Advances in Reverb and Anechoic Chamber Measurements: Half-Day Technical Workshop with Standards Updates *and* Live Demo

Wednesday, 11 September 2024
09:00 – 13:45
Kiwa, Wilmersdorf 50, Apeldoorn

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Workshop Abstract: Join us for detailed presentations by global experts on reverberation and anechoic chambers. Discover (or revisit) the essential aspects of reverberation chambers (RC) measurements, including their basic principles, field distribution modeling, and measurement uncertainty determination including some latest discoveries in metrology aspects of RCs. Learn about the challenges of testing at frequencies above 18 GHz, which have been conducted up to 231 GHz without a standardized validation method. Historically, sites validated below 18 GHz were assumed to be acceptable for higher frequencies, but this assumption lacked the support of data. With the introduction of transmitters operating at 25 GHz, 38 GHz, and higher frequencies, accurate site validation has become increasingly important. ANSI C63® and CISPR are working on developing site validation methods for frequencies from 18 GHz to 40 GHz to improve measurement accuracy and consistency. The ANSI C63 standard includes considerations for both anechoic and reverberation chambers. Join us to gain insights from two experts on these topics. As an added bonus for the technical program, learn about a novel technique for millimeter-wave (30-300 GHz) measurements and how this impacts the EMC community.

Technical Programme

Metrology Aspects of Reverberation Chambers: Theory, Uses, Open Questions, and Current Research
By Ramiro Serra, Associate Professor, EMC Laboratory, Eindhoven University of Technology, The Netherlands

Abstract: Reverberation chambers (RC) are laboratory-controlled electromagnetic environments which can generate statistically uniform fields with known and predictable probability density functions. They are widely used for different electromagnetic compatibility measurements, antenna efficiency estimation, over-the-air tests for wireless systems, and electrical characterization of materials, among other uses and applications. What are the basic principles of operation of RCs? How do you model and predict the distribution of the fields in a RC? How is measurement uncertainty determined in RCs? This extended presentation will provide some basic though fundamental answers to these questions and, hopefully, also trigger a renewed interest for these intriguing and useful chambers.

High-Frequency Emission Considerations for EMC
By Teun van den Biggelaar, Chief Technology Officer, ANTENNEX, Eindhoven, The Netherlands

Abstract: There is a trend for applications (e.g., automotive radar, wireless interconnect, PtMP communication) requiring large bandwidths that can only be found in the millimeter-wave (30-300 GHz) regime. This forces the EMC community to come up with standards and methods that accurately can determine unwanted emissions in an efficient manner. Since the wavelengths gets

shorter, but the formfactor of the devices under test more or less stays the same, the emitted radiation can be highly directive. This requires a small angular stepsize, leading to an extreme increase in measurement time as frequency increases. In this presentation, a two-stepped measurement approach will be discussed that focusses on measuring unwanted emissions in a short time span, without sacrificing accuracy.

CISPR and ANSC C63® Overview on Site Validation Measurements from 18 GHz to 40 GHz - Latest Advances in EMC Test Site Evaluation Using Advanced Antenna Measurement Techniques
By Zhong Chen, Chief Engineer, ETS-Lindgren, Cedar Park, Texas, USA

Abstract: This presentation introduces a novel approach for EMC chamber validation beyond 18 GHz, currently under consideration in ANSI C63 and CISPR standards. By integrating Cylindrical Mode Filtered Site Voltage Standing Wave Ratio (CMF SVSWR) with Compressed Sensing (CS), we address inherent challenges in traditional SVSWR methods, such as inconsistency and slow data acquisition. CMF SVSWR utilizes circular path measurements and mode domain post-processing to discern antenna and chamber reflections, crucial for comprehensive VSWR analysis. Compressed Sensing, a data-driven machine learning technique, exploits signal sparsity to reconstruct data from fewer randomly sampled measurement points, thereby reducing test times and eliminating the need for precise turntable positioning.

Cylindrical Mode Filtered SVSWR Demonstration
Following the workshop presentations, Mr. Zhong Chen will conduct a LIVE demonstration in the Kiwa EMC Anechoic test chamber.

