in different areas of their applications, the resulting consequences and requirements for EMC, as well as methods for controlling and mitigating EMI. Additionally, aspects of comprehensive EMI filter design and evaluation will be presented, with a focus on optimizing EMI filter weight, volume and performance, which are often seen as the bottlenecks for electric transport.

PLANNED SPEAKERS & TOPICS

Introduction to EMC in Power Electronics & EMI Mitigation
Niek Moonen
University of Twente, Netherlands

Sensitivity Analysis in Power Electronic Converters
Karol Niewiadomski
University of Twente, Netherlands

Aggregation of EMI in Multi-Converter Systems
Erjon Ballukja
University of Twente, Netherlands

EMI Filter Design and Performance Evaluation for Power Electronics Applications
Daria Nemashkalo
University of Twente, Netherlands

A Tunable EMI Notch Filter for AM Radio in Electrical Vehicles
Tom Hartman
Ivan Struzhko[1], Daria Nemashkalo[1], Tom Hartman[1], Frank Leferink[1,2]
[1]Universiteit Twente, Netherlands; [2]THALES, Netherlands

WT_A7 WORKSHOP

EMC REGULATIONS AND STANDARDS – PAST, PRESENT AND FUTURE

8:30AM - 5:00PM

Room: 306C

Sponsored by TC-1 EMC Management

STANDARDS WEEK

Chair:
Henry Benitez, *ElectroMagnetic Investigations, Beaverton, OR, USA*

This workshop will provide an overview of the evolution of electromagnetic compatibility dating back to the development of the Faraday's Laws. The process of EMC standards development will discussed. Actual Chairs of international and national EMC standards development committees will provide updates on some of the most significant standards. Regulatory representatives will present on behalf of the FCC, FDA, and NIST. The role of laboratory accreditation will be discussed by a representative of an Accrediting body. A former Chair of the USA Telecommunications Counsel will discuss its role in the radio certification process. An expert panel discussion will conclude the program to discuss past, present and future aspects of EMC regulations and standards.

PLANNED SPEAKERS & TOPICS

Historical Overview of EMC Regulations and Standards
Henry Benitez
ElectroMagnetic Investigations, Beaverton, OR, USA

EMC Overview of FCC Regulations
William H. Graff
Mesa Community College, USA

An update of Automotive Emissions Standards being developed by CISPR/D – A review of CISPR 12, CISPR 36, and CISPR 25
Craig Fanning
Elite Electronic Engineering, Inc., USA

Trends in Tel MRAs
Henry Benitez
ElectroMagnetic Investigations, Beaverton, OR, USA

Role of Accreditation Bodies
Janneth Marcelo
NVLAP/NIST, USA

CISPR I – CISPR 32/35
Henry Benitez
ElectroMagnetic Investigations, Beaverton, OR, USA

ANSI C63 Standards Overview
Zhong Chen
ETS-Lindgren, USA

IEC Industrial Standards Overview and Updates
Bill Morse
Schweitzer Engineering, USA

Advisory Committee on Electromagnetic Compatibility SF-19197
Bob Mitchell
TUV Rheinland AG, Germany

WT_B1 WORKSHOP

NEW EMC MEASUREMENT METHODS FROM 18-40 GHZ

1:30PM - 5:00PM

Room: 302C

STANDARDS WEEK

Chair:
Martin Wiles, *MVG World, Haydock, United Kingdom*

The workshop focuses on the current standardization work to develop measurement methods from 18-40 GHz within both IEC/CISPR and ANSI. It brings together experts from both organizations directly involved in this work to explain the latest developments.

PLANNED SPEAKERS & TOPICS

IEC CISPR A Working Group Developments in 18-40 GHz
Martin A. Wiles
MVG World, Haydock, United Kingdom

Is There a Future for Site VSWR?
Alexander Kriz
Seibersdorf Labor GmbH, Austria

ANSI C63.25-3 18-40 GHz: Overview of CATR, Reverberation Chamber and Semi-Anechoic Chamber
Nicholas Abbondante
Intertek USA Inc, USA

ANSI C63.25-3 18-40 GHz: Overview of Semi-Anechoic Chamber Validation Methods
Phillip Miller
RATLR, USA

Photo by Patrick Andre

WT_B3 TUTORIAL

BASIC EMC MEASUREMENTS

1:30PM - 5:00PM

Room: 305A

Sponsored by TC-2 EMC Measurements

Chair:
Monrad Monsen, *Oracle America Inc, Redwood Shores, CA, USA*

There continues to be those entering the EMC field who are performing measurement activity for both emissions and immunity. In addition, there are practitioners who want to get a second opinion to support what they are doing. They are all at least familiar with basic EMC immunity measurements methods that cover a wide range of electromagnetic phenomena. This tutorial will cover both emissions and immunity by highlighting the latest amendment to a major multimedia emissions standard and a selection of immunity testing standards for transients that are more difficult to implement. The transient discussion will also delve into signals that are high power in a very short time. Also included: a description of emission and immunity test sites, the sites that are becoming popular and their validation requirements, as well as an overview of test setups in these facilities.

PLANNED SPEAKERS & TOPICS

Use of Basic Measurement Facilities, Methods and Associated Errors
Dave Arnett
Garmin International Inc, USA

CISPR 32 Overview
Dave Arnett
Garmin International Inc, USA

Performing Immunity Testing to Transient Signals
Tom Braxton
TEB EMC-EMI Consulting LLC., Bolingbrook, IL, USA

Continuous Wave Immunity
Ross Carlton
Gibbs and Cox Inc, USA

High Power Electromagnetics Test Facilities and Measurement Methods
William A. Radasky
Metatech Corporation, USA

Photo by Richard Georgerian

2026 IEEE INTERNATIONAL SYMPOSIUM ON ELECTROMAGNETIC COMPATIBILITY, SIGNAL & POWER INTEGRITY

AUGUST 3-7
EMC+SIPI 2026
DALLAS, TEXAS

SAVE THE DATE

MARK YOUR CALENDAR
DALLAS, TEXAS
AUGUST 3 - 7, 2026

The IEEE EMC+SIPI 2026 Symposium leads the industry in providing state-of-the-art education on EMC and Signal Integrity and Power Integrity techniques. The Symposium features five full days of innovative sessions, interactive workshops & tutorials, "Ask the Experts" panel discussions, experiments and demonstrations, expansive technical exhibition, and social networking events.

Dallas is a leading hub for technological innovation, supporting the sixth-largest tech workforce and the most influential electronics and semiconductor companies in the United States. Downtown Dallas is a showcase of architectural brilliance and is home to thousands of restaurants for every palate.

The venue and host hotel for EMC+SIPI 2026, Hilton Anatole Dallas, offers ample meeting space, modern accommodations and an outdoor pool complex with slides and a lazy river for attendees that want to bring their families.

Like the Pritzker-prize-winning skyline, Dallas is skillfully pieced together by many strong hands, diverse culture, and innovative companies who make the city what it is today; representative of the technology, willpower, and intelligence of individuals who brought IEEE EMC+SIPI together to shape our world. We are excited to bring EMC+SIPI 2026 to Dallas to celebrate and share knowledge once more, linking together leading minds in the field.

www.2026.emcsipi.org

#IEEE_ESP26

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TUESDAY, AUGUST 19

SCHEDULE AT A GLANCE

ROOM	303	305A	305B	306A	306B	306C
8:30 AM	Keynote Presentation: THE CONVERGENCE OF EMC AND SIGNAL/POWER INTEGRITY ENGINEERING BALLROOM C					
9:30 AM	BREAK					
10:30 AM	TECHNICAL PAPERS SC3_1 MACHINE LEARNING BASED METHODS FOR EMC AND SIPI #1	SPECIAL SESSION SS_1 ELECTROMAGNETIC INFORMATION SECURITY AND ITS COUNTERMEASURES	TECHNICAL PAPERS TC4 ANALYSIS OF EMI COUPLING MECHANISMS	TECHNICAL PAPERS TC6 SPECTRUM ENGINEERING	TECHNICAL PAPERS TC10_6 APPLICATIONS OF AI AND OPTIMIZATION ALGORITHMS	TECHNICAL PAPERS TC10_7 FILTER DESIGN FOR HIGH FREQUENCY CHANNELS
11:00 AM						
11:30 AM						
12:00 PM	LUNCH BREAK					
1:30 PM	TECHNICAL PAPERS SC3_2 MACHINE LEARNING BASED METHODS FOR EMC AND SIPI #2		TECHNICAL PAPERS TC4_TC8 EMI CONTROL: SHIELDING, ANALYSIS, AND MEASUREMENT	TECHNICAL PAPERS TC2_1 EMC MEASUREMENTS: MEDICAL & PROBES	TECHNICAL PAPERS TC10_1 HIGH SPEED INTERCONNECTS #1	TECHNICAL PAPERS TC9_1 ADVANCES IN ELECTROMAGNETIC MODELING AND PREDICTION
3:00 PM	REFRESHMENT BREAK					
3:30 PM						
4:30 PM						
5:00 PM						

CLAYTON R. PAUL GLOBAL UNIVERSITY: 1:00 PM - 5:30 PM, RM 201
(Pre-Registration Required)

GLOBAL SIGNAL INTEGRITY UNIVERSITY: 1:00 PM - 5:00 PM, RM 202
(Pre-Registration Required)

EXHIBIT HALL HOURS
GRAND OPENING RIBBON CUTTING AT 9:30 AM
EXHIBITS OPEN: 9:30 AM – 6:30 PM
POSTER SESSION: 10:00 AM - 12:00 PM
EXPERIMENTS & DEMOS: 9:30 AM - 11:30 AM, 2:30 - 4:30 PM
ASK THE EXPERTS PANELS: 10:00 - 11:30 AM, 2:00 - 3:30 PM

ADDITIONAL STANDARDS SESSIONS, WORKING GROUPS AND TECHNICAL COMMITTEES
For Collateral Meetings, please see page 134

SPEAKERS BREAKFAST
Raleigh Convention Center, 301AB - 7:00 - 8:30 AM
(Breakfast Only on the Day of Presentation)

REGISTRATION/INFO DESK
7:30 AM - 5:00 PM

SENIOR MEMBER AND FELLOW ELEVATION EVENT
302B - 2:30 - 4:00 PM

BEST STUDENT PAPER CONTEST
Exhibit Hall AB - 2:30 - 3:30 PM

WELCOME RECEPTION IN THE EXHIBIT HALL
Exhibit Hall A&B - 5:00 - 6:30 PM

AFTER THE WELCOME RECEPTION" SOCIAL EVENT
Wye Hill Kitchen and Brewing, 8:00 PM - 11:00 PM (Pre-Registration Required)

GLOBAL SIGNAL INTEGRITY AND POWER INTEGRITY (SIPI) UNIVERSITY

TUESDAY – WEDNESDAY – THURSDAY, AUGUST 19 – 21, 2025

The Organizing Committee of the 2025 IEEE International Symposium on Electromagnetic Compatibility and Signal & Power Integrity (EMC+SIPI) is planning to offer a high-quality educational event encompassing Signal Integrity (SI) and Power Integrity (PI): the Global Signal Integrity and Power Integrity University.

Similar to the Clayton R. Paul Global EMC University that is held annually during the International Symposium, the intent is to offer two full days of lectures carefully curated to cover basic and advanced concepts of SI & PI during the symposium week. SI & PI are gaining ever-growing attention due to the higher data rates and larger currents in modern high-speed digital systems. Industry requires skilled engineers with a background in these two disciplines to address the increasing complexity and challenges of electronic system design.

The IEEE EMC Society therefore decided to offer – after its introduction in 2024 at the Symposium in Phoenix, Arizona – two full days of courses during the EMC + SIPI Symposium 2025 to bridge this gap. The mission of the Global SIPI University will be to give students, technicians, and engineers the opportunity to acquire SI & PI skills directly from experienced and well-known instructors from both industry and academia.

This year the program extends to 2 days to offer both lectures and practical demonstrations. The intent is to expand the discussion on the background concepts and to provide a more detailed presentation of advanced methods for achieving the current design challenges. Moreover, the demos will encompass the use of instruments typically employed for analysis, measurement and troubleshooting for the signal and power integrity.

COURSE PRE-REQUISITES:

Electrical engineers with a professional background in EMC that want to dive into or broaden their skills in state-of-the-art signal integrity and power integrity.

Full symposium registration required in addition to the SIPI GU course fee.

RATE:

$345

Photo by Patrick Andre

Read the instructor bios and presentation abstracts:
www.emc2025.org/programs/technical-programs/global-sipi-university

TECHNICAL PROGRAM

SPEAKERS AND TOPICS

TUESDAY 1:00PM-5:00PM	TIME	TOPIC	PRESENTER
	1:00pm – 1:30pm	**Registration / Introduction**	
	1:30pm – 2:15pm	**Opening**	**Stephen Scearce (Cisco)**
	2:15pm – 3:00pm	**Introduction to SI and PI** Evolution from the Basics to the Current Technology	**Francesco de Paulis (Univ. L'Aquila)**
	3:30pm – 4:15pm	**Signal Integrity I:** Transmission line effects, lumped effects, passive interconnect design, terminations and reflections	**John Golding (Siemens)**
	4:15pm – 5:00pm	**Signal Integrity II:** Crosstalk, vias, dielectric and conductive losses, surface roughness	**Bhyrav Mutnury (AMD)**
WEDNESDAY 8:30AM-5:00PM	**TIME**	**TOPIC**	**PRESENTER**
	8:30am – 9:15am	**Signal Integrity III:** Stack-up design, connectors, modulation and coding, equalization	**Brandon Gore (Samtec, Columbia SC)**
	9:15am – 10:00am	**Signal Integrity IV:** Measurements for Signal Integrity (VNA and TDR)	**Matteo Cocchini (IBM)**
	10:30am – 11:15am	**Keynote:** How useful is Machine Learning for Signal & Power Integrity Design?	**Madhavan Swaminathan (Penn State Univ.)**
	11:15am – 12:00pm	**Signal Integrity Demo I:** Time Domain – Scope measurements of the impact of transmission line effects and reflections demonstrating ringing noise, time of flight and eye diagrams.	**Eric Bogatin (Univ. Colorado)**
	1:30pm – 2:15pm	**Signal Integrity V:** Simulation and modeling for signal integrity (3D, cross-section analysis, circuit modeling)	**Roni Khazaka (McGill Univ., Montreal)**
	2:15pm – 3:00pm	**Signal Integrity Demo II:** Frequency Domain - VNA (channel analysis, calibration, de-embedding)	**Paul Peterson (R&S)**
	3:30pm – 4:15pm	**Power Integrity I:** PDN structure, IR-drop, decoupling capacitors, PDN design and optimization, low impedance measurements for PDN	**Chulsoon Hwang (MS&T)**
	4:15pm – 5:00pm	**Power Integrity II:** VRM design and modeling, PCB/package modeling of PDN	**Hanfeng Wang (Google)**
THURSDAY 8:30AM-12:00PM	**TIME**	**TOPIC**	**PRESENTER**
	8:30am – 9:15am	**Power Integrity III:** Package and IC PDN, on-chip VRM	**Zhiphing Yang (PCB Automation Inc.)**
	9:15am – 10:00am	**Hot Topic:** Engineering the Mind of Machines: Electrical Design Trends in Gen AI Processing	**Jayaprakash Balachandran (d-Matrix)**
	10:30am – 11:15am	**Power Integrity Demo:** Low impedance measurements of decaps and PDN, measurements of PDN noise on active circuit	**Benjamin Dannan (Signal Edge Solutions)**
	11:15am – 12:00pm	**Closing Session:** Compact and Surrogate Models in SI/PI	**Stefano Grivet-Talocia (PoliTo)**

CHAIR:
Christian Schuster
Hamburg University of Technology, Germany

Christian Schuster, Hamburg University of Technology, Germany (IEEE Fellow) received a Diploma degree in physics in 1996 and a Ph. D. degree in electrical engineering in 2000. Since 2006 he is a full professor at Hamburg University of Technology (TUHH), Germany. Prior to TUHH he was with the IBM T. J. Watson Research Center, Yorktown Heights, NY. His interests include signal and power integrity of digital systems, multiport measurement and calibration techniques, and development of physics-based as well as data-based modeling, simulation and optimization methods for EMC+SIPI. In the recent past, he has served as an Associate Editor for the IEEE Transactions on EMC, as an Adjunct Associate Professor at the School of Electrical and Computer Engineering of the Georgia Institute of Technology, and as the President of the NIT Northern School of Technology Management at TUHH.

CO-CHAIR:
Francesco de Paulis
University of L'Aquila, L'Aquila, Italy

Francesco de Paulis, University of L'Aquila (IEEE Senior Member) received the M.S. degree in Electrical Engineering in May 2008 from Missouri University of Science and Technology (formerly University of Missouri-Rolla), USA, and the PhD degree in Electrical and Information Engineering in 2012 from the University of L'Aquila, L'Aquila, Italy. He is currently an Associate Professor at the Electromagnetic Compatibility and Signal Integrity Laboratory, University of L'Aquila, Italy, and an Adjunct Professor at the Missouri University of Science and Technology. His main research interests are in signal and power integrity, high speed channel design, electromagnetic compatibility, antenna design and measurement techniques, design of electronic devices and systems for space applications.

CLAYTON R. PAUL GLOBAL UNIVERSITY

ADVANCE YOUR EMC KNOWLEDGE AND CAREER WITH IN-DEPTH CLASSES ON EMC AT THE IEEE EMC SOCIETY'S PREMIER EDUCATIONAL EVENT.

Chair: Arturo Mediano, *Professor, I3A, University of Zaragoza*

The topics for this year's Global University are those that have been proven to be valuable to participants in previous Symposia. The course provides attendees with a great learning experience, due to the ability for interaction between instructors and attendees, as well as providing networking opportunities.

This year's Global University will continue to honor Dr. Paul's efforts and dedication to the EMC Society as well as maintain his high standards in providing EMC educational opportunities!

Attendees may qualify for IEEE professional development hours (PDH) and continuing education units (CEU) certificates. Course size is limited and will be filled on first-come, first-served basis.

PLEASE NOTE: The Clayton R. Paul Global University course content is intended for engineers who have been working in EMC and/or SIPI for several years and wish to be able to deepen their understanding. It is suggested that those who would like to attend will have already participated in the "Fundamentals Tutorial" held on Monday during the annual IEEE EMC Society Symposium week.

*Attendees participating in Clayton R. Paul Global University must attend all 16 hours of the instruction to receive a participation certificate. Other Symposium sessions and activities can be attended outside of these hours.

RATE:

$345

Photo by Richard Georgerian

READ THE INSTRUCTOR BIOS:
https://emc2025.org/programs/technical-programs/global-university/

RALEIGH, NC
EMC+SIPI 2025

SPEAKERS AND TOPICS

The course begins with a short introduction followed by eight presentations that are designed to encourage attendees' questions. Attendees will have opportunities for discussions with the instructors.

SIGNAL SPECTRA
Dr. Flavia Grassi
Professor, Politecnico Milano

NON-IDEAL BEHAVIOR OF COMPONENTS
Dr. Anne Roc'h
Assistant Professor,
Eindhoven University of Technology

RADIATED EMISSIONS
Mr. Lee Hill
Founding Partner, SILENT Solutions LLC & GmbH, Amherst, NH, USA
MSEE, Missouri University of Science & Technology
Adjunct Faculty, Worcester Polytechnic Institute (WPI)
Associate Tutor, University of Oxford

CONDUCTED EMISSIONS
Dr. Arturo Mediano
Professor, I3A, University of Zaragoza
Professor, I3A, University of Zaragoza, Spain
Founder The HF Magic Lab
IEEE Senior Member
Chair, EMC Society Spain Chapter
Past Chair, MTT-S MTT-17 Committee
Recipient of the EMC Society's 2024 Excellence in Continuing EMC Engineering Education Award

PCB DESIGN FOR EMC COMPLIANCE
Dr. Todd Hubing
Professor Emeritus, Clemson University
IEEE Fellow, ACES Fellow
Past President, IEEE EMC Society

EMC FILTERS
Dr. Frank Leferink
Professor, Chair EMC, University of Twente, Enschede, The Netherlands
Director EMC, THALES Nederland
IEEE Fellow

SHIELDING
Karen Burnham
President and Chief Engineer of EMC United, Inc., Denver, CO, USA
2022 – 2023 Distinguished Lecturer on EMC.

CROSSTALK
Dr. Daryl G. Beetner
Professor, Missouri University of Science & Technology, Rolla, MO, USA
Director, Missouri S&T Electromagnetic Compatibility Laboratory
Director, NSF Center for Electromagnetic Compatibility

	TIME	TOPIC	PRESENTER
TUESDAY 1:00PM-5:00PM	1:00pm – 1:15pm	Registration and CRPGU Presentation	
	1:15pm – 3:00pm	Signal Spectra	Flavia Grassi (Politecnico Milano)
	3:30pm – 5:30pm	Non-Ideal Behavior of Components	Anne Roc'h (Eindhoven University of Technology)
WEDNESDAY 8:00AM-5:30PM	TIME	TOPIC	PRESENTER
	8:00am – 10:00am	Radiated Emissions	Lee Hill (SILENT Solutions LLC & GmbH)
	10:30am – 12:00pm	Conducted Emissions	Arturo Mediano (University of Zaragoza)
	1:00pm – 3:00pm	PCB Design for EMC	Todd Hubing (Clemson University)
	3:30pm – 5:30pm	EMC Filters	Frank Leferink (University of Twente)
THURSDAY 8:00AM-12:00PM	TIME	TOPIC	PRESENTER
	8:00am – 10:00am	Shielding	Karen Burnham (EMC United, Inc.)
	10:30am – 11:45am	Crosstalk	Daryl G. Beetner (Missouri University of Science & Technology)
	11:45am – 12:00pm	Closing Session	

ED_A1 EXPERIMENTS & DEMONSTRATIONS

MODELING OF HIGH-ALTITUDE ELECTROMAGNETIC PULSE (HEMP) THREAT, TEST SETUP, AND ITS EFFECTS FOR AID IN THE DESIGN OF AIRBORNE EQUIPMENT

9:30AM - 11:30AM

Room: Exhibit Floor, E&D Booth 1

HEMP phenomenon can be broken down into two types, radiated and conducted emissions. This demo showcases the modeling and simulation to analyze the problem when an airborne equipment is tested per MIL-STD-461 RS105 method. During the demo, we will use the airborne equipment, an Integrated Drive Generator (IDG) with apertures and cabling. We simulate the effects of the penetrated radiated EMP into the IDG's cavity and its resonant cavity mode coupling to the internal wiring. This method/workflow will be demonstrated using Altair Feko to aid the design of the IDG and its controller against HEMP. We will illustrate computationally efficient combined Method of Moment (MoM) and Multi Transmission Line (MTL) technology solution for the analysis of emissions. This demonstration will highlight several simulation challenges and solutions for modeling High-Altitude Electromagnetic Pulse (HEMP) threat to aid the design of IDG for airborne application.

PRESENTERS:

Dr. CJ Reddy, *Altair, USA*
Henry Soekmadji, *Collins Aerospace Rockford, USA*

ED_A2 EXPERIMENTS & DEMONSTRATIONS

USING SIMULATED EMC INSTRUMENTS TO DEVELOP, EDIT, AND VALIDATE EMC TEST ROUTINES – INCLUDING EVALUATION OF TEST DATA FOR BORESIGHT AND ALTERNATE ANTENNA HEIGHT SCAN MEASUREMENTS AS PER ANSI C63.4

9:30AM - 11:30AM

Room: Exhibit Floor, E&D Booth 2

Automating the EMC test process has the benefits of improving measurement accuracy and repeatability while also increasing test throughput. EMC testing is complex and requires multiple instruments to work in unison so that data gathered is coherently assembled to determine compliance of a device under test. Integrity of the test setup is typically done with system checks where a known signal is injected at some point in the system and compared with expected results. This approach is great for validating the entire hardware/software signal chain. Using virtual instruments, the software side of the system can be validated before assembling the instrumentation. This is a significant time saver and allows for scenario testing without tying up test equipment and chamber time. This demonstration will show how instrument simulation can be used to setup system checks as well as validate actual EMC emissions and immunity tests.

In addition, as an example, actual test data using automated EMC test software will be shown comparing boresight measurements (currently per C63.4) and alternate antenna height scan measurements (under consideration for C63.4) taken during a recent live demonstration in the new 10meter chamber at TUV Rheinland, Boxborough, MA.

PRESENTERS:

Jack McFadden, *ETS-Lindgren, USA*
Bob Mitchell, *TUV Rheinland AG, Germany*

ED_ A3 EXPERIMENTS & DEMONSTRATIONS

MODERN AUTOMATED TEST TECHNIQUES TO ADDRESS ISO 11451-5, ANNEX G

9:30AM - 11:30AM

Room: Exhibit Floor, E&D Booth 3

Annex G of ISO 11451-5 Road Vehicles – Vehicle Test Methods for the Electrical Disturbances from Narrowband Radiated Electromagnetic Energy – Part 5: Reverberation Chamber Edition 2022 included new techniques to expand the scope of testing to this standard. This hardware demonstration describes a highly efficient test and measurement system meeting Annex G, Reverb Method with Closed-Loop Power Control, for fast data acquisition.

The speaker will review the essential instrumentation required for improved testing, namely high-speed field probes and high-speed tuner(s), as well as enhanced software to automate the test process.

Demonstration attendees will learn about the advantages of a novel ISO 11451-5 test and measurement system solution, including:

- Higher efficiency — Simultaneous calibration loading and test measurements
- Higher accuracy — Less field variations with high-speed tuner(s)
- Greater test control
- Lower useable frequency — (LUF) may be extended

PRESENTER:

Garth D'Abreu, *ETS-Lindgren, USA*

ED_ A4 EXPERIMENTS & DEMONSTRATIONS

AUTOMOTIVE ELECTRICAL TRANSIENTS ON POWER BUS MITIGATION TO PROTECT SENSITIVE ELECTRONICS

9:30AM - 11:30AM

Room: Exhibit Floor, E&D Booth 4

Sponsored by TC-7

A practical comparison of protection methods for sensitive electronics connected to the automotive power buss. This will be a demonstration of the transients specified in ISO 7637-2 and ISO 16750-2 applied to a various protection circuits and measuring the amplitude of the transient that escapes pass the protection circuits into the sensitive electronics. The protection circuits will be made and designed with components readily available at any electronics supplier.

The premise of this experiment is that the voltage that makes it beyond the transient protection may destroy the devise under test.

PRESENTER:

Scott Carlson, *Element Materials Technology, USA*

ED_ A5
EXPERIMENTS
& DEMONSTRATIONS

DELVE INTO SOFTWARE GATING: FLEXIBILITY MEETS PERFORMANCE!

9:30AM - 11:30AM

Room: Exhibit Floor, E&D Booth 5

Time-domain gating is a well-known technique for isolating responses and is commonly integrated into commercial vector network analyzers (VNAs). However, once data is downloaded, users often have limited options for further processing. To address this limitation, we have developed a versatile gating library that offers enhanced flexibility and seamless integration with popular programming environments. A key issue in time-domain gating is the band edge effect caused by limited measurement bandwidth. To address this, the library incorporates standard edge treatment techniques and introduces the patented Spectrum Extension Edgeless Gating (SEEG) method, which significantly reduces edge artifacts. Beyond time-domain applications, the library also excels in spatial and spectral analyses. The demonstration will feature real-time gating, with parameters adjustable via MATLAB, Python and C. We will compare outputs from conventional edge renormalization techniques and SEEG, showcasing the advantages of the latter. We will demonstrate the gating library using a low-cost hobbyist NanoVNA, which is included in the IEEE EMC Society Inductance Testing PCB Kit. A small tool will be demonstrated to read NanoVNA data and enable time-domain processing. Both the tool and a free version of the gating library will be provided to attendees. This demonstration will highlight the practical applications of the newly developed gating library and provide attendees with hands-on experience in real-time processing.

PRESENTERS:

Yibo Wang, *ETS-Lindgren, USA*
Andrew Shyne, *The Boeing Company, USA*
Garret McKerricher, *ETS-Lindgren, USA*

ASK THE
EXPERTS
PANEL DISCUSSION

LATEST CHALLENGES FOR HIGH SPEED SERDES SYSTEMS

10:00AM - 11:30AM

Room: Exhibit Floor, AtE Stage

SPONSORED BY: RTLR

Organizer:
Stephen Scearce, *Cisco Systems, Inc., Apex, NC, USA*

With the latest drive for faster AI training systems, the electronics industry is being pushed to advance at a much faster pace. These GPU clusters require communication at extremely high data rates with minimal latency. Companies are now shipping 224Gbps SerDes in large volumes and are actively exploring the next generation of 400Gbps per lane systems. As data rates continue to climb, the challenges in signal and power integrity are pushing the limits of what is achievable in PCBs, packages, and cable backplanes. Our panel of experts from the industry and academia will each address a current challenge related to SerDes systems and provide an extended Q&A session to share their extensive experience.

PLANNED PANELISTS INCLUDE:

Todd Westerhoff, *Siemens, Maynard, MA, USA*
Scott Huss, *Cadence, Cary, NC, USA*
Quinn Gaumer, *Cisco, Durham, NC, USA*
Francesco de Paulis, University of L'Aquila, L'Aquila, AQ, Italy
Bhyrav Mutnury, *Advanced Micro Devices Inc, Austin, TX, USA*
Xiaoning Ye, *Intel Corp, Hillsboro, OR, USA*

POSTER SESSION

POSTER SESSION
10:00AM - 12:00PM
Room: Exhibit Floor

Browse Posters and discover the scientific research and findings of your peers. This is an opportunity to meet the authors and discuss their research in person!

Co-Chairs:

Samuel Connor, *International Business Machines Corp, Research Triangle Park, NC, USA*

Jacob Dixon, *International Business Machines Corp, Research Triangle Park, NC, USA*

PLANNED SPEAKERS & TOPICS

Measurement and Analysis of EMC Noise during Welding Operations.

Yena Lee, Kyungmo Sung

HD Hyundai Electric, Korea (the Republic of)

Abstract: Welding machines are generally known to produce a lot of EM noise. Welding machines have their own EMC standards, and when performing welding tasks, there are various rules in place to protect surrounding electronic devices. However, there are no specific regulations regarding the noise generated during the welding process itself. We conducted measurements of the EM noise produced during welding to set up the environment for the EMC test, and after analyzing the results, we independently selected an appropriate level of protection. Furthermore, we confirmed that there were no significant changes in the ambient conditions of the EMC test lab over an extended period.

Impact of RF Coil Characteristics on 1.5T MRI RF-Induced Heating of Active Medical Implant Leads

Kyle Bond, Arash Dabir, Anasheh Avakians, Carolyn Kwok, Nowrin Chamok, Louai Al-Dayeh

Boston Scientific, USA

Abstract: The purpose of this study is to quantify the extent to which different coil characteristics of 1.5T MRI scanners influence RF-induced lead heating of a patient with a Deep Brain Stimulator (DBS) implant. This evaluation was performed per the modeling approach of ISO/TS 10974:2018 [1] Clause 8 Tier 3, with a multitude of RF coils with different design parameters and lead heating predictions were compared. The results of this evaluation show that RF coil length is the most impactful design parameter on implant heating, with minor influence attributable to coil diameter and topology. A secondary outcome was to determine if a reduced set of RF coils with specific characteristics can be used instead of a full extended set to reduce time.

Impact of Layer Spacing in a 3x3 Layered DD Coil Array for Efficient EV Wireless Power Transfer

Babatunde Soyoye, Indranil Bhattacharya, Webster Adepoju, Muhammad Bima, Trapa Banik

Tennessee Tech University, USA

Abstract: For uses like charging electric vehicles, wireless power transfer is a potential technique. With an emphasis on intra- and inter-layer coupling effects, this study examines the performance of a 3x3 array of 3-layered Double-D coils. The study checks the coupling coefficients and mutual inductance by adjusting the lateral (dx = 10mm to 20mm) and vertical (dz = 20mm to 100mm) spacings. The findings demonstrate improved inter-layer coupling, reaching a mutual inductance of 48.75QH and a maximum k=0.488 at dz = 20mm and dx = 10mm. At dz = 100mm, performance decreases as spacing increases (k=0.142). This study emphasizes how crucial perfect alignment and layered designs are to scalable and effective wireless power transfer systems. In order to develop high-power wireless power transfer technologies, future research will concentrate on optimization and further extending the array.

Frequency Extrapolation and Scaling Transformation-Based ISAR Imaging Method

Xiongfei Long[1], Xumin Liu[2], Dan Yang[1], Xingbao Lin[1], Kebing Meng[1], Zibin Weng[1]

[1]Xidian University, China; [2]Marine Design & Research Institute of China, China

Abstract: This study presents an innovative Inverse Synthetic Aperture Radar (ISAR) imaging method based on frequency extrapolation and scaling transformation techniques. Initially, ISAR images of small-scale ships (1.15 meters in length, 0.14 meters in width) are simulated within the 8-12 GHz frequency range, generating the corresponding data. Then, the frequency extrapolation technique is used to extend these data to a broader frequency range (8-20 GHz), resulting in a second set of ISAR images. Through scaling transformation, the extrapolated high-frequency data are compared with the simulated ISAR images of large-scale ships (11.5 meters in length, 1.4 meters in width) within the 800-1200 MHz frequency range, demonstrating their similarity. This method addresses the challenges of ISAR imaging for electrically large targets, which typically require wide bandwidths and high sampling points. By compensating for these requirements, the proposed approach reduces the dependency on simulation software, improves efficiency, and provides a new solution for target identification under frequency constraints.

CONTINUED ON NEXT PAGE

POSTER SESSION CONTINUED
10:00AM - 12:00PM
Room: Exhibit Floor

Ferrite Core Optimization of Spiral Planar DD Coil for Efficient Wireless Power Transfer Applications
Tuan Kiet Le, Indranil Bhattacharya
Tennessee Tech University, USA
Abstract: While wireless power transfer (WPT) has been commercialized in many designs, its application in electric vehicles (EVs) remains limited due to the challenges posed by power transmission efficiency. The coil structure and its core configuration, including shielding, play a crucial role in improving power efficiency. Although the Spiral Planar DD-Coil has demonstrated high efficiency, modifications can still enhance the WPT performance. This paper optimizes DD-Coil parameters and proposes an optimized ferrite core structure to minimize weight while maintaining low power losses. Our results indicate that the new core structure not only provides better efficiency compared to the shaped-bar core but also performs comparably to the traditional rectangular core. Additionally, our findings show that increasing the initial radius of the coil enhances power efficiency, while highlighting the trade-off between core thickness and core power loss.

Planar Near-field Measurements Based on Kernel Ridge Regression
Xingbao Lin[1], Xumin Liu[2], Chen Liang[1], Xiongfei Long[1], Mengyao Hu[1], Zibin Weng[1]
[1]Xidian University, China; [2]Marine Design & Research Institute of China, China
Abstract: Due to the development of unmanned aerial vehicle (UAV) hardware and antenna near-field measurement post-processing techniques, the use of UAV to perform near-field measurements of antennas outdoors is gradually becoming a new situation. Near-field (NF) measurements of the antenna under test (AUT) using an unmanned aerial vehicle-mounted probe and post-processing of the NF data can be used for antenna radiation pattern evaluation and antenna troubleshooting. However, during the actual flight of the UAV outdoors, the measurement trajectory may be deviated by environmental factors such as wind and GPS positioning uncertainty, which may lead to data failure at certain near-field scanning points and affect the post-processing results. This paper focuses on the measurement errors caused by the trajectory offset of UAV and proposes a method of recovering the failed near-field data points based on the kernel ridge regression algorithm to calibrate the errors and reduce the errors of UAV measurements due to external factors. Finally, the simulated near-field sampling is performed, the NF data are sparse processed to simulate the failure data, the recovered complete near-field data are obtained by using the kernel ridge regression algorithm, and the post-processing is performed to obtain the antenna radiation pattern to verify the feasibility.

Implicit FETD for Conformal FSS (C-FSS) Analysis with Sum Factorization
Yi-Yao Wang, Qiwei Zhan, Haoxuan Zhang, Wen-Yan Yin
Zhejiang University, China
Abstract: An implicit finite-element time-domain (FETD) method is developed in this work, where matrix assembly avoided as sum factorization technique is introduced to accelerate the matrix-vector multiplication. It can significantly reduce the required computational time and memory consumption when high-order basis functions are applied. Numerical simulations of the conformal frequency selective surface (C-FSS) were conducted using the proposed algorithm.

Design and Optimization of a Miniaturized Spiral Antenna for Ultra-Wideband Applications
McKennan E. Starkey, Cody J. Goins, Victor Khilkevich, Daryl Beetner
Missouri University of Science and Technology, USA
Abstract: Ultra-wideband communication in the frequency range from 3.1 to 10.6 GHz is popular for short range wireless networks. Designing a wideband antenna that covers the entire 7.5 GHz band is challenging, particularly if the antenna should be small, unobtrusive, and should effectively communicate with another antenna as their positions and orientations change. A miniaturized wideband circularly polarized Archimedean spiral antenna is developed in this study which is wideband and circularly polarized. Miniaturization and optimization techniques are introduced to enable an antenna size of 30 mm x 30 mm and a thickness less than 0.5 mm.

Advanced Silicone Composites as Elastomeric Solutions for EMI/EMC Applications
Julia Sunderland, Dan Zhao, Shuangbing Han, Joe Sootsman
Dow Performance Silicones, USA
Abstract: Advanced elastomeric materials for automotive, communication, and consumer electronics need to meet higher demands as devices miniaturize and operate at wider frequency ranges. Electrically conductive and absorbing silicones are ideal for shielding and grounding due to their tunable electric and mechanical properties. They are suitable as adhesives, sealants, coatings, encapsulants, and thermal interface materials in electromagnetic compatibility applications. The dispensable nature of silicone composites allows application on complex module geometries and provides greater housing design freedom.

Development of Reverberation Chamber Characterization Techniques at Microwave Frequencies
Amin Aminaei
University of California Davis, USA
Abstract: Reverberation Chambers (RC's) are commonly employed for various electromagnetic investigations. As such, characterization of their properties is important to being able to effectively make measurements. Here we report on measurement techniques used to measure the quality factor (Q) of an RC in both the frequency and time domains as well as the electromagnetic field uniformity of an RC at microwave frequencies. Both methodology and results are discussed. Results are further supported with free-space measurements as well as numerical simulation methods. While these techniques are being developed for a fundamental physics application, they widely apply wherever an RC is necessary.

Parameterized Surrogate Models of Electromagnetic Systems through Decision Tree and Random Forest Models
Elia Mattucci[3], Daniele Romano[2], Giulio Antonini[2], Fabio Antonini[3]
[1]Brno University of Technology, Czech Republic; [2]University of L'Aquila, Italy; [3]TIESSE s.r.l., Italy
Abstract: Simulations are an integral part of the electromagnetic systems' design and optimization process. Mathematical models associated with them are usually very large, time and memory-consuming. It is useful to have faster surrogate models with an accuracy comparable to full-order models, especially in an optimization process. For this purpose, we propose to use Decision Trees and Random Forests as parametrized surrogate models of electromagnetic systems. We focus on approximating the parameter-dependent transfer functions using Decision Trees and Random Forests. We used limited data of the module of transfer functions obtained from PEEC simulations to train models appropriately sampled in the parameter space with Latin Hypercube sampling. Trained models predict Transfer Function Modules at any parameter sample in the design space domain with good accuracy.

Co-Optimization of Floorplanning and Decap Placement for TI and PI Based on Machine Learning
Jisoo Hwang[1,2], SoYoung Kim[1]
[1]Sungkyunkwan University, Korea (the Republic of); [2]Samsung Electronics Co Ltd, Korea (the Republic of)
Abstract: Power integrity (PI) and thermal integrity (TI) co-optimization in semiconductor packages is challenging due to floorplanning and decap placement trade-offs. This paper proposes a reinforcement learning (RL)-based floorplanning method that optimizes PI and TI while considering decap-induced PDN resistance. Using a thermal resistance matrix, our method achieves 500× faster thermal analysis than computational fluid dynamics (CFD) solvers with <2% error. Simulation results show 22.8% and 19.4% improvement over single-metric optimization, based on evaluations of 250 floorplans and 4 decap status variations, ensuring thermal performance and voltage stability. This framework provides a scalable solution for next-generation semiconductor packages.

SC3_1 TECHNICAL PAPERS

MACHINE LEARNING BASED METHODS FOR EMC AND SIPI #1

10:30AM - 12:00PM

Room: 303

Sponsored by SC-3 Special Committee on Machine Learning and Artificial Intelligence in EMC and SIPI

Chair:
Lijun Jiang, *Missouri University of Science and Technology, Rolla, MO, USA*

Co-Chair:
Alistair Duffy, *De Montfort University, Loughborough, United Kingdom*

PLANNED SPEAKERS & TOPICS

10:30am
ML-Based Approach for PCB Anomaly and Leakage Detection
Matthieu Leflon[1], Mohamed Kheir[2], Sadok Ben Yahia[2]
[1]École Nationale Superieure de l'Electronique et de ses Applications, France; [2]University of Southern Denmark, Denmark
Abstract: Machine Learning (ML) applications in our daily life have seen tremendous growth and they are closely tied to various Electromagnetic Interference and Compatibility (EMI/EMC) scenarios. This paper proposes a new ML-driven approach for detecting leakage and troubleshooting Printed Circuit Boards (PCBs) anomalies. The approach utilizes a simple Feedforward Neural Network (FNN) model that requires minimal training and a small dataset. This model is first trained on measurement points of 3D E-field data from an unslotted PCB. It then uses this training to detect the exact location of anomalies or E-field leakage within this PCB. This process achieves a high precision with a Root Mean Square Error (RMSE) of only 0.02 demonstrating an efficient detection accuracy.

11:00am
Reinforcement Learning-Assisted Optimization of Power Plane and Placement of Decoupling Capacitors in Power Delivery Networks
Nima Ghafarian Shoaee[1], Baoyin Hua[1], Werner John[1], Ralf Brüning[2], Jürgen Götze1
[1]Technische Universitat Dortmund, Germany; [2]Zucken GmbH, Germany
SIPI BEST STUDENT PAPER FINALIST
Abstract: This paper introduces a novel reinforcement learning (RL) optimization framework for designing power delivery networks (PDNs) on printed circuit boards (PCBs). The proposed framework aims to simultaneously minimize the number of decoupling capacitors (decaps) and optimize the power plane area while satisfying predefined target impedance (TI) requirements. To address complex design situations, such as irregularly shaped power planes, convolutional neural networks (CNNs) have been integrated into the RL framework, enabling efficient handling of power plane geometries. Experimental results demonstrate that this integration, coupled with a carefully structured action space, significantly accelerates the training process. Notably, the implementation of multiple parallel sub-actor networks within a hierarchical action space allows simultaneous optimization of various design parameters. This enhanced approach not only supports more realistic and complex design cases but also achieves a fourfold reduction in training time.

11:30am
Deep Reinforcement Learning (DRL) Based Signal Integrity (SI) Performance Optimization Method for Low-Power Double Data Rate (LPDDR) Memory
Dongryul Park[1], Seonghi Lee[1], Seunghun Ryu[1], Hyunwoo Kim[1], Dongkyun Kim[1], Ducksoo Kim[2], Hyunsik Kim[2], Jongwook Kim[2], Seungyoung Ahn[1]
[1]Korea Advanced Institute of Science and Technology, Korea (the Republic of); [2]SK hynix Inc., Korea (the Republic of)
Abstract: In this paper, we propose deep reinforcement learning (DRL) based LPDDR memory package optimization method for maximize SI performance. A Markov Decision Process (MDP) is designed to reflect the characteristics of the LPDDR package, employing SI metrics to capture the influence of SoCs with unknown design variables. Furthermore, Agent is designed using multi-stage multi-layer perceptron to handle multiple interrelated design parameters, and is trained on randomly generated SoC packages to address various SoC scenarios. The proposed DRL based optimization method is verified in 6 coupled channels. The optimization performance of the proposed method is confirmed in various SoC channel. The superb optimality performance is also confirmed through comparison with conventional optimization method, and other DRL method.

