

WORKSHOPS & TUTORIALS

Automotive EMC

Format: Full-day Workshop

*Chairs: Todd Hubing, Clemson University
Stephen Frei, University of Dortmund*

Abstract

This tutorial discusses the limitations and applications of different simulation techniques, as well as how to properly validate. This workshop addresses EMC test and design issues of relevance to the automotive industry. It brings automotive EMC engineers from around the world together to provide updates on the many rapid changes in the automotive industry that affect automotive EMC.

The first half-day of this workshop will focus on new automotive EMC challenges and design tools and techniques for automotive engineers. This will include talks on the impact of new automotive technologies, new design criteria, and an overview of the latest modeling tools available.

The second half-day of this workshop will focus on automotive EMC test practices. It will address the automotive industry's problems associated with out-dated, OEM-specific EMC test procedures and the challenge of trying to use component-level test results to anticipate system-level EMC problems.

Description of Topics

- New EMC design challenges facing the automotive industry
- New EMC test methods for automotive components
- EMC modeling tools for automotive engineers
- New techniques for using component-level test results for system-level modeling
- The impact of wireless technologies on automotive EMC
- EMC issues associated with electric and hybrid drives

Planned Presenters

- ◆ Martin Aidam, Daimler AG, Germany
- ◆ Stephan Frei, University of Dortmund, Germany
- ◆ Hiroki Funato, Hitachi, Japan
- ◆ Todd Hubing, Clemson University, USA
- ◆ Masato Izumichi, Denso EMC Engineering, Japan
- ◆ Roman Jobava, EMCos Ltd, Tbilisi, Georgia
- ◆ M. Klingler, PSA Peugeot Citroen, France
- ◆ Jody Nelson, Daimler AG, USA

EMC and Wireless Devices

Format: Full-day Workshop

Chair: Dan Hoolihan, Hoolihan EMC Consulting, Lindstrom, MN

Abstract

The overall workshop will provide key information on EMC concerns as they pertain to present and future wireless/cellular phone technologies and associated packaging issues. More specifically, this workshop will address the electromagnetic interference (EMI) aspects of the proliferation of modern wireless devices such as current radio and cell phone technologies. It will address both EMI from product to product such as cellular phones, wireless radio devices and packaging, as well as relevant spectrum allocation issues.

Topics to be discussed will include:

- EMI from licensed cell and wireless transmitters
- EMI for unlicensed cell and wireless transmitters
- Telecom Certification Body (TCB) issues with wireless/telecommunications devices
- EMI and future wireless and cellular technologies
- International and regulatory aspects of EMI and wireless/cellular devices.

The first part of this workshop will introduce and define the concept of Platform and Cellular Device RF/Microwave Interference. It will include presentations on the concept of RF/microwave EMI for wireless systems including measurement techniques, design methodologies and case studies to establish risks and determine mitigation requirements for platform and device-generated RF/microwave EMI.

The second part of this workshop will address specific device issues particularly as they relate to radiated electromagnetic interference and immunity for modern communications systems including cell devices, as well as the impact of new communications device technologies and dynamic frequency selection. Additional specific case studies will be presented along with a focus on selected wireless technology, packaging considerations, spectrum and laboratory measurement methods.

Planned Presenters

- ◆ Dave Case, Intel
- ◆ Mike Violette, Washington Labs
- ◆ Kevin Slattery, Intel
- ◆ Harry Skinner, Intel
- ◆ Steve Berger, TEM Consulting
- ◆ Andy Drozd, Andro Consulting
- ◆ Dan Hoolihan, Hoolihan EMC Consulting

Guide to Accreditation of EMC Laboratories in the US

Format: Half-day Workshop

Chair: Werner Schaefer, Cisco Systems

Abstract

The workshop is planned as a true exchange of information between laboratory personnel who are either considering to seek accreditation for their laboratory or who are already accredited. A formal outline of the workshop is prepared and can be followed. However, emphasis is placed on answering questions from the audience to ensure that the true interests of attendees are covered. The author, a lead assessor with A2LA, also manages the quality system for accredited laboratories and is actively participating in and contributing to national and international EMC and Quality standards work. The presenter's extensive background knowledge about RF and microwave test instrumentation allows for an in-depth discussion of complex subjects as suitability of test equipment calibration services, test equipment suitability and measurement uncertainty calculations.