Demonstration Abstract: The Cylindrical Mode Filtered SVSWR (CMF SVSWR) is measured by placing the transmit antenna (typically a low gain omni-directional antenna) at the edge of the turntable and performing a single cut vector pattern measurement. The vector S21 as a function of turntable angle at each frequency is transformed to the spectrum domain, where a filter can be applied to mathematically remove the chamber effects. The SVSWR is derived by comparing the original pattern in the chamber to the "clean" filtered pattern. This CMF SVSWR provides a more comprehensive evaluation of the EMC chamber quiet zone and can be readily measured without any special positioning fixtures. The demonstration will show an entire measurement process including the post processing which can be performed in real time. This new measurement technique is under consideration for the new draft standard ANSI C63.25.3 under development by the ANSC C63® committee for EMC test sites from 18 GHz to 40 GHz.

Speaker Biographies

Ramiro Serra received the MSc degree in electronic engineering from the Instituto Tecnológico de Buenos Aires, Argentina, in 2000, the postgraduate degree specializing in technological applications of nuclear energy from Instituto Balseiro, Bariloche, Argentina in 2004 and the PhD degree in electronics and communications engineering from Politecnico di Torino, Italy in 2009. He is currently an associate professor within the Laboratory of EMC at the Eindhoven University of Technology (TU/e) in the Netherlands and the program director of the electrical engineering department at TU/e. Dr. Serra is a member and the vice-chair of the international steering committee of EMC Europe and a member of the international TPC of EMC Compo. He is the chairman of URSI

Commission E for the Netherlands and secretary of URSI National Committee of the Netherlands. He is also co-convener of the SC 77B/CISPR-A joint working group for the standard IEC 61000-4-21 on reverberation chambers. He may be reached at R.Serra@tue.nl.

Teun van den Biggelaar received his MSc and Ph.D. degrees in Electrical Engineering (EE) with distinction from the Eindhoven University of Technology (TU/e), the Netherlands, in 2016 and 2020, respectively. During his Ph.D. studies, he worked on a project supported by NXP Semiconductors in Nijmegen, the Netherlands and worked as a guest researcher at the National Institute of Standards and Technology (NIST) in Boulder, USA. In 2020, he received the Vederprijs for his research to mm-wave phased-array antennas during his Ph.D. Teun worked for a period of two years at Ericsson in Gothenburg, Sweden, as Antenna Developer in the millimeter-wave team of the Antenna Systems and Technology division. From 2023, he is CTO and co-founder of ANTENNEX in Eindhoven, the Netherlands. He may be reached at teun.vandenbiggelaar@antennex.tech.

Zhong Chen is Chief Engineer at ETS-Lindgren, located in Cedar Park, Texas. He has over 25 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 ANSC C63® committee currently serving as Vice-Chair and is the immediate past Chair of Subcommittee 1 which is responsible for the antenna calibration (ANSI C63.5) and chamber/test site validation standards (ANSI C63.4 and the ANSI C63.25 series). Mr. Chen is chair of the IEEE Standard 1309 committee responsible for developing calibration standards for field probes, and IEEE Standard 1128 for absorber evaluation. Currently he is a member of the IEEE EMC Society Board of Directors. He is a past Distinguished Lecturer for the EMC Society and is recognized as an AMTA Fellow. His research interests include measurement uncertainty, time domain measurements for site validation and antenna calibration, and development of novel RF absorber materials. Several papers authored and co-authored by Mr. Chen have received best paper recognition at global conferences. 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.

Schedule

Time	Subject	Speaker
09:00 – 09:25	Walk in	
09:25 – 09:30	Welcome	Mark Reeve – ETS-Lindgren Gabe Alcala - ATEC Niek Moonen – University of Twente/IEEE EMC Society Benelux Chapter Rick Wesselink - Kiwa
09:30 – 10:45	Metrology Aspects of Reverberation Chambers: Theory, Uses, Open Questions, and Current Research	Ramiro Serra, Eindhoven University of Technology
10:45 – 11:10	High-Frequency Emission Considerations for EMC	Teun van den Biggelaar, ANTENNEX
11:10 – 11:30	Refreshment Break	
11:30 – 12:30	CISPR and ANSC C63® Overview on Site Validation Measurements from 18 GHz to 40 GHz - Latest Advances in EMC Test Site	Zhong Chen, ETS-Lindgren

	Evaluation Using Advanced Antenna Measurement Techniques	
12:30 – 13:15	Networking Lunch with Speakers and Attendees	
13:15 – 13:45	LIVE demonstration in Kiwa EMC Anechoic Chamber	Zhong Chen and all participants

NOTE: There is no cost to attend this meeting and all IEEE members and guests are welcome! However, you MUST register in advance in order to secure seating and lunch. Please register at https://events.vtools.ieee.org/m/431541 Badges will be available onsite for all advance registrants.