



2018 JOINT IEEE INTERNATIONAL SYMPOSIUM ON ELECTROMAGNETIC COMPATIBILITY
AND ASIA-PACIFIC SYMPOSIUM ON ELECTROMAGNETIC COMPATIBILITY

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Suntec Convention & Exhibition Centre, Singapore

14-17 May 2018

2018 Joint

*IEEE International Symposium on Electromagnetic Compatibility
& Asia-Pacific Symposium on Electromagnetic Compatibility*

2018 Joint IEEE EMC & APEMC

Workshop & Tutorial Program

14-17 May 2018

Suntec Convention & Exhibition Center, Singapore

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IEEE



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May 14 (Mon)	08:30am 10:00am	AM-1	WS-01: EMC in Railway Systems	WS-2: Electromagnetic Compatibility for 5G Communications Beyond	TT-01: EMC Fundamentals	TT-03: Introduction to EMI Modeling Techniques	TT-04: Advances in Automotive EMC Test and Measurement	TT-06: Using Reverberation Chambers for EM Experiments and EMI Testing
	10:00am 10:30am	Tea Break						
	10:30am 12:30pm	AM-2	WS-01: EMC in Railway Systems	WS-2: Electromagnetic Compatibility for 5G Communications Beyond	TT-01: EMC Fundamentals	TT-03: Introduction to EMI Modeling Techniques	TT-04: Advances in Automotive EMC Test and Measurement	TT-06: Using Reverberation Chambers for EM Experiments and EMI Testing
	12:30pm 01:30pm	Lunch Break						
	01:30pm 03:30pm	PM-1	WS-03: EMC & EMF Safety Aspects of Wireless Power Transfer in Transportation Systems	TT-02: Protection of Civil Infrastructures Against Intentional EMI	WS-05: Computational Electromagnetics (CEM) for EMC Applications	WS-04: Lightning Protection of Wind Turbines	TT-05: Advances in Antenna Calibration and Measurements for EMC Applications	WS-07: Use of FFT-Based Measuring Instruments in EMI Testing
	03:30pm 04:00pm	Tea Break						
	04:00pm 06:00pm	PM-2	WS-03: EMC & EMF Safety Aspects of Wireless Power Transfer in Transportation Systems	TT-02: Protection of Civil Infrastructures Against Intentional EMI	WS-05: Computational Electromagnetics (CEM) for EMC Applications	WS-04: Lightning Protection of Wind Turbines	TT-05: Advances in Antenna Calibration and Measurements for EMC Applications	WS-06: (a) EMC for Automotive WS-06: (b) EMC for Medical Equipment
	06:45pm 09:00pm	Welcome Reception						

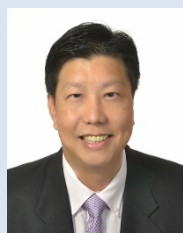
TUTORIAL PROGRAM

TUTORIAL TT-01	EMC Fundamentals
TIME	8:30am – 12:30pm, Monday, May 14 th
VENUE	Room 333
ORGANIZERS	Kye Yak See, Nanyang Technological University, Singapore Frank Leferink, THALES / University of Twente, Netherlands
SPEAKERS	Kye Yak See, Nanyang Technological University, Singapore Richard Xian-Ke Gao, Institute of High Performance Computing, A*STAR, Singapore Frank Leferink, THALES / University of Twente, Netherlands Lin Biao Wang, Continental Automotive, Singapore

ABSTRACT

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

BIOGRAPHIES OF ORGANIZERS



Dr. Kye Yak See received the B. Eng degree (1st Class Hons) from the National University of Singapore and the Ph. D degree from Imperial College London in 1986 and 1997, respectively. Between 1986 and 1991, he was with Singapore Technologies Electronics as a Senior Engineer. From 1991 to 1994, he held the position of Lead Design Engineer in ASTEC Custom Power, Singapore. He joined Nanyang Technological University (NTU), Singapore, in 1997, as a faculty member. He is currently a tenured Associate Professor in the School of Electrical and Electronic Engineering, NTU. He also holds concurrent appointment as the Director of Electromagnetic Effects Research Laboratory (EMERL) jointly funded by

DSO National Laboratories, A*STAR and NTU. His research interests are power and signal integrity, electromagnetic compatibility (EMC) and real-time condition monitoring of electrical infrastructure. He was the founding chairs of the IEEE Singapore EMC Chapter and IEEE Singapore Aerospace and Electronic Systems (AES)/Geoscience and Remoting Sensing (GRSS) Joint Chapter. He served as the Organizing Committee Chairs for 2006 EMC Zurich Symposium and 2008 Asia Pacific EMC Conference; and General Chairs for 2011 International Symposium of Integrated Circuits (ISIC 2011) and 2015 Asia Pacific Synthetic Aperture Radar Conference (APSAR 2015). He has been the Technical Editor of the IEEE EMC Magazine since January 2012. From 1 July 2016, he was appointed as Director of SMRT-NTU Smart Urban Rail Corporate Laboratory jointly funded by National Research Foundation (NRF), SMRT and NTU.



Frank Leferink (M'91–SM'08) received his B.Sc in 1984, M.Sc. in 1992 and his PhD in 2001, all electrical engineering, at the University of Twente, Enschede, The Netherlands. He has been with THALES in Hengelo, The Netherlands since 1984 and is now the Technical Authority EMC. He is also manager of the Network of Excellence on EMC of the THALES Group, with over 100 EMC engineers scattered over more than 20 units, worldwide. In 2003 he was appointed as (part-time, full research) professor, Chair for EMC at the University of Twente. At the University of Twente he lectures the courses Transmission Media, and EMC, and manages several research projects, with 2 researchers and 6 PhD student-researchers.

Over 200 papers have been published at international conferences or peer reviewed journals, and he holds 5 patents.

Prof. Leferink is past-president of the Dutch EMC-ESD association, Chair of the IEEE EMC Benelux Chapter, member of ISC EMC Europe, and associate editor of the IEEE Transactions on EMC.

Introduction

Kye Yak See, Nanyang Technological University, Singapore

Parasitic Effects of Components and Interconnects, Capacitance and Inductance

Richard Xian-Ke Gao, Institute of High Performance Computing, Agency for Science, Technology and Research, Singapore

Shielding

Frank Leferink, THALES / University of Twente, Netherland

EMI Filters

Kye Yak See, Nanyang Technological University, Singapore

EMC Fundamentals PCB Design

Lin Biao Wang, Continental Automotive, Singapore

TUTORIAL TT-02	Protection of Civil Infrastructures Against Intentional EMI
TIME	01:30pm – 06:00pm, Monday, May 14 th
VENUE	Room 332
ORGANIZERS	Frank Sabath, Bundeswehr Research Institute for Protective Technologies and CBRN Protection (WIS), Germany Frank Leferink, THALES / University of Twente, Netherlands
SPEAKERS	Frank Sabath, Bundeswehr Research Institute for Protective Technologies and CBRN Protection (WIS), Germany William A. Radasky, Metatech Corporation, USA Frank Leferink, THALES / University of Twente, Netherlands Wen-Yan Yin, Zhejiang University, Hangzhou, China Giuseppina Dall'Armi-Stoks, Defence Science & Technology Group, Edinburgh, Australia

ABSTRACT

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

BIOGRAPHIES OF ORGANIZERS



Frank Sabath (M'94–SM'04). He received the Dipl.-Ing. Degree in electrical engineering from the University of Paderborn, Paderborn, Germany, in 1993, and the Dr.-Ing. degree from the Leibniz University of Hannover, Hannover, Germany, in 1998. Since 1998, he has been with the Federal Office of Bundeswehr Equipment, Information Technology and In-Service Support (BAAINBw). From 2011 to 2017 he was head of the directorate on Nuclear Effects, High-Power Electromagnetics and Fire Protection of the Bundeswehr Research Institute for Protective Technologies and CBRN-Protection (WIS), Munster, Germany. In 2017 he took over responsibility as head of the directorate on Detection. Dr. Sabath is Senior Lecturer in the field EMI Risk Management at the Leibniz University Hannover, Germany. He is the author or coauthor of more than 150 papers published in international journals and conference proceedings. His research interests include investigations of electromagnetic field theory, High-Power Electromagnetics, investigations of short pulse interaction on electronics, and impulse radiation.

Dr. Sabath is the immediate past president of the IEEE Electromagnetic Compatibility (EMC) Society, and a member of Antennas and Propagation (AP), Microwaves Theory and Techniques (MTT) societies, and of URSI Commission E.