The workshop consists of five parts covering reasons for obtaining accreditation for an EMC laboratory, what does accreditation really mean, accrediting bodies in the US, prerequisites for an accreditation, implementation of a quality system, based on ISO 17025, plus equipment calibration requirements, measurement uncertainty requirements, test equipment and test environment suitability and other considerations for laboratory accreditation.

Planned Presenter

Werner Schaefer, Cisco Systems

Automotive EMC High Power and Field Level Immunity Testing

Format: Half-day Workshop

Chairs: Vince Rodriguez and Janet O'Neil, ETS-Lindgren, Texas

Abstract

One of the main differences between EMC testing for automotive and commercial products is the necessity to test automotive products at very high field levels. The need is very serious. With automotive EMC, lives are at risk if essential electronic safety devices fail during operation of the vehicle. Additionally, the vehicle is not a stationary device - vehicles move and operate in a variety of electromagnetic environments from driving close to substations, to under power lines, close to airports, or to TV and radio broadcast stations, to name a few "noisy" environments.

The proposed workshop will present an overview of immunity testing, concentrating on the ISO 11451-2 standard for full vehicle as well as the ISO 11452-2 standard for vehicle components. The issues of generating and measuring high field levels will be addressed as well as selection criteria for the antennas, amplifiers and field probes used during high power testing. The test environment of an anechoic chamber and reverberation chamber will be reviewed (the reverberation chamber is also an approved approach for immunity testing) with an overview of performing a test in these environments. Finally, the impact of this high power testing on OEMs will be addressed by a representative from one of the "Big Three" automotive companies in the greater Detroit area.

Planned Presenters

- ◆ Garth D'Abreu, ETS-Lindgren
- ◆ Hans-Peter Bauer, Rohde & Schwarz
- ◆ Vince Rodriguez, ETS-Lindgren
- ◆ Keith Frazier, Ford Motor Company

Basic Antenna & Probe Use in EMC

Format: Half-day Workshop

Chair: Candace Suriano, PhD, Suriano Solutions, Michigan

Abstract

Basic Antenna and Probe Use in EMC provides an introduction to antenna and probe theory and application relevant to EMC. This workshop covers fundamental principles of operation for various common antenna and field probe configurations covering the frequency spectrum associated with EMC testing. The essential descriptive characteristics of antennas and probes are defined. The nature of radiation and coupling for various types of antennas is described and illustrated including consideration of near field and far field effects. The use of antennas in EMC testing is covered, including comparison of reverberant, anechoic, and open air testing. The implications of the antenna characteristics on EMC testing are discussed, including the nature and use of antenna factors, gain, radiation resistance, VSWR, etc. Processing and interpretation of antenna signals by receivers and analyzers is discussed, including discussion of signal type, signal bandwidth and filtering of signals. The use of soft ferrites in conjunction with antennas in EMC testing is covered. Unintentional radiators/receptors will also be discussed.

Planned Presenters

- ◆ Zhong Chen, ETS-Lindgren
- ◆ Qin Yu, Alcatel-Lucent Technologies
- ◆ Tom Holmes, Agilent Technologies
- ◆ Paul Zdanowicz, Fair-Rite Products

The State of Electromagnetic Environments (EME)

Format: Half-day Workshop

*Chairs: Dave Southworth, SPAWAR Systems Center, California
Dr. Bill Strauss, NAVAIR, Maryland*

Abstract

This workshop is intended to discuss the current state of knowledge for electromagnetic environments (EME). The EME is evolving and expanding into areas previously considered "RF quiet" with the proliferation of wireless electronics. There will be a concentration on man-made environments. Major electromagnetic environments will be discussed as well as soliciting arenas that may not yet be assessed, but play a role in the future. Electromagnetic environments can affect the operation of electronic systems or equipment with unintended consequences. The design of equipment must take the EME into account and thus the EME must be known. The intent is to involve the audience both prior to, during, and after the symposium. The session is soliciting ahead of the symposium data from participants on their local urban or operational EME. The data will be presented and discussed during this session. The audience will be encouraged to continue the dialogue on expanding and unique EME in TC3 technical meetings and future workshops.

