2022 IEEE Radio & Wireless Week

Final Program

Las Vegas, NV, USA · 16-19 January, 2022 · Caesars Palace Hotel

2022 Radio & Wireless Week Sponsors

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GREETINGS FROM GENERAL CHAIR OF RADIO & WIRELESS WEEK 2022

General Chair
Kevin Chuang

I would like to welcome you to the city of Las Vegas, Nevada. This 17th IEEE RWW is being held at the Caesars Palace Hotel on the famous Las Vegas Boulevard. The venue is located in an internationally renowned major resort city, known for its shopping, fine dining, top entertainment, and nightlife.

RWW isone of the central meetings for the microwave community and spans four days from January 16 to January 19, 2022. This year, RWW 2022 will continue with the tradition of hosting five co-located topical conferences focusing on the intersection between wireless communication theory, systems, circuits, and device technologies. These topical conferences create a unique forum for engineers to discuss various technologies for state-of-the-art wireless systems and their end-use applications. The conferences that are part of RWW 2022 bridge the gaps between digital communications, RF systems, hardware, and software, which all need to be seamlessly combined to keep the wireless industry and mobile applications moving forward. The co-located conferences that are part of RWW 2022 include the 2022 IEEE Radio and Wireless Symposium (RWS), the 22nd Topical Meeting on Silicon Monolithic Integrated Circuits in RF Systems (SiRF), the IEEE Topical Conference on Power Amplifiers for Wireless and Radio Applications (PAWR), the IEEE Topical Conference on Wireless Sensors and Sensor Networks (WiSNet), and the IEEE Space Hardware and Radio Conference (SHaRC).

Our traditional RWW program will again be followed, with technical papers presented in both standard podium presentations and a series of poster sessions. RWW 2022 is planning seven Workshops on Sunday and Wednesday, a special focus session on massive MIMO beamforming technologies for 5G and beyond, a dedicated track on Monday for the IEEE Distinguished Microwave Lecturers, and a Demo Track in the Exhibition Hall. For the second time, we will have a live session on Distinguished Women in Microwaves bringing together a panel of women who have contributed to the microwave society for the last few years including high quality talks in radio and wireless applications. The Plenary Session will be held on Tuesday morning, where we are delighted to have two plenary speakers delivering the keynote presentation including topics related to artificial intelligence in circuit design and 6G, and the winners of the student paper contest and the student design competition will be announced. On Wednesday, parallel Technical Lectures on modern concepts of linearization and wireless sensing are planned. We hope that RWW 2022 will be a gathering place where one will be inspired by the diverse technical content that might spark ideas for future research and product development.

Following last year's successful co-location with RWW, the 98th Automatic Radio Frequency Techniques Group (ARFTG) meeting, will again be held during RWW 2022. ARFTG is the premier conference focused on RF, microwave, and millimeter-wave measurements, calibration, and uncertainty. Technical papers are presented on advanced measurement techniques, measurement standards, and linear and nonlinear device characterization and modeling. The ARFTG symposium includes the ARFTG conference itself with IEEE archived, technical papers, a series of short courses on microwave measurements, a joint exhibition with RWW 2022, and IEEE standards meetings. The RWW and ARFTG exhibitors will be co-located in the Exhibition Hall, so please take time to visit them to learn more about the latest software and hardware innovations impacting our field.

For the fifth year, the MTT-S and the RWW Steering Committee are partnering with the multi-Society IEEE IoT Initiatives to host an IoT Summit titled 'Sustainable Sensor Systems for IoT'. The meeting will bring together participants from industry, academia, and the public sector to explore the latest IoT technology developments and applications. The focus of this year's Summit is to address the critical role that active and passive electromagnetic sensor systems play in IoT and where their design for sustainability is important.

Always a highlight, we will again have a student paper competition as a way to support and encourage students to pursue a career in the wireless area. On Monday, all student paper competition finalists will provide an oral 'elevator pitch'-style presentation to a group of judges, and the winners will be announced in the Plenary Session. For the first time, the RWW 2022 and ARFTG are in collaboration with MTT-12 on the High Efficiency Power Amplifier Student Design Competition (HEPA-SDC). All the teams that entered the 17th HEPA-SDC will have the opportunity to participate another virtual competition for wideband linearity tests, and the live measurements will take place at the Keysight's Microwave Measurements Lab. Winners of the competition will be featured live in the Exhibition Hall.