Frank Leferink (M'91–SM'08) received the B.Sc., M.Sc., and Ph.D. degrees in electrical engineering from the University of Twente, Enschede, The Netherlands, in 1984, 1992, 2001, respectively. He has been with THALES in Hengelo, The Netherlands since 1984 and is now the Technical Authority EMC. He is also manager of the Network of Excellence on EMC of the THALES Group, with over 100 EMC engineers scattered over more than 20 units, worldwide. In 2003 he was appointed as (part-time, full research) professor, Chair for EMC at the University of Twente. At the University of Twente he lectures the courses Transmission Media, and EMC, and manages several research projects, with 2 researchers and 6 PhD student-researchers. Over 200 papers have been published at international conferences or peer reviewed journals, and he holds 5 patents.

Prof. Leferink is past-president of the Dutch EMC-ESD association, Chair of the IEEE EMC Benelux Chapter, member of ISC EMC Europe, Chairman of EMC Europe 2018 (Amsterdam), member of the Board of Directors of the IEEE EMC Society, and associate editor of the IEEE Transactions on Electromagnetic Compatibility and

the IEEE Journal on Electromagnetic Compatibility Practice and Applications (JEMCPA).

Introduction

Description of the IEMI Threat

Frank Sabath, Bundeswehr Research Institute for Protective Technologies and CBRN Protection (WIS), Germany

Review of IEMI Standardization

William A. Radasky, Metatech Corporation, USA

IEMI Risk Assessment at the System Level

Frank Sabath, Bundeswehr Research Institute for Protective Technologies and CBRN Protection (WIS), Germany

Vulnerability of Wireless Infrastructure to IEMI

Frank Leferink, THALES / University of Twente, Netherlands

IEMI Effects: from Measurements to Simulation

Wen-Yan Yin, Zhejiang University, China

Vulnerability of Autonomous Vehicles to Intentional EMI

Giuseppina Dall'Armi-Stoks, Defence Science & Technology Group, Australia

Conclusion

Frank Sabath, Bundeswehr Research Institute for Protective Technologies and CBRN Protection (WIS), Germany

TUTORIAL TT-03	Introduction to EMI Modeling Techniques
TIME	8:30am – 12:30pm, Monday, May 14 th
VENUE	Room 334
ORGANIZERS	Bruce Archambeault, Missouri University of Science and Technology/IBM, USA Matthias Troscher, CST AG, Germany
SPEAKERS	Patrick Deroy, CST of America, USA Bruce Archambeault, Missouri University of Science and Technology/IBM, USA Chuck Bunting, Oklahoma State University, USA Christian Schuster, Hamburg University of Technology, Germany Lijun Jiang, Hong Kong University, China

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 weakness, so engineers can decide which techniques are appropriate for their types of problems.

Primary Audience: Attendees who are new to computational electromagnetic modeling and are looking for an overview of the popular modeling techniques and the advantages and disadvantages of each of them.

Secondary Audience: Attendees with some modeling experience, who have run into problems and realize that they need a deeper understanding of how the various techniques work to know where the limitations are.

BIOGRAPHIES OF ORGANIZERS



Dr. Bruce Archambeault is an IEEE Fellow, an IBM Distinguished Engineer Emeritus and an Adjunct Professor at Missouri University of Science and Technology. He received his Ph. D. from the University of New Hampshire in 1997. His doctoral research was in the area of computational electromagnetics applied to real-world EMC problems. He has taught numerous seminars on EMC and Signal Integrity across the USA and the world, including the past 15 years at Oxford University.

Dr. Archambeault has authored or co-authored a number of papers in computational electromagnetics, mostly applied to real-world EMC applications. He currently serves as the President of the EMC Society. He is the author of the book “PCB Design for Real-World EMI Control” and the lead author of the book titled “EMI/EMC Computational Modeling Handbook”.



Matthias Tröscher received a Diploma in physics from the Technical University Munich, Germany, in 1994. In 2000, he got a Ph.D. degree in the Doctoral Program of Engineering Sciences from the Johannes Kepler University Linz, Austria, for his research at BMW AG, Munich, on radar technology and signal analysis for automotive pre-crash detection. Matthias has been IEEE EMC Society member since 2000, vice chair of the IEEE German EMC chapter since 2016 and vice chair of TC-9 Computational Electronics since 2016. In 2009 he joined CST AG in Munich where he evolved from software developer to application engineer, then to sales manager and finally to business development manager for Germany,

Austria and Switzerland. His main interest is on signal integrity SI, power integrity PI, and electromagnetic compatibility EMC analysis with focus on the automotive industry. In this role, Matthias has co-organized several automotive conferences in Korea, Germany and the US. He has published several articles in magazines and co-authored various papers for automotive workshops.

Transmission Line Matrix (TLM) Method

Patrick Deroy, CST of America, Framingham, MA, USA

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

Bruce Archambeault, Missouri University of Science and Technology/IBM, USA

Introduction to the Finite Element Method

Chuck Bunting, Oklahoma State University, USA

The Method of Moments in EMC Modeling and Simulation

Christian Schuster, Hamburg University of Technology, Germany

The Partial Element Equivalent Circuit Method

Lijun Jiang, Hong Kong University, Hong Kong, China

TUTORIAL TT-04	Advances in Automotive EMC Test and Measurement
TIME	8:30am – 12:30pm, Monday, May 14 th
VENUE	Room 335
ORGANIZER	Janet O’Neil, ETS-Lindgren, USA
SPEAKERS	Flavia Grassi, Politecnico di Milano, Italy Garth D’Abreu, ETS-Lindgren, USA Jianmei Lei, China Automotive Engineering, Research Institute Co., China Zhong Chen, ETS-Lindgren, USA Sergio A. Pignari, Politecnico di Milano, Italy

ABSTRACT

Traditional EMC measurements were developed based on protecting the licensed spectrum from interference caused mainly by ignition systems. Things have moved a long way from these early sources and with the proliferation of digital control systems and electric drives, there are many more on board noise sources and even more potential vulnerabilities. Modern vehicles are now fitted with an increasing number of advanced driver assistance systems (ADAS) many of which rely on external sensors. The EMC of these systems is vital in ensuring that safety is not compromised. This tutorial will review some of the automotive test and measurement trends that are developing to address this emerging need. The tutorial concludes with a presentation on the NEW XJTU-POLIMI Joint School of Design and Innovation Centre in the Western China Science and Technology Innovation Harbor. Located in Xi’an, China, this Centre is a joint project between the Politecnico di Milano and Xi’an Jiaotong University involving national and international automotive companies.

BIOGRAPHIES OF ORGANIZERS



Janet O’Neil is a customer relations specialist with ETS-Lindgren, located in Southern California. She has over 30 years of experience in the RF Microwave and Electromagnetic Compatibility (EMC) industries. She is a member of the Board of Directors of the IEEE Electromagnetic Compatibility (EMC) Society. She is also a member of Subcommittee 1 (Techniques and Development) of ANSI ASC C63® and vice-chair of the 2018 IEEE Symposium on EMC and Signal/Power Integrity to be held in Long Beach, California, July 30 - August 03. Janet was chair of the 2007 IEEE International Symposium on EMC in Honolulu, Hawaii; vice-chair of the 2011 IEEE International Symposium on EMC in Long Beach, California; Publications Chair for the IEEE International Microwave Symposium (IMS) 2013 in Seattle, Washington; and Industry Liaison for the 2017 IEEE Antennas and Propagation (APS/URSI) Symposium. In 2004, she received the Honorary Member Award from the IEEE EMC Society. Her education includes BA degrees in English and in Business Economics from the University of California, Santa Barbara. She may be reached at janet.oneil@ets-lindgren.com.