SS_1 SPECIAL SESSION

ELECTROMAGNETIC INFORMATION SECURITY AND ITS COUNTERMEASURES

10:30AM - 4:30PM

Room: 305A

Sponsored by TC-5 High Power Electromagnetics

Chair:
Yuichi Hayashi, *Nara Sentan Kagaku Gijutsu Daigakuin Daigaku, Ikoma, Japan*

Co-Chair:
William Radasky, *Metatech Corporation, Goleta, CA, USA*

Information security has become a critical challenge in modern society, with physical-layer security gaining importance alongside upper-layer security measures. The proliferation of high-precision measurement equipment, advances in computing performance, practical implementation of large-capacity storage devices, and developments in AI technology have transformed sophisticated attacks, previously considered technically unfeasible, into realistic threats. These threats now extend beyond military and diplomatic domains to affect consumer devices.

This special session focuses on electromagnetic information security, a crucial aspect of physical layer security where attacks leave minimal traces and are difficult to detect. We will discuss security threats posed by both passive and active electromagnetic attacks and examine how conventional EMC evaluation techniques can be applied to assess and counter these threats, incorporating the latest research findings.

PLANNED SPEAKERS & TOPICS

10:30am
Special Session on Emerging Security Threats from EM Information Leakage and IEMI
Yuichi Hayashi[1], William A. Radasky[2]
[1]Nara Sentan Kagaku Gijutsu Daigakuin Daigaku Joho Kagaku Kenkyuka, Japan; [2]Metatech Corporation, USA
Abstract: As the importance of information security continues to grow, securing the physical layer has become as critical as protecting upper layers [1]. Recent advancements in measurement equipment, along with faster computing and larger storage capacities, have enabled sophisticated attacks that were once difficult to carry out. These threats are expanding beyond military and diplomatic arenas, affecting various commercial applications. In light of these circumstances, this special session focuses on threats related to electromagnetic (EM) waves [2] —one of the more elusive types of physical-layer attacks due to their minimal trace evidence—and, in particular, addresses EM Information Leakage and Intentional Electromagnetic Interference (IEMI). Although some of the studies presented here might seem to enhance attack techniques, exploring such methods from an offensive security perspective is vital for identifying system vulnerabilities in advance and implementing robust countermeasures.

11:00am
Pixel Level Character Reconstruction by Background Profiling against TMDS Emanations
Taiki Kitazawa, Shohei Matsumoto, Yuichi Hayashi
Nara Institute of Science and Technology, Japan
EMC BEST STUDENT PAPER FINALIST
Abstract: In the Transition Minimized Differential Signaling (TMDS) protocol for High-Definition Multimedia Interface (HDMI), bit patterns change periodically even when the same color is displayed continuously. As a result, periodic noise appears in the reconstructed image, degrading visibility. This issue becomes particularly problematic for text composed of only a few pixels, significantly reducing the accuracy of text restoration. In response to this challenge, this study proposes a method to extract foreground text by learning the signal pattern of the background color via One-Class Classification (OCC) designed for identifying background pixels. Evaluations using an actual device confirmed that the proposed method substantially suppresses noise compared with conventional approaches, thereby improving Structural Similarity Index Measure (SSIM) and character recognition accuracy. Furthermore, under the assumption of a binary color configuration (i.e., background and foreground), readability can be maintained even for very small text.

CONTINUED ON NEXT PAGE

11:30am
Integrating Advanced Signal Analysis and Deep Learning in TEMPEST Techniques
Taesik Nam, Dong-Hoon Choi, Euibum Lee, Jong-Gwan Yook
Yonsei University, Korea (the Republic of)
Abstract: This work explores electromagnetic (EM) leakage from transition-minimized differential signal (TMDS)-based external interfaces, focusing on information leakage from video display units (VDUs) due to common mode noise caused by asynchronous differential signal. This work addresses a methodology to improve these EM leakage signals via deep learning. In this process, we provide a solution for addressing data diversity issues that are directly related to the performance of deep learning models, and suggest that applications can be extended to ambient noise and stripe noise cancellation, etc. Consequently, this work extends the scenario of side-channel attack and provides insights for the development of defense strategies.

1:30pm
Anti-Phase Signal Approach to Echo TEMPEST Self-Interference Suppression Retaining a Two-Antenna Setup
Shugo Kaji, Daisuke Fujimoto, Yuichi Hayashi
Nara Institute of Science and Technology, Japan
Abstract: The threat of Echo TEMPEST, which causes information leakage by irradiating electromagnetic (EM) waves at a specific frequency, has been reported. In this threat, reflected waves (Echo) with different amplitudes are generated depending on the output state of the IC's output buffer, and the IC's output signal leaks as amplitude-modulated waves. However, a problem in conducting Echo TEMPEST is the self-interference caused by EM coupling between the transmitting (TX) and receiving (RX) antennas. In previous research, the self-interference effects were reduced by generating signals with a different frequency from the TX signal within the target device. However, this method requires two TX antennas and one RX antenna, making it necessary to explore antenna placements and evaluation parameters while considering the transfer function between antennas and the target device, and the coupling between antennas. This paper proposes a method for suppressing self-interference during Echo TEMPEST without adding extra antennas. Specifically, we generate an anti-phase signal that is superimposed on the Echo alongside the TX signal, and combine them to reduce the self-interference effects. Evaluation on speakerphones confirmed mitigation of self-interference and improved information-acquisition accuracy while retaining the original two-antenna configuration.

2:00pm
There's Waldo: PCB Tamper Forensic Analysis using Explainable AI on Impedance Signatures
Maryam Saadat Safa, Seyedmohammad Nouraniboosjin, Fatemeh Ganji, Shahin Tajik
Worcester Polytechnic Institute, USA
Abstract: The security of printed circuit boards (PCBs) has become increasingly vital as supply chain vulnerabilities, including tampering, present significant risks to electronic systems. While detecting tampering on a PCB is the first step for verification, forensics is also needed to identify the modified component. One non-invasive and reliable PCB tamper detection technique with global coverage is the impedance characterization of PCB's power delivery network (PDN). However, it is an open question whether one can use the two-dimensional impedance signatures for forensics purposes. In this work, we introduce a novel PCB forensics approach, using explainable AI (XAI) on impedance signatures. Through extensive experiments, we replicate various PCB tamper events, generating a dataset used to develop an XAI algorithm capable of not only detecting tampering but also explaining why the algorithm makes a decision about whether a tamper event has happened. At the core of our XAI algorithm is a random forest classifier with an accuracy of 96.7%, sufficient to explain the algorithm's decisions. To understand the behavior of the classifier In the decision-making process, we utilized the SHAP values as an XAI tool to determine which frequency component influences the classifier's decision for a particular class the most. This approach enhances detection capabilities as well as advancing the verifier's ability to reverse-engineer and analyze two-dimensional impedance signatures for forensics.

2:30pm
Simulation-Based Approach to Target EMI Attenuation for Meeting Required Power Side-Channel Attack Success Rate
Masaki Himuro, Rei Mitsuyasu, Kengo Iokibe, Yoshitaka Toyota
Okayama University, Japan
EMC BEST PAPER FINALIST
Abstract: Side-channel attacks (SCAs) can recover the cryptographic secret keys from electromagnetic interference (EMI) conducted on the power delivery network (PDN). Focusing on the simulation-based secure PDN design, we previously applied simulated switching current sources in ICs to calculations of the targeted EMI attenuation. In this paper, focusing on the Correlation Power Analysis (CPA) as an SCA, we use the theoretical formula of the attack success rate (SR) of CPA to calculate the target EMI attenuation to meet the required SR of CPA. Since SR indicates the realistic CPA risk, this target attenuation provides more accurate and reliable assessment.

3:30pm
Mitigating IEMI Induced Faults in PLL-based Cryptographic Modules Through Narrow Loop Bandwidth
Hikaru Nishiyama[1], Daisuke Fujimoto[2], Yuichi Hayashi[2]
[1]National Institute of Advanced Industrial Science and Technology, Japan; [2]Nara Institute of Science and Technology, Japan
Abstract: A threat has been reported in which an intentional electromagnetic interference (IEMI) generates a glitch in the input clock of a phase-locked loop (PLL) circuits, thereby causing a temporary fault in a cryptographic module clocked by the PLL and extracting secret key using the fault outputs. This threat occurs faults based on a timing violation by increasing PLL output frequency to the extent that it exceeds the maximum operation frequency of the cryptographic module by causing a large difference in the phase comparison operation of clock signals by the PLL. To counter this threat, this paper proposes a countermeasure to reduce the fault occurrence by narrowing the loop bandwidth, which determines the frequency response characteristics of PLLs.

4:00pm
Simulation and Analysis of Intentional EMI Attack Against Power Delivery Network of Ring Oscillator Based True Random Number Generator
Youngwoo Kim[1], Changhoon Lee[2], Daisuke Fujimoto[3], Yuichi Hayashi[3]
[1]Sejong University, Korea; [2]Seoul National University of Science & Technology, Korea; [3]Nara Institute of Science and Technology, Korea (the Republic of)
Abstract: This article presents a simulation and analysis of an intentional electromagnetic interference (IEMI) attack targeting the power delivery network (PDN) of a ring-oscillator (RO)-based true random number generator (TRNG). The jitter of ROs is a source of randomness, and the randomness is key for maintaining the hardware security of the device. When the jitter is reduced due to the injected noise, the randomness of the TRNG is degraded. In this article, the simulation setup of IEMI attack is proposed. When the noise associated with IEMI injection to the PDN is delivered to the ROs and the locking occurs, the output response of the RO is affected. This phenomenon is simulated and validated via measurement. Also, the simulated outputs of the TRNG are evaluated. The proposed simulation is capable of predicting the randomness degradation under the IEMI attack.

RALEIGH FUN FACT

HOW DID RALEIGH GET ITS NAME?

Raleigh was named after Sir Walter Raleigh, an explorer and nobleman who financed the first expeditions to the coast of present-day North Carolina. In the 1580s, he attempted to establish the first English colony in the New World.

Sir Walter Raleigh was one of the most renowned explorers of Elizabeth I's reign and quickly became the Queen's favorite. Because of his close relationship with the Queen, she initially forbade him from pursuing his plan to create English colonies in North America. However, being a rebellious spirit, he organized voyages in 1584, 1585, and 1587 that eventually led to the establishment of an English colony on Roanoke Island, now part of North Carolina.

TC4 TECHNICAL PAPERS

ANALYSIS OF EMI COUPLING MECHANISMS

10:30AM - 12:00PM

Room: 305B

Sponsored by TC-4 Electromagnetic Interference Control

Chair:
Daryl Beetner, *Missouri University of Science and Technology, Rolla, MO, USA*

Co-Chair:
Lirim Koraqi, *Katholieke Universiteit Leuven, Leuven, Belgium*

PLANNED SPEAKERS & TOPICS

10:30am
Mutual Magnetic Coupling Between the Common Modes of Bifilar Windings in Equal-Delay Transformers
James McLean
TDK R&D Corp., USA
EMC BEST PAPER FINALIST
Abstract: A comprehensive model for equal-delay transmission-line transformers (TLTs) is given which includes the coupling of common-mode (CM) magnetic flux between bifilar windings. It is shown that the CM magnetic flux can be thought of as being due to a CM voltage drop or gradient along the bifilar winding. The effect of the coupling of CM magnetic flux on the TLT performance is shown to depend on the topology of the TLT as well as that of the source and the load. A shunt-series, equal-delay TLT which employs two bifilar windings and can operate as a balun/hybrid as well a transformer is analyzed as an example. The coupling of the CM magnetic flux of the two bifilar windings is beneficial in a transformer application for a particular load configuration, but detrimental to balun operation. The new model is compared with lumped circuit analysis, in particular the coupled inductor feature in SPICE, and is thereby verified over the lower portion of the operating frequency range. It is believed that this model has not previously been published.

11:00am
EMI-Related Common-Mode Noise Analysis of CMOS and CML Drivers
Guangyu Sheng[1], Hanzhi Ma[1], Zhanxi Pang[1], Jianquan Lou[2], Haiwen Lu[2], Alpesh Bhobe[3], ErPing Li[1]
[1]Zhejiang University-University of Illinois Urbana-Champaign Institute, China; [2]Cisco Systems R&D Co., Ltd., China; [3]Cisco Systems, Inc., USA
EMC BEST STUDENT PAPER FINALIST
Abstract: With the rapid advancement of high-speed serial communication technology, the common-mode (CM) noise issue in the transmitter (Tx) output driver of Serializer/Deserializer (SERDES) systems becomes increasingly prominent. This paper proposes equivalent circuit models of a 20 Gb/s CMOS driver and a 20 Gb/s Current Mode Logic (CML) driver, based on TSMC N65 technology. Simulation results demonstrate that the proposed method effectively enables the analysis of CM noise. Furthermore, this paper conducts the comparative analysis of CM noise characteristics in CMOS and CML drivers from multiple relevant factors. The results show that the CM noise performance of the CML driver is better than that of the CMOS driver.

11:30am
Extended S-Parameter Model of Power Distribution Network for Rapid Coupling Predictions
Cody J. Goins, Aaron Harmon, Cody Goins, Kristen M. Donnell, Victor Khilkevich, Daryl Beetner
Missouri University of Science and Technology, USA
Abstract: Power and return planes are part of the power delivery network of almost all modern high frequency printed circuit boards. These power and return planes can form the basis of unintended radiated emissions from, or radiated coupling to, these boards. Predicting coupling to complex systems is a difficult problem and typically reserved for full wave simulations. Recent works have introduced segmentation approaches that are able to predict coupling to complex printed circuit board designs by using pre-rendered segments and cascading these segments through a circuit solver approach. The extended S-parameter models used by the segmentation approach currently do not include a model for power-plane pairs typical of power distribution networks. This work introduces an extended S-parameter model for the power-plane pair that can easily be integrated into the segmentation approach to quickly estimate radiated coupling to complex power distribution networks including power-plane pairs, IC packages, traces, and more. The characteristics of the power-plane pair are estimated using a cavity model approach. Methods to compensate for radiation loss from the pair are discussed. This approach is then used to capture the relationship between voltages at ports looking into the power-plane pair and with radiated or coupled plane waves using an extended S-parameter model. A comparison between the radiated coupling to a power distribution network is found using the proposed analytical approach and a full wave model. The results are within 1 dB of one another up to 4.8 GHz.

TC6 TECHNICAL PAPERS

SPECTRUM ENGINEERING

10:30AM - 11:00AM

Room: 306A

Sponsored by TC-6 Spectrum Engineering

Chair:
Larry Cohen, *US Naval Research Laboratory, Gaithersburg, MD, USA*

PLANNED SPEAKERS & TOPICS

10:30am
Selective RFID Gate - Use of Absorbing EMC Materials to Eliminate Interference with the Operation of Automatic Identification Systems
Krzysztof Sieczkarek, Tomasz Warzynski, Adam Mackowiak
Lukasiewicz Research Network - Poznan Institute of Technology, Poland
Abstract: The article presents concept, design and build a prototype of a RFID gate that will enable effective and selective reading of RFID tags without the need to change the infrastructure of the environment. It will make wireless systems independent from the EMC environment in which it will be installed. It reduces the impact of external electromagnetic disturbances and uses EMC absorbers.

Photo by Patrick Andre

TC10_6 TECHNICAL PAPERS

APPLICATIONS OF AI AND OPTIMIZATION ALGORITHMS

10:30AM - 12:00PM

Room: 306B

Sponsored by TC-10 Signal and Power Integrity

Chair:
Ruihua Ding, *Meta Platforms Inc, Palo Alto, CA, USA*

Co-Chair:
Ken Willis, *Cadence Design Systems, San Jose, CA, USA*

PLANNED SPEAKERS & TOPICS

10:30am

Differential Via Modeling using Multilayer Perceptron-Sequential (MLP-SEQ) Neural Network

Hyunwook Park[1], Shruti Sawant[1], Bandi Sathvika[1], Arun Chada[2], Soumya Singh[2], Seema PK[2], Taein Shin[3], Haeseok Suh[3], Junyong Park[4], Bhyrav Mutnury[5], DongHyun (Bill) Kim[1]

[1]Missouri University of Science and Technology, USA; [2]Dell Inc., USA; [3]Korea Advanced Institute of Science and Technology, Korea (the Republic of); [4]Dankook University, Korea (the Republic of); [5]Advanced Micro Devices Inc Austin, USA

Abstract: In this paper, an encoder-decoder structured multi-layer perceptron-sequential (MLP-SEQ) networks are proposed to model high-speed differential vias for estimating differential insertion loss (IL) and return loss (RL). Sequential neural networks including recurrent neural network (RNN), long short-term memory (LSTM), and gated recurrent unit (GRU) are introduced as the decoder NN to treat frequency responses as sequences. The proposed models are validated by finite element method (FEM) simulation results. The accuracy and training times of MLP-RNN, MLP-LSTM, and MLP-GRU models are compared and analyzed. Based on the MLP-LSTM model, various design of experiments (DoEs) are conducted to enhance the reproducibility and reliability of the proposed model. In addition, to further improve accuracy, various methods to enhance long-term memory of the encoder's output feature node are investigated.

11:00am

Multi-Objective Inverse Optimization of High-Speed Interconnects using Cascaded Deep Neural Network

Yicheng Zhang[1], Ling Zhang[1], Hyunwook Park[2], Bo Pu[3], Xiao-Ding Cai[4], Chulsoon Hwang[2], Bidyut Sen[4], Jun Fan[2], Er-Ping Li[1], James Drewniak[2]

[1]Zhejiang University, China; [2]Missouri University of Science and Technology, USA; [3]DetoolIC Technology, China; [4]Cisco Inc., USA

Abstract: This paper proposes a novel multi-objective inverse optimization method for high-speed interconnects based on a cascaded deep neural network (DNN) structure, which can efficiently optimize characteristic impedance, insertion loss, and far-end crosstalk (FEXT) simultaneously. Parameter optimization for high-speed interconnects is essential to the signal integrity and electrical performance of complex designs such as multilayer printed circuit boards (PCBs) and chiplets. Conventional optimization approaches often rely on numerous optimization iterations, which is highly time-consuming, especially in high-dimensional parameter spaces. This paper proposes a novel DNN-based method by cascading an inverse-prediction network and a forward-prediction network to achieve multi-objective optimization for characteristic impedance, insertion loss, and FEXT by optimizing the trace width, trace spacing, and pair-to-pair distance. Further, by incorporating an integer programming technique, parameter optimization of multilayer PCBs, including the PCB stackup and design parameters of each signal layer, can be accomplished in seconds, much more efficiently than the conventional optimization approaches.

11:30am

USB 3.0 IBIS-AMI Model Construction using Measurement and Neural Network

Jiahuan Huang[1], Wenchang Huang[1], Muqi Ouyang[1], Hank Lin[2], Bin-Chyi Tseng[2], Chulsoon Hwang[1]

[1]Missouri University of Science and Technology, USA; [2]ASUSTek Computer Inc., Taiwan

SIPI BEST PAPER FINALIST

Abstract: The input/ output modes are essential for high-speed signal integrity analysis and channel simulation. This work aims to develop a method for generating an IBIS-AMI model for USB 3.0 using measurement data. Instead of requiring a specially designed motherboard with test points for specific measurements, this method uses measurement data obtained from an assembled motherboard. The only available data for measurement in this case is the output voltage waveform from the USB 3.0 port on the motherboard. To address this, a novel approach is proposed to extract all the required parameters for the IBIS-AMI model from a single available measurement using a neural network. The neural network is trained with a set of IBIS-AMI models, each containing parameters with varying values, and a series of voltage waveforms generated from channel simulations with these IBIS-AMI models. Once trained, the neural network can generate the IBIS-AMI model using just one measured output voltage waveform. This constructed model has no limitations related to the output channel and can be applied to different output channels for analysis, making it a versatile tool for high-speed signal integrity evaluation.

TC10_7 TECHNICAL PAPERS

FILTER DESIGN FOR HIGH FREQUENCY CHANNELS

10:30AM - 11:30AM

Room: 306C

Sponsored by TC-10 Signal and Power Integrity

Chair:
Victor Khilkevich, *Missouri University of Science and Technology, Rolla, MO, USA*

Co-Chair:
Giorgi Maghlakelidze, *NVIDIA Corp, San Jose, CA, USA*

PLANNED SPEAKERS & TOPICS

10:30am
Novel Parallel Coupled Microstrip Line-based Transition Structure Design in Narrow-Band SIW Filter Integration
Haojie Wu[1], Jiankan Weng[1], Yin Sun[2], Xinglin Sun[1]
[1]Zhejiang University, China; [2]Ningbo Detool Technology Co. Ltd, China
Abstract: Substrate integrated waveguide (SIW) technology has emerged as a prominent solution for integrating high-performance narrow-band filters in microwave circuits, due to its high quality factor and high compatibility with planar integration. One practical method to enhance the quality factor of the SIW resonator is to increase the substrate thickness within an optimal range. However, this operation simultaneously leads to the introduction of a discontinuous reference ground structure This paper presents a parallel coupled microstrip line (PCML)-based transition structure in integrating narrow-band SIW filters with microwave circuits. To mitigate the transmission discontinuity during the integration, an asymmetric PCML unit is specially designed at the discontinuous section for the first time. Further, a 3-unit cascaded PCML-based transition structure has been developed, accompanied by a detailed design guide for the structural dimensions. A prototype of the proposed transition structure was fabricated and cascaded with a SIW filter to verify its practical performance. The measured results show that the proposed transition achieved a good transmission with an insertion loss of -0.55 dB around canter frequency. Meanwhile, the bandpass characteristic of the transition effectively suppressed the parasitic passband of the SIW filter by over 40 dB, ensuring the narrow-band filtering performance of the integrated circuit.

11:00am
Ultra-Wideband Balanced-Line-Based Common-Mode Rejection Filter with Dumbbell-Shaped Conductors for Over 64 Gb/s Digital Transmission
Byung Cheol Min[1], Kang Wook Kim[1], Mun Ju Kim[1], Jaeduk Han[2], Seok Min Yun[2], You Seng Jang[2]
[1]Kyungpook National University, Korea (the Republic of); [2]Hanyang University, Korea (the Republic of)
Abstract: Ultra-high-speed data transmission over 100 Gb/s necessitates an ultra-wide frequency bandwidth that is several times the Nyquist frequency, posing numerous tough challenges in conventional digital circuits. Among them, a common-mode noise can cause degradation of the differential signal quality and originate electromagnetic (EM) interference. Various common-mode rejection (CMR) filters have been reported, but the rejection bandwidths are insufficient for ultra-high-speed data transmission. In this paper, a balanced-line-based CMR filter with significant amount of CMR level at exceeding 40 GHz is proposed. Balanced lines (BLs) are categorized into two types: coplanar stripline (CPS) and parallel stripline (PSL), both having ultra-wideband CMR characteristic. In addition, the CMR level can be significantly enhanced by using a pattern composed of conductors alongside the BL. A PSL-based CMR filter with dumbbell-shaped conductors has been designed, and the performance of the implemented filter has been measured. The proposed CMR filter demonstrates the capability to significantly reject common-mode noise, achieving suppression level of 10 dB from 5.8 GHz to 40 GHz. Also, with a 64 Gb/s PAM-4 PRBS digital data, the proposed CMR filter exhibits a substantial reduction in ultra-wideband common-mode noise levels.

SC3_2 TECHNICAL PAPERS

MACHINE LEARNING BASED METHODS FOR EMC AND SIPI #2

1:30PM - 4:30PM

Room: 303

Sponsored by SC-3 Special Committee on Machine Learning and Artificial Intelligence in EMC and SIPI

Chair:
Matteo Cocchini, *International Business Machines Corp, New York, NY, USA*

Co-Chairs:
Ling Zhang, *Zhejiang University, Hangzhou, China*
Hanzhi Ma, *Zhejiang University, Hangzhou, China*

PLANNED SPEAKERS & TOPICS

1:30pm
Data Representation and Preprocessing Effects on S-Parameter Modeling of High-Speed Channels using Machine Learning
Hyunwook Park[1], Davit Kharshiladze[1], Yifan Ding[2], Ling Zhang[3], Natalia Bondarenko[4], Hanqin Ye[4], Kaushal S. Mhalgi[4], Brice Achkir[4], Chulsoon Hwang[1]
[1]Missouri University of Science and Technology, USA; [2]Google LLC, USA; [2]Zhejiang University, China; [3]Cisco Systems Inc., USA
Abstract: In this paper, the effects of data representations and preprocessing on machine learning-based S-parameter modeling of high-speed channels are investigated. Using a transformer network as a base model, two S-parameter representations in real/imaginary and magnitude/phase are compared and studied. Considering S-parameter data distributions, various preprocessing techniques including MinMax normalization, standardization, robust scaling, power transformation, and quantile transformation are compared and analyzed to improve accuracy. Moreover, the accuracy results are compared depending on the electrical length of target channels.

2:00pm
Neural Equalizer Design based on Gated Recurrent Unit and Its Variants
Hanzhi Ma[1], Yiqin Xiang[1], Kaijun Zheng[1], Jiarui Qiu[1], Jose Schutt-Aine[2], ErPing Li[1]
[1]Zhejiang University - University of Illinois Urbana-Champaign Institute China; [2]University of Illinois at Urbana-Champaign, USA
Abstract: Compared to traditional equalizers in high-speed links, neural equalizers offer stronger nonlinear modeling capabilities and better adaptability to varying channel conditions. However, existing neural equalizers face challenges such as high memory consumption and structural complexity, limiting their practical application in hardware implementations. To address these limitations, this paper introduces neural equalizers based on the Gated Recurrent Unit (GRU) and its four variants (GRU-v1, GRU-v2, GRU-v3, and GRU-v4). Through application to a high-speed link example, the results show that GRU-v3, which simplifies the update and reset gates by retaining only the bias terms, delivers the best performance in hardware implementation. It reduces memory usage by 65.68% and improves signal equalization performance, making it a promising solution for practical applications.

3:30pm
XAI-Based Sensitivity Analysis of High-Speed Link Considering Channel Operating Margin
Junghyun Lee, Joonsang Park, Keunwoo Kim, Taein Shin, Haeyeon Kim, Keeyoung Son, Kyungmook Kim, Joungho Kim
Korea Advanced Institute of Science and Technology, Korea (the Republic of)
Abstract: In this paper, we propose explainable artificial intelligence (XAI)-based high-speed link sensitivity analysis (SA) method considering channel operating margin (COM) to provide a fast, accurate, and interpretable method for analyzing high-speed links. By computing Shapley additive explanations (SHAP) values for each design parameter, our method reveals not just their relative importance but also the direction of their influence—indicating whether adjustments in parameters lead to over- or under-equalization (EQ). We further validate our approach by comparing it to a conventional Morris method, demonstrating the advantages of SHAP in capturing context-dependent effects and detailed parameter interactions. The proposed methodology enables designers to analyze system performance more efficiently, reduce time-consuming manual tuning, and gain valuable insights into complex, nonlinear EQ behaviors in high-speed communication systems.

3:30pm
RAG-EM: Retrieval-Augmented Generation for Electromagnetic System Design
Priyank Kashyap[1], Nirjhor Rouf[2], Yongjin Choi[1], Chris Cheng[1], Paul Franzon[2]
[1]Hewlett Packard Enterprise Co, USA; [2]North Carolina State University, USA
Abstract: As large language models (LLMs) gain broader adoption, incorporating domain knowledge via proprietary data is of the utmost importance. However, data such as platform design guides (PDGs) have heavy restrictions in the design flow, meaning that the data must remain on-premise. Thus, using existing language models over the Internet is infeasible without compromising the data. This paper examines using local LLMs with domain knowledge, especially PDGs, with relevant design information and custom tool interfaces. In order to provide the LLM with domain-relevant knowledge, we use modified retrieval augmented generation (RAG). For domain-relevant knowledge, we provide the LLM with numerous PDGs and Python scripts that enable the control of an electromagnetic tool for PCB design. We demonstrate the ability of the model to perform domain-specific question/answering (QA) and generate code for manipulating 3D EM structures such as striplines and vias. We show the advantage of the on-prem RAG-based approach over finetuning by introducing new tasks/instructions.

4:00pm
ANN Based EMI Filter Optimization with Limited Data in Vehicle Power Systems
Soujun Maeta[1], Ryo Maekawa[1], Shohei Kan[2], Toshiki Mikura[2], Kengo Iokibe[1], Yoshitaka Toyota[1]
[1]Okayama University, Japan; [2]Aisin Corporation, Japan
Abstract: In an in-vehicle power system, three-phase AC, 100 V AC, and 12 V DC are generated from a high-voltage battery, requiring efficient EMI filter design. Time-domain simulations for IGBT and MOSFET switching are costly, limiting data availability. This study compares orthogonal arrays (OAs) and Latin hypercube sampling (LHS) for optimal learning of an artificial neural network (ANN) with limited data. Three ANN models were trained for different noise terminal voltages, using seven filter parameters as inputs and 300-point frequency spectra in the range of 0.1 MHz to 100 MHz as outputs. Results show OAs achieving higher accuracy than LHS.

BEST STUDENT PAPER CONTEST

The Best Student Paper Contest recognizes and celebrates outstanding research contributions from students. The contest seeks to identify and reward innovative, high-quality research papers that demonstrate exceptional insight, originality, and academic rigor. Submissions are evaluated by a panel of experts from diverse academic fields, and winners receive a prestigious award during the award luncheon. Finalists will be invited to pitch their work during the Young Professional event, and present a poster during the conference as part of the final evaluation steps. This contest aims to encourage and support the next generation of researchers and scholars, fostering a culture of academic excellence and intellectual growth.

Join us to support our students and learn more about their outstanding Technical Papers!

Tuesday, August 19
in the Exhibit Hall
2:30 - 3:30 PM

TC4_TC8 TECHNICAL PAPERS

EMI CONTROL: SHIELDING, ANALYSIS, AND MEASUREMENT

1:30PM - 5:00PM

Room: 305B

Sponsored by TC-4 Electromagnetic Interference Control & TC-8 Aeronautics and Space EMC

Co-Chairs:

Huadong Li, *Molex LLC, Naperville, IL, USA*
John Kraemer, *Collins Aerospace, Marion, IA, USA*

PLANNED SPEAKERS & TOPICS

1:30pm
Analysis of Induced Common-Mode Voltage for Four-Wire Shielded Cable Considering Cable Imbalance
Nobuo Kuwabara, Tohlu Matsushima, Yuki Fukumoto
Kyushu Instiute of Technology, Japan
Abstract: Four-wire shielded cables are used in USB systems. With the increase of their transmission speed, the communication signals become the source of radiated disturbance in the VHF band. This paper investigates the analytical model considering the imbalance of four-wire shielded cables to study the radiation mechanism. The CM voltage generated at the signal line was calculated using a chain parameter matrix and compared with the measured value. As a result, the difference in conductor radius between the signal line and the power line and the twist of the wire did not significantly affect the CM voltage for the cables with twisted quad type. On the other hand, the cable with twisted pair type needed a model considering the twist of wires. Finally, we found that the unexpected imbalance of the cable that does not appear in the cross-sectional structure can be approximately modeled by adding a capacitance between one wire of the signal lines and the shield. These results indicate that the cable model for the CM voltage can be improved by considering wire twists and unexpected imbalances.

2:00pm
Shielding Practice of HV Power Cable Lines
Erika Stracqualursi[1], Rodolfo Araneo[1], Marco Alvelli[2]
[1]Universita degli Studi di Roma La Sapienza, Italy; [2]G-Iron ELF Magnetic Shield, Italy
Abstract: The paper investigates new practices for shielding the magnetic induction at power frequency radiated from under- ground high-voltage cables. We consider typical arrangements, i.e., cables directly buried or installed in underground concrete- encased ducts. The shielding material is based on crossed grain-oriented steel plates covered with aluminum tape supplied by industry. Due to its flexibility, the material is suitable for the design and realization of several shield geometries. The shielding effectiveness yielded by different possible solutions has been measured in a laboratory setup.

2:30pm
Analysis and Simulation of Electromagnetic Interference in Computer Systems
Shun-Chia Tseng[1], Chiu-Chih Chou[1], Yi-Shang Huang[2], Kuan-Hsueh Tseng[2]
[1]National Central University, Taiwan; [2]Micro-Star International Co Ltd, Taiwan
Abstract: Abstract—With rising laptop performance and widespread wireless adoption, EMI from high-speed components like DDR memory and solid-state drives impacts wireless connectivity strongly. Yet, systematic modeling of DDR-induced platform noise remains limited. This paper analyzes DDR noise in laptops, proposes a general method to predict the noise power, and validates the method using real measurements.

3:30pm
Low-Frequency Shielding Characterization of Planar Materials Using the H-t Cell Set-up: 3D Full-Wave Simulations and Measurements Study
Lirim Koraqi[1], Pavithrakrishnan Radhakrishnan[1,2], Tim Claeys[1], Johan Catrysse[1], Davy Pissoort[1]
[1]Katholieke Universiteit Leuven, Belgium; [2]Oklahoma State University, USA
EMC BEST STUDENT PAPER FINALIST
Abstract: This paper examines the H-t cell~set-up used for the low-frequency magnetic shielding characterization of planar materials. The study combines 3D full-wave simulations with practical measurements over the frequency range of 9 kHz to 100 MHz. Numerical simulations using the Finite-Difference-Time-Domain solver are employed to model and simulate the~set-up. Various material samples are considered to gauge their shielding effectiveness through both simulations and measurements. A good correlation between the simulated and measured shielding effectiveness is observed, thereby validating our simulation model. Additionally, this paper investigates the impact of several parameters of the H-t cell set-up on the shielding effectiveness characterization. These parameters include the loops' orientation, loop-to-sample distance, and loops' radii, with the aim of better replicating real electromagnetic environments. The investigation underscores that shifting loops from coplanar to parallel configurations leads to decreased shielding. Additionally, in coplanar set-ups, the loop-to-sample distance is more impactful, whereas, in parallel configurations, the loops' radii become more influential.

4:00pm
Coupling Path Analysis of Data Center SSD Storage Systems Based on Visualization Technique
Haran Manoharan[1], Haran Manoharan[1], Jihun Kim[1], Lalit Kumar1, Heewon Kang[2], Chunghyun Ryu[2], Chulsoon Hwang[1]
[1]Missouri University of Science and Technology, USA
[2]Samsung Electronics, Korea (the Republic of)
Abstract: Electrostatic discharge (ESD) is a major source of electromagnetic interference, capable of causing damage, malfunctions, or disruptions in electronic devices. As a result, ESD immunity testing is a critical component of electromagnetic compatibility (EMC) standards. In this study, the radiation emitted from the ESD gun body over 2 GHz is characterized and modeled using Huygens' principle. The equivalent field source was validated across three different environments, demonstrating accuracy with errors of less than 10 dB. A coupling path visualization technique was then employed to identify critical coupling paths, providing guidance for the strategic placement of absorbers. Simulation results showed that applying absorbers to the identified critical areas could reduce coupling by up to 20 dB.

4:30pm
Novel Approach to Spacecraft System Level Magnetic Test
Katherine Dang[1], Pablo Narvaez[1], Klaus Mehlem[2], John Trinh[1], Corey J. Cochrane[1], Manuel Martin Soriano[1], Jodie Ream[3]
[1]Jet Propulsion Laboratory, USA; [2]Astos Solutions, Germany; [3]Massachusetts Institute of Technology, USA
Abstract: A novel and unique spacecraft system level magnetic test method was conceptualized, designed, and developed to support two concurrent spacecrafts built at NASA JPL (Jet Propulsion Laboratory), Psyche and Europa Clipper, both equipped with science-grade magnetometers. This method did not require the use of a large three-axis Helmholtz/Braunbeck coils or a mu-metal shielded chamber, typically used by the majority of magnetic test facilities to remove Earth's magnetic field. The method was accurate and robust, scalable from small electronic assemblies to large flight systems, portable, cost effective, and relatively risk-free to the spacecraft. The method underwent proof-of-concept testing with a known magnetic source as well as a mock-up spacecraft. Ultimately, it was successfully performed on the Psyche spacecraft and Europa Clipper spacecraft.

Photo by Richard Georgerian

TC2_1 TECHNICAL PAPERS

EMC MEASUREMENTS: MEDICAL & PROBES

1:30PM - 5:00PM

Room: 306A

Sponsored by TC-2 EMC Measurements

Chair:
Monrad Monsen, *Oracle America Inc, Redwood Shores, CA, USA*

Co-Chair:
Ahalya Srikanth, *Ford Motor Company, Lasalle, ON, Canada*

PLANNED SPEAKERS & TOPICS

1:30pm

Comparative Assessment of RF-Induced Heating in Epicardial Implantable Electronic Devices During 0.55 T and 1.5 T MRI: Effects of Full Systems vs. Abandoned Leads

Bhumi Bhusal[1], Pia P. Sanpitak[1], Fuchang Jiang[1], Gregory Webster[2], Jacob Richardson[3], Nicole Sieberlich[3], Laleh Golestanirad[1]

[1]Northwestern University, USA; [2]Northwestern University Feinberg School of Medicine, USA; [3]University of Michigan, USA

Abstract: Majority of young pediatric patients with cardiac implantable electronic devices (CIEDs) have epicardial leads, creating contraindication for MRI due to concerns about RF-induced heating. This limitation not only denies them access to the superior diagnostic capabilities of MRI but also forces reliance on alternative imaging modalities such as CT and X-ray, subjecting young patients to potentially harmful radiation during critical developmental years. While recently introduced low-field MRI scanners (e.g., 0.55 T) are considered more implant-friendly, current claims are based on limited data, and the implant-specific risks remain largely unexplored. In this study, we systematically evaluated the RF heating of a commercial epicardial lead under varying termination conditions during MRI at 0.55 T and compared these results with heating observed at a conventional 1.5 T scanner. Our findings reveal that RF heating of the epicardial lead was significantly lower at 0.55 T across all termination scenarios. Furthermore, leads connected to the implantable pulse generator (IPG) exhibited the highest RF heating, while abandoned leads demonstrated comparatively reduced heating. These results highlight the importance of implant-specific evaluations in assessing MRI safety, particularly at low field strengths, and provide critical insights for optimizing imaging protocols for pediatric CIED patients.

2:00pm

RF-Induced Heating in Orthopedic Implants : In Silico Assessment of Surgical and Healed Models under 1.5 T and 3 T MRI

Ananya Nandikanti, Jianfeng Zheng, Ji Chen

University of Houston, USA

Abstract: This study investigates RF-induced heating in tibial nail implants using computational models (Duke, Ella, Fats) at 1.5T and 3T MRI. Post-surgery with bone adhesives and healed models were analyzed to assess the impact of implant depth, bone adhesive properties, and nail length on RF-induced heating. Results show higher heating may occur in surgical models, especially with synovial adhesives due to their conductivity. Heating decreased with implant depth, reflecting tissue conductivity variations from surface to core. Nail length influenced worst-case heating, varying across models and MRI field strengths . These findings highlight the importance of in silico simulations to label the implants, ensuring patient safety under MRI.

2:30pm

Obstacles and Mitigations for an Accurate Low Impedance, Low Frequency Measurement

Faye E. Squires[1], Yifan Ding[1], Matthew S. Doyle[2], Matteo Cocchini[2], Samuel Connor[2], Francesco de Paulis[3], Albert E. Ruehli[1], Chulsoon Hwang[1], Lijun Jiang[1]

[1]Missouri University of Science and Technology, USA; [2]International Business Machines Corp, USA; [3]University of L'Aquila, Italy

EMC BEST PAPER FINALIST

Abstract: The two-port shunt configuration is often heralded as the gold standard for low-impedance measurements. However, this measurement method is not without its own issues. The shunt configuration inherently creates a ground loop between the measurement device's reference plane and the reference of the device under test (DUT). Additionally, probes often must be oriented in such a way that allows inductive coupling to occur. This work uses microprobes to measure the shunt impedance of a non-ideal short to explore the limitations of this measurement method in terms of both frequency and impedance. It highlights the importance of ground loop isolation and common-mode rejection ratio (CMRR) as well as limitations resulting from the mutual inductance between probes. The conclusions of these experimental measurements aim to find a path to further optimize shunt impedance measurements for power distribution networks (PDNs) as the industry points towards further lowering PDN impedance to meet increased current demands.

3:30pm
RF-Induced Heating of Deep Brain Stimulation Devices During MRI: A Comparison Study of 1.5 T and 3 T Systems
Sana Ullah[1], Safa Hameed[1], Bhumi Bhusal[1], Giorgio Bonmassar[2], Laleh Golestanirad[1]
[1]Northwestern University, United States; [2]Massachusetts General Hospital, United States
EMC BEST PAPER FINALIST
Abstract: High-field MRI systems (3 T and above) are widely used in clinical and research settings due to their high signal-to-noise ratio (SNR) and superior spatial resolution, enabling detailed anatomical visualization and enhanced diagnostic accuracy. When combined with invasive neuromodulation therapies such as deep brain stimulation (DBS), high-field MRI provides critical insights into treatment optimization and outcome interpretation. However, concerns about radio-frequency (RF) heating of implants have limited the routine use of 3 T MRI for many DBS patients. This heating risk arises from resonance effects, where specific implant configurations and lead lengths can amplify the MRI's electric fields, underscoring the importance of precise modeling and experimental validation of RF-induced heating under diverse conditions. In this work, we present a comprehensive evaluation of RF heating in a commercial DBS device during 1.5 T and 3 T MRI. Specifically, we measured and validated the transfer function of both a lead-only and a fully implanted DBS system under RF exposure at 64 MHz and 123 MHz, following FDA-recommended protocols outlined in ISO-TS 10974. Our results show that, while RF heating could still reach dangerous levels at 3 T, its magnitude was consistently and substantially lower compared to 1.5 T when the input power of the pulse sequences was adjusted to achieve the maximum allowable B+1 at both field strengths (i.e., 4.9 QT at 1.5 T and 2.82 QT at 3 T). Post-MRI assessments revealed no device malfunction following 3 T scans. These findings are consistent with prior studies, calling into question the assumption that higher-field MRI necessarily poses greater risk for patients. with implants.

4:00pm
Comparison Study of Cuff Electrode Designs on RF-induced Heating under MRI
Yuhui Xu, Ebrahim Farshad, Lijina Yang, Qingyan Wang, Jianfeng Zheng, Ji Chen
University of Houston, USA
Abstract: This study explores the influence of cuff electrode design, including variations in diameter and wrapping angle, on implantable medical device RF-induced heating under MRI procedure. Numerical and experimental studies were performed to evaluate the heating variation due to these factors inside the ASTM phantom. The results highlight that electrode design can significantly impact heating. It was observed that electrodes with smaller diameters and smaller wrapping angles can have higher RF-induced heating. It was also observed that the electrode designs will not change the shape of the device model. These findings provide critical insights for efficient and safer designs for cuff electrode.

