Antenna Design and Test Considerations for Future 5G/6G Wireless Communication

Janet O'Neil is a customer relations specialist with ETS-Lindgren. She has over 30 years of experience in the RF and Electromagnetic Compatibility (EMC) industries. She is a member of the Board of Directors of the IEEE EMC Society and past member of the Antenna Measurement Techniques Association (AMTA) Board of Directors. Ms. O'Neil has organized dozens of technical workshops during her career as well as served as chair or vice-chair of various IEEE International Symposia for the EMC and MTT Societies. Her education includes BA degrees in English and in Business Economics from the University of California, Santa Barbara.

Abstract:

Antenna design is a distinct art, combining sound engineering principals with creative and novel approaches. Design efforts can be costly and time consuming. In this workshop, speakers will address emerging test methodologies to efficiently and cost effectively validate antenna performance in a design lab environment. The significance of different test methods will be shown using near-field, far-field, and alternative test techniques. In the three presentations, attendees will learn about:

1. Development and experimental evaluations of a width-bandwidth mm-wave fully-connected hybrid beamforming metrological testbed with large antenna array.

2. The results of a study using a smaller near-field measurement system to accurately measure the antenna pattern of a modern millimeter wave phased antenna array.

3. Measurements performed in a Compact Antenna Test Range aimed at the characterization of 5G active antennas system dealing with both setup issues and 5G signal measurement and processing.

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Workshop outline:

We will have three speakers, from industry and government, with the presentations as follows:

11:00 - Title: A Metrological Millimetre-Wave Full-Connected Hybrid Beamformer Over-The-Air Test Platform with a Large Antenna Array

Abstract: Current trends in developing cost-effective and energy-efficient wireless systems operating at mm-wave frequencies and with large-scale phased array antennas for fulfilling the high data-rate demands of 5G and beyond has driven the need to explore the use of hybrid beamforming technologies. This talk focuses on the development and experimental evaluations of a width-bandwidth mm-wave fully-connected hybrid beamforming metrological testbed with large antenna array. Such testbed provides academia and industry with a unique test platform with significantly more degrees of freedom on trial and development of different robust hybrid beamforming algorithms for reaching higher data rate for mm-wave communications. It enables full exploitation over the advantages of large arrays as well as radically reduces the traceable metrological burden. Discussions include testbed design, calibration procedures, experimental evaluations, as well as the critical factors to consider for their practical implementation.

Speaker: Tian Hong Loh, Principal Research Scientist, NPL

Biography: Tian Hong Loh is a Principal Research Scientist at NPL in the United Kingdom. He leads work at NPL on a wide range of applied and computational electromagnetic metrology research areas to support the telecommunications industry. He is also a Visiting Professor at the University of Surrey, U.K., and the Vice-Chairman of UK URSI (International Union of Radio Science). He holds six patents and has authored or co-authored over 200 refereed publications, one book, and nine book chapters. His research interests include beyond 5G communications, smart antennas, small antennas, metamaterials, body-centric communications, wireless sensor networks, electromagnetic compatibility, and computational electromagnetics.

11:30 - Title: Modern 5G Millimeter Wave Antenna Array Evaluation in Near- and Far-Field Environments

Abstract: The purpose of this study is to investigate the possibility of using a smaller near-field measurement system to accurately measure the antenna pattern of a modern millimeter wave phased antenna array. The results made in near-field test system are then compared to the far-field results performed in a typical Compact Antenna Test Range (CATR). Measurements are made using CW and modulated signals to evaluate if the complexity of the waveform effects on the results. The goal of the study is to see if correlation can be found between different methods to allow a more compact and cost-effective test solution to be used for antenna evaluation.

Speaker: Mr. Jari Vikstedt, Director - Wireless Solutions, ETS-Lindgren

Biography: Jari Vikstedt is the Director - Wireless Solutions for ETS-Lindgren in Cedar Park, Texas. He has over 25 years of experience with ETS-Lindgren in developing and testing RF test solutions for EMC and Wireless applications. Mr. Vikstedt and the other engineers at ETS-Lindgren are active technical contributors to the leading wireless industry organizations, including the CTIA, 3GPP, IEEE, and the Wi-Fi Alliance®. Recently, Mr. Vikstedt has devoted his expertise to the development of CTIA and 3GPP Over-The-Air (OTA) testing solutions as well as developing innovative 5G OTA test solutions. His research interests include developing creative test solutions to meet unique customer requirements. He holds a patent for creating a novel design for an adaptive antenna performance validation system. Mr. Vikstedt earned a BSEE degree in RF Engineering from the Turku University of Technology, Finland.

12:00 - Title: Characterization and Measurement of Active Antenna System for NR 5G in Compact Antenna Test Range

Abstract: This presentation concerns the activities performed in a Compact Antenna Test Range aimed at the characterization of 5G Active Antennas System dealing with both setup issues and 5G signal measurement and processing. The characterization of antennas radiating a 5G signal requires, in addition to the classic measurement of radiation patterns and their directivity and gain, also the evaluation of the EIRP and radiated power, verification of the EIRP limitation mechanisms and correlation among radiated signal and 5G network

measurement counters. The signal measurement aspects have been addressed both in the time-frequency domain in which the Resource Element RE is the unitary element and in the field of channel power measurement. Since the duration of the measurement is a critical aspect, especially if the measurement is performed on a significant portion of the sphere, the receiver is the key component of the system. For this purpose, a receiver based on FPGA has been developed. Such receiver can measure, at frame level, the power level of a finite set of RE allowing real-time simultaneous measurement of both user traffic patterns and broadcast patterns. Some measured results will be presented.

Speaker: Daniele Disco, Eng., Telecom Italia

Biography: Daniele Disco started working in 1994 in the CSELT (now TIM) in the propagation department. After a few years he moved to the antenna department, dealing with smart antennas. He participated in the realization of a PoC related to a fully adaptive receiver for GSM (UpLink). With respect to 4G, he participated in the creation of a PoC to measure the radiation pattern of an antenna in a commercial network using a drone and programming an embedded device used as a receiver. This latest experience was then put to good use in the development of the necessary software in an anechoic chamber (in the Compact Antenna Test Range configuration) to carry out the measurement of active antennas, using SDR receiver instead of commercial ones. He is currently still involved in this area, in the characterization of active antenna system for the 5G.