Simulation of Bulk Current Injection Test Setups involving Complex Cable Harnesses

Flavia Grassi, Politecnico di Milano, Milan, Italy

Meeting the Need for Full Vehicle Enhanced EMC and Antenna Measurements

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

Vehicle-level Antenna Performance Analysis and Test in Intelligent Connected Vehicles

Jianmei Lei, China Automotive Engineering Research Institute Co., LTD/ EMC Test Department, China

Common RF Absorbers Evaluations in the W Band (75-110 GHz)

Zhong Chen, ETS-Lindgren, Cedar Park, Texas, USA

The XJTU-POLIMI Joint School of Design and Innovation Centre in the Western China Science and Technology Innovation Harbor

Sergio A. Pignari, Politecnico di Milano, Milan, Italy

TUTORIAL TT-05	Advances in Antenna Calibration and Measurements for EMC Applications
TIME	01:30pm – 06:00pm, Monday, May 14 th
VENUE	Room 335
ORGANIZERS	Zhong Chen, ETS-Lindgren, USA Takehiro Morioka, National Institute of Advanced Industrial Science and Technology (AIST), Japan
SPEAKERS	Donglin Meng, National Institute of Metrology, China Carlo F. M. Carobbi, Department of Information Engineering, University of Florence, Italy Zhong Chen, ETS-Lindgren, USA David Knight, NPL, Middlesex, UK Takehiro Morioka, National Institute of Advanced Industrial Science and Technology (AIST), Japan

ABSTRACT

Antennas are used in diverse environments for radiated EMC measurements. Accurate antenna calibration and characterization have a direct impact on the uncertainties of radiated measurements. During calibrations, the antenna test environment can be well controlled, but it may not be representative for the end use case. It is important to understand how the test environments interact with the antennas, and how the overall measurement uncertainties are affected. One of the goals of the tutorial is to address antenna measurements in these diverse and sometimes complicated test environments. Advances in latest research and standards development in antenna measurements are presented.

BIOGRAPHIES OF ORGANIZERS



Zhong Chen is the Director of RF Engineering at ETS-Lindgren, located in Cedar Park, Texas. He has over 20 years of experience in RF testing, anechoic chamber design, as well as EMC antenna and field probe design and measurements. He is an active member of the ANSI ASC C63® committee and Chairman of Subcommittee 1 which is responsible for the antenna calibration and chamber/test site validation standards. He is chairman of the IEEE Standard 1309 committee responsible for developing calibration standards for field probes, and chairman of the IEEE Standard 1128 committee for absorber measurements. His research interests include measurement uncertainty, time domain measurements for site validation and antenna calibration, development of novel RF absorber materials, and anechoic chamber designs. Zhong Chen received his M.S.E.E. degree in electromagnetics from the Ohio State University at Columbus. He may be reached at zhong.chen@ets-lindgren.com.



Takehiro Morioka received the Ph.D. degree in electrical engineering from the University of Tsukuba, Tsukuba, Japan, in 1998. He has been with the National Institute of Advanced Industrial Science and Technology (AIST), Tsukuba since 1998 and is a Chief Senior Researcher in Electromagnetic Fields Standards Group, National Metrology Institute of Japan (NMIJ) in AIST.

Dr. Morioka's current research includes precision electromagnetic fields measurement and related areas. He investigated the calibration methodology of the dipole antenna and performed the uncertainty analysis. The calibration capability of the dipole antenna was authorized by the intercomparison among the National Metrology Institutes. In addition to the dipole antenna measurement, he is investigating the E-field characterization technique both in free space and TEM waveguides for the field probe calibration. The numerical approach to improve the accuracy of the E-field measurement has been one of his major interests.

The Validation of Calculable Antennas and Their Application in Evaluating the Uncertainty Sources in EMC

Donglin Meng, National Institute of Metrology, Beijing, China

E-field Measurements below 30 MHz in Military and Automotive EMC Testing

Carlo F. M. Carobbi, Department of Information Engineering, University of Florence, Italy

Time Domain Techniques to Remove Close-by Objects for Antenna Calibrations

Zhong Chen, ETS-Lindgren, Cedar Park, TX, USA

Requirements for Antenna Calibration and Introduction to Methods in CISPR 16-1-6 for Frequencies below 1 GHz

David Knight, NPL, Middlesex, England, UK

High-Precision Electric Field Measurement and Uncertainty

Takehiro Morioka, National Institute of Advanced Industrial Science and Technology (AIST), Japan

TUTORIAL TT-06	Using Reverberation Chambers for EM Experiments and EMI Testing
TIME	08:30am-12:30pm, Monday, May 14 th
VENUE	Room 336
ORGANIZERS	Wee Jin Koh, Defense Science and Technology Organisation, Singapore Mathias Magdowski, Otto von Guericke University Magdeburg, Germany Frank Leferink, THALES / University of Twente, Netherlands
SPEAKERS	Frank Leferink, THALES / University of Twente, Netherlands Mathias Magdowski, Otto von Guericke University Magdeburg, Germany Aizan Ubin, University of Johor, Malaysia Robert Vogt-Ardatjew, University of Twente, Netherlands Wee Jin Koh, Defense Science and Technology Organization, Singapore
	Vignesh Rajamani, Exponent, USA

ABSTRACT

The focus of this workshop is on the use of reverberation chambers and their advantages for EMI testing. The workshop will start with the general setup and several examples of such chambers, some short theoretical foundations and deal with the properties as well as statistics of the electromagnetic field. The typical validation according to the IEC standard and the corresponding basic measurement procedures for immunity and emission will also be explained. The workshop will close with advanced topics as the measurement of shielding efficiency in reverberation chambers and the comparison and conversion of limits with respect to other test facilities.

BIOGRAPHIES OF ORGANIZERS



reverberation chamber.

Wee Jin Koh received his B. Sc degree in EEE from University of Manchester Institute of Science and Technology, Manchester, UK in 1979, M. Sc degree in EE from Naval Postgraduate School, Monterey, California, USA in 1987, and Ph. D. degree from Ohio State University, Columbus, Ohio, USA in 1995. He has been working DSO National Laboratories since 1981 and is currently the Distinguished Member of Technical Staff specialising in Electromagnetics. He is the co-director of Electromagnetic Effect Research Laboratory and Adjunct Associate Professor in Nanyang Technological University since 2007 and 2004 respectively. His current research interests are lightning protection, signal/power integrity and



Mathias Magdowski was born in Wolmirstedt, Germany in 1984. He received his Dipl.-Ing. and Dr.-Ing. degree in electrical engineering from the Otto-von-Guericke University, Magdeburg, Germany in 2008 and 2012, respectively, where he is currently working as a scientific co-worker at the Institute for Medical Engineering. His current research interests include statistical and analytical methods for modeling EMC problems.



and 6 PhD student-researchers. Over 200 papers have been published at international conferences or peer reviewed journals, and he holds 5 patents.

Frank Leferink (M'91–SM'08) received the B.Sc., M.Sc., and Ph.D. degrees in electrical engineering from the University of Twente, Enschede, The Netherlands, in 1984, 1992, 2001, respectively. He has been with THALES in Hengelo, The Netherlands since 1984 and is now the Technical Authority EMC. He is also manager of the Network of Excellence on EMC of the THALES Group, with over 100 EMC engineers scattered over more than 20 units, worldwide. In 2003 he was appointed as (part-time, full research) professor, Chair for EMC at the University of Twente. At the University of Twente he lectures the courses Transmission Media, and EMC, and manages several research projects, with 2 researchers

Prof. Leferink is past-president of the Dutch EMC-ESD association, Chair of the IEEE EMC Benelux Chapter, member of ISC EMC Europe, Chairman of EMC Europe 2018 (Amsterdam), member of the Board of Directors of the IEEE EMC Society, and associate editor of the IEEE Transactions on Electromagnetic Compatibility and the IEEE Journal on Electromagnetic Compatibility Practice and Applications (JEMCPA).

Introduction and Fundamental of Reverberation Chamber

Frank Leferink, THALES / University of Twente, Netherlands

Using Reverberation Chambers for EM Experiments and EMI Testing

Mathias Magdowski, Otto von Guericke University Magdeburg, Germany

Stirrer Design for Reverberation Chamber

Aizan Ubin, University of Johor, Malaysia

Shielding Effectiveness Measurement

Robert Vogt-Ardatjew, University of Twente, Netherlands

Pulsed Signal Testing in Reverberation Chamber

Wee Jin Koh, Defense Science and Technology Organisation, Singapore

Time Domain Measurement of the Quality Factor of a Reverberation Chamber

Vignesh Rajamani, Exponent, USA

WORKSHOP PROGRAM

WORKSHOP WS-01	EMC in Railway Systems
TIME	8:30am – 12:30pm, Monday, May 14 th
VENUE	Room 331
ORGANIZERS	Peter Sai Wing Leung, City University of Hong Kong, China Kai Sang Lock, Singapore Institute of Technology, Singapore Sergio A. Pignari, Politecnico di Torino, Italy
SPEAKERS	Peter Sai Wing Leung, City University of Hong Kong, China Mark Tin Kin Ho, MTRC, Hong Kong, China Patrick Wong, EMCCL Hong Kong, China Yinghong Wen, Beijing Jiaotong University, China Sergio A. Pignari, Politecnico di Torino, Italy Kai Sang Lock, Singapore Institute of Technology, Singapore

ABSTRACT

There are non-researchers in the EMC or Railway industries, who would like to gain knowledge in this applied topic in the joint conference. This is a half-day tutorial/workshop with fundamentals together with specific EMC Railways topics, with tutorial notes provided. The tutorial/workshop will supplement the Topical Symposium on EMC in Railway Systems of the conference which is more technical in-depth and research orientated.

