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**Chair:** Jun Fan, Missouri University of Science and Technology, Rolla, MO, USA

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**Chair:** Alessio Tamburrano, Sapienza University of Rome, Rome, Italy

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## **TU-PM-6-SIPI SI/PI High Speed Interconnect Design and Analysis I**

**Chair:** Antonio Orlandi, University of L'Aquila, L'Aquila, Italy

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## WEDNESDAY TECHNICAL PAPERS

**Wednesday, August 6, 2014**

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### **WED-AM-2 TC2 Measurement – Immunity**

**Chair:** Tom Fagan, Raytheon, Tucson, AZ, USA

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**Co-Chair:** Andy Drozd, ANDRO Computational Solutions, LLC, Rome, NY, USA

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### **WED-AM-4 TC7 Low Frequency EMC**

**Chair:** Magnus Olofsson, Elforsk - Swedish Electrical Utilities' R&D Company, Stockholm, Sweden

**Co-Chair:** John Maas, IBM Corporation, Rochester, MN, USA

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### **WED-AM-5-SIPI SI/PI GHz Power Integrity Design**

**Chair:** A. Ege Engin, San Diego State University, San Diego, CA, USA

**Co-Chair:** Zhiping Yang, Apple Inc., Cupertino, CA, USA

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Dong-Ho Han (*Intel Corporation, Hillsboro, OR, USA*)

## WED-AM-6-SIPI SI/PI Co-Design and Co-Simulations

**Chair:** Antonio Ciccimancini, CST of America, Framingham, MA, USA

**Co-Chair:** Qing He, Oracle Corporation USA, Santa Clara, CA, USA

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Kai Xiao (*Intel Corporation, DuPont, WA, USA*)

## WEDNESDAY POSTER PAPERS

**Wednesday, August 6, 2014**

### WED-AM-7 Poster Session

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## WEDNESDAY TECHNICAL PAPERS

**Wednesday, August 6, 2014**

### **WED-PM-2 TC4 PCB EMC**

**Chair:** John Kraemer, Rockwell Collins, Cedar Rapids, IA, USA

1:30 pm	<b>Modulation of 1 MHz Clock with Low Frequency (LF) Signals to Analyze Common-Mode Radiation from Printed Circuit Boards</b> .....	507
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2:30 pm	<b>A Method for Compensating Imbalance Component of Asymmetrical Differential-Paired Lines Due to Turnoff Point for SI and EMI Performances</b> .....	519
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3:30 pm	<b>Investigating a Guard Trace Ring to Suppress the Crosstalk due to a Clock Trace on a Power Electronics DSP Control Board</b> .....	525
	Jun Xu ( <i>University of Texas at San Antonio, San Antonio, TX, USA</i> ); Shuo Wang ( <i>University of Texas at San Antonio, San Antonio, TX, USA</i> )	
4:00 pm	<b>PCB Structures for Common Mode Suppression on Differential Microstrip Lines</b> .....	533
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### WED-PM-3 TC5 High Power EM Including Intentional EMI, ESD and Lightning

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

**Co-Chair:** Michael McInerney, US Army Corp of Engineers, Champaign, IL, USA

1:30 pm	<b>AC Harmonics Effects on Small External Power Supplies (Wall Warts)</b> .....	538
	Edward Savage ( <i>Metatech Corporation, Goleta, CA, USA</i> ); William Radasky ( <i>Metatech Corporation, Goleta, CA, USA</i> ); Michael Madrid ( <i>Metatech Corporation, Goleta, CA, USA</i> )	
2:00 pm	<b>Influence of Software Effects on the Susceptibility of Ethernet Connections</b> .....	544
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3:30 pm	<b>The Electric Field at the Surface of a Cylindrical Monopole</b> .....	554
	William Price ( <i>The Boeing Company, Seattle, WA, USA</i> ); Benjamin Andros ( <i>The Boeing Company, Seattle, WA, USA</i> ) <i>Finalist for Best EMC Paper Award</i>	
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4:30 pm	<b>Simplified Techniques for Treating the Ocean-Land Interface for Geomagnetically Induced Electric Fields</b> .....	566
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5:00 pm	<b>Transient Grounding Characteristics of a Wind Turbine Foundation with Grounding Wires and Plates</b> .....	570
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## WED-PM-4 Wireless EMC

**Chair:** Alpesh Bhole, Cisco Systems, Inc., San Jose, CA, USA

**Co-Chair:** Wilson Wu, Shenzhen Sunway Communication Co., Ltd., Shenzhen, China

1:30 pm	<b>Radiation Physics and EMI Coupling Path Determination for Optical Links</b> .....	576
	Jing Li ( <i>Missouri University of Science and Technology, Rolla, MO, USA</i> ); Sukhjinder Toor ( <i>Cisco Systems, Inc., San Jose, CA, USA</i> ); Alpesh Bhole ( <i>Cisco Systems, Inc., San Jose, CA, USA</i> ); James L. Drewniak ( <i>Missouri University of Science and Technology, Rolla, MO, USA</i> ); Jun Fan ( <i>Missouri University of Science and Technology, Rolla, MO, USA</i> ) <i>Finalist for Best Student EMC Paper Award</i>	
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2:30 pm	<b>Reliable Wi-Fi Communication in EMC Critical Multipath Propagation Environment using Phased Array Antennas</b> .....	588
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## WED-PM-5-SIPI SI/PI Full Link Modeling and Design Optimization