4:30pm
Effect of Leads Insertion Variations on the MRI Conditionality of AIMDs under 1.5T MRI
Farshad Ebrahimi, Tanvir Islam, Qingyan Wang, Jianfeng Zheng, Ji Chen
University of Houston, USA
Abstract: This research examines the effects of a partially inserted lead on RF-induced heating in a 12-electrode IPG system during MRI scans. Two scenarios were evaluated: a fully inserted lead and leads displaced by 1 mm. The results revealed that even a slight displacement (1 mm) led to a minor increase in heating. These findings emphasize the critical role of proper lead placement during IPG implantation and highlight the necessity for enhanced MRI safety protocols to minimize risks associated with lead misalignment, ensuring patient safety and reducing potential adverse effects during MRI procedures

SENIOR MEMBER ELEVATION AND IEEE FELLOW CLASS OF 2025

TAKING YOUR EMCS MEMBERSHIP TO THE NEXT LEVEL

TUESDAY, AUGUST 19, 2025 • 2:30 – 4:00PM • ROOM 302B

Join us at this informal meeting where you can quickly learn about elevating your current IEEE membership to the Senior or Fellow category.

Being a Senior or Fellow Member is a prestigious honor within the IEEE community. It signifies your accomplishments and expertise in your field. But how do you apply for these elevations in membership? Do you qualify for the next level?

Join us to find out the next steps needed to enhance your career with an elevated IEEE membership. We will have experts on hand to answer any question you may have on these membership elevations, but were afraid to ask, or didn't know who to ask. Bring your resume to be paired with potential references as required per the Senior Member application.

Refreshments will be served during the normal break time.

TC10_1 TECHNICAL PAPERS

HIGH-SPEED INTERCONNECTS #1

1:30PM - 5:00PM

Room: 306B

Sponsored by TC-10 Signal and Power Integrity

Chair:
Hanfeng Wang, *Google Inc, Mountain View, CA, USA*

Co-Chair:
Kinger Cai, *Arm Ltd, San Jose, CA, USA*

PLANNED SPEAKERS & TOPICS

1:30pm
Interlaced Spoof Surface Plasmon Polariton for Improvement of Transmission Line Signal Integrity
Ming-Lung Kung[1], Zheng-yu Ke[2], Ken-Huang Lin[2]
[1]R.O.C. Air Force Academy, Taiwan; [2]National Sun Yat-sen University, Taiwan
Abstract: Crosstalk between adjacent transmission lines (TLs) is among the factors that strongly affect the signal routing integrity of printed circuit boards and integrated circuit packages. In contrast to traditional methods of suppressing crosstalk on high-density TL layouts, including guard traces or stubs, spoof surface plasmon polariton (SPP) can help design smaller structures for crosstalk suppression. Accordingly, this study proposes an interlaced SPP for reducing impedance discontinuities on double-sided SPP TLs. The experimental results indicated greater signal integrity in the interlaced SPP, with an eye-height improvement of 6.4% at a data rate of 16 Gbps.

2:00pm
IBIS Model Simulation Accuracy Improvement with Slew Rate Correction
Yifan Ding, Chulsoon Hwang
[1]Missouri University of Science and Technology, USA
SIPI BEST PAPER FINALIST
Abstract: The accuracy of Power-Supply-Induced Jitter (PSIJ) simulation in Input/Output Buffer Information Specification (IBIS) models is critical for ensuring robust high-speed signal integrity analysis but it lacks accuracy in predicting the PSIJ when the pre-driver exists in the model. Previous studies have proposed methods to improve IBIS PSIJ simulation accuracy with pre-driver effect included in the IBIS switching coefficients modification process. However, these methods fail to accurately model the output waveform slew rate change with varied power noise. In this work, an improved modification method was proposed to incorporate power-aware characteristics into the modified IBIS model, thereby improving the accuracy of slew rate prediction. The method builds upon prior approaches by introducing the ratio modification and time correction steps to address both jitter and output slew rate inaccuracies. The model validation was conducted under power supply DC noise, single-frequency and multi-frequency AC noise. Simulation results validate the effectiveness of the proposed method, showing significant improvements in both timing accuracy and slew rate modeling.

2:30pm
Skew Characterization Analysis in CCL Fabrication
ChangChih Liu, ChaoHui Kuo, KuoLiang Chao
Taiwan Union Technology Corporation, Taiwan
Abstract: High speed digital (HSD) system is essential in modern communication as Artificial Intelligence (AI) grows at remarkably speed. Printed-Circuit-Board (PCB) is the bedrock of all complex high speed digital system, and Copper-Clad-Laminate (CCL) as a whole provides the critical materials to construct the entire PCB industry. SI has many metrics, and skew is one of the key factors. Poor skew could be catastrophic in the whole system performance. At the very beginning, taking the glass-weave-effect in CCL into account can mitigate skew effect. Different kinds of fabric, such as 2116, 1067 and 1037 with variant positions of transmission lines produce distinct skew. This heuristic approach is consistent with the experimental data.

3:30pm
Design Strategies for Skew Compensation in High-Speed PCB Strip Line Interconnects
Sathvika Bandi[1], Reza Asadi[1], Zhekun Peng[1], Srinivas Venkataraman[2], Granthana Rangaswamy[2], Santosh Pappu[2], Xu Wang[2], DongHyun (Bill) Kim[1]
[1]Missouri University of Science and Technology, USA; [2]Meta Platforms Inc., USA
Abstract: This paper presents a comprehensive analysis of the impact of intra-pair PN skew compensation in printed circuit board (PCB) strip line (SL) traces, for a high-speed 224 Gbps lane for the first time. The study investigates the effects of skew compensation placement both with and without via discontinuities. Detailed evaluations are performed in both time and frequency domains, examining critical parameters such as time-domain reflectometry (TDR), input impedance, return loss, insertion loss, and common-mode S-parameters. The findings reveal that, in a simple strip line trace without via discontinuities, the location of skew compensation has negligible influence on signal margins. However, when via discontinuities are introduced, the impact becomes significant on signal margins and common-mode conversion. This highlights the crucial role of skew compensation placement in high-speed designs, where increasingly tight performance margins and reduced PCB dimensions exacerbate signal integrity challenges. The results underscore the importance of careful design considerations to optimize performance in modern high-speed interconnects.

4:00pm
Optimized Modeling of PCB Vias with Non-Functional Pads and High-Frequency Behavior up to 150 GHz
Mehdi Mousavi[1], Kevin Ca[i2], Chaofeng Li[1], Sathvika Bandi[1], Manish Mathew[1], Mehdi Khaleghi[1], Shameem Ahmed[2], DongHyun Kim[1]
[1]Missouri University of Science and Technology, USA; [2]Cisco Systems, Inc., USA
Abstract: This paper presents an enhanced closed-form approach for modeling and optimizing high-frequency PCB vias, implemented in Python and validated against industry-standard tools such as ADS and HFSS. The model incorporates resistance alongside inductance and capacitance to capture frequency-dependent losses and integrates non-functional pads (NFPs), demonstrating significant improvements in signal integrity by reducing reflections and enhancing return loss, particularly at 100 GHz. The methodology extends the frequency range of previous models from 100 GHz to 150 GHz, ensuring compatibility with next-generation standards like PCIe Gen 6. Validation results show insertion loss deviations under 3 dB and consistent return loss across the frequency range. The Python-based implementation offers a scalable and efficient solution for multilayer via designs, significantly reducing computational time compared to HFSS. This work provides a robust framework for high-speed PCB via modeling, with applications in academic research and industry, and includes future extensions to model differential signal vias

4:30pm
Resonance Suppression in Microstrip to Grounded Coplanar Waveguide Transitions
Navid Elahi, Jian-Ming Jin
University of Illinois Urbana-Champaign, USA
Abstract: In this paper, we propose two methods to suppress unwanted resonances in grounded coplanar waveguides (GCPWs) based on a novel understanding of the resonance phenomenon. These methods are based on the phase difference tuning between the excited coplanar mode and the parallel plate mode in the GCPWs. Simulation results demonstrate clearly the effectiveness of the resonance suppression.

TC9_1 TECHNICAL PAPERS

ADVANCES IN ELECTROMAGNETIC MODELING AND PREDICTION

1:30PM - 5:00PM

Room: 306C

Sponsored by TC-9 Computational Electromagnetics

Chair:
Shengxuan Xia, *Missouri University of Science and Technology, Santa Clara, CA, USA*

Co-Chair:
Wei Zhang, *Marvell Semiconductor Inc., Reading, MA, USA*

PLANNED SPEAKERS & TOPICS

EXEMPLARY PAPER

Multiscale EMC Modeling, Simulation, and Validation of a Synchronous Step-Down DC-DC Converter

Presenting Author:
Jie Chen, *Texas Instruments Incorporated, Dallas, TX, USA*
Dipanjan Gope, *Department of Electrical Communication Engineering, Indian Institute of Science (IISc), Bengaluru, India*
R. Murugan, **J Chen**, A. Tripathi, B. P. Nayak, H. Muniganti, **D. Gope** (2023)
Citation: R. Murugan, J Chen, A. Tripathi, B. P. Nayak, H. Muniganti, D. Gope "Multiscale EMC modeling, simulation, and validation of a synchronous step-down DC-DC converter," in *IEEE Journal on Multiscale and Multiphysics Computational Techniques*, vol. 8, pp. 269-280, doi: 10.1109/JMMCT.2023.3276358.

2:00pm
Radiated Emission Estimation of the Electric Vehicle Powertrain System using Hybrid Method
Jaehoon Kim[1], Jordi Soler[1], Philippe Le Marrec[1], Yun-kyoung Ko[2]
[1]Altair Engineering Inc, USA; [2]FEV Europe GmbH, Germany
Abstract: A hybrid method, combining circuit analyzer and electromagnetic field simulator, is applied to estimate the radiated emission (RE) of the electric vehicle powertrain system. The powertrain system is represented by its equivalent circuit models to calculate the electric signals generated in the system, which are applied as the source of the main radiated field evaluation with the CISPR 25 RE setup. Additionally, an integrated electric drive module (EDM) is studied in the aspect of the RE reduction.

2:30pm
A Representative Contents Modeling Approach for Predicting Electronics Susceptibility
Jon W. Wallace, Ian J. Timmins
Sandia National Laboratories, USA
EMC BEST PAPER FINALIST
Abstract: A technique is described that partitions the electromagnetic susceptibility analysis of a printed circuit board (PCB) inside a metal enclosure into two parts. First, the PCB is replaced with a representative contents (ReCos) surrogate and characterization of the loaded enclosure yields scalar power density in the vicinity of the PCB. Second, analysis of coupling from enclosing fields to PCB traces is performed to predict PCB voltages and currents. In this work, simple and efficient power balance is applied for the second step. Accuracy of the technique is explored through experiments involving a cylindrical metallic enclosure housing a custom PCB with 30 transmission lines over a frequency range of 500 MHz to 20 GHz.

3:30pm
Comparison of Techniques for Predicting Statistical Distribution of Fields in Chaotic Enclosures
Evelyn A. Dohme Dhombridge[1], Zhen V. Peng[2], Paul Bremner[3], Thomas W. Hussey[4]
[1]Sandia National Laboratories, USA; [2]University of Illinois at Urbana-Champaign, USA; [3]Robust Physics, USA; [4]University of New Mexico, USA
Abstract: Here we explore a key difference between statistical techniques for estimating electric fields in chaotic, overmoded cavities. The Stochastic Power Balance, the Random Coupling Model, and the Stochastic Green's Function are all based on expanding field parameters in statistical cavity eigenfunctions approximated by a sum over random plane waves where eigen-mode spacing is given by random matrix theory. They differ, however, in how they evaluate the statistics of fields over an ensemble. Power balance, initially developed by the acoustics community, first averages the field energy over the cavity and then notes that this average energy varies over an ensemble of such cavities, empirically characterizing this variation with a lognormal distribution. Then, noting that for each value of average cavity energy the field is Rayleigh distributed, they get field statistics from a convolution integral over the two distributions. Both the Random Coupling Model and Stochastic Green's Function calculate the point-to-point coupling for each member of the ensemble and calculate field statistics using a Monte Carlo approach. In this paper we compare the two approaches, finding that for high modal overlap they are identical and differ only modestly at lower modal overlap.

4:00pm
Efficient Statistical Analysis of EM Coupling to PCB Power Planes in Complex Enclosures
Sangrui Luo[1], Shen Lin[1], Yang Shao[1], Thomas Antonsen[2], Zhen Peng[1]
[1]University of Illinois Urbana-Champaign, USA; [2]University of Maryland, USA
EMC BEST PAPER FINALIST
Abstract: This paper presents a hybrid deterministic-statistical simulation framework for analyzing electromagnetic coupling to printed circuit boards (PCBs) housed within electronic enclosures. The proposed method integrates a stochastic Green's function integral equation formulation with the reciprocity theorem to model the interaction between cavity fields, PCB power planes, and aperture currents. The work enables efficient statistical prediction of far-field radiation patterns for radiated emission problems and induced voltages at critical PCB port locations for electromagnetic coupling scenarios. Representative numerical experiments are conducted to validate the methodology against full-wave simulations.

4:30pm
A Stable TDIE Method for Analyzing the Shielding Effectiveness of Typical Metallic Structures
Rongchuan Bai, Ming-Da Zhu, Hao-Xuan Zhang, Zhe Chen, Zheng-Wei Du, Wen-Yan Yin
Zhejiang University, China
Abstract: In this work, we adopt a stability-improved time-domain integral equation (TDIE) method to predict the transient response under electromagnetic irradiation. This method is specifically designed to evaluate the shielding effectiveness (SE) of typical enclosure deckhouse structures. When compared with the commercial software FEKO, which also utilizes surface mesh discretization, the results show excellent agreement. Therefore, this method offers a promising tool for electromagnetic compatibility (EMC) analysis.

ASK THE EXPERTS
PANEL DISCUSSION

AUTOMOTIVE HYBRID, ELECTRIC AND AUTONOMOUS – ADDRESSING THE COMPLEXITY OF MODERN VEHICLES

2:00PM - 3:30PM

Room: Exhibit Floor, AtE Stage

SPONSORED BY: RETLR

Organizer:

Janet O'Neil, *ETS-Lindgren, Cedar Park, TX, USA*

Today's complex vehicle platforms include propulsion, entertainment and safety related systems all having to function reliably without impacting safety or the legacy communications infrastructure. The increased interest in autonomous vehicles is also driving the need for more sophisticated automotive EMC design and test scenarios, such as those addressing EMC, sensors (including radar) and wireless considerations. This impacts both component level and full-vehicle level emissions and immunity. Our Automotive "Ask the Experts" panelists represent a diversity of automotive related organizations, including full vehicle manufacturers, an integrated circuit (IC) test specialist, members of the ISO/CISPR D Automotive EMC Committees, an automotive test chamber and instrumentation manufacturer, and a commercial automotive EMC test lab. These experts will share their knowledge on current and future automotive EMC design and test considerations. Bring your questions or simply listen and learn.

PLANNED PANELISTS INCLUDE:

Bob Mitchell, *TUV Rheinland AG, Boxborough, MA, USA*
Garth D'Abreu, *ETS-Lindgren, Cedar Park, TX, USA*
Ronald Missier, *Ford Motor Company, Northville, MI, USA*
Rich Boyer, *Aptiv Plc, Warren, OH, USA*
Robert Kado, *Stellantis US, Auburn Hills, MI, USA*
Craig Fanning, *Elite Electronic Engineering, Inc., Downers Grove, IL, USA*

ED_B1
EXPERIMENTS & DEMONSTRATIONS

ABSORBING MATERIALS AND SPECIALTY SILICONE COMPOSITE, MATERIALS AS TERMINATIONS FOR FEXT AND NEXT MEASUREMENTS

2:30PM - 4:30PM

Room: Exhibit Floor, E&D Booth 1

Sponsored by TC-10

Numerous types of materials, including metallic, polymeric composites and electrically conductive silicones, can be utilized to mitigate and control electromagnetic shielding interference. In this demonstration, absorbing materials and specialty silicone composite materials will be demonstrated for use in signal integrity termination for FEXT and/or NEXT measurements as an alternative to screw on SMA terminations.

PRESENTERS:

Daniel L. Commerou, *Missouri University of Science and Technology, USA*
Julia Sunderland, *The Dow Chemical Company, USA*

ED_ B2 EXPERIMENTS & DEMONSTRATIONS

COMPUTATIONAL MODELING AND CHARACTERIZATION FOR SIGNAL INTEGRITY AND POWER INTEGRITY: A COMPREHENSIVE APPROACH FOR THE IEEE EMC/SIPI CONFERENCE SOFTWARE DEMONSTRATION

2:30PM - 4:30PM

Room: Exhibit Floor, E&D Booth 2

Sponsored by TC-10

Signal Integrity and Power Integrity are critical in the design of high-speed, high-frequency, and power-sensitive electronic circuits. SI refers to the quality and reliability of the signals transmitted across PCB traces and interconnects, while PI ensures that the power distribution network within the system operates without significant noise or fluctuations that could affect the performance of sensitive components. With the rising complexity of designs and higher operational frequencies, SI and PI become increasingly difficult to manage using traditional design methods.

Objective:

- Highlight the utility of the modeling framework in adhering to EMC regulations and achieving design compliance.
- Demonstrate the capabilities of a comprehensive computational modeling framework that integrates SI and PI simulations.
- Provide a software demonstration that highlights the accuracy and effectiveness of these simulations in identifying and mitigating issues such as signal distortion, crosstalk, power noise, and EMI.
- Showcase the integration of computational techniques for optimizing the SI and PI performance of high-speed and power-sensitive electronic systems.

PRESENTER:

Shahid Ahmed, *Ansys, Inc., USA*

ED_ B3 EXPERIMENTS & DEMONSTRATIONS

EMC COMPLIANCE OUT OF THE BOX, INSIDE A METAL BOX

2:30PM - 4:30PM

Room: Exhibit Floor, E&D Booth 3

Electronic devices are designed to meet EMC requirements on their own, but in many cases the device needs to be inside a metal box for one reason or another which then becomes a major aspect of their EMC compliance. While these metal boxes are generally helpful, housing material, apertures, and pesky wiring can wreak havoc being a liability for both radiated emissions and susceptibility therefore the importance of knowing the impact of these boxes is clear! In this demonstration, we will examine typical housing features using both hardware and electromagnetic simulation to explain the effects of these features and impact on EMC compliance.

PRESENTER:

Scott Piper, *Dassault Systemes, USA*

ED_B4 EXPERIMENTS & DEMONSTRATIONS

HARDWARE DEMONSTRATION: TIME DOMAIN VS. FREQUENCY DOMAIN

2:30PM - 4:30PM

Room: Exhibit Floor, E&D Booth 4

Sponsored by TC-8

The two primary "domains" we have for observing electrical signals are the time domain, as observed with an oscilloscope, and the frequency domain, as observed with a spectrum analyzer. A solid understand of both domains, along with a solid understanding of how the two domains relate to each other through the Fourier Transform and Fourier Series Expansions, is crucial for a complete understanding of the behavior of electrical signals.

This demonstration will provide an overview of the Fourier Transform and Fourier Series Expansions followed by measurements of representative signals in both the time and frequency domains in order to show agreement with theoretical models. Once this relationship is demonstrated, these theoretical models provide useful and powerful analytical tools that can come in handy especially in situations in which direct measurements may not be feasible.

PRESENTER:

John C. McCloskey, *Jen Dimov, NASA, USA*

ED_B5 EXPERIMENTS & DEMONSTRATIONS

DEMONSTRATING PROPER PROBE PLACEMENT IS PARAMOUNT IN PRACTICAL SYSTEMS

2:30PM - 4:30PM

Room: Exhibit Floor, E&D Booth 5

The proposed experiment will illustrate how probe loading can present challenges when measuring signals in electrical systems. The demonstration will employ a Curl-E box, which comprises:

- An AM Ferrite Road Antenna
- A project box equipped with measurement hooks
- A signal generator

This setup will highlight how a common oscilloscope probe can inadvertently create a loop during measurement — formed by the probe tip and the pigtail or reference clip. By orienting two probes in opposite directions the result will be as shown below. The flux generated by the ferrite rod antenna will intersect the surface area of each probe and the circuit, inducing a voltage.

Due to the specific orientation of the probes, one will display a sine wave while the other will show a phase-shifted waveform resembling a cosine wave (nearly 180° out of phase with the first), caused by the magnetic flux passing through the probe loop. This demonstration and explanation are crucial because many early to mid-career engineers have yet to learn proper probing techniques. Often, they simply attach their leads to a test point and leave them in the circuit, which can result in erroneous measurements.

Additionally, the lecture will provide an overview of probe non-idealities and probe construction, further underscoring the importance of proper measurement techniques.

PRESENTER:

Christopher J. Semanson, *Renesas Electronics America Inc., USA*

INTERNATIONAL SYMPOSIUM ON ELECTROMAGNETIC COMPATIBILITY

EMC EUROPE 2026

31 AUGUST - 3 SEPTEMBER

PRAGUE, CZECH REPUBLIC

On behalf of the combined organising committee of the Czech EMC community and the University of Twente, we are delighted to extend a warm welcome to all of you to the EMC Europe 2026 symposium in the enchanting city of Prague.

SYMPOSIUM VENUE

Prague is one of the most enchanting capitals in the world. Prague's historic streets and lively atmosphere invite visitors to explore its charming cafés, traditional beer halls, and exquisite restaurants, making it a truly unforgettable destination.

The EMC Europe 2026 symposium is an essential meeting place where leading international experts, researchers and engineers will come together to share the latest scientific contributions in the field of electromagnetic compatibility. The program will include plenary talks on major topical issues, technical sessions, workshops and tutorials, covering a wide range of subjects such as measurement techniques, modelling and electromagnetic risk management, as well as application fields such as automotive and defence industries.

We look forward to your active participation and once again extend a warm welcome to the EMC Europe 2026 Symposium in Prague.

IMPORTANT DATES

- Special Session Proposals: January 12, 2026
- Paper Submission Deadline: February 16, 2026
- Workshop & Tutorial Proposals: March 30, 2026
- Notification of Paper Acceptance: April 27, 2026
- Registration of participants: March 31, 2026 (starting date)
- Reduced Registration Fee: June 1, 2026
- Final Paper Submission: June 1, 2026
- Exhibition Application: June 26, 2026

CONTACT

emceurope2026@utwente.nl
www.emceurope2026.org

SCHEDULE AT A GLANCE

ROOM	302C	303	305A	305B	306A	306B	306C
8:30 AM			SPECIAL SESSION SS_2 ACHIEVING POWER INTEGRITY WITH AI/ML ALGORITHMS	TECHNICAL PAPERS TC5_SC1 EVALUATION OF EM INTERFERENCE	TECHNICAL PAPERS TC2_2 EMC MEASUREMENTS: EMISSIONS	TECHNICAL PAPERS TC10_2 HIGH-SPEED INTERCONNECTS #2	TECHNICAL PAPERS TC9_2 EMC CHALLENGES IN COMPLEX SYSTEMS AND REVERBERANT ENVIRONMENTS
10:00 AM	REFRESHMENT BREAK						
10:30 AM		TECHNICAL PAPERS TC12 WIRELESS EMC ADVANCES: RFI MITIGATION, IMMUNITY, AND COEXISTENCE TESTING	↓	TECHNICAL PAPERS TC5_1 HEMP TEST METHODS	↓	↓	↓
11:30 AM							
12:00 PM	LUNCH BREAK						
1:30 PM	WORKSHOP WT_C1 EFFECTIVELY NAVIGATING THE COMPLEXITIES OF MEASUREMENT UNCERTAINTY IN EMC TESTING	WORKSHOP WT_C2 TEST AND MEASUREMENT FUNDAMENTALS OF EMC	TUTORIAL WT_C3 TUTORIAL ON MACHINE LEARNING		TUTORIAL WT_C5 LESSONS LEARNED CREATING RELIABLE COMPUTATIONAL MODELS FOR SI, PI AND EMC APPLICATIONS	WORKSHOP WT_C6 P2855, A CHARACTERIZATION OF SHIELDING CCA FROM DC TO 40 GHZ	WORKSHOP WT_C7 AUTOMOTIVE EMC – STANDARDS, MEASUREMENT AND SIMULATION FOCUSING ON EVS
3:00 PM	REFRESHMENT BREAK						
3:30 PM	↓	↓	↓		↓	S ↓	S ↓
5:00 PM							
5:30 PM							

CLAYTON R. PAUL GLOBAL UNIVERSITY: 8:00 AM - 5:30 PM, RM 201
(Pre-Registration Required)

GLOBAL SIPI UNIVERSITY: 8:00 AM - 5:00 PM, RM 202
(Pre-Registration Required)

EXHIBIT HALL OPEN: 10:00 AM – 5:00 PM
EXPERIMENTS & DEMOS: 9:30 AM - 11:30 AM, 2:30 PM - 4:30 PM
ASK THE EXPERTS PANELS: 10:00 - 11:30 AM

ADDITIONAL STANDARDS SESSIONS, WORKING GROUPS AND TECHNICAL COMMITTEES
For Collateral Meetings, please see page 134

SPEAKERS BREAKFAST
Raleigh Convention Center, 301AB - 7:00 - 8:30 AM
(Breakfast Only on the Day of Presentation)

REGISTRATION/INFO DESK
7:30 AM - 5:00 PM

IEEE EMC SOCIETY WOMEN IN ENGINEERING (WIE) EVENT
301A - 4:00 PM – 5:30 PM

GALA DINNER
Ballroom BC – Raleigh Convention Center - 7:00 PM - 10:00 PM
(Ticketed Event)

S **STANDARDS WEEK**
For more information about Standards Week, please visit page 132

SS_2 SPECIAL SESSION

ACHIEVING POWER INTEGRITY WITH AI/ML ALGORITHMS

8:30AM - 12:00PM

Room: 305A

Sponsored by TC-10 Signal and Power Integrity

Chair:
Chulsoon Hwang, *Missouri S&T EMC Laboratory, Missouri University of Science and Technology, Rolla, MO, USA*

Co-Chair:
Ling Zhang, *Zhejiang University, Hangzhou, China*

Achieving power integrity (PI) across PCB, package, and silicon for complex, multi-domain systems remains a major challenge, often relying on iterative design and expert experience despite mature post-layout tools. Modern PI demands—such as sub-milliohm impedance targets and space-constrained layouts—exceed the capabilities of traditional methodologies. Recently, AI/ML techniques have emerged as promising solutions for pre-layout PI design and decoupling capacitor optimization, offering the potential to reduce design cycles and enable advanced EDA tools. This special session will address AI/ML algorithms in PI design, which may contribute to new ideas and solutions to the above challenges.

PLANNED SPEAKERS & TOPICS

8:30am
Fast and Simple Pre-Design of Decoupling Capacitors using Reinforcement Learning
Taein Shin[1], Keunwoo Kim[1], Junghyun Lee[1], Seonguk Choi[1], Haeseok Suh[1], Hyunah Park[1], Hyunwoo Kim[1], Jinwook Song[2], Seokwoo Hong[2], Youngjun Ko[2], Joungho Kim[1]
[1]Korea Advanced Institute of Science and Technology, Korea; [2]Samsung Electronics, Korea (the Republic of)
SIPI BEST PAPER FINALIST
Abstract: In this paper, we propose a reinforcement learning (RL)-based methodology for the pre-design of decoupling capacitors (decaps) in power distribution networks (PDNs). The method aims to optimize the quantity and size of decaps across the PCB, package (PKG), and chip to meet target specifications of ripple voltage and power supply-induced jitter (PSIJ). By utilizing RL, the approach rapidly estimates the decap configuration without needing retraining for different RLC profiles, enhancing design efficiency. Compared to traditional genetic algorithms (GA), the proposed RL-based method significantly improves both performance and computational efficiency, achieving optimal results with over 10 times faster inference time. This approach is particularly useful in the early stages of design, where estimating the required decap quantity is more critical than determining precise placement. The results validate the effectiveness of RL in optimizing decap design for diverse product scenarios.

9:00am
Multiple PDN Design Optimization Using Deep Reinforcement Learning for Low PSIJ in PCIe Gen6.0 Interfaces
Chulhee Cho, Youngjun Ko, Hyunwoo Kim, Seokwoo Hong, Sungwoo Jin, Chorom Jang, Sungwon Roh, Hyeongi Lee, Sungjin Yoon, Youngjae Lee, Seonho Um, Jinwook Song, Kyungsuk Kim, Sunghoon Chun
Samsung Electronics Co Ltd, Korea (the Republic of)
Abstract: In this paper, for the first time, we propose a large language model (LLM)-based decoupling capacitor (decap) placement optimization method. By leveraging Optimization by PROmpting (OPRO), we harness pre-trained LLMs' pattern-recognition capabilities, demonstrating their potential to address complex power integrity (PI) domain engineering problems beyond simple question-and-answer interactions. We structured the LLM's input prompts to include task descriptions, domain knowledge, output formats, and information from previous attempts, enabling effective optimization. We applied the proposed algorithm to solve the decap placement problem for power distribution networks (PDNs) composed of high bandwidth memory (HBM) base die, silicon interposer, and package. The proposed approach is compared with traditional optimization algorithms, such as random search and simulated annealing, showing that an LLM-based optimizer can effectively capture PI-related patterns and deliver competitive solutions. This work highlights the potential of LLM-driven optimization in solving complex engineering problems, extending the application of LLMs beyond their conventional use as chatbots or general-purpose assistants.

9:30am
Large Language Model-based Decoupling Capacitor Placement Optimization
Taein Shin[1], Keunwoo Kim[1], Junghyun Lee[1], Seonguk Choi[1], Haeseok Suh[1], Hyunah Park[1], Hyunwoo Kim[1], Jinwook Song[2], Seokwoo Hong[2], Youngjun Ko[2], Joungho Kim[1]
[1]Korea Advanced Institute of Science and Technology, Korea; [2]Samsung Electronics, Korea (the Republic of)
Abstract: In this paper, for the first time, we propose a large language model (LLM)-based decoupling capacitor (decap) placement optimization method. By leveraging Optimization by PROmpting (OPRO), we harness pre-trained LLMs' pattern-recognition capabilities, demonstrating their potential to address complex power integrity (PI) domain engineering problems beyond simple question-and-answer interactions. We structured the LLM's input prompts to include task descriptions, domain knowledge, output formats, and information from previous attempts, enabling effective optimization. We applied the proposed algorithm to solve the decap placement problem for power distribution networks (PDNs) composed of high bandwidth memory (HBM) base die, silicon interposer, and package. The proposed approach is compared with traditional optimization algorithms, such as random search and simulated annealing, showing that an LLM-based optimizer can effectively capture PI-related patterns and deliver competitive solutions. This work highlights the potential of LLM-driven optimization in solving complex engineering problems, extending the application of LLMs beyond their conventional use as chatbots or general-purpose assistants.

10:30am
Homogeneous Multi-Chip PDN Optimization for DDR Memory Architecture using RL
Kyungmook Kim, Haeyeon Kim, Junghyun Lee, Jiwon Yoon, Joonsang Park, Keunwoo Kim, Joungho Kim
Korea Advanced Institute of Science and Technology, Korea (the Republic of)
Abstract: In this paper, we propose a reinforcement learning (RL)-based framework to address hierarchical feature variations, multi-chip interactions, and partial decoupling capacitor (decap) allocation across hierarchical power distribution network (PDN) levels, including the PCB, PKG, and chip domains. We formulate the problem as a multi-decap placement problem (MultiDPP), aimed at optimizing the location and allocation of decaps to achieve three critical objectives: minimizing PDN impedance, reducing cost, and optimizing chip area utilization. The RL framework employs a dual-reward mechanism combining a stepwise reward (Rstep) for immediate action evaluation and an episode-wise reward (Rep) to achieve overall decap minimization. To validate the proposed approach, we apply it within a DDR5 environment, demonstrating significant reductions in design time, overall decap usage, and SSN compared with traditional methods. The results confirm that accounting for hierarchical differences and multi-chip interactions yields a robust, scalable solution for on-chip PDN design, paving the way for more efficient and reliable DIMM architectures in current and future memory technologies.

11:00am
Graph-Based Reinforcement Learning Approach for Multi-Power-Domain PCB PDN Shape and Stackup Synthesis
Haran Manoharan[1], Hanfeng Wang[2], Jingnan Pan[2] Yuchu He[2], Xu Gao[2], Jianmin Zhang[2], Chulsoon Hwang[1]
[1]Missouri University of Science and Technology, USA; [2]Google LLC, USA
Abstract: Efficient power plane and stackup optimization is critical for Printed Circuit Board (PCB) Power Delivery Networks (PDNs), particularly in multi-power-domain designs with stringent DC Resistance (DCR) specifications. This work presents a novel reinforcement learning-based framework that assigns stackup layers for each power domain and iteratively refines power plane shapes to meet design constraints while ensuring non-overlapping layouts. The approach leverages Minimum Spanning Trees (MSTs) for initializing power plane shapes. It dynamically refines them using the A* (A-Star) algorithm with weighted pathfinding, ensuring optimal connectivity and compliance with DCR requirements. Tested extensively on multi-power-domain scenarios, the algorithm demonstrates robust performance and scalability, offering an unprecedented solution to power plane and stackup optimization challenges in PCB PDN design.

11:30am
Reinforcement Learning-Based Via Placement Optimization in Package Substrate for Multiple Power Domain 3D-ICs
Seunghun Ryu[1], Seonghi Lee[1], Dongryul Park[1], Sanguk Lee[1], Hyunwoo Kim[1], Dongkyun Kim[1], Jinwook Lee[1], Seokbeom Yong[2], Sangsub Song[2], Seungyoung Ahn[1]
[1]Korea Advanced Institute of Science and Technology, Korea (the Republic of); [2]Samsung Electronics Co Ltd, Korea (the Republic of)
Abstract: In this paper, reinforcement learning-based via placement optimization methodology is proposed for multiple power domain (MPD) 3D-ICs. The package substrate is responsible for routing power and ground to appropriate power domains and components in MPD 3D-ICs. Proper design of the package substrate contributes to obtaining power integrity by efficiently allocating power resources and lowering PDN impedance. Among components in the package substrate, microvia transfers power vertically and lowers PDN impedance through proper assignment. However, the package substrate is exposed to the optimization challenges resulted from MPD. Accordingly, a reinforcement learning algorithm is adopted with a deep learning network to optimize the power/ground microvia placement so that power noise can be minimized. Markov decision process (MDP) is defined and simultaneous switching noise (SSN) is modeled with analytical modeling of the package substrate component. The proposed method demonstrates the superior optimality performance compared to meta-heuristic optimization algorithms while consuming lower execution time.

TC5_SC1 TECHNICAL PAPERS

EVALUATION OF EM INTERFERENCE

8:30AM - 10:00AM

Room: 305B

Sponsored by TC-5 & SC-1 High Power Electromagnetics & Special Committee on Smart Grid

Co-Chairs:

Michael McInerney, *Consultant, Champaign, IL, USA*

William Radasky, *Metatech Corporation, Goleta, CA, USA*

PLANNED SPEAKERS & TOPICS

8:30am

A Systematic Approach to Quantify Electromagnetic Interference Risk by Cloud Modeling

Parthib Khound[1], Omar Mohammed[2], Frank Gronwald[2]

[1]Indian Institute of Technology Bombay, India;
[2]University of Siegen, Germany

Abstract: Electromagnetic interference (EMI) can lead from minor performance degradation to a complete failure of an electric or electronic system. Therefore, particularly for safety-critical systems, risk assessment is the first step to quantify the effect of EMI on a system, allowing remedial modifications to reduce risk. Risk is a multidimensional function that depends on several factors, such as the EMI scenario, frequency of occurrence, and threat to the system. Often, electromagnetic compatibility (EMC) specialists or reliability engineers subjectively rate these variables based on EMI tests or conceptual understanding of the system. Subjective ratings, such as “low”, “medium”, or “high”, are not always satisfactory due to the stochastic and fuzzy nature of subjectivity. Here we introduce the so-called cloud model which is a useful tool to address the problems associated with subjectivity. The cloud model is analyzed and used to present a general and systematic approach to quantify the risk of EMI in a system, inspired by a specific case study of an onboard railway signaling system.

9:00am

Electromagnetic Energy from Multiple Sources Within Perfect and Imperfect Faraday Shields

Robert G. Olsen, John B. Schneider

Washington State University, USA

Abstract: The energy injected into a Faraday shield by one or more pulsed dipoles is calculated. The residual energy (after the pulses are extinguished) is related to the dipole’s radiation fields. It is also shown that the energy from randomly placed multiple sources is propositional to the number of sources. Finally, it is shown that energy does not radiate through electrically small holes in the walls but does if conductors penetrate through the holes.

9:30am

Three-Dimensional Electromagnetic and Circuit Co-Simulation for Printed Circuit Boards Mounted Linear and Non-Linear Electric Elements

Soki Akutsu, Akio Ikeda, Hisashi Shimizu, Toshihiko Nishimori, Jun Yasui

Mitsubishi Heavy Industries, Ltd., Japan

EMC BEST PAPER FINALIST

Abstract: Currently, there is no established method for simulating the excessive response of printed circuit boards (PCBs) with nonlinear circuit elements through electromagnetic field simulation. On the other hand, the threat of intentional electromagnetic interference (IEMI) is increasing, making it urgent to establish simulation techniques for designing countermeasures. In this paper, we performed simulations of PCBs with linear and nonlinear circuit elements by integrating the Finite-Difference Time-Domain (FDTD) method with SPICE in a co-simulation approach. Furthermore, this study constructed a measurement system to evaluate the accuracy of the simulation results. It was confirmed that the simulation reproduced the measurement results with an error of a few dB. It is possible to handle nonlinear elements through the co-simulation that integrates the FDTD method and SPICE. Therefore, this paper concludes that this co-simulation can be utilized in the design of IEMI countermeasures.

TC2_2 TECHNICAL PAPERS

EMC MEASUREMENTS: EMISSIONS

8:30AM - 11:30AM

Room: 306A

Sponsored by TC-2 EMC Measurements

Chair:
Dave Arnett, *Garmin International Inc, Olathe, KS, USA*

Co-Chair:
Monrad Monsen, *Oracle America Inc, Redwood Shores, CA, USA*

PLANNED SPEAKERS & TOPICS

8:30am
An Omni-Directional Horizontally Polarized Antenna for 18-40GHz Site VSWR
Garret McKerricher, Yibo Wang, Ivan Morales, Zhong Chen
ETS-Lindgren, USA
Abstract: This paper presents the design and demonstration of an Omni-Directional Horizontally Polarized Antenna. Classified as a "loop" or "magnetic dipole" antenna, it exhibits an ultra-wide bandwidth of 18 to 40 GHz. The antenna has a 50 mm diameter, is constructed on a PCB substrate and maintains a dipole-like radiation pattern across the entire frequency range. Notably, it demonstrates H-Plane symmetry with a deviation of less than 31.5 dB. Chamber validation has been successfully conducted, utilizing the cylindrical mode filter technique to prove the antennas performance.

9:00am
Estimation of the Phase Center Position of a Hybrid Antenna for Radiated Emission Measurement
Fuminori Kanahara[1], Akira Murakami[2], Nobuo Kuwabara[3], Kunihiro Osabe[4], Hidenori Muramatsu[4]
[1]Sony Global Manufacturing and Operations, Japan; [2]e-OHTAMA, LTD., Japan; [3]Kyushu Kogyo Daigaku, Japan; [4]VCCI Council, Japan
Abstract: This paper describes the estimation of the phase center position, which is required on the phase center correction of LPDAs and hybrid antennas described in CISPR 16-2-3 Ed.4.2, on actual measurement.

9:30am
EMI Testing System Speed Optimization
Tobias Groß
Rohde & Schwarz, Germany
Abstract: Modern EMI testing becomes more challenging with more complex DUTs, rising frequencies and faster operating cycles. A complete system test consist of many individual measurement's over height, turning angle, polarization or DUT operating modes. With modern instrumentation, the bottlenecks shifts from the EMI receiver to the mechanical accessories as the antenna mast or the turntable. The paper examines the performance gain of optimized use of the EMI setup, both in testing speed as well as the increased reliability and better analysis capabilities for emission identification for the case of a failed EMI test. This not only saves time and money for the test, but also shortens development cycles with clearer information on where to find the EMI emission cause.

10:30am
Impact on Radiated Emission with EUT Mains Cable Termination by Balanced VHF-LISN
Kunihiro Osabe[1], Nobuo Kuwabara[2], Hidenori Muramatsu[1]
[1]VCCI Council, Japan; [2]Kyushu Institute of Technology, Japan
Abstract: To investigate the impact of Alternating Current (AC) mains cable termination devices on the radiated emission measurement, the difference in maximum emission levels was compared among termination devices with no termination condition. For two types of Very High Frequency (VHF) – Line Impedance Stabilization Network (LISN), the necessity of considering the emission limit was raised due to the impact on radiated emission characteristics. Therefore, from the results of the Round Robin Test (RRT) held in 2019, the comb-generator and actual product data were assessed precisely to solve this issue. As a result, from the peak-level comparison, the balanced VHF-LISN for AC mains cable is suggested as the most preferred termination device based on the data of the comb generator and 19 actual product measurements in each test site.

11:00am
Thin Film Near Field Absorbers in Specific EMI Environments
Sergei A. Manuilov, Shane White, Seong-Woo Woo, Taehoon Noh, Jeff Tostenrude, Jung Ju Suh
3M, USA
Abstract: In this work we utilize different electromagnetic interference (EMI) environments to test near field absorber performance as well as absorber placement. We use in-house designed test fixtures to mimic some of the real-world EMI environments: shield cans and metal shielding screens. The near field test results are compared to the reflection loss, one of the most used absorber metrics.

TC10_2 TECHNICAL PAPERS

HIGH-SPEED INTERCONNECTS #2

8:30AM - 12:00PM

Room: 306B

Sponsored by TC-10 Signal and Power Integrity

Chair:
Daniel Commerou, *Missouri University of Science and Technology, Rolla, MO, USA*

Co-Chair:
Yifan Ding, *Google LLC, Rolla, MO, USA*

PLANNED SPEAKERS & TOPICS

8:30am
Analysis Method for Curved Coupled Stripline with Triangular Tabs within Pin Field of High-Speed Channels
Yingcong Zhang[1], Xiao-Ding Cai[2], Kai Li[3], Yan Li[3], Dongxu Fu[3], Bidyut Sen[2], Guoan Wang[1]
[1]University of South Carolina, USA; [2]Cisco Systems Inc., USA; [3]Cisco Systems Inc., China
Abstract: Triangular tabs are a widely adopted method for enhancing signal integrity in routing design. However, traditional numerical tools utilized in the design process are time-consuming and computationally intensive. This paper presents an equation-based approach for quick and accurate calculation of scattering parameters (S-parameters) in curved coupled striplines with facing triangular tabs. The novel electric field compliant geometrical discretization (ECGD) method is explored and applied to derive a precise equation-based model. Both asynchronized and synchronized curved coupled stripline with facing triangular tabs, which are commonly applied in the pin field of the DDR channels, are investigated. Furthermore, the proposed methodology is employed to optimize impedance matching in DDR5 channels. Results demonstrate that this approach yields bathtub curves (derived from touchstone file) with a maximum deviation of 4% compared to numerical methods (Ansys HFSS), while reducing simulation time by approximately 238x. This combination of high accuracy and computational efficiency in calculating S-parameters performance for practical interconnects within the pin field underscores the significant potential of this approach in routing designs for DDR channels with improved signal integrity.

9:00am
Suppression of Ground Resonances in a Transmission-Line Based Connector
Navid Elahi, Jian-Ming Jin
University of Illinois Urbana-Champaign, USA
Abstract: Two methods are proposed to suppress "ground resonances" in transmission-line based connectors with guard traces. These methods are based on phase difference compensation between the excited signal and ground differential modes in the coplanar section of the connector. The first method eliminates the initial phase difference introduced by the junction at the input port. The second method compensates the initial phase difference by slowing down the signal differential mode.

