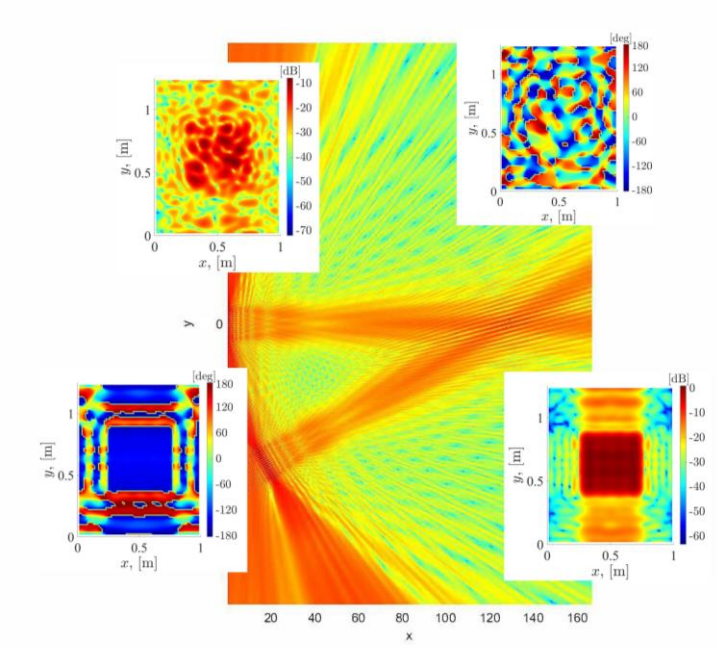
The 17th European Conference on Antennas and Propagation (EuCAP)
26 - 31 March 2023

Principles of Over-The-Air Test Environments and Characterization of Antenna Systems

Abstract

Multiple antenna systems are employed in many different devices for both communications, sensing and localization applications. Antennas are at the core of 5G and beyond wireless communications systems. It is the objective of over-the-air (OTA) characterization to ensure that radiated performance of wireless devices, including the antenna, complies with standardized requirements in order to deliver the promised quality of service. Wireless devices operate in complex dynamic environments that need to be reproduced in laboratory conditions. Therefore, automated, accurate, dependable, and time- and cost efficient OTA characterization techniques and technologies are in high demand, which are the topic of this tutorial.

Graphical abstract



Recommended prerequisites

The course requires a basic knowledge on antennas, propagation, signal processing and wireless communications

Learning objectives

After the course the participant will be able to describe different over-the-air (OTA) characterization techniques and provide examples of their applications. They will get an insight into the physical principles governing the emulation of different OTA measurement environments. Participants will learn about the different chamber technologies as well as other the fundamental components of the OTA measurement setups. They will be able to understand the limitations and strengths of specific OTA characterization techniques. Participants will recognize the main challenges in the characterization of both single as well as multiple antenna systems. They will be able to assess the applicability of various OTA figures of merit and to gauge their significance in the evaluation of the performance of wireless devices and antenna systems for various applications, e.g., vehicular and cellular communications. Participants will be able to describe standardized OTA methods, required measurement accuracy and radiated performance requirements.

Course outline

- The course can be a half day, i.e., 4 times 45 min lectures, more or less.The course will consist of three main OTA themes regarding the generation of single and multiple plane wave, test zone accuracy, figures of merits:

✓ OTA in anechoic/semi-anechoic chambers
✓ OTA in reverberation chambers
✓ OTA in hybrid chambers

- Participants may bring a laptop if they wish, but it is not required.

Instructor 1 – biography

Zhi Andrés Alayón Glazunov was born in Havana, Cuba. He received the M.Sc. degree in physical engineering from Peter the Great St. Petersburg Polytechnic University (Polytech), St. Petersburg, Russia, in 1994, the Ph.D. degree in electrical engineering from Lund University, Lund Sweden, in 2009, and the Docent (Habilitation) qualification in antenna systems from Chalmers University of Technology, Gothenburg, Sweden, in 2017. From 1996-2005, he held various research and specialist positions in Ericsson Research, Telia Research, and TeliaSonera, in Stockholm, Sweden.

Dr. Glazunov is currently an Associate Professor with the Department of Electrical Engineering, University of Twente, Enschede, the Netherlands, where he is leading the research on the design and characterization of smart devices and environments for communications and sensing. He is also an Affiliate Associate Professor with the Chalmers University of Technology, Gothenburg, Sweden. He is the co-author and co-editor of the text book LTE-Advanced and Next Generation Wireless Networks – Channel Modelling and Propagation (Wiley, 2012). His research interest include topics on antennas, propagation and signal processing at large. He has been one of the pioneers in producing the first standardized OTA measurement techniques for 3GPP, and devising novel OTA techniques, e.g., the Random-LOS and the Hybrid Chamber antenna characterization techniques.

Key bibliography

1. The teacher's own teaching material as well as diverse specialized publications by the teacher as well as others, and various books, e.g.

2. A. Hussain, P. -S. Kildal and A. A. Glazunov, "Interpreting the Total Isotropic Sensitivity and Diversity Gain of LTE-Enabled Wireless Devices From Over-the-Air Throughput Measurements in Reverberation Chambers," in IEEE Access, vol. 3, pp. 131-145, 2015, doi: 10.1109/ACCESS.2015.2411393

3. M. S. Kildal, S. Mansouri Moghaddam, A. Razavi, J. Carlsson, J. Yang and A. Alayón Glazunov, "Verification of the Random Line-of-Sight Measurement Setup at 1.5-3 GHz Including MIMO Throughput Measurements of a Complete Vehicle," in IEEE Transactions on Vehicular Technology, vol. 69, no. 11, pp. 13165-13179, Nov. 2020, doi: 10.1109/TVT.2020.3021250

4. R. Maaskant, O. A. Iupikov, P. S. Krasov, R. Rehammar, A. A. Glazunov and M. V. Ivashina, "A New Hybrid Chamber for Generating a Spectrum of Oblique Incident Plane Waves at the DUT," in IEEE Transactions on Antennas and Propagation, vol. 69, no. 10, pp. 6806-6815, Oct. 2021, doi: 10.1109/TAP.2021.3069480

5. Xu, Q.; Huang, Y. Anechoic and Reverberation Chambers: Theory, Design and Measurements; John Wiley & Sons (Wiley): Hoboken, NJ,USA, 2018