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THE INTERNATIONAL JOURNAL OF
ELECTROMAGNETIC COMPATIBILITY™

2013

EMC SYMPOSIUM GUIDE

AUGUST 4 - 9 DENVER

YOUR COMPREHENSIVE GUIDE TO THE IEEE
INTERNATIONAL SYMPOSIUM ON EMC

FEATURED INSIDE

SYMPOSIUM OVERVIEW	7
TECHNICAL PROGRAM	22
TECHNICAL COMMITTEE MEETINGS	56
COMPANY PROFILES	66
SOCIAL EVENTS	82
RESTAURANTS	84

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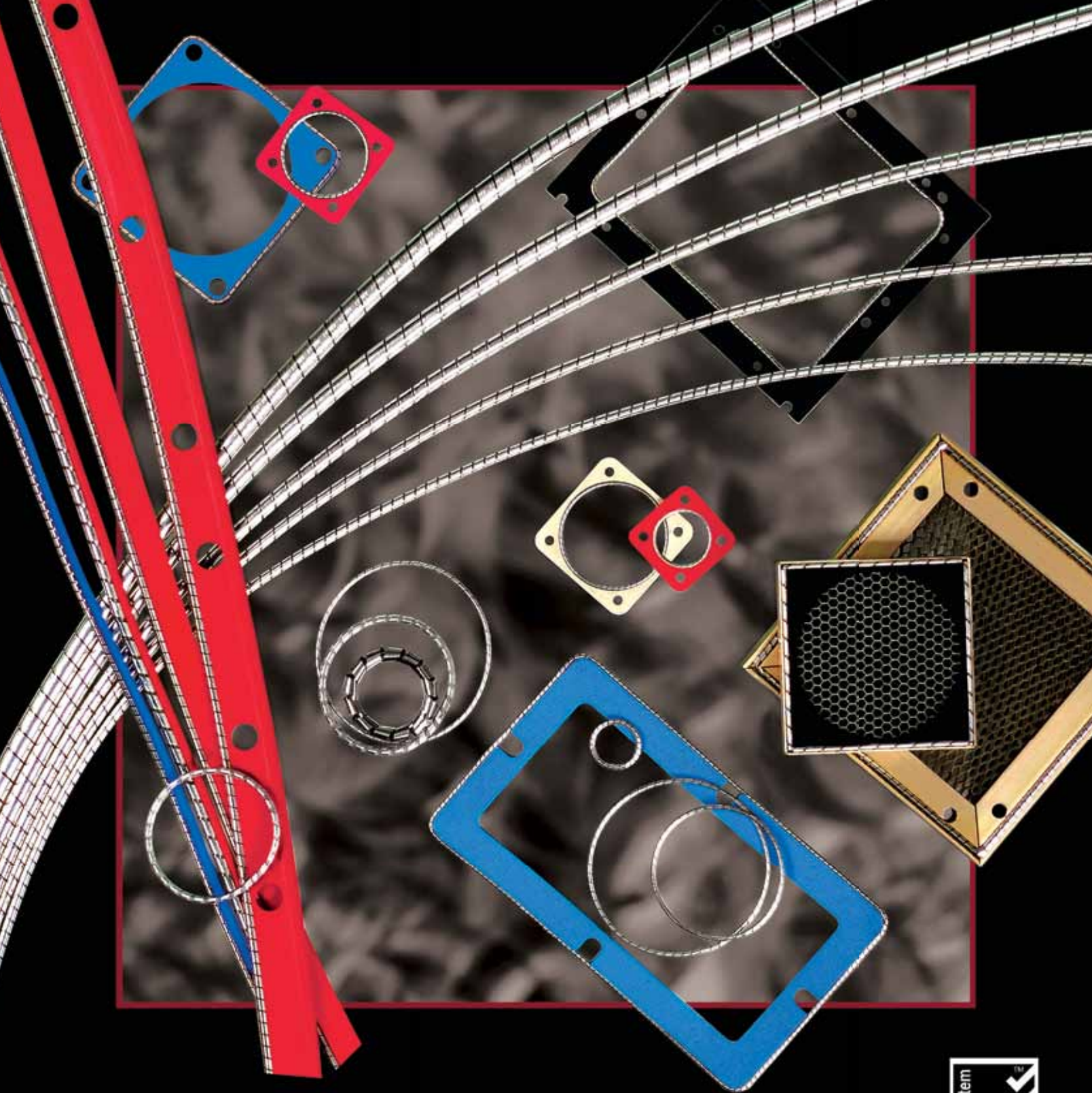


- 4 Message from the Chairman**
- 7 Symposium Overview**
- 18 Feature**

TECHNICAL PROGRAM

- 22 Monday**
- 30 Tuesday**
- 38 Wednesday**
- 44 Thursday**
- 50 Friday**
- 56 Technical Committees**
- 57 Experiments & Demonstrations**
- 60 ANSI / iNARTE**
- 62 Global University**
- 64 Exhibit Hall Map**

- 66 Company Profiles**
- 74 Product Finder**
- 80 Companion Program**
- 82 Social Events**
- 84 Restaurants**
- 86 Attractions**
- 88 Index of Advertisers**



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DEAR EMC SOCIETY MEMBERS, EMC COLLEAGUES, AND VISITORS



WOULD LIKE TO WELCOME YOU to the 2013 IEEE International Symposium on Electromagnetic Compatibility in Denver, Colorado. I would also like to extend a welcome to the Denver Section of the IEEE and to our local Electromagnetic Compatibility Society Chapter.

This year's Symposium Organizing Committee has planned and designed the 2013 EMC Symposium with the goal of ensuring the most enriching technical and professional networking opportunities possible through multiple exhibits, technical programs, companion programs, and social events.

We are offering 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 meetings and a full exhibit hall to learn about the latest offerings in EMC products and services.

We have some excellent educational workshops in our agenda. We are really looking forward to the Grounding – Concepts and Physics Workshop. This will be an informative workshop featuring an esteemed panel of experts who will answer questions after the presentations. Also, the workshop on Advanced Computational Electromagnetics and Multi-Physics Methods has an impressive list of speakers from universities around the world! Read more about both of these in the Workshops and Tutorials section. In addition, this year we are trying out a new online program scheduler that will allow you to build your symposium schedule on various types of portable electronic devices.

The host hotel is the Sheraton Denver Downtown Hotel, which is in the heart of downtown Denver and a short distance to the Colorado Convention Center. Our Welcome Reception will be at Katie Mullen's Irish Restaurant and Pub which is within the same city block as the hotel. It's a gorgeous venue! And while I am mentioning our social events, many of my fellow committee members would want me to mention the Self-Guided Brewery Tour. Denver has a well-known reputation for excellence in craft brewing and has been touted as the Beer Capital of the U.S. This is an opportunity to sample some of the local breweries with your fellow EMC Society members. It's a walking tour, of course!

We hope you join us for EMC 2013 in Denver to enjoy the networking, education, and hospitality of the Mile High City.

Danny Odum

General Chairman
2013 IEEE International EMC Symposium

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COMPATIBILITY (EMC 2013)
BOOTH 521
5 AUG - 9 AUG 2013

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DENVER, CO
AUGUST 4-9, 2013

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WELCOME TO DENVER AND THE 2013 IEEE SYMPOSIUM on Electromagnetic Compatibility. This Symposium Overview is designed to give you a day-by-day summary of the technical, social, and educational programs available to attendees of the IEEE EMC Symposium and their families. Use it to plan your days and nights and get the maximum benefit of five days plus of non-stop immersion in everything EMC.*

SUNDAY, AUG. 4

- 8:00 am – 6:00 pm
- Exhibitor Move-In

MONDAY, AUG. 5

- 8:00 am – 6:00 pm
- Exhibitor Move-In

MORNING WORKSHOP & TUTORIALS PROGRAM

- 8:30 a.m. – 12:00 p.m.
- **MO-AM-1** Fundamentals of EMC
- **MO-AM-2** Measurement Uncertainty – Challenges and Solutions

- **MO-AM-3** Introduction to EMI Modeling Techniques
- **MO-AM-4** Introduction to EM Information Leakage from Electronic Devices
- **MO-AM-5** Low Frequency EMC within the Smart Grid including interference between equipment for renewables and smart meters

AFTERNOON WORKSHOP & TUTORIALS PROGRAM

- 1:30-5:30pm
- **MO-PM-1** Fundamentals of EMC
- **MO-PM-2** Recent Developments in EMC for Emerging Wireless Technologies
- **MO-PM-3** How to Break Complex Systems into Realistic, Solvable, Accurate Models
- **MO-PM-4** EMC Consultant's Toolkit
- **MO-PM-5** EMC Leadership Training

TUESDAY, AUG. 6

- 8:00 am – 6:00 pm
- Exhibitor Move-In

MORNING WORKSHOP & TUTORIALS PROGRAM

- 8:30 a.m. – 12:00 p.m.
- **TU-AM-1 SC-4** RF Interference and Wireless Measurement
- **TU-AM-2 TC10** EM Modeling and Validation
- **TU-AM-3 TC-9:** Statistical Analysis and Model Validation
- **TU-AM-4 SC-3** Transportation Systems

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*All events are subject to change. Check www.2013emc.org and the Registration Area daily for updates.

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This state-of-the art precision DSP based receiver reduces your valuable test time from days to minutes and changes the playing field in EMC receivers. It is extremely easy to operate with all functions menu driven and displayed on a supplied 23" flat panel LED monitor, so you can adjust the necessary test functions and see the disturbances quickly and easily.

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The NEW AR MultiStar precision DSP Receiver is verified by an accredited laboratory to all applicable tests according to CISPR-16-1-1 Edition 3.0 2010-01.

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That doesn't just mean they're fast; it means they're much more accurate than any other kind of field monitor equipment to date while delivering the detailed information comprising the electric field.

The FA7000 series of field analyzers are based on an innovative approach that uses an isotropic field sensor to sample the composite field and transmit its amplitude digitally over optical fiber to a processor unit.

They represent a whole new way to more accurately measure modulated and CW electric fields in both conventional and reverberation chambers and allow the user to see the modulation envelope.

Accuracy and Speed you never thought possible.



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- **TU-AM-5 Special Session (TC6)**
Spectrum Analysis and Measurements
in a Congested Electromagnetic
Environment
- **TU-AM-6 Technical Committee**
Poster Session

AFTERNOON WORKSHOP & TUTORIALS PROGRAM

- 1:30-5:30pm
- **TU-PM-1 TC2** Reverberation
- **TU-PM-2 TC-7** Low Frequency EMC
- **TU-PM-3 TC-9: Practical Applications**
of Numerical Modeling
- **TU-PM-4 Special Session**
(TC10-CPMT/TC12) High Speed
Signaling Design Optimization

WEDNESDAY, AUG. 7

- 8:00 am – 6:00 pm
- Exhibit Hall Opens

MORNING WORKSHOP & TUTORIALS PROGRAM

- 8:30 a.m. – 12:00 p.m.
- **WED-AM-1 TC2** Measurements –
General
- **WED-AM-2 TC-4** Radiation and
Susceptibility

- **WED-AM-3 TC-11** Nanotechnology
and Advanced Materials
- **WED-AM-4 TC-1** Managing Risk in
EMC Compliance

AFTERNOON WORKSHOP & TUTORIALS PROGRAM

- 1:30-5:30pm
- **WED-PM-1 TC2** Antennas
- **WED-PM-2 TC-4** Shielding,
Transmission lines and Grounding
- **WED-PM-3 TC-9: Time Domain Methods**
- **WED-PM-4 Special Session (TC-11)**
Nanotechnology in EMC
- **WED-PM-5 Special Session (TC9/TC10)**
System Level SI/PI Analysis for High
Speed Design

THURSDAY, AUG. 8

- 8:00 am – 6:00 pm
- Exhibit Hall Opens

MORNING WORKSHOP & TUTORIALS PROGRAM

- 8:30 a.m. – 12:00 p.m.
- **TH-AM-1 TC2** Measurements I
- **TH-AM-2 TC-4** Emissions, Filters
and Enclosure Suppression
Techniques

- **TH-AM-3 SC-4** Wireless EMC
- **TH-AM-4 Special Session (TC-9)** EMC in and on Transportation Structures
- **TH-AM-5 TC10** Signal Integrity Enhancement and Crosstalk Management

AFTERNOON WORKSHOP & TUTORIALS PROGRAM

- **1:30-5:30pm**
- **TH-PM-1 TC2** Measurements II
- **TH-PM-2 Special Session (SC4)** EMC for Emerging Wireless Technologies
- **TH-PM-3 TC-9:** Reverberation Chambers and Rectangular Cavities
- **TH-PM-4 TC5** High Power EM including Intentional EMI, ESD, and Lightning
- **TH-PM-5 TC10** Signal Integrity and Power Integrity

FRIDAY, AUG.9

- **8:00 am – 6:00 pm**
- Exhibit Hall move out

MORNING WORKSHOP & TUTORIALS PROGRAM

- **8:30 a.m. – 12:00 p.m.**

- **FR-AM-1** Advanced Computational Electromagnetics/ Multi-physics Methods for Fast Characterizing Electromagnetic/Electromagnetic-Thermal Effects in Complex Structures
- **FR-AM-2** Basic EMC Measurements
- **FR-AM-3** The Scoop on Hybrid Antennas – Dispelling the Controversy for Qualification Testing
- **FR-AM-4** Fundamentals of Signal and Power Integrity
- **FR-AM-5** Grounding – Concepts, Physics and Myths

AFTERNOON WORKSHOP & TUTORIALS PROGRAM

- **1:30-5:30pm**
- **FR-PM-1** Advanced Computational Electromagnetics/ Multi-physics Methods for Fast Characterizing Electromagnetic/Electromagnetic-Thermal Effects in Complex Structures
- **FR-PM-2** Application of Reverb Chambers
- **FR-PM-3** Advanced Topics in Signal and Power Integrity
- **FR-PM-4** Best Practices for Organizing and Hosting Lessons Learned Discussions
- **FR-PM-5** EMC in 3D Integration

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multi star Multi-Tone Tester

This incredible system cuts RF Radiated Immunity testing from days down to hours by testing multiple frequencies simultaneously, reducing product development cost and time to market.



multi star Precision DSP Receiver

This 18 GHz EMI receiver changes the way you think about emissions testing. Data is more accurate and test time is reduced. Testers have a suite of new mitigation tools.



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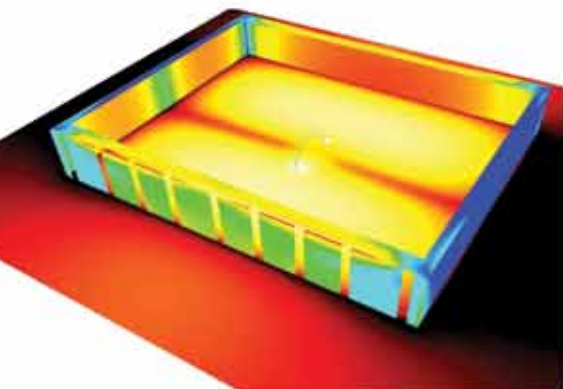
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INFORMATION for Authors

Join your colleagues in Raleigh where you can share your insight, ask questions, learn from the experts/innovators and see new products at the 2014 IEEE International Symposium on Electromagnetic Compatibility. The IEEE EMC Society seeks original, unpublished papers covering all aspects of electromagnetic compatibility, including EMC design, modeling, measurements and education. This year's symposium includes an embedded conference, 2014 IEEE International Conference on Signal and Power Integrity (SIPI 2014), featuring workshop, tutorials and technical sessions devoted to topics of interest to both EMC and Signal Integrity engineers.

Conference proceedings will be submitted for posting to IEEE Xplore. In addition, authors of accepted papers will be invited to submit an extended version of their symposium paper for possible publication in a special issue of the IEEE Transactions on Electromagnetic Compatibility.

PAPER TOPICS of Interest

Topics include and are not limited to the following technical areas.

TC-1 EMC Management

- Personnel & Laboratory Accreditation
- EMC Education
- Legal Issues

TC-2 EMC Measurements

- Test Instrumentation & Facilities
- Measurement Techniques
- Standards and Regulations

TC-3 EM Environment

- EM Signal Environment
- Atmospheric & Man-Made Noise

TC-4 EM Interference Control

- Shielding, Gasketing & Filtering
- Cables and Connectors
- Circuit & System EMC Analysis
- Grounding

TC-5 High Power Electromagnetics

- ESD & Transients
- EMP, IEMI & Lightning
- Information Leakage
- Electric Power EMC

TC-6 Spectrum Management

- Spectrum Management
- Spectrum Monitoring

TC-7 Low Frequency EMC

- Power Quality and Conducted EMC
- Power Electronics

TC-9 Computational Electromagnetics

- Computer Modeling Methods
- Tools and Techniques
- Validation Methods
- Statistical Analysis

TC-11 Nanotechnology & Advanced Materials

- Nanomaterials & Nanostructures
- Smart Materials

SC1 Smart Grid EMC

- RF Environment
- Performance Degradation

SC4: EMC for Emerging Wireless Technologies

- EMC Planning/Testing/Specifications
- Wireless Coexistence
- Intra-System Interference

Embedded Conference on Signal and Power Integrity (SIPI 2014)

- High-Speed Interconnects
- Device Modeling & Characterization
- Crosstalk, Jitter, Noise Coupling, BER analysis
- 3D IC & TSV
- Power Distribution Networks & Decoupling
- SI/PI/EMI Co-Design



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STUDENT PAPER CONTEST

Graduate and undergraduate authors are eligible for the Best Student Paper contest. The student must be the primary author and should indicate they wish to be considered for the contest when submitting the preliminary manuscript. Each student's professor will be asked to certify that the paper is primarily the work of the student. A Student Design Contest is also being held. Obtain the design kit, rules, and award details from the website: www.emcs.org.

SPECIAL ISSUE OF IEEE TRANSACTIONS ON EMC

Authors of accepted papers will be invited to submit an extended version of their symposium paper for possible inclusion in a special issue of the IEEE Transactions on Electromagnetic Compatibility featuring papers from the 2014 IEEE International Symposium on EMC. These submissions will be subjected to the same rigorous review as papers submitted for publication in regular issues of the IEEE Transactions on EMC.

GUIDELINES FOR AUTHORS & SUBMITTAL PROCEDURES

Prospective authors must submit electronically**.

- **A preliminary manuscript (4 – 6 pages) including all relevant results and conclusions.**
- **Choice of presentation format (traditional oral or open forum).**

** Preliminary Manuscripts and Final papers are to be submitted using the link provided on the symposium website at www.emc2014.org after November 1, 2013. During the electronic submission process a unique author code is created for tracking purposes. Submissions are reviewed anonymously, so **please do not include author names or affiliations on the Preliminary Manuscript**. Failure to comply with submission requirements may result in rejection.

PAPER ACCEPTANCE PROCEDURES & CRITERIA

- **Importance of Topic:** Does it have direct significance to the EMC community?
- **Technical Sophistication and Depth:** Does it present information that is a significant contribution, advancement, application or refinement of the state of the art? Does it expose the reader to a higher knowledge level than currently available from other sources?
- **Readability, Clarity and Presentation:** Is the value of the submission clearly defined? Is the material written in clear and concise English, with topics presented in an organized and logical manner?
- **Novelty and Originality:** Does it propose a new and unique concept or expand on an existing premise from a unique point of view?

AUTHOR SUBMISSION SCHEDULE

- **Preliminary Full Paper Manuscript:**
November 1, 2013 -
January 20, 2014
Late papers will not be accepted.
- **Acceptance Notification:**
March 10, 2014
- **Final Paper and Workshop/Tutorial Material Due:**
May 9, 2014

PAPER FORMATS

- **Traditional Oral presentation:**
Presentation for those interested in presenting to large groups with limited potential for interactions with attendees. Six-page paper maximum, 20-minute presentation with 10-minute question and answer session.
- **Poster Paper:**
Presentation for those interested in direct interaction with individuals or small groups.

Technical Paper Chair
Jun.Fan@ieee.org

Technical Program Chair
T.Hubing@ieee.org

See website for more details www.emc2014.org

SUN. MONDAY	7 am	8 am	9 am	10 am	11 am	Noon	1 pm	2 pm	3 pm	4 pm	5 pm	6 pm	7 pm	
		Exhibitor Set Up												
	7 am	8 am	9 am	10 am	11 am	Noon	1 pm	2 pm	3 pm	4 pm	5 pm	6 pm	7 pm	
	Companion Suite Open													
		Exhibitor Set Up												
				Break		Lunch			Break					
			Workshops & Tutorials					Workshops & Tutorials						
TUESDAY				Denver City Highlights with State Capitol Tour										
								Chapter Chair Training Session and Dinner (until 9 PM)						
	7 am	8 am	9 am	10 am	11 am	Noon	1 pm	2 pm	3 pm	4 pm	5 pm	6 pm	7 pm	
	Companion Suite Open													
			Exhibit Hall Open											
			Technical Paper Sessions					Technical Paper Sessions						
			Global University					Global University						
			Experiments and Demos					Experiments and Demos						
				Break		Lunch			Break					
				Historic Browns Tour										
WEDNESDAY	Team EMC Bike Tour											Welcome Reception		
										7:30-9 pm Gold EMC Ice Cream Social - Sheraton				
	7 am	8 am	9 am	10 am	11 am	Noon	1 pm	2 pm	3 pm	4 pm	5 pm	6 pm	7 pm	
	Companion Suite Open													
THURSDAY			Exhibit Hall Open											
			Technical Paper Sessions					Technical Paper Sessions						
			Global University					Global University						
			Experiments and Demos					Experiments and Demos						
				Break		Lunch			Break					
			Denver Mountain Parks and Coors Brewery Tour											
												Gala Event		
	7 am	8 am	9 am	10 am	11 am	Noon	1 pm	2 pm	3 pm	4 pm	5 pm	6 pm	7 pm	
	Companion Suite Open													
			Exhibit Hall Open				Exhibit Hall Move Out							
FRIDAY			Technical Paper Sessions					Technical Paper Sessions						
			Global University					Global University						
			Experiments and Demos											
			Youth Technical Program											
				Break		Lunch			Break					
	Awards Luncheon								Local Breweries: Self-Guided Walking Tour (evening)					
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SHOOTING STARS: UP-AND-COMING EMC ENGINEERS READY TO TAKE ON CHALLENGES IN THE FIELD

BY VINTI SINGH

DURING PLAYTIME, while Benjamin Orr's classmates were playing superheroes, cops and robbers or house, Orr was playing engineer. He would use crayon drawn "schematics" to "rewire" the playground. His curious classmates asked what he was doing, and soon after he was leading a crew of young technicians through the jungle gym. About two decades later, Orr has moved from the playground to the lab, where he continues to lead.

Orr is part of the next generation of electrical and electronic engineering students who are tackling some of the most common, yet persistent problems in the field, and show that with them leading the way the future promises exciting innovations for the industry.

LEADING IN-DEPTH STUDIES OF COMMON INDUSTRY PROBLEMS

Orr, 24, is a second year Ph.D. student at the Missouri University of Science and Technology. For his Ph.D., Orr is studying end user induced soft failures in devices. He is comparing a public domain device similar to a smartphone or tablet to an internal reference device. The internal reference device allows him to understand exactly what is happening inside, a rare luxury usually unavailable to electromagnetic compatibility testers because of intellectual property concerns.

Orr's work will eventually have the potential to be used by industry councils to set a soft failure model standard, allowing engineers to design products with a more complete understanding of those failure levels.

"It reduces the time to market," Orr said. "We're trying to expand models given to original equipment manufacturers so they can produce products in a shorter design cycle."

Lisa Linna, a 28-year old graduate student at the University of Michigan –Dearborn, is

creating new labs to test EMC theories. One lab, for example, is focused on methods for mitigating crosstalk – studying the effects that neighboring circuits have on one another.

"In electrical engineering we're taught how to design based on the characteristics of various components" Linna said. "What you have to realize is there's more to the circuit, the supply and return paths can play a key role in how the circuit functions."

"Some people try to save money by sharing paths or reducing the area on a ground plan, but this can cause unwanted effects" Linna said. "You have to realize a path is not just a path – it's essentially another component."

Another one of Linna's labs is focused around shielding, and how the sizes and shapes of apertures reduce the effectiveness of the shield. Her goal is to demonstrate how linear dimension is a major factor in determining how a wave passes through a shield, but the lab is not yet complete.

Linna currently works for Robert Bosch, although not in an EMC specific position. Her career goal is to become a key person in an electrical hardware group in which she can influence new designs.

STILL A NICHE

A gap between industry demands for graduates with EMC experience and the shortage of those graduates actually being supplied by the universities has existed since the mid-1980s, said Mark Steffka, an electrical and computer engineering professor at the University of Michigan-Dearborn. Although the gap has gotten narrower, it is still nowhere close to disappearing, he added.

Linna agreed, saying she was surprised how many upperclassmen in engineering classes have no exposure to basic EMC principles.

Employer Joe DiBiase described how in a previous role he held at Motorola, even though he received resumes from students around the country, it was still a challenge to find those with an adequate background in EMC.



Lisa Linna
graduate student
University of Michigan
– Dearborn



Li Niu
Ph.D. candidate
Clemson University



Jhonnatan Ascate
graduated from
University of California
- Davis with a Bachelor
of Science in electrical
engineering

"Many schools do not have EMC programs" DiBiase said. "Of those universities that do offer courses they tend to be more theoretical than hands on testing."

EMC courses have slowly become more common in the last decade, Steffka said, with fewer than 10 universities around the United States offering a range of EMC elective classes.

The Missouri University of Science & Technology in Rolla, Missouri, is considered to have the pre-eminent EMC program in the country, said Mike Viollette, president of Washington Laboratories, a compliance solutions company based in Gaithersburg, MD.

An EMC basics course used to be a requirement for all computer and electrical engineering majors at Georgia Institute of Technology, but was recently removed from the computer engineering curriculum.

"The students seemed to be happy about that because they tend not to like it because it's more rigorous as far as the math and phys-



Left, a student studies test results in a lab. Below, electrical engineers at Louisiana Tech University work as a team. Bottom, a Portland State University student works with test equipment.

Photos courtesy of LTU and PSU



ics behind it," Pranav Ramesh, 21, a graduate student at Georgia Tech, said. "But I think there could be more emphasis on it."

In his undergraduate studies at Georgia Tech, Ramesh worked on a chip-to-package interconnect component made of copper instead of the traditional solder, as it does a much better job at preserving signal integrity reducing distortion, he added.

For his master's thesis, Ramesh is trying to find a working solution to a long existing problem - to harvest excess electromagnetic radiation, specifically radio frequency energy that does not reach the end user and is left floating around in the atmosphere. He and his team are designing basic antennae that will pick up the radiation, which they plan to convert to voltage stored in a battery. That project is in its early stages, but Ramesh said he senses alternative energy solutions is where the industry is heading.