Planned Topics

- EME Standards
- Industrial EME
- Military EME
- Public common areas EME
- Unique stories of EME interference
- Urban EME

Planned Presenters

- ◆ Dave Southworth (e.g. C63) and Bernd Jaekel
- ◆ Kimball Williams, Scott Lytle and Dr. Bill Strauss
- ◆ Dave Southworth, Matt Grenis, Fred Heather
- ◆ Keith Armstrong
- ◆ Doug Kramer

Practical EMI Filter Design

Format: Half-day Workshop

Chair: Dipl. Ing.(FH) Alexander GERFER, Würth Electronics, SD

Abstract

The workshop is targeted on a practical approach and offers practical design rules for the designer, who has to fit EMI-filters into his design. The workshop starts with training about the passive components Capacitor, Inductor and EMI-Ferrite and their parasitics. Additionally some basic design rules around PCB-board-layout and the influence of source and load impedances on the filter damping will be discussed. New simulation tools and improved simulation models help to find the best filter solution for a certain noise problem. A practical filter measurement of different filter topologies shows how the filter reaction is on a practical PCB-board.

Planned Topics

- EMI Components: the real view on Capacitor, Inductor and Bead
- Simulation Models of Capacitor and Inductor, Chip-Bead
- The Current Dependent Simulation Model of Chip Beads
- EMI Filter Topologies
- Source and Load Impedances—How to Define?
- Simulation Software Tools
- Common Mode Choke
- Common Mode Choke Simulation Model
- Analysis of EMI Filters
- Layout
- Parasitics
- Comparison Measurement ↔ Simulation

Planned Presenters

- ◆ Dipl. Ing (FH) Alexander GERFER
- ◆ Dipl. Ing. Michael ECKERT

Module Level EMI Measurements and Estimation

Format: Half-day Workshop

*Chairs: H. R. Hofmann, Hofmann Electromagnetic Compatibility Engineering
Hiroshi Yamane, NTT Energy and Environment Systems
Laboratories/VCCI, Tokyo, Japan*

Abstract

This workshop describes the technical measurement methods for measuring emissions from module products and to determine emission levels. Included in the requirements are measurement methods and evaluation of emission level. These measurement methods measure the applying area for the emission of modules. Several IEC Standardization of measurement methods for IC EMI have been developed, these methods are applied to the evaluation method of the module level disturbances.

This workshop is clarified for these measurement methods applying area, and what is the evaluated part of the module level disturbance.

Planned Topics

- Trend and outline of the estimation for Module level EMI measurements
- TEM cell method for estimating the radiated electric field strength from PCB module
- WBFC method for Common mode Current of 150Ω line
- VDE Method for the ground Current using 1Ω Resistance probe contact
- MP Method for the supply currents using M.P probe (non contact)

Planned Presenters

- ◆ Prof. Osami Wada, Kyoto University of Japan
- ◆ Prof. Todd H. Hubing, Clemson University, USA
- ◆ Mr. Rainer Gehrmann, HP
- ◆ Mr. Toshiki Shimasaki, NEC Engineering, Japan

Limitations of Simulation Techniques and Proper Model Validation for Both Signal Integrity and EMC

Format: Half-day Workshop

Chair: Dr. Bruce Archambeault, IBM Corporation, North Carolina

Abstract

As signal speeds increase into the Gbit/sec range, the use of modeling and simulation is more important than ever before and has become quite common in real-world product design. However, using the right tool for the right job has become critical, since all simulation techniques have limitations. Standard SPICE or transmission line tools are only effective for cases with a true transmission line, and are completely inappropriate for cases where the signal is no longer TEM. Quasi-static tools for L,R,C parameter extraction are also accurate over a limited frequency range. And, finally, full-wave tools are accurate since they make no simplifying assumptions, but must be used with great care, since they can easily provide an incorrect result. Each fullwave modeling technique has types of problems where the technique excels, and other problem types where the technique is often less than adequate. It is important for simulation tool users to know when to use which technique and when not to use it.

Model validation has never been more important. It is not enough to simply 'believe' the result is correct because someone else made a model with the same commercial tool and seemed to get the right result. Many little things can cause errors without the user being aware of the errors. Simulation tools will provide a very accurate answer to the question it was asked...was the question entered properly? Measurements can help validate simulations, but measurements at very high frequencies are difficult and often introduce other effects that can mask the effects under study.

This workshop will include a number of experts in different modeling and validation techniques. Each speaker will provide a presentation concerning different modeling techniques, their practical limitations and how to validate simulation results.