BIOGRAPHIES OF ORGANIZERS



Dr. Peter Leung obtained his first degree at the City University, London in 1976, and his doctorate degree in 1981 at the same university. His Ph.D. thesis was in electromagnetic analysis in linear motors in High Speed Ground Transport applications. Dr. Leung joined CHAM Ltd. as a project Engineer in 1981; joined ERA Technology Ltd., as Senior Engineer and was responsible for various applied electromagnetic research projects funded by the UK industry.

He was a Principal Engineer with Hirst Research Centre, GEC in 1984, responsible for leading a project on the development of electromagnetic launchers for armour-piercing applications. In 1985 he joined the Weapons Department of Thorn EMI Electronics Ltd., for the development of the Multi-Launch Rocket System. In 1987, Dr. Leung moved to the USA joining Martin Marietta Aerospace in Orlando, working on the same system for one year. In 1988 Dr. Leung joined the City University of Hong Kong as Senior Lecturer, and at present he is an Associate Professor in the Electronic Engineering Department and a team member of the Applied Electromagnetics Laboratory.

Dr. Leung is actively involved in numerous EMC consultancy projects, in both Hong Kong and overseas, as an EMC expert for Railway Systems. He was a Director of the EMC Consulting Group of the CityU Professional Services Ltd, City University of Hong Kong 2004 -2011.

Dr. Leung acted also as the authorized representative and technical manager of the EMC test facilities of the City University of Hong Kong, from 2000 to 2004. He is an EMC technical assessor for the Hong Kong Laboratory Accreditation Scheme, and a member of the working party on Electrical and Electronic Products, Accreditation Advisory Board, Government of Hong Kong SAR from 2000 till now.

Dr. Leung is also the founding Chairman of EMC Chapter, founding Chairman of Product Safety Engineering Chapter, of IEEE Hong Kong Section, and a Director of EMC Consortium Limited for railway consultancy projects, Hong Kong, as a Concurrent post, from 2015.

Dr. Leung's experience has covered over 100 EMC consultancy projects, including railway and metro systems in Sao Paolo, Doha, Macau, Atlanta, Dubai, Miami, Hong Kong and Singapore, providing expert advice from equipment level to system level since the 1990s, EMC in-situ test logistic planning, and resolutions in addressing EMC system and intersystem issues. Dr. Leung is the author or co-author of over 200 papers in journals, conference proceedings, and in EMC technical briefs and consultancy reports.



Professor Lock has a unique blend of practicing and academic experience acquired through a career equally split between the industry and the academia. He received his B.Sc. (1st Class Honours) in Electrical and Electronics Engineering in 1975 from the University of Strathclyde, UK. He completed his Ph.D. degree at the same university in 1979 researching on the design optimization of electrical machines. He joined the National University of Singapore as a lecturer in 1980 and was the Head of its Power and Machines Division, Department of Electrical Engineering, when he left in 1997 to set up his consulting practice. After 19 years in consulting practice, he returned to the academia in 2016 as a Professor at Singapore Institute of Technology. Concurrently, he is an Adjunct Professor at Singapore University of Technology and Design (SUTD) since 2013.

He has authored over 200 consultancy reports, mainly in power quality and reliability, lightning and surge protection, EMC, and power system design for mission-critical facility. He has conducted several lightning-related failure investigations for equipment at MRT viaduct and on-board rolling stock.

He is a Past President and Honorary Fellow of the Institution of Engineers, Singapore. He received the Public Service Medal (2015), Singapore for his contribution to the engineering profession in Singapore. He was conferred the Outstanding Power Engineer Award by the IEEE Power Engineering Chapter in 1998. He is a Fellow of Academy of Engineering, Singapore, Senior Fellow of ASEAN Academy of Engineering and Technology and an Honorary Fellow of ASEAN Federation of Engineering Organizations.

He is the co-author of a book "Grounds for Grounding: a Circuit-to-System Handbook" published by IEEE/Joh Wiley in 2010.



Sergio A. Pignari received the Laurea (M.S.) and Ph.D. degrees in electronic engineering from Politecnico di Torino, Turin, Italy, in 1988 and 1993, respectively.

From 1991 to 1998, he was an Assistant Professor with the Dept. of Electronics, Politecnico di Torino, Turin, Italy. In 1998, he joined Politecnico di Milano, Milan, Italy, where he is currently a Full Professor of Circuit Theory and Electromagnetic Compatibility (EMC) at the Dept. of Electronics, Information, and Bioengineering, and Chair of the B.Sc. and M.Sc. Study Programmes in Electrical Engineering, term 2015-20. He is the author or co-author of more than 200 papers published in international journals and conference proceedings. His research interests are in the field of EMC and include field-to-wire coupling and crosstalk, conducted immunity and emissions in multi-wire structures, statistical techniques for EMC, and experimental procedures and setups for EMC testing. His research activity is mainly related to Aerospace, Automotive, Energy, and Railway industry sectors.

Dr. Pignari is a Fellow of the IEEE. He is a recipient of the 2005 and 2016 IEEE EMC Society Transactions Prize Paper Award, and a 2011 IEEE EMC Society Technical Achievement Award. He is currently serving as an Associate Editor of the IEEE Transactions on Electromagnetic Compatibility. From 2010 to 2015 he served as the IEEE EMC Society Chapter Coordinator. From 2007 to 2009 he was the Chair of the IEEE Italy Section EMC Society Chapter. He has been Technical Program Chair of the ESA Workshop on Aerospace EMC in 2009, 2012, and 2016, Technical Program Chair of EMC' Beijing in 2017, and a Member of the Technical Program Committee of the Asia Pacific EMC Week since 2010. He is currently serving as the Italian URSI Officer for Commission E (Electromagnetic Noise and Interference), term 2015-18.

Introduction to EMC and to Railway Systems

Peter Sai Wing Leung, City University of Hong Kong, China

Principle of Signalling Systems

Mark Tin Kin Ho, MTRC, Hong Kong, China

EMC Equipment Compliance and Laboratory Tests

Patrick Wong, EMCCL Hong Kong, China

Electromagnetic Compatibility Technology for China High-speed Railway System

Yinghong Wen, Beijing Jiaotong University, China

EMC Management in Railway Systems

Peter Sai Wing Leung, City University of Hong Kong, China

Aspects of Low-Frequency Conducted and Radiated Emissions from the Railway Infrastructure

Sergio A. Pignari, Politecnico di Torino, Italy

Lightning Electromagnetic Protection


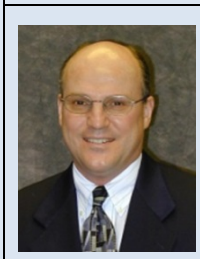
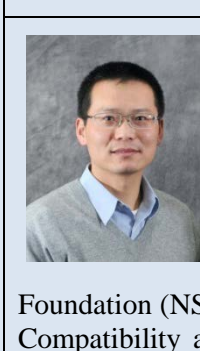
Kai Sang Lock, Singapore Institute of Technology, Singapore

WORKSHOP WS-02	Electromagnetic Compatibility for 5G Communications Beyond
TIME	8:30am – 12:30pm, Monday, May 14 th
VENUE	Room 332
ORGANIZERS	Er-Ping Li, Zhejiang University, China James L. Drewniak, EMC Laboratory, Missouri S&T, USA Jun Fan, Missouri University of Science and Technology, USA Qi Yihong, General Test Systems, China
SPEAKERS	Er-Ping Li, Zhejiang University, China Yihong Qi, General Test Systems, China Jun Fan, Missouri University of Science and Technology, USA Yaojiang Zhang, Huawei Technologies, China Michael Violette, Washington Laboratories, Ltd., USA

ABSTRACT

With the advancement of mobile communication technology, ultra-high-speed 5G communication technology is going to be deployed. The bandwidth, and data transmission rate are going to be much higher, but the size is going to be smaller, which introduces a great challenge in electromagnetic interference, signal integrity and power integrity. In particular, the spectrum in the range of 28.5 GHz is most likely to become the working frequency band of 5G communication. The electromagnetic interference and shielding becomes a key issue in the system and antenna design. This workshop will address the electromagnetic challenges, and possible solutions. Specially, the presentations will touch on the development in design, simulation, and measurements for novel techniques in 5G communication.