While Steffka teaches elective EMC courses at University of Michigan-Dearborn, he works full time for General Motors.

"I bring in a number of 'real world' engineering examples and examples from professional publications... and say these are the types of systems being designed today," Steffka said. "This is real. I have people who are lined up to take my class because I discuss relevant theories and relevant mathematics. Ramesh's comment is typical for those instructors who are not in the industry," and so their classes tend to be more theory based."

When Todd Hubing began teaching a grounding and shielding class at the University



of Missouri University of Science and Technology in 1989, he was lucky if 10 students signed up to take it.

"Then people started realizing it was a practical class, and that students were getting job offers because of this one course they had taken," Hubing said.

Word got around, and by the time he left in 2006 to teach at Clemson University in Clemson, S.C., the class regularly drew about 50 students per year. At Clemson, where he is now the Michelin Chair and professor of electrical and computer engineering, he witnessed a similar trend.

Hubing's students work with companies to analyze EMC problems. Since 1995, he has led students in an ever evolving project where decisions are based on EMC requirements rather than by following design guidelines.

"One of the biggest challenges future EMC grads face is the development of better modeling and test procedures," Hubing said.

"Too many companies today think they can buy expensive modeling tools that will solve all of their problems, and it's just not the case," Hubing said. "The next generation of students will hopefully understand that and take the time to learn to do EMC modeling more intelligently."

One of Hubing's Ph.D. candidates, Li Niu, 26, is working on his design project. His goal is to determine the maximum possible radiation from a printed circuit board with an attached cable, so that by design, it can be guaranteed that the component pass the standardized Radiated Emission Test.

"We are actually pretty confident of this matter because we worked with automotive suppliers and helped them meet the OEM

standards when they took our advice," Niu said. "But there continues to be a challenge because meeting the standard is relatively easy, but to make sure the product is EMC trouble free in a real vehicle is completely another story."

DiBiase, who is now an applications engineer for AR RF/Microwave Instrumentation, an EMC solution provider based out of Souderton, Penn., said it would also be beneficial if students were exposed to EMC standards requirements in their classes.

"As the electronics industry becomes more global, a solid understanding of internationally accepted protocols and standards is crucial," said Violette, who is also director of the American Certification Body.

"If you look at world trade, standards are a bridge for trade," he said. "As far as curriculum, a push for standards integration will not only lead to harmonized trading platforms, but better products."

Violette said Washington Laboratories looks for candidates with a strong grounding in the fundamentals and application of electromagnetics, but that is rare unless those hires are coming from other labs or are already established within the industry.

To work toward a solution, DiBiase said he is working on creating a student internship at his company to offer hands-on research experience to the next generation. But most importantly, what he looks for in new hires is "great engineering talent and willingness to be a team player," he said.

Jhonnatan Ascate, 22, said he received more than one job offer after graduating from University of California - Davis with a Bachelor of Science in electrical engineering. He accepted a position at National Instruments because he liked the corporate culture he observed when he visited its offices.

"The boss' cube was right next to the new hires' cubes," Ascate said. "I could sense by the way they interacted, the teams there were organized and well managed."

Electrical/Electronics and Communications Engineering majors graduating with bachelor's degrees earned an average starting salary of \$63,400 in 2013, a 6.2 percent increase from the previous year, according to the National Association of Colleges and Employers. At the bachelor's degree level, an electrical engineering degree ranked 7 in the top 10 degrees in demand, according to the 2013 NACE Job Outlook Survey.

An electrical engineering degree was the fourth most sought after type at the master's level, and second most sought after at the doctorate level, according to the survey.

Ascate and his peer Huangqing Ziao, of Zhejiang University in China, won first place in the 2012 IEEE Microwave Theory and Technique Society 2012 video competition for an entry titled "Visualizing Electromagnetic Waves."

Ascate and Ziao used an oscillator to generate the waves, which they then passed through an amplifier to achieve levels congruent with

everyday devices that cause this magnitude of interference. The effects of the simulated interferences were then displayed by LED lights. Their display surpassed the binary intensities of existing visualizations. Ascate worked on the project for hours every day in the months leading up to the deadline. The tedium of the constant debugging process required patience and a tolerance for continuous trial and error, something Ascate suggested all those interested in making a career in EMC be sure to have.

Niu is currently interning at a major automotive supplier in Michigan and said based on his experience there and conversations he has had with others in the industry, he thinks there is currently too much reliance on simulation software.

"They spend thousands of dollars and think, given as much details as possible, the software will crank out results for you," Niu said. "But that's rarely the case, you always have to understand the physics behind each problem first, aware of the strength and limitation of simulation code, then start with simple structure. Many times after this process, you end up building a EMC model yourself for specific problem which make more sense than general commercial simulation codes."

INTERNATIONAL TALENT

"Given the demand for engineering and computer related degrees among international graduates, it comes as no surprise that engineering services and information employers...have

plans to hire international students," the NACE Job Outlook Survey reported. Almost 72 percent of respondents in engineering services said they plan to hire international students, according to the results.

Niu said he has not officially decided, but he is tempted to return to China, his native country, after finishing his program. Engineering systems are developing quickly there, and EMC specialists are in demand.

Dazhao Liu, a Ph.D. candidate at Missouri University of Science & Technology, is from China as well. While almost every other student who was interviewed said they chose to go into engineering to follow in their fathers' footsteps, Liu said Chinese education officials funneled him into the major because of his results on a standardized test in high school.

Liu hopes to stay in the US after graduating because he believes the political atmosphere in his home country is not favorable to the engineering profession. He is seeking a career in signal integrity because he said it offers the most job security in the EMC field.

SEEKING CREATIVITY

Orr said when he is ready to enter the job market, he will look for a job that encourages creativity.

"I had an internship at a company and I came away from that experience bored to tears because they were satisfied to just copy and continue the existing product design," Orr said.

Orr wants more than that; as many other young engineers do.

A GAP BETWEEN INDUSTRY DEMANDS FOR GRADUATES WITH EMC EXPERIENCE AND THE SHORTAGE OF THOSE GRADUATES ACTUALLY BEING SUPPLIED BY THE UNIVERSITIES HAS EXISTED SINCE THE MID-1980S. ALTHOUGH THE GAP HAS GOTTEN NARROWER, IT IS STILL NOWHERE CLOSE TO DISAPPEARING.

— MARK STEFFKA,

UNIVERSITY OF MICHIGAN-DEARBORN



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WORKSHOPS/TUTORIALS

- Fundamentals of EMC
- Measurement Uncertainty - Challenges and Solutions
- Introduction to EMI Modeling Techniques
- Introduction to EM Information Leakage from Electronic Devices
- Low Frequency EMC within the Smart Grid Including Interference Between Equipment for Renewables and Smart Meters
- Fundamentals of EMC
- Recent Developments in EMC for Emerging Wireless Technologies
- How to Break Complex Systems into Realistic, Solvable, Accurate Models
- EMC Consultant's Toolkit
- EMC Leadership Training

OTHER EVENTS

- Technical Committee Meetings
- iNARTE Examinations Preparation Tutorial (Page 60)
- Global University Welcome Reception (Page 62)
- Chapter Chairs Training Session and Dinner
- GOLD Special Session
- Denver City Highlights and State Capitol Tour (Page 80)

EXHIBITOR SET UP

*All events are subject to change. Check www.emc2013.org and the Registration Area daily for updates

Fundamentals of EMC

Format: Full-day Tutorial – MO-AM-1 and MO-PM-1 8:30AM-Noon ROOM 201

Chair: Henry W. Ott, Henry Ott Consultants, Livingston, New Jersey, US

ABSTRACT

This tutorial is designed to present the basics of EMC to those who are new to the field of EMC, those who are seeking information on an aspect of EMC that they have not previously encountered, or those who desire a refresher on the proposed EMC topics.

PLANNED SPEAKERS AND TOPICS

1. Introduction

Henry W. Ott, Henry Ott Consultants, Livingston, New Jersey, US

2. The Secret Lives of Capacitors, Inductors, and Resistors ("Things Your Professors Didn't Tell You!")

Mark Steffka, University of Michigan-Dearborn, Dearborn, Michigan, US

There are a number of unanticipated EMC engineering ramifications that result from the typical engineering curriculum that focuses on "ideal" components and their intended functionality in "ideal" systems. While this information is important - the problem is that engineers are required to work in the "real world" where "ideal" components simply do not exist! This causes confusion and problems occur that seem unsolvable to even experienced engineers.

This session will begin by discussing the concepts and theory behind "ideal" components and how those conceptual aspects are affected by the physics involved in actual component and system implementation. The session will conclude with guidelines on how to estimate the "real world" effects on the "ideal" components and how to minimize those effects in order to have a product that achieves the goal of cost-effective EMC success.

3. Grounding: The Grounds for EMC Design

Elya B. Joffe, KTM Project Engineering, Israel

One of the problems with grounding is the term itself. It's too vague. Often a single ground may serve multiple needs, with different rules to each. The concept of "grounding" is probably among the most important, yet less understood topic of electronic design, often considered as "black magic". Yet, grounding forms an inseparable part of all electronic and electrical designs, from circuit through system up to installation design. Grounding is implemented for EMC and ESD protection, for safety purposes, for lightning and surge protection, etc.

This Tutorial is intended to shed some light on the fundamental concept of grounding - an essential and inseparable concept in EMC design. No design will be acceptable without it being properly implemented.

4. Dealing with EMI in Cables

William Kimmel, Kimmel-Gerke Associates, St. Paul, Minnesota, US

The majority of EMI problems that are found during testing are ultimately traced to a problem with cabling: more specifically, with the cable terminations. Filters or cable shields are very often improperly terminated, perhaps by misapplication of the basics. Proper attention to the basics of cable terminations will eliminate most of these problems - these can be determined almost by inspection. This presentation discusses the problems, how to identify them and how to eliminate them.

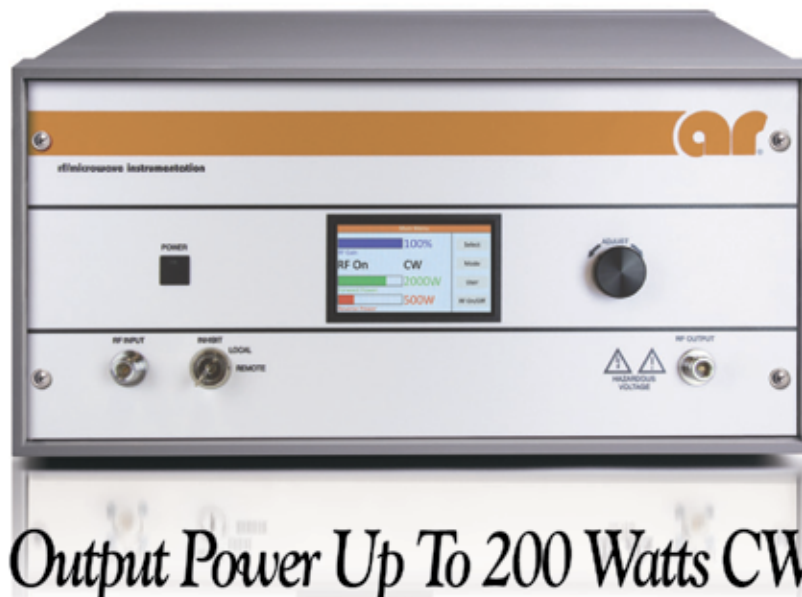
5. The Ten Best Ways to Maximize the Emission from Your Product

Henry W. Ott, Henry Ott Consultants, Livingston, New Jersey, US

This presentation discusses the ten best ways to maximize the emission from your product. My experience, as an EMC consultant, indicates that many product designers are already familiar with these techniques and practice them regularly. However for those of you new to the EMC business, this presentation should help you quickly become proficient in maximizing emissions, and put you on a par with your more experienced colleagues. Using the techniques described in this session, you should be able to increase the emissions from your product by 20 dB or more.

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6. Basic EMC Measurements

Andy Marvin, University of York, United Kingdom

This presentation describes the basic philosophy behind common EMC measurement techniques. Both conducted and radiated measurements are covered, however two types of measurements are considered in detail as examples. These are Radiated Emissions and Radiated Immunity. Taking the basic requirement for the protection of the intended victim system from interference, the presentation shows how the common EMC measurements emerge as engineering procedures. Numerical examples of power levels and field strengths in example systems are used to show how test levels are defined. Issues of repeatability and reproducibility in the measurements are discussed.

Measurement Uncertainty - Challenges and Solutions

Format: Full-day Tutorial – MO-AM-2 8:30AM-Noon Room 203

Co-chairs: Vince Rodriguez, ETS-Lindgren, Cedar Park, Texas, US; Ray Adams, The Boeing Company, El Segundo, California, US; Janet O'Neil, ETS-Lindgren, Cedar Park, Texas, US

ABSTRACT

In recent years, there has been an increasing need for accredited calibration test services in the commercial EMC area. This is likely to impact the military and aerospace test communities as well in the future. Part of the accreditation process based on ISO 17025 is the determination

of measurement uncertainty – a requirement that is often misunderstood or misinterpreted. This tutorial will provide an overview and discussion of measurement uncertainty to further the knowledge of this subject in the EMC testing community, both in the US and internationally. One of the goals of the tutorial is to address head on the fact that the majority of people new to measurement uncertainty are intimidated and overwhelmed. A common scenario is that these people receive a guide on measurement uncertainty and are told “now you are the company expert.” Tips and tools will be provided to make those associated with measurement uncertainty educated and comfortable moving forward in this area.

This tutorial brings together a number of different viewpoints on measurement uncertainty in order to provide a well rounded discussion of the topic. Speakers include an aerospace EMC systems engineer, a metrology laboratory engineer/manager, an antenna designer and manufacturer, the member of an IEC working group responsible for addressing measurement uncertainty, and a laboratory manager of an independent EMC test laboratory, who provides test results and the associated uncertainty data to a variety of third party clients.

PLANNED SPEAKERS AND TOPICS

- 1. Overview of EMC Measurement Uncertainty for the Novice and Veteran Engineer – Why These Measurements are Important, but Often Overlooked**
Ray Adams, The Boeing Company, El Segundo, California, US
- 2. Everyday, Practical Tools for Measurement Uncertainty Evaluation in a Lab Environment**
Dennis Lewis, The Boeing Company, Seattle, Washington, US



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Bill Gates

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3. On Whether Variation in the Uniform Field Area Should be Included in Calculation of Uncertainty for 61000-4-3

Carlo F. M. Carobbi, University of Florence, Italy Member of the Joint Task Force between IEC TC 77 and CISPR on Measurement Uncertainty

4. Simplifying the Complexity of Making a Good Measurement Uncertainty Calculation: A Review of Numerical Studies

Vince Rodriguez, ETS-Lindgren, Cedar Park, Texas, US

5. Calculating and use of Measurement Uncertainty from the Perspective of an Independent, Accredited EMC Lab

Per Thåstrup Jensen, Delta, Denmark Member, IEC SC77B/WG10

Introduction to EMI Modeling Techniques

Sponsored by TC9
Format: Half-day Tutorial – MO-AM-3 8:30AM-Noon Room 205

Chair: Giulio Antonini, Università degli Studi dell'Aquila, Italy

ABSTRACT

This tutorial will provide an introduction to all of the commonly used numerical EMC modeling techniques. It is intended to provide EMC engineers who are interested in learning the basics of these modeling techniques a fundamental understanding of all the different techniques, 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 along with their strengths and weaknesses, so engineers can decide which techniques are appropriate for their types of problems.

PLANNED SPEAKERS AND TOPICS

1. The Transmission Line Method

David Johns, CST of America, Boston, Massachusetts, US

2. Introduction to the Partial Element Equivalent Circuit Technique

Albert Ruehli, Missouri University of Science and Technology, Rolla, Missouri, US

3. Introduction to the Finite Difference Time-Domain (FDTD) Technique

Sam Connor, IBM, Raleigh, North Carolina, US

4. Introduction to the Finite Element Method

Chuck Bunting, Oklahoma State University, Stillwater, Oklahoma, US

5. Integral Equation Methods (MOM) in Numerical Modeling

Ji Chen, University of Houston, Houston, Texas, US

6. The Finite Integration Technique

Antonio Ciccomancini, CST of America, Boston, Massachusetts, US

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Benjamin Franklin

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Introduction to EM Information Leakage from Electronic Devices

Sponsored by TC5
Format: Half-day Tutorial – MO-AM-4 8:30AM-Noon Room 210

Chair: William A. Radasky, Metatech Corporation, Goleta, California
Co-chair: Yuichi Hayashi, Tohoku University, Sendai, Japan

ABSTRACT

This tutorial presents an overview of the research trends related to information leakage, which introduces different kinds of information leakage from electronic devices via electromagnetic fields. Measurement/analysis methods of EM radiation correlated to the significant information of the devices are also presented.

PLANNED SPEAKERS AND TOPICS

1. Introduction

Yuichi Hayashi, Tohoku University, Sendai, Japan

2. Overview of EM Information Leakage from Cryptographic Modules

Naofumi Homma, Tohoku University, Sendai, Japan

3. Evaluation of EM Information Leakage with Cartography/Transient IEMI Threats for Cryptographic Devices

Yuichi Hayashi, Tohoku University, Sendai, Japan

4. Power-Noise Measurements and Simulation Techniques for Side-Channel Analysis

Makoto Nagata, Kobe University, Kobe, Japan

5. A Method for Resistance Validation Against Side-Channel Analysis Attacks at Printed Circuit Board Level

Kengo Iokibe, Okayama University, Okayama, Japan

6. Standardization Works for EM Information Leakage

Tetsuya Tominaga, Nippon Telegraph and Telephone, Osaka, Japan

Low Frequency EMC within the Smart Grid Including Interference Between Equipment for Renewables and Smart Meters

Sponsored by TC7

Format: Half-day Tutorial – MO-AM-5 8:30AM-Noon Room 207

Chair: Magnus Olofsson, Elforsk, Stockholm, Sweden

ABSTRACT

Increasingly electronic equipment is being used in power systems connected together through electrical networks. Adjustable speed drives for wind power, photovoltaic solar power equipment, electronically operated luminaries, and smart metering are examples of development towards electronic systems. Standards are lacking in the region 2 kilohertz to 150 kilohertz and this gap is now of intensive interest in the standardization community. This tutorial aims at presenting examples from the field where interference has occurred. It also highlights mitigation and standardization matters.

PLANNED SPEAKERS AND TOPICS

1. What are the Experiences from the Field? Experiences from Field Measurements

Frank Leferink, University of Twente, Enschede, Netherlands

2. Interference Related to Electronic Equipment Including Smart Metering and LEDs

Math Bollen, Luleå University of Technology, Skellefteå, Sweden

3. Lower Frequency Phenomena in Smart Grids

Jaroslav Luszcz, University of Zielona Góra, Zielona Góra, Poland

4. Influence of Conducted EMI on Transmission Systems and Novel Filtration Methods for Power Electronics in Smart Grids

Robert Smolenski, University of Zielona Góra, Zielona Góra, Poland

5. Standardization Progress in the Range of 2 kilohertz to 150 kilohertz

Theo Laughner, Tennessee Valley Authority, Tennessee, US

Fundamentals of EMC

Format: Full-day Tutorial – MO-PM-1 1:30-5:30PM Room 201

Chair: Henry W. Ott, Henry Ott Consultants, Livingston, New Jersey, US

See MO-AM-1 for description

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Recent Developments in EMC for Emerging Wireless Technologies

Format: Half-day Tutorial – MO-PM-2 1:30-5:30PM Room 203

Co-chairs: Yihong Qi, DBJ Tech, Waterloo, Ontario, Canada Doug Kramer, ETS-Lindgren, Cedar Park, Texas, US Dan Hoolihan, Hoolihan EMC Consulting, Lindstrom, Minnesota, US

ABSTRACT

With the continuous development of wireless technologies and their tight integration with various electronic/computer/communication devices, EMC issues, at both the system and the intra-system levels, become increasingly important. This tutorial, sponsored by SC4 EMC for Emerging Wireless Technologies, will provide an overview of the issues and challenges, as well as the recent developments in modeling, measurements, test practices, and standards. Planned topics include interference from digital to wireless, noise mitigation (EMC design) through system planning, wireless performance testing methodologies, anechoic and reverberation chambers in wireless testing, and other topics.

PLANNED SPEAKERS AND TOPICS

- 1. Interference Issues Related to Personal Electronic Devices (PEDs)**
Harry Skinner, Intel, Hillsboro, Oregon, US
- 2. Estimating RF Interference Levels in Mixed Digital/RF Designs**
Jun Fan, Missouri University of Science and Technology, Rolla, Missouri, US
- 3. Radiated Two Stage Method for MIMO Throughput Test – An Ideal Way for Both Certification and R&D**
Yangguang Xu, Tri-L Solutions, Shenzhen, Guangdong, China
- 4. Wireless Testing Using a Reverberation Chamber**
Chris Holloway, National Institute of Standards and Technology, Boulder, Colorado, US
- 5. A Personal Test Environment for Every Wireless Engineer – An Innovative Multi-Purpose Compact Anechoic Chamber**
Kefeng Liu, Tri-L Solutions, Shenzhen, Guangdong, China
- 6. Real World Over-The-Air Performance Measurements of Wireless Devices**
Garth D'Abreu, ETS-Lindgren, Cedar Park, Texas, US

How to Break Complex Systems into Realistic, Solvable, Accurate Models

Format: Half-day Tutorial – MO-PM-3 1:30-5:30PM Room 205

Chair: David Johns, CST of America, Boston, Massachusetts, US

ABSTRACT

The focus of this tutorial will be on helping both the new and experienced users of software simulation tools understand the limitations of today's tools, and how to model real world complex systems by breaking the overall problem into smaller and solvable pieces. Complex systems cannot be modeled completely using today's tools, and if a user is not careful, they could break the overall problem into a smaller portion that does not correctly represent what they are trying to determine. In addition, it is important for users to understand the importance of validating the results from the simulations, and how to perform this validation, especially when measurements are not

always available or possible. The format will be a conference presentation style (lectures) followed by questions moderated by the chairman.

PLANNED SPEAKERS AND TOPICS

- 1. Modeling a Complex Cable System Subject to MIL-STD-461F CS114 1:30 PM – 2:10 PM**
John G. Kraemer, Rockwell Collins, Cedar Rapids IA, US
- 2. Comprehensive Vehicle System EMC/EMI Models with Realistic Structures and Cabling 2:10 PM – 3:00 PM**
Carl G. Baldwin, Lockheed Martin, Grand Prairie TX, US
- 3. Importance and Process of Validation for all Levels of Modeling Problems 3:30 PM – 4:10 PM**
Bruce Archambeault, IBM, Research Triangle Park NC, US
- 4. Simplifying Automotive EMC Simulations and Verifying Results with Measurements 4:10 PM – 4:50 PM**
Scott Piper, Gentex Corporation, Zeeland MI, US
- 5. Modeling Techniques for Reducing the Complexity of EMC simulations 4:50 PM – 5:30 PM**
David P. Johns, CST of America, Framingham MA, US

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EMC Consultant's Toolkit

Format: Half-day Tutorial – MO-PM-4 1:30-5:30PM Room 210

Chair: Jerry Meyerhoff, JDM Labs LLC, Illinois, US

ABSTRACT

As more engineering and design firms outsource and reduce staff, more qualified EMC engineers are finding themselves "homeless." As well, there are hundreds of companies that do not have the resources to hire a full-time EMC engineer. The purpose of this tutorial is to provide an introduction to the technical, business, and marketing skills to interested EMC engineers so that they can successfully locate, market and provide effective services to these companies at a fair profit and with job satisfaction.

Topics to be addressed include practical tools and skills in the following areas – Marketing and self-promotion, acquiring low-cost equipment, developing a troubleshooting kit using new and low-cost DIY tools and probes, how to use social media marketing such as LinkedIn, to bring in business, networking practices, advertising, setting up your office, pricing your services, tracking your time, best business practices, how to present yourself professionally, tax & legal obligations as well as contracts and non-disclosure agreements. Presenters' own experiences and case histories in business, along with a panel Q&A will insure covering the needs and concerns of the audience.

PLANNED SPEAKERS AND TOPICS

1. Marketing Yourself

Jerry Meyerhoff, JDM Labs LLC, Buffalo Grove, Illinois, US

2. Networking, Branding & Providing Customer Value

Kenneth Wyatt, Wyatt Technical Services LLC, Woodland Park, Colorado, US

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Christel Amburgey

Scientist, Electro Magnetic Applications
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- **Town you live in:** Denver
- **Years spent in the area:** Just over 5
- **Attraction you would recommend to a first time visitor:**
I have three - Hike to Buffalo Bills Grave, REI flagship store and Red Rocks
- **Favorite place to eat:**
Anywhere outdoor on Larimer Square under the lights
- **Must have souvenir:**
Colorado gold
- **Denver's best kept secret:**
It's really not that cold here!
- **Best view:**
From City Park west over downtown towards the mountains

3. Presenting Yourself Professionally

Patrick André, André Consulting Inc, Bothell, Washington, US

4. Acquiring Test Equipment & Developing a Low-Cost EMC Troubleshooting Kit

Patrick André, André Consulting Inc, Bothell, Washington
Kenneth Wyatt, Wyatt Technical Services LLC, Woodland Park, Colorado, US

5. How and Why I Developed My Part-Time EMC Consultancy

Thomas P. Van Doren, Van Doren Company, Missouri University of Science and Technology, Rolla, Missouri, US

6. Panel Discussion

Audience Q&A with all Presenters

EMC Leadership Training

Sponsored by TC1

Format: Full-day Tutorial – MO-PM-5 1:30-5:30PM Room 207

Chair: Kimball Williams, IEEE Southeast Michigan Section, Dearborn, Michigan

ABSTRACT

Sufficient training in the 'soft skills' is often lacking in the curricula of engineers. The industry approach of 'sink or swim' can be harsh. This session will provide opportunities to learn or brush up on critical communications and business skills necessary for career success as an engineer in today's market.