**Chair:** Er-Ping Li, Zhejiang University, Hangzhou, China

**Co-Chair:** Antonio Ciccomancini, CST of America, Framingham, MA, USA

- 1:30 pm **Additional Coupling for Far End Crosstalk Cancellation in High Speed Interconnects** ..... 615  
Raul Enriquez (*Intel Corporation, DuPont, WA, USA*); Gong Ouyang (*Intel Corporation, DuPont, WA, USA*); Kai Xiao (*Intel Corporation, DuPont, WA, USA*); Trung-Thu Nguyen (*Intel Corporation, DuPont, WA, USA*); Beomtaek Lee (*Intel Corporation, DuPont, WA, USA*); Jose Guillen (*Intel Corporation, DuPont, WA, USA*); Arun Chandrasekhar (*Intel Corporation, DuPont, WA, USA*); César Méndez Ruiz (*Intel Corporation, Tlaquepaque, Mexico*)
- 2:00 pm **PCB via to Trace Return Loss Optimization for >25Gbps Serial Links** ..... 619  
Ji Zhang (*Cisco Systems, Inc., San Jose, CA, USA*); Jane Lim (*Cisco Systems, Inc., San Jose, CA, USA*); Wei Yao (*Cisco Systems, Inc., San Jose, CA, USA*); Kelvin Qiu (*Cisco Systems, Inc., San Jose, CA, USA*); Rick Brooks (*Cisco Systems, Inc., San Jose, CA, USA*)
- 2:30 pm **Package Technology Evaluation and Optimization for High-Speed Applications** ..... 625  
Louis Lo (*Intel Corporation, Folsom, CA, USA*);  
Bok Eng Cheah (*Intel Corporation, Penang, Malaysia*)
- 3:30 pm **Impedance Transparency Design for PCI-Express Gen 3 SerDes Channel on HDI PCBs** ..... 631  
Jue Chen (*Cisco Systems, Inc., San Jose, CA, USA*);  
Bidyut Sen (*Cisco Systems, Inc., San Jose, CA, USA*)
- 4:00 pm **Interconnect Impedance Optimization for High Speed IO up to 12Gbps Under HVM Condition** ..... 636  
Xinjun Zhang (*Intel Asia Pacific Research and Development Ltd., Shanghai, China*); Chunfei Ye (*Intel Corporation, DuPont, WA, USA*); Ming Wei (*Intel Asia Pacific Research and Development Ltd., Shanghai, China*); Weifeng Shu (*Intel Asia Pacific Research and Development Ltd., Shanghai, China*); Xiaoning Ye (*Intel Corporation, Hillsboro, OR, USA*)
- 4:30 pm **Proximity Effects between Striplines and Vias** ..... 642  
Young H. Kwark (*IBM Thomas J. Watson Research Center, Yorktown Heights, NY, USA*); Renato Rimolo-Donadio (*Costa Rica Institute of Technology (ITCR), Cartago, Costa Rica*); Christian W. Baks (*IBM Thomas J. Watson Research Center, Yorktown Heights, NY, USA*); Sebastian Müller (*Technische Universität Hamburg-Harburg, Hamburg, Germany*); Christian Schuster (*Technische Universität Hamburg-Harburg, Hamburg, Germany*)
- 5:00 pm **An Exercise in Applying Channel Operating Margin (COM) for 10GBASE-KR Channel Design** ..... 648  
Brandon Gore (*Intel Corporation, Columbia, SC, USA*);  
Richard Mellitz (*Intel Corporation, Columbia, SC, USA*)