BIOGRAPHIES OF ORGANIZERS

	<p>LI Er-Ping is a Changjiang Chair Professor in Zhejiang University, Dean of ZJU-UIUC Institute (Zhejiang University- University of Illinois at Urbana-Champaign), IEEE Fellow, He authored or co-authored over 400 papers published in the referred international journals and conferences, authored two books published by John-Wiley-IEEE Press and Cambridge University Press, received numerous international awards.</p> <p>His current research interests include electromagnetic compatibility, signal integrity, 3D integrated circuits and modern communication antenna and systems.</p>
	<p>James L. Drewniak, Fellow of IEEE, received B.S., M.S., and Ph.D. degrees in electrical engineering from the University of Illinois at Urbana-Champaign. He is currently professor with the Electromagnetic Compatibility Laboratory at Missouri S&T, in the Department of Electrical and Computer Engineering.</p> <p>His research is in electromagnetic compatibility, signal and power integrity, and electronic packaging.</p>
	<p>Jun Fan (S'97-M'00-SM'06-F'16) received his B.S. and M.S. degrees in Electrical Engineering from Tsinghua University, Beijing, China, in 1994 and 1997, respectively. He received his Ph.D. degree in Electrical Engineering from the University of Missouri-Rolla in 2000. From 2000 to 2007, he worked for NCR Corporation, San Diego, CA, as a Consultant Engineer. In July 2007, he joined the Missouri University of Science and Technology (formerly University of Missouri-Rolla), and is currently a Professor and Director of the Missouri S&T EMC Laboratory. Dr. Fan also serves as the Director of the National Science Foundation (NSF) Industry/University Cooperative Research Center (I/UCRC) for Electromagnetic Compatibility and Senior Investigator of Missouri S&T Material Research Center. His research</p>

interests include signal integrity and EMI designs in high-speed digital systems, dc power-bus modeling, intra-system EMI and RF interference, PCB noise reduction, differential signaling, and cable/connector designs. In the IEEE EMC Society, Dr. Fan served as the Chair of the TC-9 Computational Electromagnetics Committee from 2006 to 2008, the Chair of the Technical Advisory Committee from 2014 to 2016, and a Distinguished Lecturer in 2007 and 2008. He currently is an associate editor for the IEEE Transactions on Electromagnetic Compatibility and IEEE EMC Magazine. Dr. Fan received an IEEE EMC Society Technical Achievement Award in August 2009.



Yihong Qi (M'92–SM'11) received a B.S. degree in Electronics from the National University of Defense Technologies, Changsha, China in 1982, a M.S. degree in Electronics from the Chinese Academy of Space Technology, Beijing, China in 1985, and a Ph.D. degree in Electronics from Xidian University, Xi'an, China in 1989 respectively.

From 1989 to 1993, he was a Postdoctoral Fellow and then an Associate Professor with the Southeast University, Nanjing, China. From 1993 to 1995, he was a Postdoctoral Researcher at McMaster University, Hamilton, ON, Canada. From 1995 to 2010, he was with Research in Motion (Blackberry), Waterloo, ON, where he was the Director of Advanced Electromagnetic Research. Currently, he is the President and Chief Scientist with General Test Systems, Inc., Shenzhen, China; he founded DBJay in 2011, and he is the CTO of ENICE. He is also an Adjunct Professor in the EMC Laboratory, Missouri University of Science and Technology, Rolla, MO and an Adjunct Professor in Hunan University, Changsha, China. He is an inventor of more than 250 published and pending patents. The patent that of multi-resonance antenna has been used by more than 1.4 billion smart phones annually. The O-ring connector invention is shipping more than 4 billion pieces per year. Dr. Qi was a Distinguished Lecturer of IEEE EMC Society for 2014 and 2015, and serves as the Chairman of the IEEE EMC TC-12 and he is a member of advisory board in IEEE Transaction on Electromagnetic Compatibility. He received 2017 technology achievement award from IEEE EMC society.

Electromagnetic Compatibility in 5th Generation Communications

Er-Ping Li, Zhejiang University, China

Diagnostic OTA Measurement for Phased Array

Yihong Qi, General Test Systems, China

Desense Evaluation and Debugging Using Radiated Two-Stage Method in MIMO Testing

Jun Fan, Missouri University of Science and Technology, USA

System EMC in 5G Communication

Yaojiang Zhang, Huawei Technologies, China

The IEEE IoT and 5G Initiatives

Michael Violette, Washington Laboratories, Ltd., USA

WORKSHOP WS-03 EMC & EMF Safety Aspects of Wireless Power Transfer Technologies in Transportation Systems

TIME 01:30pm – 06:00pm, Monday, May 14th

VENUE Room 331

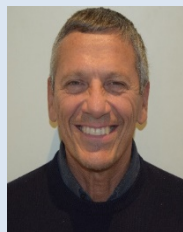
ORGANIZERS Mauro Feliziani, University of L'Aquila, Italy
Francesca Maradei, Sapienza University of Roma, Italy
Tommaso Campi, University of L'Aquila, Italy

SPEAKERS Francesca Maradei, Sapienza University of Roma, Italy
Seungyoung Ahn, Korea Advanced Institute of Science and Technology (KAIST), Korea
Lionel Pichon, University of Paris-Sud, UPSaclay, Sorbonne Université, France
Sang-Wook Park, Korea Automotive Technology Institute, Korea
Mauro Feliziani, University of L'Aquila, Italy
Teruo Onishi, NTT DOCOMO Inc., Japan
Niels Kuster, IT'IS Foundation, Switzerland

ABSTRACT

The goal of this workshop is to analyze the EMC and EMF safety aspects on electric vehicles (EVs) equipped with wireless power transfer (WPT) systems. These systems based on inductive coupling are very useful because they allow a safe and comfortable charging procedure of the batteries in EVs. However, the WPT systems are intentional sources of time varying magnetic field and the field levels can be very high due to the relevant power required by the charging process. One of the main concerns is the compliance of the emitted magnetic fields with the EMC and EMF safety standards and regulations. In the workshop the magnetic field generated by automotive WPT systems will be characterized. Then, mitigation techniques based on shielding and innovative compensation circuits will be presented. The impact of the magnetic field on EV passengers or pedestrians will be examined by a numerical dosimetric analysis using sophisticated human body models. Finally, an overview on standardization and compliance testing methods for assessment of wireless power transfer related to human exposure will be given.

BIOGRAPHIES OF ORGANIZERS



Mauro Feliziani (M'91-SM'00) received the degree in electrical engineering from Sapienza University of Rome, Italy, in 1983. He was with the Sapienza as a Researcher (1987-1992), and Associate Professor (1992-1994). He joined the University of L'Aquila, Italy, as Full Professor of Electrical Engineering in 1994. He is the author or coauthor of more than 150 papers published in the fields of electromagnetic compatibility (EMC) and in electromagnetic field numerical computation. His current research interests include numerical modelling, wireless power transfer, wireless communications and bioelectromagnetics. Prof. Feliziani received the Best Paper Award of the IEEE TRANSACTIONS ON INDUSTRY APPLICATIONS in 1995, and the EMC Europe Symposium, in 2000. From 1995 to 2000, he was Associate Editor of the IEEE TRANSACTIONS ON ELECTROMAGNETIC COMPATIBILITY. In March 2003, he was the Guest Editor of a special issue of the IEEE TRANSACTIONS ON MAGNETICS. In 1994, he was co-founder of the EMC Europe Symposium. He was the General Chairman of the EMC Europe Symposium, Sorrento, Italy, in 2002, and of the EMC Europe Workshop, Rome, in 2005. He was Technical Program Committee Chair of EMC Europe 2012, Rome, Italy. He was the Chair of the International Steering Committee of the EMC Europe Symposium 2012–2015.