PLANNED SPEAKERS AND TOPICS

1. Managing for Success

Keynote Speaker, Sam Keene, Keene and Associates, Lyons, Colorado, US

2. Effective Presentations

Bruce Archambeault, IBM, Research Triangle Park, North Carolina, US

3. Manager's Role in EMI Control

Noel Sargent, NASA, Cleveland, Ohio, US

4. Effective Communication with the Bean-Counters who Manage us

Keith Armstrong, Cherry Clough Consultants Ltd, Brocton, Stafford, UK

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TUESDAY INCLUDES*

WORKSHOPS/TUTORIALS

- RF Interference and Wireless Measurement
- EM Modeling and Validation
- Statistical Analysis and Model Validation
- Transportation Systems
- Spectrum Analysis and Measurements in a Congested Electromagnetic Environment
- Technical Committee Poster Session
- Reverberation
- Low Frequency EMC
- Practical Applications of Numerical Modeling
- High Speed Signaling Design Optimization

EXPERIMENTS AND DEMONSTRATIONS

- Computer Modeling & Simulation Demonstrations
- Hardware Experiments & Demonstrations (Pages 57-59)

OTHER EVENTS

- Technical Committee Meetings
- Welcome Reception (Page 82)
- Global University (Page 62)
- GOLD EMC Ice Cream Social (Page 82)
- Historic Browns Tour (Page 80)

EXHIBIT HALL OPEN

*All events are subject to change. Check www.emc2013.org and the Registration Area daily for updates

RF Interference and Wireless Measurement

TU-AM-1 SC-4 8:30 AM - 10:00AM

Chairs: Hark Byeong Park, Samsung Electronics Company and Ji Chen, University of Houston

PLANNED SPEAKERS AND TOPICS

- 1. Influence of the Interaction between Antenna Currents and Return Currents on the Coupling between Digital Interfaces and On-Board Antennas 8:30 AM**
Davy Pissoot: KU Leuven, Ostend, Belgium
- 2. Investigating Intra-System Radio-Frequency Interference from High-Speed Traces to a GPS Patch Antenna 9:00 AM**
Satyajeet Shinde: Missouri University of Science and Technology, Rolla, MO, US;
Liang Li, Jun Fan: EMC Laboratory, Missouri University of Science and Technology, Rolla, MO, US; Koichi Ito, Noriyuki Mukai, Kenji Araki: Sony EMCS Corporation, Tokyo, Japan; Yoshihiro Kato: Sony Corporation, Tokyo, Japan
- 3. Study of Cross Polarization of Tapered Slot Antenna for EMC Measurements 9:30 AM**
Jun Fan: EMC Laboratory, Missouri University of Science and Technology, Rolla, MO, US; Fenghan Lin, Yongchang Jiao: Xidian University, Xi'an, China; Yihong Qi: DBJ Technologies, Zhuhai, China

EM Modeling and Validation

TU-AM-2 TC10 8:30 AM - 10:00AM

Chairs: Li Jun Jiang, The University of Hong Kong and Davy Pissoot, KU Leuven

PLANNED SPEAKERS AND TOPICS

- 1. Full-Wave Modeling of Inductive Coupling Links for Low-Power 3D System Integration 8:30 AM**
Giulio Antonini, Giovanni De Luca: Università degli Studi dell'Aquila, L'Aquila, Italy; Tommaso Vali, Giulio Marotta, Luca De Santis: Micron Semiconductor Italia S.r.l., Avezzano, Italy; Daniele Romano: Dipartimento di Ingegneria Industriale e dell'Informazione e di Economia, L'Aquila, Italy
- 2. The Frequency Band where the Solution to Maxwell's Equations Is Unknown - A Challenge Facing the Analysis of Multiscale Problems and Its Solution 9:00 AM**
Jianfang Zhu: Intel Corporation, Santa Clara, CA, US; Saad Omar, Dan Jiao: Purdue University, West Lafayette, IN, US
- 3. Experimental Validation of an 8 GHz Based Common Mode Filter and Impact of Manufacturing Uncertainties ** Nominated for Best Technical Paper Award 9:30 AM**
Antonio Orlandi, Francesco de Paulis, Hilmi Nisanci: University of L'Aquila, L'Aquila, Italy; Xiaoxiong Gu, Renato Rimolo-Donadio, Christian Baks, Young Kwark: IBM Research, Yorktown Heights, NY, US; Bruce Archambeault, Samuel Connor: IBM Corporation, RTP, NC, US

Statistical Analysis and Model Validation

TU-AM-3 TC-9 8:30 AM - 10:00AM

Chairs: Jianmin Zhang, Altera Corp., and Alistair Duffy, De Montfort University

PLANNED SPEAKERS AND TOPICS

- 1. Simulation of the Stochastic Electromagnetic Field Coupling to an Unshielded Twisted Pair of Wires 8:30 AM**
Mathias Magdowski, Ralf Vick: Otto-von-Guericke University, Magdeburg, Germany

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- DC link capacitors
- Audio film capacitors
- Custom power film capacitors

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2. Statistical Multipole Expansion and its Application to an Arbitrary Shielding Geometry with Small Variations 9:00 AM

Kai Krber, Ludger Klinkenbusch: Christian-Albrechts-University zu Kiel, Kiel, Germany

3. Feature Selective Normalized Mutual Information Index for the Validation of Computational Electromagnetics 9:30 AM

Marco Azpurua: Instituto de Ingeniería, Caracas, Venezuela;
Eduardo Paez: Instituto de Ingeniería, Caracas, Venezuela;
Ricardo Jauregui: Grup de Compatibilitat Electromagnética, Barcelona, Spain

Transportation Systems

TU-AM-4 SC-3 8:30 AM - 10:00AM

Chair: Mark Steffka, University of Detroit Mercy College of Engineering

PLANNED SPEAKERS AND TOPICS

1. Electromagnetic ambient inside an aircraft from transmitting antennas mounted on the outside compared to safety levels and radiated susceptibility test levels 8:30 AM

David Weston: EMC Consulting Inc, Merrickville, ON, Canada

2. Troubleshooting Automotive Radiated Emission Non-Compliance, a Practical Approach 9:00 AM

Cyrus Rostamzadeh: Bosch, Plymouth, MI, US;

Flavio Canavero: Politecnico di Torino, Torino, Italy;
Feraud Kashefi: University of Texas at Arlington, Arlington, TX, US

3. On the Nature of the Electromagnetic Field In the Immediate Vicinity of Inductive Power Transfer System 9:30 AM

James McLean, Robert Sutton: TDK R&D Corp., Cedar Park, TX, US

Spectrum Analysis and Measurements in a Congested Electromagnetic Environment Special Session (TC6)

TU-AM-5 SC-3 8:30 AM - 12:00 PM

Chairs: Bob Johnk, Institute for Telecommunication Sciences (NTIA/ITS) and Sarah Seguin, University of Kansas

ABSTRACT

This special session will present methodologies and measurement techniques to better manage, control and quantify the use of spectrum. The session will consist of a short introduction followed by six talks covering various aspect of spectrum management. The objective is threefold. The first goal is to inform on measurement and regulatory compliance strategies and techniques that more accurately and effectively quantify spectrum occupancy by RF systems in a congested electromagnetic spectral environment. The novelty of this special session is that it offers potential solutions to a growing number of spectrum related problems faced by EMC

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engineers and technologists. The second goal is to showcase a variety of state-of-the-art measurement systems and techniques that are used to study and quantify spectrum issues. The third goal is to present some of the latest research into the design of components, such as power amplifiers, waveforms and filters that promote more optimum use and cohabitation of the electromagnetic spectrum by wireless and radar systems.

PLANNED SPEAKERS AND TOPICS

1. Spectrum Analysis and Measurement in a Congested Electromagnetic Environment 8:30 AM

Larry Cohen: Naval Research Laboratory, Washington, DC, US;
Randy Jost: Ball Aerospace, Westminister, CO, US

2. Electromagnetic Interference to Radar Receivers due to In-Band OFDM Communications Systems 9:00 AM

Brian Cordill: The University of Kansas, Lawrence, KS, US;
Sarah Seguin: University of Kansas, Lawrence, KS, US;
Larry Cohen: Naval Research Laboratory, Washington, DC, US

3. Spectrum Occupancy Results from Several Surveys 9:30 AM

Chriss Hammerschmidt, Heather Ottke: NTIA/ITS, Boulder, CO, US

4. Break 10:00 AM

5. Hardware-in-the-Loop Radar Waveform Optimization using Radiated Emissions 10:30 AM

Sarah Seguin, John Jakabosky, Shannon Blunt:
University of Kansas, Lawrence, KS, US

6. Radiated Measurements of an Ultrawideband Surveillance Radar 11:00 AM

Bob Johnk, Frank Sanders, Kristen Davis, Geoffery Sanders,
John Ewan, Ronald Carey: Institute for Telecommunication
Sciences (NTIA/ITS), Boulder, CO, US; Steven Gunderson: Naval
Facilities Engineering Command, Port Hueneme, CA, US

Technical Committee Poster Session

TU-AM-6 10:00 AM - 12:00 PM

Chair: Perry Wilson, NIST

PLANNED SPEAKERS AND TOPICS

1. A High-Voltage Driving 60 GHz Power Amplifier with Psat of 13 dBm and PAE of 9.1% in 90 nm CMOS for IEEE 802.11ad Communication Systems

Chien-Chin Wang, Jin-Fa Chang, Yo-Sheng Lin:
National Chi Nan University, Puli, Taiwan

2. A Low Power and High Conversion Gain 60-GHz CMOS Up-Conversion Mixer Using Current Injection and Dual Negative Resistance Compensation Techniques

Chien-Chin Wang, Yo-Sheng Lin, Tzung-Min Tsai, Wei-Chen
Wen: National Chi Nan University, Puli, Taiwan

3. Electromagnetic Compatibility (EMC) Analysis Approach for Band Migration to Provide Spectrum for the President's Spectrum Initiative

Nicholas DeMinco: Institute for Telecommunication Sciences,
Boulder, CO, US; Timothy Riley: U.S. Department of Commerce,
Boulder, CO, US; Christopher Behm: U.S. Department of
Commerce, NTIA/ITS.E, Boulder, CO, US

4. Termination Effects on Attenuation Properties of Ferrites Installed Around Cable Conductors

Dheena Moongilan: Alcatel-Lucent, Murray Hill, NJ, US

5. Toward a Definition of the Shielding Effectiveness in the Time - Domain

Salvatore Celozzi, Rodolfo Araneo: Sapienza University of Rome,
Roma, Italy

6. Using Unconventional Materials for Electromagnetic Shielding

Lothar O. Hoeft: Consultant Emeritus, Electromagnetic Effects,
Albuquerque, NM, US

7. New Controllable Noise Suppression Methods for Near-Magnetic Field Radiations on PCB Using Small Active Component Circuits

Kimitoshi Murano, Youji Kotsuka: Tokai University,
Hiratsuka-shi, Japan

8. Assessing Linearity of Injection Probes Used in BCI Test Setups for Automotive Applications

Flavia Grassi, Giordano Spadacini, Sergio A. Pignari:
Politecnico di Milano, Milan, Italy; Cyrus Rostamzadeh, Paul
Kolbe: Bosch, Plymouth, MI, US

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9. Effect of Cooling on the Probe System Sensitivity for Low Signal Strength RFI Problems

Guanghua Li: Missouri University of Science and Technology, Rolla, MO, US; David Pommerenke: EMC Laboratory, Missouri University of Science and Technology, Rolla, MO, US; Wei Huang: ESDEMC Technology LLC, Rolla, MO, US

10. Proposal for Evaluation Method of Proficiency Test Results on EMI Measurement

Kunihiro Osabe, Tetsuo Kato: VLAC, Tokyo, Japan

11. Radio Approval in China

Grace Lin: Crestron Electronics, Inc., Rockleigh, NJ, US

12. Noise reduction of bended differential transmission lines using compensation capacitance

Mohammad Ali Khorrami: University of Arkansas, Fayetteville, AR, US

13. Analysis of Single-Ended and Differential Striplines Crossing Split Reference Planes in PCBs

Dror Haviv: RAFAEL- Advanced Defense Systems LTD, Haifa, Israel

14. Effect of Head Heterogeneity on a Cellular Phone Field

Motti Haridim: Holon Institute of Technology, Holon, Israel; Boris Levin: Holon Institute of Technology, Lod (Ganay Aviv), Israel; Stav Revich: Holon Institute Technology, Azor, Israel; Stefan Chulski: Holon Technology Institute, Holon, Israel;

Ronan Sauleau: Institute d'Electronique et de Telecommunications de Rennes, Rennes, France

15. Shielding Effectiveness Evaluation of a Loaded Perforated Enclosure by Hybrid FDFD-MoM

Parisa Dehkhoda: Amirkabir university of Technology, Tehran, Iran; Mohammad Azadifar, Seyed Hossein Hesameddin Sadeghi, Rouzbeh Moini: Amirkabir uni of Technology, Tehran, Iran

16. Hardening Lightning Protection for Avionics on Composite Aircraft

Clay McCreary, Brian Lail: Florida Institute of Technology, Melbourne, FL, US

17. Design of Multiple Stage Avionics Lightning Protection for DC Power Input Lines Using a Graphical User Interface (GUI)

Clay McCreary, Brian Lail: Florida Institute of Technology, Melbourne, FL, US

18. A Differential Evolution Based Equivalent Source Approach for Predicting Electromagnetic Emissions Using Near-Field Scanning

Er-Ping Li, Wei-Jiang Zhao, Binfang Wang, En-Xiao Liu: Institute of High Performance Computing, Singapore, Singapore; Hark Byeong Park, Eakhwan Song: Samsung Electronics Company, Suwon, South Korea; Hyun Ho Park: University of Suwon, Suwon, South Korea

19. Effect of Skew and Rise time-Fall time Asymmetry on PCB Emissions

Venkatesh Seetharam: Avago Technologies, San Jose, CA, US; Michael Brosnan: AVAGO Technologies Fiber Optics Product Division, San Jose, CA, US

20. Optimization of the Transition from Connector to PCB Board

Shuai Jin, Jun Fan: EMC Laboratory, Missouri University of Science and Technology, Rolla, MO, US; Ji Zhang: EMC Laboratory, Missouri S&T, Rolla, MO, US

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Reverberation

TU-PM-1 TC2 1:30 PM - 5:30 PM

Chairs: Galen Koepke, NIST and William Radasky, Metatech Corporation

PLANNED SPEAKERS AND TOPICS

1. On the Effects of Chamber Loss on the Lower Bound of Efficiency 1:30 PM

Levon Barsikyan: University of Colorado Denver, Denver, CO, US

2. Pulsed Signals in Reverberation Chambers: Modulating the Input Signal to Reduce the Rise-Time 2:00 PM

Tim Artz, Holger Hirsch: University Duisburg-Essen, Duisburg, Germany

3. Stirrer Performance of Reverberation Chambers Evaluated by Time Domain Fidelity 2:30 PM

Franco Moglie, Giuseppe Esposito, Valter Mariani Primiani: Universit  Politecnica delle Marche, Ancona, Italy; Gabriele Gradoni: University of Maryland, College Park, MD, US

4. Break 3:00 PM

5. Determination of the "Quasi-ideal Reverberation Chamber Frequency - According to Loading 3:30 PM

Guillaume Andrieu, Aziz Adardour, Alain Reineix: XLIM Laboratory, Limoges, France

6. Effects of Loading on Independent Samples and Uniformity of a Reverberation Chamber 4:00 PM

Vignesh Rajamani, James West, Chuck Bunting: Oklahoma State University, Stillwater, OK, US

7. A Wide-band Hybrid Antenna for Use in Reverberation Chambers ** Nominated for Best Technical Paper Award 4:30 PM

Andrew Marvin: York EMC Services, York, United Kingdom; John Dawson, Ian Flintoft, Linda Dawson, Jeremy Everard, Gregory Melia: University of York, York, United Kingdom; Giuseppe Esposito: Università Politecnica delle Marche, Ancona, Italy

8. The Use of Wave Diffusers to Reduce the Contribution of Specular Wall Reflections to the Unstirred Energy in a Reverberation Chamber 5:00 PM

Andrew Marvin: York EMC Services, York, United Kingdom; Eva Karadimou: York EMC Services Ltd, York, United Kingdom

Low Frequency EMC

TU-PM-2 TC-7 1:30 PM - 5:30 PM

Chairs: Magnus Olofsson, Elforsk - Swedish Electrical Utilities' R & D Company and Dave Thomas, University of Nottingham

Petre-Marian Nicolae, Ileana-Diana Nicolae: University of Craiova, Craiova / Dolj County, Romania

7. Assessment of Magnetic Field Levels Generated by a Wireless Power Transfer (WPT) System at 20 kHz 4:30 PM

Francesca Maradei: Sapienza University, ROME, Italy; Silvano Cruciani: University of L'Aquila, L'Aquila, Italy; Mauro Feliziani: University of L'Aquila, L'Aquila, Italy

8. Magnetic Testing and Modeling, Simulation and Analysis for Space Applications 5:00 PM

Mary Boghosian: The Aerospace Corporation, Pasadena, CA, US; Pablo Narvaez: Jet Propulsion Laboratory, Pasadena, CA, US; Ray Herman: N/A, El Segundo, CA, US

Practical Applications of Numerical Modeling

TU-PM-3 TC-9 1:30 PM - 5:30 PM

Chairs: Samuel Connor, IBM Corporation and Siming Pan, Cisco Systems, Inc.

PLANNED SPEAKERS AND TOPICS

1. Shield Transfer Impedance Model of a Multi-Branched Braid Shielded Cable Harness 1:30 PM

John Rohrbaugh: Northrop Grumman Technical Services, Hill AFB, UT, US

PLANNED SPEAKERS AND TOPICS

1. Experimental Characterization of CFL Bulbs for Power Quality Assessment 1:30 PM

Frank Leferink: Thales Nederland B.V., Hengelo, Netherlands; University of Twente, Enschede, Netherlands; Pieter van Vugt, Roelof Bernardus Timens: University of Twente, Enschede, Netherlands; Igor Stievano, Flavio Canavero: Politecnico di Torino, Torino, Italy

2. Emulation of Conducted Emissions of an Automotive Inverter for Filter Development in HV Networks 2:00 PM

Martin Reuter, Tobias Friedl, Stefan Tenbohlen, Wolfgang Kähler: University of Stuttgart, Stuttgart, Germany

3. Electromagnetic Compatibility and Power Quality Problems at Low Frequency for Loads from an Urban Transportation System and in a Power Substation 2:30 PM

Petre-Marian Nicolae, Ileana-Diana Nicolae, Marian-Stefan Nicolae: University of Craiova, Craiova / Dolj County, Romania

4. Break 3:00 PM

5. AC Motor Feeding Cable Consequences on EMC performance of ASD 3:30 PM

Jaroslav Luszcz: Gdansk University of Technology, Gdansk, Poland

6. Fast Interharmonics and Harmonics Identification Using Hybrid Wavelet Algorithms 4:00 PM



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2. A Hybrid Method Combining Static and Full Wave Techniques to Solve Conducted Emissions Problems

**** Nominated for Best Technical Paper Award 2:00 PM**

Markus Kopp: ANSYS, Pittsburgh, PA, US; Juliano Mologni, Cesareo de La Rosa Siqueira: ESSS - Engineering Simulation & Scientific Software, Sao Paulo, Brazil; Gerson Eguni: Whirlpool, Rio Claro, Brazil; Marco Antonio Robert Alves: UNICAMP, Campinas, Brazil

3. Model of Human Body for Electrostatic Discharge Analysis Based on Method of Moments and Frequency-Dependent Surface Resistance 2:30 PM

Dragan Olcan, Antonije Djordjevic: University of Belgrade, Belgrade, Serbia

4. Break 3:00 PM

5. Eigenmodes of Electrical Components and their Relation to Electrical Circuits

**** Nominated for Best Technical Paper Award 3:30 PM**

Felix Traub: Robert Bosch GmbH, Gerlingen-Schillerhoehe, Germany; TU Darmstadt, Institut Theorie elektromagnetischer Felder, Darmstadt, Germany; Jan Hansen: Robert Bosch GmbH, Gerlingen-Schillerhoehe, Germany; Wolfgang Ackermann, Thomas Weiland: TU Darmstadt, Institut Theorie elektromagnetischer Felder, Darmstadt, Germany

6. Modeling of Electromagnetic Emissions from a Multilayer PCB 4:00 PM

Chijioke Obiekezie, Dave Thomas, Angela Nothofer, Steve Greedy, Luk Arnaut, Phil Sewell: University of Nottingham, Nottingham, United Kingdom

7. High-Frequency EMC Design Verification through Full-Wave Simulations and Measurements in Reverberation Chamber 4:30 PM

Alpesh Bhobe, Philippe Sochoux: Cisco Systems, Inc., San Jose, CA, US; Xiaoxia Zhou: Cisco Systems, Inc., San Jose, CA, US; Jing Li: EMC Laboratory Missouri University of Science and Technology, Rolla, MO, US; Hongmei Fan, Jinghan Yu: Cisco Systems, Inc., Shanghai, China

High Speed Signaling Design Optimization Special Session (TC10-CPMT/TC12)

TU-PM-4 1:30 PM - 5:30 PM

Chairs: Xiaoning Ye, and Dale Becker, IBM

PLANNED SPEAKERS AND TOPICS

1. Performance Comparison of Different Encoding Schemes in Backplane Channel at 25Gbps+ 1:30 PM

Davi Correia: Molex Inc, Eindhoven, Netherlands; Vivek Shah, Peerouz Amleshi: Molex Inc, Lisle, IL, US; CheeParng Chua: Molex Inc, Singapore, Singapore

2. Comparative Study of Transmission Lines Design for 2.5D Silicon Interposer 2:00 PM

Brice Achkir, Siming Pan: Cisco Systems, Inc., San Jose, CA, US

3. Improve Signal Integrity Performance By Using Hybrid PCB Stackup 2:30 PM

Cesar Mendez Ruiz, Enrique Lopez-Miralrio: Intel Corporation, Tlaquepaque, Mexico; Chunfei Ye: Intel Co., DuPont, WA, US; Xiaoning Ye: Intel Corporation, Hillsboro, OR, US; Maoxin Yin: Intel Corporation, Shanghai, China; Jimmy Hsu, Thomas Su: Intel Corp, Taipei, Taiwan

4. Break 3:00 PM

5. Implementation of Power Transmission Lines to Field Programmable Gate Array ICs for Managing Signal and Power Integrity 3:30 PM

Sang Kyu Kim, Satyanarayana Telikepalli, Sung Joo Park, Madhavan Swaminathan, David Keezer: Georgia Tech, Atlanta, GA, US; Youkeun Han: DRAM technology, Memory Division Samsung Electronics Co. Ltd., Seoul, South Korea

6. The Effect of Various Skew Compensation Strategies on Mode Conversion and Radiation from High-Speed Connectors 4:00 PM

Bruce Archambeault, Samuel Connor: IBM Corporation, RTP, NC, US; Hung-Chuan Chen: Student, Taipei, Taiwan; TzongLin Wu: Professor & Director, Taipei, Taiwan

7. Optimization of Power Delivery Network Design for Multiple Supply Voltages 4:30 PM

Siming Pan, Brice Achkir: Cisco Systems, Inc., San Jose, CA, US

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WEDNESDAY
INCLUDES*

WORKSHOPS/TUTORIALS

- Measurements - General
- Radiation and Susceptibility
- Nanotechnology and Advanced Materials
- Managing Risk in EMC Compliance
- New Developments in Intentional Electromagnetic (IEMI)
- Antennas
- Shielding, Transmission lines and Grounding
- Time Domain Methods
- System Level SI/PI Analysis for High Speed Design

EXPERIMENTS AND
DEMONSTRATIONS

- Computer Modeling & Simulation Demonstrations
- Hardware Experiments & Demonstrations (Pages 57-59)

OTHER EVENTS

- Technical Committee Meetings
- Gala event (Page 82)
- Global University (Page 62)
- Denver Mountain Parks and Coors Brewery Tour (Page 80)

EXHIBIT HALL OPEN

*All events are subject to change. Check www.emc2013.org and the Registration Area daily for updates

Measurements - General

WED-AM-1 TC-2 8:30 AM - 10:00AM

Chairs: Tom Fagan, Raytheon and Clifford Hauser, Raytheon

PLANNED SPEAKERS AND TOPICS

1. Three Dimensional Polarization Controllable Electromagnetic Cell 8:30 AM

Lijun Jiang: University of Hong Kong, Hong Kong, Hong Kong; B. Zhu: Nanjing University, China, Nanjing, China; W Chew: University of Illinois, Urbana-Champaign, Chicago, IL, US

2. Investigation of the ESD induced Clock Disturbances in Portable Electronic Products**** Nominated for Best Technical Paper Award 9:00 AM**

Viswa Pilla, Pratik Maheshwari, Tianqi Li, David Pommerenke: EMC Laboratory, Missouri University of Science and Technology, Rolla, MO, US; Kenji Araki, Hideki Shumiya, Junji Maeshima: Sony EMCS Corporation, Tokyo, Japan; Takashi Yamada: Sony Corporation, Tokyo, Japan

3. EM Radiation Estimation Using an Automatic Probe Position Recording System Coupled to Hand Scanning 9:30 AM

Hui He, Pratik Maheshwari, Andriy Radchenko, David Pommerenke: EMC Laboratory, Missouri University of Science and Technology, Rolla, MO, US

Radiation and Susceptibility

WED-AM-2 TC-4 8:30 AM - 10:00AM

Chairs: Phil Berger, and John Kraemer, Rockwell Collins

PLANNED SPEAKERS AND TOPICS

1. Controlling Common Mode Noise Radiation Through Differential Signaling IO Buffer Optimization 8:30 AM

BoonPing Koh: Intel Technology Sdn. Bhd., Penang, Malaysia; Chung-Hao (Joseph) Chen: Intel Corporations, Hillsboro, OR, US

2. Imbalance Component and EM Radiation from Differential-Paired Lines with Serpentine Equi-Distance Routing 8:50 AM

Yoshiki Kayano, Hiroshi Inoue: Akita University, Akita, Japan

3. NASA Standard Initiator Susceptibility to UHF and S-Band Radio Frequency Power and Lightning Strikes 9:10 AM

Karen Burnham, John Norgard: NASA Johnson Space Center, Houston, TX, US; Bob Scully: NASA, Houston, TX, US

Nanotechnology and Advanced Materials

WED-AM-3 TC-11 8:30 AM - 10:00AM

Chairs: Marina Koledintseva, Missouri University of Science & Technology and Maria Sabrina Sarto, Sapienza University of Rome

PLANNED SPEAKERS AND TOPICS

1. Using Long Fiber Nickel Coated Carbon Fiber (LFNCCF) to Produce Light Weight EMI Shielding Plastic Composites ** Nominated for Best Technical Paper Award 8:30 AM

Ned Bryant: RTP Company, Winona, MN, US

2. Improved FDTD Method for Studying on Graphene Frequency Selective Surface (GFSS) Characteristics for Nanoelectromagnetics Applications 9:00 AM