9:30am
Impact of Z^{ref} Estimation for Transmission Line Characterization based on 2x-thru Calibration
Feng-Ting He, Chiu-Chih Chou
National Central University, Taiwan
Abstract: When using 2x-thru calibration for PCB transmission line characterization, accurate estimation of the reference impedance (Zref) is crucial to the accuracy of the renormalized S parameters. In this paper, we compare three different methods of estimating Zref: the mid-point method, initial-value method, and an analytic method. The results show that (i) initial value method is accurate at high-frequency, but not so at lowfrequency, (ii) constant-Zref methods can have incorrect DUT TDR regardless of the chosen Zref, and (iii) analytic method using frequency-dependent Zref produces better results.

EXEMPLARY PAPER
10:30am
Beyond 200G: Brick Walls of 400G Links per Lane
Presenting Author:
Brandon T. Gore, *Samtec Inc., Colorado Springs, CO, USA*
B. Gore, A. Josephson, R. Mellitz, F. de Paulis, L. Boluna, J. Calvin, R. Rabinovich, M. Resso (2025)
Citation: B. Gore, A. Josephson, R. Mellitz, F. de Paulis, L. Boluna, J. Calvin, R. Rabinovich, and M. Resso, "*Beyond 200G: Brick Walls of 400G Links per Lane*," in *Proceedings of DesignCon 2025*, Santa Clara, CA, USA, January 29th – 30th, 2025.

11:00am
224 Gbps High Speed Link Design and Measurement Correlation
Tao Wang, Jiangeng Mao, Benjamin Harding, Brian Brecht
DIS Tech, USA
Abstract: Boosted by the hardware demands for the machine learning, AI, and data center, the signal delivery speed is unprecedent. 224 Gbps PAM4 high speed link design has become increasingly popular. This paper discusses the transmission line design details needed for 224 Gbps and many necessaries concerns that are forgivable for low speed designs but not tolerable for high speed ones. Our testing coupon has demonstrated great correlation results after the mentioned details are carefully addressed throughout the design, modeling, and optimization process. This paper serves as a design guide for practical 224 Gbps signal delivery based on copper technology on the PCB boards. Keywords— 224 Gbps, High-speed Channel, High Speed Transmission Line, PAM4, Surface Roughness.

11:30am
A Non-Destructive and Simple Setup Method for Dielectric Liquid Characterization in a Wide Frequency Range with Djordjevic-Sarkar Model
Reza Vahdani[1], Seyedmehdi Mousavi[1], Reza Asadi[1], Xiaoning Ye[2], DongHyun (Bill) Kim[1]
[1]Missouri University of Science and Technology, USA; [2]Intel Corp, Hillsboro, OR, USA
Abstract: This paper introduces a non-destructive and simple setup method for characterizing dielectric liquids over a broad frequency range (up to 30 GHz) using the Djordjevic-Sarkar model. By employing a differential microstrip line and comparing scattering parameters in air-filled and liquid-immersed scenarios, the proposed method achieves precise dielectric constant (DK) and dissipation factor (Df) extraction. 2 Liquid samples (PAO4 and DC-15) were tested using this method. Validation against the cavity resonance method demonstrates a strong agreement for the extracted DK values, with a relative error of less than 1.5%, indicating high accuracy. However, the method is less sensitive to Df, particularly for low-loss dielectrics, with a relative error of 67% at the cavity resonance frequency. Despite this limitation, the technique provides a practical approach for wideband dielectric characterization, particularly for applications in immersion cooling and high-frequency electronic systems.

EDCOM INFORMATION SESSION

WEDNESDAY, AUGUST 20, 2025 • 7:00 AM TO 8:30 AM • ROOM 402

OPEN TO ALL SYMPOSIUM ATTENDEES

- Learn about the mission of EdCom.
- Be informed of what EdCom has been working on.
- Provide interaction between current EdCom leadership (and members) with those who might be interested in participating in the work of the committee.
- Other ideas....

TC9_2 TECHNICAL PAPERS

EMC CHALLENGES IN COMPLEX SYSTEMS AND REVERBERANT ENVIRONMENTS

8:30AM - 12:00PM

Room: 306C

Sponsored by TC-9 Computational Electromagnetics

Chair:
Shaohui Yong, *Missouri University of Science and Technology, San Jose, CA, USA*

Co-Chair:
Patrick DeRoy, *Analog Devices Inc, Norwood, MA, USA*

PLANNED SPEAKERS & TOPICS

8:30am
Investigating the Impact of Antenna Directivity on Working Volume Equivalence in Reverberation Chambers Using Reconstructed Sensitivity Maps
Anett Kenderes[1,2], Péter Tamás Benko[2], Szabolcs Gyimóthy[1]
[1]Budapest University of Technology and Economics, Hungary; [2]Robert Bosch Kft., Hungary
Abstract: In this paper, the equivalence of working volumes (WV) in reverberation chambers (RCs) is investigated by the regime of state-of-the-art sensitivity analysis (SA) techniques by inspecting the effect of changing configuration parameters to the field uniformity (FU) in a frequency-dependent study close to the lowest usable frequency (LUF). The Sobol'indices as SA measures are evaluated at each stirrer step and frequency. For efficient calculation, different state-of-the-art surrogate modeling techniques were utilized to substitute the full-wave simulation model depending on the characteristics of the WVs. The computational expenses of the problem are further reduced by using a decreased number of stirrer steps and frequencies, which are achieved by means of adaptive sampling techniques through Kriging interpolation. Furthermore, the size of the experimental design (ED) set, i.e., the number of different configurations is controlled by performing convergence studies. This method is able to reconstruct the 2D sensitivity map (SM) of the configuration parameters as functions of the stirrer steps and the frequency with a fewer number of samples. In this work, the effects of the directivity of the trasmitting (TX) antenna are investigated by evaluating the SM, while comparing the results obtained by antennas having different directivity properties.

9:00am
The Impact of Connector Brackets on the CS114 Performance of Digital Interconnects
David Norte
BAE Systems, Inc., USA
Abstract: Conductive susceptibility requirements for many missions require that systems demonstrate full functionality in the presence of the expected conductive noise environment for the mission. The CS114 standard attempts to simulate such environments by subjecting cables to modulated sinewaves, where the modulation is a baseband 1.0 kHz, 50% duty cycle bipolar square wave signal. Oftentimes, connector brackets are inserted along the cable's propagation path when the cable run is long (e.g., 5.0 m). The impacts of these brackets on the response of the cable run to the CS114 excitation is not well known. This paper addresses the performance of a 5.0 Gbps differential digital interconnect in the presence of the CS114 excitation and attempts to disclose how this interference degrades the received differential signal when a connector bracket exists along the propagation path.

9:30am
The Impacts of RE102 Exceedances on a Received BPSK Satellite Signal
David Norte
BAE Systems, Inc., USA
Abstract: During a RE102 EMC test campaign, several RF receiver notches normally exist, with low levels, over the frequency range of this test campaign. In this case, it is desired not to have any exceedances within any of the RF receiver notches. However, when an exceedance occurs within a given RF notch, it must be determined if this exceedance increases the bit-error-rate of the received modulated carrier or is negligible where no further countermeasures are required. This paper describes a simplified approach for characterizing exceedances within an RF notch and depends upon characterizing the impact of the exceedance on the received envelope of a BPSK carrier that then ultimately affects the received differential eye pattern and associated bit-error-rate (BER).

10:30am
Statistics of Electromagnetic Fields within Reverberant Nested Cavities when Coupled by Slotted Apertures
Marshall D. Sowell, Carl Hager
Naval Surface Warfare Center Dahlgren Division, USA
Abstract: An experimental study has been performed to understand the behavior of the received power within a nested reverberant cavity. Two groups of slotted apertures were used for coupling between cavities: Group 1 included apertures of equal length, but varying quantity and Group 2 was a single aperture of varying length. The Anderson-Darling and Pearson's Chi-Squared goodness-of-fit tests were used to test the data against the exponential distribution and K-distribution (KD), respectively, at a 95% confidence. The KD was shown to provide a good-fit for apertures of varying quantity and length. It was also observed that as the number independent and equivalent coupling mechanisms increased, the KD approached an exponential distribution. For electrically long apertures, it was shown that the number of statistically independent coupling mechanisms is equivalently defined as an integer multiple of half-wavelengths. Additional information regarding the behavior of the KD is presented.

11:00am
Radiation Coupling Between Reverberant Cavities through Cables
Weitao Dai, Paul Bremner
Robust Physics, USA
Abstract: This paper addresses the contribution to enclosure shielding effectiveness (SE) of transmission via multi-conductor cable penetrations. We use antenna theory, the reciprocity theorem and electric field statistical power balance (SPB) theory to develop a fast, robust algorithm to calculate the coupling between reverberant cavities through cables. Validation of both mean shielding effectiveness predictions and electric field statistical distribution predictions are compared with published test data to show the present level of accuracy and reliability.

11:30am
Simple Model to Predict RS103 Responses from Single UTP Circuits
David Norte
BAE Systems, Inc., USA
Abstract: Manufacturing practices when building unshielded twisted pair (UTP) cables can cause the lengths of the half twists to be random, which then affects the RS103 responses of such cables. This paper uses a simple transmission line model to extract the RS103 responses from unshielded twisted pair cables when the half twists are nominally either 0.5" or 0.125" and when the lengths of the half twists are uniformly distributed between +/-25% or +/-5% about the given nominal length, and when the length of the cable is 23 inches. In addition, two cable routing profiles are considered.

ED_C1 EXPERIMENTS & DEMONSTRATIONS

MASTERING SHIELDING CABINET: A HANDS-ON ON CAVITY RESONANCE

9:30AM - 11:30AM

Room: Exhibit Floor, E&D Booth 1

Sponsored by TC-4

As electronic components become increasingly compact on printed circuit boards (PCBs), the risk of electromagnetic interference (EMI) due to unintended coupling rises. To optimize the performance of integrated circuits (ICs) and ensure electromagnetic compatibility (EMC), board-level shields (BLS) are crucial in mitigating EMI in PCB designs. The shielding cabinet, or shielding can, is the most common BLS component. By connecting to the PCB's reference plane, it forms five of the six walls needed for a Faraday cage. While effective in shielding, it can cause undesired cavity resonance issues.

Join this tutorial for exploring the impact of cabinet dimensions on cavity resonance frequency for knowing how to face this issues in your projects.

PRESENTERS:

Victor Martinez Garcia, *Wurth Elektronik eiSos GmbH & Co KG, Germany*
Jared Quenzer, *Würth Elektronik, USA*

ED_C2 EXPERIMENTS & DEMONSTRATIONS

AIRCRAFT LIGHTNING INDUCED TRANSIENT SUSCEPTIBILITY: A NOVEL METHOD FOR POWER PINS TESTING

9:30AM - 11:30AM

Room: Exhibit Floor, E&D Booth 2

In order to perform as intended, electric and electronic systems from aircraft require, among others, testing against lightning induced transients. There are two main types of tests described in RTCA DO-160 and similar standards: pin injection and cable induction tests. This demonstration introduces a novel method to performing tests on power pins, and focuses on the relevance of power source protection elements and their influence on calibration results.

PRESENTERS:

Adrian Matoi, *EMC Partner AG, Switzerland*
Patrick Bolliger, *HV Technologies, Inc., USA*

ED_C3 EXPERIMENTS & DEMONSTRATIONS

MEASURING DIFFERENTIAL AND COMMON MODE CONDUCTED EMISSIONS FROM DC-DC CONVERTERS

9:30AM - 11:30AM

Room: Exhibit Floor, E&D Booth 3

DC-DC converters are commonly used to supply power to high speed GPUs and other processors. The high currents delivered to these devices often produces large wideband conducted emissions. This experiment will demonstrate how to use a 2-channel DC LISN and an oscilloscope to measure the common mode and differential mode conducted emissions and the proper use of input filtering to mitigate these effects.

PRESENTER:

Michael Schnecker, *Rohde & Schwarz, USA*

ED_C4 EXPERIMENTS & DEMONSTRATIONS

SIMULATION OF RADIATED EMISSIONS FOR EV POWERTRAIN

9:30AM - 11:30AM

Room: Exhibit Floor, E&D Booth 4

Sponsored by TC-9

An electric vehicle (EV) powertrain is a traction power system providing moving power to an EV by converting electric energy into mechanical motion. The powertrain is basically composed of a battery system, DC/AC inverter, an electric motor, and DC/AC power buses. The battery is a high DC voltage source and the inverter is designed to accomplish the DC-to-AC conversion which is needed to operate the electric motor. The DC bus connects between the battery and the inverter, whereas the AC bus exists between the inverter and the electric motor in the form of a three-phase line. Since the inverter is a fast switching device to generate a high power oscillating signal, the inverter is known as a significant electromagnetic(EM) interference source. Furthermore, it is easily anticipated that the high power signal is mainly radiated from the AC power bus next to the inverter. Therefore, it is highly required to set up the radiated emission (RE) procedure of the EV powertrain in the early EV design stage with capable simulation tools.

This software demonstration introduces a hybrid method, combining the circuit analysis of the EV inverter system (using Altair PSIM) and the EM simulation (using Altair Feko) to estimate the RE of the EV powertrain system. The powertrain system is represented by its equivalent circuit models to calculate the electric signals generated in the system, which are used as the source of the main radiated field evaluation with the CISPR 25 RE setup. Additionally, an integrated electric drive module (EDM) is presented in terms of how effectively the module reduces the RE of the EV powertrain.

PRESENTERS:

Jaehoon Kim, *Altair Engineering Inc., USA*
C.J. Reddy, *Altair Engineering Inc., USA*

ED_C5
EXPERIMENTS
& DEMONSTRATIONS

LOW COST TOOLS FOR EMC TROUBLESHOOTING

9:30AM - 11:30AM

Room: Exhibit Floor, E&D Booth 5

Sponsored by TC-3

This demonstration will show off some low cost tools that can assist with EMC troubleshooting. You don't need tens of thousands of dollars worth of equipment to get a sense of what's in the RF environment, either in terms of radiation surrounding a piece of equipment or conducted noise on cabling. The main focus will be on low cost software defined radio (SDR) devices that are easily available, along with some accessories that can make them more illuminating when tracking down EMC issues.

PRESENTER:
Karen Burnham, *EMC United, Inc., USA*

TC12 TECHNICAL PAPERS

WIRELESS EMC ADVANCES: RFI MITIGATION, IMMUNITY, AND COEXISTENCE TESTING

10:30AM - 12:00PM

Room: 303

Sponsored by TC-12 EMC for Emerging Wireless Technologies

Chair:
Harry Skinner, *Intel Corporation, Hillsboro, OR, USA*

Co-Chair:
Gang Feng, *Christie Digital Systems Canada Inc, Waterloo, ON, Canada*

PLANNED SPEAKERS & TOPICS

10:30am
RFI Mitigation System for Smart Phones by Automatic Calibration of MIPI Data Rate
Akihiro Tsukioka[1], Kotaro Fujimori[2], Yasuhiro Ochiai[1]
[1]Sony Semiconductor Solutions, Japan; [2]Sony Corporation, Japan
EMC BEST PAPER FINALIST
Abstract: This paper presents a method for mitigating Radio Frequency Interference (RFI) in smart phones caused by noise radiation from Mobile Industry Processor Interface (MIPI) D-PHY. As the imaging performance of camera modules in smart phones improves continually, the data rates of image signals, which can be a factor of Electromagnetic Interference (EMI), are increasing, thereby raising the possibility of RFI generation in built-in antennas. Our RFI mitigation system utilizes Received Signal Strength Indicator (RSSI), a metric for the strength of received signals in wireless communication, as a feedback control variable. While a camera module captures images, an Application Processor (AP) dynamically calibrates MIPI data rates, monitoring fluctuations in RSSI, thus preventing interference from MIPI D-PHY noise radiation within channels. The proposed method is realized through software operations on an AP, thus enabling its application to any IC module controlled by an AP. This method does not require additional new EMI countermeasure components, thereby reducing component costs and evaluation efforts in smart phone EMC design. The effectiveness of this method was measured using a test board equipped with an image sensor and a test circuit emulating a Radio Frequency (RF) circuit inside a smart phone. The method confirmed the mitigation in wireless interference to be sufficient, measuring approximately 9.1 dB.

11:00am
ARVTDNN-Based Digital Predistortion for High-Power Amplifier Nonlinearity Compensation in Broadband Radiated Immunity Test
GyeongRyun Choi[1], Hanyang Li[1], Hongsik Keum[2], Hyeongtae Kim[3], GeunHo Kim[3], Wansoo Nah[1]
[1]Sungkyunkwan University, Korea (the Republic of); [2]E&R, Korea (the Republic of); [3]Rohde&Schwarz Korea, Korea (the Republic of)
Abstract: This paper proposes the use of test signals with an applied augmented real-valued time-delay neural network (ARVTDNN)-based digital predistortion (DPD) to mitigate test signal distortion caused by the nonlinearity of high-power amplifiers (HPAs) in radiated immunity (RI) tests. Orthogonal frequency division multiplexing (OFDM)-based broadband signals were generated to obtain the input and output IQ data of the HPA, and these data were used to build two neural network (NN) models: one for the HPA and the other for the predistorter. Based on these models, DPD simulations were conducted, and the results demonstrated that the signal distortion was effectively compensated, as verified through amplitude modulation (AM) and phase modulation (PM) characteristics and the power spectral density (PSD). Specifically, the simulations showed that the DPD restores the crest factor (CF), one of the key test signal specifications defined in the IEC 61000-4-41, thereby recovering the original input signal characteristics. In conclusion, this paper proposes a method for establishing a robust test setup for broadband RI test and suggests the potential for future research to analyze whether the CF is a risk factor for the EUT.

11:30am
Wireless Immunity Enhancement using Waveguiding Techniques for High Voltage Battery Packs
Saranraj Karuppuswami, Aseim Elfrgani
General Motors Company, USA
Abstract: In this paper, a method is proposed to enhance the immunity of the wireless communication within a compact metal enclosed high voltage battery pack environment. In this method, structural modifications of the pack are utilized as a technique to improve the immunity of wireless network communication. The cross members are modified by introducing gaps with and without dielectrics to promote better received signal strength indicator for the different antennas that monitor the cell parameters within the battery pack

TC5_1 TECHNICAL PAPERS

HEMP TEST METHODS

10:30AM - 12:00PM

Room: 305B

Sponsored by TC-5 High Power Electromagnetics

Co-Chairs:

William Radasky, *Metatech Corporation, Goleta, CA, USA*

Michael McInerney, *Consultant, Champaign, IL, USA*

PLANNED SPEAKERS & TOPICS

10:30am

Application of D-dot Sensor in HEMP Shielding Effectiveness Measurement

Rakesh Kichouliya, Sandeep M. Satav

Reserach Centre Imarat, India

Abstract: Shielding effectiveness (SE) measurements are essential for ensuring the electromagnetic isolation of electronic equipment inside a shielded shelter from external electromagnetic environments. IEEE-STD-299 defines the methodology for SE measurement. However, SE measurement becomes challenging when the shielded shelter is populated with electronic and electrical systems, as antenna placement becomes difficult.This experimental study investigates the suitability of a D-dot sensor for SE measurement in a shielded shelter designed to meet highaltitude electromagnetic pulse (HEMP) shielding specifications (80 dB) as per MIL-STD-188-125-1. The paper proposes the application of a single D-dot sensor (operating up to 1 GHz) for SE measurement, along with pre-amplifiers and power amplifiers, to assess the SE of a shelter. A Montena make ACD (asymptotic conical dipole) type free-field D-dot sensor (SFE1G) with an equivalent sensing area of 1 × 10−2 m2 is utilized. The SE measurement is conducted on an anteroom of an EMC chamber with known SE values ≥ 80 dB, using both the D-dot sensor and conventional antennas (biconical and log-periodic). The SE measurement results obtained with the D-dot sensor are compared and validated against those from conventional antennas, indicating the feasibility of using the D-dot sensor for shielding measurements.

11:00am

Insertion Loss Requirement and Low Level PCI Testing of HEMP Power Line Filter

Rakesh Kichouliya[1], Saurabh Kichouliya[2], Sandeep M. Satav[1]

[1]Research Centre Imarat, India; [2]Indian Institute of Science, India

Abstract: High Altitude Electromagnetic Pulse (HEMP) power line filters are used to suppress the conducted HEMP on the power lines of a facility. The insertion loss requirement, however, is not very clear in any of the public standards related to HEMP. MIL-STD-188-125 1/2 requires Pulsed Current Injection (PCI) verification testing for filters and specifies maximum limits for norms of the measured residual internal transient currents and shielding requirements of a facility. IEEE-STD-1560 specifies how to test a filter for RF characteristic test, mismatched impedance, attenuation measurements (100 kHz to 30 MHz), S-parameter measurement up to 30 MHz and aperture leak testing by electric fields (1 GHz to 10 GHz). However, the conducted HEMP contains its maximum frequency content up to 50 MHz, where most of the pulse energy is concentrated. This paper aims to investigate the upper frequency range of insertion loss specifications for HEMP power line filters to ensure their effectiveness across all possible conducted environments. Additionally, low-level (1 kA) PCI testing is explored as a pre-compliance measure for HEMP filter design and performance verification.

11:30am

Proposal of HEMP Conducted Disturbance Test Method for Semi-Conductor Protective Devices on Electronic Circuit

Takuya Hoshino, Masaharu Sao, Tetsuya Tominaga, Minoru Tsukazaki

NTT Advanced Technology Corporation, Japan

Abstract: Many consumer electronics are equipped with semi-conductor-based protective devices, such as a TVS –diode, a multilayer chip varistor or an ESD-suppressor, to protect internal circuits from steep surges produced by a lightning strike or electrostatic discharge (ESD). In the occurrence of a high-altitude electromagnetic pulse (HEMP) event, a strong pulsed electromagnetic wave may be induced on communication and/or power cables and penetrate sensitive electronics through them. To protect internal circuit from such pulses, protective devices are installed in a manner similar to lightning surge protection. During such events, these protective devices are subjected to high level of stress, potentially leading to performance degradation in characteristics such as threshold voltage and electrical insulation performance. Therefore, it is important to consider performance degradation; however, information regarding the degradation is often absent from datasheets of devices. Additionally, it is important for determining system-level malfunction to conduct immunity tests on consumer electronic apparatus while they are in operation condition. Thus, for the protection devices, tests should be conducted under powered conditions with the application of steady-state voltage to the devices. This paper describes novel test method for the semi-conductor protective devices against HEMP-induced conducted disturbance test and demonstrates that the degradation trends of the devices differ depending on whether a DC bias is applied during the HEMP conducted disturbance test.

WT_C1 WORKSHOP

EFFECTIVELY NAVIGATING THE COMPLEXITIES OF MEASUREMENT UNCERTAINTY IN EMC TESTING

1:30PM - 5:00PM

Room: 302C

Co-Chairs:

Janet O'Neil, *ETS-Lindgren, Cedar Park, TX, USA*

Dennis Lewis, *The Boeing Company, Seattle, WA, USA*

This workshop brings together leading experts in the field of measurement uncertainty, focusing on its critical role in electromagnetic compatibility (EMC) testing. The session will delve into essential concepts of measurement uncertainty, providing practical methodologies for conducting calculations in commercial test labs, including data gathering techniques and efficient calculation methods. Another presentation will address estimating uncertainty specifically for antenna measurements, aligning with the Guide to Uncertainty in Measurements, while a discussion will cover the complexities of measuring uncertainties within a multipurpose robotic antenna test system. Insights will also be provided on measurement uncertainties associated with high-altitude electromagnetic pulse (HEMP) and high-power electromagnetic (HPEM) testing, including various test sites, instrumentation, and the assessment of normative specifications against civil and military standards. Finally, the workshop will introduce Polynomial Chaos Theory as a method for uncertainty propagation and sensitivity analysis in power electronic circuit design, demonstrating how stochastic simulations can effectively incorporate uncertainties from various sources. This workshop aims to equip participants with the knowledge and tools necessary to navigate the complexities of measurement uncertainty in EMC testing, fostering a deeper understanding of its implications in both commercial and research settings.

PLANNED SPEAKERS & TOPICS

Practical Considerations Related to Measurement Uncertainty for EMC Test Labs
Nicholas Abbondante
Intertek USA Inc, USA

Understanding Uncertainties for EMC Antenna Measurements in Accordance with the Guide to Uncertainty in Measurements
Zhong Chen
ETS-Lindgren, USA

Evaluation of Complex Measurement Uncertainties in a Multipurpose Robotic Antenna Test System
Dennis Lewis
The Boeing Company, USA

3:30pm
Measurement Uncertainty of HEMP and Other HPEM Testing Procedures
Sven Fisahn
Bundeswehr Research Institute for Protective Technologies and CBRN Protection (WIS), Germany

4:00pm
Uncertainty Propagation and Sensitivity Analysis Using Polynomial Chaos Theory
Karol Niewiadomski
Universiteit Twente, Netherlands

WT_C2 WORKSHOP

TEST AND MEASUREMENT FUNDAMENTALS OF EMC

1:30PM - 5:00PM

Room: 303

Chair:
John McCloskey, *NASA, Washington, DC, USA*
Co-Chair:
Vignesh Rajamani, *Rohde & Schwarz USA, Inc., Phoenix, AZ, USA*

EMI/C testing is crucial for ensuring that electronic devices perform reliably in their intended electromagnetic environment, and don't interfere with other devices. Optimizing such tests involves improving efficiency, reducing cost and most importantly understanding of the test equipment and its capabilities to ensure the robustness of the testing process. In this workshop, we will cover some fundamental concepts of testing accompanied by live demonstrations showcasing proper usage of oscilloscopes, spectrum analyzers, and EMI receivers for EMC measurements and debugging.

PLANNED SPEAKERS & TOPICS

Test and Measurement Workshop: Introduction and Overview (Part 1)
John C. McCloskey
EMC-Closkey LLC, USA

Test and Measurement Workshop: Introduction and Overview (Part 2)
Vignesh Rajamani
Rohde & Schwarz USA, Inc., Phoenix, AZ, USA

Photo by Patrick Andre

WT_C3 TUTORIAL

TUTORIAL ON MACHINE LEARNING

1:30PM - 5:30PM

Room: 305A

Sponsored by SC-3 Special Committee on Machine Learning and Artificial Intelligence in EMC and SIPI

Chair:
Lijun Jiang, *Missouri University of Science and Technology, Rolla, MO, USA*

Co-Chair:
Alistair Duffy, *De Montfort University, Loughborough, United Kingdom*

Machine learning is profoundly impacting the landscape of every technology domain, including signal integrity, power integrity, EMC, and EMI engineering. This tutorial is for entry-level audiences who are interested in machine learning. The topics in this tutorial will practically guide audiences through the fundamentals of machine learning methods, resources needed for using machine learning methods, and successful application examples for EMC society. This tutorial could be repeated with updated state-of-the-art technology and demands from EMC society in the following two years. The invited speakers are frontier experts who have practical experience in machine learning method development and applications. This tutorial will aim to draw broader attention and guide hands-on experiences of machine learning for EMC/EMI, SI and PI technologies.

PLANNED SPEAKERS & TOPICS

Popular Machine Learning Methods and Their Typical Applications in EMC/SIPI
Ling Zhang
Zhejiang University, China

Outlook of AI- and ML-Assisted Signal Integrity and Power Integrity
Matteo Cocchini
IBM Corp., USA

ML-Assisted Power Integrity Solutions
Chulsoon Hwang
Missouri University of Science and Technology, USA

AI/ML Augmentation of Hardware Compliance Processes
Samuel Connor
IBM Corp., USA

Physics-Informed Machine Learning Techniques for Different EMI Applications
Mohamed Kheir
University of Southern Denmark, Denmark

Compressed Sensing for EMC Applications
Zhong Chen
ETS-Lindgren, USA

Mathematical and Physical Thinking Behind Machine Learning
Lijun Jiang
Missouri University of Science and Technology, USA

WT_C5 TUTORIAL

LESSONS LEARNED CREATING RELIABLE COMPUTATIONAL MODELS FOR SI, PI AND EMC APPLICATIONS

1:30PM - 5:00PM

Room: 306A

Sponsored by TC-9 Computational Electromagnetics

Co-Chairs:

Scott Piper, *Dassault Systemes Americas Corp, Waltham, MA, USA*
Patrick DeRoy, *Analog Devices Inc, Norwood, MA, USA*

This tutorial will expose the attendees to the lessons learned by a number of industry experts over the years. The goal being that the attendees will benefit from the, sometimes painful, learning experiences of the presenters. Computational tools are very powerful and simulation is invaluable to the modern design engineer but there is still an art to using these tools effectively. In all disciplines, hindsight is perfect and the opportunity to learn from others is a valuable resource. This tutorial will not only show lessons learned but also expose the attendees to fundamental ways of thinking through their models to better ensure success. Examples relevant for Signal Integrity, Power Integrity and Electromagnetic Compatibility design will be shared.

PLANNED SPEAKERS & TOPICS

What I Wish I Knew About EMC Simulation When I First Started
Scott Piper
Dassault Systemes Americas Corp, USA

Trying to Simulate EMI in Power Converters | Lessons from the Field
Albert Dunford
Altair Engineering Inc, USA

What Did I Learn and Why Did I Learn It?
Colin Brench
IEEE, USA

Everything Should Be Simulated ASAP (As Simple As Possible), But No Simpler
Patrick DeRoy
Analog Devices Inc, USA

Photo by Richard Georgerian

WT_C6 WORKSHOP

P2855, A CHARACTERIZATION OF SHIELDING CCA FROM DC TO 40 GHZ

1:30PM - 5:00PM

Room: 306B

Sponsored by TC-4 Electromagnetic Interference Control

STANDARDS WEEK

Chair:
Charles Jullien, *Safran Electrical and Power, Blagnac, France*

Co-Chair:
Huadong Li, *Molex LLC, Naperville, IL, USA*

This workshop will give a general introduction to the future standard in construction P2855 about cable/connector assembly shielding effectiveness characterization from DC to 40GHz. This standard provides recommended measurement techniques for evaluating, and methods for specifying, the capabilities or effectiveness of shielding on cable/connector assemblies for the control of Electromagnetic Interference (EMI) to allow product compliance to common Government, regulatory, and customer requirements, and for achieving system Electromagnetic Compatibility (EMC). This standard also provides measurement techniques to evaluate, and methods to specify, cable/connector assemblies shielding capabilities for reducing the coupling of electromagnetic energy between cable/connector assemblies. Emphasis is placed on measurement techniques that have been adopted through incorporation into standards, both commercial and military, or that have been used extensively. A set of novelties will be presented on the methods that will be present in the standard.

PLANNED SPEAKERS & TOPICS

Cable/Connector Assembly Shielding Effectiveness Characterization from DC to 40 GHz, The New STD P2855
Charles Jullien[1], Huadong Li[2]
[1]Safran Electrical and Power, France; [2]Molex LLC, USA

Parallel Plate Box [PPB] Method for EMC
Gary Biddle, Michael Cieslak
Samtec Inc, USA

Shielding Effectiveness Test Methods Using Semi-Anechoic Chamber and the Gigahertz Transverse Eletro-Magnetic (GTEM) Cell
Jack McFadden
ETS-Lindgren, USA

Localized Injection Up to 20 GHz, New Transfer Parameter
Charles Jullien, Thomas Colleter
Safran Electrical and Power, France

Shielding Effectiveness Measurands of Cables, Connectors, and Their Assemblies
Huadong Li
Molex LLC, USA

Reverberation Chamber Results of Connector/Cable Assemblies
Michael Cieslak, Gary Biddle
Samtec Inc, USA

WT_C7 WORKSHOP

AUTOMOTIVE EMC — STANDARDS, MEASUREMENT AND SIMULATION FOCUSING ON EVS

1:30PM - 5:00PM

Room: 306C

STANDARDS WEEK

Chair:
Martin Wiles, *MVG World, Haydock, United Kingdom*

Co-Chair:
Marco Klingler, *Klingler International Consulting Services, Bagneux, France*

This workshop covers different aspects of Automotive EMC looking at Simulation, Measurement and Standardisation, focusing primarily on Electric Vehicles.

PLANNED SPEAKERS & TOPICS

Overview of Automotive EMC Standardisation Work
Martin A. Wiles
MVG World, United Kingdom

Contribution of Cabling to EMC Issues in EVs
Karen Burnham
EMC United, Inc., USA

Modeling of Conducted Emission Tests of EV On-Board Powertrain Chargers - Comparisons Between Measurement and Simulation Results on Table and on Vehicle
Abdivall Maouloud[1], Marco Klingler[1], Abdelhak Benali[2], Jérôme Mollet[2]
[1]Stellantis, France; [2]Dassault Systèmes, France

EMC Simulations for Power Electronics in EVs
Tyler Dodge
Dassault Systemes Americas Corp, USA

Automotive Virtual EMC Testing in Reverberation Chambers Using the Method of Moments with Poisson Acceleration for MIM Solution
Faik Bogdanov, Roman Jobava
EMCoS LLC, Georgia

Simulation Strategies to Evaluate Functional Safety in Automotive EMC
Christoph Mäurer, C.J. Reddy
Altair, USA

Photo by Patrick Andre

ED_ D1
EXPERIMENTS
& DEMONSTRATIONS

SPEED UP YOUR RC: CLOSED-LOOP E-FIELD CONTROL IN REVERBERATION CHAMBERS

2:30PM - 4:30PM

Room: Exhibit Floor, E&D Booth 1

The demo session will start with a brief introduction on the basics of reverberation chambers (RCs). Validation and radiated immunity testing are discussed.

We will bring a small, but fully working, stirred RC to the stage. Eight fast, synchronized electric-field probes will showcase real-time E-field strength measurements and closed loop E-field control based on statistics. LUMILOOP's LSProbe E-field Probes enable accelerated measurements according to ISO 11451-5.

The reverb chamber basics will also be visualized using live measurements, helping to quickly grasp how the invisible electric field behaves.

Learn on how to improve your EMC measurement. Save time and money while testing!

PRESENTER:
Samuel Hildebrandt, *LUMILOOP GmbH, Germany*

ED_ D2
EXPERIMENTS
& DEMONSTRATIONS

GOOD IDEA? GROUND PLANES UNDER A CMC

2:30PM - 4:30PM

Room: Exhibit Floor, E&D Booth 2

Ground planes under a common mode choke (CMC) can create a path for electrical noise to bypass the CMC. Let's investigate what causes this and diagnose what variables affect noise coupling to the ground plane:

(A) What layer is acceptable to use on a 4 layer PCB (Z direction)?
(B) How far away from the CMC in the X,Y direction should the keepout zone be?

Let's test with a real PCB and also do some Finite Element Analysis simulations to find empirical answers to these questions.

PRESENTER:
Jared Quenzer, *Würth Elektronik, USA*

ED_D3 EXPERIMENTS & DEMONSTRATIONS

MICROSTRIP PULSE PROPAGATION EXPERIMENTS WITH THE NANOVNA IN TRANSIENT MODE

2:30PM - 4:30PM

Room: Exhibit Floor, E&D Booth 3

Sponsored by Education Committee

In this demonstration Nano VNA (in transient mode) will be used to study some characteristics of pulse propagation on four microstrip boards. Designs for the four boards will be available to anyone who is interested.

The four boards have:
1. Two lengths of microstrip line (Z0 = 50 ff and 100 ff)
2. A single length of microstrip line (Z0 = 50 ff) with a 90 degree angle
3. A single length of microstrip line (Z0 = 50 ff) with a short circuited stub connected at the center
4. A set of two parallel (closely coupled) microstrip lines (Z0 = 50)

This equipment will be used to demonstrate:
1. Propagation time and velocity factor of the dominant quasi-TEM microstrip mode
2. Reflections at junctions with discontinuities in impedance
3. Model attenuation
4. Path of ”ground” currents for microstrip lines with bends
5. The impact of stubs and excitation and differences in propagation speeds of differential and common modes.

PRESENTER:

Robert Olsen, *Washington State University, USA*

ED_D4 EXPERIMENTS & DEMONSTRATIONS

THE CHALLENGES OF COMMODITY PRODUCT DESIGN WITH CAPACITIVE TOUCH

2:30PM - 4:30PM

Room: Exhibit Floor, E&D Booth 4

Interfacing with devices such as smartphones, appliances, and cars has become the cornerstone of high-end industrial design. Smooth, polished interfaces that were once limited to premium devices like smartphones are now finding their way into the everyday products we use. The motivation for this includes numerous benefits, all stemming from eliminating mechanical buttons from the user interface.

However, with this innovation come product design challenges due to the nature of the sensing methods used. Depending on the sensing technology, measurements can be easily disturbed by electrical disturbances that closely follow IEC 61000-4-6 standards. This is a common design challenge when evaluating white goods, as false actuations resulting from immunity problems often violate system requirements. Each technology addresses this problem differently by implementing various features. This experiment will explain voltage sensing technology and compare it with current sensing technology, showcasing the drawbacks and operation of each method with and without electrical noise.

This demonstration will cover:
- How capacitive touch works, and the various ways of implementing it.
- How the parasitic nature of surrounding copper can disrupt electrostatic field measurements, potentially leading to false actuations.
- How spread spectrum techniques can influence the measurement and sensing method.
- How different sensing technologies have weaknesses when subjected to conducted immunity testing, focusing on IEC 61000-4-6 tests.

PRESENTERS:

Christopher J. Semanson, *Renesas Electronics America Inc., USA*
James Page, Renesas Electronics America Inc., USA

ED_D5
EXPERIMENTS
& DEMONSTRATIONS

FFT-TIME DOMAIN SCAN IN EMI RECEIVERS AND KEY BENEFITS

2:30PM - 4:30PM

Room: Exhibit Floor, E&D Booth 5

EMC testing is required for just about any product that has digital and radio components. With the growth of those products, time to complete EMC testing typically takes longer, due to competition for lab time, and for the surprises in tracking down short-burst or impulse-type emissions. The automotive industry, for example, requires exacting methodologies to measure all emissions accurately. Long test times impact test facility availability and potentially reduces the number of devices that are certified. It's also easy to miss intermittent disturbance signals with conventional scans since an extended dwell time must occur at each frequency.

With the implementation of a Short Time FFT (STFFT) engine, EMI Receivers include Time Domain Scan (TDS) and Accelerated TDS capabilities that enable independent compliance test laboratories and in- house certification labs to shorten their overall test time.

This presentation will provide an overview of TDS and Accelerated TDS capabilities to meet EMI measurement requirements and comply with EMC standards such as CISPR 16-1-1 and MIL-STD-461 and highlight how you can easily reduce receiver scan and test time from multiple hours to seconds.

PRESENTER:

Bill Koerner, *Keysight Technologies Inc., USA*

IEEE EMCS SINGAPORE CHAPTER | IEEE RFID Malaysia Chapter | EMC SOCIETY | APEMC

APEMC 2026 Asia-Pacific International Symposium and Exhibition on Electromagnetic Compatibility

May 4 – 7, 2026, Kuala Lumpur, Malaysia

CALL FOR PAPERS

The 17th Asia-Pacific International Symposium and Exhibition on Electromagnetic Compatibility (APEMC 2026) will be held at **Kuala Lumpur Convention Centre (KLCC)** in **Kuala Lumpur, Malaysia**, from **May 4 to 7, 2026**. The symposium fosters global collaboration, providing a unique opportunity for academia, industry, and regulatory bodies to exchange knowledge and strengthen connections. It also recognizes innovations and pioneering works through the Best Symposium Paper Awards, the Best Student Paper Awards, and other notable contributions. The scope of the symposium involves the entire spectrum of electromagnetic compatibility (EMC), electromagnetic environment, signal integrity and other featured EMC topics in emerging technologies. We warmly invite all prospective authors to submit original papers with the latest research findings and outcomes. We also welcome proposals for focused sessions, industrial forums, workshops, and tutorials.

SYMPOSIUM TOPICS

- EMC Management and Standards
- EMC Measurements and Environment
- Lighting and Protection
- High Power Electromagnetics
- EMC in Renewal Energy and Power Grid
- System-Level EMC and Protection
- Transportation EMC
- Antenna and Propagation
- Aerospace EMC
- IC and Semiconductor EMC
- Signal Integrity and Power Integrity
- Wireless Communication EMC
- Computational Electromagnetics & Multiphysics
- Bio-Medical EM & Wearable Devices EMC
- Nanotechnology and New Materials
- Artificial Intelligence in EMC

More Related Topics are Welcome!

PAPER SUBMISSION

Authors have options for the full-length paper or 1-page abstract submissions.

- Authors can submit a **full-length paper (3-4 pages)** with title, author's affiliation, abstract, methodology, figures and references. The presented full papers will be included in the ***IEEE Digital Xplore***.
- Authors can choose to submit a **1-page abstract** with title, author's affiliation, and crucial findings. The abstract will be published in the conference proceedings, but **NOT** in ***IEEE Digital Xplore***.

A template is available on the APEMC 2026 Symposium website.

The submission must be in electronic format (PDF) via the EDAS system.

IMPORTANT DATES

Proposal for Special Session	October 3, 2025
Proposal for Workshop & Tutorial	November 1, 2025
Paper Submission	**November 21, 2025**
Notification of Acceptance	January 31, 2026
Final Manuscript Submission	February 16, 2026

ADVANCE by LEARN and SHARE

CONTACT US

APEMC 2026 Secretariat
Mrs. Jasmine Leong
Tel: +65 6743 2523
Email: jasmine@jjayes.com

LOCATION

Malaysia
Kuala Lumpur
Convention Centre
(KLCC)

Please visit: **https://www.apemc2026.org**

SCHEDULE AT A GLANCE

ROOM	305A	305B	306A	306B	306C
8:30 AM	SPECIAL SESSION SS_3 ADVANCES IN HIGH ALTITUDE ELECTROMAGNETIC PULSE (HEMP) ENVIRONMENTS AND PROTECTION	TECHNICAL PAPERS TC7_1 EMC OF ELECTRICAL SYSTEMS	TECHNICAL PAPERS TC2_3 EMC MEASUREMENTS: DESIGN RELATED	TECHNICAL PAPERS TC10_3 HIGH-SPEED INTERCONNECTS AND NOISE COUPLING	TECHNICAL PAPERS TC9_3 ELECTROMAGNETIC EFFECTS IN POWER SYSTEMS AND MEDICAL DEVICES
10:00 AM	REFRESHMENT BREAK				
10:30 AM					
11:00 AM					
12:00 PM	LUNCH BREAK				
1:30 PM	TECHNICAL PAPERS TC5_2 HEMP AND ESD DESIGN AND MODELING	TECHNICAL PAPERS TC7_2 POWER ELECTRONICS EMC	TECHNICAL PAPERS TC2_4 EMC MEASUREMENTS: IMMUNITY & SHIELDING	TECHNICAL PAPERS TC10_4 POWER DISTRIBUTION NETWORKS AND DECOUPLING	TECHNICAL PAPERS TC10_5 SIMULATION AND MODELING TECHNIQUES
2:00 PM					
2:30 PM					
3:00 PM	REFRESHMENT BREAK				
3:30 PM					
4:00 PM					
4:30 PM			TECHNICAL PAPERS TC11 NANOTECHNOLOGY AND ADVANCED MATERIALS		
5:00 PM					

CLAYTON R. PAUL GLOBAL UNIVERSITY: 8:00 AM - 12:00 PM, RM 201

EXHIBIT HALL OPEN: 10:00 AM - 12:00 PM
EXPERIMENTS & DEMOS: 9:30 AM - 11:30 AM

ADDITIONAL STANDARDS SESSIONS, WORKING GROUPS AND TECHNICAL COMMITTEES
For Collateral Meetings, please see page 134

SPEAKERS BREAKFAST
Raleigh Convention Center, 301AB - 7:00 - 8:30 AM
(Breakfast Only on the Day of Presentation)

REGISTRATION/INFO DESK
7:30 AM - 5:00 PM

AWARDS LUNCHEON
Ballroom BC – Raleigh Convention Center - 12:00 PM - 1:30 PM
(Ticketed Event)

STANDARDS WEEK
For more information about Standards Week, please visit page 132

SS_3 SPECIAL SESSION

ADVANCES IN HIGH ALTITUDE ELECTROMAGNETIC PULSE (HEMP) ENVIRONMENTS AND PROTECTION

8:30AM - 12:00PM

Room: 305A

Sponsored by TC-5 High Power Electromagnetics

Chair:
William Radasky, *Metatech Corporation, Goleta, CA, USA*

Over the last 10 years the IEC has updated the understanding of HEMP through a series of standards, which have been tailored to the protection of commercial facilities and equipment. The main improvements that have been made recently are to make the standards even more applicable for commercial rather than military purposes. One of the major changes is to avoid relying only on worst-case electromagnetic fields, but rather to show the variability of the HEMP fields in the IEC standards, which generally result in lower levels of the electromagnetic environments, and consequently on more modest protection techniques, such as those found in typical EMC applications. It is noted that individuals with more than 40 years of experience have been invited to describe recent advancements in the HEMP environments. Also those active in the work of the IEC have been invited to discuss important aspects of protection for commercial applications.