Francesca Maradei (M'96, SM'06) received the Laurea degree in electrical engineering (cum laude) from Sapienza University of Rome in 1992, the Diplome d'Etudes Approfondies (DEA) in electrical engineering from the INPG, Laboratoire d'Electrotechnique de Grenoble, France, in 1993, and the Ph.D. degree in Electrical Engineering from the Sapienza University of Rome, Italy, in 1997. She joined the Department of Electrical Engineering at the Sapienza University in 1996 where she is currently full professor. She has authored more than 150 technical papers in the field of computational electromagnetics and EMC. Prof. Maradei received the 2015 Laurence Cumming Award for outstanding service to the EMC society. She also received the James Melcher Price Paper Award for the paper "Analysis of upset and failures due to ESD by the FDTD-INBCs method," the Oral Presentation Best Paper Award at the International Symposium on Electromagnetic Compatibility—EMC ROMA 1994, Rome, Italy, and the Poster Presentation Best Paper Award at the EMC EUROPE 2000, Brugge, Belgium. She was the President of the IEEE Electromagnetic Compatibility Society from 2010 to 2011, and an Associate Editor of the IEEE TRANSACTIONS ON ELECTROMAGNETIC COMPATIBILITY from 1999 to 2000.



Tommaso Campi received the Laurea Degree in Electronic engineering from Sapienza University of Rome Italy, in 2012, the Master Laurea Degree in Telecommunication Engineering from the University of L'Aquila, Italy, in 2014, the Ph.D. Degree in Electrical Engineering at the University of L'Aquila, Italy, in 2017. He is currently a post-doctoral researcher at the University of L'Aquila.

His research interests include wireless power transfer, biomedical devices and electromagnetic compatibility. He was the recipient of the Best Poster Presentation at the IEEE CEFC 2014, Annecy, France.

Magnetic Field Characterization and Mitigation in an EV Equipped with a WPT System

Silvano Cruciani¹, Francesca Maradei², and Tommaso Campi¹

¹ *Department of Industrial and Information Engineering and Economics, University of L'Aquila, L'Aquila, Italy*

² *Department of Astronautics, Electrical and Energetic Engineering, Sapienza University of Roma, Roma, Italy*

Electromagnetic Shielding Technology for Wireless Charging Electric Vehicle

Jaehyoung Park, Jedok Kim, and Seungyoung Ahn

Korea Advanced Institute of Science and Technology (KAIST), Daejeon, Korea

Assessment of Human Exposure from Wireless Power Transfer Systems in Automotive Applications

Lionel Pichon¹, Vincenzo Cirimele², Fabio Freschi²

¹ *Group of Electrical Engineering-Paris, UMR CNRS 8507, Centrale Supélec, University of Paris-Sud, UPSaclay, Sorbonne Universités UPMC, University of Paris 06, 91192 Gif-sur-Yvette Cedex, France*

² *Department of Energy, Politecnico di Torino, Turin, Italy.*

EMF Evaluation of 6.6 kW Wireless Charging System for Electric Vehicles

Sang-Wook Park, Korea Automotive Technology Institute, Korea

Human Exposure in an Electric Vehicle Equipped with A WPT System

Mauro Feliziani, T. Campi, S. Cruciani, V. De Santis, F. Maradei

University of L'Aquila, Sapienza University of Rome, Italy

Recent Standardization Activities of Methods for Assessment of Wireless Power Transfer Related to Human Exposure

Teruo Onishi¹ and Kanako Wake²

¹ *NTT DOCOMO Inc., Japan*

² *National Institute of Information and Communications Technology, Japan*

Traceable Assessment of the Basic Restrictions by Measurement in the Very Close Near-field of Wireless Power Transfer Systems (3kHz to 10MHz)

Ilaria Liorni, Eugene Pikulin, Sven Kuehn, Myles Capstick, and Niels Kuster, IT'IS Foundation, Zurich, Switzerland

WORKSHOP WS-04	Lightning Protection of Wind Turbines
TIME	01:30pm – 06:00pm, Monday, May 14 th
VENUE	Room 334
ORGANIZERS	Marcos Rubinstein, University of Applied Sciences Western Switzerland, Switzerland Farhad Rachidi, Swiss Federal Institute of Technology, Switzerland
SPEAKERS	Farhad Rachidi, Swiss Federal Institute of Technology, Switzerland Marcos Rubinstein, University of Applied Sciences Western Switzerland, Switzerland Søren Madsen, Global Lightning Protection Services A/S, Denmark Takatoshi Shindo, Central Research Institute of Electric Power Industry, Japan Kazuo Yamamoto, Chubu University, Japan

ABSTRACT

Lightning protection and modelling of modern wind turbines exhibit a number of new challenges due to the large size of the blades, the use of carbon-reinforced plastics (CRP) in them, the current reflections at the top, the bottom and at different junctions along the structure, and the growing number of new installations worldwide. In addition, risk assessment estimates are based essentially on downward flashes, even though upward lightning represents a considerable fraction of the flashes to wind turbines. This workshop presents the current knowledge and challenges related to lightning protection of modern wind turbines.

BIOGRAPHIES OF ORGANIZERS



Marcos Rubinstein (M'84–SM'11–F'14) received the Master's and Ph.D. degrees in electrical engineering from the University of Florida, Gainesville, FL, USA, in 1986 and 1991, respectively.

In 1992, he joined the Swiss Federal Institute of Technology, Lausanne, Switzerland, where he was involved in the fields of electromagnetic compatibility and lightning. In 1995, he was with Swisscom, where he worked in numerical electromagnetics and EMC. In 2001, he moved to the University of Applied Sciences of Western Switzerland HES-SO, Yverdon-les-Bains, where he is currently a full Professor, head of the advanced Communication

Technologies Group and a member of the IICT Institute Team. He is the author or coauthor of more than 200 scientific publications in reviewed journals and international conferences. He is also the coauthor of seven book chapters. He is the Chairman of the International Project on Electromagnetic Radiation from Lightning to Tall structures, served as the Editor-in-Chief of the Open Atmospheric Science Journal, and currently serves as an Associate Editor of the IEEE Transactions on Electromagnetic Compatibility.

Prof. Rubinstein received the best Master's Thesis award from the University of Florida. He received the IEEE achievement award and he is a co-recipient of the NASA's Recognition for Innovative Technological Work award. He is a Fellow of the IEEE and of the SUMMA Foundation, a member of the Swiss Academy of Sciences and of the International Union of Radio Science.



Farhad Rachidi (M'93–SM'02–F'10) received the M.S. degree in electrical engineering and the Ph.D. degree from the Swiss Federal Institute of Technology, Lausanne, Switzerland, in 1986 and 1991, respectively. He was with the Power Systems Laboratory, Swiss Federal Institute of Technology, until 1996. In 1997, he joined the Lightning Research Laboratory, University of Toronto, Toronto, ON, Canada. From 1998 to 1999, he was with Montena EMC, Rossens, Switzerland. He is currently a Titular Professor and the Head of the EMC Laboratory with the Swiss Federal Institute of Technology, Lausanne, Switzerland. He has authored or co-authored over 170 scientific papers published in peer-reviewed journals and over 350 papers presented at international conferences.

Dr. Rachidi is currently a member of the Advisory Board of the IEEE TRANSACTIONS ON ELECTROMAGNETIC COMPATIBILITY and the President of the Swiss National Committee of the

International Union of Radio Science. He has received numerous awards including the 2005 IEEE EMC Technical Achievement Award, the 2005 CIGRE Technical Committee Award, the 2006 Blondel Medal from the French Association of Electrical Engineering, Electronics, Information Technology and Communication (SEE), the 2016 Berger Award from the International Conference on Lightning Protection, the 2016 Best Paper Award of the IEEE Transactions on EMC, and the 2017 Motohisa Kanda Award for the most cited paper of the IEEE Transactions on EMC. In 2014, he was conferred the title of Honorary Professor of the Xi'an Jiaotong University in China. He served as the Vice-Chair of the European COST Action on the Physics of Lightning Flash and its Effects from 2005 to 2009, the Chairman of the 2008 European Electromagnetics International Symposium, the President of the International Conference on Lightning Protection from 2008 to 2014, the Editor-in-Chief of the Open Atmospheric Science Journal (2010-2012) and the Editor-in-Chief of the IEEE TRANSACTIONS ON ELECTROMAGNETIC COMPATIBILITY from 2013 to 2015.

