



## 95<sup>th</sup> ARFTG Microwave Measurement Conference

### Technical Program

**0800-0810**    **Welcome and Introduction**  
Joe Gering, ARFTG President, Jon Martens, General Chair, Peter Aaen, TPC Chair

### Oral Session A: Electromagnetic Field Measurements

**A-1**        **Electro-Optic Mapping Techniques for Characterization of Microwave**  
**0810-0840**    **Circuits, Devices and Antenna Systems (Keynote)**  
Kaz Sabet, EMAG Technologies Inc, Ann Arbor, MI, USA

**A-2**        **Over-the-Air Test of Dipole and Patch Antenna Arrays at 28 GHz by Probing**  
**0840-0900**    **Them in the Reactive Field**  
Utpal Dey<sup>1</sup>, Jan Hesselbarth<sup>1</sup>, Jose Moreir<sup>2</sup>, Krzysztof Dabrowiecki<sup>3</sup>  
<sup>1</sup>University of Stuttgart, <sup>2</sup>Advantest Europe GmbH, <sup>3</sup>Feinmetall GmbH

**A-3**        **5G Waveform vs. CW: Near-Field Measurement of De-Coupled Electric and**  
**0900-0920**    **Magnetic Fields for Power Density Assessment**  
Maryna Nesterova<sup>1</sup>, Stuart Nicol<sup>1</sup>, Yuliya Nesterova<sup>2</sup>  
<sup>1</sup>APREL.Inc, <sup>2</sup>Queen's University

**A-4**        **Over-the-Air Characterization Of mm-Wave On-Chip Antennas and Tx Modules,**  
**0920-0940**    **Concept and Calibration**  
Carmine De Martino<sup>1</sup>, Akshay Visweswaran<sup>2</sup>, Marco Spirito<sup>1</sup>  
<sup>1</sup>Delft University of Technology, <sup>2</sup>IMEC

### Break—Exhibits and Interactive Forum

**0940-1040**

## Oral Session B: Sources and Nonlinear Device Measurements

- B-1**  
**1040-1100**     **A Cryogenic Quantum-Based RF Source**  
J. Brevik, A. Boaventura, M. Castellanos-Beltran, C. Donnelly N. Flowers-Jacobs, A. Fox, P. Hopkins, P. Dresselhaus, D. Williams, S. Benz, National Institute of Standards and Technology
- B-2**  
**1100-1120**     **Modulation Distortion Analysis for Mixers and Frequency Converters**  
J. Verspecht, T. Nielsen, A. Stav, J. Dunsmore, and J.-P. Teysier  
Keysight Technologies, Santa Rosa, CA
- B-3**  
**1120-1140**     **Swept Notch NPR for Linearity Assessment of Systems Presenting Long-Term Memory Effects**  
R. Figueiredo<sup>1</sup>, A. Piacibello<sup>2</sup>, V. Camarchia<sup>2</sup>, N. Borges Carvalho<sup>3</sup>  
<sup>1</sup>University of Aveiro, <sup>2</sup>Politecnico di Torino, <sup>3</sup>Instituto de Telecomunicacoes
- B-4**  
**1140-1200**     **Vector Gain Based Behavioral Models for Distortion Evaluation in mm-Wave Devices**  
J. van 't Hof<sup>1</sup>, E. Malotau<sup>1</sup>, M. Squillante<sup>2</sup>, M. Marchetti<sup>2</sup>, L. Galatro<sup>3</sup>, M. Spirito<sup>1</sup>  
<sup>1</sup>Delft University of Technology, <sup>2</sup>Anteverta-mw B.V., <sup>3</sup>Vertigo Tech

## Awards Luncheon

1200-1320

## Oral Session C: VNA Measurements and Calibration

- C-1**  
**1320-1350**     **How Did We Get Here? A Short History of VNA Technology (Invited Talk)**  
Andrea Ferrero, Keysight Technologies
- C-2**  
**1350-1410**     **Calibration, Repeatability and Related Characteristics of On-wafer, Broadband 70 kHz-220 GHz Single-Sweep Measurements**  
Andrej Rumiantsev<sup>1</sup>, Jon Martens<sup>2</sup>, Steve Reyes<sup>2</sup>  
<sup>1</sup>MPI Corporation, <sup>2</sup>Anritsu
- C-3**  
**1410-1430**     **Multi-port Reflectometry Applied to a Varactor-Tuned Sampled-Line**  
Steven Claessens and Taylor Barton  
University of Colorado - Boulder
- C-4**  
**1430-1450**     **Towards Commercially Available Quartz Calibration Substrates**  
L. Galatro<sup>1</sup>, C. De Martino<sup>2</sup>, J. van 't Hof<sup>2</sup>, M. Alomari<sup>3</sup>, J. Burghartz<sup>3</sup>, M. Spirito<sup>2</sup>  
<sup>1</sup>Vertigo Tech, <sup>2</sup>Delft University of Technology, <sup>3</sup>Institut für Mikroelektronik Stuttgart (IMS)