PLANNED SPEAKERS & TOPICS

8:30am
Update of IEC 61000-2-9: Description of the HEMP Radiated Environment
William A. Radasky, Edward B. Savage
Metatech Corporation, USA
EMC BEST PAPER FINALIST
Abstract: Edition 1 of IEC 61000-2-9 was developed in the early 1990s and published in 1996; it provided information on the early-time (E1), intermediate-time (E2) and the late-time (E3) HEMP radiated environments, including worst-case waveforms for each time period to be used for coupling to commercial systems and equipment. This approach was similar to that used for military systems at the time, as the location of a high-altitude burst is unknown and is only under the control of the attacker. Military systems during the Cold War considered that there would be many high altitude bursts during a nuclear attack, and therefore it was likely that all important military systems would be exposed to the maximum HEMP fields. Given that all commercial systems may not need to consider the worst-case threats due to the fewer high altitude bursts and the possibility of recovery over time, it was decided that the new edition of IEC 61000-2-9 should contain more information concerning the variability of the HEMP waveforms. This was done in particular for the E1 and E3 HEMP waveforms.

9:00am
Database of E1 HEMP Shielding Effectiveness of Various Building Types
Edward B. Savage, William A. Radasky
Metatech Corporation, USA
Abstract: We have been involved in many E1 HEMP (early time high altitude electromagnetic pulse from a nuclear burst) evaluations that included measuring the shielding effectiveness of buildings or ships. For this we have used a simple measurement approach which has some advantages over traditional approaches. In this paper we discussion this approach and summarize the results.

9:30am
Validating the HEMP Protection Capabilities of Power Filters
Sergio Longoria
ETS-Lindgren, USA
Abstract: This paper will explain the need for High Altitude Electromagnetic Pulse (HEMP) protection power filters for the mitigation of conducted disturbances resulting from HEMP fields picked up on power lines going into a building. The paper will examine the filter's design, construction, and HEMP conducted performance in relation to standards applicable for operational safety and HEMP performance. This performance can be validated by testing using either military or commercial standards and thus the paper will look at these in some detail.

10:30am
Techniques for Generating the Geographical Distribution of Early-Time HEMP Coupling to Horizontal Lines and Antennas
James L. Gilbert
Metatech Corporation, USA
Abstract: This paper presents techniques for analyzing the early time EMP (E1) environments and coupling to systems using approximate techniques suitable for use on a small computer. These include the generation of databases of E1 radiated environments and simplified coupling techniques for EMP analysis and hardening. Keywords—Early-time EMP environments, E1 EMP, EMP on antennas, EMP on power lines.

11:00am
Update of IEC 61000-5-6 and Discussion of the Application of Resilience for HEMP Protection
Richard Hoad[1], William Radasky[2], Barney Petit[1]
[1]QinetiQ Group UK Ltd., United Kingdom; [2]Metatech Corporation, USA
Abstract: Standardization in the field of High Power Electromagnetic (HPEM) environments, protection design and test methods is becoming increasingly important due to the increased risk to society from HPEM disruption. This paper will provide a discussion of a new International Electrotechnical Commission (IEC) standard on High Altitude Electromagnetic Pulse (HEMP) protection, IEC 61000-5-6. This new standard introduces the concept of a resilience-based approach to HEMP disturbance mitigation.

11:30am
Calculational Techniques for the Late-Time HEMP Effects on Power Distribution Systems
James L. Gilbert
Metatech Corporation, USA
Abstract: This paper presents the steps in modeling the effects produced by late time E3 EMP on the US grid. The basic technique consists of creating a quasi-static model of the grid to calculate the current flow in the grid resulting from late time HEMP and use a set of tables based on the transformer voltage and type to calculate the reactive demand in MVAR in the system. If this exceeds the available generation capacity, the system will undergo voltage collapse Keywords—grid stability, nuclear weapons effects, MHD EMP, E3 EMP

Photo by Patrick Andre

TC7_1 TECHNICAL PAPERS

EMC OF ELECTRICAL SYSTEMS

8:30AM - 11:00AM

Room: 305B

Sponsored by TC-7 Electrical System and Power Electronics EMC

Co-Chairs:

Flavia Grassi, *Politecnico di Milano, Milano, Italy*

Cong Li, *GE Global Research, Clifton Park, NY, USA*

PLANNED SPEAKERS & TOPICS

8:30am

System Level EMI Diagnostic by Terminated Loop Antenna Concept

Scott Lee, Ken Su, Kyle Lin, Hill Wu

Google Cloud, Taiwan

Abstract: In modern server system design, EMI (electromagnetic interference) diagnostics is not work straightforwardly due to the complexity of the system. Analysis of EM (electromagnetic) radiation and shielding design is usually based on the assumption of a simplified radiation source, that is, a dipole antenna. However, EMI issues still occur even based on rules or formulas driven by the assumption. This paper provides another approach based on the terminated loop antenna concept and starts from actual EMI issues of two server systems. With the assumption, radiation mechanism is more close to actual condition and loop area difference is consistent with the actual failure syndrome

9:00am

CAE Based Electromagnetic Field Exposure Assessment in an Electrified Vehicle

Nitin Parsa, Ahalya Srikanth, Varittha Sanphuang, Ronald Missier

Ford Motor Company, Canada

Abstract: This paper discusses a Computer-Aided Engineering (CAE) methodology to estimate the low frequency Electromagnetic Field (EMF) exposure within the vehicle during vehicle operation. The simulation results are validated with EMF exposure measurements at the vehicle level. Results show that CAE method can predict the exposure ratio within 5% of the measurement.

9:30am

Study on Radiation Interference from Pantograph-Catenary Detachment Arc in AC Electrified Railway Considering the Influence of Train Speed

Ke Huang, Feng Zhu

Southwest Jiaotong University, China

EMC BEST PAPER FINALIST

Abstract: The pantograph-catenary system, comprising the pantograph and contact wire, plays a critical role in providing traction power to AC electrified railway train through a sliding contact. However, pantograph detachment can lead to arc formation, which generates intense broadband electromagnetic radiation, posing significant electromagnetic compatibility challenges. As train speeds increase, the arc radiation characteristics become more pronounced. This study proposes an evaluation method for arc radiation interference in the pantograph-catenary system, combining both modeling and field testing. A detailed traction power system model, incorporating pantograph detachment arcs, is developed using ATP-EMTP software, with arc parameters adjusted for varying train speeds. The relationship between arc current, electric field strength, and train speed is derived, and the electric field characteristics are extracted from the simulated arc currents. Field tests are then conducted, and a modified least squares algorithm is employed to fit the amplitude-frequency characteristics of the measured radiated electric fields. The validity of the proposed evaluation method is verified, and the influence of train speed on radiation intensity is analyzed. The interference impact on airport communication systems is selected as a case study, with results demonstrating that at 250 km/h, the radiation interference complies with electromagnetic compatibility standards.

10:30am

EMI from Rear-View Mirror LCDs: Impact on GNSS Sensitivity

Ali Attaran, Varittha Sanphuang, Ronald Missier, Nicholas Hare

Ford Motor Company, USA

Abstract: This study examines electromagnetic interference (EMI) from the PCB of rear-view mirror LCDs and its effect on GNSS receivers, particularly within the L1 band. Measurements indicate emissions at 11.6 dBQV near 1549 MHz, leading to a 14% reduction in GNSS positioning accuracy. This significant impact on navigation and safety systems underscores the need for effective EMI mitigation strategies. Potential solutions include improved PCB design and shielding techniques to protect GNSS functionality in automotive applications. Addressing these challenges is crucial for maintaining the reliability and accuracy of vehicle navigation systems in increasingly complex electromagnetic environments.

TC2_3 TECHNICAL PAPERS

EMC MEASUREMENTS: DESIGN RELATED

8:30AM - 12:00PM

Room: 306A

Sponsored by TC-2 EMC Measurements

Chair:
John Kraemer, *Collins Aerospace, Marion, IA, USA*

Co-Chair:
Monrad Monsen, *Oracle America Inc, Redwood Shores, CA, USA*

PLANNED SPEAKERS & TOPICS

8:30am
Measurements of Bonding and Faying Resistances for Stacked Bonds
David Norte
BAE Systems, Inc., USA
EMC BEST PAPER FINALIST
Abstract: Bonding requirements are specified for a given mission to enable a near equipotential surface over the structure of the space vehicle. A very commonly encountered bonding resistance value is given in the MIL-STD-464 standard [1], which specifies a bond resistance of 2.5 milliohms for single faying surfaces. This value has been adopted as the default resistance for many missions for individual faying interfaces within the equipment. As such, it is important to understand the impact of stacking multiple faying surfaces on the bond resistances between each faying surface and structure. This paper discloses measured bond resistances for a stack of up to five M5 circular terminations, as well as a stack of five M6 circular terminations.

9:00am
Mitigating Optical Module EMI Using Common- and Differential-Mode Filters
Shivali Singh[1], Rakshith Kumar Gopalaiah[1], Di Li[2], Mokshit Tejasvi[2], Shipra Shipra[2], Victor Khilkevich[1]
[1]Missouri University of Science and Technology, United States; [2]Juniper Networks, United States
Abstract: A strategy to mitigate electromagnetic interference in quad/octal small form-factor pluggable interfaces using a common-mode/differential-mode filter is presented in this research. Differential source imbalance produces significant common- and differential-mode noise in the differential pseudorandom binary sequence signal. EMI associated with this noise can be reduced by incorporating a bandstop filter onto the differential line on a printed circuit board. Two kinds of filters were tested: common mode and common/differential mode. It was demonstrated that the application of a common-mode/differential-mode filter is more advantageous than a common-mode filter and allows to achieve the suppression of the total radiated power by 17 dB to 7 dB in the frequency range from 10 GHz to 26 GHz.

9:30am
Analysis of Noise Current from an Inverter at High Frequency by a Spectrum Analyzer
Yu-Sheng Li[1], Chiu-Chih Chou[2], Ying-Fan Chen[3], Tzong-Lin Wu[1]
[1]National Taiwan University, Taiwan; [2]National Central University, Taiwan; [3]Delta Electronics Inc, Taiwan
Abstract: This paper provides measurement results of the common-mode noise of a 380-V inverter system by a spectrum analyzer (SA). Emphasis is on how to obtain the characteristics of the noise at 50 MHz, a frequency >1000x higher than the switching frequency. It is demonstrated that using the normal sweeping mode of SA, the results provide little information regardless of the RBW used. In contrast, the zero-span mode of SA can clearly reveal the property of the noise, thereby facilitating EMC diagnostic and optimization.

10:30am
A Numerical Investigation Comparing Boresighting and Linear Scanning Methods for EMC Emissions Measurements
Yibo Wang, Zhong Chen
ETS-Lindgren, USA
Abstract: This paper compares boresighting and linear scanning methods in EMC emissions measurements above 1 GHz. At higher frequencies, emissions from typical equipment exhibit complex radiation patterns, making it statistically challenging to capture the true peak radiation. Numerical experiments are conducted to demonstrate the advantages of boresighting. The findings contribute to the development of standards and aim to enhance the accuracy and reliability of EMC emissions measurements.

11:00am
Conducted and Radiated Emissions of Power Chips with High Temperature Environment
Jean Marc Dienot[1,2]
[1]Laboratoire SIAME, E2S-UPPA, France; [2]Universite de Toulouse, France
Abstract: We present experimental studies of external temperature impacts on electromagnetic emissions issued from Power Printed Circuit Board (PPCB). A canonical Power PCB has been defined and realized to support comparative EMC characterizations, both in conducted and radiated modes. EMC test setups in these two modes have been completed with a heating system that modifies the external thermal environment of the PPCB, from ambient to 200°C. The new parametric EMC figures obtained led to the discussion of new cases of EM emissions and couplings with electronic devices in harsh environments .

TC10_3 TECHNICAL PAPERS

HIGH-SPEED INTERCONNECTS AND NOISE COUPLING

8:30AM - 12:00PM

Room: 306B

Sponsored by TC-10 Signal and Power Integrity

Chair:
Wei Zhang, *Marvell Semiconductor Inc., Reading, MA, USA*

Co-Chair:
Chaofeng Li, *Qualcomm Inc, San Diego, CA, USA*

PLANNED SPEAKERS & TOPICS

8:30am
A Transceiver using Mode-Division-Multiplex-Transmission Method for a Single-Ended Cable
Ryoma Sakida[1], Hayato Yatabe[2], Yuki Fukumoto[2], Tohlu Matsushima[2], Takefumi Yoshikawa[1]
[1]Toyama Prefectural University, Japan; [2]Kyushu Institute of Technology, Japan
SIPI BEST STUDENT PAPER FINALIST
Abstract: This paper describes a transceiver of semiconductor Integrated Circuit (IC) to implement a mode division-multiplex-transmission method for high-speed and single-ended signaling through a shielded multi-wire cable. Usually, single-ended digital data transmission over long multi wire cables makes it difficult to achieve high bandwidth data communication because crosstalk between wires in the cable degrades the data eye opening of each wire. The proposed method can significantly reduce crosstalk in principle by assigning eigenmodes to wires in the cable. The transceiver can transmit and receive multi-level digital data that conforms to the proposed method. Appropriate eye openings were verified in actual measurements using the transceiver and cable, demonstrating the reliability and effectiveness of this method.

9:00am
Frequency Domain-Based Signal Integrity Evaluation Metrics for High-Density Interconnection (HDI) Systems
Hyunwoo Kim[1], Dongryul Park[1], Changmin Lee[1], Seunghun Ryu[1], Seonghi Lee[1], Sanguk Lee[1], Dongkyun Kim[1], Jinwook Lee[1], Jongwook Kim[2], Seungyoung Ahn[2]
[1]Korea Advanced Institute of Science and Technology, Korea; [2]SK hynix Inc., Korea
Abstract: In this paper, we propose frequency domain-based signal integrity (SI) evaluation metrics for high-density interconnection systems. The proposed approach introduces two key metrics: eye aperture metric Am and overshoot metric Om, derived from the voltage transfer function in the frequency domain. These metrics enable fast and efficient SI performance evaluation across various channel environments in HDI systems. Compared to conventional eye diagram simulation, the proposed metrics accurately capture the relative SI performance trends across channels while significantly reducing computation time.

10:00am
Signal Integrity Analysis-Based Channel and Equalizer Co-Design Methodology for High-Speed Serial Links
Seonghi Lee[1], Sanguk Lee[1], Seunghun Ryu[1], Dongryul Park[1], Hyunwoo Kim[1], Yongho Lee[2], Jiyoung Park[2], Seungki Nam[2], Sungwook Moon[2], Jiseong Kim[1], Seungyoung Ahn[1]
[1]Korea Advanced Institute of Science and Technology, Korea; [2]Samsung Electronics Co., Ltd., Korea
Abstract: This study investigates the noise performance of ensemble non-return-to-zero (ENRZ) signaling in comparison to non-return-to-zero (NRZ), specifically examining six distinct noise modes. These modes comprise three two-wire configu- rations—common mode (CM), differential mode (DM), and pseudo-differential mode (PDM)—along with three four-wire configurations. Two scenarios, lossless deterministic and lossless random, are analyzed. Results indicate that under deterministic noise conditions, both signaling formats maintain effective signal swings. However, ENRZ exhibits notable level shifts, which can be readily removed through AC coupling. In the two random noise scenarios, the 224 Gbps ENRZ scheme demonstrated less eye height degradation compared to the 112 Gbps NRZ (19.02% versus 25.37% for Type I noise), attributed to its inherent four- wire architecture providing enhanced noise averaging capabilities over the NRZ structure.

RALEIGH FUN FACT

RALEIGH'S MANY PARKS

Did you know Raleigh boasts over 200 parks across the city? The parks accommodate a variety of classes and programs, art, athletic facilities, lakes, nature preserves, dog parks, playgrounds, swimming pools, greenway trails, and historic sites- a tribute to their nickname, "the City of Oaks." Raleigh is home to Pullen Park, the first public park in North Carolina and oldest operating amusement park in the U.S named Pullen Park, founded in 1887. Pullen Park features a historic carousel and miniature train, rentable pedal boats, playgrounds, and grilling and picnic areas, sports fields, and tennis courts within 5 minutes of downtown.

TC9_3 TECHNICAL PAPERS

ELECTROMAGNETIC EFFECTS IN POWER SYSTEMS AND MEDICAL DEVICES

8:30AM - 12:00PM

Room: 306C

Sponsored by TC-9 Computational Electromagnetics

Chair:
Scott Piper, *Dassault Systemes Americas Corp, Waltham, MA, USA*

Co-Chair:
Shubhankar Marathe, *Amazon, Sunnyvale, CA, USA*

PLANNED SPEAKERS & TOPICS

8:30am
A Comprehensive In-Silico Study on MRI Safety of Pedicle Screw Systems Using Bone-Inclusive Phantom
Jiarui Lu, Lijian Yang, Zhongrui Wang, Lingfei Zhang, Jianfeng Zheng
University of Houston, USA
Abstract: This paper introduces a bone-inclusive phantom designed to improve the accuracy of radiofrequency (RF) energy absorption assessments for pedicle screw systems under 1.5T MRI conditions. A total of 225 numerical simulations were performed to evaluate electromagnetic fields and RF-induced energy absorption, encompassing three distinct modeling strategies: a conventional device-only phantom, a bone-inclusive phantom, and a human body model. The results in this study demonstrate that for small screws the device-only phantom simulations align more closely with the human body model while bone-inclusive phantom simulations achieve higher accuracy as screw size increases. Notably, for longer pedicle screws, the bone-inclusive phantom more accurately identifies the location of the peak specific absorption rate (pSAR1g) at the rod tip, whereas the device-only phantom erroneously indicates the screw tip as the site of maximum absorption. These findings show the importance of incorporating critical skeletal structures and carefully selecting device and bone dimensions when conducting phantom-based simulations for implantable devices, as these factors significantly enhance the fidelity and accuracy of the resulting RF energy absorption predictions.

9:00am
Low-Frequency EMI Prediction by Electromagnetic FEA and Machine Learning in Consumer Electronics Devices with PCBs
Jingchen Liang, Peng Han, Pavani Gottipati
Ansys, Inc., USA
Abstract: Rapid technology advancements in recent years have resulted in increasing functionality, increasing complexity and reduced footprint of consumer electronics devices. Flex Printed Circuit Boards (flex PCBs) have gained popularity as they enable smaller device footprints by creating additional space within the device to accommodate component modules such as permanent magnets (PMs), sensors, cameras, chargers, batteries, etc. With tightly packed flex PCBs and component modules, Electromagnetic Interference (EMI) has become a critical design consideration that must be carefully analyzed and mitigated to prevent significant impacts on device performance and efficiency. This paper presents an electromagnetic FEA solution assisted by machine learning (ML) for low-frequency (LF) EMI prediction in consumer electronics devices incorporating rigid/flex PCBs. Comprehensive analyses of device operating modes, magnetic shielding effects, and component placements are conducted using a wireless charging example with flex PCBs and a general-purpose rigid PCB to study their influence on EMI. Simulation results demonstrate the effectiveness of magnetic shielding and optimized component placement in reducing LF EMI.

9:30am
Electromagnetic Surge Simulation in Inductors Using an Adaptive Time-Stepping FEM
Zhe Chen, Hao-Xuan Zhang, Zheng-Wei Du, Rongchuan Bai, Yi-Yao Wang, Wenyan Yin
Zhejiang University, China
Abstract: This study employs a self-developed time-domain finite element method (FETD) integrated with adaptive time stepping technique to simulate the impact of an electromagnetic pulse on some magnetic components with magnetic saturation and lossy effects treated appropriately. Through field-circuit co-simulation, transient magnetic saturation and eddy current loss distributions are quantitatively resolved. The method achieves accelerated simulation with maintained accuracy, enabling efficient design of surge-resistant components.

10:30am
Multi-Physics Simulation Workflow for PCB Acoustic Vibrations Induced by Components
Jingsong Wang
Dassault Systemes Americas Corp, USA
Abstract: Abstract—Integrating multiple sensors and antennas in high-tech devices increases susceptibility to internal noise and vibrations. Printed circuit board (PCB) vibrations arise from electromagnetic and mechanical interactions in components such as multilayer ceramic capacitors (MLCCs) and power inductors. These interactions—driven by the piezoelectric effect, magnetostriction, and Lorentz forces—coupled with PCB resonances, leading to structural deformations and acoustic emissions. Unlike traditional force-extraction methods, this study directly simulates force fields by applying signals to components, enabling more accurate predictions of PCB-induced vibrations. A multi-physics simulation framework integrating electromagnetic, structural, and vibroacoustic analyses is presented to evaluate and mitigate PCB vibrations. The proposed approach enhances the understanding of force-induced PCB oscillations, providing design insights for improving structural integrity and electromagnetic compatibility (EMC) in electronic devices.

11:00am
A Study on RF-Induced Heating of Passive Implantable Medical Devices at 5T MRI
Mir Khadiza Akter, Ao Shen, Md Zahidul Islam, Jianfeng Zheng, Ji Chen
University of Houston, USA
Abstract: This paper investigates the RF-induced heating of passive implantable medical devices (PIMDs) within the newly developed 5T whole-body MR system. Numerical and experimental studies identified the worst-case device length inside the ASTM phantom, which was then positioned at a clinically relevant location within an anatomically accurate human body model to evaluate RF-induced heating. The results indicate that the worst-case construct for RF-induced heating can be determined, and MR conditionality can be achieved for medical implants at 5T MRI.

11:30am
Impact of Transfer Function & E-Field Spatial Resolution on AIMD RF-Induced Voltage
Nowrin Chamok, Carolyn Kwok, Kyle Bond, Arash Dabir, Anasheh Avakians, Louai Al-Dayeh
Boston Scientific Neuromodulation, USA
Abstract: This study investigated whether reducing the spatial resolution of measured Transfer Function and simulated tangential E-fields impacts the accuracy of MRI RF-Induced injection voltage modeling for an Active Implantable Medical Device (AIMD) per testing standards. Transfer Function scalars were computed and compared at different spatial resolutions for an implant in 1.5T and 3T MRI scanners. For both frequencies, the scalar remained stable for spatial resolutions of 0.2-1 cm. At 3T, the Transfer Function scalar was more sensitive to resolution changes, deviating from baseline quicker than 1.5T.

ED_ E1 EXPERIMENTS & DEMONSTRATIONS

MIL-STD-461 G/H RECEIVER SCAN DEMONSTRATION

9:30AM - 11:30AM

Room: Exhibit Floor, E&D Booth 1

The purpose of this demonstration is to discuss and demonstrate the differences between traditional stepped scan and time-domain/FFT scan using EMI Test Receivers and industry software due to the proposed changes in 461H that disallows spectrum analyzers.

The demonstration will introduce about the MIL-STD receiver measurement requirements, then dive into the fundamental differences in stepped vs time-domain. The physical demonstration will have a vector signal generator with varying signals that can cause receivers difficulty without taking care of measurement time, and how to overcome these challenges.

PRESENTER:

Sean R. Lynch, *Rohde & Schwarz, USA*

ED_ E2 EXPERIMENTS & DEMONSTRATIONS

TAMING RADIATED EMISSIONS : BUILDING A PRECOMPLIANCE SETUP

9:30AM - 11:30AM

Room: Exhibit Floor, E&D Booth 2

Sponsored by TC-9 Computational Electromagnetics

Effective EMC precompliance testing is critical for predicting how a product will perform during formal EMC certification. This demonstration will illustrate the process of designing and building a radiated emissions precompliance antenna using CST Studio Suite. It will also delve into the selection and evaluation of low-noise amplifiers (LNAs), incorporating them into full-wave simulation results to assess their impact on performance. Finally, the fully constructed setup will be demonstrated to validate the design.

PRESENTERS:

Clint Patton, *GoEngineer, USA*

ED_E3 EXPERIMENTS & DEMONSTRATIONS

EFFECTIVE, FAST AND RELIABLE EMI MEASUREMENTS WITH MODERN EMI TEST RECEIVERS

9:30AM - 11:30AM

Room: Exhibit Floor, E&D Booth 3

This workshop starts with an introduction to the basics of the EMI test receiver. Characteristics, differences to oscilloscopes or spectrum analyzers, as well as important parameters for a successful EMI measurement are highlighted. This serves as a basis for the following topics of the workshop and offers participants with different levels of knowledge the opportunity to attend this workshop.

The technological development of EMI measurement technology and the outstanding advantages of modern instruments will be demonstrated. Modern EMI test receivers rely on the Fast Fourier Transform (FFT), which was only made possible by modern signal processing and high computing power. Large bandwidths not only ensure enormous measurement speed improvements, but also increase reliability, repeatability and offers unprecedented possibilities for analyzing the measurement objects. This will be examined in a practical way on the instrument as well as with external automation software.

In addition, the workshop shows current measurement methods in practice that highlights the problem of high input levels and solutions to avoid false measurements or even costly damages to the device. The teaching of theory in this workshop is always supported by practical measurements and demonstrations directly on the instrument.

PRESENTER:

Tobias Gross, *Rohde & Schwarz GmbH & Co KG, Germany*

ED_E5 EXPERIMENTS & DEMONSTRATIONS

WIRELESS COEXISTENCE TESTING ACCORDING TO ANSI C63.27 STANDARD

9:30AM - 11:30AM

Room: Exhibit Floor, E&D Booth 5

Sponsored by TC-9 Computational Electromagnetics

As the use of connected medical devices and internet of things (IoT) devices continue to increase, the challenges associated with wireless coexistence also increases. Furthermore, the growing use of connected medical devices in mission-critical applications (operating rooms, remote health, implanted devices) means that the consequences of poor coexistence are more severe than ever before. It is crucial for medical device manufacturers to guarantee a seamless user experience and reliability of the device operating in environments with numerous competing wireless signals and to comply with ANSI C63.27 standard or guidance. Neglecting to consider unforeseen usage scenarios can expose vulnerabilities in the performance and resilience of the wireless devices. The absence of defined testing parameters and unambiguous pass/fail benchmarks leads to irregular assessment, impeding the efficiency of quality evaluation. In this session, attendees will learn the challenges of wireless coexistence testing, and understand the key guidance and standards associated with wireless coexistence testing.

PRESENTER:

Bill Koerner, *Keysight Technologies Inc., USA*

ASK THE EXPERTS
PANEL DISCUSSION

ASK A PRACTITIONER: A PANEL OF EMC LAB COORDINATORS AND ASSESSORS

10:00AM - 11:30AM

Room: Exhibit Floor, AtE Stage

Organizer:
Jacob Dixon, *International Business Machines Corp., Rochester, MN, USA*

When theory becomes practice. This panelist discussion will allow attendees, both new and experienced, to ask direct questions and listen to discussion from leaders in the EMC community from a practitioner point of view.

The format of the panel will be 8 speakers. Four lab coordinators coming from diverse DUT backgrounds. Four lab assessors/assessor managers; two from NVLAP, and two from A2LA, to give their perspective from a quality assessment point of view.

ASK THE EXPERTS SPONSORED BY:

R&TLR

PLANNED PANELISTS INCLUDE:

David Schaefer, *Element Materials Technology, Fridley, MN, USA*
Bob Mitchell, *TUV Rheinland AG, Boxborough, MA, USA*
Daniel Hoolihan, *Hoolihan EMC Consulting, Lindstrom, MN, USA*
Victor Kuczynski, *Vican Corporation, Scarborough, ON, Canada*
David Zimmerman, *Spectrum EMC, LLC, Sierra Vista, AZ, USA*
Megan McConnell, *American Association for Laboratory Accreditation, Frederick, MD, USA*

Photo by Patrick Andre

TC5_2 TECHNICAL PAPERS

HEMP AND ESD DESIGN AND MODELING

1:30PM - 4:00PM

Room: 305A

Sponsored by TC-5 High Power Electromagnetics

Co-Chairs:

Michael McInerney, *Consultant, Champaign, IL, USA*

William Radasky, *Metatech Corporation, Goleta, CA, USA*

PLANNED SPEAKERS & TOPICS

1:30pm

Designing a Sensitive Compartmented Information Facility

Sergio Longoria

ETS-Lindgren, USA

Abstract: This paper will explain the overall design strategy for the construction of SCIF's, primarily focusing on overcoming the challenges in shielding and SCIF performance.

2:00pm

E1 Incidence Modeling Response of Solid-State Transformer Transistors

Tyler Bowman, Mihai Negoita

Sandia National Laboratories, USA

Abstract: Understanding the potential vulnerabilities from future grid architecture is critical in developing resilient energy generation and transmission systems. This work investigated the response of a rectifier leg from a solid-state transformer to an early-time conducted high-altitude electromagnetic pulse. SPICE modeling of a single-phase representative layout of a 4-leg rectifier was used to define the voltage and current behavior across the typical filter elements and half-bridge transistor elements to look for voltage conditions that may exceed damages thresholds of equipment. Results show that even basic, achievable filtering elements have a potential to significantly reduce the incident pulse impacts on rectifier transistors.

2:30pm

4-Leg Inverter Modeling for E2 Mitigation in Solid-State Transformers

Tyler Bowman, Ronald Matthews, Lee Rashkin

Sandia National Laboratories, USA

Abstract: Understanding the potential vulnerability of future grid components is critical to ensuring system resilience as distributed energy capabilities are introduced. This work investigated the response of a four-leg inverter stage of a solid-state transformer to the intermediate-time E2 conducted environment of a high-altitude electromagnetic pulse. Hamiltonian-based controls that were originally designed to reduce low frequency common-mode currents in the system were used to mitigate the E2 disturbance described by MIL-STD-188-125-1. Negligible impact was observed on the phase currents or voltages on the transistor elements or DC bus in response to the standard pulse.

3:30pm

Comprehensive Computational Simulations of ESD Analysis for Complex Devices

Shahid Ahmed

Ansys, Inc., USA

Abstract: The evolution of electronic design, driven by demand for innovation across various sectors, introduces challenges in mitigating electrostatic discharge (ESD) risks. Miniaturization and high-density integration amplify these risks, which are compounded by nonlinear plasma channels from non-contact ESD, demanding proactive and reactive measures for prevention and mitigation. Computational modeling offers essential insights and enables seamless integration of full-wave models with circuits, providing efficient solutions through finite element adaptive mesh refinement in frequency and time domains. Through this paper in this conference, we will focus on ESD analysis and mitigation strategies for contact and non-contact air discharge events, aiming to enhance the reliability of modern electronic systems.

TC7_2 TECHNICAL PAPERS

POWER ELECTRONICS EMC

1:30PM - 3:00PM

Room: 305B

Sponsored by TC-7 Electrical System and Power Electronics EMC

Co-Chairs:

Flavia Grassi, Politecnico di Milano, Milano, Italy

Niek Moonen, *Universiteit Twente, Enschede, Netherlands*

Cong Li, *GE Global Research, Clifton Park, NY, USA*

PLANNED SPEAKERS & TOPICS

1:30pm

Radiated Immunity (ISO 11452-2) Failure Debugging of a High-Side Driver Using EMI Modeling

Jie Chen[1], Rajen M. Murugan[1], Madison Eaker[1], Rakesh Panguloori[1], Bibhu P. Nayak[2], Harikiran Muniganti[2], Dipanjan Gope[2]

[1]Texas Instruments, Inc., USA; [2]Simyog Technology, India

Abstract: Abstract—ISO 11452-2 specifies an absorber-lined shielded enclosure method for testing the radiated immunity (RI) of a device under test (DUT), where the DUT and harness are subjected to the electromagnetic disturbance generated inside the enclosure. In the debugging of the RI failure of a High-Side Driver IC device, EMI simulation is used to predict the IC pin voltage (voltage vs. frequency) and correlated with the lab measurement failure result. This modeling approach optimizes the PCB layout and components design to mitigate the RI failure. As such, enhanced predictive RI modeling can be performed early in the design phase to reduce the PCB design iterations, save time to market, and avoid additional testing costs. Keywords—RI, Radiated Immunity, EMC, modeling, PCB optimization

2:00pm
Impact of Magnetic Field Surge Interference on IGBTs in Inverter Circuits
Zheng-Wei Du, Zhe Chen, Kai-Yi Yang, Rongchuan Bai, Wen-Yan Yin
Zhejiang University, China
Abstract: This paper investigates the effects of non-contact magnetic field surge interference on IGBTs within inverter circuits, where the susceptibility of IGBTs to external magnetic field disturbances is examined. Experimental results indicate that the magnetic field surges can induce significant voltage and current fluctuations. Due to the presence of parasitic inductance and capacitance, the inverter circuit exhibits damped oscillation phenomena. Further, the fluctuating output current could lead to an operational instability or failure of the IGBT.

2:30pm
High Voltage Cable and Load Termination Effect Study to Improve EMC Testing of an Inverter
Varittha Sanphuang, Nitin Parsa, Ali Attaran, Ronald Missier
Ford Motor Company, USA
Abstract: This paper investigates an approach to evaluate the impedance of representative load (HV shielded cables + termination) as seen by the inverter for component-level electromagnetic compatibility (EMC) testing. Simulations were performed and validated with measurements. Results show that better correlation between the component-level data and the vehicle-level measurement is achieved if actual HV shielded cables and representative termination are used at the component-level EMC test setup.

Photo by Richard Georgerian

TC2_4 TECHNICAL PAPERS

EMC MEASUREMENTS: IMMUNITY & SHIELDING

1:30PM - 4:30PM

Room: 306A

Sponsored by TC-2 EMC Measurements

Chair:
Ahalya Srikanth, *Ford Motor Company, Lasalle, ON, Canada*

Co-Chair:
Monrad Monsen, *Oracle America Inc, Redwood Shores, CA, USA*

PLANNED SPEAKERS & TOPICS

EXEMPLARY PAPER

1:30pm
An Overview of the IEEE P2715 Guide for the Characterization of the Shielding Effectiveness of Planar Materials
Presenting Author: Davy Pissoort, *ESAT-WaveCoRE, Mechatronics Group (M-Group), KU Leuven, Bruges Campus, Bruges, Belgium*
A. Suarez Zapata, J. F. Dawson; Y. Ariën; J. Catrysse; **D. Pissoort**; A. C. Marvin (2023)
Citation: A. Suarez Zapata, J. F. Dawson, Y. Ariën, J. Catrysse, D. Pissoort, A. C. Marvin "An overview of the IEEE P2715 guide for the characterization of the shielding effectiveness of planar materials," in *IEEE Electromagnetic Compatibility Magazine*, vol. 12, no. 2, pp. 78-88, doi: 10.1109/MEMC.2023.10201434.

2:00pm
Analysis of Capacitive Touchscreen Electrodes Design Patterns from an EMI/EMS Perspective
Subramaniam S. Sankar[1], Stanislav Kovar[1], Michael Galda[2]
[1]Tomas Bata University in Zlin, Czech Republic; [2]NXP Semiconductors, Czech Republic
Abstract: Capacitive touch sensing has gained traction in modern human-machine interfaces (HMIs) due to its cost efficiency, versatility, and reliability. In parallel, the proliferation of high-speed wireless systems has spurred interest in integrating high-frequency antennas within touch screen panels (TSPs). As device dimensions continue to expand, particularly in large-screen applications, addressing challenges arising from the touch-sensing circuitry and TSP design is crucial, particularly in electromagnetic interference (EMI) and electromagnetic susceptibility (EMS). This research primarily focuses on the simulation and experimental study of various commonly used capacitive touchscreen patterns and the analysis of how these configurations influence signal coupling between touch electrodes and the surrounding environment. The results show that larger screens with complex touch electrode patterns exhibit an increased propensity to couple with undesired signals across different frequencies. While TSPs with simpler electrode design patterns can partially mitigate these effects, they might introduce additional challenges, such as higher parasitic capacitances and increased loading on the drive circuitry. However, designing TSPs with intrinsically higher immunity to EMS and lower emissions while keeping the signal-to-noise ratio (SNR) within tolerance remains vital for touch-based HMI deployment for critical systems in noise-prone environments, such as electric automotive systems.

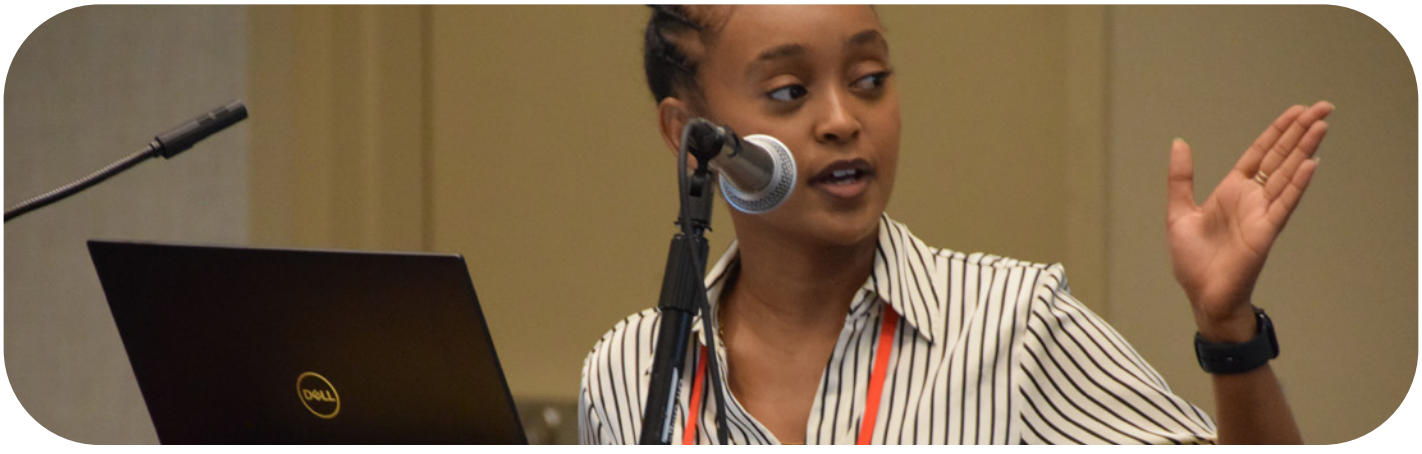

Photo by Richard Georgerian

2:30pm
Application of Time Reversal Techniques for Identifying Shielding Effectiveness in Complex Electronic Systems
Mohammad Abedi[1], Oameed Noakoasteen[1], Sameer D. Hemmady[2], Christos Christodoulou[1], Edl Schamiloglu[1]
[1]University of New Mexico, USA; [2]Verus Research, USA
Abstract: This paper proposes a novel method for determining the passive resonances of large and complicated electronic systems in the GHz frequency range. In this context, Time Reversal (TR) and the Decomposition of the Time Reversal Operator (DORT) have previously been demonstrated as techniques to identify resonances in various dispersive media (RF and acoustic). Here, we present an application of these methods for non-invasively identifying passive resonances as an alternative to the traditional ones that usually involve invasive measurement probes. The proposed method uses the multistatic data matrix (MDM) in the frequency domain for the detection of resonances with high accuracy. These techniques can be utilized in the EMI/EMC community to derive better shielding topologies for complex electronics.

3:30pm
Radiated Susceptibility Testing Using Near-Field Scanning
McKennan E. Starkey, Aaron Harmon, Cody J. Goins, Kristen M. Donnell, Victor Khilkevich, Daryl Beetner
Missouri University of Science and Technology, USA
Abstract: Determining locations and components in a system responsible for radiated coupling is challenging. Methods, such as near field injection susceptibility scanning or direct power injection, can only find locations and frequencies where a component is sensitive to the near field or to an injected signal but cannot deduce if the component is well coupled to the far-field. In this paper, a method to experimentally determine the levels of radiated coupling within a target system is proposed. A near-field differential loop probe is scanned over the target device while measuring the radiated energy in a stirred-mode tent. By sweeping the near field probe across the device, the total radiated power can be found as a function of its position over the target and used to determine frequencies where the radiated energy is more likely to couple effectively to the system as well as the location of structures that are connected to efficient unintentional antennas. Validation is performed by scanning known radiators, such as patch antennas and dipoles.

4:00pm
Effect of Chamber Loading in Reverberation Chamber Testing
Leela Manepalli[1], Nitin Parsa[1], Hui Zhou[1], Varittha Sanphuang[1], Yuqing Tang[1], Ronald Missier[1], Aaron Verellen[2], Alberto Jimenez[2], Alexander Foreman
[1]Ford Motor Company, USA; [2]Vitesco Technologies, USA
Abstract: In the shift to reverberation testing for automotive radiated immunity, ISO 11452-11:2010 suggests chamber loading factor, FCLF=1 if the average received power matches values from empty chamber characterization. However, our study finds that with large Device Under Test (DUT) even when this criterion is met, it is essential to evaluate and include FCLF for forward power calculation which otherwise would result in significant forward power discrepancies leading to under-testing

TC10_4 TECHNICAL PAPERS

POWER DISTRIBUTION NETWORKS AND DECOUPLING

1:30PM - 4:30PM

Room: 306B

Sponsored by TC-10 Signal and Power Integrity

Chair:
Tao Wang, *DIS Tech, Thousand Oaks, CA, USA*
Co-Chair:
Ji Zhang, *Waymo, San Jose, CA, USA*

PLANNED SPEAKERS & TOPICS

1:30pm
Impact of Voltage Regulator Modules on Power Distribution Network Impedance
Hanyu Zhang[1], Zhiping Yang[2], Alvis Hsu[3], Ryan Hou[3], Chulsoon Hwang[1]
[1]Missouri University of Science and Technology, USA; [2]PCB Automation Inc, USA; [4]Google LLC, USA
Abstract: The voltage regulator module (VRM) impacts the power distribution network (PDN) impedance in the low-frequency range. The effect of VRM is essential for reliable PDN analysis and simulation. However, the existing VRM models for power integrity (PI) simulation lack an in-depth understanding of the effect of the feedback control in the VRM. In this paper, the impact of the VRM control loop on the PDN impedance is investigated. The relationship between the VRM output impedance and the PDN impedance at the IC input pin is derived. The output impedance of a VRM is analyzed using small signal analysis. Eventually, the PDN impedance considering the VRM is obtained. The analysis method was validated on a commercial VRM. The proposed method can be used to calculate the PDN impedance with the VRM on in the PDN design stage.

RALEIGH FUN FACT

WHAT IS RALEIGH KNOWN FOR?

