92nd ARFTG Microwave Measurement Conference

Next Generation Microwave and Millimeter-Wave Measurement Techniques and Systems

Invited Speakers

Session A: Wireless Communication Test and Measurements

Keynote Speaker: Michael O'Neal, Qorvo

Title: 5G: Changing the Way We Work, Live and Play

Abstract: This talk will begin with a review of the progression of mobile networks and the motivation for a 5G network. Then we will have a look at a synopsis of frequency allocation, standards and carrier activity. 5G use cases and ecosystem will be presented. From a systems architecture standpoint we will describe where we are now and where we may go in the future. Sub-6GHz and mm-wave system and semiconductor technology choices and tradeoffs are reviewed. Finally, we will discuss system simulation capabilities and test challenges.

Bio: Dr. Michael O'Neal is the Senior Director of Design & Advanced Engineering for Qorvo's Infrastructure and Defense Products Group. His team is responsible for Qorvo's R&D activities in 5G infrastructure.

Session C: Load-Pull Measurements

Invited Speaker: Dr. Mauro Marchetti, Maury Microwave

Title: Wideband load-pull measurement techniques: architecture, accuracy, and applications

Abstract: This lecture will concentrate on load pull measurements for wideband communication applications. We will discuss the architecture and the design aspects of a state-of-the-art load pull measurement system which enables wideband impedance control with complex modulated signals both at RF and baseband frequencies. We will present several application examples, ranging from high speed load pull for technology evaluations and power amplifier design to modulated testing for 5G applications. Finally, we will describe a procedure for evaluating traceable uncertainty of power measurements as a function of the load impedance.

Bio: Mauro Marchetti received the B.S. degree (cum laude) and the M.Sc. degree (cum laude) in electrical engineering from the University of Naples "Federico II," Naples, Italy, in 2004 and 2006 respectively, and the Ph.D. degree from Delft University of Technology, Delft, The Netherlands, in 2013. In 2006 he joined the Electronics Research Laboratory, Delft University of Technology where he carried out his Ph.D. research on the development of advanced characterization setups for RF high-power and high-linearity amplifier design. In 2010 he co-founded and was appointed CEO of Anteverta-mw B.V, a company providing pioneering solutions in the fields of load pull device characterization and high performance power amplifier design. His research interests include the development of advanced characterization setups for RF high-power and high-linearity amplifier design.

Session E: On-Wafer Measurements II

Invited Speaker: Prof. Kubilay Sertel, The Ohio State University

Title: Automated Performance of On-wafer Calibration and Characterization Using Non-contact Probes

Abstract: This lecture will present the repeatability performance of automated non-contact on-wafer probing for millimeter-wave and terahertz band applications. Recently incorporated computer control into the existing non-contact probing hardware to automate the test wafer manipulation will be presented. A digital microscope with pattern recognition is used to precisely control the alignment of on-wafer antennas at the test ports to minimize repeatability errors. The commercial-off-the-shelf micro-positioners used in our system allow for sub-micron repeatability in device alignment, resulting in 2× to 5× improvement in performance between subsequent measurements. The automated non-

contact probing exhibits 0.75% deviation in signal magnitude and better than 0.5-degrees in signal's phase for re-measured offset-short calibration standards for the WR3.4 band. We will present the results for WR1.5 band at the conference.

Bio: Kubilay Sertel (M'03, SM'07) is an Associate Professor at the Electrical and Computer Engineering Department at the Ohio State University. He received his PhD in 2003 from the Electrical Engineering and Computer Science Department at the University of Michigan-Ann Arbor and was an Assistant Professor from 2012-2017. During 2003-2012, he was a Research Scientist at the ElectroScience Laboratory and an Adjunct Professor at the Electrical and Computer Engineering Department at the Ohio State University. His current research focuses on the analysis and design of THz and mmW sensors and radars, on-wafer non-contact metrology systems for device and IC testing, biomedical applications of THz imaging, as well as spectroscopy techniques for non-destructive evaluation. His research interests also include ultra-wideband low-profile phased arrays for cognitive sensing and opportunistic wireless networks, reconfigurable antennas and arrays, applied electromagnetic theory and computational electromagnetics, particularly, curvilinear fast multipole modeling of hybrid integral equation/finite element systems and efficient solution of large-scale, real-life problems on massively parallel supercomputing platforms.

Prof. Sertel is a Senior Member of IEEE, member of IEEE Antennas and Propagation and Microwave Theory and Techniques Societies and an elected member of URSI Commission B. He is a Fellow of Applied Computational Electromagnetics Society. He is also the Editor-in-Chief for Electronic Publications for the IEEE Antennas and Propagation Society. He co-authored two books: *Integral Equation Methods for Electromagnetics* (SciTech Publishing, 2012) and *Frequency Domain Hybrid Finite Element Methods in Electromagnetics* (Morgan & Claypool, 2006), 6 book chapters, 3 patents, and published over 80 journal papers and more than 300 conference articles.

Session F: Panel Session

Invited Speaker: Dr. Kate A. Remley, National Institute of Standards and Technology

Title: Next Generation Microwave and Millimeter-Wave Measurement Techniques

Abstract: New wireless technology includes highly integrated, multiple-antenna arrays, making over-the-air (OTA) test and measurement a necessity. Industry and standards groups are facing challenges from the need for accurate, repeatable OTA measurements at both microwave and millimeter-wave frequencies. We focus on current and proposed approaches for characterizing wireless devices having integrated multiple-element arrays, including the use of reference fields in which the source chain is fully characterized. Such reference fields can be used to characterize receivers and, ultimately, to assess OTA test methods, eliminating ambiguities as to the origin of various impairments.

Bio: Kate A. Remley (S'92-M'99-SM'06-F'13) received the Ph.D. degree in Electrical and Computer Engineering from Oregon State University, Corvallis, in 1999. From 1983 to 1992, she was a Broadcast Engineer in Eugene, OR, serving as Chief Engineer of an AM/FM broadcast station from 1989-1991. In 1999, she joined the RF Technology Division of the National Institute of Standards and Technology (NIST), Boulder, CO, as an Electronics Engineer. She is currently the Leader of the Over-the-Air Metrology Project at NIST, where her research activities include development of calibrated measurements for microwave and millimeter-wave wireless systems, characterizing the link between nonlinear circuits and system performance, and developing standardized over-the-air test methods for the wireless industry.

Dr. Remley was the recipient of the Department of Commerce Bronze and Silver Medals, an ARFTG Best Paper Award, and is a member of the Oregon State University Academy of Distinguished Engineers. She was the Chair of the MTT-11 Technical Committee on Microwave Measurements (2008-2010), the Editor-in-Chief of IEEE Microwave Magazine (2009-2011), and Chair of the MTT Fellow Evaluating Committee (2017-2018). She was a Distinguished Lecturer for the IEEE Electromagnetic Compatibility Society (2016-2017).