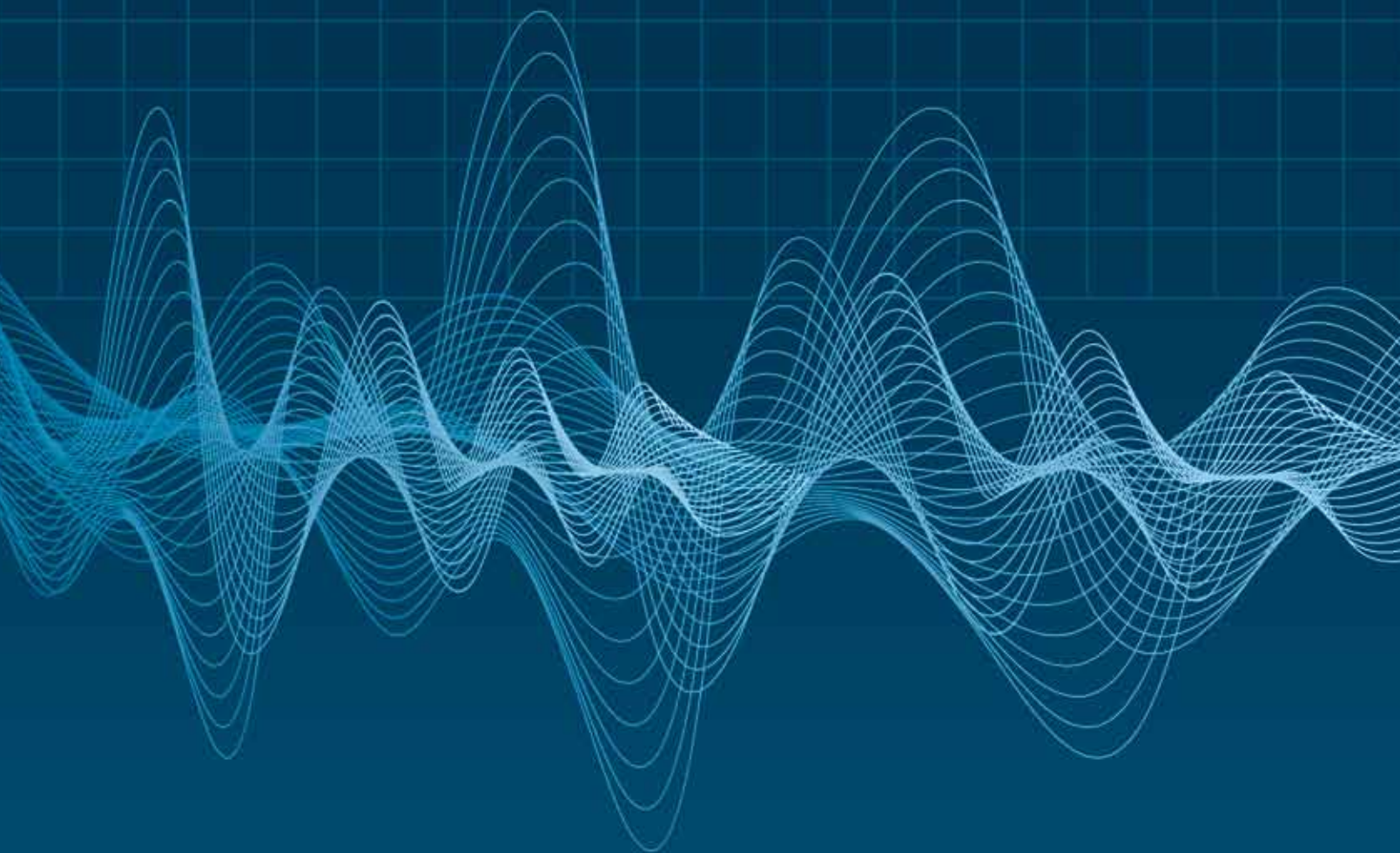
Wen-Yan Yin: Shanghai Jiao Tong University, Shanghai, China; Zhejiang University,

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Hangzhou, China; Tian Zhang, Xiang-Hua Wang, Yang Guo, Jun Hu: Zhejiang University, Hangzhou, China

3. Towards Electromagnetic Metamaterial: Negative Permeability Spectra of YIG Composite Materials 9:30 AM

Takanori Tsutaoka, Hideaki Kinoshita: Hiroshima University, Higashi-Hiroshima, Japan; Teruhiro Kasagi: Tokuyama College of Technology, Shunan, Japan; Shinichiro Yamamoto, Kenichi Hatakeyama: University of Hyogo, Himeji, Japan

Managing Risk in EMC Compliance

WED-AM-4 TC-1 8:30 AM - 10:00AM

Chair: Doug Kramer, ETS-Lindgren

PLANNED SPEAKERS AND TOPICS

1. Cost-effective Risk Management of EMC without special design expertise or testing 8:30 AM

Keith Armstrong: Cherry Clough Consultants Ltd, Stafford, United Kingdom

2. Part 1: Dealing with Complexities of Worldwide Regulatory Compliance; Beginning with EMC 9:00 AM

Dave Staggs: IEEE Sr. Member, Hunt, TX, US

New Developments in Intentional Electromagnetic (IEMI)

Special Session (TC5)

WED-AM-5 8:30 AM - 12:00 PM

Chairs: William Radasky, Metatech Corporation and Frank Sabath, Bundeswehr Research Institute for Protective Technologies and NBC Protection

PLANNED SPEAKERS AND TOPICS

1. A Survey of Narrowband IEMI Global Threats 8:30 AM

Sarita Prasad, Edl Schamiloglu: University of New Mexico, Albuquerque, NM, US

2. Concept of Stochastic Modeling for High-Power Electromagnetics (HPEM) Risk Analysis at System Level 9:00 AM

Frank Sabath: Bundeswehr Research Institute for Protective Technologies and NBC Protection, Munster, Germany; Heyno Garbe: Institute of Electrical Engineering and Measurement Technology, Leibniz University Hannover, Hannover, Germany

3. IEMI Evaluation of Network Protectors 9:30 AM

Edward Savage, Bill Radasky: Metatech Corporation, Goleta, CA, US

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4. Break 10:00 AM**5. HPEM Protection of Commercial Facilities 10:30 AM**

Bill Radasky: Metatech Corporation, Goleta, CA, US

6. Critical Equipment Input Impedance Measurement for IEMI Calculations 11:00 AM

Nicolas Mora, Maria Jesus Salvatierra: EMC Lab, Swiss Federal Institute of Technology (EPFL), LaUSnne, Switzerland;
Carlos Romero, Farhad Rachidi: Swiss Federal Institute of Technology (EPFL), LaUSnne, Switzerland; Marcos Rubinstein: University of Applied Sciences of Western Switzerland, Yverdon, Switzerland

7. Design of a Switched Oscillator for IEMI Susceptibility Testing

**** Nominated for Best Technical Paper Award 11:30 AM**

Felix Vega: EMC Lab- Swiss Federal Institute of Technology EPFL, LaUSnne, Switzerland; National University of Colombia, Bogota, Colombia; Nicolas Mora: EMC Lab, Swiss Federal Institute of Technology (EPFL), LaUSnne, Switzerland; Farhad Rachidi: Swiss Federal Institute of Technology (EPFL), LaUSnne, Switzerland; Nestor Peña: Los Andes University, Bogota, Colombia; Francisco Roman: National University of Colombia, Bogota, Colombia

Antennas

WED-PM-1 TC-2 1:30 PM - 5:30PM

Chair: Zhong Chen, ETS-Lindgren

PLANNED SPEAKERS AND TOPICS**1. New Computation Method of Electric Field Strength in Close Vicinity of Half-Wavelength Dipole Antennas 1:30 PM**

Masaru Nakayama: Tokyo Denki University, Tokyo, Japan

2. Electromagnetic Modeling and Measurements of the 104cm Rod and Biconical Antenna for Radiated Emissions Testing Below 30MHz 2:00 PM

Harry Gaul: General Dynamics C4 Systems, Scottsdale, AZ, US

3. Shortened Dipole Antenna Factors by the Reference Antenna Method at a Finite Separation 2:30 PM

Takehiro Morioka: National Institute of Advanced Industrial Science and Technology, Tsukuba, Japan; Masaki Yamanaka: Panasonic, Osaka, Japan; Kazuhiro Hirasawa: University of Tsukuba, Tsukuba, Japan

4. Break 3:00 PM**5. Design of Electromagnetic Field Immunity Test System applying with 128-element Array Antenna 3:30 PM**

Takeshi Uchida: Mitsubishi Electric Corporation, Kamakura, Kanagawa, Japan

6. Measurement Model Based Uncertainty Evaluations for Calibrations of Dipole-like Antennas

**** Nominated for Best Technical Paper Award 4:00 PM**

Zhong Chen: ETS-Lindgren, Cedar Park, TX, US

Shielding, Transmission lines and Grounding

WED-PM-2 TC-4 1:30 PM - 5:30PM

Chairs: Ross Carlton, and Phil Berger,

PLANNED SPEAKERS AND TOPICS**1. Low-Frequency Intertwined Spiral-Aperture Absorbers for Shielded Enclosures 1:30 PM**

Salvatore Celozzi, Rodolfo Araneo, Giampiero Lovat: Sapienza University of Rome, Roma, Italy

2. SE Measurements with a TEM Cell to Study Gasket Reliability 2:00 PM

Parisa Faraji, Douglas McBain: Laird Technologies, Cleveland, OH, US; James Drewniak, Victor Khilkevich: Missouri University of Science and Technology, Rolla, MO, US; David Pommerenke: EMC Laboratory, Missouri University of Science and Technology, Rolla, MO, US

3. Flexible PCB Grounding Connections for Hybrid Systems 2:30 PM

Michael Cracraft: IBM Corporation, Poughkeepsie, NY, US; Samuel Connor, Bruce Archambeault: IBM Corporation, RTP, NC, US

4. Break 3:00 PM**5. The Gigahertz Two-Band Common-Mode Filter for 10-Gbit/s Differential Signal Lines 3:30 PM**

Miroslav Pajovic, John Savic, Xiaoxia Zhou: Cisco Systems, Inc., CA, San Jose, CA, US; Alpesh Bhobe: Cisco Systems, Inc., San Jose, CA, US

6. Modeling the Performance Of Ferrite Based Common-Mode Filters: An Educational Approach Using SPICE And Mathcad 4:00 PM

Andrew Norte: Ricoh and ITT Technical Institute, Westminster, CO, US

7. Modeling Timing Variations in Digital Logic Circuits Due to Electrical Fast Transients 4:30 PM

Xu Gao, Chunchun Sui, Daryl Beetner, David Pommerenke: EMC Laboratory, Missouri University of Science and Technology, Rolla, MO, US; Sameer Hemmady, Joey Rivera: TechFlow Scientific-A Division of TechFlow Inc., Albuquerque, NM, US; Susumu Yakura: Air Force Research Laboratory, Kirtland, NM, US; Julio Villafuerte: Defense Threat Reduction Agency (DTRA/NTES), Fort Belvoir, VA, US

8. On the Combined Effect of Random Nonuniformity and Deformation of Twisting on the Radiated Immunity of Twisted-Wire Pairs 5:00 PM

Giordano Spadacini, Flavia Grassi, Sergio A. Pignari: Politecnico di Milano, Milan, Italy

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Time Domain Methods

WED-PM-3 TC-9 1:30 PM - 5:30 PM

*Chairs: Alan Roden, and Wen-Yan Yin, Shanghai Jiao Tong University***PLANNED SPEAKERS AND TOPICS****1. Co-simulation of Distributive and Lumped Systems Using the Discontinuous Galerkin Finite Element Time Domain Method 1:30 PM***Lijun Jiang: University of Hong Kong, Hong Kong, Hong Kong;
Ping Li: Dept. of EEE, the University of Hong Kong, Hong Kong, Hong Kong***2. Parallel FDTD Electromagnetic Effects Simulation using On-Demand Cloud HPC Resources 2:00 PM***Timothy McDonald, Robert Fisher, Gregory Rigden, Rodney Perala: Electro Magnetic Applications, Inc., Lakewood, CO, US***3. Wire Harness Model Complexity Evaluation in a HIRF Environment 2:30 PM***Jennifer Kitaygorsky: EMA, Lakewood, CO, US***4. Break 3:00 PM****5. Enhanced Conformal FDTD Method for Predicting Transient Responses of Arbitrary PEC Wedges Illuminated by an Electromagnetic Pulse 3:30 PM***Wen-Yan Yin: Shanghai Jiao Tong University, Shanghai, China; Xiang Yuan, Xiang-Hua Wang, Jing Jin, Jun Hu: Zhejiang University, Hangzhou, China***6. Numerical Dispersion Optimized Leapfrog ADI-FDTD Method and Its Application for Capturing Surface Current Distributions of Complex Objects Illuminated by an Electromagnetic Pulse (EMP) 4:00 PM***Yang Guo, Jing Jin: Zhejiang University, Hangzhou, China; Xiang-Hua Wang: Tianjin university of Technology and Education, Tianjin, China; Zhejiang University, Hangzhou, China; Wen-Yan Yin: Shanghai Jiao Tong University, Shanghai, China; Zhejiang University, Hangzhou, China***7. Modeling of Wireless Electromagnetic Environment Effects in Multi-Interconnected Metallic Cabins Using the Leapfrog ADI-FDTD Method 4:30 PM***Wen-Yan Yin: Shanghai Jiao Tong University, Shanghai, China; Zhejiang University, Hangzhou, China; Meng-Lin Zhai: Shanghai Jiao Tong University, Shanghai, China; Zhizhang (David) Chen: Dalhousie University, Halifax, NS, Canada***8. Novel Parallel Meshing Technique Adopted for Parallel FDTD Simulation Using Function Language for Solving Electrically Large and Complex EMC Problems 5:00 PM***Yang Guo, Xiang-Hua Wang, Jing Jin: Zhejiang University,***EMC TESTING
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Nanotechnology in EMC

Special Session (TC-11)

WED-PM-4 1:30 PM - 5:30PM

Chairs: Marina Koledintseva, Missouri University of Science & Technology; Alessio Tamburrano, Sapienza University of Rome and Maria Sabrina Sarto, Sapienza University of Rome

ABSTRACT

Nanotechnology is the understanding and controlling of matter at an atomic and a molecular scale. It involves the development of new materials or devices with unusual physical, chemical and biological properties. As a consequence, nanotechnology has profound implications for all branches of engineering and science and will permeate industrial products in the years to come.

Nanotechnology has already found its way into many 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. The contributions in this special session deal with the afore- mentioned EMC issues related to nanotechnology. The papers are focused on modelling, simulation and experimental characterization of nanomaterials and nanodevices for EMC applications.

PLANNED SPEAKERS AND TOPICS

1. Review of Multi-Layer Graphene Nanoribbons for on-chip Interconnect Applications 1:30 PM

Vachan Kumar, Azad Naeemi: Georgia Institute of Technology, Atlanta, GA, US; Shaloo Rakheja: Massachusetts Institute of Technology, Cambridge, MA, US

2. Energy Band Gap Study of Semiconducting Single Walled Carbon Nanotube Bundle 2:00 PM

Asmaa Elkadi, Samir M. El-Ghazaly: University of Arkansas, Fayetteville, AR, US; Emmanuel Decrossas: California Institute of Technology, Pasadena, CA, US

3. High Frequency Performance Limits of Nanointerconnects Based on CVD-Grown Graphene Films Transferred on SiO₂-Substrate 2:30 PM

Alessio Tamburrano, Alessandro Giuseppe D'Aloia, Giovanni De Bellis, Marcello D'Amore, Maria Sabrina Sarto: Sapienza University of Rome, Rome, Italy; Nicola Lisi, Theodoros Dikonimos, Rossella Giorgi: ENEA C.R. Casaccia, Rome, Italy

4. Break 3:00 PM

5. Analysis of the Permeability Spectra of Spinel Ferrite Composites Using Mixing Rules 3:30 PM

Takanori Tsutaoka: Hiroshima University, Higashi-Hiroshima, Japan; Teruhiro Kasagi: Tokuyama College of Technology, Shunan, Japan; Kenichi Hatakeyama: University of Hyogo, Himeji,

Japan; Marina Koledintseva: Missouri University of Science & Technology, Rolla, MO, US

6. Limitations on High-Frequency Permeability of Magnetic Materials 4:00 PM

Marina Koledintseva: Missouri University of Science & Technology, Rolla, MO, US; Konstantin Rozanov: ITAE RAS, Moscow, Russia

7. Reflection and Transmission of Laminated Structures Using Finite- and Infinite-Length Metal Wire Array 4:30 PM

Shinichiro Yamamoto, Kenichi Hatakeyama: University of Hyogo, Himeji, Japan; Takanori Tsutaoka: Hiroshima University, Higashi-Hiroshima, Japan

System Level SI/PI Analysis for High Speed Design

Special Session (TC9/TC10)

WED-PM-5 1:30 PM - 5:30PM

Chairs: Jianmin Zhang, Altera Corporation and Mauro Lai, Intel Corp.

PLANNED SPEAKERS AND TOPICS

1. Decompositional Electromagnetic Analysis of Digital Interconnects 1:30 PM

Yuriy Shlepnev: Simberian Inc., Las Vegas, NV, US

2. ASIC Package to Board BGA Discontinuity Characterization in >10Gbps SerDes Links 2:00 PM

Jane Lim: Cisco Systems, Inc, San Jose, CA, US; Ji Zhang: Cisco Systems, San Jose, CA, US

3. A New Design Flow to Evaluate High-speed SerDes Link Performance with Re-driver 2:30 PM

Chunfei Ye: Intel Co., DuPont, WA, US; Xiaoning Ye: Intel Corporation, Hillsboro, OR, US; Yinglei Ren: Intel Asia Pacific Research and Development Ltd, Shanghai, China; Kai Xiao: Intel Corp, DuPont, WA, US; Odilon Argueta: DCSG, Guadalajara, Mexico; Nick Peterson: DCSG, San Jose, CA, US

4. Break 3:00 PM

5. Optimizing Return Via Locations to Reduce Mode Conversion in Connector Pin Fields 3:30 PM

Michael Cracraft: IBM Corporation, Poughkeepsie, NY, US; Samuel Connor, Bruce Archambeault: IBM Corporation, RTP, NC, US

6. High Speed Single-Ended Bus: Full-Wave Modeling Methodology and Correlation 4:00 PM

Mauro Lai: Intel Corp., Dupont, WA, US; Darryl Kostka: CST of America, San Mateo, CA, US; Jonathan Casanova: Intel Corp, Hillsboro, OR, US; Madhumitha Seshadri: Intel Corp, DuPont, WA, US

7. System Level Simulation Solutions for High-Speed Channels - Package and PCB Interface 4:30 PM

Jianmin Zhang: Altera, San Jose, CA, US; Antonio Ciccocomancini Scogna, Tracey Vincent: CST of America, Framingham, MA, US; Hong Shi: Altera Corporation, San Jose, CA, US; Hui Liu: Altera Corp, San Jose, CA, US

8. Full Switching Voltage Regulator Modeling for High Performance Computing Platform Power Delivery 5:00 PM

Wei Xu, Jiangqi He, Dong Zhong: Intel Corporation, Chandler, AZ, US

THURSDAY
INCLUDES*

WORKSHOPS/TUTORIALS

- Measurements I & II
- Emissions, Filters and Enclosure Suppression Techniques
- Wireless EMC
- EMC in and on Transportation Structures
- Signal Integrity Enhancement and Crosstalk Management
- EMC for Emerging Wireless Technologies
- Reverberation Chambers and Rectangular Cavities
- High Power EM including Intentional EMI, ESD, and Lightning
- Signal Integrity and Power Integrity

EXPERIMENTS AND
DEMONSTRATIONS

- Computer Modeling & Simulation Demonstrations
- Hardware Experiments & Demonstrations (Pages 57-59)

OTHER EVENTS

- Technical Committee Meetings
- Global University (Page 62)
- Youth Technical Program
- Local Breweries Self-Guided Walking Tour (Page 83)

EXHIBIT HALL OPEN

*All events are subject to change. Check www.emc2013.org and the Registration Area daily for updates

Measurements I

TH-AM-1 TC-2 8:30 AM - 12:00AM

Chairs: Don Heirman, Don HEIRMAN Consultants and Dave Arnett, Hewlett Packard

PLANNED SPEAKERS AND TOPICS

1. Pre-Compliance Test Method for Radiated Emissions with Multiple Segment Transfer Functions 8:30 AM

Daniel Schneider, Martin Bottcher, Stefan Tenbohlen, Wolfgang Kohler: University of Stuttgart, Stuttgart, Germany

2. Comparison of Conducted Disturbance Voltages at Telecommunication Ports Measured Using Different Reference Ground Planes in Accordance with CISPR32 9:00 AM

Yoshiharu Akiyama: NTT Energy and Environment Systems Laboratories, Tokyo, Japan; Yoshihisa Aotani: NEC Access Technica Ltd., Kakegawa-shi, Japan; Kazuo Okada: Ishikawa Ltd., Yokohama-shi, Japan; Hidenori Muramatsu: VCCI Council, Tokyo, Japan

3. Investigation of Interference in a Mobile Phone from a DC-to-DC Converter 9:30 AM

Satyajeet Shinde: Missouri University of Science and Technology, Rolla, MO, US; Andriy Radchenko, Jingnan Pan, Jun Fan, David Pommerenke: EMC Laboratory, Missouri University of Science and Technology, Rolla, MO, US; Sung-Hee Kang, Dongjin Kim, Sangyeob Lee: LG Electronics, Seoul, South Korea

4. Break 10:00 AM

5. Double Position-Signal-Difference Method for Electric Near-Field Measurements 10:30 AM

Hiroki Funato, Takashi Suga: Hitachi, Ltd., Yokohama, Japan; Michihiko Suhara: Tokyo Metropolitan University, Hachioji, Japan

Emissions, Filters and Enclosure
suppression techniques

TH-AM-2 TC-4 8:30 AM - 12:00 PM

Chairs: John Kraemer, Rockwell Collins and Phil Berger,

PLANNED SPEAKERS AND TOPICS

1. Estimating the Radiated Emissions from Cables Attached to a Switching Power Supply in a MIL-STD 461 Test 8:30 AM

Guanghua Li, Wei Qian, Thomas Van Doren: Missouri University of Science and Technology, Rolla, MO, US; Andriy Radchenko, Daryl Beetner, David Pommerenke: EMC Laboratory, Missouri University of Science and Technology, Rolla, MO, US; Robert Hoeckele, Gary Hess, Pete Jalbert: Hamilton Sunstrand, Windsor Locks, CT, US

2. Radio Frequency Interference due to USB3 Connector Radiation 9:00 AM

Pujitha Davuluri: Intel Architecture Group, Intel Corporation, Hillsboro, OR, US; Chung-Hao (Joseph) Chen: Intel Corporations, Hillsboro, OR, US

3. Break 9:30 AM

4. Design of Low-Pass filters with Ultra-wide Stopband Using Novel Asymmetric DGS 10:00 AM

Yunan Han, Qing Guo: Beijing University of Chemical Technology, Beijing, China; Biao Yang: China academic of aerospace technology, Beijing, China

5. A Reconfigurable Dual-Band Metasurface for EMI Shielding of Specific Electromagnetic Wave Components

**** Nominated for Best Technical Paper Award 10:30 AM**

Muhammad Masud: North Dakota State University, Fargo, ND, US; Bilal Ijaz, Adnan Iftikhar, Muhammad Rafiq, Benjamin Braaten: North Dakota State University, Fargo, ND, US

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6. Sheet Absorbing Material Modeling and Application for Enclosures 11:00 AM

Andriy Radchenko, David Pommerenke: EMC Laboratory, Missouri University of Science and Technology, Rolla, MO, US; Joseph Bishop, James Drewniak: Missouri University of Science and Technology, Rolla, MO, US; Richard Johnson: Laird Technologies, San Marcos, CA, US; Paul Dixon: Laird Technologies, Randolph, MA, US; Marina Koledintseva: Missouri University of Science & Technology, Rolla, MO, US; Roman Jobava: EMCoS Ltd., Tbilisi, Georgia

7. Prediction of 3D-Near Field Coupling between a Toroid Inductor and a Transmission Line 11:30 AM

Hanan Shall, Zouheir Riah, Moncef Kadi: IRSEEM/ESIGELEC, Rouen, France

Wireless EMC

TH-AM-3 8:30 AM - 12:00 PM

Chairs: Antonio Orlandi, University of L'Aquila and Wilson Wu, Shenzhen Sunway Communication Co., Ltd.

PLANNED SPEAKERS AND TOPICS**1. In-Band Spurious Attenuation in LTE-Class RFIC Chip using a Soft Magnetic Thin Film 8:30 AM**

Sho Muroga: Tohoku University, Sendai, Japan

2. Wireless Power Transmission for Geophysical Applications 9:00 AM

Xiyao Xin, David R. Jackson, Ji Chen: University of Houston, Houston, TX, US; Paul Tubel: Tubel Energy, Inc., The Woodlands, TX, US

3. Measurement Validation of the Dipole-Moment Model for IC Radiated Emissions**** Nominated for Best Technical Paper Award 9:30 AM**

Jingnan Pan, Yao-Jiang Zhang, Jun Fan: EMC Laboratory, Missouri University of Science and Technology, Rolla, MO, US; Guanghua Li: Missouri University of Science and Technology, Rolla, MO, US; Yan Zhou, Yadong Bai, Xuequan Yu: Huawei Technologies Co., Ltd, Shenzhen, China

4. Break 10:00 AM**5. Proximity and Antenna Orientation Effects for Large-Form-Factor Devices in a Reverberation Chamber 10:30 AM**

Kate Remley, Christopher Holloway: NIST, Boulder, CO, US; Willem Burger: Technical University of Eindhoven, Eindhoven, Netherlands; John Ladbury: National Institute of Standards and Technology, Boulder, CO, US

6. Impact of Parasitic Inductance on Effectiveness of TVS Diodes 11:00 AM

Qian Huang: BlackBerry, Waterloo, ON, Canada; Gang Feng: BlackBerry, Waterloo, ON, Canada



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7. Distributed Wireless Coexistence, Middleware Solutions and Immunity Hardening 11:30 AM

Dheena Moongilan: Alcatel-Lucent, Murray Hill, NJ, US

EMC in and on Transportation Structures Special Session (TC-9)

TH-AM-4 8:30 AM - 12:00 PM

Chairs: Giuseppina Dall'Armi-Stoks, DSTO and Giulio Antonini

ABSTRACT

The challenges of EMC/EMI in and on transportation structures (transportation structures refers to, but is not limited to, ships, automobiles, trucks, aircrafts, spacecrafts, space systems, and trains) can include, but are not limited to,

1. The numerous sensor systems installed on transportation structures. Having numerous sensor systems installed on transportation structures increases the probability of EMI/ EMC problems, such as cosite interference due to intense near field power density, intermodulation, and antenna-to-antenna mutual coupling.

2. Addressing the operational Electromagnetic safety standards in and on the transportation structure, e.g. Radiation Hazard (RADHAZ), Hazards of Electromagnetic Radiation to Personnel (HERP), Hazards of Electromagnetic Radiation to Ordnance (HERO) and Electromagnetic Pulse (EMP).

3. Addressing the operational performance of sensor systems once installed on the transportation structure, and thus the overall performance of the transportation structure.