Planned Presenters

- ◆ Bruce Archambeault, IBM
- ◆ Jim Drewniak, UMR
- ◆ Colin Brench, Southwest Research
- ◆ Chuck Bunting, OK State Univ
- ◆ Jim Nadolny, Samtec
- ◆ Jun Fan, UMR

Introduction to EMI Modeling Techniques

Format: Half-day Workshop

Chair: Charles Bunting, Oklahoma State University, Oklahoma

Abstract

This workshop 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. Substantially revised over last year's workshop, this workshop will begin with circuit based approaches and end with Maxwell's equation – full field solution methods.

The format will be a conference presentation style (lecture) followed by questions moderated by the chairman. The chairman takes responsibility for weaving the threads of cohesiveness and dissimilarities between the methods. This session was heavily attended last year with well over 100 people.

Planned Topics and Presenters

- The Transmission Line Method
- Introduction to the Partial Element Equivalent Circuit Technique
- The Finite-Difference Time-Domain Technique
- Understanding the Finite Element Method
- Introduction to the Method of Moments

Planned Presenters

- ◆ Dr. David Johns
- ◆ Giulio Antonio
- ◆ Dr. Bruce Archambeault or Sam Conners
- ◆ Dr. Charles F. Bunting
- ◆ Professor Ji Chen

EMC and Modern Power Electronic Systems

Format: Half-day Tutorial

Chair: Dr. Firuz Zare, Queensland University of Technology, Australia

Abstract

The purpose of this tutorial is to address basic and advanced concepts of EMC in modern power electronic systems which help EMC experts to analyze EMC problems of power electronics used in different applications. Introducing power electronics in details such as transformer and motor design, modulation strategy, and switching losses to EMC experts may open a new research area and help development engineers to find better solutions to minimize sources of EMI noise at the development phase and improve cost, size and performance of the system.

Planned Topics

- Power Electronics: Topologies, Applications, Pulse Width Modulation
- Major EMI Problems In Power Electronic Systems
- Active EMI Filters Used In Motor Drives
- Methods To Predict And Minimize Conducted Emission Noise In Motor Drive Systems
- Important Feedbacks From EMC Experts To Development Engineers

Fundamentals of EMC

Format: Full-day Tutorial

Chair: Daryl Beetner, Missouri University of Science and Technology, Missouri

Abstract

Organized by the EMC Society Education and Student Activities Committee, this tutorial is designed to present the basics of EMC to those who are new to the field of EMC, those who are seeking information on an aspect of EMC that they have not previously encountered, or those who desire a refresher on the proposed EMC topics.

Planned Topics and Presenters

Introduction

D. Beetner, Missouri University of Science and Technology, Rolla, MO
Overview of the EMC area. Introduction of the following talks.

PCB Design: The Path of Least Impedance

Elya Joffe, K.T.M. Project Engineering, Hod Hasharon, Israel

What is “Partial Inductance”?

Clayton Paul, Mercer University, Macon, GA

Many signal integrity problems are due to the “inductance” of the interconnect conductors. The inductance of a segment of a conductor is very different from the conventional “loop inductance” that we have studied in school. This seminar explains the concept and calculation of “partial inductance” which allows us to allocate inductances to segments of conductors.

Automotive EMC

Todd Hubing, Clemson University, Clemson, SC

This presentation introduces EMC concepts and solutions that are of particular interest to the automotive industry. It is organized in 3 parts. The first part describes problems that have been reported by customers in the past and reviews the changes occurring in automotive electronics. The second part summarizes automotive EMC standards and test procedures and discusses methods for predicting system level performance based on component level tests. The third part reviews good EMC design practices for automotive designs at the component and system levels.

Basic EMC Measurements

Format: Half-day Tutorial

Chair: Don Heirman, Don HEIRMAN Consultants, New Jersey

Abstract

This workshop will be an introduction to basic EMC measurements with primary focus on emission testing. While intended for those new to these disciplines, the latest activity in national and international standards related to EMC measurements and standards will be presented. A special focus will be on measurements and associated issues above 1 GHz as well as measurement uncertainty. An open discussion will follow the presentations.