## WED-PM-6-SIPI SI/PI High Speed Interconnect Design and Analysis II

**Chair:** Chunfei Ye, Intel Corporation, DuPont, WA, USA

**Co-Chair:** Changwook Yoon, Missouri University of Science and Technology, Rolla, MO, USA

- 1:30 pm **Design Criteria of Automatic Fixture Removal (AFR) for Asymmetric Fixture De-Embedding** ..... 654  
Changwook Yoon (*Missouri University of Science and Technology, Rolla, MO, USA*); Mikheil Tsiklauri (*Missouri University of Science and Technology, Rolla, MO, USA*); Mikhail Zvonkin (*Missouri University of Science and Technology, Rolla, MO, USA*); Jun Fan (*Missouri University of Science and Technology, Rolla, MO, USA*); James L. Drewniak (*Missouri University of Science and Technology, Rolla, MO, USA*); Jinguook Kim (*Ulsan National Institute of Science and Technology, Ulsan, South Korea*); Alexander Razmadze (*Altera Corporation, San Jose, CA, USA*); Aman Aflaki (*Altera Corporation, San Jose, CA, USA*); Qinghua Bill Chen (*Yangtze Delta Region Institute of Tsinghua University, Jiaxing, China*)
- 2:00 pm **De-Embedding Techniques for Transmission Lines: An Application to Measurements of On-Chip Coplanar Traces** ..... 660  
Nicholas Erickson (*Missouri University of Science and Technology, Rolla, MO, USA*); Jun Fan (*Missouri University of Science and Technology, Rolla, MO, USA*); Xu Gao (*Missouri University of Science and Technology, Rolla, MO, USA*); Brice Achkir (*Cisco Systems, Inc., San Jose, CA, USA*); Siming Pan (*Cisco Systems, Inc., San Jose, CA, USA*)
- 2:30 pm **High-Speed Differential IO Crosstalk – The Impact of Phase, Bit Rate, Jitter and Equalization** ..... 667  
Chunfei Ye (*Intel Corporation, DuPont, WA, USA*); Xiaoning Ye (*Intel Corporation, DuPont, WA, USA*); Brian Wang (*Intel Corporation, DuPont, WA, USA*); Juan Robledo (*Intel Tecnologia de Mexico SA de CV, Jalisco, Mexico*)
- 3:30 pm **Impact on Signal Integrity of Interconnect Variabilities** ..... 673  
Paolo Manfredi (*Politecnico di Torino, Torino, Italy*); Dries Vande Ginste (*Ghent University, Gent, Belgium*); Daniël De Zutter (*Ghent University, Gent, Belgium*); Flavio G. Canavero (*Politecnico di Torino, Torino, Italy*)
- 4:00 pm **DC Blocking Capacitor Design and Optimization for High Speed Signalling** ..... 679  
Weifeng Shu (*Intel Asia Pacific Research and Development Ltd., Shanghai, China*); Chunfei Ye (*Intel Corporation, DuPont, WA, USA*); Dan Liu (*Intel Asia Pacific Research and Development Ltd., Shanghai, China*); Xiaoning Ye (*Intel Corporation, DuPont, WA, USA*); Enrique Lopez (*Intel Corporation, Tlaquepaque, Mexico*); Xinjun Zhang (*Intel Asia Pacific Research and Development Ltd., Shanghai, China*)
- 4:30 pm **Stochastic Modeling of a High-Speed Signal Channel by Polynomial Chaos Method** ..... 686  
Yansheng Wang (*Missouri University of Science and Technology, Rolla, MO, USA*); Alexander Razmadze (*Altera Corporation, San Jose, CA, USA*); Timothy Lu (*Altera Corporation, San Jose, CA, USA*); YaoJiang Zhang (*Missouri University of Science and Technology, Rolla, MO, USA*); Ji Chen (*University of Houston, Houston, TX, USA*); Jun Fan (*Missouri University of Science and Technology, Rolla, MO, USA*)

# THURSDAY TECHNICAL PAPERS

Thursday, August 7, 2014

## TH-AM-1 TC2 Antennas

**Chair:** Don Heirman, Don HEIRMAN Consultants, Lincroft, NJ, USA

- 8:30 am **A Substitution Method for Antenna Calibration by the use of Broadband Antenna (30 to 1000 MHz)** ..... 691  
Mitsunobu Samoto (*Liberty Labs Asia, Inc., Yokohama, Japan*); Nobuhito Samoto (*Liberty Labs Asia, Inc., Yokohama, Japan*); Hiroyuki Shimano (*Liberty Labs Asia, Inc., Yokohama, Japan*); Ikuo Makino (*Liberty Labs Asia, Inc., Yokohama, Japan*); Kazuo Shimada (*ETS-Lindgren Japan, Edogawa-ku, Japan*)
- 9:00 am **Optical Tracking based EM-field Probing System for EMC Near Field Manual Scanning** ..... 697  
Hui He (*Missouri University of Science and Technology, Rolla, MO, USA*); Pratik Maheshwari (*Missouri University of Science and Technology, Rolla, MO, USA*); David Pommerenke (*Missouri University of Science and Technology, Rolla, MO, USA*)
- 9:30 am **Broadband Measurement of Near-Fields for Predicting Far-Fields for EMC Applications** ..... 702  
Prasanna Padmanabhan (*University of Kentucky, Lexington, KY, USA*); Keith Hardin (*Lexmark International, Inc., Lexington, KY, USA*); William Smith (*University of Kentucky, Lexington, KY, USA*)
- 10:30 am **Coupling Path Visualization using a Movable Scatterer** ..... 707  
Sen Yang (*Missouri University of Science and Technology, Rolla, MO, USA*); Pratik Maheshwari (*Missouri University of Science and Technology, Rolla, MO, USA*); Victor Khilkevich (*Missouri University of Science and Technology, Rolla, MO, USA*); David J. Pommerenke (*Missouri University of Science and Technology, Rolla, MO, USA*)

## TH-AM-2 Special Session: TC9 and TC10 Large Scale Modeling for Signal and Power Integrity

**Chair:** Kai Xiao, Intel Corporation, Dupont, WA, USA

**Co-Chair:** Duo Chen, Intel Corporation, Santa Clara, CA, USA

- 8:30 am **Checking PCB Design Electrically for PI/SI Issues** ..... 712  
Kai Xiao (*Intel Corporation, DuPont, WA, USA*); Thonas Su (*Intel Corporation, Taipei, Taiwan*); Jimmy Hsu (*Intel Corporation, Taipei, Taiwan*); Weifeng Shu (*Intel Corporation, Shanghai, China*); Xiaoning Ye (*Intel Corporation, Hillsboro, OR, USA*); Yuan-liang Li (*Intel Corporation, Taipei, Taiwan*)
- 9:00 am **Mobile-Oriented CPS (Chip-Package-System) Integrated Power Integrity Techniques at Early Chip Design Stage** ..... 717  
Youngsoo Lee (*Samsung Electronics, Seoul, South Korea*); Kyoungchoul Koo (*Samsung Electronics, Yong-in, South Korea*); Woncheol Baek (*Samsung Electronics, Yong-in, South Korea*)
- 9:30 am **Direct Finite-Element Solver of Linear Complexity for System-Level Signal and Power Integrity Co-Analysis** ..... 721  
Bangda Zhou (*Purdue University, West Lafayette, IN, USA*); Dan Jiao (*Purdue University, West Lafayette, IN, USA*)