4. Providing EMI/EMC analysis in and on transportation structures, as part of any design and build phases for new transportation structure projects and to then provide any mitigation strategies associated with any EMI/EMC issues.

With all these above challenges comes the challenge of how to analyze and assess accurately each of the EMI/EMC issues in and on the transportation structure. Ideally, making measurements on the transportation structure would be an accurate means to assess the EMI/EMC issues. However, this approach overall, and in most cases, would be extremely costly. A more cost effective approach has been to use Computational Electromagnetic Modeling (CEM) techniques, such as full wave techniques (Method-of-Moment, Finite Difference Time Domain, and Finite Element Methods) or asymptotic high frequency techniques (Uniform Theory of Diffraction and Physical Optics). However, with the use of CEM arise many questions, for example, which CEM technique is the appropriate one to use, when, and for what problem? There are also the added limitations using CEM, which include finite computer memory, and more importantly, the accuracy and validation of the results provided by CEM.

Therefore, this session endeavors to initiate discussions among the international EMC community to try and answer these questions and hopefully obtain a practitioner's "best code of practice" regarding analyzing EMI/EMC issues in and on transportation structures using CEM, working within the confines of limited computer memory, while at the same time achieving a relatively high level of accuracy.

PLANNED SPEAKERS AND TOPICS

1. Automotive EMC Analysis Using the Hybrid Finite Element Boundary Integral Approach 8:30 AM

Markus Kopp: ANSYS, Pittsburgh, PA, US; Juliano Mologni, Cesareo de La Rosa Siqueira: ESSS - Engineering Simulation & Scientific Software, Sao Paulo, Brazil; Arnaud Collin, Artur Nogueira: FIAT, Betim, Brazil; Marco Antonio Robert Alves: UNICAMP, Campinas, Brazil

2. A Surface PEEC Formulation for the Analysis of Electrical Networks in Airplanes 9:00 AM

Giulio Antonini: Universit  degli Studi dell'Aquila, L'Aquila, Italy; Daniele Romano: Dipartimento di Ingegneria Industriale e dell'Informazione e di Economia, L'Aquila, Italy; Mauro Bandinelli, Alessandro Mori, Mirko Bercigli: IDS Ingegneria Dei Sistemi S.p.A, Pisa, Italy

3. A High Frequency EMI/EMC Analysis Methodology for Ships 9:30 AM

Giuseppina Dall'Armi-Stoks: DSTO, Edinburgh, Australia

4. Break 10:00 AM

5. A Methodology for Modeling IEMI Problems on Transportation Platforms 10:30 AM

Mauro Bandinelli, Mirko Bercigli: IDS Ingegneria Dei Sistemi S.p.A, Pisa, Italy; Gianmarco Sammarone: Ingegneria dei Sistemi S.p.A, Pisa, Italy; Kevin Mitchell: IDS Ingegneria Dei Sistemi (UK) Limited, Fareham, Hampshire, United Kingdom

Signal Integrity Enhancement and Crosstalk Management

TH-AM-5 TC10 8:30 AM - 12:00 PM

Chairs: Bill Chen, Yangtze Delta Region Institute of Tsinghua University and Antonio Ciccomancini, CST of America

PLANNED SPEAKERS AND TOPICS

1. Signal Integrity Enhancement of High-Speed Digital Interconnect with Discontinuous and Asymmetric Structures for Mobile Applications 8:30 AM

Tae-Wan Koo, Hee-do Kang, Jong-Gwan Yook: Yonsei university, Seoul, South Korea; Jeunguk Ha, EunKwang Koh: LG Electronics, Seoul, South Korea

2. Crosstalk Analysis for Dual Stripline with Parallel and Angled Routing 9:00 AM

Weifeng Shu, Yinglei Ren, Xinjun Zhang: Intel Asia Pacific Research and Development Ltd, Shanghai, China; Xiaoning Ye: Intel Corporation, Hillsboro, OR, US

3. Inter-layer Crosstalk Management in Differential Dual-striplines 9:30 AM

Kai Xiao: Intel Corp, DuPont, WA, US; Jimmy Hsu: Intel Corp, Taipei, Taiwan; Yuan-liang Li: Intel Corporation, Taipei, ; Richard Kunze, Trung-Thu Nguyen: Intel Corporation, ; Yinglei Ren: Intel Asia Pacific Research and Development Ltd, Shanghai, China

4. Break 10:00 AM

5. Differential Symmetry Principle for Differential Crosstalk Cancellation 10:30 AM

Raul Enriquez, Miguel Tlaxcalteco: Intel, Guadalajara, Mexico; Kai Xiao: Intel Corp, DuPont, WA, US; Beomtaek Lee: Intel Corporation, Santa Clara, CA, US

6. Differential Mode to Common Mode Conversion on Differential Signal Vias due to Asymmetric GND Via Configurations 11:00 AM

Bruce Archambeault, Samuel Connor: IBM Corporation, RTP, NC, US; Alma Jaze: IBM, Poughkeepsie, NY, US

7. Debugging and Analysis of a Noise Coupling Mechanism in Computer System 11:30 AM

Weifeng Shu, Yinglei Ren: Intel Asia Pacific Research and Development Ltd, Shanghai, China; Xiaoning Ye: Intel Corporation, Hillsboro, OR, US

Measurements II

TH-PM-1 TC2 2:30 PM - 5:30 PM

Chairs: H. Robert Hofmann, Hofmann EMC Engineering and Tom Fagan, Raytheon

PLANNED SPEAKERS AND TOPICS

1. One-Port Time Domain Measurement Technique for Quality Factor Estimation of Loaded and Unloaded Cavities 2:30 PM

David Green, Vignesh Rajamani, Chuck Bunting: Oklahoma State University, Stillwater, OK, US; Bruce Archambeault, Samuel Connor: IBM Corporation, RTP, NC, US

2. Cross-Validation of Transmission-Line Super Theory Radiated Power Calculations With Measurements for Open Waveguide Structures 3:00 PM

Ronald Rambousky: Bundeswehr Research Institute for Protective Technologies, Munster, Germany; Heyno Garbe: Institute of Electrical Engineering and Measurement Technology, Leibniz University Hannover, Hannover, Germany; Hans Georg Krauthuser: Technical University Dresden, Dresden, Germany

3. Break 3:30 PM

4. Prediction of Radiated Emission for Complex Systems under Realistic Operating Conditions 4:00 PM

David Hamann, Marcin Mleczko, Heyno Garbe: Institute of Electrical Engineering and Measurement Technology, Leibniz University Hannover, Hannover, Germany; Sven Battermann: WAGO Kontakttechnik GmbH & Co KG, Minden, Germany

5. High Frequency Battery Impedance Measurements for EMI Prediction 4:30 PM

Roberto Mrad: Ampere laboratory - Ecole Centrale de Lyon, Ecully, France; INL laboratory - CPE Lyon, Villeurbanne, France; ST Ericsson, Grenoble, France; Mohammad Sami Tabbakh, Youssef Zaatar: Lebanese University, Campus Fanar, Jdeidet, Lebanon; Florent Morel: Ampere laboratory - Ecole Centrale de Lyon, Ecully, France

6. A Novel Measurement Fixture for Characterizing USB 3.0 Radio Frequency Interference 5:00 PM

Chung-Hao (Joseph) Chen: Intel Corporations, Hillsboro, OR, US; Pujitha Davuluri: Intel Architecture Group, Intel Corporation, Hillsboro, OR, US; Dong-ho Han: Intel Architecture Group, Hillsboro, OR, US

EMC for Emerging Wireless Technologies Special Session (SC4)

TH-PM-2 2:30 PM - 5:30 PM

Chairs: Yihong Qi, DBJ Technologies and Jun Fan, EMC Laboratory, Missouri University of Science and Technology

PLANNED SPEAKERS AND TOPICS

1. Electromagnetic Interference Shielding Effects in Wireless Power Transfer using Magnetic Resonance Coupling for Board-to-Board Level Interconnection 2:30 PM

Sukjin Kim, Hongseok Kim, Jonghoon. J Kim, Bumhee Bae, Sunkyu Kong, Joung-ho Kim: KAIST, Daejeon, South Korea

2. Innovative O-Shape Spring Contact Use in Mobile Devices 3:00 PM

Joe Zhou: Yehai-Bi, Shanghai, China; YeHai Bi: Joe Zhou, Shanghai, China; Wilson Wu, ShenZhen, China; Wilson Wu: Shenzhen Sunway Communication Co., Ltd., Shanghai, China; Yehai-Bi, Shanghai, China

3. Break 3:30 PM

4. An Electromagnetic Interference (EMI) Evaluation Method for Components in Mobile Devices 4:00 PM

Eakhwan Song, Hark Byeong Park: Samsung Electronics Company, Suwon, South Korea; Hyun Ho Park: University of Suwon, Suwon, South Korea

5. The Application of Spark gaps on Audio Jack for ESD Protection 4:30 PM

Jing Li: EMC Laboratory Missouri University of Science and Technology, Rolla, MO, US; Jun Fan, David Pommerenke: EMC Laboratory, Missouri University of Science and Technology, Rolla, MO, US

6. Fast Characterization of the Radiated Desensitization of Mobile Devices 5:00 PM

Jingyu Huang: Nokia Inc., San Diego, CA, US

Reverberation Chambers and Rectangular Cavities

TH-PM-3 TC-9 2:30 PM - 5:30 PM

Chairs: Vignesh Rajamani, Oklahoma State University and James West, Oklahoma State University

PLANNED SPEAKERS AND TOPICS

1. Calculation of Currents Induced in a Long Transmission Line Placed Symmetrically Inside a Rectangular Cavity 2:30 PM

Ronald Rambousky: Bundeswehr Research Institute for Protective Technologies, Munster, Germany; Sergey Tkachenko: Otto-von-Guericke University Magdeburg, Magdeburg, Germany; Jrgen Nitsch: Otto-von-Guericke University, Magdeburg, Germany

2. How to Handle a Huygens' Box Inside an Enclosure 3:00 PM

Morten Srensen, Ivan Bonev Bonev, Ondrej Franek, Gert F. Pedersen, Hans Ebert: Antennas, Propagation and Radio Networking, Department of Electronic Systems, Faculty of Engineering and Science, Aalborg University, Aalborg, Denmark

3. Break 3:30 PM

4. Simulation of Reverberation Chambers Using Method of Moments with Cavity Green's Function and Spectral Domain Factorization 4:00 PM

Michael Gruber, Thomas Eibert: Technische University Munchen, Munchen, Germany

5. Practical Considerations for the Evaluation of the 3-D Green's Function in a Rectangular Cavity Moment Method at High Frequency 4:30 PM

James West, Vignesh Rajamani, Chuck Bunting: Oklahoma State University, Stillwater, OK, US

6. Carousel Stirrer Efficiency Evaluation by a Volumetric Lattice-Based Correlation Matrix 5:00 PM

Franco Moglie, Valter Mariani Primiani: Università Politecnica delle Marche, Ancona, Italy; Gabriele Gradoni: University of Maryland, College Park, MD, US

High Power EM including Intentional EMI, ESD, and Lightning

TH-PM-4 TC5 2:30 PM - 5:30 PM

Chairs: William Radasky, Metatech Corporation and Michael McInerney, US Army Corp of Engineers

PLANNED SPEAKERS AND TOPICS

1. Lightning Currents Measured on the Santis Tower: A Summary of the Results Obtained in 2010 and 2011 2:30 PM

Farhad Rachidi, Carlos Romero, Mario Paolone: Swiss Federal Institute of Technology (EPFL), LaUSnne, Switzerland; Marcos Rubinstein: University of Applied Sciences of Western Switzerland, Yverdon, Switzerland

2. A Framework for the Simulation of Electrostatic Discharge Immunity Using the Unified Circuit Modeling Technique 3:00 PM

Tadatashi Sekine, Hideki Asai: Shizuoka University, Hamamatsu-shi, Japan

3. Break 3:30 PM

4. Map-based Analysis of IEMI Fault Injection into Cryptographic Devices ** Nominated for Best Technical Paper Award 4:00 PM

Yuichi Hayashi, Naofumi Homma, Takaaki Mizuki, Takafumi Aoki, Hideaki Sone: Tohoku University, Sendai, Japan

5. Identification of Simultaneous Switching Noise Current in Encryption Circuit from On-Board Measurement 4:30 PM

Kengo Iokibe: Okayama Univ., Okayama, Japan

Signal Integrity and Power Integrity

TH-PM-5 TC10 2:30 PM - 5:30 PM

Chairs: Chunfei Ye, Intel Co. and Jianfang Zhu, Intel Corporation

PLANNED SPEAKERS AND TOPICS

1. De-embedding Techniques for Transmission Lines: An Exploration, Review, and Proposal

**** Nominated for Best Technical Paper Award 2:30 PM**

Nicholas Erickson, Ketan Shringarpure: Missouri S&T EMC Lab, Rolla, MO, US; Jun Fan: EMC Laboratory, Missouri University of Science and Technology, Rolla, MO, US; Siming Pan, Brice Achkar: Cisco Systems, Inc., San Jose, CA, US; Chulsoon Hwang: KAIST, Deajeon, South Korea

2. Investigation of Power & Ground Co-Reference for High-Speed Signal in Package Design 3:00 PM

Jianmin Zhang, Hong Shi, Dan Oh: Altera Corporation, San Jose, CA, US; Siow Chek Tan: Altera Corporation, Penang, Malaysia

3. Break 3:30 PM

4. Major Error and Sensitivity Analysis for Characterization of Laminate Dielectrics on PCB Striplines 4:00 PM

Aleksei Rakov: Missouri S&T, EMC Lab, Rolla, MO, US; Marina Koledintseva: Missouri University of Science & Technology, Rolla, MO, US; James Drewniak: Missouri University of Science and Technology, Rolla, MO, US; Scott Hinaga: Cisco Systems, San Jose, CA, US

5. Study of BGA Package Cap for High-performance Computing GPU 4:30 PM

Wenjie Mao: Nvidia Corporation, Santa Clara, CA, US

6. Fast Channel Performance Evaluation Using Time Domain Metrics 5:00 PM

Xiaoning Ye: Intel Corporation, Hillsboro, OR, US; Weifeng Shu: Intel Asia Pacific Research and Development Ltd, Shanghai, China

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WORKSHOPS/TUTORIALS

- Advanced Computational Electromagnetics / Multi-physics Methods for Fast Characterizing Electromagnetic / Electromagnetic - Thermal Effects in Complex Structures
- Basic EMC Measurements - part 2
- The Scoop on Hybrid Antennas - Dispelling the Controversy of Qualification Testing
- Fundamentals of Signal and Power Integrity
- Grounding - Concepts, Physics and Myths
- Application of Reverberation Chambers
- Advanced Topics in Signal and Power Integrity
- Best Practices for Organizing and Hosting Lessons Learned Discussions
- EMC in 3D Integration

OTHER EVENTS

- iNARTE Certification Examinations (Page 60)
- Pikes Peak, Garden of the Gods and Air Force Academy (Page 81)

EXHIBITOR MOVE OUT

*All events are subject to change. Check www.emc2013.org and the Registration Area daily for updates

Advanced Computational Electromagnetics/ Multi-physics Methods for Fast Characterizing Electromagnetic/ Electromagnetic-Thermal Effects in Complex Structures

Format: Full-day Tutorial – FR-AM-1 and FR-PM-1 ROOM 201

Chair: Wen-Yan Yin, Zhejiang University, China

ABSTRACT

EMI/EMC design often requires system-level electromagnetic simulations that not only solve for EM fields in a multi-scale environment but also the coupling between fields and nonlinear circuitries. Such multi-scale field-circuit co-design problems are usually very challenging to solve.

We will present our recent work in solving realistic multi-scale system-level transient EM design simulation problems coupled with complex nonlinear circuitries. The discontinuous Galerkin method is used as the fundamental framework for interfacing multiple scales with finite-element method, finite difference method, and spectral element time domain (SETD) method. We further incorporate a nonlinear circuit solver based on SPICE, making it possible to perform nonlinear circuit simulation with RF interactions in a seamless manner. Several challenging realistic problems will be demonstrated for EMI/ EMC applications.

PLANNED SPEAKERS AND TOPICS

1. Electromagnetic and Thermal Effects Co-Simulations for Electronic Circuits

8:30 AM – 9:30 AM

J. F. Lee, The Ohio State University, Ohio, US

2. Finite-Difference Based Time-Domain Modeling for EMC/EMI Applications

9:30 AM – 10:00 AM and 10:30 AM – 11:00 AM

Z. Chen, Dalhousie University, Halifax, Nova Scotia, Canada

3. Multi-scale and Multi-physics Modeling: Their Role in 3D Integration

11:00 AM – 12:00 PM

M. Swaminathan, Georgia Institute of Technology, Atlanta, Georgia, US

4. Explicit Time-Domain Methods that are Unconditionally Stable

1:30 PM – 2:30 PM

Dan Jiao, Purdue University, West Lafayette, Indiana, US

5. Multi-physics Co-simulations and their Applications

2:30 PM – 3:00 PM and 3:30 PM – 4:00 PM

Lijun Jiang, The University of Hong Kong, Hong Kong, China

6. Multi-physics Methods for High-Power Electromagnetics

4:00 PM – 5:00 PM

Wen-Yan Yin, Shanghai Jiao Tong University, Shanghai, China

Basic EMC Measurements - Part 2

Sponsored by TC2

Format: Half-day Tutorial – FR-AM-2 ROOM 203

Chair: Don Heirman, Don HEIRMAN Consultants, Lincroft, New Jersey, US

ABSTRACT

This tutorial will be an introduction to product immunity testing to comply with basic EMC immunity measurements methods for a wide range of products. Included will be a description of the latest test site validation requirements and construction review. The latest activities in national and international standards related to EMC immunity measurements and application will also be presented as time allows.

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PLANNED SPEAKERS AND TOPICS

1. Basic Measurement Facilities, Methods and Associated Errors
8:30 AM – 9:15 AM*Don Heirman, Don HEIRMAN Consultants, Lincroft, New Jersey***2. IEC Approach to Immunity Test Methods using the Application of Continuous RF Disturbances**
9:15 AM – 10:00 AM*John Maas, IBM Corporation, Rochester, Minnesota, US***3. IEC Transient Immunity Testing Overview** **10:30 AM – 11:15 AM***Thomas E. Braxton, Braxton EMC Consulting, Niles, Illinois, US***4. High Power Electromagnetics Test Facilities and Measurement Methods** **11:15 AM – 12:00 PM***Bill Radasky, Metatech, Goleta, California, US***The Scoop on Hybrid Antennas - Dispelling the Controversy of Qualification Testing**

Format: Half-day Tutorial – FR-AM-3 Room 205

Co-chairs: *Zhong Chen, ETS-Lindgren, Cedar Park, Texas, US*
Dan Hoolihan, Hoolihan EMC Consulting, Lindstrom, Minnesota, US

ABSTRACT

The hybrid biconical/log periodic antenna (Hybrid Antenna) was developed by York University of Great Britain in 1993. EMC labs around the world quickly began to use it for product testing due to the reduced test time based on the Hybrid Antenna's wider frequency range capability. Many technical improvements have been made to the hybrid antenna over the past 20 years. However, radiated emission test results obtained with a Hybrid Antenna may be different due to some labs inappropriately using Hybrid Antennas designed for immunity testing as transducers for emission testing. This tutorial will explore the physics of utilizing Hybrid Antennas for formal qualification testing, and will discuss whether they can be used in accordance with ANSI C63.4/ C63.5, as well as their compliance with CISPR 16-1-4. Test results, including Normalized Site Attenuation testing, from a variety of labs using Hybrid Antennas will be presented and discussed.

PLANNED SPEAKERS AND TOPICS

1. The Initial Development of the Hybrid Biconical/ Log Periodic Antenna for Radiated Emissions*Andy Marvin, York University, Great Britain***2. Comparison of Hybrid Antenna Performance Across Multiple Facilities***Greg Kiemel, Northwest EMC, Hillsboro, Oregon, US***3. A Comparison of Bilog, Biconical, and Log Periodic Antenna Measurement Results***John Hirvela, Hewlett-Packard, Houston, Texas, US* *John Fessler and Keith Hardin, Lexmark, Lexington, Kentucky, US***4. Hybrid Antennas: Comparative : Measurements with Other Antennas***Andy Griffin, Cisco Systems, Santa Clara, California, US***5. Making Sense of the Comparison Data using Biconical and Biconical/LPDA Hybrid Antennas***Zhong Chen, ETS-Lindgren and Chair of ANSI C63 Subcommittee 1, Cedar Park, Texas, US***Fundamentals of Signal and Power Integrity**

Format: Half-day Tutorial – FR-AM-4 Room 210/212

Chair: *A. Ege Engin, San Diego State University, San Diego, California, US*

ABSTRACT

As the clock frequencies for off-chip signals approach 20 GHz and beyond, maintaining signal and power integrity are becoming major issues to design a computer system that can actually support such speed. This tutorial will cover fundamentals of modeling, simulation, and characterization techniques to ensure signal and power integrity.

The list of topics covered in this tutorial can be summarized as:

- SI/PI modeling techniques: Modeling of frequency- dependent parameters due to skin effect and dielectric loss; modeling of transmission line return currents and return path discontinuity; modeling of power distribution networks; glass-weave effect.
- SI/PI simulation techniques: EM simulation techniques for SI/PI; ensuring causality and passivity in simulations; power distribution network optimization based on target impedance; simulation of package discontinuities such as slots, vias, wirebonds.

PLANNED SPEAKERS AND TOPICS

1. Power Distribution Network Design for Low Power Supply Voltage Applications*Yutaka Uematsu, Hitachi, Yokohama, Japan***2. GHz Power Integrity Modeling and Design***A. Ege Engin, San Diego State University, San Diego CA***3. Methods, Models and Measures (M3) for RF/High-Speed Interconnects***Ivan Ndip, Fraunhofer IZM, Berlin, Germany***4. Modeling of High Speed Interconnects for Signal Integrity Analysis***Antonio Ciccomancini, CST of America, Boston MA***Grounding - Concepts, Physics and Myths** Sponsored by TC-4

Format: Half-day Workshop – FR-AM-5 Room 207

Co-chairs: *Bruce Archambeault, IBM Corporation, Raleigh, North Carolina, US**Jim Drewniak, Missouri University of Science & Technology, Rolla, Missouri, US*

ABSTRACT

Grounding in digital, analog, and power electronic circuits as well as mixed circuits when done well can avoid EMC problems or result in EMC problems when done poorly. There are many identifiers for ground, including digital ground, chassis ground, analog ground, power ground, ESD ground, and safety ground. There are also a myriad of ground notions and issues, e.g., ground loops, quiet ground, dirty ground and single-point ground. Ideas and methods can be held with religious-like zeal and fervor. However, the

physics of grounding comes down to managing return currents – from intentional and unintentional sources across intended and unintended paths. In any given electronics design there will be return currents from many types of sources, some that can use a common current return path without difficulty, some that will be trouble if allowed to use certain return paths, and some that must not have any other but the intended return current use its path.

This workshop will be comprised of three individual contributions followed by a panel of experts that will take questions from the audience and give their experience and solutions that have worked in practice. The panel will be comprised of the speakers as well as additional industry engineers with EMC design and compliance experience.

PLANNED SPEAKERS AND TOPICS

1. Summarizing Ground Concepts Over the Past years & Discussing when “Ground Loops” are Really an Issue

Henry Ott, Henry Ott Consulting, Livingston, New Jersey, US

2. “Grounding” – it’s about managing currents. Sources of current – low-voltage high-frequency digital signals, digital power, high-power low- frequency, low-frequency analog, high-frequency analog, ESD, external interference – and the physics of current return, both intended return paths and un-intended return paths T

Bruce Archambeault, IBM Corporation, Raleigh, North Carolina, US

3. What does “Ground” Mean in Outer Space?

Bob Scully, NASA Space Center, Houston, Texas, US

Advanced Computational Electromagnetics/ Multi-physics Methods for Characterizing Electromagnetic/ Electromagnetic-Thermal Effects in Complex Structures

Format: Full-day Tutorial – FR-AM-1 and FR-PM-1 Room 201

Chair: Wen-Yan Yin, Zhejiang University, China

See FR-AM-1 for description

Application of Reverberation Chambers

Format: Half-day Tutorial – FR-PM-2 Room 203

Chair: Vignesh Rajamani, Oklahoma State University, Stillwater, Oklahoma, US

ABSTRACT

This tutorial will provide an introduction to recent applications of reverberation chambers. It is intended to provide EMC engineers who are interested in applying reverberation chambers to various measurement issues and the extension of reverberation chambers to solve a variety of EMC problems. This half-day tutorial provides a brief overview of Reverberation Chamber (RC) theory, followed by recent applications of RCs. The tutorial material will be updated to reflect recent research results and implications. The format will be a conference presentation style (lecture) followed by questions moderated by the chairman. 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 AND TOPICS

1. Introduction – Rationale for RC testing

Vignesh Rajamani, Oklahoma State University, Stillwater, Oklahoma, US

2. Models for Antennas in Reverberation Chambers

John Ladbury, National Institute of Science and Technology, Boulder, Colorado, US

3. Characterization of EM Environments using RC Techniques

Chuck Bunting, Oklahoma State University, Stillwater, Oklahoma, US

4. Measuring Intrinsic Material Shielding Effectiveness Using Coupled Reverberant Cavities

Greg Tait, Naval Surface Warfare Center, Dahlgren, Virginia, US

5. Antenna Performance Evaluation in Reverberation Chambers

Dennis Lewis, Boeing, Seattle, Washington, US

6. Wireless Device Testing in Reverberation Chambers

Garth D’Abreu, ETS-Lindgren, Cedar Park, Texas, US

Advanced Topics in Signal and Power Integrity

Sponsored by EMCS TC-10 and CPMT-12

Format: Half-day Workshop – FR-PM-3 Room 205

Co-chairs: Dale Becker, IBM Corporation, Poughkeepsie, New York, US
Xiaoning Ye, Intel Corporation, Hillsboro, Oregon, US

ABSTRACT

The challenges of high-speed channel system design require the electrical engineer to understand signal integrity, power integrity, and EMC and make the appropriate decisions so that all electrical constraints are met. This workshop is sponsored by the CPMT TC-12 which sponsors EPEPS Conference and EMC TC-10 committees to present advanced topics of signal integrity and bridge these topics with EMC.

PLANNED SPEAKERS AND TOPICS

1. Cross-talk in High-Speed Channels

Kai Xiao and Xiaoning Ye, Intel Speaker: Xiaoning Ye, Hillsboro, Oregon, US

2. Power Integrity for Simultaneous Switching in High Data-Rate Packages

Tingdong Zhou and Dale Becker, IBM Speaker: Dale Becker, Poughkeepsie, New York, US

3. Common Mode Noise Mitigation on Differential Signaling

Tzong-Lin Wu, National Taiwan University, Taipei, Taiwan, R.O.C.