Planned Topics and Presenters

- Emission Measurements for Tabletop Equipment
- Emission Measurements for Floor-Standing Equipment
- IEC Transient-Immunity Testing Overview
- Immunity to Continuous RF Disturbances
- Basic Measurement Sites, Methods, and Associated Errors
- Selecting a Quality EMC Lab
- Uncertainty Considerations in Stating Pass/Fail

Planned Presenters

- ◆ H. R. (Bob) Hofmann, Hofmann EMC Engineering
- ◆ Thomas E. Braxton, Braxton EMC Consulting
- ◆ John Maas, IBM
- ◆ Don Heirman, Don HEIRMAN Consultants
- ◆ Daniel D. Hoolihan, Hoolihan EMC Consulting

Advanced Topics for Antennas and Field Probes in Radiated Measurements

Format: Half-day Tutorial

Chair: Zhong Chen, ETS-Lindgren, Texas

Abstract

This “Advanced Topics for Antennas and Field Probes in Radiated Measurements” tutorial covers antenna and probe theory with a focus on advanced application specific topics relevant to EMC. This tutorial will address aspects of applications of antennas and field probes beyond those specified in typical manufacturer’s data sheets. The discussions are concentrated on the usage of antennas and probes in testing to EMC industry standards. Time domain methods related to antenna calibration and usage will be discussed. The implications of the antenna characteristics on EMC testing will be reviewed, including the nature and use of antenna factors, gain, radiation resistance, VSWR, etc. Uncertainty evaluations of the antenna and probe calibrations will be considered, along with the implications of the uncertainties in typical end use situations. Applications of the antennas and probes in radiated emissions and immunity tests as well as radiated site validation measurements will be addressed, including those for measurements below and above 1 GHz. This tutorial will also provide the latest updates on ANSI and CISPR standards on antenna calibrations, and IEEE 1309 and IEC 61000-4-3 standards on probe calibrations.

Planned Presenters

- ◆ Zhong Chen, Senior Principal Design Engineer, ETS-Lindgren
- ◆ Dr. Vince Rodriguez, Senior Principal Antenna Engineer, ETS-Lindgren
- ◆ Mike Windler, Associate Managing Engineer, Underwriters Laboratory, Chairman of ANSI ASC C63 Subcommittee 1 (C63.4/C63.5)
- ◆ Alexander Kriz, Research Scientist, Austrian Research Centers (Seibersdorf, Austria) Project leader for several antenna related programs in CISPR/A
- ◆ Dennis Camell, National Institute of Standards and Technology, Boulder, Colorado. Primary author of the 2007 IEEE International Symposium on EMC Best Paper titled “Free Space Antenna Factors through the Use of Time-Domain Signal Processing”

Fundamentals of Signal Integrity

Format: Half-day Tutorial

*Chairs: Prof. Tzong-Lin Wu, National Taiwan University, Taipei, Taiwan
Prof. James Drewniak, Missouri University of Science and Technology,
Missouri*

Abstract

This workshop will introduce the audience to the fundamental concepts of signal and power integrity for high-speed digital boards or packages and in particular, High-speed Signal Link Path, SI/PI Modeling and Analysis, Jitter, Power Distribution Networks, Models of Active Devices, and, Measurement for SI.

The focus of this workshop will be on the fundamental modelling and design concepts of signal and power integrity (SI & PI) for high-speed circuit systems. Several important topics will be highlighted, including the models of the active devices for SI and PI simulation, modelling and analysis of the high-speed signal link path in PCB and packages, jitter in high-speed signals, modelling and design for the power distribution network, and the measurement techniques for SI.

Planned Topics

- High-speed Signal Link Path: Models and Analysis
- Jitter
- Power Distribution Networks
- Models of Active Devices
- Measurement for SI

Planned Presenters

- ◆ Prof. James Drewniak, Missouri University of Science and Technology, Missouri, USA
- ◆ Prof. David Pommerenke, Missouri University of Science and Technology, Missouri, USA
- ◆ Prof. Tzong-Lin Wu, NTU, Taiwan
- ◆ Dr. Ben Beker, AMD Fellow, AMD
- ◆ Dr. Vittorio Ricchiuti, Technolabs, Italy

Aerospace Lightning Protections

Format: Half-day Tutorial

Chair: Fred Heather, Navair, Maryland

Abstract

This tutorial will cover the area of lightning protection of aerospace vehicle. The session will open with a brief on lightning attachment to aircraft. The session will expand out to cover space vehicles and charge control. The session will examine the indirect effects modeling using TLM, complimented by the Pitfall and success of equipment level lightning test. The session will close with a look at direct effects of lightning to materials.