Raleigh, often referred to as the "City of Oaks," boasts an abundance of oak trees that line its roads and streets, creating a beautiful and lush green canopy throughout the city. This rich foliage includes white, red, and black oaks, as well as various hybrid varieties.

Additionally, Raleigh is known as the "Smithsonian of the South" due to the impressive quality and quantity of its free museums. The city is also part of "The Triangle," which includes Raleigh, Durham, and Chapel Hill, renowned for their vibrant cultural and educational offerings.

2:00pm
SPICE-Compatible Nonlinear Macromodels for Fast Power Integrity Verification
Antonio Carlucci, Stefano Grivet-Talocia
Politecnico di Torino, Italy
Abstract: We present a SPICE-compatible frequency-domain macromodeling method that extends the well-known Vector Fitting algorithm to systems that exhibit weakly nonlinear behavior. The models are specifically developed to speed up the transient simulations required for Power Integrity verification of electronic systems equipped with voltage regulators.

2:30pm
Noncausality of AR-Extrapolated S-Parameters
Chia-Cheng Huang, Chiu-Chih Chou
National Central University, Taiwan
Abstract: The autoregression (AR) model has been recently used for S-parameter extrapolation to improve TDR stability and reduce the edge effect of time-gating. In this paper, several simulated and measured data are extrapolated using AR, and then causality is examined using the dispersion relation with subtraction. Some cases indicate that AR may give noncausal responses; the results thus raise concerns about the general applicability of AR, and call for solution on fixing the causality.

3:30pm
CVRM with Feedback for Platform PDN PI Design
Xingjian Kinger Cai[1], Yimajian Yan[1], Dong Zhong[1], Sumant Srikant[2]
[1]Arm Ltd., USA; [2]Arm Ltd., United Kingdom
Abstract: The Compact VRM Model (CVRM) with feedback, addresses key limitations of the original CVRM with Lvr & Rvr in accurately supporting PDN designs with sub-milli-ohm impedance and/or highly distributed decoupling capacitance, below 1 MHz and remains robust under various DC Load Line (DCLL), and has been correlated with lab measurements for platform PI design.

4:00pm
Efficient Decoupling Capacitor Impact Calculation
Faye E. Squires[1], Yifan Ding[1], Matthew Doyle[2], Matteo Cocchini[2], Samuel Connor[2], Francesco de Paulis[3], Albert E. Ruehli[1], Chulsoon Hwang[1], Lijun Jiang[1]
[1]Missouri University of Science and Technology, USA; [2]IBM Corp, USA; [3]University of L'Aquila, Italy
Abstract: Methods of optimizing decoupling capacitor placement on power distribution networks (PDNs) are often limited due to the computational complexity required to calculate the impact of connecting loads to an impedance matrix with hundreds of rows and columns. This work proposes that by removing all but one member of the impedance matrix before calculating, checking the impact of adding capacitors to the matrix can be done efficiently, and optimization methods can be viable even when requiring millions of impedance calculations.

TC10_5 TECHNICAL PAPERS

SIMULATION AND MODELING TECHNIQUES

1:30PM - 5:00PM

Room: 306C

Sponsored by TC-10 Signal and Power Integrity

Chair:
Baolong Li, *Cadence Design Systems Inc, San Jose, CA, USA*

Co-Chair:
Zhenggang Cheng, *Ampere Computing, Cary, NC, USA*

PLANNED SPEAKERS & TOPICS

1:30pm
Layout Parasitics Extraction of DC–DC Converters for Virtual Reference Designs in InfineonSpice
Thomas F. Landinger[1,2], Marius-Andrei Voicu[3]
[1]Infineon Technologies AG, Germany; [2]Technische Hochschule Rosenheim, Germany; [3]Infineon Technologies Romania SCS, Romania
Abstract: Power electronics electrical performance depends largely on the layout design and its parasitic effects such as stray inductances. This paper presents a novel holistic approach to extract printed circuit board (PCB) layout parasitics and include them into the circuit simulator InfineonSpice to predict the electrical transient behavior of a 48 V–12 V dc–dc converter real reference design. Dedicated stray inductances of the layout are extracted by different industry-standard electromagnetics (EM) simulators and compared with vector network analyzer measurements. The entire PCB layout parasitics are extracted and imported into the circuit simulator InfineonSpice. The resulting virtual reference design (VRD) is run to steady state and exhibits a close correlation to the real reference design, which is validated by time-domain measurements with fiber optic oscilloscope probes.

2:00pm
Comparison of Three Macromodeling Methods
Yi-Hsiang Huang, Chiu-Chih Chou
National Central University, Taiwan
Abstract: The Vector Fitting (VF) and Loewner Matrix (LM) are two popular macromodeling methods and are implemented in many commercial tools. Recently, a new approach called Orthogonal Rational Approximation (ORA) has been proposed. This paper aims to compare the performance of ORA against VF and LM. The comparison will focus on execution time, error with respect to the original data, and order of the rational model (the number of poles). The objective is to establish guidelines for selecting the more efficient macromodeling method based on the characteristics of the given dataset.

EXEMPLARY PAPER

2:30pm
Machine Learning for EMC/SI/PI – Blackbox, Physics Recovery, and Decision Making
Presenting Author: **Lijun Jiang**, *Missouri University of Science and Technology Rolla, MO, USA*
Citation: **L. Jiang** "Machine learning for EMC/SI/PI – Blackbox, physics recovery, and decision making," in *IEEE Electromagnetic Compatibility Magazine*, vol. 12, no. 4, pp. 65-75, doi: 10.1109/MEMC.2023.10466473.

3:30pm
Error Bound and Implementation of a Simplified Causality Assessment Method
Chung-Tzu Hsu, Chiu-Chih Chou
National Central University, Taiwan
Abstract: Time domain simulation of channel transfer functions sometimes results in fatal error due to causality violation. To address this issue, despersion relation with subtractions (DRwS) has been introduced. In this work, we propose formulation and implementation detail for the case of zero subtractions, which is not a special case of DRwS and the results thus complement the knowledge in the literature. Test cases show that the formulation is correct, and the consideration of singularity is crucial to the correct detection of noncausality.

4:00pm
Causality of Microstrip Models in Simulation Tools
Chien Lee, Chia-Cheng Huang, Chiu-Chih Chou
National Central University, Taiwan
Abstract: The causality of built-in microstrip models from three simulation tools is evaluated using the DRwS method. Two tools exhibit causality violations, supported by time-domain analysis. Although DRwS identifies noncausal behavior, it does not confirm causality. Model validation is essential for reliable simulation.

4:30pm
Method of Termination with Absorbers for Far-end Crosstalk Measurements
Daniel L. Commerou[1], Reza Asadi[1], Sathvika Bandi[1], Seyed Mostafa Mousavi[1], Xiaoning Ye[2], DongHyun Kim[1]
[1]Missouri University of Science and Technology, USA; [2]Intel Corporation, USA
Abstract: The increasing demand for higher data rates in modern electronic systems has heightened the challenges of maintaining signal integrity, particularly in addressing far-end crosstalk (FEXT). This paper presents a novel approach using absorber-based terminations to perform signal integrity measurements in high-speed PCB designs. The performance of magnetically and electrically loaded absorber materials is evaluated against traditional 50~Ω terminations with performance parameters such as S-parameters, Time-Domain reflectometry (TDR), and induced far-end crosstalk voltage. Simulations and experimental measurements demonstrate that electrically loaded absorbers can achieve performance characteristics comparable to high-quality terminations, particularly for reflections and impedance matching. The results indicate that absorbers offer a cost-effective and adaptable solution for termination applications, with the potential for fast application on existing PCB layouts. However, challenges remain in ensuring consistent pressure for optimal performance. The findings in this paper underlines the feasibility of absorbers for terminations.

TC11 TECHNICAL PAPERS

NANOTECHNOLOGY AND ADVANCED MATERIALS

4:30PM - 5:00PM

Room: 306A

Sponsored by TC-11 Nanotechnology and Advanced Materials

Chair:
Marina Koledintseva, *The Boeing Company, Saint Louis, MO, USA*

PLANNED SPEAKERS & TOPICS

4:30pm
Design and Fabrication of Graphene-Based Absorbing Textiles for 5G Applications
A.G. D'Aloia, H.C. Bidsorkhi, M. D'Amore, A. Tamburrano
Sapienza University of Rome, Italy
EMC BEST PAPER FINALIST

Abstract: A novel method for designing and fabricating graphene-based flexible absorbers is proposed. These absorbers consist of graphene-based coatings acting as lossy layers, textile spacers, and metallic backings serving as perfect electric conductors (PECs). Polyester fabric is selected as the textile substrate, while the coatings are composed of polyvinylidene fluoride (PVDF) matrices embedded with varying amounts of graphene nanoplatelets (GNPs). An analytical procedure is developed to design absorbers at a target resonant frequency using a rigorous theoretical model to determine the optimal spacer and lossy layer thicknesses based on material properties. Specifically, the absorber is designed for a resonance at 32.5 GHz, achieving a −10 dB bandwidth that covers the 5G frequency range from 27.7 to 38.2 GHz. The graphene-based textile is fabricated and characterized, with measured absorption performance compared to theoretical predictions, demonstrating strong agreement

Photo by Patrick Andre

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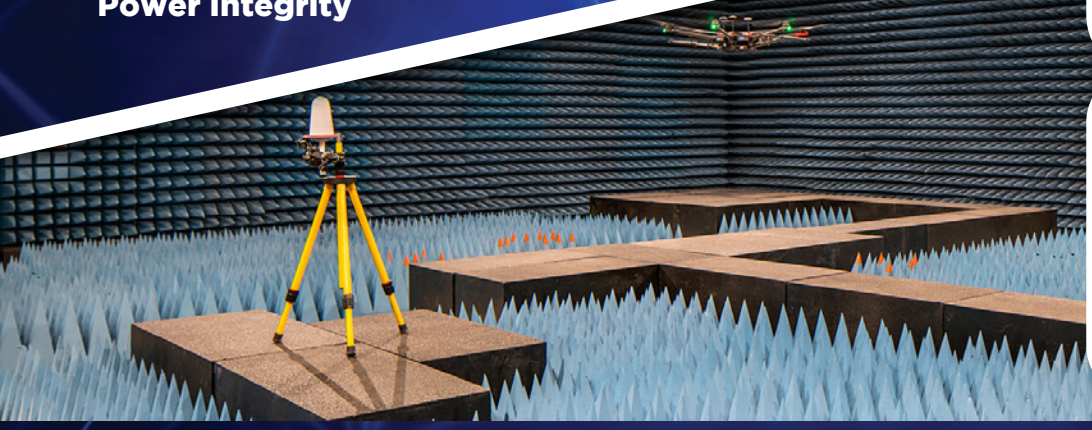

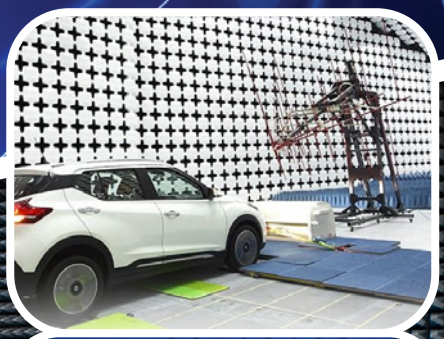

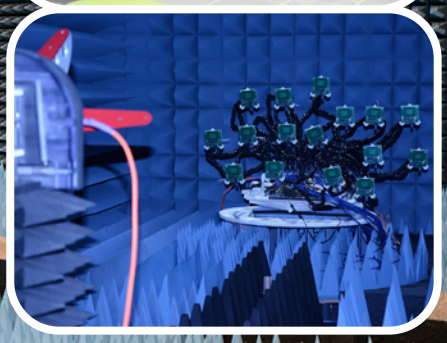

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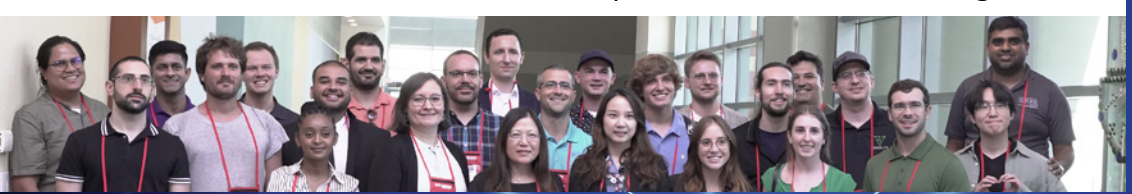

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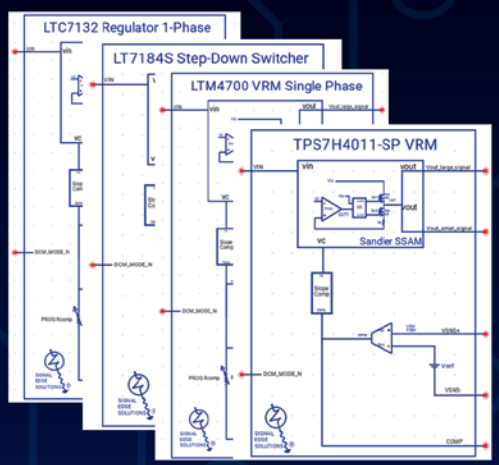

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SCHEDULE AT A GLANCE

ROOM	302C	303	305A	305B	306A	306B	306C
8:30 AM	TUTORIAL WT_D1 "MORE, BETTER, FASTER" — THE RAPID EVOLUTION OF AUTOMOTIVE EMC DESIGN AND TEST	TUTORIAL WT_D2 EMC AND HAM RADIO	TUTORIAL WT_D3 ELECTROMAGNETIC SHIELDING IN ELECTRIC MOBILITY	TUTORIAL WT_D4 OPTIMIZATION OF SYSTEM LEVEL ESD AND SIGNAL INTEGRITY WHEN USING EXTERNAL ESD PROTECTION DEVICES	WORKSHOP WT_D5 UNDERSTANDING, DEBUGGING, AND MODELING ENOISE – A CRUCIAL SYSTEM PERFORMANCE INDICATOR FOR CONSUMER ELECTRONIC DEVICES	WORKSHOP WT_D6 AEROSPACE EMC	TUTORIAL WT_D7 PSES TUTORIAL: PRODUCT SAFETY COMPLIANCE AND GLOBAL MARKET ACCESS
10:00 AM	REFRESHMENT BREAK						
10:30 AM	↓	↓	↓	↓	↓	↓	↓
12:00 PM	LUNCH BREAK						
1:00 PM							
1:30 PM	WORKSHOP WT_E1 APPLICATION OF REVERB CHAMBERS	WORKSHOP WT_E2 ACHIEVING CAB RECOGNITION: TEL MRA BEST PRACTICES, FCC & ISED LAB/CB REQUIREMENTS, AND KEY CYBERSECURITY INSIGHTS	↓	WORKSHOP WT_E3 DIRECT-TO-PIN COMPONENT-LEVEL ESD TESTING USING SYSTEM-LEVEL ESD STANDARDS AND EQUIPMENT	WORKSHOP WT_E5 INDUSTRY BEST PRACTICES IN COMPUTATIONAL EMI AND EMC	↓	WORKSHOP WT_E7 SELLING EMC TO THOSE WHO NEED IT
3:00 PM	REFRESHMENT BREAK						
3:30 PM	↓	↓ (S)		↓	↓	↓	↓
5:00 PM							

ADDITIONAL STANDARDS SESSIONS, WORKING GROUPS AND TECHNICAL COMMITTEES
For Collateral Meetings, please see page 134

SPEAKERS BREAKFAST
Raleigh Convention Center, 301AB - 7:00 - 8:30 AM
(Breakfast Only on the Day of Presentation)

REGISTRATION/INFO DESK
8:00 AM - 10:00 AM

(S) **STANDARDS WEEK**
For more information about Standards Week, please visit page 132

WT_D1 TUTORIAL

"MORE, BETTER, FASTER" — THE RAPID EVOLUTION OF AUTOMOTIVE EMC DESIGN AND TEST

8:30AM - 12:00PM

Room: 302C

Co-Chairs:

Garth D'Abreu, *ETS-Lindgren, Cedar Park, TX, USA*
Craig Fanning, *Elite Electronic Engineering, Inc., Downers Grove, IL, USA*
Janet O'Neil, *ETS-Lindgren, Cedar Park, TX, USA*
Robert Kado, Stellantis, Auburn Hills, MI, USA

The automotive industry is rapidly evolving with electric propulsion and advanced driver assistance systems, often leading the requirements of current standards. This tutorial will address the testing of vehicle components related to communications, control and propulsion, demonstrating how in some cases, measured S-parameters of automotive high-speed cable assemblies (HSCA) can predict immunity to radiated electric fields. Measurements taken using a time domain reflectometer or vector network analyzer, can be used to analyze performance metrics like the eye diagram. We will explore various in-vehicle communication technologies, including automotive Ethernet and SerDes (Serializer/Deserializer) with PAM2, PAM3, and PAM4 techniques. The rise of Electric Vehicles (EVs) introduces significant EMC testing challenges due to their high-voltage architecture, which traditional low-voltage methods cannot adequately address. This tutorial will also discuss the unique transients generated by the HV bus and the additional emissions and immunity testing required by ISO 7637-4 and 21498 standards. Additionally, we will compare antenna calibration methods in CISPR 25 5th Ed., referencing SAE ARP 958D and ARP 958E for 1-meter radiated emissions measurements.

PLANNED SPEAKERS & TOPICS

Reverberation Test Methods, ISO 11451 5 Annex G, Close Loop Leveling with Power Control
Jack McFadden, Garth D'Abreu
ETS-Lindgren, USA

Complexities of 11451-5
Garth D'Abreu
ETS-Lindgren, USA

Measured Link Segment Data Use in SI Simulation to Predict Immunity Performance of In-Vehicle Networks
Rich Boyer
APTIV – Signal and Power Solutions, Ireland

Challenges in Testing Electric Vehicle High Voltage Components for Electromagnetic Compatibility
Ronald Missier
Ford Motor Company, USA

Additional Powerline Emissions and Immunity Requirements for Automotive Modules Connected to a Vehicle's High Voltage Bus
Craig Fanning
Elite Electronic Engineering, Inc., USA

Update on SAE ARP 958D vs. ARP 958E for 1 Meter Antenna Calibrations
Leon N. Enriquez
ETS-Lindgren, USA

WT_D2 TUTORIAL

EMC AND HAM RADIO

8:30AM - 12:00PM

Room: 303

Sponsored by TC-1 EMC Management

Chair:
Kimball Williams, *IEEE, Dearborn, MI, USA*

Co-Chair:
Tom Braxton, *TEB EMC-EMI Consulting LLC, Bolingbrook, IL, USA*

Ham Radio has led the technology for locating and resolving radio interference. We will also explore some other aspects of Ham Radio.

PLANNED SPEAKERS & TOPICS

EMC & Ham Radio
Tom Braxton
TEB EMC-EMI Consulting LLC., Bolingbrook, IL, USA

POTA – Experiences from the Field
Charles Bunting
Oklahoma State University, USA

RALEIGH FUN FACT

RALEIGH'S CITY MARKET

First established in 1914, the Raleigh City Market is a tourist attration with a rich history, right in the heart of Downtown.

Originally built for only $23,386.06, the market accomodated horse drawn carriages from farmers bringing produce, seafood, poultry and flowers.

When grocery stores became more popular, the City Market no longer drew the crowds it once did. But in the 1980's the city placed it on the National Registry of Historic Places and began renovating it.

When the 1990's rolled around, City Market opened shops, bars and restaurants from around the world instead. It quickly became a popular go-to spot again for tourists and locals alike.

WT_D3 TUTORIAL

ELECTROMAGNETIC SHIELDING IN ELECTRIC MOBILITY

8:30AM - 3:00PM

Room: 305A

Sponsored by TC-4 Electromagnetic Interference Control

Co-ChairS:
Anne Roc'h, *Technische Universiteit Eindhoven, Eindhoven, Netherlands*
Lirim Koraqi, *Katholieke Universiteit Leuven, Leuven, Belgium*
Davy Pissoort, *Katholieke Universiteit Leuven, Bruges, Belgium*
Subramaniam Sankar, *Univerzita Tomase Bati ve Zline, Zlin, Czechia*

To meet the growing demands for sustainability and innovation, mobility is set to undergo several significant transformations in the coming decade. Two closely connected developments are (1) the rise of fully electric vehicles and (2) autonomous cars. On the one hand, fully electric vehicles will inevitably rely heavily on power electronics. On the other hand, autonomous cars will depend extensively on sensors, actuators, and programmable electronics. Both fully electric vehicles and autonomous systems generate electromagnetic disturbances, both at low and high frequencies. These disturbances are of particular concern, as the systems in autonomous cars are becoming increasingly sensitive to them. The coexistence of these systems within compact vehicle architectures makes electromagnetic shielding a critical design consideration.
In this two-part tutorial, we will provide a comprehensive overview of the principles of electromagnetic shielding in electric mobility. We will begin by examining how shielding can be optimized for connected and autonomous vehicle systems, offering insights into electromagnetic compatibility (EMC) challenges and solutions for modern transportation. Additionally, we will explore how the Safe-and-Sustainable-by-Design (SSbD) approach can be integrated into shielding solutions for electric mobility, focusing on key factors such as electromagnetic safety, weight, volume, mechanical strength, and cost. For electric vehicles, low-frequency magnetic shielding is particularly important, and we will discuss strategies for addressing this challenge. This tutorial will also showcase the contributions of the Doctoral Network PARASOL project, funded by the Marie Skłodowska-Curie Actions (MSCA) under the Horizon Europe (HE) framework, as a multidisciplinary initiative that bridges EMC, materials engineering, system safety engineering, and the SSbD approach in developing innovative shielding solutions for electric mobility.

PLANNED SPEAKERS & TOPICS

Overview of Recent IEEE Shielding Standards
Davy Pissoort[1,2]
[1]Katholieke Universiteit Leuven, Belgium; [2]Flanders Make, Belgium

Areas of EMI/EMS Improvements That Can Be Applied for Capacitive Touch Applications
Subramaniam Saravana Sankar[1], Milan Adámek[1], Stanislav Kovář[1], John Dawson[2], Michael Galda[3]
[1]Tomas Bata University in Zlín , Czech Republic; [2]University of York, United Kingdom; [3]NXP Semiconductors, Czech Republic

Understanding EMC Challenges in Electric Mobility: Shielding and High-Frequency Noise
Karen Burnham
EMC United, Inc.

Low-Frequency (LF) Shielding Characterization of Planar Materials
Lirim Koraqi
Katholieke Universiteit Leuven, Belgium

Simulation and Measurement Based Study of the Asymptotic Low-Frequency Electric and Magnetic Shielding Effectiveness for Board Level Applications
Pavithrakrishnan Radhakrishnan
Oklahoma State University, USA

Applying the SSbD Approach Into Electromagnetic Shielding
Anne Roc'h
Eindhoven University of Technology, Netherlands

Optimized Shielding for Aeronautical Applications
Charles Jullien, Thomas Colleter
Safran Electrical and Power, France

WT_D4 TUTORIAL

OPTIMIZATION OF SYSTEM LEVEL ESD AND SIGNAL INTEGRITY WHEN USING EXTERNAL ESD PROTECTION DEVICES

8:30AM - 12:00PM

Room: 305B

Sponsored by TC-5 High Power Electromagnetics

Chair:
Andreas Hardock, *Nexperia, Hamburg, Germany*

By applying SI and ESD simulations, the selection of the ESD risk itself as well as the right choice of suitable ESD protection components can already be made in the concept phase of hardware development, resulting in significant time and resource savings and lowering the risk of a failure to a minimum. This topic is explored in this tutorial in the context of the impact of external ESD protection on SI, and using SEED simulations of transient ESD events.

PLANNED SPEAKERS & TOPICS

Introduction to ESD in Automotive and Mobile Applications

Optimization of ESD and Signal Integrity on System Level for Automative Applications
Andreas Hardock, Sergej Bub
Nexperia, Germany

Optimization of System Level ESD Robustness for Applications using SEED Simulations
Sergej Bub
Nexperia, Germany

Photo by Karthik Vepuri

WT_D5 WORKSHOP

UNDERSTANDING, DEBUGGING, AND MODELING ENOISE – A CRUCIAL SYSTEM PERFORMANCE INDICATOR FOR CONSUMER ELECTRONIC DEVICES

8:30AM - 12:00PM

Room: 306A

Sponsored by TC-9 Computational Electromagnetics

Chair:
Jianmin Zhang, *Google LLC, Mountain View, CA, USA*

Co-Chairs:
Gemin Li, *Google LLC, Mountain View, CA, USA*
Mingfeng Xue, *Google LLC, Mountain View, CA, USA*

eNoise, an unwanted acoustic noise, is one of the crucial system performance indicators for consumer electronic devices including smart phones, watches, earbuds and tablets etc. Mobile system companies have spent lots of efforts in the area by putting research resources and building engineering teams to concur the challenges and improve the performances of their products. However, not too many studies were reported or published in academia. This workshop will share the research and engineering practices achieved in the area.

PLANNED SPEAKERS & TOPICS

eNoise Introduction
Gemin Li
Google LLC, USA

eNoise Debugging, Layout Practicing, and Measurement Technologies
Jianmin Zhang
Google LLC, USA

EM and Multiphysics Modeling Flow for eNoise Simulation
Mingfeng Xue
Google LLC, USA

Singing Capacitor EIMO Souce Model Library Development
Yifan Ding
Google LLC, USA

System Level Acoustic Noise Prediction by Using Singing Capacitor EIMO Source Model
Chulsoon Hwang
Missouri University of Science and Technology, United States

Photo by Richard Georgerian

WT_D6 WORKSHOP

AEROSPACE EMC

8:30AM - 5:00PM

Room: 306B

Sponsored by TC-8 Aeronautics and Space EMC

Chair:
Jim Lukash, *Lockheed Martin Space Systems, Palo Alto, CA, USA*

Co-Chair:
Dennis Lewis, *The Boeing Company, Seattle, WA, USA*

This workshop discusses topics in Aerospace EMC, including design, development, and test for airplanes, helicopters, missiles, and spacecraft.

PLANNED SPEAKERS & TOPICS

Overview of Aeronautics and Space EMC
Jim Lukash
Lockheed Martin Corporation, USA

Aeronautical Power Chain (Aircraft Power Systems)
Charles Jullien
Safran Electrical and Power, France

How To Do Simulation-Based Design for System Level EMC
Paul Bremner
Robust Physics, USA

Introduction to Spacecraft Major Electronics and Electromechanical Systems and EMC Implications
Reinaldo Perez
Jet Propulsion Laboratory, USA

EMC for Missiles
Flynn Lawrence
Lockheed Martin Corporation, USA

Tailoring MIL-STD-461 RE02
Karen Burnham
EMC United, Inc.

Overview of Radio Cosite EMC on Airborne Platforms
John G. Kraemer
Kraemer EMC, USA

Some Topics on E3 Safety Requirements for Military Aircraft
Kin S. Sze, L. Gregory Hiltz
Department of National Defense, Canada

Lightning Protection of Aircraft
Eric S. Cramer, Bruce R. Crain
Northrup Grumman Corporation, USA

Comprehensive EMC Design of Military Helicopters
Ken Lynch
Sikorsky Aircraft, USA

EMC Airworthiness of Navy Aircraft
John LaSalle
Northrup Grumman Corporation, USA

Spacecraft System Level EMC Test Planning
Angela Adams
Lockheed Martin Corporation, USA

WT_D7 TUTORIAL

PSES TUTORIAL: PRODUCT SAFETY COMPLIANCE AND GLOBAL MARKET ACCESS

8:30AM - 12:00PM

Room: 306C

WORKSHOP FROM IEEE PSES SISTER SOCIETY OF IEEE EMCS

Chair:
Grant Schmidbauer, *British Columbia Institute of Technology, Burnaby, BC Canada*

The goal of most companies is not to only design products to be safe, perform according to customer demands, and to meet regulatory requirements, it is to sell those products globally. While your product must comply with the EMC and SIPI requirements, there are a myriad of other technical requirement that must also be considered to facilitate the sale of the product. The plan for this tutorial is to delve into some of the "other technical requirements" that products must comply with, including product safety requirements (ie, concepts such as fire, shock, mechanical, temperature, and radiation); and then once your products are compliant, we will discuss the commercialization of the product through obtaining the many country approvals that are needed in order to legally sell the product around the world. This tutorial should be attended by product realization managers, design engineers, test technicians, product regulatory personnel, project managers, marketing personnel, and others interested in learning more about product safety and global market access requirements.

PLANNED SPEAKERS & TOPICS

Compliance 101
Ken Kapur
Thermo Fisher Scientific, USA

Compliance 201
John Allen
Southern Illinois University, USA

Global Market Access
Grant Schmidbauer
Nemko North America, Inc., USA

Panel Discussion - Open Q&A
John Allen[1], Ken Kapur[2], Grant Schmidbauer[3]
[1]Southern Illinois University, USA; [2]University of the Pacific, USA; [3]British Columbia Institute of Technology, Canada

WT_E1 WORKSHOP

APPLICATION OF REVERB CHAMBERS

1:30PM - 5:00PM

Room: 302C

Chair:
Vignesh Rajamani, *Rohde & Schwarz USA, Inc., Phoenix, AZ, USA*

This half-day tutorial will provide an introduction to recent applications of reverberation chambers. It 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 reverberation chambers and will be valuable to personnel evaluating the use of reverberation chambers 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.

PLANNED SPEAKERS & TOPICS

Introduction and Overview of Reverberation Chamber Theory
Vignesh Rajamani
Rohde & Schwarz USA, Inc., USA

Shipboard Below-deck Electromagnetic Environment Characterizations
Carl Hager
NSWC Dahlgren, USA

What Does ISO 11451-5 Mean For You?
Garth D'Abreu
ETS-Lindgren, USA

Flexible Testing - Shaken, Not Stirred
Frank Leferink[1,2,3]
[1]University of Twente, Netherlands; [2]The University of Nottingham, United Kingdom; [3]Thales Nederland, Netherlands

Photo by Richard Georgerian

WT_E2 WORKSHOP

ACHIEVING CAB RECOGNITION: TEL MRA BEST PRACTICES, FCC & ISED LAB/CB REQUIREMENTS, AND KEY CYBERSECURITY INSIGHTS

STANDARDS WEEK

1:30PM - 5:00PM

Room: 303

Sponsored by TC-1 EMC Management

Co-Chairs:

Daniel Hoolihan, *Hoolihan EMC Consulting, Lindstrom, MN, USA*
Ramona Saar, *NIST, Washington Grove, MD, USA*

This workshop brings together key stakeholders from the U.S. TEL MRA community, including Designating Authorities (DAs) and Accreditation Bodies (ABs), to exchange practical insights and best practices for implementing TEL MRAs. Additionally, it will provide updates on the evolving requirements for cybersecurity conformity assessment bodies (CABs) under both the EU Radio Equipment Directive (RED) and the U.S. Federal Communication Commission (FCC) Cyber Trust Mark Program.

PLANNED SPEAKERS & TOPICS

TEL MRAs – Introduction & Best Practices
Ramona Saar
NIST, USA

US Test Lab and TCB Requirements
Megan McConnell
American Association for Laboratory Accreditation, USA

Canada ISED Recognized Test Lab and CB Requirements
Randy Long
ANSI National Accreditation Board, USA

Accreditation and Designation of Non-MRA Labs to the FCC and ISED
Amanda McDonald
NIST, USA

EU – Radio Equipment Directive - Cybersecurity
Ramona Saar
NIST, USA

USCTM Program and the Lead Administrator Role
Chanté Maurio
UL Solutions, USA

A2LA Role and CyberLABS Requirements
Megan McConnell
American Association for Laboratory Accreditation, USA

ANAB Role and CYBER Labeling Administrator
Keith Mowry
ANSI National Accreditation Board, USA

WT_E3 WORKSHOP

DIRECT-TO-PIN COMPONENT-LEVEL ESD TESTING USING SYSTEM-LEVEL ESD STANDARDS AND EQUIPMENT

1:30PM - 5:00PM

Room: 305B

Sponsored by TC-5 High Power Electromagnetics

Chair:
Hans Kunz, *Texas Instruments Inc, Dallas, TX, USA*

Co-Chair:
John Kinnear, *ESDA, Rome, NY, USA*

The IEC 61000-4-2 Electrostatic discharge immunity test applies to electrical and electronic equipment exposed to static electricity discharges, either directly or to adjacent objects. While it is unclear if the standards body ever intended for the test to be applied in a way that would deliver the discharge current directly to an electronic component inside the equipment, it is clear that doing so is quite prevalent in the industry today. Datasheet entries for electronic components citing ESD immunity to IEC 61000-4-2 are quite common and numerous standards and recommend-practice documents have been written expressly to define how a component should be exposed to this equipment test. Unfortunately, the application of an equipment-level test to a single component is difficult, and such tests are widely deemed to be unrepeatable and unreproducible, with a significant number of existing publications supporting this view. Beyond the difficulty of applying the test, there are also questions regarding how to apply the results of a single component's immunity to the overall immunity of the final electronic equipment using it.

PLANNED SPEAKERS & TOPICS

Direct-to-Pin Component-Level ESD Testing Using System-Level ESD Standards and Equipment, Part 1
Hans Kunz
Texas Instruments Inc, USA

Direct-to-Pin Component-Level ESD Testing Using System-level ESD Standards and Equipment, Part 2
John Kinnear
ESD Association, USA

WT_E5 WORKSHOP

INDUSTRY BEST PRACTICES IN COMPUTATIONAL EMI AND EMC

1:30PM - 5:00PM

Room: 306A

Sponsored by TC-9 Computational Electromagnetics

Chair:
ErPing Li, *Zhejiang University, Hangzhou, China*

Participants will gain practical knowledge of computational tools and techniques for both EMC and EMI applications. The workshop will facilitate networking and knowledge exchange among professionals in the field. Attendees will leave with insights into incorporating computational approaches to enhance EMC/EMI design and testing processes.

PLANNED SPEAKERS & TOPICS

Transforming Electromagnetic Engineering through Advanced Computation, Simulation, and Visualization
Shahid Ahmed
Ansys, Inc., USA

AI-Enabled Computational EMC for EMI
ErPing Li
Zhejiang University, China

Unlocking the Power of PyAEDT
Aishah Shahid
Princeton University, USA

HFSS 3D Modeling for Filtered Connectors
Bin Lin
TE Connectivity, USA

Photo by Richard Georgerian

WT_E7 WORKSHOP

SELLING EMC TO THOSE WHO NEED IT

1:30PM - 5:00PM

Room: 306C

Sponsored by TC-1 EMC Management

Chair:
Tom Braxton, *TEB EMC-EMI Consulting LLC, Bolingbrook, IL, USA*

EMC engineers often deal with skepticism and misunderstanding from non-EMC engineers, managers, and non-technical customers. This is especially true when troubleshooting an interference or non-compliance issue with a device. Those not familiar with EMC and RF behavior may look on this work as dark magic. The challenge is how to explain the phenomenon and the necessity of the steps being taken.

This workshop will describe EMC challenge scenarios and how they were resolved, both technically and in how they raised the customer's EMC awareness.

PRESENTATION TOPICS
Speakers will discuss the challenges and rewards of EMC work, especially the process of explaining to developers, managers, and customers both why the work is necessary and what steps are required. Among the topics to be presented and discussed are those that deal with working in a product-development environment:

- Initiating and sustaining an early EMC design-review process.
- Establishing an early prototype-testing schedule.
- Preparing for regulatory testing and developing a test plan.
- Allowing a margin of development time for EMI mitigation work.
- In addition, the workshop will discuss the need to inform the non-EMC technical community and the non-technical public of the need for EMC. As our lives depend on increasingly complex devices, good EMC practice grows ever more important for reliability and public safety.

Among the topics to be presented and discussed dealing with EMC awareness:

- The importance of educating a broader audience on EMC as a vital technology and not a dark-magic mystery.
- The need for EMC standards and regulations and their origins.
- Examples that demonstrate the growing need for good EMC practice as a matter of public safety.

PLANNED SPEAKERS & TOPICS

Working with Skeptical Project Managers on EMC Issues
Tom Braxton
TEB EMC-EMI Consulting LLC., Bolingbrook, IL, USA

Addressing EMC Issues as an Outside Consultant
Karen Burnham
EMC United, Inc., USA

Dealing with EMC Issues and Explaining Them to Customers
Jeffrey Blum
Verdelite Consulting, USA

BEST EMC PAPER FINALISTS

TUESDAY, AUGUST 19, 2025

TC4

ANALYSIS OF EMI COUPLING MECHANISMS

Room: 305B

10:30AM: Mutual Magnetic Coupling between the Common Modes of Bifilar Windings in Equal-Delay Transformers

James Mclean

Tdk R&D Corp., United States

SS_1

ELECTROMAGNETIC INFORMATION SECURITY AND ITS COUNTERMEASURES

Room: 305A

2:30PM: Simulation-Based Approach to Target EMI Attenuation for Meeting Required Power Side-Channel Attack Success Rate

Masaki Himuro, Rei Mitsuyasu, Kengo Iokibe, Yoshitaka Toyota

Okayama University, Japan

TC9_1

ADVANCES IN ELECTROMAGNETIC MODELING AND PREDICTION

Room: 306C

2:30PM: A Representative Contents Modeling Approach for Predicting Electronics Susceptibility

Jon W. Wallace, Ian J. Timmins

Sandia National Laboratories, United States

4:00PM: Efficient Statistical Analysis of EM Coupling to PCB Power Planes in Complex Enclosures

Sangrui Luo[1], Shen Lin[1], Yang Shao[1], Zhen Peng[1], Thomas Antonsen[2]

[1]University Of Illinois Urbana-Champaign, United States, [2]University Of Maryland, United States

TC2_1

EMC MEASUREMENTS: MEDICAL AND PROBES

Room: 306A

2:30PM: Obstacles and Mitigations for an Accurate Low Impedance, Low Frequency Measurement

Faye Squires[1], Yifan Ding[1], Matthew S. Doyle[2], Matteo Cocchini[2], Samuel Connor[2], Francesco De Paulis[3], Albert Ruehli[1], Chulsoon Hwang[1], Lijun Jiang[1]

[1]Missouri University Of Science And Technology, United States, [2]Ibm Corp, United States, [3]University Of L'Aquila, Italy

3:30pm: RF-Induced Heating of Deep Brain Stimulation Devices During MRI: A Comparison Study of 1.5 T and 3 T Systems

Sana Ullah[1], Safa Hameed[1], Bhumi Bhusal[1], Giorgio Bonmassar[2], Laleh Golestanirad1

[1]Northwestern University, United States, [2]Massachusetts General Hospital, United States

BEST EMC PAPER FINALISTS

WEDNESDAY, AUGUST 20, 2025

TC5_SC1
EVALUATION OF EM INTERFERENCE
Room: 305B
9:00AM: Electromagnetic Energy from Multiple Sources within Perfect and Imperfect Faraday Shields
Robert G. Olsen, John B. Schneider
Washington State University, United States
9:30AM: Three-Dimensional Electromagnetic and Circuit Co-Simulation for Printed Circuit Boards Mounted Linear and Non-Linear Electric Elements
Soki Akutsu, Akio Ikeda, Hisashi Shimizu, Toshihiko Nishimori, Jun Yasui
Mitsubishi Heavy Industries, Ltd., Japan

TC12
WIRELESS EMC ADVANCES: RFI MITIGATION, IMMUNITY, AND COEXISTENCE TESTING
Room: 303
10:30AM: RFI Mitigation System for Smart phones by Automatic Calibration of MIPI Data Rate
Akihiro Tsukioka[1], Kotaro Fujimori[2], Yasuhiro Ochiai[1]
[1]Sony Semiconductor Solutions, Japan, [2]Sony Corporation, Japan

THURSDAY, AUGUST 21, 2025

SS_3
ADVANCES IN HIGH ALTITUDE ELECTROMAGNETIC PULSE (HEMP) ENVIRONMENTS AND PROTECTION
Room: 305A
8:30AM: Update of IEC 61000-2-9: Description of the HEMP Radiated Environment
William A. Radasky, Edward B. Savage
Metatech Corporation, United States

TC2_3
EMC MEASUREMENTS: DESIGN RELATED
Room: 306A
8:30AM: Measurements of Bonding and Faying Resistances for Stacked Bonds
David Norte
Bae Systems, Inc., United States

TC7_1
EMC OF ELECTRICAL SYSTEMS
Room: 305B
9:30AM: Study on Radiation Interference from Pantograph-Catenary Detachment Arc in AC Electrified Railway Considering the Influence of Train Speed
Ke Huang, Feng Zhu
Southwest Jiaotong University, China

TC11
NANOTECHNOLOGY AND ADVANCED MATERIALS
Room: 306A
4:30PM: Design and Fabrication of Graphene-Based Absorbing Textiles for 5G Applications
A.G. D'Aloia, H.C. Bidsorkhi, M. D'Amore, A. Tamburrano
Sapienza University Of Rome, Italy

BEST SIPI PAPER FINALISTS

TUESDAY, AUGUST 19, 2025

TC10_6

APPLICATIONS OF AI AND OPTIMIZATION ALGORITHMS

Room: 306B

11:30AM: USB 3.0 IBIS-AMI Model Construction using Measurement and Neural Network

Jiahuan Huang[1], Wenchang Huang[1], Muqi Ouyang[1], Hank Lin[2], Bin-Chyi Tseng[2], Chulsoon Hwang[1]

[1]Missouri University Of Science And Technology, United States, [2]Asustek Computer Inc., Taiwan

TC10_1

HIGH-SPEED INTERCONNECTS #1

Room: 306B

2:00PM: IBIS Model Simulation Accuracy Improvement with Slew Rate Correction

Yifan Ding, Chulsoon Hwang

Missouri University Of Science And Technology, United States

WEDNESDAY, AUGUST 20, 2025

SS_2

ACHIEVING POWER INTEGRITY WITH AI/ML ALGORITHMS

Room: 305A

8:30AM: Fast and Simple Pre-Design of Decoupling Capacitors using Reinforcement Learning

Taein Shin[1], Keunwoo Kim[1], Junghyun Lee[1], Seonguk Choi[1], Haeseok Suh[1], Hyunah Park[1], Hyunwoo Kim[1], Jinwook Song[2], Seokwoo Hong[2], Youngjun Ko[2], Joungho Kim[1]

[1]Korea Advanced Institute Of Science And Technology, Korea, [2]Samsung Electronics, Korea

THURSDAY, AUGUST 21, 2025

TC10_4

POWER DISTRIBUTION NETWORKS AND DECOUPLING

Room: 306B

1:30PM: Impact of Voltage Regulator Modules on Power Distribution Network Impedance

Hanyu Zhang[1], Zhiping Yang[2], Alvis Hsu[3], Ryan Hou[3], Chulsoon Hwang[1]

[1]Missouri University Of Science And Technology, United States, [2]Pcb Automation Inc., United States, [3]Google Llc, United States

BEST EMC STUDENT PAPER FINALISTS

TUESDAY, AUGUST 19, 2025

TC4

ANALYSIS OF EMI COUPLING MECHANISMS

Room: 305B

11:00AM: EMI-Related Common-Mode Noise Analysis of CMOS and CML Drivers

Guangyu Sheng[1], Hanzhi Ma[1], Zhanxi Pang[1], Jianquan Lou[2], Haiwen Lu[2], Alpesh Bhobe[3], Erping Li[1]

[1]Zhejiang University-University Of Illinois Urbana-Champaign Institute, China, [2]Cisco Systems R&D Co., Ltd., China, [3]Cisco Systems, Inc., United States

SS_1

ELECTROMAGNETIC INFORMATION SECURITY AND ITS COUNTERMEASURES

Room: 305A

11:00AM: Pixel Level Character Reconstruction by Background Profiling against TMDS Emanations

Taiki Kitazawa, Shohei Matsumoto, Yuichi Hayashi

Nara Institute of Science and Technology, Japan

TC4_TC8

I CONTROL: SHIELDING, ANALYSIS, AND MEASUREMENT

Room: 305B

3:30PM: Low-Frequency Shielding Characterization of Planar Materials using the H-t Cell Set-Up: 3D Full-Wave Simulations and Measurements Study

Lirim Koraqi[1], Pavithrakrishnan Radhakrishnan[1,2], Tim Claeys[1], Johan Catrysse[1], Davy Pissoort[1]

[1]Katholieke Universiteit Leuven, Belgium, [2]Oklahoma State University, United States

BEST SIPI STUDENT PAPER FINALISTS

TUESDAY, AUGUST 19, 2025

SC3_1

MACHINE LEARNING BASED METHODS FOR EMC AND SIPI #1

Room: 303

11:00AM: Reinforcement Learning-Assisted Optimization of Power Plane and Placement of Decoupling Capacitors in Power Delivery Networks

Nima Ghafarian Shoaee1, Baoyin Hua[1], Werner John[1], Ralf Brüning[2], Jürgen Götze[1]

[1]Technische Universitat Dortmund, Germany, [2]Zucken Gmbh, Germany

THURSDAY, AUGUST 21, 2025

TC10_3

HIGH-SPEED INTERCONNECTS AND NOISE COUPLING

Room: 305A

8:30AM: A Transceiver using Mode-Division-Multiplex-Transmission Method for a Single-Ended Cable

Ryoma Sakida[1], Hayato Yatabe[2], Yuki Fukumoto[2], Tohlu Matsushima[2], Takefumi Yoshikawa[1]

[1]Toyama Prefectural University, Japan, [2]Kyushu Institute Of Technology, Japan

TC10_4

POWER DISTRIBUTION NETWORKS AND DECOUPLING

Room: 306B

1:30PM: Impact of Voltage Regulator Modules on Power Distribution Network Impedance

Hanyu Zhang[1], Zhiping Yang[2], Alvis Hsu[3], Ryan Hou[3], Chulsoon Hwang[1]

[1]Missouri University Of Science And Technology, United States, 2Pcb Automation Inc., United States, [3]Google Llc, United States

"STANDARDS WEEK" is a combination of talks, tutorials, workshops, panel sessions, and demonstrations that will inform us about new developments in international EMC and Signal Integrity/Power Integrity (SIPI) standards. You can also attend one of the many standards committee meetings and/or working group meetings during the Symposium week to learn more about the standards process, and how you can get involved.
These meetings are open to all. Step up and serve your community and share your expertise!