4. High-bandwidth and Low Noise TSV and Interposer Design for 2.5D/3D IC

Joung-Ho Kim, Korea Advanced Institute of Science and Technology, Seoul, Republic of Korea

5. Alternate Signaling Methods for Managing Return Path Discontinuities

Madhavan Swaminathan, Georgia Institute of Technology, Atlanta, Georgia, US

Best Practices for Organizing and Hosting Lessons Learned Discussions

Format: Half-day Workshop – FR-PM-4 Room 210/212

Chair: Carl Irby, Senior Member, IEEE EMC Society, Keller, Texas, US

ABSTRACT

The arena of Electromagnetic Environmental Effects presents challenges that range in scope from highly technical to interpersonal. Many of these challenges are resolved by learning from personal experience or from more experienced members of a design team or one's professional network. Local chapters of the IEEE EMC Society can offer unparalleled opportunities for sharing of these experiences and for the more experienced members of the Society passing on their depth and breadth of knowledge to personnel who are at earlier stages in their EMC journey.

This workshop intends to communicate recommendations for organizing and hosting technical sessions. An example session will be presented to demonstrate the implementation of best practices. The workshop is based on the experiences of the Dallas chapter of the EMC Society from the annual sessions they have organized over a dozen years.

TIPS FROM THE LOCALS

Guy Dodds

Business Development
EMC Integrity, Inc.



- **Town you live in:** Longmont
- **Years spent in the area:** 20+
- **Attraction you would recommend to a first time visitor:**
Estes Park/Rocky Mountain National Park
- **Favorite place to eat:**
The Rib House (www.theribhouse.com) in Longmont
- **Must have souvenir:** EMC Integrity T-Shirt
- **Denver's best kept secret:**
The Mile High Club at Coors Field
(The Purple Seats to watch the Rockies play Baseball at 5280 feet above sea level)
- **Best view:** Purple Mountain Sunrise of Longs and Meeker Peaks (Twin Peaks in Longmont)

PLANNED SPEAKERS AND TOPICS

THE TOPICS TO BE EXPLORED IN THIS WORKSHOP INCLUDE:

1. How to Set Up a Lessons Learned Technical Session
2. Advance Notification of Chapter Members and Guests
3. Breaking the Ice
4. Engaging the Audience to Share their Stories and Ask Questions

PLANNED SPEAKERS INCLUDE:

1. Carl Irby, Senior Member, IEEE EMC Society, Keller, Texas, US
2. James Robert Queen, Bell Helicopter, Hurst, Texas, US
3. Bill Paschtag, Sachse, Texas, US

EMC in 3D Integration

Sponsored by EMCs TC-10

Format: Half-day Tutorial – FR-PM-5 Room 207

Co-chairs: Antonio Ciccomancini, CST of America, Boston, Massachusetts, US

Giulio Antonini, Università degli Studi dell'Aquila, L'Aquila, Italy

ABSTRACT

3D ICs promise "more than Moore" integration by packing a lot of functionality into small form factors. Interposers along with TSVs play an important role in 3D integration from an electrical, thermal and mechanical point of view. Efficient and low-cost design of electronic packages and 3D integration technologies requires a good understanding of the root causes of signal integrity (SI), power integrity (PI) and electromagnetic interference (EMI) problems at GHz frequencies, as well as methods to analyze, prevent or solve them. This tutorial will illustrate a wide range of methods for electrical modeling, measurement and optimization of electronic packages, PCBs, and 3D integration technologies, under consideration of SI, PI, and EMI/EMC effects.

PLANNED SPEAKERS AND TOPICS

1. Managing Power Integrity for 3D Integration

Madhavan Swaminathan, Georgia Institute of Technology, Atlanta, Georgia, US

2. Co-Simulation of Distributive and Lumped Systems Using the Discontinuous Galerkin Finite Element Time Domain Method

Ping Li, Li Jun Jiang and Hakan Bagci,
The University of Hong Kong, Hong Kong

3. Efficient and Scalable Modeling for Power Distribution Networks in 3D IC

Tzong-Lin Wu and Yu-Jen, National Taiwan University, Taipei, Taiwan

4. Eye-diagram Simulation of a High-speed TSV Channel

Heegon Kim, Jonghyun Cho, Kiyeong Kim, Manho Lee and Joung-Ho Kim, Korea Advanced Institute of Science and Technology, South Korea

5. Full-Wave Modeling of Inductive Coupling Links for Low-Power 3D System Integration

Tommaso Vali, Giulio Marotta, Luca De Santis, Micron Italia, Italy
Giulio Antonini, Daniele Romano and Giovanni De Luca,
Università degli Studi dell'Aquila, Aquila, Italy
Presenter: Giulio Antonini



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ELECTROMAGNETIC COMPATIBILITY | **technology**

TECHNICAL COMMITTEES (TC) play an important role in the overall success of the EMC Society by promoting activities in their fields and providing expert knowledge and assistance to generate and review technical papers, organize and operate sessions at symposia, generate and develop standards, and evaluate the state of the art in EMC science. All meetings are open to everyone; join them for breakfast, a break, lunch, or dinner. Listen to the discussions and learn what they are working on. Join your peers who volunteer to make EMC better. Just by attending, you can be part of the solution and the future of EMC! Visit www.emc2013.com for more information.

TECHNICAL COMMITTEE 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.

TECHNICAL COMMITTEE 2: **EMC MEASUREMENTS**

This committee is concerned with the measurement and instrumentation requirements in EMC standards and procedures and how they are interpreted. Also concerned with the adequacy of measurement procedures and measurement instrumentation specifications for radiated and conducted emission and susceptibility tests and the rationale for performance limits for these tests.

TECHNICAL COMMITTEE 3: **ELECTROMAGNETIC ENVIRONMENT**

This committee is to encourage research in the following areas: 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.

TECHNICAL COMMITTEE 4: **EMI 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.

TECHNICAL COMMITTEE 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 electromagnetic environments. These environments include electromagnetic pulse (EMP), intentional EMI environments (e. g. high power microwaves and ultrawideband), lightning electromagnetic currents and fields, and electrostatic discharge. Interactions with aircraft and other mobile systems are included.

TECHNICAL COMMITTEE 6: **SPECTRUM MANAGEMENT**

This committee is concerned with frequency coordination, management procedures for efficient spectrum use, band occupancy and congestion, federal regulations and their adequacy.

TECHNICAL COMMITTEE 7: **LOW FREQUENCY EMC**

This 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.

TECHNICAL COMMITTEE 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.

TECHNICAL COMMITTEE 10: **SIGNAL INTEGRITY**

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

TECHNICAL COMMITTEE 11: **NANOTECHNOLOGY**

The newest technical topic area for the EMC Society, the topics include carbon nanotubes, composite materials, and other measurements, design, and analysis applications.

SPECIAL COMMITTEE 1: **SMART GRID**

This special committee is concerned with coordination 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 and in some cases exiting a house or building.

SPECIAL COMMITTEE 3: **TRANSPORTATION SYSTEM EMC**

This committee is concerned with the component and system design, testing and modeling/ simulation of transportation systems. This includes both passenger carrying and non-passenger vehicles such as automobiles, trucks, trains/trams, and aircraft. Special emphasis is placed on the latest developments in high power and high voltage systems used for propulsion or control.

SPECIAL COMMITTEE 4: **EMC FOR EMERGING WIRELESS TECHNOLOGIES**

This committee is concerned with the design, analysis, modeling and measurement for interference control and mitigation in emerging wireless products. The committee encourages researches including but not limited to the following areas: EMC-based system architecture design and system planning, strategic EMC performance budgeting and distribution, new system interface requirements and new system integration methods, intra-system coupling path analysis, modeling and validation, new EMC evaluation/measurement methods and standards for components/devices, Innovative component designs with integrated EMC functionalities, new EMC material requirements, applications and evaluation methods, and interdisciplinary issues involving EMC, audio, mechanical, and thermal designs.

Computer Modeling & Simulations Demonstrations

TUESDAY, AUGUST 6: 9:00 – 11:00AM

TOPIC: Using Simulated EMC Instruments to Develop, Edit, and Validate EMC Test Routines

PRESENTER: Joe Tannehill, ETS-Lindgren, Austin, TX, US

ABSTRACT: 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.

TUESDAY, AUGUST 6: 2:00 – 4:00PM

TOPIC: Coupling of Radiated Fields Inside an Aircraft Through Seams and Apertures Using FDTD Technique

PRESENTER: Jennifer Kitaygorsky, PhD, Electro Magnetic Applications, Inc., Lakewood, CO, US

ABSTRACT: Many physically-small aircraft features are critical in lightning simulation. Modeling these small features can be done via 1) advanced techniques to automatically capture the behavior of elements smaller than the mesh 2) anisotropic material modeling approaches 3) techniques in which an analyst manually determines the bulk properties of cells based on the aggregate performance of sub-cell features.

WEDNESDAY, AUGUST 7: 9:00 – 11:00AM

TOPIC: Demonstration of Sub-Cell Modeling Techniques for Lightning Indirect Effects and Fuel System Simulation

PRESENTER: Timothy McDonald, PhD, Electro Magnetic Applications, Inc., Lakewood, CO, US

ABSTRACT: Many physically-small aircraft features are critical in lightning simulation. Modeling these small features can be done via 1) advanced techniques to automatically capture the behavior of elements smaller than the mesh 2) anisotropic material modeling approaches 3) techniques in which an analyst manually determines the bulk properties of cells based on the aggregate performance of sub-cell features.

WEDNESDAY, AUGUST 7: 2:00 – 4:00PM

TOPIC: Time Domain Field / Cable Coupling Analysis for EMC Applications

PRESENTERS: Marlize Schoeman EM Software and Systems – S.A. (Pty) Ltd, Stellenbosch, South Africa, C. J. Reddy, EM Software & Systems (US) Inc. Hampton VA, US, & Ulrich Jakobus, EM Software & Systems – S.A. (Pty) Ltd, Stellenbosch, South Africa

ABSTRACT: Many modern electromagnetic systems involve cables. From an EMC and EMI perspective it is crucial that already in the design process coupling effects involving these cables and other devices (e.g. antennas) are taken into account. The susceptibility and emissions performance of a complex system will be illustrated with focus on time domain principles and results.

THURSDAY, AUGUST 8: 9:00 – 11:00AM

TOPIC: Multichannel Link Path Analysis

PRESENTER: Dr. James L. Drewniak, EMC Laboratory, Missouri S&T, Rolla, MO, US

ABSTRACT: This demonstration will discuss how to perform multichannel link path analysis as a critical component of the signal integrity design and discovery process. The presentation will include an overview of S-parameter matrices and their USge, including concepts like single-ended parameters, mixed-mode parameters, conversions between formats, cascading, de-embedding, and passivity and caUSlity checking and enforcement. These s-parameter blocks, which represent pieces of an entire link path, can come from measurements or simulations or from cross-sectional analysis of circuit board and cable structures, and users need to understand how to assess the quality of these s-parameters to get high quality results. Finally, signal processing concepts like pre-emphasis and equalization are a key part of modern link path design, and this demo will show why link path analysis tools must include these capabilities to provide a complete signal integrity evaluation of a channel.

Hardware Experiments and Demonstrations

TUESDAY, AUGUST 6: 9:00 – 11:00AM

TOPIC: Electromagnetic Field Containment Using the Principle of "Self-Shielding"

PRESENTER: Tom Van Doren

ABSTRACT: The "self-shielding" principle involves routing a current so that the geometric centroids of the outgoing and the return paths are coincident. This is a new way to visualize an old idea. This simple principle makes it easy to see which current routing arrangements will provide good electric and magnetic field containment without the need for externally added shielding. The self-shielding concept will be explained and then demonstrated using a variety of cables; such as an untwisted pair, a twisted pair, and a coaxial cable.

TOPIC: Spectral Content and Response of Various Signals

PRESENTERS: Bill Kimmel, Kimmel Gerke Associates, & Bill Byrom, Tektronix

ABSTRACT: There will be two topics, interleaved. Bill Kimmel will do the first half, showing the effects of risetime and duty cycle on harmonic generation. Bill Byrom will do the second half, showing emission signatures of some common signals, including spread spectrum and some serial channels.

TOPIC: Demonstration of an IC Device Coupling onto a Cable Resulting in an EMC Emissions Failure

PRESENTER: Doug Smith

ABSTRACT: A small HC240 octal inverting buffer, set up to oscillate between 5 and 60 MHz, couples energy onto a nearby cable. Measurements will be made of common mode current on the cable to confirm an emissions problem has been created. Also demonstrated: why a low frequency clock can be dangerous.

First, I demonstrate a magnetic field at the top of the IC on the spectrum analyzer, lots of harmonics. Then I put a four meter cable on the demonstration table such that its middle lays on the top of the IC. Using a current probe to measure common mode current on the cable, I show three things:

CONTENT:

1. Enough current is generated in the cable to be a class A emissions failure by quite a few dB.
2. Only those harmonics, of the original shown with a magnetic loop over the IC, that correspond to resonant frequencies in the cable are picked up as relatively high current on the cable.
3. With the oscillator set at 5 MHz resonances are easily seen where as at 60 MHz, it is possible to tune the oscillator to a frequency that does not correspond to a cable resonant frequency, hence sometimes a low frequency clock can be more dangerous than a higher frequency one."

TUESDAY, AUGUST 6: 2:00 – 4:00PM

TOPIC: Stop, Look, and LISN: Power Distribution Harness Impedance Measurements

PRESENTER: John McCloskey, NASA GSFC

ABSTRACT: Line Impedance Stabilization Networks (LISNs) are commonly specified in EMI testing in order to simulate power source impedance. In many cases,

a default LISN is specified that does not accurately represent the power source impedance on the actual platform. In order to ensure meaningful test results, the platform's power source impedance must be well defined and a LISN must be specified that accurately represents that impedance.

The power source impedance tends to be dominated by the resistance, inductance, capacitance, and characteristic impedance of the power distribution harness. In this demonstration, these parameters are measured for different cable configurations and compared to their respective models. The results are used to provide guidance for specifying an appropriate LISN that accurately represents the power source impedance of a given harness configuration.

TOPIC: Spread Spectrum Clock Generation - The Great Debate

PRESENTER: Ken Wyatt

ABSTRACT: There continues to be a debate as to whether SSCG are merely "cheating the system" or is a valid method to reduce the amplitude of high-frequency clock harmonics. This demo should help answer that question.

CONTENT:

1. Brief history of SSCG from 1994 and description of modulation technology used.
2. Demo with SSCG board and spectrum analyzer showing the apparent "cheat."
3. Demo showing the actual spread clock signal and why it's a valid EMI reduction technique.

4. A brief explanation of the mathematics.

TOPIC: Inductive Effects in Cables

PRESENTER: Jerry Meyerhof, JDM Labs LLC

ABSTRACT: Understand the practical implementation details of "cables" or "transmission lines" which are critical to EMC performance, when used between modules/units, across systems and within Printed Circuit Boards (PCBs).

ANALYZE & PREDICT THE OBSERVED EFFECTS:
Signal currents follow the path of least impedance
Cable geometry effects and self-shielding
Conversion mechanisms between differential and common mode signal propagation
Impact of cable mechanical end termination geometry such as "pigtail" connections
Use of Common-Mode Chokes.

WEDNESDAY, AUGUST 7: 9:00 – 11:00AM

TOPIC: Why and Where to Connect the Shield on a Twisted Pair Cable

PRESENTER: Tom Van Doren

ABSTRACT: The metal braid or foil shield around a twisted pair of signal conductors can be used to reduce either electric field or magnetic field or electromagnetic wave emission and susceptibility depending on the shield material, construction, and where the shield is connected to the current path being protected. Where and how to

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connect the shield on a twisted pair depends on which of the 3 problems dominates a particular situation. In most cases, this shield is used to reduce electric field coupling to the twisted signal pair at frequencies below a few MHz. For this particular situation, the equivalent circuit model for electric field coupling will be explained and then used to demonstrate where the shield should be connected to reduce low frequency electric field emission and susceptibility. Several cabling examples will be used to demonstrate good and bad connection locations.

TOPIC: PCB-Based EMC Issues: Crosstalk vs. Circuit Topology

PRESENTERS: Scott Piper & Jim Teune Gentex Corp

ABSTRACT: Demonstration of PCB crosstalk as a function of PCB geometry and constitutive materials.

TOPIC: Make Pre-Compliance EMI Measurements On Your Bench

PRESENTER: Louann Devine, Panduit

ABSTRACT: The presentation will be brief review of the important parameters for EMI designs and explore real world applications. A review of how common mode emissions are generated will be discussed. The demo will focus on how to make an EMI probes and predict a small product's emissions and compare to semi-anechoic chamber measurements. This demo is based on one of Clayton Paul's experiments, but I think it helps explain and show how bench top measurements are useful for trouble shooting during the product development cycle.

WEDNESDAY, AUGUST 7: 2:00 – 4:00PM

TOPIC: Minimizing Magnetic Field Susceptibility

PRESENTERS: Mary Boghosian, Aerospace Corp, & Pablo Narvaez, NASA JPL

ABSTRACT: The Aerospace Corporation (Aerospace) with Jet Propulsion Laboratory (JPL) and Lockheed Martin Space Systems (LMSS) participated in the implementation of a magnetic cleanliness program of the NASA/JPL JUNO mission. This hardware experiment and demonstration will present magnetic shielding methods similar to those applied on JUNO hardware during magnetic cleanliness program.

TOPIC: Crosstalk Demonstration

PRESENTER: Chris Semanson

ABSTRACT: This demonstration is designed off of Clayton Paul's crosstalk lab found in the EMC Society lab manual, the goal of which is to introduce to the student the parameters which govern capacitive and inductive coupling between receptor and source circuits, and introduce them to different techniques commonly used to reduce crosstalk in cabling.

TOPIC: Knowing the Gap Between test Standards and ESD Phenomena in ESD Test

PRESENTER: Tony Tokuya

ABSTRACT: All ESD phenomena that occur in nature are air discharge. In the actual ESD test, the contact discharge method is also applied because of the test repeatability. This presentation explains the characteristic features and the differences between the contact discharge test and the air discharge test, showing some examples. In addition, this presentation proposes how to improve repeatability each of the two ESD test methods.

The contact discharge test is applied to the metal housing of the EUT. This test generates a fluctuation of electric potential and a surface current to the metal housing. An arc discharge is stabilized using gas filled relay of the ESD gun. The air discharge test is applied to the non-metal parts of the EUT, intended to be discharged to the internal metal part of the EUT. The air discharge test is affected by the air humidity or the approach speed of the ESD gun to the EUT.

Explanation of the test environment and the discharge current waveform defined in IEC 61000-4-2 standard, to discuss the purpose and meaning of the ESD test, showing some examples and experimental results.

Important points for test repeatability are discussed, including how to position the ground return cable, how to hold the ESD gun, and how to apply ESD to the EUT, etc.

THURSDAY, AUGUST 8 - 9:00 – 11:00AM

TOPIC: Using Near Field Probes with VSWR bridges in EMI/EMC.

PRESENTER: Arturo Mediano, University of Zaragoza, Zaragoza, Spain

ABSTRACT: A Voltage Standing Wave Ratio (VSWR) bridge is a device used by RF/MW engineers to discern between forward and reflected waves in transmission lines.

The bridge provides a sample from coupling to electric field and other to magnetic field in the line. They are summed resulting in addition in the forward orientation and subtraction in the reflected orientation.

The VSWR Bridge has three ports labelled as RFin (RF input port), RFout (RF output port) to be connected to the Device Under Test (DUT) and Coupled (Reflected signal from DUT).

We can use a typical EMI/EMC near field probe (NFP) to obtain an excellent design and troubleshooting tool.

Holding the NFP near a component, circuit, system, cable, PC board, structure, etc., while sweeping with the spectrum analyzer frequency in a range of interest, and there is a resonance, some part of the incident energy will be absorbed at that frequency and a "dip" will appear in the screen (part of the tracking generator output is being absorbed in the resonant system).

You can use this technique in a broad range of applications in EMI/EMC fields finding structural resonances in shields or cables, looking for resonances in PC board traces, etc.

In this experiment for EMC 2013, the basics for this technique will be explained and some real experiments will be developed to demonstrate its usefulness.

TOPIC: Spread Spectrum Clock Generation - The Great Debate

PRESENTER: Ken Wyatt

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Questions?

Mary Rehm Psychometrician mrehm@rabqsa.com

MONDAY, AUGUST 5

Learn more about iNARTE Certifications

This workshop is recommended for anyone interested in learning more about iNARTE certifications. During this workshop, you will learn more about the following iNARTE certification programs:

- EMC Engineer and Technician
- EMC Design Engineer
- Wireless Device Certification Professional
- Spectrum Management

You will have an opportunity to ask questions regarding application and examination for these programs, as well as an opportunity to take a practice test. Register today to take the certification exams for all of these programs by visiting: <http://www.narte.org/h/examregform.asp> Identify your testing location using the "Special Event Location" feature.

More information about iNARTE certifications

The EMC Engineer and Technician certification is currently under review and will be re-launched at the 2013 EMC Symposium. It is anticipated that a practitioner level of certification will be added to this certification program, opening the door for individuals entering this job role with a few years of work experience.

The Spectrum Management program is currently under development and will be launched at the 2013 EMC Symposium. Come to the workshop to learn more about this program or visit www.narte.org for more information and to apply.

The newest iNARTE programs include the EMC Design Engineer and Wireless Device Certification Profes-

sional certifications. Visit www.narte.org/h/wdcp.asp to learn more about the WDCP and www.narte.org/h/emcdesignengineer.asp to learn more about the Design Engineer, or visit us at the workshop.

AUGUST 6-8

Visit the iNARTE exhibition booth to learn more about the iNARTE Certification programs.

FRIDAY, AUGUST 9

The iNARTE Certification Examinations for the following programs will be held at the Symposium from 8:00 a.m. to 5:00 p.m.

- EMC Engineer and Technician
- EMC Design Engineer
- Wireless Device Certification Professional
- Spectrum Management Register for the exams by visiting <http://www.narte.org/h/examregform.asp>

Identify your testing location using the "Special Event Location" feature.

If you attend The Global EMC University lectures, this is an opportunity to validate your knowledge and experience by becoming iNARTE Certified. You may take the Examination at the Symposium and apply for the certification later, or apply now and register for the exam by visiting www.narte.com

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ANSI C63 TWO NEW WORKSHOPS FOR 2013:

ANSI C63.23

Guide for Computations and Treatment of Measurement Uncertainty - 1:00-5:00 PM Sheraton Colorado Room

ANSI C63.10

Standard for Testing Unlicensed Wireless Devices - 8:30AM-5:30PM Sheraton Colorado Room

(Visit www.c63.org for more information)

THIS WORKSHOP IS PRESENTED IN TWO PARTS COVERING:

(1) the present C63.10-2009 with emphasis on the proposed revision of C63.10-201x, due to be published this year. It captures in one place most of the procedures for testing unlicensed wireless devices to show compliance with to FCC requirements. (The FCC has referenced C63.20-2009);

(2) the mature draft of a C63.23 guide on measurement uncertainty highlighting the seldom used "Type A" repeat observations technique.

The two workshops are designed to increase understanding of both of these documents, as it applies to compliance testing unlicensed wireless devices and how to analyze the impact of measurement uncertainties (MU), respectively. Both standards will be covered in a two day workshop. The first day and half will provide an overview of C63.10 with specific emphasis on the new procedures (mentioned below). The remaining half day of the workshop, will cover MU for radiated and conducted emissions in accordance with C63.23. – Specifically, differences between type A and type B contributors and how Type A contributors can be achieved. Group discussions and demonstrations will be a highlight of this workshop. The instructors have an intimate knowledge of the technology and helped in the development of these procedures.

While covering all of C63.10-2009, this workshop will on focus on the following new material in C63.10-201x:

- Instrumentation (including detectors) requirements
- Average value of pulse emissions
- Reference level, attenuation headroom
- Antenna requirements
- Test site requirements > 1 GHz
- New exploration procedures < 30 MHz
- Test channel and test modes
- New procedures for > 1 GHz
- Alternative procedures > 1 GHz
- OBW procedures
- Band-edge procedures
- Frequency-hopping procedures
- New mm-wave procedures

- New DTS procedures
- New UNII procedures
- Revised MIMO procedures
- New vehicle FM transmitter procedure
- New inductive loop procedures
- Expanded cross-reference of FCC requirements and C63 10

In the half day MU workshop, you will learn:

- Basic concepts of Measurement Uncertainty
- Type A contributor analysis
- Type B contributor analysis
- How to conduct a Type A analysis
- What are the advantages and disadvantages of a Type A analysis

SUPPORT MATERIAL

- A complete lecture notebook
- Related FCC KDB interpretations

WHO SHOULD ATTEND

- Product Managers and Developers
- EMC Engineers and test technicians
- Regulatory Compliance Managers
- Test Instrumentation Developers
- Calibration labs/technicians
- Accreditation bodies and lab quality assessors
- Test instrumentation and chamber manufacturers

HOST HOTEL – SHERATON DENVER

See EMC symposium website for details.

DATE AND LOCATION

August 2-3, 2013: Symposium host hotel – Sheraton Denver.

(Workshop attendees are responsible for making and paying for hotel accommodations.)

EXPERT INSTRUCTIONS

Art Wall, ANSI C63® Wireless Working Group Chairman; Michael Heckrotte, UL, WWG member; Robert Delisi, UL, WWG member; Donald Heirman, Don HEIRMAN Consultants

FEE INCLUDES

Continental breakfast, lunch and breaks for both days and completion certificates. Soft copy of workshop notes will be provided.

(Fee does NOT include draft or published standards.)

AGENDA

C63.10 Wireless workshop:

Aug 2: Registration 8:30 am

Class: 9:00 am to 5:00 pm

Aug 3: Class 9:00 am to 12:00 pm

C63.23 Uncertainty workshop:

Aug 3: Registration: 12:30 pm

Class: 1:00 pm to 5:00 pm

GLOBAL EMC UNIVERSITY was first offered at the 2007 IEEE EMC Symposium in Honolulu to provide advanced education on a variety of topics that are an important part of EMC engineering. The overwhelming response to this program caused the EMC Society to add it to the technical program then and every year since. It has continued to receive high praise from those who attend. We are pleased to be able to offer Global EMC University once again at the 2013 IEEE International EMC Symposium in Denver, Colorado.

As was done in 2012, we are including Signal Integrity (SI) as a "parallel track." This change is one that required a name change to Global EMC and SI University. Signal integrity is an extremely important area that has seen a great deal of coverage within many tutorials, workshops, and special sessions within the EMC Society.