Lightning attachment to an aircraft is unavoidable! It presents the most extreme natural electrical stress on modern all electric aircraft. This session will span the subject to introduce the unavoidable lightning strike and then provide the engineering technology that allows these aircraft to fly safely afterwards. Learn about modeling, designs, testing and materials that are the enablers.

Planned Topics

- Welcome, Introduction & Overview of Workshop
- Aerospace Lightning
Aircraft Lightning Attachment and Protection Introduction
- Space Vehicle Charge Control from Launch To Orbit
The engineering and design of launch platforms and space vehicle to deal with the charging and discharging of charge from their environments
- Indirect Effect Modeling using TLM
This paper will focus on the use of TLM to model and predict the coupling of lightning current to internal aircraft system. The session will describe the approach needed to full model a full-scale aircraft and the use of the data for design and development.
- Pitfall and Success of Do-160 Lightning Testing
Discussion of the basic test method for equipment level lightning qualification testing, followed by some practical insight to testing. Lessons learned will be share on successful and unsuccessful test methods.
- Direct Effects To Materials
This final part of the session will look at direct effect of lightning to aircraft. The areas to be covered are skins and structure effects and then the material optimization for protection and low cost.

Planned Presenters

- ◆ Fred Heather, JSF JPO EEE Lead
- ◆ Mr. Larsson's SAAB, Sweden [???
- ◆ Dian Heidlebaugh, Boeing
- ◆ Bob Scully, NASA Johnson Space Center
- ◆ Neal Kiely BAES
- ◆ Andy Plumer LTI

The European EMC Directive 2004/108/EC: Conformance Requirements

Format: Half-day Tutorial

Chair: Mr Chris Marshman, York EMC Services Ltd, York, UK

Abstract

This tutorial addresses the conformance requirements placed on Manufacturers for CE Marking products to the EMC Directive. Particularly it addresses the changes to the 'old' EMCD 89/336/EEC, the new requirements for technical documentation and product information. The new EMCD also sets a regulatory regime for fixed installations in EEA member countries. This will be reviewed; the documentation and 'responsible person' requirements identified.

Directive 2004/108/EC will have been in force for 12 months by August 2008. This allows the opportunity for a timely review of issues that have arisen and observations on its application to be presented.

Objectives include enabling participants to understand and be aware of:

- the mandatory requirement to perform an EMC assessment; use of harmonized standards and/or the justification for why an apparatus meets the essential requirements
- the mandatory documentation requirements under 2004/108/EC for manufacturers
- to understand the implications of harmonized standards and the 'presumption of conformity'
- the role of the Notified Bodies
- the need for Technical Documentation and Declarations of Conformity to be held in Europe by companies placing products on the EEA market
- the Technical Documentation contents
- the ease with which member states can now carry out market surveillance/regulatory enforcement
- the requirements for fixed installations and discuss the implications of these
- how 2004/108/EC has been applied since 20 July 2007

Planned Presenter

Chris Marshman

Aircraft EMP Hardening Specifications and Measurement Methods

Format: Half-day Tutorial

Chair: William D. Prather, AFRL/RDHP, Aberdeen, SE

Abstract

This tutorial will address the approach to writing specifications for electromagnetic shields, especially electromagnetically shielded aircraft which require a different approach than that taken with a ground-based screen room or armored vehicle. The electromagnetic shielding specifications can, be written in measurable engineering units, and if this is done correctly, the shield performance may be measured in an unambiguous fashion during design, verification, and subsequent maintenance.

This discipline was coming into full maturity in the early 90's, but following the dissolution of the Soviet Union, most of the funding was redirected to other projects. As a result, very little has been done in the ensuing 15 years. Now, there is suddenly a renewed interest in this discipline, and new efforts are being initiated. However, what I am observing is that almost all of the personnel with knowledge in this area have retired, and the new engineers coming into the field have no history to draw upon.

The objective of this tutorial is provide the new generation of aircraft and EMC engineers with knowledge of some of the basic concepts on how to specify and measure EM shielding in situ that will help them to accomplish their jobs. As such, this knowledge is not new. Much of it was published in the EMC literature during the 80s and early 90s. Papers that were published in the EMC Transactions are available on line and conference proceedings are available back to about 1988 which will make some, but not nearly all of the information available.