10:30 am	<b>Post-Layout PCB Check and Simulations for Signal Integrity</b> .....	727
	Jiang Li ( <i>Cadence Design Systems, San Jose, CA, USA</i> ); Yingzhi Wu ( <i>Cadence Design Systems, San Jose, CA, USA</i> )	
11:00 am	<b>Wavelet Compression for Signal Integrity Analysis</b> .....	732
	Jianfang Zhu ( <i>Intel Corporation, Hillsboro, OR, USA</i> ); Adam J. Norman ( <i>Intel Corporation, Hillsboro, OR, USA</i> )	

### **TH-AM-3 Special Session: TC5 Recent Research and Education in EM Information Security**

**Chair:** Yu-ichi Hayashi, Tohoku University, Sendai, Japan

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

**Co-Chair:** William Price, Boeing, Seattle, WA, USA

8:30 am	<b>Precisely Timed IEMI Fault Injection Synchronized with EM Information Leakage</b> .....	738
	Yu-ichi Hayashi ( <i>Tohoku University, Sendai, Japan</i> ); Naofumi Homma ( <i>Tohoku University, Sendai, Japan</i> ); Takaaki Mizuki ( <i>Tohoku University, Sendai, Japan</i> ); Takafumi Aoki ( <i>Tohoku University, Sendai, Japan</i> ); Hideaki Sone ( <i>Tohoku University, Sendai, Japan</i> )	
9:00 am	<b>Investigation in Burst Pulse Injection Method for Fault based Cryptanalysis</b> .....	743
	Kengo Iokibe ( <i>Okayama University, Okayama, Japan</i> ); Kazuhiro Maeshima ( <i>Okayama University, Okayama, Japan</i> ); Hiroto Kagotani ( <i>Okayama University, Okayama, Japan</i> ); Yasuyuki Nogami ( <i>Okayama University, Okayama, Japan</i> ); Yoshitaka Toyota ( <i>Okayama University, Okayama, Japan</i> ); Tetsushi Watanabe ( <i>Industrial Technology Center of Okayama Prefecture, Okayama, Japan</i> )	
9:30 am	<b>Integrated-Circuit Countermeasures against Information Leakage through EM Radiation</b> .....	748
	Noriyuki Miura ( <i>Kobe University, Kobe, Japan</i> ); Daisuke Fujimoto ( <i>Kobe University, Kobe, Japan</i> ); Yu-ichi Hayashi ( <i>Tohoku University, Sendai, Japan</i> ); Naofumi Homma ( <i>Tohoku University, Sendai, Japan</i> ); Takafumi Aoki ( <i>Tohoku University, Sendai, Japan</i> ); Makoto Nagata ( <i>Kobe University, Kobe, Japan</i> )	
10:30 am	<b>Software and Hardware Co-Verification for Privacy-Enhanced Passive UHF RFID Tag</b> .....	752
	Yang Li ( <i>The University of Electro-Communications, Tokyo, Japan</i> ); Toshiki Nakasone ( <i>The University of Electro-Communications, Tokyo, Japan</i> ); Kazuo Sakiyama ( <i>The University of Electro-Communications, Tokyo, Japan</i> )	
11:00 am	<b>Hardware/Software Co-Design Flavors of Elliptic Curve Scalar Multiplication</b> .....	758
	Josep Balasch ( <i>KU Leuven, ESAT/COSIC and iMinds, Leuven, Belgium</i> ); Benedikt Gierlichs ( <i>KU Leuven, ESAT/COSIC and iMinds, Leuven, Belgium</i> ); Kimmo Järvinen ( <i>Aalto University, Espoo, Finland</i> ); Ingrid Verbauwhede ( <i>KU Leuven, ESAT/COSIC and iMinds, Leuven, Belgium</i> )	
11:30 am	<b>Development of Human Resources in Hardware Security through Practical Information Technology Education Program</b> .....	764
	Naofumi Homma ( <i>Tohoku University, Sendai, Japan</i> ); Yu-ichi Hayashi ( <i>Tohoku University, Sendai, Japan</i> ); Toshihiro Katashita ( <i>AIST, Tsukuba, Japan</i> ); Hideaki Sone ( <i>Tohoku University, Sendai, Japan</i> )	