This year's Global EMC and SI University is approximately 18 hours of instruction on advanced EMC and SI related topics that are run in parallel with the traditional technical sessions at the symposium. Students are encouraged to participate in symposium workshops, exhibits and other activities when they are not in class. Classes are taught by an international panel of educators, who have been selected for this program based on their reputation for excellence in areas of practical importance to EMC engineers, and their demonstrated ability to communicate effectively with students.

OTHER INFORMATION ON GLOBAL UNIVERSITY

WHO IS IT FOR: Engineers, technicians and professionals who have been in EMC/SI at least 5 years or more.

OVERALL OBJECTIVE: To provide an in-depth exposure to the concepts and skills that are necessary to be successful in EMC/SI.

PREREQUISITES: Engineering or Technology Degree with Electrical Theory

A certificate of completion will be provided to students who have signed in and signed out each day thereby confirming 100% attendance at all lectures. Continuing Education Units (CEUs) will be assigned to this course

REGISTRATION: A 5-Day symposium registration is required in addition to the Global University fee for these special classes. Attendance is limited, and early registration for Global University is strongly recommended.

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SI UNIVERSITY
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NOTE: You must be paid in full by July 8 to receive the advanced rates.

Global University Schedule

TUESDAY, AUGUST 6

ESSENTIAL RULES OF THUMB

Eric Bogatin

INDUCTANCE AND RETURN CURRENT

Bruce Archambeault, IBM

TRANSMISSION LINES AND DIFFERENTIAL PAIRS

Robert Hay, Boise State University

HIGH SPEED SERIAL LINKS

Stephen Mueller, Teledyne- LeCroy

WEDNESDAY, AUGUST 7

JUST HOW GOOD IS YOUR SI SIMULATOR?

Heidi Barnes, Agilent

HIGH SPEED PROBING

- **Active Probes**

Larry Jacobs, Teledyne

- **VNA and TDR Probes**

Don DeGroot, CCM Labs

- **Passive Probes**

Chris Loberg, Tektronix

WAR STORIES: APPLYING THE PRINCIPLES

Jim Herrmann, Applied Logix

SI AND EMC DESIGN PRINCIPLES FOR CABLES AND CONNECTORS

Greg Fitzgerald, Molex

THURSDAY, AUGUST 8

RADIATED EMISSIONS

Lee Hill, Silent

ANTENNAS

Andy Marvin, University of York

CONDUCTED EMISSIONS AND POWER SUPPLY FILTERS

Mark Steffka, University of Michigan-Dearborn

EM SHIELDING

Don Sweeney, DLS Electronic Systems



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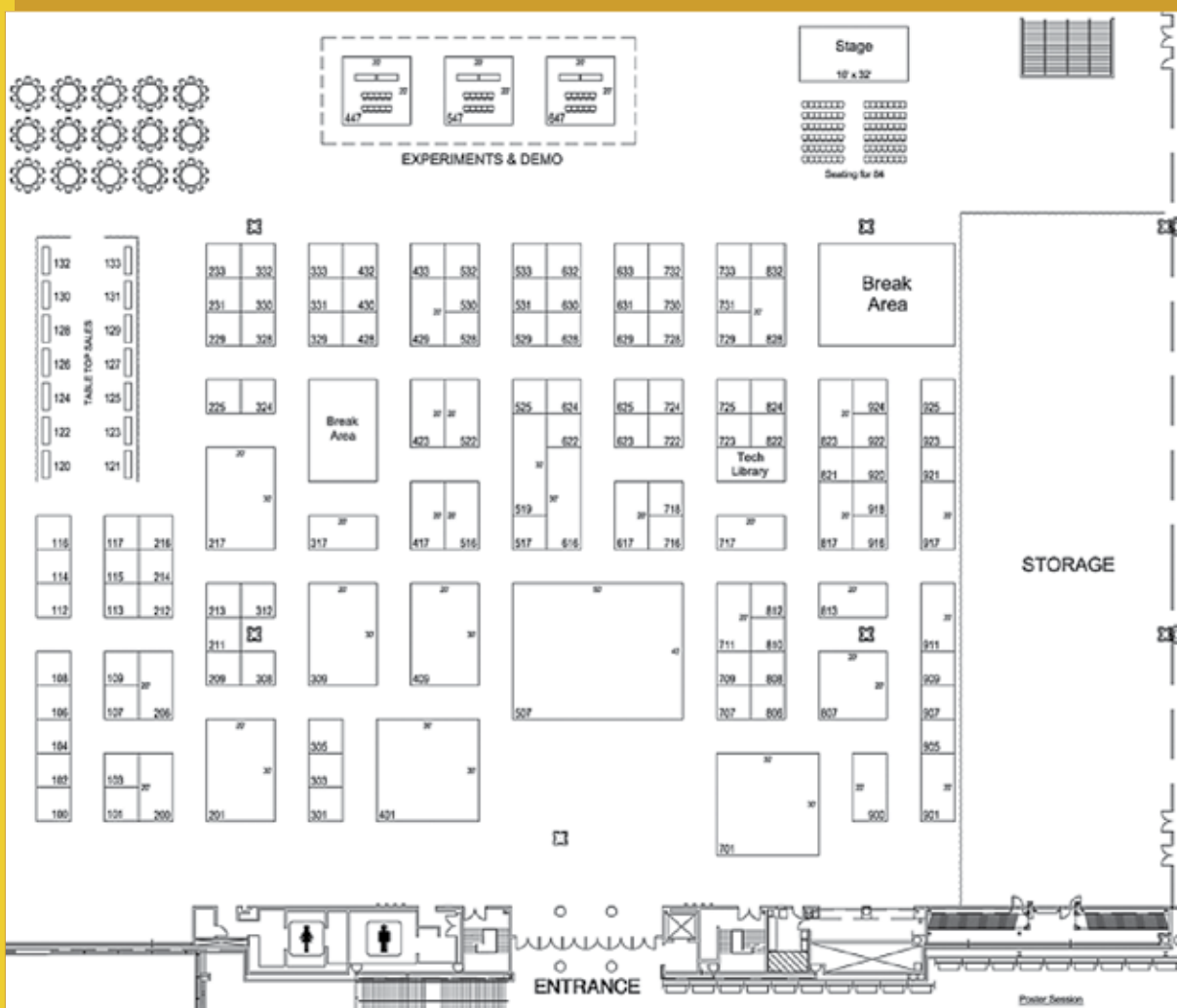
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ANSI-ASC C63 Committee on EMC	918	Fischer Custom Communications Inc	201
3G Metalworx Inc.....	728	Gauss Instruments GMBH.....	423
A.H. Systems, Inc.....	616	Genisco Filter Corporation	332
A2LA - American Association for Laboratory Accreditation..	823	Haefely EMC	625
Advanced Test Equipment Rentals	320	HV Technologies, Inc.	806
AE Techron.....	516	IEEE 2014 EMC Symposium	917
Agilent Technologies	830	IEEE EMC Society	921
American Council of Independent Laboratories (ACIL) ...	120	IEEE EMC SOCIETY HISTORY COMMITTEE	920
Amber Precision Instruments, Inc	731	IEEE EMC Society Standards.....	922
Amphenol Canada Corporation	429	IEEE PSES - Product Safety Engineering Society	124
Andro Computational Solutions.....	617	IN Compliance Magazine	317
Applied EM Technology & EMS-Plus.....	530	innco systems GmbH.....	631
AR RF / Microwave Instrumentation.....	507	Intelligent RF	122
ARC Technologies, Inc.	200	Interference Technology / ITEM Media	717
Axiom Test Equipment.....	622	Intermark-USA	828
Boeing.....	330	Intertek.....	729
Captor Corporation	825	Isodyne Inc.	431
Cascade Tek	821	Jiangsu WEMC Technology Co., Ltd	225
Cima NanoTech	214	Laird Technologies.....	305
Communiation and Power Industries	303	Leader Tech Inc.	907
COM-POWER	901	Liberty Labs, Inc. - World Cal, Inc.....	707
CST of America, Inc.	409	MET Laboratories	730
Cuming Lehman Chambers	417	Michigan Scientific Corp.	624
D.L.S. Electronic Systems, Inc.....	812	Microwave Journal.....	127
Dayton T. Brown, Inc.....	329	Microwave Vision Group	432
Delcross Technologies, LLC	519	MITEQ Inc.	216
Denkenseiki Research Institute Co., Ltd.....	328	Moss Bay EDA/IBM.....	528
Dexmet Corporation	209	NEC TOKIN	628
Detectus	428	Nemko USA.....	817
Dutch Microwave Absorber Solutions	709	NEXIO SAS	725
Dynamic Sciences International	633	NIST/NVLAP	324
East Coast Shielding	101	Noiseken / Shinyei Corp of American for Noiseken	331
EE-Evaluation Engineering	532	Northwest EMC.....	623
Electro-Magnetic Applications, Inc.	722	NTS.....	211
Elite Electronic Engineering, Inc.....	718	Oak-Mitsui Technologies.....	430
EM Software & Systems-FEKO	900	Ophir RF Inc	308
EM Test Switzerland GMBH	521	Panashield	711
EMCoS Ltd.....	905	Pearson Electronics Inc	723
Empower RF Systems.....	206	P-MT	229
EMSCAN	312	Quell Corporation	132
ENR.....	125	Reliant EMC	217
Espresso Engineering	913	RF Exposure Lab, LLC.....	824
ETS-Lindgren.....	401	Rigol Technologies USA.....	129
Fair-Rite Products	716	Rohde & Schwarz	701
Filconn Inc.	724	SAFETY & EMC Magazine.....	128

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Schlegel Electronic Materials, Inc.	529	Thermo Fisher Scientific, Inc.	522
SciTech Publishing / TheIET	632	Timco Engineering, Inc.	916
SGS North America Inc	213	Tomurt Electronics	121
Simberian Inc.	126	Transient Specialists, Inc.	531
Souriau PA&E	822	TRU Corporation	924
Spira Manufacturing Corp	517	TUV Rheinland of N.A.	301
TDK Corporation of America	807	Universal Shielding Corp.	629
Techmaster	533	V Technical Textiles, Inc./ Shieldex U.S.	123
Tektronix, Inc.	732	Vectawave	819
TESEQ, Inc.	309	WIPL-D	433
The Nippon Synthetic Chemical Industry Co, LTD	909	Wurth Electronics Midcom	316

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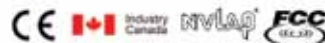
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FERRITE BEADS & CORES

Fair-Rite Products Corp.....
Leader Tech, Inc.....
MAJR Products.....

FERRITE SUPPRESSION COMPONENTS

ARC Technologies, Inc.....
Fair-Rite Products Corp.....
Intermark (USA) Inc.....
Leader Tech, Inc.....

FIBER OPTIC CABLES/SYSTEMS

Advanced Test Equipment Rentals.....
Fischer Custom Communications, Inc.....
HV Technologies Inc.....
Michigan Scientific Corp.....

FIELD INTENSITY METERS

Advanced Test Equipment Rentals.....
ETS-Lindgren.....

FILTER ARRAYS

Curtis Industries/ Filter Networks.....
Quell Corp.....

FILTER CAPACITORS

API Technology-Spectrum Control.....
Curtis Industries/ Filter Networks.....
EMI Filter Company.....
Quell Corp.....

FILTER CHOKES

Curtis Industries/ Filter Networks.....
Fair-Rite Products Corp.....
Schurter, Inc.....

FILTER COILS

Curtis Industries/ Filter Networks.....
Schurter, Inc.....

FILTER CONNECTORS

Amphenol Canada.....
API Technology-Spectrum Control.....

FILTER MODULES

Curtis Industries/ Filter Networks.....
Schurter, Inc.....

FILTER PINS/PIN CONNECTORS

EMI Filter Company.....
Quell Corp.....

FILTERED POWER ENTRY MODULES

Americor.....
API Technology-Spectrum Control.....
Curtis Industries/ Filter Networks.....
Schurter, Inc.....
Tri-Mag, Inc.....
V Technical Textiles, Inc./Shieldex U.S.....

FILTERS

Americor.....
Amphenol Canada.....
Curtis Industries / Filter Networks.....
EMI Filter Company.....
Souriau PA&E.....
WEMS Electronics.....

GTEM CELLS

Fischer Custom Communications, Inc.....
Rohde & Schwarz, Inc.....

H FIELD ANTENNAS

A.H. Systems, Inc.....
AR RF / Microwave Instrumentation.....
EM TEST USA.....
Rohde & Schwarz, Inc.....

HELMHOLTZ COILS

ETS-Lindgren.....
Fischer Custom Communications, Inc.....

HONEYCOMB SHIELDING

Leader Tech, Inc.....
Spira Manufacturing Corp.....
Tech-Etch, Inc.....
V Technical Textiles, Inc./Shieldex U.S.....

HORN ANTENNAS

A.H. Systems, Inc.....
Advanced Test Equipment Rentals.....
AR RF / Microwave Instrumentation.....
ETS-Lindgren.....
HV Technologies Inc.....
Rohde & Schwarz, Inc.....
TESEQ, Inc.....

IMMUNITY TESTING

A.H. Systems, Inc.
EM TEST USA
National Technical Systems.....
Nemko USA
Reliant EMC.....
Retlif Testing Laboratories.....
TESEQ, Inc.
TÜV SÜD America Inc.....

IMPULSE GENERATORS

Advanced Test Equipment Rentals
AR RF / Microwave Instrumentation.....
EM TEST USA
EMC Partner AG
HV Technologies Inc.
TESEQ, Inc.

INDUCED CURRENT METERS & PROBES

AR RF / Microwave Instrumentation.....
ETS-Lindgren.....

INDUCTORS

Curtis Industries/ Filter Networks
Schurter, Inc.

INTERFERENCE GENERATORS

Advanced Test Equipment Rentals
EMC Partner AG
EM TEST USA

ISOTROPIC FIELD SENSORS

ETS-Lindgren.....

LIGHTNING GENERATORS

Advanced Test Equipment Rentals
EM TEST USA
EMC Partner AG
Fischer Custom Communications, Inc.....
HV Technologies Inc.

LIGHTNING SIMULATORS

Advanced Test Equipment Rentals
EM TEST USA
Fischer Custom Communications, Inc.....
HV Technologies Inc.

LIGHTNING STRIKE TESTING

National Technical Systems.....
Retlif Testing Laboratories.....
TÜV SÜD America Inc.....

LINE IMPEDANCE STABILIZATION NETWORKS (LISNS/PLISNS)

Fischer Custom Communications, Inc.....
TESEQ, Inc.

LOG PERIODIC ANTENNAS

A.H. Systems, Inc.
Advanced Test Equipment Rentals
AR RF / Microwave Instrumentation.....

Rohde & Schwarz, Inc.....

MAGNETIC FIELD PROBES/METERS

AR RF / Microwave Instrumentation.....
ETS-Lindgren.....
Fischer Custom Communications, Inc.....
Rohde & Schwarz, Inc.....

MAGNETIC SHIELDING GASKETS

Spira Manufacturing Corp.....

MICROWAVE ABSORBERS

ARC Technologies, Inc.
Dutch Microwave Absorber Solutions.....
Laird Technologies.....
Leader Tech, Inc.

MICROWAVE FILTERS

EMI Filter Company.....
V Technical Textiles, Inc./Shieldex U.S.....

MICROWAVE POWER AMPLIFIERS

Advanced Test Equipment Rentals
AR RF / Microwave Instrumentation.....
HV Technologies Inc.
Ophir RF.....
R&K Company Limited.....

MIL-STD 188/125 TESTING

MET Laboratories Inc.....
National Technical Systems.....

MIL-STD 461/462 TESTING

National Technical Systems.....
TÜV SÜD America Inc.....

MOBILE SHIELDED ROOMS

Advanced Test Equipment Rentals

MONOPOLE ANTENNAS

Rohde & Schwarz, Inc.....

MRI SHIELDING

ETS-Lindgren.....
Leader Tech, Inc.
Mushield Company
Panashield
Universal Shielding Corp.
V Technical Textiles, Inc./Shieldex U.S.....

NAVLAP / A2LA APPROVED TESTING

Cascade Tek
National Technical Systems.....
Northwest EMC Inc.

NETWORK ANALYZERS

Agilent Technologies, Inc.

PARALLEL PLATE LINE TEST SET

ETS-Lindgren.....
Fischer Custom Communications, Inc.....

Rohde & Schwarz, Inc.....

PORTABLE TEST EQUIPMENT

A.H. Systems, Inc.
Advanced Test Equipment Rentals

POWER LINE FILTERS

Curtis Industries/ Filter Networks
Schurter, Inc.
Reliant EMC.....
V Technical Textiles, Inc./Shieldex U.S.....

PRINTED CIRCUIT BOARD FILTERS

Curtis Industries/ Filter Networks
Schurter, Inc.
Tri-Mag, Inc.

PRODUCT SAFETY TESTING

National Technical Systems.....
Nemko USA
Retlif Testing Laboratories.....
TIMCO Engineering, Inc.....

RADIATION HAZARD METERS/PROBES

Advanced Test Equipment Rentals
ETS-Lindgren.....

RETROFIT FILTERS & CONNECTORS

Amphenol Canada
Curtis Industries/ Filter Networks
Quell Corp.
Schurter, Inc.
V Technical Textiles, Inc./Shieldex U.S.....

RF POWER AMPLIFIERS

Advanced Test Equipment Rentals
AR RF / Microwave Instrumentation.....
HV Technologies Inc.
Ophir RF.....
R&K Company Limited.....
TESEQ, Inc.

RF POWER METERS

AR RF / Microwave Instrumentation.....
ETS-Lindgren.....
Rohde & Schwarz, Inc.....

RF SHIELDING GASKETS

MAJR Products
Spira Manufacturing Corp.....
Tech-Etch, Inc.

RF SHIELDING MATERIAL

Dexmet Corporation.....
Spira Manufacturing Corp.....
Tech-Etch, Inc.
V Technical Textiles, Inc./Shieldex U.S.....

RS03<200 V/METER TESTING

Elite Electronic Engineering Inc.
National Technical Systems.....

RTCA DO-160 TESTING

Cascade Tek
National Technical Systems.....
Retlif Testing Laboratories.....
TÜV SÜD America Inc.....

SCIF DESIGN, CONSTRUCTION, & MAINTENANCE

ETS-Lindgren.....

SHIELDED AIR FILTERS

ETS-Lindgren.....
Leader Tech, Inc.
Spira Manufacturing Corp.....
Tech-Etch, Inc.....

SHIELDED BUILDINGS

Advanced Test Equipment Rentals
ETS-Lindgren.....
MET Laboratories Inc.....
V Technical Textiles, Inc./Shieldex U.S.....

SHIELDED COMPONENTS

Schurter, Inc.
Spira Manufacturing Corp.....
Tech-Etch, Inc.....

SHIELDED DOORS

ETS-Lindgren.....
Panashield
V Technical Textiles, Inc./Shieldex U.S.....

SHIELDED FANS

ETS-Lindgren.....
Leader Tech, Inc.
Spira Manufacturing Corp.....
Tech-Etch, Inc.....

SHIELDED ROOM FILTERS

ETS-Lindgren.....
Panashield
V Technical Textiles, Inc./Shieldex U.S.....

SHIELDED ROOMS

Advanced Test Equipment Rentals
Applied Electromagnetic Technology
Braden Shielding Systems
ETS-Lindgren.....
Panashield

SHIELDED ROOMS/ACCESSORIES

Leader Tech, Inc.
National Technical Systems.....
V Technical Textiles, Inc./Shieldex U.S.....

SHIELDED ROOMS / LEAK DETECTORS

ETS-Lindgren.....

SHIELDED TUBING

Mushield Company

SHIELDING

Intermark (USA) Inc.
Metal Textiles Corp.....
Mushield Company
Panashield
Quell Corp.....
Vermillion Inc.....

SHIELDING EFFECTIVENESS TESTING

ETS-Lindgren.....
Leader Tech, Inc.
National Technical Systems.....
Retlif Testing Laboratories.....
TÜV SÜD America Inc.....

SHIELDING, MAGNETIC FIELD

Silk Metallic Corporation.....
Spira Manufacturing Corp.....

SIGNAL GENERATORS

Advanced Test Equipment Rentals
Agilent Technologies, Inc.....
AR RF / Microwave Instrumentation.....
Rohde & Schwarz, Inc.....

SIGNAL LINE FILTERS

Curtis Industries/ Filter Networks
EMI Filter Company.....
ETS-Lindgren.....
V Technical Textiles, Inc./Shieldex U.S.....

SITE ATTENUATION TESTING

ETS-Lindgren.....
MET Laboratories Inc.....
National Technical Systems.....

SITE SURVEY SERVICES

ETS-Lindgren.....
National Technical Systems.....

SOFTWARE, EMI/EMC RELATED

2comu.....
ANSYS, Inc. (Ansoft Products).....
Delcross Technologies, LLC.....
Detectus (Interfax)
Electro-Magnetic Applications, Inc.....
EM Software & Systems (USA) - FEKO.....
EMSCAN
Moss Bay EDA
NEXIO.....
Techcelerant.....

SOLID-STATE AMPLIFIERS

AR RF / Microwave Instrumentation.....
HV Technologies Inc.....
R&K Company Limited.....

SPECTRUM ANALYZERS

Agilent Technologies, Inc.
Rohde & Schwarz, Inc.....

STANDARDS TRANSLATIONS

ANDRO Computational Solutions, LLC.....
TÜV SÜD America Inc.....

STATIC CONTROL MATERIALS & EQUIPMENT

Advanced Test Equipment Rentals

SUPPRESSORS

Fair-Rite Products Corp.....
Fischer Custom Communications, Inc.....

TELCORDIA TESTING

MET Laboratories Inc.....
National Technical Systems.....
TÜV SÜD America Inc.....

TELECOMMUNICATIONS TEST NETWORKS

Advanced Test Equipment Rentals
Agilent Technologies, Inc.
Ophir RF.....

TEM CELLS

Advanced Test Equipment Rentals
ETS-Lindgren.....
Fischer Custom Communications, Inc.....
Rohde & Schwarz, Inc.....
TESEQ, Inc.

TEMPEST TESTING/ TEST EQUIPMENT

A.H. Systems, Inc.
Advanced Test Equipment Rentals
Curtis Industries/ Filter Networks
Fischer Custom Communications, Inc.....
National Technical Systems.....
Rohde & Schwarz, Inc.....
Shinyei Corporation of America (Noiseken).....

TEST ACCESSORIES

A.H. Systems, Inc.
Advanced Test Equipment Rentals
AR RF / Microwave Instrumentation.....
EM TEST USA
ETS-Lindgren.....
Fischer Custom Communications, Inc.....
Inco Systems GmbH.....
Ophir RF.....
Rohde & Schwarz, Inc.....
TESEQ, Inc.

TEST EQUIPMENT, LEASING & RENTAL

A.H. Systems, Inc.
Advanced Test Equipment Rentals
AR RF / Microwave Instrumentation.....
EM TEST USA
TESEQ, Inc.

TEST EQUIPMENT, REPAIR & CALIBRATION

Advanced Test Equipment Rentals
Agilent Technologies, Inc.
ETS-Lindgren.....
Fischer Custom Communications, Inc.....

Tektronix, Inc.
TESEQ, Inc.

TEST INSTRUMENTATION

A.H. Systems, Inc.
EMI Instrumentation
Haefely EMC
HV Technologies Inc.
Pearson Electronics Inc.
Thermo Fisher Scientific.....

TESTING

A.H. Systems, Inc.
DNB Engineering, Inc.
Electronics Test Centre (ETC) - Kanata.....
Empower RF Systems, Inc.
Intertek
NAVAIR
Nemko USA Inc.
NEXIO.....
Northwest EMC Inc.
Qualtest
Retlif Testing Laboratories.....
RF Exposure Lab LLC.....
Timco Engineering Inc.
TUV Rheinland of North America, Inc.
Washington Laboratories, Ltd.

TESTING LABORATORIES

D.L.S. Electronics Systems Inc.
Elite Electronic Engineering Inc.
Liberty Labs Inc.-World Cal Inc.....
National Technical Systems.....
Northwest EMC Inc.
Qualtest
Retlif Testing Laboratories.....
TIMCO Engineering, Inc.

TRAINING, SEMINARS, & WORKSHOPS

A2LA
China Electrotechnical Society (CES).....
CST of America, Inc.
Delcross Technologies, LLC.....
EM TEST USA
Kimmel Gerke Associates, Ltd.....
Leader Tech, Inc.
TESEQ, Inc.

TRANSIENT DETECTION & MEASURING EQUIPMENT

Advanced Test Equipment Rentals
AR RF / Microwave Instrumentation.....
Transient Specialists, Inc.

TRANSIENT GENERATORS

Advanced Test Equipment Rentals
AR RF / Microwave Instrumentation.....
EM TEST USA
EMC Partner AG
Fischer Custom Communications, Inc.....
Haefely EMC
TESEQ, Inc.
Transient Specialists, Inc.

TRAVELING WAVE TUBE AMPLIFIERS

AR RF / Microwave Instrumentation.....

VOLTAGE PROBES

Advanced Test Equipment Rentals
Fischer Custom Communications, Inc.....
Haefely EMC
Rohde & Schwarz, Inc.


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DISCOVERING DENVER, CO DURING THE 2013 EMC SYMPOSIUM



WELCOME TO DENVER! The mile-high city has plenty of destinations and attractions for you to enjoy during your stay. Denver is beautiful in the summertime. Take in the sights of beautiful flora and fauna at the Denver Botanic Gardens or venture a little further and go for a hike in Rocky Mountain National Park. The Denver Zoo offers plenty for an animal-lover – the zoo has 3,500 different animals, representing more than 650 species.

For those interested in history and culture, visit the U.S. Mint, Colorado State Capital or Denver Art Museum. Looking to shop and socialize instead? Check out the 16th Street Mall, a mile-long promenade which has 200 trees, 50,000 flowers and 28 outdoor cafes. More shopping can be had at Cherry Creek Shopping District, with its more than 500 upscale stores.

Finally, relax from your long day with dinner and a tour of a local brewery. Coors is located in Denver; join them for a Coors Brewery Tour – free samples for those over 21!

Denver has history, culture, fun and adventure all rolled into one large city. The only problem is making enough time to do it all!

Companion Program

MONDAY, AUG. 5

DENVER CITY HIGHLIGHTS WITH STATE CAPITOL TOUR

Experience two sides of Denver - a historic western town and thriving modern city - all in the same trip. Travel through the quiet tree-lined streets of Denver's residential neighborhoods and journey back to the 19th century.

Witness the elegance of historic Larimer Square and the lovely Victorian mansions.

Along the way, you will pass a variety of cultural attractions, such as our beautiful City Park, Civic Center Park, the United States Mint and the Denver Art Museum, to name a few. Another highlight is bustling 17th Street, Denver's financial nerve center with its towering skyscrapers set against the backdrop of the Rocky Mountains. A picture stop will be made at Mile High Stadium, home of the Colorado Bronco's and one of the top tourist stops in the Denver area.