Cloud-To-Ground Lightning and Wind Turbines

Farhad Rachidi and Marcos Rubinstein, University of Applied Sciences Western Switzerland, Switzerland

Challenges of Lightning Protection of Modern Wind Turbines

Marcos Rubinstein and Farhad Rachidi, Swiss Federal Institute of Technology, Switzerland

Lightning Protection of Wind Turbine Blades

Søren Madsen, Global Lightning Protection Services A/S, Denmark

Lightning Protection of Wind Turbine Nacelles

Søren Madsen, Global Lightning Protection Services A/S, Denmark

Lightning Observations at Wind Turbine Parks in Japan

Takatoshi Shindo, Central Research Institute of Electric Power Industry, Japan

Grounding of Wind Turbines

Kazuo Yamamoto, Chubu University, Japan

WORKSHOP WS-05	CEM for EMC: Computational Electromagnetics (CEM) for EMC Applications
TIME	01:30pm – 06:00pm, Monday, May 14 th
VENUE	Room 333
ORGANIZERS	Christian Schuster, Hamburg University of Technology, Germany Lijun Jiang, University of Hong Kong, China Bruce Archambeault, Missouri University of Science and Technology/IBM, USA
SPEAKERS	Cheng Yang, Southeast University, China Dries Vande Ginste, Ghent University, Belgium Hideki Asai, Shizuoka University & SESAME Technology Inc, Japan Bruce Archambeault, Missouri University of Science and Technology/IBM, USA Lijun Jiang, University of Hong Kong, China Huapeng Zhao, University of Electronic Science and Technology, China Zi-Liang Liu, Temasek Laboratories, National University of Singapore, Singapore Xing-Chang Wei, Zhejiang University, China

ABSTRACT

Facing the increasing complexity in modern electronics from IC chips to entire systems, computer aided simulations are indispensable in every product development stage. From the parametric extraction to full wave diagnosis, computational electromagnetics and its supported tools are playing deterministic roles in safeguarding the signal/power quality and system specifications. Upon the critical roles of CEM in EMC, this workshop is intended to cover the computational electromagnetics algorithm developments, parametric extraction methods, hybrid electromagnetics and circuit simulations, model order reduction, ESD modeling, large-scale computing, and other CEM methods in EMC, EMI, signal integrity and power integrity for optimized electromagnetic designs. The applications could range from IC back end technology development, packaging SI/PI design, PCB optimization, PDN, systematic EMI reduction, cable harness in EV, power grid, etc. This workshop will benefit audiences in EMC/EMI/SI/PI researchers and engineers, EDA solution developers, large-scale electromagnetic analysis, etc.

BIOGRAPHIES OF ORGANIZERS



Christian Schuster (S'98 - M'00 - SM'05) received the Diploma degree in physics from the University of Konstanz, Germany, in 1996, and the Ph. D. degree in electrical engineering from the Swiss Federal Institute of Technology (ETH), Zurich, Switzerland, in 2000. Since 2006 he is full professor and head of the Institute of Electromagnetic Theory at the Hamburg University of Technology (TUHH), Germany. Prior to that he was with the IBM T. J. Watson Research Center, Yorktown Heights, NY, where he was involved in high-speed optoelectronic package and backplane interconnect modeling and signal integrity design for new server generations. His current interests include signal and power integrity of digital systems, multiport measurement and calibration techniques, and development of electromagnetic simulation methods for communication electronics.

Dr. Schuster received IEEE Transactions on EMC Best Paper Awards in 2001 and 2015, IEEE Transactions on CPMT Best Paper Awards in 2012 and 2016, IEC DesignCon Paper Awards in 2005, 2006, 2010 and 2017, three IBM Research Division Awards between 2003 and 2005, and IBM Faculty Awards in 2009 and 2010. He is a member of the German Physical Society (DPG) and several technical program committees of international conferences on signal and power integrity, and electromagnetic compatibility. He was serving as a Distinguished Lecturer for the IEEE EMC Society in the period 2012-2013, as a member of the Board of Directors of the EMC Society in 2015, and is currently chair of the German IEEE EMC Chapter.



Lijun Jiang (S'01-M'04-SM'13) received the B.S. degree in electrical engineering from the Beijing University of Aeronautics and Astronautics in 1993, the M.S. degree from the Tsinghua University in 1996, and Ph. D from the University of Illinois at Urbana-Champaign in 2004. From 1996 to 1999, he was an application engineer with the Hewlett-Packard Company. Since 2004, he has been the postdoctoral researcher, the research staff member, and the senior engineer at IBM T.J. Watson Research Center. Since the end of 2009, he is an Associate Professor with the Department of Electrical and Electronic Engineering at the University of Hong Kong, tenured in 2014. From Sept. 2014, he is also a frequent visiting scholar at the University of California at Los Angeles. Currently he is the Director of Electromagnetics and Optics Laboratory at EEE, HKU.

Dr. Jiang and his research team have received numerous awards and recognitions from international symposiums and conferences. He is the IEEE Senior Member, the Associate Editor of IEEE Transactions on Antennas and Propagation, the Editor of Progress in Electromagnetics Research, the Associate Guest Editor of the Proceedings of IEEE Special Issue in 2011~2012. He has been serving as General Chair, TPC Chair, Session Organizers, and Session Chairs for many international conferences and symposiums. He has been serving as the reviewer for majority of electromagnetics and microwave related journals.

His research interests focus on electromagnetics, computational electromagnetics, IC signal/power integrity, IC EMC/EMI, antennas, multi-physics modeling, etc.



Dr. Bruce Archambeault is an IEEE Fellow, an IBM Distinguished Engineer Emeritus and an Adjunct Professor at Missouri University of Science and Technology. He received his Ph. D. from the University of New Hampshire in 1997. His doctoral research was in the area of computational electromagnetics applied to real-world EMC problems. He has taught numerous seminars on EMC and Signal Integrity across the USA and the world, including the past 15 years at Oxford University.

Dr. Archambeault has authored or co-authored a number of papers in computational electromagnetics, mostly applied to real-world EMC applications. He currently serves as the President of the EMC Society. He is the author of the book "PCB Design for Real-World EMI Control" and the lead author of the book titled "EMI/EMC Computational Modeling Handbook".

Using the Method of Moments for Computation of Nonlinear Shielding

Cheng Yang, Southeast University, China

Heinz-D. Brüns, Hamburg University of Technology, Germany

Christian Schuster, Hamburg University of Technology, Germany

A Rigorous Full-Wave Computational Modeling Technique for the Signal Integrity Analysis of 3-D Interconnects

Martijn Huynen, Ghent University, Belgium

Daniël De Zutter, Ghent University, Belgium

Dries Vande Ginste, Ghent University, Belgium

Acceleration Techniques for SI/PI/EMI Simulation and the Integrative Framework

Hideki Asai, Shizuoka University & SESAME Technology Inc, Japan

A Physics-based Circuit Approach for Power Integrity in Multi-layered PCBs

Bruce Archambeault, Missouri University of Science and Technology/IBM, USA

Circuit Oriented Electromagnetic Modeling using the PEEC Techniques

Lijun Jiang, University of Hong Kong, China

Albert E. Ruehli, Missouri University of Science and Technology, USA

Giulio Antonini, Università degli Studi dell'Aquila, Italy

Recent Progress in Equivalent Modeling of Electromagnetic Compatibility Problems

Huapeng Zhao, University of Electronic Science and Technology, China

EMC Modeling of Large-Scale Antenna/Platform System with GPU Accelerated Fast MoM-PO Hybrid Technique – Theory, Acceleration , and Application

Zi-Liang Liu, Temasek Laboratories, National University of Singapore, Singapore

Near-Field Scanning based EMI Source Reconstruction Algorithm

Xing-Chang Wei, Zhejiang University, China

WORKSHOP WS-06	(a) EMC for Automotive (b) EMC for Medical Equipment
TIME	4:00pm – 6:00pm, Monday, May 14 th
VENUE	Room 336
ORGANIZERS	Hideki Asai, Shizuoka University, Japan Dong Jiang, Huazhong University of Science and Technology, China Junhong Deng, TÜV SÜD PSB Pte Ltd, Singapore
SPEAKERS	Fengchao Xiao, University of Electro-Communications, Japan Hideki Asai, Shizuoka University, Japan Dong Jiang, Huazhong University of Science and Technology, China Junhong Deng, TÜV SÜD PSB Pte Ltd, Singapore

ABSTRACT

Recently, automotive and medical industry is growing up all over the world. Especially, the scope of the technical interests becomes much wider than consumer electronics. In this workshop, the technical issues regarding the electromagnetic interference to automotive and medical equipment are discussed and analyzed. The EMC trends in automotive is also introduced, and the EMC standards for medical equipment is presented.