## TH-AM-4 TC9 Reverb Chambers and Complex Cavities

**Chair:** Vignesh Rajamani, Oklahoma State University, Stillwater, OK, USA

**Co-Chair:** James West, Oklahoma State University, Stillwater, OK, USA

- 8:30 am **A Hybrid Approach to Calculate Mean Response and Variance in a Reverberant Environment** ..... 768  
Robin S. Langley (*University of Cambridge, Cambridge, United Kingdom*);  
Andrea Barbarulo (*University of Cambridge, Cambridge, United Kingdom*);  
Louis Kovalevsky (*University of Cambridge, Cambridge, United Kingdom*)
- 9:00 am **Dependence of Reverberation Chamber Performance on Distributed Losses: A Numerical Study** ..... 775  
Gabriele Gradoni (*The University of Nottingham, Nottingham, United Kingdom*);  
Valter Mariani Primiani (*Università Politecnica delle Marche, Ancona, Italy*);  
Franco Moglie (*Università Politecnica delle Marche, Ancona, Italy*)
- 9:30 am **Simulation of Stirred Fields within a Reverberation Chamber using a Refined Spectral-Domain-Factorization Moment Method** ..... 781  
James C. West (*Oklahoma State University, Stillwater, OK, USA*); Vignesh Rajamani (*Oklahoma State University, Stillwater, OK, USA*); Charles F. Bunting (*Oklahoma State University, Stillwater, OK, USA*)
- 10:30 am **Search for Limits of Complex Cavity Model by Progressive Simplification** ..... 787  
F. Todeschini (*AIRBUS Defense & Space, Les Mureaux, France*); A. Bertrand (*AIRBUS Defense & Space, Les Mureaux, France*); M. Ramos (*AIRBUS Defense & Space, Les Mureaux, France*)
- 11:00 am **Random Coupling Model for Interconnected Wireless Environments** ..... 792  
Gabriele Gradoni (*University of Maryland, College Park, MD, USA*); Thomas M. Antonsen Jr. (*University of Maryland, College Park, MD, USA*); Steven M. Anlage (*University of Maryland, College Park, MD, USA*); Edward Ott (*University of Maryland, College Park, MD, USA*)

## TH-AM-5A-SIPI SI/PI Package/PCB Material Characterization

**Chair:** Xiaoning Ye, Intel Corporation, Hillsboro, OR, USA

**Co-Chair:** Brice Achkir, Cisco Systems, Inc., San Jose, CA, USA

- 8:30 am **Effective Roughness Dielectric in a PCB: Measurement and Full-Wave Simulation Verification** ..... 798  
Tracey Vincent (*CST of America, Framingham, MA, USA*); Marina Koledintseva (*Missouri University of Science and Technology, Rolla, MO, USA*); Antonio Ciccomancini (*CST of America, Framingham, MA, USA*); Scott Hinaga (*Cisco Systems Inc., San Jose, CA, USA*)  
*Finalist for Best SI/PI Paper Award*
- 9:00 am **Modelling Jitter Induced by Fibre Weave Effect in PCB Dielectrics** ..... 803  
Yuriy Shlepnev (*Simberian Inc., Las Vegas, NV, USA*);  
Chudy Nwachukwu (*Isola Group USA, Chandler, AZ, USA*)

- 9:30 am **Characterization of PCB Dielectric Properties using Two Striplines on the Same Board** ..... 809  
 Lei Hua (*Missouri University of Science and Technology, Rolla, MO, USA*); Bichen Chen (*Missouri University of Science and Technology, Rolla, MO, USA*); Shuai Jin (*Missouri University of Science and Technology, Rolla, MO, USA*); Marina Koledintseva (*Missouri University of Science and Technology, Rolla, MO, USA*); Jane Lim (*Cisco Systems, Inc., San Jose, CA, USA*); Kelvin Qiu (*Cisco Systems, Inc., San Jose, CA, USA*); Rick Brooks (*Cisco Systems, Inc., San Jose, CA, USA*); Ji Zhang (*Cisco Systems, Inc., San Jose, CA, USA*); Ketan Shringarpure (*Missouri University of Science and Technology, Rolla, MO, USA*);  
 Jun Fan (*Missouri University of Science and Technology, Rolla, MO, USA*)

### TH-AM-5B-SIPI SI/PI High Speed Interconnect Design and Analysis III

**Chair:** Brice Achkir, Cisco Systems, Inc., San Jose, CA, USA

**Co-Chair:** Dan Oh, Altera Corporation, San Jose, CA, USA

- 10:30 am **An Accurate, Robust and Intuitive Technique to Detect Causality Violations in Broadband Frequency Measurements** ..... 815  
 Piero Triverio (*University of Toronto, Toronto, ON, Canada*)  
*Finalist for Best SI/PI Paper Award*

- 11:00 am **SI-PI Cosimulation Analysis of Dual Referencing and VSS-Referencing Memory Bus** ..... 821  
 Mauro Lai (*Intel Corporation, DuPont, WA, USA*); Krishna Srinivasan (*Intel Corporation, DuPont, WA, USA*); Ritochit Chakraborty (*Intel Corporation, DuPont, WA, USA*); Madhumitha Seshadhri (*Intel Corporation, DuPont, WA, USA*)

- 11:30 am **A Jitter Equalization Technique for Minimizing Supply Noise Induced Jitter in High Speed Serial Links** ..... 827  
 Yujeong Shim (*Altera Corporation, San Jose, CA, USA*); Dan Oh (*Altera Corporation, San Jose, CA, USA*); Tim Hoang (*Altera Corporation, San Jose, CA, USA*); Yanjing Ke (*Altera Corporation, San Jose, CA, USA*)