Sam Connor
IBM, EMC+SIPI 2025 Technical Program Chair

Photo by Jamie Ramie

DON'T MISS THE EMC+SIPI 2025 STANDARDS WEEK SESSIONS

(WT_A2) Military EMC

(WT_A7) EMC Regulations and Stds

(WT_B1) New EMC Measurement Methods

(WT_E6) P2855

(WT_C7) Automotive EMC

(WT_E2) CAB Recognition

Photo by Karthik Vepuri

STANDARDS HAPPY HOUR

THURSDAY AUGUST 21, 2025
4:00 – 6:00 PM
Location: 301B

Open to all who join us for one of the Standards Meetings this week, while supplies last.

Come join us for a chance to mingle and network with professionals who care about standards and technical excellence just as much as you do. As thanks to everyone who sits around a U-shaped conference table for an hour or two, we'd like to provide you with a more relaxed and informal setting to chat. Drinks and heavy appetizers will be available with ticket.

Meeting Name	Date	Room	Start Time	End Time	Webex Meeting ID
Standards Advisory and Coordination Committee Meeting	Monday, August 18	302B	12:00 PM	1:30 PM	2335 053 5413
Shielding Standards Continuity Group Meeting (with focus on IEEE 299 and 299.1)	Tuesday, August 19	302B	8:00 AM	11:00 AM	2343 582 1096
IEEE 1560 Power Line Filters Working Group	Tuesday, August 19	304	9:00 AM	12:00 PM	2343 396 9013
Managing Functional Safety Risks Caused by EMI - IEEE 1848-2020 Continuity Working Group	Wednesday, August 20	304	8:00 AM	11:30 AM	2348 772 6667
P2855 Working Group Monthly Meeting (Cables, Connectors, and their Assembies' Shielding Effectiveness)	Wednesday, August 20	304	2:00 PM	4:00 PM	2346 136 6411
IBIS summit	Thursday, August 21	304	8:00 AM	12:00 PM	2344 176 9945
PAR 2838 WG Aerospace Components Lightning Direct Effects Qualification	Thursday, August 21	402	9:30 AM	11:00 AM	2341 413 8876
EMC-S PerCom Meeting	Thursday, August 21	302A	2:00 PM	3:00 PM	2335 170 5341
Standards Development and Education Committee	Thursday, August 21	302B	2:00 PM	4:00 PM	2347 069 3303
Standards Reception (Invitation Only)	Thursday, August 21	301B	4:00 PM	6:00 PM	

ANSC C63®

COMPLIANCE TESTING OF WIRELESS DEVICES AND UNINTENTIONAL RADIATORS

(Visit www.c63.org for more information)

This workshop provides an overview of the current changes to the standard C63.10 for unlicensed transmitter testing and the proposed changes to the standard C63.26 for licensed transmitter testing. In addition, there will be an overview of C63.30:2021 for wireless power transfer devices. There will be specific emphasis on new procedures. C63.10 and C63.26 capture most of the procedures for testing unlicensed and licensed wireless devices to show compliance with FCC and ISED Canada requirements. Group discussions will be a highlight of the wireless workshop. A demonstration will supplement the lecture material. The instructors are members of ANSC C63®; they have an intimate knowledge of the technology and contributed directly to the development of these procedures.

This 1.5 day workshop will cover many of the traditional and updated procedures in C63.10-2020 and in C63.26-201X including:

- Instrumentation requirements
- Average value of pulse emissions
- Antenna requirements
- Test site requirements
- RF output power measurements
- Modulation measurements
- Occupied bandwidth procedures
- Band-edge procedures
- Direct and signal substitution radiated emission measurements
- Frequency stability measurements
- Conducted tests at antenna port
- Smart antenna system tests
- Revised MIMO procedures
- Annexes covering example of OOB masks, consumer booster requirements, ERP/EIRP guidelines, path loss characterization, sample test report, compliance tests verses regulatory requirements and other informative guidance

Who Should Attend

Those responsible for determining compliance with FCC Rules and Regulations, including:

- Product managers and developers
- EMC engineers and test technicians
- Regulatory compliance managers
- Test instrumentation developers
- Calibration and measurement accreditation bodies
- Lab quality assessors
- Test instrumentation and chamber manufacturers

Tentatively Rescheduled to July 31-August 1, 2026, immediately before next year's EMC+SIPI Symposium in Dallas, Texas

Date and Location

Friday, August 15 (all day) and Saturday, August 16 (morning)
UL Solutions - 2800 Perimeter Park Drive, Morrisville, NC 27560

Expert Instructors

Mark Briggs, UL Director, Wireless Certification Program
Bob DeLisi, UL Principal Engineer
Travis Thul, Vice President for Student Success & Engagement, Minnesota State University

Speaker bios are available at: https://www.c63.org/workshops.htm.

Fee Includes

Continental breakfast and refreshment breaks will be provided on both days; lunch will also be provided on Friday. A completion certificate and soft copy only of the workshop notes will be provided.

Agenda

C63.10/C63.26/C63.30 Wireless Workshop - August 15 and 16
Registration: 8:30 am August 15
Class: 9:00 am to 5:00 pm on Friday and 9:00am to Noon on Saturday

REGISTRATION FORM

Contact: Janet O'Neil, *ETS-Lindgren* **Telephone: +1 512-531-2676** **Email: j.n.oneil@ieee.org**

(Please print legibly or type)

Ms./Mr._____
Company_____
Address_____
City_____State_____Zip_____
Daytime Phone_____
Email_____

C63.10/26/30 Workshop:

By July 7* $1,100 USD _____
Add $200 if registered after July 7 $200 USD _____

Total ** $ _____ USD

*Please do not mail after August 1, 2025.
**A 20% discount applies to ANSC C63® main committee and subcommittee paid members.

NOTE: *You are not registered until you receive confirmation. On site or "at the door" registrations can only be accepted with prior telephone or email confirmation.*

PAYMENT OPTIONS:

ON LINE: To pay on line, send an email to j.n.oneil@ieee.org along with a scan of this completed registration form. An invoice will be returned to you via email which you can use to pay on line with your credit card.

CHECK: Make check payable to U.S. EMC Standards Corporation in U.S. dollars drawn on a U.S. bank. Mail to:

US EMC Standards Corp.
P.O. Box 13
St. Croix Falls, WI 54024

Please visit https://www.c63.org/workshops.htm for more information on ANSC C63®, this workshop, and speaker biographies.

The organizing committee reserves the right to substitute speakers, modify the program (or lecture notes), restrict attendance or to cancel the workshop. In the event the workshop is canceled, registration fees will be refunded. No refunds will be made to individuals who cancel after July 7, 2025. Substitutions are allowed. Workshops without a minimum of six attendees registered by June 18, 2025 will be cancelled and registration fees returned. It is suggested that you book refundable travel arrangements as appropriate if the workshop is canceled.

WORKING GROUPS, COLLATERAL MEETINGS & SOCIAL EVENTS

Times are subject to change. Please confirm the meeting schedule on the website, in the final program, and on the mobile app closer to the symposium start date.

SUNDAY, AUGUST 17

Meeting Name	Room Assigned	Start Time	End Time	Type	Attendees	Webex Meeting ID
EMC Board Meeting	Marriott Raleigh	9:00 AM	5:00 PM	Other	Pre-Registration	

MONDAY, AUGUST 18

Meeting Name	Room Assigned	Start Time	End Time	Type	Attendees	Webex Meeting ID
Speaker Breakfast	301AB	7:00 AM	8:30 AM	Other	Speakers Only	
Technical Advisory Committee (TAC) Meeting #1	302A	7:00 AM	8:30 AM	Technical Services		2335 185 7375
EMC Society Chapter Chair Training	302A	12:00 PM	1:30 PM	Member Services		2345 463 1012
Standards Advisory and Coordination Committee Meeting	302B	12:00 PM	1:30 PM	Standards Services		2335 053 5413
SC-1 Smart Grid and EMC Issues Committee Meeting	302B	5:30 PM	6:30 PM	Technical Services		2349 087 4593
"Speed Networking" with EMC+SIPI Experts	Raleigh Marriott City Center-Rye Bar and Southern Kitchen	6:00 PM	10:00 PM	Social Event	Pre-Registration	

TUESDAY, AUGUST 19

Meeting Name	Room Assigned	Start Time	End Time	Type	Attendees	Webex Meeting ID
Speaker Breakfast	301AB	7:00 AM	8:30 AM	Other	Speakers Only	
TC-2 EMC Measurements Committee Meeting	302A	7:00 AM	9:00 AM	Technical Services		2343 582 1096
Shielding Standards Continuity Group Meeting (with focus on IEEE 299 and 299.1)	302B	8:00 AM	11:00 AM	Standards Services		2343 582 1096
IEEE 1560 Power Line Filters Working Group	304	9:00 AM	12:00 PM	Standards Services		2343 396 9013
TC-8 Aeronautics and Space EMC Committee Meeting	302B	12:00 PM	1:00 PM	Technical Services		2335 317 6627
TC-4 Electromagnetic Interference Control Committee Meeting	302A	12:00 PM	1:30 PM	Technical Services		2341 183 8370
TC-9 Computational Electromagnetics Committee Meeting	402	12:00 PM	1:00 PM	Technical Services		2347 957 1355
TC-7 Electrical Systems and Power Electronics EMC Committee Meeting	302C	12:00 PM	1:30 PM	Technical Services		2348 918 4606
IEEE STD 1309 WG Meeting	302C	2:30 PM	3:30 PM			2339 428 4978
Senior Member Elevation and IEEE Fellow Class of 2025	302B	2:30 PM	4:00 PM	Member Services		2338 946 9134
Welcome Reception	Exhibit Hall A&B	5:00 PM	6:30 PM	Social Event		
"After the Welcome Reception" Social Event	Wye Hill Kitchen and Brewing	6:30 PM	9:00 PM	Social Event	Pre-Registration	

Photo by Richard Georgerian

TECHNICAL COMMITTEES, STANDARDS, AND EDCOM MEETINGS

All meetings will be held via WebEx for those unable to attend in person.
Meeting URL: https://ieee.webex.com/ieee
Password: EMC2025

WEDNESDAY, AUGUST 20

Meeting Name	Room Assigned	Start Time	End Time	Type	Attendees	Webex Meeting ID
Speaker Breakfast	301AB	7:00 AM	8:30 AM	Other	Speakers Only	
Education Committee Information Session	402	7:00 AM	8:30 AM	Technical Services		2348 546 0839
TC-1 EMC Management Committee	302A	7:30 AM	9:00 AM	Technical Services		2332 914 1169
TC-12 EMC for Emerging Wireless Technologies Committee Meeting	302B	8:00 AM	9:00 AM	Technical Services		2349 130 4213
Managing Functional Safety Risks Caused by EMI - IEEE 1848-2020 Continuity Working Group	304	8:00 AM	11:30 AM	Standards Services		2348 772 6667
Past Presidents Lunch	301A	12:00 PM	1:30 PM	Social Event	Invitation Only	
2025 Youth Technical Program	301B	12:00 PM	1:30 PM	Other		
TC-5 High Power Electromagnetics (HPEM) Technical Committee Meeting	304	12:00 PM	1:30 PM	Technical Services		2339 407 8617
TC-11 Nanotechnology and Advanced Materials Committee Meeting	302B	12:00 PM	1:30 PM	Technical Services		2337 896 5220
TC-10 Signal and Power Integrity Committee Meeting	402	12:00 PM	1:30 PM	Technical Services		2332 254 5801
P2855 Working Group Monthly Meeting (Cables, Connectors, and their Assembies' Shielding Effectiveness)	304	2:00 PM	4:00 PM	Standards Services		2346 136 6411
Women In Engineering Event	301A	4:00 PM	5:30 PM	Member Services	Pre-Registration	2346 887 3303
Gala Dinner	Ballroom BC	7:00 PM	10:00 PM	Social Event	Pre-Registration	

THURSDAY, AUGUST 21

Meeting Name	Room Assigned	Start Time	End Time	Type	Attendees	Webex Meeting ID
Team EMC Bike Ride	Raleigh Marriott City Center	6:45 AM		Other	Pre-Registration	
Speaker Breakfast	301AB	7:00 AM	8:30 AM	Other	Speakers Only	
SC-3 Special Committee on Machine Learning and AI in EMC and SIPI Committee Meeting	304	7:00 AM	8:30 AM	Technical Services		2349 418 0045
TC-6 Spectrum Engineering	402	7:30 AM	8:30 AM	Technical Services		2349 131 9134
TC-3 Electromagnetic Environment Committee Meeting	302A	8:00 AM	9:30 AM	Technical Services		2336 503 5189
T-EMC, T-SIPI, L-EMCPA Associate Editor Meeting	302B	8:00 AM	10:00 AM	Communication Services		2330 184 4275
PAR 2838 WG Aerospace Components Lightning Direct Effects Qualification	402	9:30 AM	11:00 AM	Standards Services		2341 413 8876
Third Division IV Inter-Society Technology Panel (ISTP)	302C	10:00 AM	11:30 AM	Other		2338 479 2753
Awards Luncheon	Ballroom BC	12:00 PM	1:30 PM	Social Event	Pre-Registration	
EMC-S PerCom Meeting	302A	2:00 PM	3:00 PM	Standards Services		2335 170 5341
Standards Development and Education Committee	302B	2:00 PM	4:00 PM	Standards Services		2347 069 3303
Standards Reception	301B	4:00 PM	6:00 PM	Standards Services	Invitation Only	
EMS+SIPI 2025 Wrap-Up Meeting	402	4:00 PM	6:00 PM	Other	Invitation Only	2330 354 1202
EMC Board Meeting	402	6:00 PM	8:00 PM	Other	Pre-Registration	

FRIDAY, AUGUST 22

Meeting Name	Room Assigned	Start Time	End Time	Type	Attendees	Webex Meeting ID
Speaker Breakfast	301AB	7:00 AM	8:30 AM	Other	Speakers Only	
Technical Advisory Committtee (TAC) Meeting #2	302A	7:00 AM	8:30 AM	Technical Services		2343 207 5375
IBIS Summit	304	8:00 AM	12:00 PM	Technical Services		2344 176 9945

EMC SOCIETY TECHNICAL COMMITTEES – BUILD YOUR EXPERTISE AND YOUR CAREER

No matter where you are in the industry, at some point you will deal with an EMC issue. Maybe a device is causing interference or maybe it's vulnerable to radio-frequency fields. Maybe a device crashes or resets after an electrostatic discharge. Maybe you've been looking for help explaining an EMC problem to your customer or your boss. All of these things happen. **Become part of the solution.**

The **IEEE EMC Society's Technical Committees (TCs)** convene to set EMC standards & practices and develop tools for success. Covering topics ranging from professional development to nanotechnology, the TCs are volunteer consensus groups that build our industry's foundations. Join remotely or in-person and help form important technical practices.

Find your place among these forward-looking committees. Join a TC today and set standards, explore emerging technology and help develop programs and create the tools that you and your industry need.

If you are interested in joining a committee, please complete the TC/SC Interest form.
www.emcs.org/technical-committees/tc-sc-interest-form

WORKING GROUPS AND TECHNICAL COMMITTEE MEETINGS

The EMC Society has many working groups and committees that are tackling the wide range of functions of the society's mission. The working groups primarily come out of the EMC Society Standards activities developing new EMC Standards and revising existing standards. Standing and special committees are formed to address a broad range of needs, ranging from interfacing with other industry organizations to dealing with the administration of the society. All of these meetings are open to everyone (unless listed otherwise). Join them for breakfast, breaks, lunch or dinner. Learn what other EMC members are working on and influence how the society operates.

COLLATERAL MEETINGS

With so many people attending this pinnacle event from across the globe, it's a perfect opportunity for groups other than the EMC Society to hold meetings in parallel to the Symposium. Be sure to check out the schedule to find out about the numerous collateral meetings and who can participate. The EMC Society is neither responsible for nor endorses any of these collateral meetings and discourages any meetings from conflicting with the technical and networking programs of the Symposium.

If you would like to schedule a meeting, please contact:
Michelle Measel - m.measel@ieee.org

Photo by Richard Georgerian

TC 1 EMC Management	This committee is concerned with the development and dissemination of Best Practices and Methodologies for the successful leadership, supervision and guidance of EMC related activities. These Best Practices and Methodologies shall be structured so as to provide assistance to all managers, and engineers. Appropriate and convenient tools shall serve as a foundation to these Best Practices and Methodologies.
TC 2 EMC Measurements	The committee reviews the adequacy of measurement procedures and measurement instrumentation specifications for radiated and conducted emission and immunity tests. Also discussed is the rationale for product emission limits and immunity test levels including performance requirements. The committee also supports EMC standards and procedures that deal with measurements and their uncertainty and how they are interpreted and applied.
TC 3 Electromagnetic Environment	The charter of TC3, the Technical Committee on Electromagnetic Environment is to encourage research on the: • electromagnetic environment (EME) • development of standards for EME measurement and characterization • natural and man-made sources of electromagnetic environment that comprise this environment • effects of noise (unwanted portions of EME) on systems performance • effects of international civil and military standards intended to control man-made intentional and unintentional emissions of electromagnetic energy.
TC 4 Electromagnetic Interference Control	This committee is concerned with design, analysis, and modeling techniques useful in suppressing interference or eliminating it at its source. Bonding, grounding, shielding, and filtering are within the jurisdiction of this committee. These activities span efforts at the system, subsystem, and unit levels
TC 5 High Power Electromagnetics	This committee is concerned with the effects and protection methods for electronic equipment and systems for all types of high power and other electromagnetic threat environments. These environments include electromagnetic pulse (EMP), intentional EMI environments (i.e., narrowband and wideband), lightning electromagnetic currents and fields, electrostatic discharge and geomagnetic storms. In addition this committee deals with the commercial data security issue through electromagnetic information leakage activities. Interactions with subsystems, systems and platforms are included.
TC 6 Spectrum Engineering	This committee is concerned with the analysis, design, and measurement techniques for intentional RF transmitting and receiving equipment to prevent interference and promote efficient spectrum use through technology and operational based approaches,such as software design, dynamic spectral allocation, waveform control, as well as frequency coordination and management procedures.
TC 7 Electrical Systems and Power Electronics EMC	This technical committee is concerned with low-frequency EMC including Power Quality in electric power systems. The committee is focusing on application of fundamental EMC concepts also to low frequency conducted disturbances. EMC in power systems is expected to be increasingly important. This is due to increased use of electronics in renewables, electric vehicles, energy efficient technologies and Smart Grid applications.

TC 8 Aeronautics and Space EMC

This committee is concerned with EMI/EMC issues in aircraft, spacecraft & space launch vehicles, robotic and crewed. The space environment provides unique challenges in the design, development, test and operation of space systems to avoid EMI and achieve EMC. Aeronautics & space EMC covers a wide range of topics on the part, board, box, system, multi-system, planetary and interplanetary levels. The harshness of the atmospheric, launch and space environments necessitates a broader view of EMC issues than traditional terrestrial projects, often leading to creative methods and solutions that can benefit our society's efforts elsewhere on Earth.

TC 9 Computational Electromagnetics

This committee is concerned with broad aspects of Applied Computational Electromagnetic techniques which can be used to model electromagnetic interaction phenomena in circuits, devices, and systems. The primary focus is with the identification of the modeling methods that can be applied to interference (EMC) phenomena, their validation and delineating the practical limits of their applicability. Included are low and high frequency spectral-domain techniques and time-domain methods.

TC 10 Signal and Power Integrity

This committee is concerned with the design, analysis, simulation, modeling and measurement techniques useful in maintaining the quality of electrical signals and power distribution network in printed circuit boards, ICs and within systems. These activities encompass all aspects of signal and power integrity from the integrated circuit level to the system level.

TC 11 Nanotechnology and Advanced Materials

Concerned with modelling, simulation and experimental characterization of nanomaterials and nanodevices for EMC applications. Nanotechnology is the understanding and controlling of matter at atomic and molecular scale.
Nanotechnology has already found its way into various EMC applications. New materials such as single- and multi-phase composites filled with nanoparticles, nanotube and/or nanofibres have been designed and tested for gaskets and absorbing screens with outstanding performance and capabilities. Innovative nanostructured shields have shown multifunctional properties and higher efficiency than commonly used materials. Nanowires for high speed interconnects and high density integrated systems, could replace copper in the near future, but require adequate modelling and simulation approaches for signal integrity and also to avoid electromagnetic interference problems.

TC 12 EMC for Emerging Wireless Technologies

This committee is concerned with the EMC design, analysis, modeling, measurement, and testing aspects of emerging wireless products, such as Internet of Things and 5th Generation of Wireless Communication. The committee encourages research including but not limited to the following areas:

- Innovative Wireless Component Design for System Integration: wireless component design with integrated EMC functions and/or meeting certain EMC specifications
- Radio-Frequency Interference and De-sense: characterization and mitigation of interference from digital circuits to wireless antennas
- EMC and OTA Measurement & Testing of Wireless Systems: development of methods and standards for wireless performance and compliance testing
- Wireless Coexistence: interference control/mitigation among various wireless radios, as well as related testing methods and standard development
- Wireless Product or Subsystem EMC: wireless-specific EMC design for Autonomous cars, Phased Array, and others.

SC 1 Smart Grid Support and EMC Issues

This special committee is concerned with coordinating the EMC Society activity on providing EMC principles for those organizations and associated documentation and specifications that address the efficient use of the AC power grid including the control of power entering a house or building. Such control may be from a meter at the point of power entry into these facilities to control incorporated into appliances and other electronic devices in these facilities. Such controllers may be sources of undesirable RF emissions and at the same time vulnerable to the RF environment which speaks to the need for EMC. It is expected that the coordination aspect of this special committee will involve several EMCS Technical Committees.

SC 3 Machine Learning and Artificial Intelligence in EMC and SIPI

This special committee is concerned with all aspects of machine learning, artificial intelligence and deep learning as it applies to the Society's Field of Interest (FoI). It is not limited to any specific aspect of the Society but recognizes that machine learning and related approaches have relevance across the entire spectrum of Society activities.

Standards Advisory and Coordination Committee (SACCom)

The IEEE EMC Society Standards Advisory and Coordination Committee is responsible for providing technical liaison between the IEEE EMC Society Standards Development Committee and various non-IEEE entities involved with EMC standards activities.

In particular, the SACCom will include the following:

- Propose to the EMCS board of directors (BOD), the appointment of representatives to various non-IEEE standards developing entities.
- To monitor the activities of various non-IEEE standards developing organizations with a view toward making recommendations to the EMCS board of directors on any required coordination of those activities within the society.
- To communicate and coordinate with non-IEEE standards developing activities and the EMCS Standards Development Committee on matters relating to the development of EMC related standards.

Standards Development and Education Committee (SDECom)

The IEEE EMC Society Standards Development and Education Committee is responsible for guiding the development of IEEE EMC Standards, the training of those involved in the standards making process and the education of the EMC Society community on all aspects of EMC Standards. The IEEE EMC Society is the primary international developer of fundamental test, measurement and verification standards for EMC.

Education Committee (EdCom)

This committee's mission is to promote EMC education related activities of the IEEE EMC Society. Our vision is to provide opportunities for individuals and organizations involved with electrotechnology and products to become aware of EMC at levels consistent with their needs, and our goals are to establish an awareness of EMC fundamentals throughout industry and academia as well as to enhance EMC education through the development of improved education techniques, materials, opportunities, and communications.

MEET AND NETWORK WITH LIKE-MINDED INDIVIDUALS AT OUR SOCIAL EVENTS

The following information is preliminary and subject to change.

WELCOME RECEPTION

The EMC+SIPI 2025 Welcome Reception will be held in the Exhibit Hall at the Phoenix Convention Center on Tuesday.

One ticket to this event is included in all 5-Day technical registrations, Companion Program and exhibit hall registrations. All others may purchase a ticket to the Welcome Reception as an add-on to your registration.

Photo by Patrick Andre

Location: Exhibit Hall
Raleigh Convention Center
Date: Tuesday, August 19, 2025
Time: 5:00 – 6:30 PM
Cost: No Charge

Network with your peers and other top industry professionals throughout the week during numerous planned events!

Photo by Patrick Andre

EVENING GALA EVENT

The Gala is our symposium celebration that is traditionally a sit-down dinner event with entertainment.

One ticket to this event is included in all 5-Day technical registrations EXCEPT student registrations. This is a change from previous years, made to keep student registration costs down. Extra tickets to the Gala may be purchased as an add-on to your registration.

Location: Raleigh Convention Center, Ballroom B&C
Date: Wednesday, August 20, 2025
Time: 7:00 – 10:00 PM
Cost: $120

Photo by Richard Georgerian

AWARDS LUNCHEON

The Awards Luncheon is a wonderful opportunity to recognize achievements and network with families and EMC professionals from academia, industry, government, military, and retired sectors. The event will start off with a catered sit-down meal. Afterwards, the EMC Society will take time to recognize members and non-members for their contribution to the Society and for professional excellence.

Location: Raleigh Convention Center, Ballroom B&C
Date: Thursday, August 21, 2025
Time: 12:00 – 1:30 PM
Cost: $70

CHAPTER CHAIR TRAINING SESSION AND LUNCHEON

The Chapter Chair Training Session provides a forum for focused training to the Chapter Chairs, the opportunity to discuss chapter issues and get group feedback. Additionally, the session gives the Chapter Chairs the opportunity to meet other Chapter Chairs from around the world and for the Chapter Coordinator to disseminate important information from IEEE headquarters and the EMC Society Board of Governors.
A Social Session will precede the Luncheon to give the Chapter Chairs the opportunity to socialize with the other Chapter Chairs and their Angels.

The Luncheon will be served at the end of the Social Session. Besides a great meal, each Chapter Chair or their representatives will have the opportunity to share what their chapter has been doing for the past year. After the Luncheon, an interactive brainstorming session will conclude the meeting. This session is intended to allow participants to exchange information and new ideas for effective chapter management, as well as to discuss best practices and suggestions for future development and growth of the EMC chapters.

Photo by Karthik Vepuri

Location: 302A
Date: Monday, August 18, 2025
Time: 12:00 - 1:30 PM
Cost: Free for Chapter Chairs
This is a free event open to Chapter Chairs or their representatives. Please check with your Chapter Chair, as you can be that representative for your chapter if your Chapter Chair cannot attend this event

PAST PRESIDENTS LUNCHEON

The Luncheon is open to Past-Presidents of the EMC Society, and current members of the Board of Directors. The luncheon is a chance for the old and the new to mix, exchanging experiences of the past and challenges of the future relative to the EMC profession. A sit down lunch is provided. Past-Presidents should inform the Chair of the History Committee (danhoolihanemc@aol.com) of their interest in attending so there will be seating and food available for all.

Photo by Jerry Ramie

Location: 301A- Raleigh Convention Center
Date: Wednesday, August 20, 2025
Time: 12:00 – 1:30 PM

TEAM EMC

Ready to explore Raleigh on two wheels with your fellow EMC Members? We're excited to announce that the plans for our 12th Annual TEAM EMC Bike Ride are officially underway!

This fun, leisurely morning ride is open to riders of all skill levels. It's the perfect opportunity to get some exercise, enjoy the fresh air, and experience the beautiful area in a whole new way.

Photo by Richard Georgerian

Meeting Location: Meet at the main entrance of Raleigh Marriott City Center by 6:45 AM
Date & Time: Thursday, August 21 • 6:45 AM
Bike Rental Information: www.emc2025.org/programs/social-events/team-emc/

IEEE EMC SOCIETY WOMEN IN ENGINEERING (WIE) EVENT

IEEE Women in Engineering (WIE) is a global network of IEEE members and volunteers dedicated to promoting women engineers and scientists, and inspiring girls around the world to follow their academic interests in a career in engineering and science. Our goal is to facilitate the recruitment and retention of women in technical disciplines globally. We envision a vibrant community of IEEE women and men collectively using their diverse talents to innovate for the benefit of humanity.

Let's meet for a networking and enrichment event during the Raleigh Symposium and share experiences. We, the IEEE WIE and the IEEE EMC Society, invite you to attend this free event. Refreshments are provided. Join us for a festive celebration at the end of the presentation.

Location: 301A
Date: Wednesday, August20, 2025
Time: 4:00 – 5:30 PM
Cost: Free

Photo by Richard Georgerian

Everyone is welcome - men and women - to attend the special presentations!

WIE AGENDA

WELCOME PRESENTATION

Navigating a Professional Career as a Woman in the Engineering Field

Ms. Tara Kellogg, *ETS-Lindgren, EMC Society WIE Chair, Americas, IEEE EMC Chapter Chair, Central Texas*

Tara Kellogg is Global Director of Business Development with ETS-Lindgren, where she brings over 18 years of global experience in IEMI, RF, EMP, and EMC applications across the test and measurement, governmental, industrial, and medical sectors. She specializes in turnkey chamber solutions and shielding technologies. Tara also serves as IEEE EMC Society WIE Coordinator for North America and Chair of the IEEE Central Texas EMC Chapter, championing diversity and professional development for women in STEM. She is a proud member of AFCOM (Association for Computer Operations Management) and can be reached at tara.kellogg@ieee.org.

GUEST PRESENTATION

Spark the Chain Reaction — Mentorship and Outreach in STEM

Stephanie Zajac, *Johns Hopkins Applied Physics Laboratory*

What does it mean to be a mentor? How do you find a mentor? How do we become better mentors? Join your peers in Raleigh at the 2025 IEEE International Symposium on EMC+SIPI for an interactive Women in Engineering presentation that will discuss the impact of mentoring and K-12 outreach on recruiting and retention of under-represented groups. Together, we will explore why mentoring matters, how to get the most out of our mentoring relationships, and how we can all be better mentors to one another.

About the Speaker: Stephanie Zajac is a Radiation Effects Engineer at the Johns Hopkins Applied Physics Laboratory in Laurel, Maryland. She specializes in ionizing radiation effects on electronics and modeling natural space environment phenomena. Stephanie's love of physics, mathematics, and astronomy motivated her undergraduate and graduate studies, and she has maintained a passionate involvement in STEM outreach activities over the years. She is currently serving in her first year as an Officer at Large on the EMC Society Board of Governors. Stephanie also serves the EMC Society as the Awards Committee Chair. She can be reached at stephzajac@ieee.org.

EMC Society would like to invite all Young Professionals (BS within 15 years) and Undergraduates to our Networking Events at the 2025 EMC+SIPI.

"SPEED NETWORKING" WITH EMC+SIPI EXPERTS

All YPs (BS within 15 years) are invited for dinner and socializing at our "Speed Networking" event. Don't miss this opportunity to spend the evening and network with EMC, SI and PI Experts, including Eric Bogatin, Lee Hill, Flavia Grassi, Todd Hubing, Anne Roc'h, Samuel Hildebrandt, Karen Burnham and Davy Pissoort. We'll also be highlighting the Best Student Paper Candidates and announcing the Call for 2026 EMC Society YP Ambassadors at this event. Get to know the other young members of EMC Society and comingle with seasoned experts as well!

Meeting Location: Raleigh Marriott City Center (Rye Bar and Southern Kitchen)
Date & Time: Monday, August 18, 2025 • Time: 6:00-10:00 PM
Fee: $40 registration (Includes dinner and 1 drink)

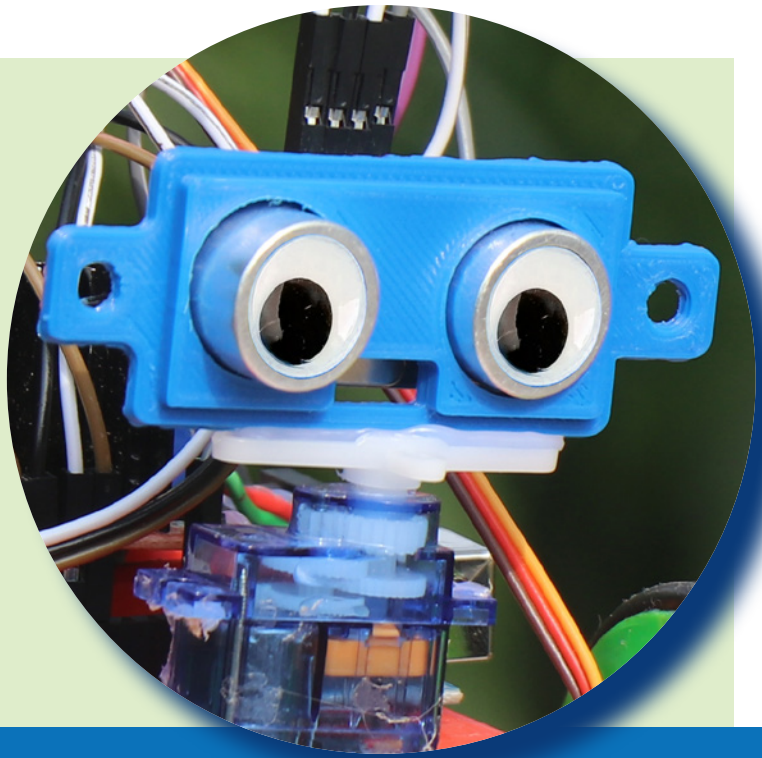
"AFTER THE WELCOME RECEPTION" SOCIAL EVENT

This is a great opportunity to continue the conversations and fun from the Welcome Reception into the rest of the evening. Relationships formed in the EMC Society can lead to future collaborations and will provide valuable contacts when you need a friend to bounce ideas off!

Meeting Location: Wye Hill Kitchen and Brewing
Date & Time: Tuesday, August 19, 2025 • Time: 6:30 - 9:00 PM
Fee: $25 registration (Includes 2 drinks & shared appetizers

BIOMEDICAL ENGINEERING: ROBOTICS IN REAL LIFE

Engineering offers the processes, methods, and mindsets to create practical changes and innovations in the physical world around us, from designing and building bridges, making airplanes more fuel efficient, or masterminding the electronics in our cars! Biomedical engineering applies these principles to medicine and healthcare, creating solutions that improve people's health and daily lives, engineering devices such as hearing aids, artificial joints, and heart monitors.



Join us on August 20 from 1:00 – 3:30pm for the 2025 Youth Technical Program of the IEEE EMC+SIPI Symposium in Raleigh, NC, where we'll learn about the intersection of engineering and medicine and create our own precursor to real-life prosthetics — a robotic arm model!

Open to children ages 6-19. Children younger than 6 may participate, if a parent or older sibling accompanies them. Please sign up via the Registration portal. Please plan on escorting your child to drop them off at the activity, and picking them up at the end. Parents are welcome to stay for the entire session, if they wish.

Location: 301 B
Date: Wednesday, August 20, 2025
Time: 1:00-3:30 PM
Registration Fee: FREE

COMPANION CLUB

The Companion Club is your chance to meet new people and catch up with old friends. You may register for the Companion Club as a part of the technical attendee's registration or separately.

Paid Companion Club members are welcome to visit the beautiful Companion Suite where a delicious breakfast will be served Monday to Thursday, from 7:00 to 10:00 am.

This year, the EMC+SIPI Symposium offers four attractive group Companion Tours/Events. However, you don't have to be registered for the Companion Club to participate in a tour/event.

If you register for the Companion Club, you may sign up for the tours with your own registration. Otherwise, you may purchase tours through the technical attendee's registration; there will be a drop down space to add your name.

Join your technical attendee at any of our Social Events for more fun and to meet more people. We have special prices for companions under the age of 18. Tickets to the Welcome Reception, a great networking time for all, are included in all Companion Club registrations. The Evening Gala is also a fun event, and companions are invited to register for this event separately in their Companion Club or technical attendee's registration.

For the younger crowd, our ever popular Youth Technical Program is back once again to amaze all companions and guests aged 6 to 19. This program will again be free of charge, but please register early to be assured of a project kit. Your children do not need to be registered in the Companion Club to sign up for the Youth Technical Program. Please sign them up via the Registration portal. Children younger than 6 may participate, if a parent or older sibling accompanies them. Please plan on escorting your child to drop them off at the activity, and picking them up at the end. Parents are welcome to stay for the entire session, if they wish. A minor release form will need to be completed and submitted before obtaining a badge for anyone under the age of 18.

JOIN THE BREAKFAST CLUB

Would you like to invite your technical attendee to join you for breakfast in the Companion Suite? **"Breakfast Club"** tickets may be purchased by the technical attendee as an option for each day breakfast is desired. Tickets must be purchased at a minimum 24 hours in advance to ensure adequate seating and catering.

New for this year, on Tuesday and Wednesday, from 9 – 10AM, the Breakfast Club will feature a guest speaker, who will be talking about Interior Decorating. Jill Vitek, owner of "Romancing the Home" will be the speaker.

Join fellow Companions at the symposium by registering for the Companion Club. This is an excellent opportunity to meet new people and reconnect with old friends! Adult or youth (ages 8 to 17) companions who are pre-registered may go directly to the registration desk located in the Convention Center to obtain their Companion Registration Badge.

Breakfast Club tickets will include:

- Name badge that will allow you access to the Companion Suite and Exhibit Hall (during regular hours)
- Gift bag with goodies
- One ticket to the Tuesday evening Welcome Reception
- Any tour/event or social event tickets you may have purchased

Youths (ages 8-17) who are registered for the Junior Companion Club are welcome in the Companion Suite with an adult Companion Club member. Children under age 8 do not receive a gift bag but will be admitted free if accompanied by a registered adult Companion Club member.

Your ticket to the Welcome Reception is an opportunity to enjoy another great event with your technical attendee where everyone can have more fun and meet new people. It is a great networking time for all. The Wednesday night Gala Banquet is also a fun event; however, companions must purchase tickets separately for that event.

Discounted prices are available for youth under age 18, and children under age 8 will be admitted for free if accompanied by a registered adult.

COMPANION CLUB RATES:

Adult, age 18+: $270
Junior, age 8-17 (PG): $85
Children under 8: No charge

A LA CARTE TOURS ARE AVAILABLE

www.emc2025.org/programs/companions-tours

RALEIGH & DURHAM, NC: A DAY IN THE CITY OF OAKS & MEDICINE

A 5-hour, professionally guided bus tour of the cities of Raleigh and Durham, with a stop for lunch (lunch is not included in the cost of the tour).

The Raleigh tour visits the North Carolina State Capital, legislative, Governor's Mansion, Historic Mordecai, Warehouse District, Pullen Park Fayetteville Street districts and you will be introduced to Sir Walter Raleigh & Shimmer Wall, plus more.

The Durham tour visits the Historic American Tobacco Campus, Main St Major the Ball, Parrish Street or Black Wall Street, the Hill and Blackwell building and a visit to the Duke Campus and Duke Chapel.

Location: Raleigh Convention Center, Ballroom B&C
Date: Monday, August 18, 2025
Time: 9:00AM – 2:00PM
Cost: $70

ENGLISH TEA PARTY

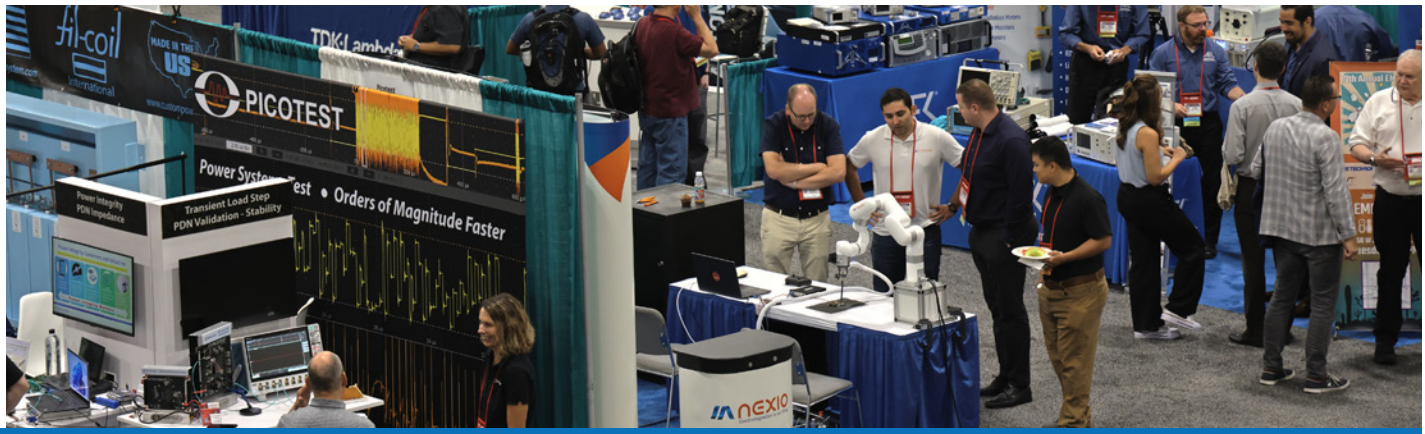
We have a Formal English Tea Party event in the afternoon. It will be a hands-on cooking class and tea party. Attendees will be making tea sandwiches, cold strawberry soup, scones with topping, short breads and miniature cakes. After cooking, we will eat and have a tea party, where we will have a discussion on various English teas.