BIOGRAPHIES OF ORGANIZERS



Hideki Asai received the B.E., M.E., and Ph.D. degrees in electrical engineering from Keio University, Yokohama, Japan, in 1980, 1982, and 1985, respectively. In 1985, he was with the Department of Electrical and Electronics Engineering, Sophia University, Tokyo, Japan. He was an oversea researcher at Carleton University, Ottawa, ON, Canada, and Santa Clara University, Santa Clara, CA (1999–2000). Since 1986, he has been with Shizuoka University (Faculty of Engineering), Hamamatsu, Japan, where he is currently a Professor of the Research Institute of Electronics, involved with VLSI-CAD/CAE including signal/power integrity design & simulation technologies, electrical design automation (EDA), analog circuit design, and neural networks, and has published about 100 articles in peer-reviewed journals and more than 250 conference proceedings, and had a variety of collaborations with major companies, was selected as one of the leading researchers in Shizuoka University (2011–2013, 2014–2016). He is an author of the books, “Exercise Notes of Digital Circuits, CORONA PUBLISHING. CO., LTD., 2001” and “Electronic Circuit Simulation Techniques, SCI TECHS PRESS, 2003.” Dr. Asai is a member of the IEEE Nonlinear Circuits and Systems Technical Committee. He was secretary for the IEEE Circuits and Systems Society Tokyo Chapter (1994–1995), and secretary of the Technical Committee on Nonlinear Problems of the Institute of Electronics, Information and Communication Engineers (IEICE) (1997–1999). He was a chairman of the Technical Committee on Nonlinear Problems of the IEICE (2007–2008) and a chairman of the Technical Committee on System Packaging CAE of JIEP (2007–2009), and was an executive board member of JIEP. He was a general chair of the EDAPS2013 (Electrical Design of Advanced Packaging Systems Symposium 2013, Nara, Japan) and a guest editor of Special Section on Analog Circuit Techniques and Related Topics in the IEICE Trans. on Fundamentals issued in March, 2014.

He was the recipient of the Research Encouragement Awards on the occasion of the Takayanagi anniversary, the 50th anniversary of the founding of the IEICE Tokai branch, and on the occasion of the Saitoh anniversary, in 1988, 1989 and 1993, respectively. Furthermore, he received the Prize for Science and Technology (Research Category) awarded by MEXT (Minister of Education, Culture, Sports, Science and Technology), and Takayanagi anniversary Awards, in 2009, and the best paper ward at the APEMC2017, and a fellow of the IEICE.



Dong Jiang (S05'-M12'-SM16') received B.S and M.S degrees in Electrical Engineering from Tsinghua University, Beijing, China, in 2005 and 2007 respectively. He began his PhD study in Center for Power Electronics Systems (CPES) in Virginia Tech in 2007 and was transferred to University of Tennessee with his advisor in 2010. He received his PhD degree in University of Tennessee in Dec. 2011. He was with United Technologies Research Center (UTRC) in Connecticut as a Senior Research Scientist/Engineer from Jan 2012 to July 2015. He has been with Huazhong University of Science and Technology (HUST) in China as a professor since July 2015. Dong Jiang's major research area is power electronics and motor drives, with more than 60 published IEEE journal and conference papers in this area. He has two best paper awards in IEEE conferences. He is an associate editor of IEEE Transactions on Industry Applications.



Dr. Deng Junhong is the Vice President (Electrical and Electronics) of TÜV SÜD PSB, the Chairman of EMC Service Line Committee and the EMC Senior Product Specialist of TÜV SÜD Product Service. His expertise is mainly in EMC consultancy, EMC design, EMC testing, EMC certification, and laboratory management. Additionally, as a senior member of IEEE, he has been serving in IEEE EMC Singapore Chapter as an executive committee member since 2005, Chairman in 2014 and 2015, Vice Chairman in 2009, 2010, 2012 and 2013. Dr. Deng has also been servicing in the IECEE CB scheme as a member of IECEE CTL EMC Expert Task Force since 2007. Dr. Deng is an iNARTE certified EMC engineer, a member of Singapore National Working Group (WG) on IEC/TC 77 on EMC. Prior to joining TÜV SÜD PSB in 1998, Dr. Deng was a lecturer with East China Jiaotong University in 1987 – 1994 and a senior design engineer with Mitsubishi Electric in 1996-1998. Dr. Deng published around 30 research papers in EMC and power electronics, and gave numbers of paper presentations at International conferences. He also provided EMC consultancy to the industry, gave technical talks in various conferences and seminars on EMC regulations, EMC design, EMC testing techniques, EMC standards, etc. and served in the committees of a few international EMC conferences. Dr. Deng holds a Bachelor degree and a Master degree of Engineering from Beijing Jiaotong University, majoring in Railway Electric Propulsion & Automation, and also graduated from Nanyang Technological University with a Master degree of Engineering and Doctor of Philosophy in the area of EMC research.

Electromagnetic Field Measurements for Analysis of Wave Propagation around Automobile

Fengchao Xiao and Yoshio Kami, University of Electro-Communications, Japan

Advanced SI/PI/EMI Simulation Technology for Electrical Optimization in Automotive Design: Consideration to 1-D from 3-D

Hideki Asai, Shizuoka University, Japan

EMI Issues and Mitigation for Power Electronics Converter – Approach through PWM

Dong Jiang, Huazhong University of Science and Technology, China

EMC for Medical Equipment

Junhong Deng, TÜV SÜD PSB Pte Ltd, Singapore

WORKSHOP WS-07	Use of FFT-based measuring instruments in EMI testing
TIME	01:30pm-03:30pm, Monday, May 14 th
VENUE	Room 336
ORGANIZERS	Jens Medler, Rohde & Schwarz GmbH & Co. KG, Germany Matthias Keller, Rohde & Schwarz GmbH & Co. KG, Germany ChunSoong Wong, Rohde & Schwarz Region Headquarters, Singapore
SPEAKERS	Jens Medler, Rohde & Schwarz GmbH & Co. KG, Germany Matthias Keller, Rohde & Schwarz GmbH & Co. KG, Germany ChunSoong Wong, Rohde & Schwarz Region Headquarters, Singapore

ABSTRACT

Facing the booming converged devices and the fast growing wireless technologies, the complexity of electromagnetic interference and related research become serious topic to the industry. This goes along with a high demand for reducing test time and to comprehensively record the disturbance characteristic of the equipment under test. Usage of FFT-based measuring instruments is the key for addressing these topics. The workshop will address the applicability of FFT-based receivers for EMI compliance measurements against international standards, gives an inside view on the technology of such receivers and will conclude with a practical use cases.

BIOGRAPHIES OF ORGANIZERS



Jens Medler joined Rohde & Schwarz, Munich, Germany, a company specialising in test equipment and radio equipment in 1996. He is responsible for the standardization and application support of EMI test receivers and accessories for both hardware and software and is active member of various CISPR Subcommittees since 1999.

This includes CIS/A on EMC measurement instrumentation and methods, CIS/D on equipment on vehicles and internal combustion engine powered devices and CIS/I on information technology equipment, multimedia equipment and receivers. Since October 2017 he is acting as Convenor of CIS/A WG2; the CISPR Working Group on EMC measurement methods, statistical techniques and uncertainty. He is recipient of the IEC 1906 Award.



Matthias Keller joined the test and measurement division of Rohde & Schwarz, Munich, Germany in 1985. He worked in the development department for EMI test receivers, EMI test software and real time spectrum analyzers and was project manager for these products. Now he is product manager for EMI test receivers and EMI test software. Matthias holds several patents for EMI test technology.



Chun Soong is currently the Oscilloscope Product Manager in Asia. He was previously Regional Application Engineer specializing in oscilloscopes since 2010. His main focus in Rohde & Schwarz is to drive product business development and roll out in the region. He is also working on providing training and guidance on oscilloscope applications. Prior to Rohde & Schwarz, Chun Soong was with Intel for 7 years, where he spent his early years in Chipset Electrical Validation, and was subsequently involved in USB, DDR2 & DDR3 measurement methodology definition. Chun Soong eventually progressed to Platform Application where he worked closely with ODM and OEM in motherboard design for Intel chipset launch.

Chun Soong graduated from the University of Sydney with the Bachelor of Engineering (Electrical) degree.

Applicability of FFT-based Measuring Receivers for EMI Compliance Measurements

Jens Medler, Rohde & Schwarz GmbH & Co. KG, Standardization and Application Specialist for EMC Test Equipment, Germany

FFT-based Receiver for EMI Measurements

Matthias Keller, Rohde & Schwarz GmbH & Co. KG, EMC product manager, Germany

EMI Debugging by using Oscilloscope with FFT Functionality

Chun Soong Wong, Rohde & Schwarz Region Headquarters Singapore, Oscilloscope product manager, Singapore