### TH-AM-6-SIPI SI/PI On-Chip and Off-Chip Power Integrity Issues and Design

**Chair:** Dale Becker, IBM, Poughkeepsie, NY, USA

**Co-Chair:** Young Kwark, IBM Research, Yorktown Heights, NY, USA

- 8:30 am **Power Integrity Analysis for Core Timing Models** ..... 833  
 Dan Oh (*Altera Corporation, San Jose, CA, USA*);  
 Yujeong Shim (*Altera Corporation, San Jose, CA, USA*)  
*Finalist for Best SI/PI Paper Award*

- 9:00 am **Effect of Narrow Power Fills on PCB PDN Noise** ..... 839  
 Ketan Shringarpure (*Missouri University of Science and Technology, Rolla, MO, USA*); Biyao Zhao (*Missouri University of Science and Technology, Rolla, MO, USA*); Bruce Archambeault (*IBM Corporation, Durham, NC, USA*); Albert Ruehli (*Missouri University of Science and Technology, Rolla, MO, USA*); Jun Fan (*Missouri University of Science and Technology, Rolla, MO, USA*); James Drewniak (*Missouri University of Science and Technology, Rolla, MO, USA*)

- 9:30 am **Optimization of PCB PDN Design using Enhanced VRM Model** ..... 845  
 Guang Chen (*Altera Corporation, San Jose, CA, USA*); Ahmed Abou-Alfotouh (*Altera Corporation, San Jose, CA, USA*); Zhiwei Liu (*Altera Corporation, San Jose, CA, USA*); Mostafa Shabban (*Altera Corporation, San Jose, CA, USA*); Dan Oh (*Altera Corporation, San Jose, CA, USA*)

10:30 am **Electrical Characterization of Bump-Less High Speed Channel on Silicon, Organic and Glass Interposer** ..... 850  
Hyunsuk Lee (*KAIST, Daejeon, South Korea*); Heegon Kim (*KAIST, Daejeon, South Korea*); Kiyeong Kim (*KAIST, Daejeon, South Korea*); Daniel H. Jung (*KAIST, Daejeon, South Korea*); Jonghoon J. Kim (*KAIST, Daejeon, South Korea*); Sumin Choi (*KAIST, Daejeon, South Korea*); Jaemin Lim (*KAIST, Daejeon, South Korea*); Joungho Kim (*KAIST, Daejeon, South Korea*); Hyungsoo Kim (*SK Hynix Semiconductor Inc., Icheon, South Korea*); Kunwoo Park (*SK Hynix Semiconductor Inc., Icheon, South Korea*)

11:00 am **Switching Voltage Regulator Modeling and its Applications in Power Delivery Design** ..... 855  
Wei Xu (*Intel Corporation, Chandler, AZ, USA*); Jin Fang (*Intel Corporation, DuPont, WA, USA*); Jiangqi He (*Intel Corporation, Chandler, AZ, USA*); Tae Kim (*Intel Corporation, Chandler, AZ, USA*)

11:30 am **Accelerating the Large-Scale Simulation of Power Distribution Networks by using the Multi-GPU LIM** ..... 861  
Yuta Inoue (*Shizuoka University, Hamamatsu, Japan*); Hideki Asai (*Shizuoka University, Hamamatsu, Japan*)

### TH-PM-1 TC9 Numerical Modeling Approaches

**Chair:** Alan Roden, Aerospace Corporation, Chantilly, VA, USA

**Co-Chair:** Albert E. Ruehli, Missouri University of Science and Technology, Rolla, MO, USA

2:30 pm **Parallel Power Grid Analysis using Distributed Direct Linear Solver** ..... 866  
Qing He (*Oracle Corporation USA, Santa Clara, CA, USA*); William Au (*Oracle Corporation USA, Santa Clara, CA, USA*); Alexander Korobkov (*Oracle Corporation USA, Santa Clara, CA, USA*); Subramanian Venkateswaran (*Oracle Corporation USA, Santa Clara, CA, USA*)

3:00 pm **Uncertainty Quantification of EM-Circuit Systems using Stochastic Polynomial Chaos Method** ..... 872  
Ping Li (*The University of Hong Kong, Hong Kong, China*); Li Jun Jiang (*The University of Hong Kong, Hong Kong, China*)  
*Finalist for Best Student EMC Paper Award*

4:00 pm **An Active Thevenin Equivalent Network Approach to EMI/EMC Problems** ..... 878  
Jeffery T. Williams (*Sandia National Laboratories, Albuquerque, NM, USA*); Larry D. Bacon (*Sandia National Laboratories, Albuquerque, NM, USA*); Michael J. Walker (*Sandia National Laboratories, Albuquerque, NM, USA*); Erik C. Zeek (*Sandia National Laboratories, Albuquerque, NM, USA*)

4:30 pm **A Wigner Function Approach for Describing the Radiation of Complex Sources** ..... 882  
Gabriele Gradoni (*University of Nottingham, Nottingham, United Kingdom*); Stephen C. Creagh (*University of Nottingham, Nottingham, United Kingdom*); Gregor Tanner (*University of Nottingham, Nottingham, United Kingdom*)