We will end the sightseeing drive at the State Capitol, where we will enjoy a box lunch. Following lunch we will see and tour the spectacular State Capitol Building.

DEPART at 10 a.m. and return at 3:30 p.m., tour buses will be boarding on Court Place next to Katie Mullens.

COST: \$50 per person includes transportation and city tour, the State Capitol tour and a box lunch. Box lunch choices are: ha.m., turkey, roast beef, club or veggie and includes chips, drink and a cookie. Sandwich choices are needed by Aug. 1. (For those who miss the deadline, lunch is available at the Capital Building.)

TUESDAY, AUG. 6

HISTORIC BROWNS

Today we tour the "Unsinkable" Molly Brown House, the entirely restored home of Colorado's most colorful Victorian heroine. Located in the Capitol Hill area, the house was originally built in the late 1800's and reflects turn-of-the-century Victorian influence.

Next we visit the historic Brown Palace Hotel. Known to native's as "The Brown," this hotel has welcomed the rich and famous since opening in 1892.

We will enjoy their signature afternoon High Tea complete with scones, garden tea sandwiches, pastries and tea....along with one glass of Browns Kir Royale! (Martinelli sparkling cider is available). After tea, we will begin a behind-the-scenes tour of "The Brown" revealing loads of secrets!

DEPART at 10 a.m. and return at 4 p.m.. Tour buses will be boarding on Court Place next to Katie Mullens.

COST: \$79 per person includes transportation, both tours and the tea

Tour the historic Molly Brown House on Tuesday, Aug. 6. ▶

WEDNESDAY, AUG. 7

DENVER MOUNTAIN PARKS AND COORS BREWERY TOUR

This unforgettable tour displays Colorado's variety of natural treasures.

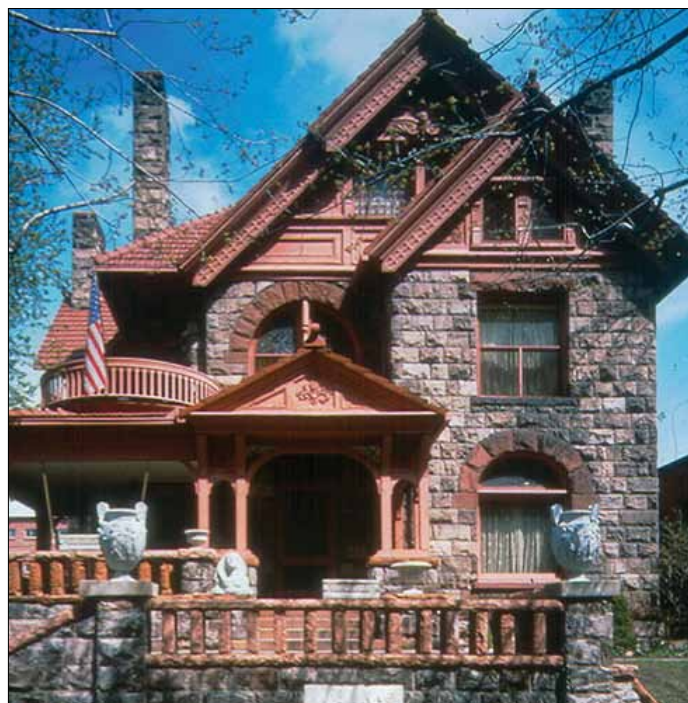
We travel through the preserved wilderness of the splendid Rocky Mountain foothills.

Our first stop is Red Rocks Park, the 250 million year-old geological creation named after its red sandstone monoliths. Here, take time to view the majestic amphitheater setting, stroll, explore and take photos. Then, we journey up Bear Creek Canyon, the tranquil home to mountain communities and wildlife, such as elk, deer and buffalo!

We continue on to visit the Buffalo Bill Cody Grave Site (and museum) at Lookout Mountain located above Denver, where you can witness breathtaking views. Homeward bound we stop in Golden for lunch at the Old Capitol Grill, one of Colorado's most historic buildings and was the first capitol building of the Colorado Territory. After lunch we board the bus for a short hop over to the Coors Brewery for a self-guided walking tour of the facility and with proper ID, beer sampling!

DEPART at 9:30 a.m. and return 4 p.m.. Tour buses will be boarding on Court Place next to Katie Mullens.

COST: \$66 per person includes transportation, lunch and Coors tour. Lunch choices are: salmon, chicken or buffalo burgers with baked potato, Texas Toast and drink. Lunch choices are needed by Monday, Aug. 5.



THURSDAY, AUG. 8

WHISTLES, BELLS AND MOUNTAIN PEAKS

All aboard for thrills, chills and a photographer's dream come true! Today we travel westward and climb into the foothills, heading along Squaw Pass, where you will see beautiful flora and fauna.

Our first stop is the historic lodge on Echo Lake with many photo opportunities of some beautiful scenes. While at Echo Lake Lodge you will enjoy a delicious lunch combined with the unforgettable mountain scenery. After lunch we head to Silver Plume to board the Colorado Historical Society's Georgetown Loop Railroad!

Leap back into time while riding this 19th century narrow gauge railway at over 9,000 feet above sea level. Take a breathtaking descent down an ancient canyon and equally exciting return trip! Then we drive through the historic Mecca of Georgetown where impressive Victorian homes, buildings and unique shops still exist.

DEPART at 8:30 a.m. and return at 5:30 p.m.. Tour buses will be boarding on Court Place next to Katie Mullens.

COST: \$95 per person includes transportation, fully guided excursion, lunch at Echo Lodge and train tickets...lunch selections: hamburger, veggie burger, homemade tuna salad stuffed tomato, homemade Buffalo Chili or turkey sandwich. Entrees include your choice of drink AND a piece of homemade pie with ice cream!

Recommended: Bring a camera and light jacket

FRIDAY, AUG. 9

PIKES PEAK, GARDEN OF THE GODS AND THE AIR FORCE ACADEMY

A pleasure-filled, unforgettable day! As the tour leaves Denver, heading south on Interstate 25, watch for the town of Castle Rock to the east, pinpointed by the huge rock that depicts its name. Then enjoy the scenic drive through the United States Air Force Academy and the celebrated Cadet Chapel with impressive mountain views and fine architecture.

Next we drive through beautiful Colorado Springs, the state's second largest city. Tour the fantastic Garden of the Gods with its magnificent red sandstone rock formations, followed by lunch at the Old Trading Post.

Tour climaxes with the ascent of Pikes Peak by boarding the Pikes Peak Cog Railway. Known as the world's highest cog railway, it is 9 miles long

and climbs from a starting elevation of 6,571 to 14,110 feet at the summit of Pikes Peak. Pass above the tree line, then up to the summit for gorgeous panoramic views of the plains and western mountains.

We owe the inspiration for the lyrics of the beloved song "America the Beautiful" to the stunning vistas from the summit of Pikes Peak.

Please note: Due to national security, access to the USAF may not be available. Instead, a visit to the US Olympic Training Facility may be substituted.

DEPART at 8:30 a.m. and return 5:30 p.m. Tour buses will be boarding on Court Place next to Katie Mullens.

COST: \$95 per person includes transportation, fully-guided excursion, lunch and cog wheel tickets Recommended: Camera and light jacket as the temperature can be 30 degrees cooler at the summit.

Board the Colorado Historical Society's Georgetown Loop Railroad on Thursday, Aug. 8. ▼



Pikes Peak is a mountain in the front range of the Rocky Mountains in Pike National Forest - see it Friday, Aug. 9.





MONDAY, AUG. 5

CHAPTER CHAIR TRAINING SESSION AND DINNER

The Chapter Chair Training Session and Dinner will be held on Aug. 5.

The Chapter Chair Training Session provides a forum for providing focused training to the Chapter Chairs, provides the Chapter Chairs with the opportunity to discuss their chapter issues and get group feedback, 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 Directors.

A Social Session will precede the Dinner, to give the Chapter Chairs the opportunity to socialize with the other Chapter Chairs and their Angels.

The Dinner 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 Dinner, an interactive brainstorming session will conclude the meeting. This session is intended 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.

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.

TUESDAY, AUG. 6

WELCOME RECEPTION

Join us for the Welcome Reception at Katie Mullen's Irish Pub. One ticket to this event is included in all 5-Day technical registrations and the Companion Program registration. All others may purchase a ticket to the Welcome Reception as an add-on to your registration.

- An Adult Reception
Ticket price: \$55 (Advance)/\$65 (Regular)
- A Junior (Age 8 to 17, inclusive)
Reception Ticket is: \$25 (Advance)/\$35 (Regular)
- Children under age 8 are free,
but must be accompanied by a registered adult.

GOLD EMC ICE CREAM SOCIAL

After the Tuesday Welcome Reception from 7:30 - 9 p.m. at the Sheraton Hotel GOLD EMC will have a table to provide you with GOLD EMC information and a Raffle ticket. Only GOLD EMC eligible can receive a raffle ticket so your chance of winning is high! Look for us by the Registration desk.

RAFFLE SCHEDULE:

1. At the Ice Cream Social
2. At the Engineering Ethics session
3. At the GOLD EMC Booth on Thursday during the afternoon break at 3:15 p.m.

WEDNESDAY, AUG. 7

FOUNDERS AND PAST-PRESIDENTS LUNCHEON

The Founders and Past-Presidents Luncheon will be held at the convention center. The Luncheon is open to the Founders of the EMC Society, Past-Presidents of the EMC Society, current members of the Board of Directors, and students. The luncheon is a chance for the old and the new to mix, exchanging experiences of the past, challenges of the future and learning about the EMC profession. A sit down lunch is provided. When making your reservation, please indicate that you plan to attend so there will be seating and food for you.

GALA EVENT

**EVENING ENTERTAINMENT,
THE FLYING W WRANGLERS**

One ticket to this event is included in all 5-Day technical registrations except student registrations. This is a change from last year, made to keep student registration costs down. Extra tickets to the Gala may be purchased as an add-on to your registration.

- An Adult Gala Ticket is:
\$80 (Advance)/\$90 (Regular)
- A Junior (Age 8 to 17, inclusive) Gala Ticket is:
\$35 (Advance)/\$45 (Regular)
- Children under age 8 are free,
but must be accompanied by a registered adult



◀ Visit our Facebook page at
www.facebook.com/ieeegoldemc
GOLD EMC or eligible members only



LEFT: The Flying W Wranglers will perform at the Gala Wednesday, Aug. 7.

RIGHT: Katie Mullen's Irish Pub will host the Welcome Reception Tuesday, Aug. 6.

THURSDAY, AUG. 8

AWARDS LUNCHEON

The Awards Luncheon will be held on Aug. 8. The Awards Luncheon will be the last formal opportunity to gather 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.

One ticket to this event is included in all 5-Day technical registrations. All others may purchase a ticket to the Awards Luncheon as an add-on to their registration.

- An Adult Awards Luncheon Ticket is: \$45 (Advance)/\$50 (Regular)
- A Junior (Age 8 to 17, inclusive) Awards Luncheon Ticket is: \$20 (Advance)/\$25 (Regular)
- Children under age 8 are free, but must be accompanied by a registered adult.

ANTICIPATED AWARDS:

- Best Symposium Paper
- Best Visual Poster Paper
- Best Student Paper
- Special Service
- Richard R. Stoddart Award for Outstanding Performance
- Lawrence G. Cumming Award for Outstanding Service
- President's Memorial Award 2nd Year Extension
- President's Memorial Award
- Technical Achievement Award
- Honorary Life Member Award
- Certificate of Appreciation
- Certificate of Acknowledgement
- Certificate of Recognition
- Hall of Fame
- Sustained Service
- Symposium Chair Award
- Richard B. Schultz Best Transactions Paper Award

LOCAL BREWERIES: SELF-GUIDED WALKING TOUR

Denver is becoming well-known for its Micro-Brewery industry. We are lucky in the fact that several small breweries are within walking distance from the convention center and hotels. Listed below are six of the breweries. Walk to these breweries at your leisure. Besides great beer, several of these breweries have great food menus. On Thursday night all of the breweries will give you \$1 off each glass of beer if you show your EMC conference badge. Enjoy your walk and enjoy your beer responsibly.

1) GREAT DIVIDE BREWING CO

(great beer, no food)

2201 Arapahoe Street, 303-296-9460
www.greatdivide.com

2) RIVER NORTH BREWERY

(great beer, food trucks)

2401 Blake Street, Unit 1, 303-296-2617
www.rivernorthbrewery.com

3) BRECKENRIDGE BREWERY

(great beer and food)

2220 Blake Street, 303-297-3644
www.breckbrew.com

4) CHOP HOUSE AND BREWERY

(great beer and food)

1735 19th Street, 303-296-0800
www.chophouse.com

5) WYNKOOP BREWING COMPANY

(great beer and food)

1634 18th Street, 303-297-2700
www.wynkoop.com

6) ROCK BOTTOM RESTAURANT AND BREWERY

(great beer and food)

1001 16th Street #100, 303-534-7616
www.rockbottom.com



TEAM EMC BIKE RIDE

Interested in exploring some of Denver's many biking trails with your fellow EMCS members? The first annual Team EMC bike ride is tentatively scheduled for Tuesday morning.

Please join us for a leisurely morning ride to get some exercise and to explore part of the city. Aug. is a beautiful time of year in Denver. A Team EMC jersey will be included.

We can arrange the Bike rental with **The Bike Doctor Bike Shop** <http://bicycledr.com>. (Approximate Price \$30- \$75 depending on bike selected). Beach Cruiser Bikes, Comfort Bike, Mountain Bike to High Performance Road Bikes are available.

We will have to rent the bike the night before since the bike shop doesn't open till 10 a.m.

You will need to provide the type bike you want, size (or your height if you don't know). Helmets and bike locks are included with the rental. If you want to use your bike shoes and need clipless pedals you can bring your own or pay \$10 extra. Almost all pedal types are available. They can only provide up to 30 bikes so please sign up early to insure availability. You are also welcome to bring your own bike.

Contact Ray Adams for more details
at r.k.adams@ieee.org

Restaurants

SYMPOSIUM TRIPS ARE EXPENSIVE, IS THERE ANYTHING CHEAP TO EAT?

BACKSTAGE COFFEE COFFEE, BREAKFAST

1000 14th Street
Denver, CO 80202
303-623-1300

\$5-10 per entrée

BONEY'S BARBECUE BARBECUE, DELIVERY

1555-C Champa Street
Denver, CO 80202
303-825-9900
www.boneysbbq.com

\$10-15 per entrée

CHEBA HUT TOASTED SUBS SANDWICHES/SUBS

1531 Champa Street
Denver, CO 80202
720-974-1880
www.chebahut.com

\$10-15 per entrée

CITY GRILLE AMERICAN

321 East Colfax Avenue
Denver, CO 80203
303-861-0726
www.citygrille.com

\$5-15 per entrée

DOZENS BREAKFAST, CAFÉ

236 West 13th Avenue
Denver, CO 80204
303-572-0066
<http://dozensdenver.com>

\$5-15 per entrée

LEELA'S EUROPEAN CAFÉ BREAKFAST, PANINI

820 15th Street
Denver, CO 80202
303-534-2255
www.leelacafe.com

\$5-10 per entrée

MICI HANDCRAFTED ITALIAN PIZZA, ITALIAN, DELIVERY

1531 Stout Street
Denver, CO 80202
302-629-6424
www.miciitalian.com

\$5-15 per entrée

ORGANIC PIZZA COMPANY PIZZA, DELIVERY

891 14th St, Suite 120
Denver Co, 80202
720-956-1520
<http://organicpizzacompany.net>

\$10-20 per entrée

SAM'S #3 MEXICAN, AMERICAN, MEDITERRANEAN

1500 Curtis Street
Denver, CO 80202
303-534-1927
<http://samsno3.com>

\$10-20 per entrée

SNARF'S SUB SHOP SANDWICH SHOP

891 14th Street, Suite 160
Denver, CO 80202
303-573-3939
www.eatsnarfs.com

\$5-10 per entrée



WOK UPTOWN CHINESE, DELIVERY

1789 Ogden Street
Denver, CO 80218
303-861-2888
www.wokuptown.com

\$10-15 per entrée



LOOKS GOOD BUT I'M TRYING TO IMPRESS MY CLIENT!

BONES ASIAN, FRENCH

701 Grant Street
Denver, CO 80203
303-860-2929
www.bonesdenver.com
\$15-20 per entrée

CAFÉ BERLIN GERMAN

1600 Champa Street, Unit 230
Denver, CO 80202
303-377-5896
www.cafeberlindenver.com
\$10-20 per entrée

CHOLON ASIAN

1555 Blake Street, Suite 101
Denver, CO 80202
303-353-5223
https://www.cholon.com
\$10-20 per entrée

Denver asian restaurant
ChoLon, which means "big
market," is named after the
largest Chinese-influenced
market in Saigon, Vietnam.

EUCLID HALL BAR & KITCHEN CONTEMPORARY

1317 14th Street
Denver, CO 80202
303-595-4255
http://www.euclidhall.com/
\$10-20 per entrée

IZAKAYA DEN JAPANESE, SUSHI

1518 South Pearl Street
Denver, CO 80210
303-777-0691
www.izakayaden.net
\$10-20 per entrée

JAX FISH HOUSE & OYSTER BAR SEAFOOD

1539 17th Street
Denver, CO 80202
303-292-5767
www.jaxdenver.com
\$15-30 per entrée

LITTLE INDIA INDIAN

1533 Champa Street
Denver, CO 80202
303-629-5777
www.littleindiadenver.com
\$15-20 per entrée

Ellyngtons, an upscale Denver
restaurant, features a champagne
brunch and afternoon tea. ▶

LOS CABOS II LATIN / SOUTH AMERICAN, PERUVIAN

1525 Champa Street
Denver, CO 80202
303-595-3232
www.loscabosii.com
/LosCabosIIsegundo.htm
\$15-20 per entrée

I MEAN I REALLY WANT TO IMPRESS MY CLIENT!

CY STEAK AMERICAN, FRENCH

1222 Glenarm Place
Denver, CO 80202
303-571-4242
http://cysteakdenver.com
\$25-60 per entrée

ELLYNGTON'S BRUNCH, CONTEMPORARY

321 17th Street
The Brown Palace Hotel
Denver, CO 80202
303-297-3111
www.brownpalace.com/Dining/
Ellyngton-s
\$45-60 per entree

KEVIN TAYLOR'S AT THE OPERA HOUSE AMERICAN

950 13th Street
Denver, CO 80204
303-640-1012
www.ktrg.net/kevin-taylors-at-the-
opera-house
\$20-30 per entrée



LE GRAND BISTRO & OYSTER BAR SEAFOOD, AMERICAN

1512 Curtis Street
Denver, CO 80202
303-534-1155
www.legranddenver.com
\$20-30 per entrée

ROW 14 BISTRO AND WINE BAR AMERICAN

891 14th Street, Suite 100
Denver, CO 80202
303-825-0100
http://row14denver.com
\$20-30 per entrée



Attractions



BUFFALO BILL MUSEUM & GRAVE

987 ½ Lookout Mountain
Golden, CO 80401
303-526-0744
www.buffalobill.org

Located in Lookout Mountain Park, part of the Denver Mountain Parks system, the gravesite of William Frederick "Buffalo Bill" Cody—famous for the cowboy-themed shows he organized—offers visitors an expansive view of the Great Plains and the Rocky Mountains. The exhibits at the nearby Buffalo Bill Museum's include memorabilia from Buffalo Bill's life and Wild West shows, antique firearms and Indian and other Old West artifacts.

DENVER ART MUSEUM

100 West 14th Avenue Parkway
Denver, CO 80204
720-865-5000
www.denverartmuseum.org

Known as one of the largest comprehensive collections of world art between Chicago and the West coast, the Denver Art Museum features more than 68,000 works of art, including those of its internationally recognized American Indian art collection. Other areas of concentration include pre-Columbian and Spanish Colonial, European and American, Asian, African, Oceanic, textile, modern and contemporary art.

U.S. MINT

320 West Colfax Avenue
Denver, CO 80204
www.usmint.gov/mint_tours/index.cfm?action=StartReservation

The Denver U.S. Mint produces 50 million coins per day. Free tours are offered Monday through Friday (excluding federal holidays) and give visitors the opportunity to observe every step of the coin manufacturing process. Reservations are recommended.



HISTORY COLORADO CENTER

1200 Broadway
Denver, CO 80203
303-447-8679
www.historycolorado.org

One of Denver's newest cultural attractions, the History Colorado Center was established to collect, preserve and educate visitors on all aspects of Colorado history through interactive exhibits, special events and programs designed for all ages.

16TH STREET MALL

1001 16th Street
Denver, CO 80265
303-534-6161
www.16thstreetmalldenver.com

Built in 1982, the tree-lined, red-and-gray granite walkway runs through the center of downtown Denver and is lined with outdoor cafes, renovated historic office buildings, restaurants, shops and retail stores. Numerous fountains and plazas along the promenade feature a variety of special events and entertainers. Free shuttle bus transportation is available, and horse-drawn carriages also provide transportation after dark.

ROYAL GORGE BRIDGE & PARK

4218 Fremont County Rd. 3A
Canon City, CO 81212
719-275-7507
www.royalgorgebridge.com

Spanning one of the most massive gorges in the world, the Royal Gorge Bridge is one of the world's highest suspension bridges and offers a panoramic view of Royal Gorge. The nearby Royal Gorge Park features a number of rides and attractions that utilize the gorge's natural beauty to deliver a unique combination of breathtaking nature and human achievement.



Flamingos sit near water at the Denver Zoo. Left, elephants at the zoo enjoy a snack.



The Denver Botanic Garden features more than 33,000 plants and is a top conservatory.



DENVER ZOO

2300 Steele Street
Denver, CO 80205
303-376-4800
www.denverzoo.org

The fourth most popular zoo in America features over 3,500 different animals representing over 650 species, including 189 threatened or endangered species and three that are extinct in the wild. The zoo's largest new addition is the Toyota Elephant Passage, a 10-acre exhibit housing the Zoo's elephants, rhinos, fishing cats and clouded leopards.

DENVER BOTANIC GARDENS

1007 York Street
Denver, 80206
720-865-3713
www.botanicgardens.org

Located in the middle of the city, this 23-acre oasis is home to 45 different gardens and over 33,000 plants, as well as one of the nation's top 10 conservatories.

COORS BREWERY TOUR

13th & Ford Street
Golden, CO 80401
800-642-6116
www.millercoors.com/golden-brewery-tour.aspx

The Coors Brewery experience offers visitors a 30-minute, self-paced tour through the company's malting, brewing and packaging processes. After the tour, visitors can sample Coors products; view historical photos, neon signs, beer cans, bottles and memorabilia; and shop in the Coors & Co. gift shop.



COLORADO RAILROAD MUSEUM

17155 West 44th Avenue
Golden, CO 80403
303-279-4591
www.coloradorailroadmuseum.org

The Colorado Railroad Museum is home to over 100 narrow and standard gauge steam and diesel locomotives, passenger cars and cabooses dating back to the mid-20th century. Visitors are invited to visit the museum's exhibit galleries, railroad reference library and round-house restoration facility, complete with a 90-foot, functioning turntable.

DENVER MICROBREW TOUR

Denver, CO 80205
www.denvermicrobrewtour.com

A guided walking tour through the lower downtown and Ballpark Neighborhood historic districts of Denver offers beer samplings at several microbreweries and a tap room, as well as local Denver history.

BANJO BILLY'S BUS TOUR

4525 Martin Dr.
Boulder, CO 80305
8720-938-8885
www.banjobilly.com

Listen to the ghost tales, tall tales, crime stories and local history that have contributed to the modern identities of Boulder and Denver, Colorado from the seat of an old school bus modeled to look like a traveling hillbilly shack.

For more events, visit
www.denver.org/what-to-do/attractions

Advanced Test Equipment Rentals.....	58	<i>Interference Technology</i>	1, 21, 26, 33, 55, 63, 71, 78, 88
Agilent Technologies	Inside Front Cover	Kimmel Gerke Associates Ltd.	70
AH Systems, Inc	29	Mesago Messe Frankfurt GmbH	39
Albatross Projects GmbH.....	24, 25	Molded Fiber Glass Tray Company.....	34
API Technology - Spectrum Control.....	31	Montrose Compliance Services.....	71
AR RF/Microwave Instrumentation	Inside Back Cover,	NEXIO	45
.....	9, 10, 11, 12, 23	OMICROM Electronics GmbH	68
CST-Computer Simulation Technology.....	13	Quell Corp.	17
Curtis Industries	36	R&K Company Limited	1
Dutch Microwave Absorber Solutions	27	Retlif Testing Laboratories.....	42
<i>Electronics Cooling</i>	60	Rohde & Schwarz, Inc.	6
EM TEST USA	5	Schurter Inc	49
Empower RF Systems, Inc.	32	Siemic Laboratories	70
<i>Environmental Test & Design</i>	37,51	Spira Mfg. Corp.	3
ETC - Electronics Test Centre - Kanata.....	69	TESEQ	40
ETS - Lindgren	Back Cover	TIMCO Engineering, Inc.	35
Fischer Custom Communications, Inc.....	46		
IEEE 2014.....	14		

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AR's EMC solutions make complicated test processes easier and more accurate. Everything is simplified – calibration, testing processes, DUT troubleshooting, and generation of reports directly into convenient formats, such as Microsoft Word or Excel.

These products also have excellent speed, feature a modular design approach and allow their integrated components to be used in a variety of automotive test standards such as ISO, SAE, CISPR, and OEM requirements. These products have the flexibility to handle engineering development, mitigation and testing to numerous other standards such as MIL-STD-461, RTCA DO-160, CISPR, EN, ETSI, FCC, ICES, AS/NZS, and VCCI.

The DER2018, with 140 MHz instantaneous bandwidth, is the One Receiver that catches short duration transient disturbances, and scans in seconds. By streamlining testing, this CISPR 16 compliant EMI receiver will change the way you approach testing.

AR's AS4000 radiated immunity system gives you a turnkey package to perform susceptibility tests, in one self-contained unit up to 40 GHz. Our standard systems can also be customized to include testing to both radiated and conducted immunity and emissions requirements.

The Conducted Immunity (CI) platform offers flexibility to address any Bulk Current Injection (BCI) test method, as well as the ability to access components from the CI housing, such as the power meter and amplifier, to use in other test applications. With three Conducted Immunity Test Systems to choose from, you should never again have to perform laborious manual CI test procedures or worry about the accuracy of the results.

AR supplies a multitude of unique RF solutions to some of the best-known companies worldwide. Our products are backed by the strongest, most comprehensive warranty in the industry, and a global support network that's second to none. Call your local AR sales associate for a demonstration.

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Colorado Convention Center, Denver, Colorado, August 6-8, 2013 – Booth 507

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