Planned Topics

In this tutorial, we propose to describe the nuclear EMP and how it's very broad range of frequencies couples to an aircraft. This will introduce some very basic concepts upon which the rest of the presentations will depend. The coupling of EM energy to an aircraft is very different from the coupling of energy to a ground-based screen room. The engineer should understand this. By understanding how the currents and charges distribute themselves around an airframe as a function of frequency, one can then introduce

- EMP and EMP Simulation
- EMP coupling to aircraft
- EM specifications and hardening elements
- Shielding measurement techniques
 - Apertures
 - Cable shields
 - Full body resonance (SPEHS)
 - System-level CW Illumination
 - Direct drive testing

Planned Presenters

- William Prather

- Kurt Sebacher
- Dr. Parviz Parhami
- Peter Richeson
- Dr. Lothar Hoefft

Basic to Advanced EMI Failure Analysis

Format: Half-day Tutorial

Chair: Dr. David Pommerenke, Missouri University of Science and Technology, Missouri

Abstract

Many products will experience EMI problems in initial testing. Those problems need to be understood and solved. Knowing and understanding a variety of EMI analysis methods is essential to achieve a cost effective EMI solution. Why a variety of methods? No method is superior, but for every situation there is a best method.

This workshop will help EMI engineers better understand and select a variety of methods for analyzing EMI failures in systems. The foundation of the methods will be explained and typical applications shown. The methodologies span from simple, well known methods such as current clamp measurements to complex methods like near field scanning or correlation analysis and spectrogram analysis for broadband signals and tough cases in which multiple sources and antennas radiate on the same frequency.

The novelty of this workshop will lie in the advanced EMI analysis methods, like correlation analysis, spectrogram methods, using mode stirred chambers (=metalized tent) for EMI debugging.

Planned Presenters

- Tom. Van Doren
- Doug Smith
- Lee Hill
- David Pommerenke
- Simon Xu (Huawei)
- Kenji Araki (Sony)

Carbon Nanotube Technology for Next-Generation Nanointerconnects

Format: Half-day Tutorial

Chair: Prof. Maria Sabrina Sarto, University of Rome Sapienza, Rome, Italy

Abstract

The scope of this tutorial is to present and to discuss the international most advanced state-of-art in the field of next-generation nanointerconnects based on carbon nanotube technology. Within the Seventh European Framework three research projects have been founded by the European Commission on CNT-based nanointerconnects during the first call. Among them the research project CATHERINE (with Prof. Sarto as Scientific Coordinator) will be presented. The tutorial will introduce the audience to the challenges of ITRS-2007 as regards nanointerconnects, to the fundamental concepts concerning carbon nanotubes, to the advanced modelling tools of carbon-nanotube nanointerconnects both in the frequency and in the time-domain. Issues related to the experimental characterization of CNT-based nanointerconnects will be also addressed.

The focus of this tutorial will be on the carbon nanotube technology and on its application in the field of nanointerconnects in order to overcome the limitation of copper for the 45-nm down to 22-nm-node technology. The tutorial will focus on the fundamental properties of carbon nanostructures, in particular of single- and multi-wall carbon nanotubes, on the fundamental approaches for the modelling of the electromagnetic properties of CNT-nanointerconnects, from the nano- to the macro-scales, on the analysis methods in the frequency and in the time-domains, on the EMC related issues, on the measurement aspects.

Planned Topics

- Fundamentals of carbon nanotube technology.
- State-of-art of CNT-nanointerconnects technology. Overview of the research project CATHERINE.
- Modelling approaches of the electromagnetic properties of CNT-nanointerconnects from the nano- to the macro-scale.
- Frequency-domain and time-domain analysis methods of CNT-nanointerconnects.
- Issues related to experimental characterization methods.

Planned Presenters

- ◆ Prof. Sarto, Sapienza Univ. Rome, Italy
- ◆ Dr. Tamburrano, Sapienza Univ. Rome, Italy
- ◆ Prof. Massoud, Rice Univ., USA
- ◆ Dr. Naeemi, George Tech Univ., USA
- ◆ Dr. S. Kabir, Smoltek, Sweden.