5:00 pm **Locally Stabilized Explicit Method for Fast Transient Analysis of Inhomogeneously-Meshed Plane Structures** ..... 888  
Tadatoshi Sekine (*Shizuoka University, Hamamatsu-shi, Japan*); Hideki Asai (*Shizuoka University, Hamamatsu-shi, Japan*)

## TH-PM-2 TC2 TEM and Reverb Measurements

**Chair:** Galen Koepke, National Institute of Standards and Technology, Boulder, CO, USA

- 2:30 pm **A Methodology to Generate a Time-varying Adjustable Wave Impedance inside a TEM Cell** ..... 894  
Guanghua Li (*Missouri University of Science and Technology, Rolla, MO, USA*); V.A.K. Prabhala (*Missouri University of Science and Technology, Rolla, MO, USA*); Abhinav Saxena (*Missouri University of Science and Technology, Rolla, MO, USA*); Qian Wang (*Missouri University of Science and Technology, Rolla, MO, USA*); Pratik Maheshwari (*Missouri University of Science and Technology, Rolla, MO, USA*); David Pommerenke (*Missouri University of Science and Technology, Rolla, MO, USA*)  
*Finalist for Best Student EMC Paper Award*
- 3:00 pm **Enhanced Estimates of Field Distribution's Uncertainty Contribution for TEM Waveguides** ..... 899  
David Hamann (*Leibniz Universität Hannover, Hannover, Germany*); Heyno Garbe (*Leibniz Universität Hannover, Hannover, Germany*)
- 4:00 pm **Over-the-Air Performance Testing of a Real 4G LTE base Station in a Reverberation Chamber** ..... 903  
Massimo Barazzetta (*Nokia Solutions and Networks Italia, Cassina de' Pecchi, Italy*); Davide Micheli (*TELECOM Italia, Rome, Italy*); Franco Moglie (*Università Politecnica delle Marche, Ancona, Italy*); Valter Mariani Primiani (*Università Politecnica delle Marche, Ancona, Italy*)
- 4:30 pm **Effectiveness of Absorbing Materials on Reducing Electromagnetic Emissions from Cavities Measured using a Nested Reverberation Chamber Approach** ..... 909  
Logan J. Washbourne (*Oklahoma State University, Stillwater, OK, USA*); Vignesh Rajamani (*Oklahoma State University, Stillwater, OK, USA*); Charles F. Bunting (*Oklahoma State University, Stillwater, OK, USA*); James C. West (*Oklahoma State University, Stillwater, OK, USA*); Bruce Archambeault (*IBM Corporation, Durham, NC, USA*); Samuel Connor (*IBM Corporation, Durham, NC, USA*)  
*Finalist for Best Student EMC Paper Award*

## TH-PM-3 TC1 Business and Management Concerns in EMC

**Chair:** Doug Kramer, ETS-Lindgren, Cedar Park, TX, USA

- 2:30 pm **ITE EMC Requirements in BRIC Countries** ..... 913  
Mark Maynard (*SIEMIC, Inc., Milpitas, CA, USA*)
- 3:00 pm **Demographics of Bench Level Automotive Electrical and Electromagnetic Compatibility Validation Test Laboratories** ..... 919  
Lawrence Banasky Jr. (*Ford Motor Company, Dearborn, MI, USA*)
- 4:00 pm **Part 2: Dealing with Complexities of Worldwide Regulatory Compliance; Beginning with EMC** ..... 924  
David Staggs (*Regulatory Consultant, Hunt, TX, USA*)
- 4:30 pm **Why Few (if any) Medical Devices Comply with their EMC Standard, and What Can be Done About It** ..... 929  
Keith Armstrong (*Cherry Clough Consultants Ltd., Stafford, United Kingdom*)