Location: Raleigh Marriott City Center
Date: Tuesday, August 19, 2025
Time: 2:00PM – 4:00 PM
Cost: $75

VIDERI CHOCOLATE FACTORY

The event will start with coffee and pastries followed by a tour of the factory, while the factory is making chocolate candies. Each attendee will receive a box of chocolate bars and bonbons. The tour guide will talk about how you pair chocolates with different wines.

Location: Videri Chocolate Factory- 327 W Davie St
Date: Thursday, August 21, 2025
Time: 10:00AM – 12:00 PM
Cost: $70



EXPLORE THE EXHIBIT HALL AND LEARN ABOUT NEW TECHNOLOGIES, INSTRUMENTATION AND SOLUTIONS THAT SERVICE THE INDUSTRY

WHAT'S HAPPENING IN THE EXHIBIT HALL?

- Explore and learn from top suppliers
- Attend "Ask the Experts" panels and get your questions answered
- Enjoy Experiments, Demonstrations and Poster Sessions
- Visit exhibitor booths to participate in raffles and games.

EXHIBIT HALL SCHEDULE

EXHIBIT HOURS:

TUESDAY, AUGUST 19
Exhibits Open: 9:30 AM – 6:30 PM
Welcome Reception: 5:00 PM – 6:30 PM

WEDNESDAY, AUGUST 20
Exhibits Open: 10:00 AM – 5:00 PM

THURSDAY, AUGUST 21
Exhibits Open: 10:00 AM – 12:00 PM

EMC+ SIPI 2025 SCAVENGER HUNT

Play the Exhibit Hall Scavenger Hunt in the Mobile App for a chance to win some cash!

VIEW THE EMC+SIPI 2025 INTERACTIVE FLOORPLAN

DISCOVER OUR EXHIBITORS!

Absolute EMC LLC.	701
Advanced Programs, Inc.	716
Advanced Test Equipment Rentals	303
AE Techron	301
Altair	411
Amber Precision Instruments	516
American Association for Laboratory Accreditation (A2LA)	312
AMETEK CTS USA, Inc.	311
Amphenol Advanced Compact Connectors	528
Antenna Measurement Techniques Association (AMTA)	721
AP Americas Inc.	812
Applied Technical Services	426
Applus+ Laboratories	811
Bureau Veritas Consumer Products Services, Inc.	814
C63-EMC Committee	625
Cergen GmbH	713
Changzhou Pioneer Electric Co., Ltd	810
Classic Coil Company, Inc.	526
Com-Power Corporation	400
Comtest	615
Copper Mountain Technologies	327
CPI TMD Technologies Ltd.	422
D.L.S. Electronic Systems Inc.	310
Dassault Systems SIMULIA	728
DesignCon	721
Electro Magnetic Applications, Inc.	323
Element Materials Technology	627
Elite Electronic Engineering, Inc.	523
EMCoS LLC	715
ETS-Lindgren Inc.	401
Exodus Advanced Communications, Corp.	302
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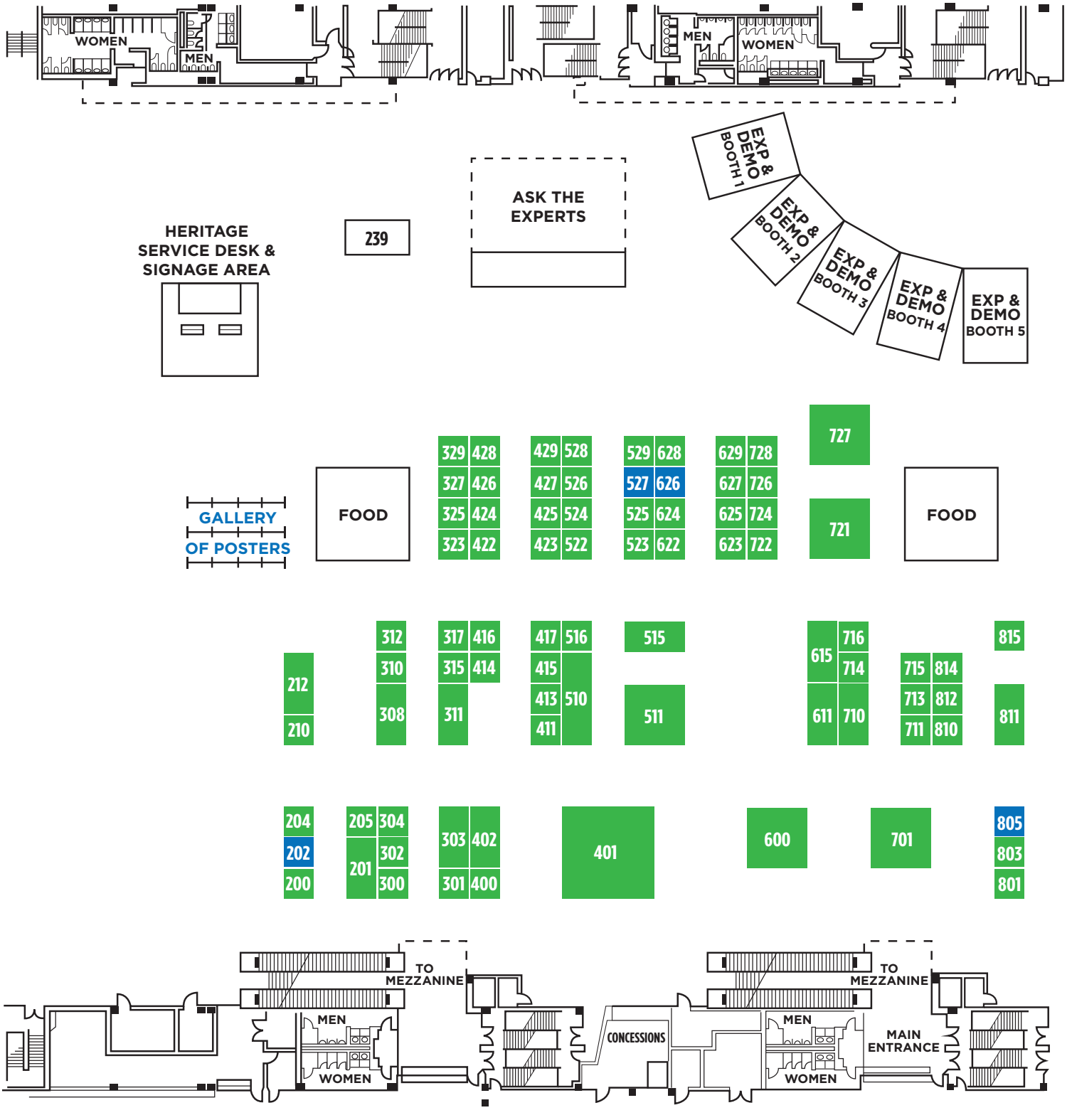
EXHIBIT HALL FLOORPLAN



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Absolute EMC LLC brings decades of EMC expertise in testing, standards, and equipment. We partner with top manufacturers—Haefely, BOLAB Systems, Montena Technologies, YIC Technologies, EMC Instruments, EMZER, Lumiloop, HILO/TEST, Schloder EMV-Systems, Schwarzbeck, Tekbox, and mk messtechnik—to deliver superior products. Guided by our founder's commitment to excellence, we offer expert advice to ensure the right choice the first time. We treat customers like family, prioritizing their needs. Our portfolio includes impulse generators, ESD, surge, EFT, lightning, EMP, HIRF, RF test systems, turnkey projects, test tables, EUT supports, coax, antennas, preamps, LISNs, fiber-optic interfaces, cameras, and more.

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2026 IEEE INTERNATIONAL SYMPOSIUM ON ELECTROMAGNETIC COMPATIBILITY, SIGNAL & POWER INTEGRITY

AUGUST 3-7

EMC+ SIPI 2026

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THE COMMITTEE PROPOSES SPECIAL TOPIC AREAS:

Chip-level EMC; Urban Air Mobility (UAM) and EMC requirements; Emerging EMC challenges in Military and Space applications; EMC and SIPI for Data Centers and High-Speed Digital applications; AI/ML application to EMC and SIPI problems.

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TOPICS OF INTEREST

- **TC-1:** **EMC Management -** Personal & Laboratory Accreditation, EMC Education & Awareness, Legal Issues
- **TC-2:** **EMC Measurements -** Techniques, Test Instrumentation & Facilities, Standards and Regulations, Measurement Uncertainty
- **TC-3:** **EMC Environment -** Signal Environment, Atmospheric & Manmade Noise, Characterization
- **TC-4:** **EM Interference Control -** Shielding, Gaskets, Cables, Connectors, Grounding & PCB Layout
- **TC-5:** **High Power Electromagnetics -** ESD & Transients, EMP, IEMI & Lightning, Geomagnetic Storm EMC
- **TC-6:** **Spectrum Engineering -** Characterization and Modeling, Design, Adaptive Interference Mitigation
- **TC-7:** **Electrical System and Power Electronics EMC -** Power EMC, Conducted Emissions, Power Conversion, Transportation & Electric Vehicles, Grid
- **TC-8:** **Aeronautics and Space EMC -** Aircraft, Atmospheric Environment, Drones, Spacecraft, Missiles
- **TC-9:** **Computational Electromagnetics -** Modeling & Simulation, Multi-Physics Techniques, Tools, and Applications
- **TC-10:** **Signal and Power Integrity -** Interconnects, Modeling & Characterization, Crosstalk, Jitter, Noise
- **TC-11:** **Nanotechnology & Advanced Materials -** Nanomaterials & Nanostructures, Smart Materials
- **TC-12:** **EMC Wireless Technologies -** EMC Planning/Testing/Specifications, Wireless Coexistence
- **SC-1:** **Smart Grid EMC -** Renewable Generation, Grid Communications
- **SC-3:** **Machine Learning and Artificial Intelligence in EMC and SIPI -** Deep Neural Networks, Support Vector Machines, Gaussian Process Regression, Bayesian Optimization

KEY DATES

DECEMBER 12, 2025:
Submission Deadline for Special Session Proposals

JANUARY 16, 2026:
Submission Deadline for Traditional and Special Session Papers

FEBRUARY 6, 2026:
Submission Deadline for Workshops & Tutorials and Experiments & Demonstrations Proposals

FEBRUARY 27, 2026:
Notification of Acceptance/Rejection for Traditional and Special Session Papers

MARCH 13, 2026:
Submission Deadline for Abstract-Reviewed Papers

MARCH 13, 2026:
Notification of Acceptance/Rejection for Workshops & Tutorials and Experiments & Demonstrations

MARCH 27, 2026:
Submission Deadline for Revised Traditional and Special Session Papers

APRIL 24, 2026:
Notification of Acceptance/Rejection for Traditional, Abstract-Reviewed, and Special Session Papers

MAY 22, 2026:
Submission Deadline for Final Papers and Workshop & Tutorial Presentations (Registration Required)

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CROSSTALK

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Raytheon, An RTX Business and US Army Electronic Proving Ground are proud to host the 47th Annual Meeting and Symposium of the AMTA at The Westin La Paloma Resort & Spa, Tucson, Arizona November 2-7, 2025. We cordially invite you to attend and participate in this annual event.

AMTA 2025 is the premier conference dedicated to the field of antenna & related measurements.

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C63-EMC Committee
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The uniqueness of the committee is the close link of its EMC standards with the needs of manufacturers and testing organizations and the acceptance of its standards by US regulatory organizations such as the Federal Communications Commission, which references several C63 standards in its Rules. The diversity of its forty active members provides extensive representation of the stakeholders.

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- EMC test enclosures – Minimize electromagnetic disturbances for EMC compliance in dense RF environments as test and measurement enclosures/setups.
- Antenna decoupling – Reduce interference for high-performance multi-antenna systems in 5G/6G, RF sensors, radar, and non-terrestrial networks.

IEEE Antenna and Propagation Society
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www.ieeeaps.org

The IEEE Antennas and Propagation Society consists of 8,000 members and over 125 chapters worldwide. The society offers a field of interest with strong relevance to the EMC community. Focus areas include antenna analysis, design and testing. APS also encompasses radiation, propagation, and the interaction of electromagnetic waves with discrete and continuous media. The society further focuses on applications and systems pertinent to antennas, propagation, and sensing.

IEEE EMC Society
Booth 727
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The IEEE Electromagnetic Compatibility Society is the world's largest organization dedicated to the development and distribution of information, tools and techniques for taming electromagnetic interference. The society's field of interest includes standards, measurement techniques and test procedures, instrumentation, equipment and systems characteristics, interference control techniques and components, education, computational analysis, and spectrum management, along with scientific, technical, industrial, professional or other activities that contribute to this field.

Explore the many benefits of EMC Society membership, from being part of the Young Professionals, the many Standards resources, Distinguished Lecturer and engagement at the local Chapter level. Join today and give your career a much-need zap!

IEEE EMC Society History Committee
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www.emcs.org/about-us/history
The EMC Society is responsible for recording and maintaining the historical records of the EMC Society. That includes photos and papers as well as equipment artifacts. The Committee has digitized old EMC Symposium records and has distributed them via USB memory sticks and CDs.

IEEE EMC Society Sister Society Booth
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The EMC Society has a vision to increase cooperation and awareness of global EMC issues that are essential to the continued development of safe and reliable electronic systems and devices, to increase the participation of individual members of the IEEE EMC Society with global partners, and to facilitate the growth and support of emerging and expanding technologies. Through Sister Society Agreements, possible collaboration in the areas of membership, publications, technical meetings, and various joint activities are promoted.

IEEE EMC Society Standards
Booth 727
www.emcs.org/standards
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- Community Programs

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www.mtt.org
The IEEE Microwave Theory and Technology Society (MTT-S) is a transnational society with more than 14,500 members and 350 chapters worldwide. MTT-S promotes the advancement of microwave theory and its applications, including RF, microwave, millimeter-wave, and terahertz technologies. It is an all-volunteer society, driven to excellence by its leadership and with the active participation of all its world-wide members. The activities sponsored by the MTT-S include a broad spectrum of conferences, workshops, technical committees, chapter meetings, publications and professional education programs. Our principal publications and conferences are peer-reviewed and recognized as top of the class.

IEEE Product Safety Engineering Society (PSES)
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www.ewh.ieee.org/soc/pses
The IEEE Product Safety Engineering Society focuses on the theory, design, development and practical implementation of product safety engineering methodologies and techniques for equipment and devices. This includes the study and application of analysis, techniques, construction topologies, testing methodologies, conformity assessments and hazard evaluations. The Society provides a focus for cooperative activities, including the promotion of product safety engineering for the benefit of humanity.

IEEE Women in Engineering
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IEEE Women in Engineering (WIE) is the largest international professional organization dedicated to promoting women engineers and scientists and inspiring girls around the world to follow their academic interests to a career in engineering. The mission of IEEE WIE is to inspire, engage, encourage, and empower IEEE women worldwide.

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Booth 515
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In Compliance is a leading source of news, information, and resources for electrical engineering professionals. We deliver coverage on the latest standards updates, global compliance news, and technical explanations & guidance. Visit incompliancemag.com to discover the latest design practices and testing tips, stay current with important updates, learn fundamental concepts, and explore our many resources. Activate your free subscription and join our community of over 19,000 engineers world-wide.

Intertek
Booth 423
www.intertek.com/emc
With one of the largest global network of EMC Testing labs, Intertek provides the capacity, proximity and engineering resources to streamline your EMC Compliance Testing process for any market you want to reach.

Intertek is a leading Total Quality Assurance provider to industries worldwide. Our network of more than 1,000 laboratories and offices in more than 100 countries, delivers innovative and bespoke Assurance, Testing, Inspection, and Certification solutions for our customers.

We deliver Total Quality Assurance expertise with precision, pace, and passion,

Keysight Technologies
Booth 300
www.keysight.com
Keysight Technologies is a global leader in electronic design and test solutions, serving industries like telecom, aerospace, automotive, and semiconductors. Spun off from Agilent in 2014, it offers a broad portfolio of instruments and software for validating performance across the product lifecycle. Headquartered in Santa Rosa, California, Keysight supports next-gen technologies such as 5G, 6G, AI, and quantum computing. With strong R&D investment and strategic acquisitions, the company helps customers accelerate innovation, ensure compliance, and reduce time-to-market.

Little Mountain Test Facility - The Boeing Company
Booth 414
www.boeing.com
Little Mountain Test Facility is a one-of-a-kind laboratory dedicated to simulation testing of radiation, shock, vibration, environmental, electromagnetic effects, and other environments for defense and commercial systems.

The AFNWC contractor, Boeing, operates and maintains the LMTF for the United States Air Force at Hill AFB, Ogden, Utah. LMTF ensures delivery of a solution that emphasizes reduced life-cycle costs, greater speed-to-deployed capability, and the ability for customers to reconfigure systems and capabilities to support changing missions. Testing is facilitated by certified engineers and lab technicians, supported by a full machine shop, shipping and receiving, and a maintenance and fabrication team.

LUMILOOP GmbH
Booth 415
www.lumiloop.de
LUMILOOP GmbH is a German manufacturer of laser-powered electronic sensors. These are used wherever other systems are disturbed by high voltages and currents or electric and magnetic fields: In electromagnetic compatibility (EMC) and high-frequency (HF) measurement environments, near lightning conductors and high-voltage lines, or where there is a risk of explosion.

LUMILOOP's key competence is the optical supply of sensor systems using lasers. In combination with patented opto-electronic components and the patented process for controlling the optical power, reliable, safe measuring systems are created.

LUMILOOP combines this Power-over-Fiber (PoF) technology with state-of-the-art low-power electronic design.

M Precision Laboratories, INC.
Booth 622
www.mprecisionlabs.com
M Precision Laboratories, INC is a global supplier of Electromagnetic Compatibility (EMC) and Electrostatic discharge (ESD) systems and solutions (high voltage test devices). Along with manufacturing our own line of products, we are also A2LA accredited calibration laboratory for multiple types of test equipment.

Maury Microwave
Booth 201
www.maurymw.com
Maury Microwave is a trusted calibration, measurement, and modeling solutions partner that leverages measurement expertise to identify, create, and supply every single component from the smallest adapter to the largest test system. Customers can develop and validate the world's most advanced wireless communications systems through seamless lab integration and best-in-class solutions. Maury Microwave solutions for the EMC market include both components and turn-key solutions. Typical components are amplifiers, synthesizers, power sensers, couplers, adapters, cable assemblies and calibration kits. Turn-key characterization solutions include system integration and measurement software.

emv

International exhibition and conference
on electromagnetic compatibility
Cologne, 24 – 26 March 2026

MESAGO Messe Frankfurt GmbH
Booth 724
www.emv.mesago.com/koeln/en.html
Mesago Messe Frankfurt GmbH is organizing EMV - Europe's leading exhibition and conference on electromagnetic compatibility which will take place 24 - 26 March 2026 in Cologne, Germany. More than 120 exhibitors present their EMC-specific products and services. In Cologne, participants can look forward to a scientific conference as well as practical workshops in both German and English. EMV is the ideal platform for the dialogue between science, research, product development and application.

MVG (Microwave Vision Group)
Booth 611
www.mvg-world.com
MVG specializes in Antenna Measurements and EMC Testing Solutions. Particularly for EMC, we design, manufacture, supply and install shielded enclosures, anechoic chambers, shielded doors, absorbers and more. MVG can provide exceptional turnkey solutions for the most demanding EMC requirements. Our manufacturing knowledge from over 30 years of experience ensures you quality and durability in our products and expertise from our team.

Narda Safety Test Solutions S.r.l. - Italy
Booth 624
www.narda-sts.it
Since 1980 we design and manufacture EMC instruments and test systems under the well recognized brand "PMM, as well as measuring instruments and systems for assessing the exposure to electromagnetic fields. Worldwide support is assured by highly qualified Sales Partners. Quality system certified ISO 9001: 2008. Accredited Calibration Center LAT n. 008, traceable on national and international standards.

We are part of the Narda Safety Test Solutions Group, a global leader that owns over 95% of the published patents for electromagnetic field testing equipment. Highly innovative solutions matching the highest standards of quality and reliability are the Company's trademarks.

Nemko Canada
Booth 325
www.nemko.com
Nemko serves as a comprehensive hub for compliance testing, certification, and global market access. With Nemko Direct, clients access major market certifications through a single point of contact. Services include EMC, Wireless, Electrical Safety, and Environmental testing. Pre-compliance reliability testing to aid in design-to-deployment success. Nemko offers US and Canadian NRTL Safety certification, CB certification, and is a TCB for several regions including the US, Canada, Taiwan, and more. It also provides international telecom and type approval certifications for over 150 countries. Operating in 24 locations globally, Nemko assures timely testing, inspection, and certification with Scandinavian reliability.

NEXIO INC
Booth 416
www.nexiogroup.com
NEXIO, founded in 2003, offers the market's widest range of electromagnetic automation test software through a global network of support staff and sales representatives. NEXIO develops the software range called BAT, which stands for "Benchtop Automated Testing". BAT is a package of high-performance automation test software for a variety of electromagnetic compliance and RF testing requirements for all industries. Our star product, BAT-EMC, is a world leader in automated test software. The world's top accredited labs and top industries leaders are equipped with BAT-EMC. BAT-EMC is used in more than 20 countries worldwide (Germany, USA, China, Japan, Canada, Mexico...). Other star products are BAT-SCANNER (near field measurements), and BAT-ELEC (for burst, surge, transients, etc.).

Our key points are:
- Hardware independent & free drivers
- 25 years experience
- Support and maintenance
- Flexibility and evolution
- Monitoring functions
- Automatic report

Nexperia Semiconductor
Booth 428
www.nexperia.com
Nexperia is a leading expert in high-volume essential semiconductors, that are required in every electronic design. The company's extensive portfolio includes Diodes, Bipolar Transistors, ESD protection, MOSFETs, SiC, GaN FETs, and ICs for Power, Analog & Logic. Headquartered in the Netherlands, Nexperia ships +100 billion products annually, meeting automotive standards. Our industry-leading packages are recognized as benchmarks in efficiency – size, power and performance. Nexperia has +12,000 global employees.

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www.ophirrf.com
Ophir RF has been designing and manufacturing the finest High Power Class A RF Amplifiers for over 30 years.
- Frequencies from 10 KHz to 40 GHz.
- Power Levels from 1 W to 25 kW.
- All Ophir RF Solid State Amplifiers come with a 5-year Warranty.
- All Ophir RF Amplifiers are designed and manufactured in the USA.

Pearson Electronics Inc.
Booth 522
www.pearsonelectronics.com
Pearson Electronics has the Probes and Clamps to assist with MIL-STD-461 measurements. The model 8700i injection probe and the 8705C current probe are designed for CS 114, 115 and 116, plus other EMC standards. Features include a 10 kHz to 400 MHz bandwidth, 100 watt input power rating for the 8700i, and a compact design which allows one fixture to hold both probes in support of MIL-STD-461G. Pearson Clamp on Current Probes meet all the lightning susceptibility test requirements for CS 117 and RTCA/DO160 with the ability to measure surge currents with amplitudes up to 500 kilo amps.

PPG Cuming Microwave & Cuming Lehman Chambers
Booth 801
www.cumingmicrowave.com
PPG Cuming Microwave Corporation is an ISO 9001:2015 US manufacturer of C-RAM® RF/Microwave absorbers, C-STOCK® low-loss dielectric materials, and PPG C-SHIELD™ conductive materials, serving defense and commercial markets for over 40 years. Cuming-Lehman Chambers, a wholly owned subsidiary, provides design, project management and installation of new anechoic chambers, specialty test boxes, and other RF test environments. When your project calls for a retrofit, refurbishment or relocation of an existing chamber our expert staff will guide you through all of the considerations. Call 508-521-6700 or email cmcsales@ppg.com. Point browsers to www.cuminglehman.com and www.cumingmicrowave.com

R&K Company Limited
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www.rk-microwave.com
R&K is a leading Japanese manufacturer of "RF Solid State Power Amplifier" which is established in 1977. We manufacture highly reliable products and have many achievements in the accelerator and EMC fields. We also can manufacture custom products for each customer.

Raymond EMC
Booth 710
www.raymondemc.com
Raymond EMC specializes in the engineering, design, fabrication, installation, and testing of custom radio frequency (RF) shielded enclosures, reverb, and anechoic chambers for military, government, automotive, high-tech, medical, medical, and industrial applications. Raymond EMC prides itself on being an industry leader in product quality, performance, and innovation while providing unmatched client care and product support.

Products: Shielded Enclosures - Electromagnetic Compatibility (EMC) Chambers - Reverberation Chambers - Deployable Solutions - Shielded Doors - Shielded Cabinets - Anechoic Chambers

Services: Chamber Relocation - Chamber and Shielded Enclosure Upgrades - Maintenance Programs – Consulting – Engineering – Installation - RF Testing

RF Exposure Lab
Booth 413
www.rfexposurelab.com
RF Exposure Lab, LLC is an independent, privately owned SAR Testing Lab. We are A2LA Accredited and have significant expertise in SAR Testing from both an industry and a laboratory environment. We provide SAR testing for companies and other test laboratories. We are located in Southern California.

Robust Physics
Booth 524
www.robustphysics.com
San Diego-based RobustPhysics has developed STOCHASTICA- an entirely new class of simulation software for system-level EMC design. Based on statistical wave mechanics, STOCHASTICA eliminates the need for detailed geometry and numerical meshing, providing FAST, INTERACTIVE solutions, enabling full system level EMC design to 10GHz and beyond. The software has been extensively validated experimentally under years of research funding by NASA, DARPA and NAVY. This is something NEW and DIFFERENT. Whether you are an EMC simulation specialist looking for faster/higher frequency tools; EMC Test engineer wanting to add simple but effective simulation to your toolset... come and evaluate this new technology

Rohde & Schwarz USA, Inc.
Booth 600
www.rohde-schwarz.com
Rohde & Schwarz is a global leader in test and measurement solutions and offers equipment for EMC test applications, including EMI test receivers, broadband amplifiers, antennas, oscilloscopes, and turn-key systems for compliance and pre-compliance testing. Additionally, R&S offers solutions for signal integrity/power integrity and other test and measurement applications.

Safety & EMC Magazine
Booth 726
www.safetyandemc.com
SAFETY & EMC magazine started the first publication from 1989, it is the unique official publication (CN 11-3452/TM, ISSN 1005-9776) synthetically introducing the safety and EMC technology of electronic and electric industry at present in China, which is sponsored by China Electronic Standardization Institute (CESI).

SAFETY & EMC is a bimonthly publication. In 2008, it started its English edition yearly, and erected the bridge for international academic communication. Until now, its readers are more 500'000. Most of them are engineers, teachers and students; however, there are a lot of marketing and purchasing personnel becoming its faithful readers.

Schlegel Electronic Materials
Booth 317
www.schlegelemi.com
Schlegel Electronic Materials is the pioneer of fabric-over-foam gaskets and a leader in manufacturing EMI shielding and thermal management materials that protect sensitive electronics. Schlegel serves customers worldwide in electronics, transportation, medical, telecommunications, and other industries. In addition to the innovative fabric-over-foam (FOF) gaskets, Schlegel's high-performance products include I/O backplane shielding gaskets, Conductive Elastomers, RF Absorber Materials, and other enclosure gasketing and board-level shielding products. Schlegel manufactures Polymer and adhesive materials, Insulation Materials, Inductive Components, and Bulk Molding Compounds. In addition, we design and manufacture custom extruded components in many shapes and sizes, Die-cutting, and Profiles or lengths.

SGS North America
Booth 200
www.sgs.com/emc
We are the world's leading Testing, Inspection and Certification company. Our brand promise – when you need to be sure – underscores our commitment to trust, integrity and reliability.

We are recognized as the benchmark for quality and integrity in the global EMC testing market. With a range of state-of-the-art facilities, including 10 m and 3 m SAC, we can test and verify a variety of electrical and electronic products for compliance with regulatory requirements. Our experts can also help with the selection of appropriate countermeasure components, helping you to solve difficult and complex problems during product development.

Signal Edge Solutions
Booth 628
www.signaledgesolutions.com
Signal Edge Solutions provides highly advanced services and products that focus on high-speed measurement, measurement-based modeling, ASIC/Chiplet/MCM/SiP advanced package design, and electromagnetic (EM) modeling services tailored to ASIC, package, and printed circuit board (PCB) design, in addition to other specialized engineering consulting services, which include mobile EMC testing, end-to-end SI/PI simulation modeling of complex ASICs and FPGA designs. Signal Edge Solutions also offers a library of SI/PI models.

SimYog Technology
Booth 815
www.simyog.com
SimYog Technology offers Compliance-Scope®, a pioneering software tool for EMI/EMC simulation in electronics design. It provides early diagnostic capabilities to efficiently detect and resolve EMI/EMC issues, optimizing time to market and reducing Bill of Materials (BOM) costs. By supporting agile development with PCB-level optimization, SimYog uses proprietary technology and advanced physics-based solvers for precise results. Ideal for hardware engineers and electronics designers, Compliance-Scope® ensures streamlined and compliant product development.

Spira Manufacturing Corporation
Booth 304
www.spira-emi.com
Find out why top manufacturers choose Spira when they need the best, most reliable EMI/RFI Shielding Gaskets and Honeycomb Filters – exceptional products, on-time delivery, superior customer service, and expert technical support. Spira's unique spiral design offers extremely low compression set, long life and high shielding. Gaskets are available both groove or surface mounted, EMI/environmental protection, and meet requirements including ITAR, DFAR and RoHS. AS9100/ISO9001 certified. Celebrating 40 years of Inspiration in EMI Shielding with our new website: www.spira-emi.com.

TDK Lambda Americas
Booth 210
www.us.lambda.tdk.com
TDK-Lambda Americas, Inc. is a leading manufacturer of high reliability Low/High Voltage Programmable DC and High Voltage Programmable Capacitor Charging power supplies and DC Electronic Loads. Programmable DC products include the Genesys™Series, the GENESYS+™ Series, the ALE Series and the SFL Series. For more information, please visit https://www.us.lambda.tdk.com.

TDK RF Solutions, Inc.
Booth 212
www.tdkrfsolutions.tdk.com
TDK RF Solutions is a world leader in the design, development & manufacture of technical solutions for the EMC testing and Antenna measurement industries. We offer a complete range of solutions including automated test systems, anechoic chambers, RF absorber, antennas, software, RF filters, and a wide range of test products & accessories. We call it Total System Technology®, and it means TDK RF Solutions is your best choice of partner for proven solutions & services. TDK....attracting tomorrow!

Teledyne LeCroy
Booth 205
www.teledynelecroy.com/oscilloscope

Teledyne LeCroy is a leading provider of oscilloscopes, probes, and software analysis solutions for power integrity, power electronics, power conversion, switch-mode power supply, and three-phase power and motor testing. New products include a 1 GHz high voltage optically isolated probe and software analysis for gallium-nitride (GaN) and silicon-carbide (SiC) power semiconductor devices, power rail probes with 60 V offset, and dq0 transformation analysis software.

Testups, LLC
Booth 427
www.testups.com
TESTUPS offers Electromagnetic Compatibility (EMC), Radio Frequency (RF) anechoic chambers, shielded rooms, test systems, test equipments, turn-key laboratory installations, EMI filters for shielded rooms and RF absorbers for anechoic chambers.

TESTUPS offers EMC, RF, antenna testing related services like training, consultancy, product testing, certification, laboratory instrumentation ,commissioning, anechoic chamber installation, dismantling, relocation, refurbishment, validation, calibration.

The EMC Shop
Booth 204
www.theemcshop.com
The EMC Shop is an ISO 17025 accredited company, registered government contractor (Cage Code #7JDN6) and an established vendor in Exostar, Ariba and other purchasing networks for large companies. The EMC Shop brings the ease and convenience of online shopping to the electromagnetic compliance and test equipment market.

Transient Specialists
Booth 315
www.transientspecialists.com
We are a leader in EMC test equipment rentals designed for both immunity and emissions testing. We carry many of the most common test systems including transient generators, conducted RF Test systems, LISNs, amplifiers, power sources, and many others. As the U.S. distributor for Ametek CTS ESD equipment, we stock and carry the most common ESD simulators including the Teseq NSG 435, EM Test Dito, and the Teseq NSG 437/438 series.

TUV Rheinland
Booth 529
www.tuv.com/usa/en
TUV Rheinland offers a comprehensive service portfolio for testing and certification, including regulatory, interoperability, performance, safety and security. As an EMC Notified Body and international service provider, we offer a flexible service to help you meet the requirements of the EMC directive 2004/108/EC as well as FCC. Our EMC/wireless labs are equipped with 3, 5, and 10 meter chambers as well as OTA chambers and SAR test systems to handle a wide range of products. We are a TCB for the US and an FCB for Canada and an authorized test lab for Wi-Fi, ZigBee, Thread, Bluetooth and LoRa Alliance.

TUV SUD America Inc.
Booth 425
www.tuv-sud.ca
TÜV SÜD is a trusted partner of choice for safety, security and sustainability solutions. It specialises in testing, certification, auditing and advisory services. Through close to 30,000 employees across over 1,000 locations, the company adds value to customers and partners by enabling market access and managing risks. By anticipating technological developments and facilitating change, TÜV SÜD inspires trust in a physical and digital world to create a safer and more sustainable future.

UEMC, INC.
Booth 629
www.uemcinc.com
UEMC, Inc. specializes in the research, development, and production of EMC and information safeguard products. We collaborate closely with our partners to deliver high-quality shielding solutions that meet the diverse needs of customers across various industries.

Vectawave
Booth 417
www.vectawave.co.uk
Vectawave is a manufacturer of robust, air cooled, class A broadband power amplifiers for use in industrial, military and medical applications. Our range covers 9kHz–6GHz with powers up to 10kW. Vectawave have been designing and manufacturing power amplifiers for 27 years. These amplifiers are in daily use in EMC labs and test houses around the world. Our amplifiers have been designed to meet the specific EMC applications, and are ideal for integration into EMC immunity test systems.

Washington Laboratories, Ltd
Booth 329
www.wll.com

Washington Laboratories is an ISO/IEC 17025:2017 and ISO/IEC 17065:2012 accredited EMI/EMC testing and certification lab with over 35 years of experience. Recognized by ANAB, ANSI, iNARTE, and BSMI, we are a one-stop shop for global compliance — including FCC, MIL-STD, RTCA, CE Marking, and international certifications (US, Canada, Japan, EU). As Notified Body #1317 and a trusted TCB partner, we provide end-to-end services in EMI/EMC, environmental, product safety, nuclear EMC, EMP, shielding, lightning protection, and cybersecurity testing — all under one roof.

Wurth Elektronik
Booth 429
www.we-online.com

Würth Elektronik offers sophisticated electronic components for a multitude of applications in all industrial sectors. For us, it's not the individual component that's most important – it's finding the solutions to problems. We're the reliable partner for our customers. With Würth Elektronik, customers realize electronic visions – we're on board from start to finish. The passive division include inductors, ferrites, chokes, LEDs, capacitors, crystals, resistors, sensors, transformers and wireless charging coils. Board-to-Board, Wire-to-Board, Terminal Blocks, and Input/Output connectors are included in the electromechanical division.

ATTENDEES REGISTRATION INFO

Photo by Richard Georgerian

JOIN US IN RALEIGH FOR THE PREMIER EMC AND SIPI EDUCATIONAL SYMPOSIUM!

Attendees include all authors, speakers, delegates, companions, and Exhibit Hall visitors.

A full, 5-day attendee registration includes:

- Access to all of EMC+SIPI 2025
- Multiple days of EMC+SIPI original papers
- Five days of practical EMC+SIPI Workshops and Tutorials
- Experiments and Demonstrations of fundamental and advanced topics
- Exhibit Hall, showcasing the latest EMC+SIPI products and services
- Welcome Reception
- Gala Event
- Awards Luncheon
- Symposium Proceedings with all Workshop & Tutorial slide presentations and Technical papers

REGISTRATION TYPES

TECHNICAL ATTENDEE:

We offer 5-Day or 1-Day Registrations:

You have access to all EMC and SIPI paper sessions, Workshops & Tutorials, Experiments & Demonstrations, and the Exhibit Hall. There are also special events available, as well as Technical Committee Meetings, Standards Meetings, and networking opportunities.

- The 5-Day registration includes 5 days of technical sessions, 3 day pass to the exhibit hall, Symposium Record, and social events.
- The 1-Day registration includes 1 day of technical sessions, same day pass to the exhibit hall (if open), and the Symposium Record.

EXHIBIT HALL ONLY:

This is an EMC+SIPI exhibition with many technical activities. For adult (age 18+) customers and clients of our exhibitors. **$25/day**.

- Companions/guests may obtain a pass (Basic Badge) through their technical attendee's registration. Anyone under age 18 may be registered as a companion and must be accompanied by a registered adult. A minor release form will need to be completed and submitted before obtaining a badge for anyone under the age of 18.

COMPANIONS/GUESTS:

Our Companions are family and friends of all ages who are accompanying a registered, technical attendee.

We offer two types of badges:

- **Companion Club:** This package will again include a gift, access to the Companion Suite (4 mornings with breakfast), Exhibit Hall pass, and Welcome Reception ticket. Individual registrations are required. **Cost: $270**
- **Basic Badge:** For Exhibit Hall entrance and/or Youth Technical Program registration. Sign up your companion within your own 5-Day or 1-Day technical registration. No bar code, no tracking, no charge. Basic Badges are limited to 1 adult companion and their children. **Cost: Free**
  You may sign up your companion within your own registration or they may be registered separately for the **Companion Club**.

EXHIBITOR:

All adult (age 18+) exhibitor staff, reps, and booth workers must register using the link and discount code sent to the Exhibitor/ Sponsor contact to receive an EXHIBITOR ribbon and early access to the Exhibit Hall. Anyone under age 18 must be accompanied by a registered adult and a minor release form submitted prior to obtaining a badge.

There are two badge types:

- **Technical Exhibitor:** receives a full, 5-Day Technical Registration plus EXHIBITOR ribbon.
- **Booth Staff:** receive 3-Day pass to the Exhibit Hall, with early access plus an EXHIBITOR ribbon and access to the welcome reception is included.

www.emc2025.org/registration

REGISTRATION INFORMATION

RALEIGH, NC
EMC+SIPI 2025

IMPORTANT REGISTRATION INFORMATION

AUTHORS: Symposium registration (IEEE Member or Non-Member) is required by at least one author, or the speaker, before the final paper submission deadline, May 23, 2025. Failing to meet this requirement will result in the paper not being published or presented – no exceptions. Your registration confirmation number will be needed for the final paper submittal.

More details can be found on the AUTHOR/SPEAKER page

ADVANCE REGISTRATION: You must be paid in full by midnight PDT, July 18, 2025 to receive the Advanced rates.

EMC SOCIETY MEMBERS: Special rate for full, 5-Day Technical Registrations only. Your membership must be in good standing and paid in full for 2025. If you are not a member and would like to become a EMC-S member, please CLICK HERE or call 1-800-678-IEEE. Please note that you must be a member at the time of registration to receive the member rate.

IEEE MEMBERS: Your membership must be in good standing and paid in full for 2025. Have your member number and current member grade ready when registering. If you are not a member and would like to become an IEEE member, please CLICK HERE or call 1-800-678-IEEE. Please note that you must be a member at the time of registration to receive the member rate.

SISTER SOCIETY MEMBERS: Members of IEEE EMC-S Sister Societies are eligible for the discounted EMC-S Member rate at the annual symposium. Contact the Registration Service to obtain this discount. View a list of the 2025 active Sister Society relationships.

IEEE LIFE MEMBER: There is a further rate reduction for IEEE Life members. IEEE Life Membership is automatically bestowed upon an active IEEE member based on age and years of membership.

EMC-S HONORED MEMBER: You must be an EMC Society Honored Award recipient who was presented with this award in a prior year. No discount code is necessary to register; this is a special rate category.

EMC-S RETIRED OR UNEMPLOYED: EMC-S Retired or Unemployed. Special ADVANCE rate discount for retired / unemployed EMC Society members only. Have your last place of employment and the date of retirement or unemployment ready when registering.

COMPANY GROUP RATE: Sign up to request a company-wide discount code now! We will give each employee a special discounted rate which is roughly 35% off the non-member rate, and over 10% off the EMC-S Member rate! Send an email to: **EMC@iplanitmeetings.com** to receive your Company Discount Code.

Cost: Advance rate is $715/person

FULL-TIME STUDENTS: Special rates for both IEEE members and non-members. You must be enrolled in a full time course of study at a college or university to register in the student categories. Have your college ID number and advisor's name & email ready when registering.

NOTE: Student 5-Day registration packages will include the Symposium Record and tickets to the Welcome Reception & Awards Luncheon. The Gala ticket, however, is NOT included, but may be purchased separately or awarded through volunteering at the symposium.

More details at the EMC+SIPI 2025 Website AUTHOR/PRESENTER page

OTHER INFORMATION:

CERTIFICATE OF PARTICIPATION

A Certificate of Participation may be used to officially document attendance at the Symposium. A personalized certificate will be available at no charge to all registered Symposium attendees and participants. Please visit the Registration Desk to verify your name and affiliation and to pick up your certificate. If you have any questions, please email: **emc@iplanitmeetings.com**.

PAYMENT

Payment is due upon submittal of your registration. Payment can be made by:

- Check (in USD) made out to IEEE EMC+SIPI 2025, and mailed within 2 weeks.
- Credit Card: Visa, MasterCard, American Express, Discover Card.
- Wire Transfer: (Note: Banks usually charge a fee for wire transfers. These are the responsibility of the registrant.)
- Invoice (Government Purchase Order)

Payments by credit card will be charged immediately upon submission of registration. Checks and Wire Transfers must be received within two weeks of the registration date.

You may pay for Companion Club Registration along with your own registration, or via a separate credit card. If you need to pay for tours and social events separately, select "Check" as your payment method and then contact Registration Services at the number on your email confirmation.

CANCELLATION POLICY

For Registration and total order:

- Notice of cancellation must be received in writing via email, sent to **emc@iplanitmeetings.com**. A $50.00 (USD) processing fee will be charged for registrations cancelled by July 18, 2025. For cancellations between July 19 and August 4, 2025, a 50% refund will be given. There will be no refunds after midnight PDT on August 4, 2025.If you applied for a Visa and it is denied, a full refund will be issued less a $20 service charge.
- If you applied for a Visa and it is denied, a full refund will be issued less a $20 service charge.
- In the event of a full cancellation of the conference, IEEE and EMC Society are not responsible for, and will not reimburse, flight costs and other expenses incurred by the attendee.

FOR SOCIAL EVENTS, TOURS AND EXTRAS ONLY

- Notice of cancellation of an individual "extra" item must be received in writing via email, sent to **emc@iplanitmeetings.com**, A $50.00 (USD) processing fee will be charged for registrations cancelled by July 18, 2025. There will be no refunds after midnight PDT on July 18, 2025.
- The EMC 2025 Symposium Committee reserves the right to cancel any tour that does not meet the minimum requirement. If a tour is cancelled, you will receive a full refund and will be contacted prior to the symposium.

2025 TECHNICAL REVIEWERS

THE EMC+SIPI 2025 TECHNICAL PROGRAM COMMITTEE

would like to extend our gratitude to this year's reviewers for their support of the Symposium and dedication to a high-quality technical program.

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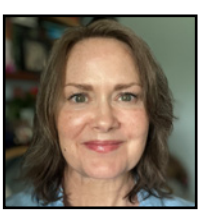

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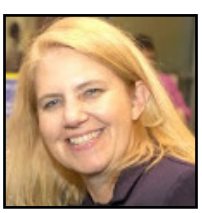

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