## Break—Exhibits and Interactive Forum

1450-1540

### Oral Session D: Additional Measurement Topics

- D-1**  
**1540-1600**      **Cryogenic Calibration of a Quantum-based Radio Frequency Source**  
Zain Ahmed Khan<sup>1,2</sup>, Peter Händel<sup>2</sup>, and Magnus Isaksson<sup>1</sup>  
A. Boaventura, J. Brevik, D. Williams, A. Fox, M. Castellanos-Beltran, P. Hopkins, P. Dresselhaus, S. Benz,  
National Institute of Standards and Technology
- D-2**  
**1600-1620**      **Measurement of Dielectric Properties Using Reflected Group Delay of an Over-Coupled Resonator**  
Gaurav Walia, Paul Laforge, Muhammed Suleman  
University of Regina
- D-3**  
**1620-1640**      **Setup and Control of a Millimeter-Wave Synthetic Aperture Measurement System with Uncertainties**  
A. Weiss<sup>1</sup>, J. Quimby<sup>1</sup>, R. Leonhardt<sup>1</sup>, B. Jamroz<sup>1</sup>, D. Williams<sup>1</sup>, K. Remley<sup>1</sup>, P. Vouras<sup>1</sup>,  
A. Elsherbeni<sup>2</sup>, <sup>1</sup>National Institute of Standards and Technology, <sup>2</sup>Colorado School of Mines
- D-4**  
**1640-1700**      **Over-the-Air Testing of Cellular Large-Form-Factor Internet-of-Things Devices in Reverberation Chambers**  
K. Remley<sup>1</sup>, C. Bax<sup>2</sup>, E. Mendivil<sup>3</sup>, M. Foegelle<sup>3</sup>, J. Kvarnstrand<sup>4</sup>, D. Skousen<sup>4</sup>, D. Sánchez-Hernández<sup>5</sup>, M. García-Fernández<sup>5</sup>, L. Chang<sup>6</sup>, J. Gutierrez<sup>7</sup>, E. Yen<sup>7</sup>, J. Harbour<sup>7</sup>  
<sup>1</sup>National Institute of Standards and Technology, <sup>2</sup>Bureau Veritas, <sup>3</sup>ETS-Lindgren, <sup>4</sup>Bluetest AB, <sup>5</sup>EMITE, <sup>6</sup>Sporton, <sup>7</sup>Dell.

### Interactive Forum Session

#### Backward Unknown-Thru Calibration Method

JeongHwan Kim, Jin-Seob Kang, Jeong-Il Park, Chihyun Cho  
KRISS

#### Active Interferometry-Based Vector Network Analyzer Reference Impedance Renormalization

Haris Votsi<sup>1</sup>, Cristian Matei<sup>2</sup>, Stavros Iezekiel<sup>1</sup>, Peter H. Aaen<sup>3</sup>  
<sup>1</sup>University of Cyprus, <sup>2</sup>University of Surrey, <sup>3</sup>Colorado School of Mines

#### SOLT and SOLR calibration methods using a single multiport “thru” standard connection

Tibault Reveyrand, Silvia Hernandez, Sebastien Mons, Edouard Ngoya  
XLIM, University of Limoges

#### Fast Software-Defined Radio-based System Performance Evaluation for Real-time Adaptive RF Systems

Austin Egbert<sup>1</sup>, Benjamin Kirk<sup>2</sup>, Charles Baylis<sup>1</sup>, Anthony Martone<sup>3</sup>, Robert J. Marks II<sup>1</sup>  
<sup>1</sup>Baylor University, <sup>2</sup>Pennsylvania State University, <sup>3</sup>Army Research Laboratory

### **Model of Probe Transition Including Probe Mispositioning**

Robin Schmidt<sup>1</sup>, Dominique Schreurs<sup>2</sup>, Michael Dieudonné<sup>1</sup>, Pawel Barmuta<sup>2</sup>  
<sup>1</sup>Keysight Technologies, <sup>2</sup>Katholieke Universiteit Leuven

### **Vector Network Analyzer Calibration for Characterization of Packaged Power MOSFET Device at RF Frequency**

Masahiro Horibe and Iku Hirano, AIST

### **High-Performance Probe for Over-the-Air Measurement**

Mohammadreza Ranjbar Naeini, Yuchen Gu, Daniel van der Weide  
University of Wisconsin-Madison

### **Complex Permittivity Measurement Technique for a 3D Printed Rectangular Dielectric Rod using an NRD Guides at 60-GHz Band**

Takashi Shimizu and Yoshinori Kogami, Utsunomiya University