5:00 pm	<b>Size of Devices to be Measured at 3m</b> .....	935
	Andy Griffin ( <i>Cisco Systems Inc., San Jose, CA, USA</i> )	
	<i>Finalist for Best EMC Paper Award</i>	
 <b>TH-PM-5-SIPI SI/PI Channel Emulation</b>		
<b>Chair:</b> Zhiping Yang, Apple Inc., Cupertino, CA, USA		
<b>Co-Chair:</b> Michael Cracraft, IBM Corporation, Poughkeepsie, NY, USA		
2:30 pm	<b>Electro-Mechanical Structures for Channel Emulation</b> .....	939
	Satyajeet Shinde ( <i>Missouri University of Science and Technology, Rolla, MO, USA</i> ); Sen Yang ( <i>Missouri University of Science and Technology, Rolla, MO, USA</i> ); Nicholas Erickson ( <i>Missouri University of Science and Technology, Rolla, MO, USA</i> ); David Pommerenke ( <i>Missouri University of Science and Technology, Rolla, MO, USA</i> ); Chong Ding ( <i>Cisco Systems, Inc., Durham, NC, USA</i> ); Douglas White ( <i>Cisco Systems, Inc., Durham, NC, USA</i> ); Stephen Scearce ( <i>Cisco Systems, Inc., Durham, NC, USA</i> ); Yaochao Yang ( <i>Cisco Systems, Inc., San Jose, CA, USA</i> )	
3:00 pm	<b>Emulation of Lossy Channels using a Low Loss Microstrip Trace with added Lossy Materials</b> .....	945
	Wei Qian ( <i>Missouri University of Science and Technology, Rolla, MO, USA</i> ); Guanghua Li ( <i>Missouri University of Science and Technology, Rolla, MO, USA</i> ); Pratik Maheshwari ( <i>Missouri University of Science and Technology, Rolla, MO, USA</i> ); Victor Khilkevich ( <i>Missouri University of Science and Technology, Rolla, MO, 65401, USA</i> ); David Pommerenke ( <i>Missouri University of Science and Technology, Rolla, MO, USA</i> ); Chong Ding ( <i>Cisco Systems, Inc., Durham, NC, USA</i> ); Douglas White ( <i>Cisco Systems, Inc., San Jose, CA, USA</i> ); Stephen Scearce ( <i>Cisco Systems, Inc., Durham, NC, USA</i> ); Yaochao Yang ( <i>Cisco Systems, Inc., San Jose, CA, USA</i> )	
4:00 pm	<b>Implementation of a 18 GHz Bandwidth Channel Emulator using FIR Filter</b> .....	950
	Abhishek Patnaik ( <i>Missouri University of Science and Technology, Rolla, MO, USA</i> ); Atieh Talebzadeh ( <i>Missouri University of Science and Technology, Rolla, MO, USA</i> ); Mikheil Tsiklauri ( <i>Missouri University of Science and Technology, Rolla, MO, USA</i> ); David Pommerenke ( <i>Missouri University of Science and Technology, Rolla, MO, USA</i> ); Chong Ding ( <i>Cisco Systems, Inc., San Jose, CA, USA</i> ); Douglas White ( <i>Cisco Systems, Inc., San Jose, CA, USA</i> ); Stephen Scearce ( <i>Cisco Systems, Inc., San Jose, CA, USA</i> ); Yaochao Yang ( <i>Cisco Systems, Inc., San Jose, CA, USA</i> )	
4:30 pm	<b>Designing a 3D Printing based Channel Emulator</b> .....	956
	Xiangyang Jiao ( <i>Missouri University of Science and Technology, Rolla, MO, USA</i> ); Hui He ( <i>Missouri University of Science and Technology, Rolla, MO, USA</i> ); Guanghua Li ( <i>Missouri University of Science and Technology, Rolla, MO, USA</i> ); Wei Qian ( <i>Missouri University of Science and Technology, Rolla, MO, USA</i> ); Guangyao Shen ( <i>Missouri University of Science and Technology, Rolla, MO, USA</i> ); David Pommerenke ( <i>Missouri University of Science and Technology, Rolla, MO, USA</i> ); Chong Ding ( <i>Cisco Systems, Inc., San Jose, CA, USA</i> ); Douglas White ( <i>Cisco Systems, Inc., San Jose, CA, USA</i> ); Stephen Scearce ( <i>Cisco Systems, Inc., San Jose, CA, USA</i> ); Yaochao Yang ( <i>Cisco Systems, Inc., San Jose, CA, USA</i> )	
	<i>Finalist for Best Student SI/PI Paper Award</i>	
	<i>Finalist for Best SI/PI Paper Award</i>	



## TH-PM-6-SIPI SI/PI High Speed Interconnect Design and Analysis IV

**Chair:** Venkatesh Seetharam, Avago Technologies, San Jose, CA, USA

**Co-Chair:** Olena Zhu, Intel Corporation, Santa Clara, CA, USA

- 2:30 pm **Causality and Delay and Physics in Real Systems** ..... 961  
Mikheil Tsiklauri (*Missouri University of Science and Technology, Rolla, MO, USA*);  
Mikhail Zvonkin (*Missouri University of Science and Technology, Rolla, MO, USA*); Jun Fan  
(*Missouri University of Science and Technology, Rolla, MO, USA*); James Drewniak (*Missouri  
University of Science and Technology, Rolla, MO, USA*); Qinghua Bill Chen (*Yangtze Delta Region  
Institute of Tsinghua University and Peking University, Tiaxing / Beijing, China*);  
Alexander Razmadze (*Altera Corporation, San Jose, CA, USA*)
- 3:00 pm **Signal Integrity Optimization by Suppressing Resonance of Multi-Port  
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Xing-Ming Li (*Beijing Institute of Technology, Beijing, China*); Shan-Qing Hu (*Beijing Institute of  
Technology, Beijing, China*); Kye-Yak See (*Nanyang Technological University, Singapore,  
Singapore*); Yi Deng (*Virginia Polytechnic Institute and State University, Arlington, VA, USA*)
- 4:00 pm **Simulation Models for Signal Integrity Analyses Extracted from Computed  
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Sven Simon (*University of Stuttgart, Stuttgart, Germany*); Jürgen Hillebrand (*University of Stuttgart,  
Stuttgart, Germany*); Steffen Kieß (*University of Stuttgart, Stuttgart, Germany*)
- 4:30 pm **NEXT and FEXT Characteristics andSuppressions in Dense 25Gbps+ Backplane Vias** ..... 979  
Peerouz Amleshi (*Molex Inc., Lisle, IL, USA*); Cong Gao (*Molex Inc., Lisle, IL, USA*)