On Monday evening, we will host our traditional reception, where exhibitors and attendees wrap up their first day, with talks from various RWW 2022 and/or ARFTG presenters at the PAWR panel. We plan to host another Young Professionals Panel session on Tuesday evening, where senior executives from nearby companies will speak to young engineers and scientists in the community on applications of artificial intelligence in RF, microwave, and signal processing. In parallel, the MTT Space Night will be a premier event launched for the first time to boost networking of the space community among the MTT society in an inspiring atmosphere.

Finally, I would like to recognize and thank all of those on the RWW 2022 Steering Committee for their volunteer time and effort in helping bring RWW 2022 to fruition. I hope to see you in Las Vegas, 16-19 January 2022, for four days of great technical presentations, discussions, and networking.

RWW 2022 General Chair
Kevin Chuang, *Analog Devices*

RWW 2022 STEERING COMMITTEE

General Co-Chair
Alexander Koelpin

Technical Program Chair
Changzhi Li

General Chair:
Kevin Chuang, *Analog Devices*

General Co-Chair:
Alexander Koelpin, *Hamburg University of Technology*

Technical Program Chair:
Changzhi Li, *Texas Tech University*

Finance Chair:
Holger Maune, *Otto-von-Guericke-Universität Magdeburg*

Topical Conferences

PAWR Co-Chairs:
Václav Valenta, *European Space Agency*
Roberto Quaglia, *Cardiff University*

WiSNet Co-Chairs:
Rahul Khanna, *Intel*
Paolo Mezzanotte, *Università degli Studi di Perugia*

SHaRC Co-Chairs:
Markus Gardill, *Bradenburg University of Technology Cottbus-Senftenberg*
Maximilian C. Scardelletti, *NASA Glenn Research Center*

SHaRC Publicity Chair:
Sarah Dever, *NASA Glenn Research Center*

SiRF Chair:
Saeed Zeinolabedinzadeh, *Arizona State University*

Distinguished Microwave Lecturers Chair:
Markus Gardill, *Brandenburg University of Technology Cottbus-Stenftenberg*

Workshops Chairs:
Venkata Vanukuru, *GlobalFoundries*
Václav Valenta, *European Space Agency*

Short Courses Chair:
Juan A. Becerra, *Universidad de Sevilla*

Focus/Special Sessions Chair:
Youngho Suh, *MIT Lincoln Laboratory*

Women in Engineering Chair:
Jasmin Grosinger, *Graz University of Technology*

Student Paper Contest Co-Chairs:
Fabian Lurz, *Hamburg University of Technology*
Holger Maune, *Otto-von-Guericke-Universität Magdeburg*

University Demo Chair:
Mario Pauli, Karlsruhe Institute of Technology

Young Professionals Chair:
Pushkar Kulkarni, *Qualcomm*

Publicity & Publications Co-Chairs:
Glauco Fontgalland, *Universidade Federal de Campina Grande*
Roberto Gomez-Garcia, *University of Alcala*
Jasmin Grosinger, *Graz University of Technology*

Microwave Magazine Special Issue Editor:
Kenneth Kolodziej, *MIT Lincoln Laboratory*

MTT Transactions Mini Special Issue Editors:
Changzhi Li, *Texas Tech University*
Changzhan Gu, *Shanghai Jiaotong University*

Exhibition/Sponsorships Chair:
Elsie Vega, *IEEE MCE*

Exhibits/MarCom Liaison:
Robert Caverly, *Villanova University*

RWW Executive Committee Chair:
Rashaunda Henderson, *University of Texas at Dallas*

Conference Management:
Elsie Vega, *IEEE MCE*
Erin Dolan, *IEEE MCE*

International Liaison:
Zaher Bardai

Webmasters:
Min Hua, *Raysilica*
Joel Arzola, *Raytheon Technologies*

At Large (Advisors):
Nuno Borges Carvalho, *Universidade de Aveiro*
Robert Caverly, *Villanova University*
Rashaunda Henderson, *University of Texas at Dallas*
Charlie Jackson, *Northrop Grumman*

REGISTRATION HOURS:

Registration will be open during the following times in the Promenade Foyer:

Sunday, 16 January 2022 1:00PM – 6:00PM
Monday, 17 January 2022 7:00AM – 6:00PM
Tuesday, 18 January 2022 7:00AM – 4:00PM

EXHIBIT HOURS:

The joint RWW/ARFTG Exhibition area in the Roman Ballroom will be open during the following times:

Monday, 17 January 2022 1:00PM – 7:00PM
Tuesday, 18 January 2022 9:00AM – 5:00PM

Please refer to the conference website at http://www.radiowirelessweek.org/exhibits for the latest information and details on how to become a sponsor and exhibit at RWW.

SOCIAL EVENTS:

Joint RWW/ARFTG Welcome Reception
Monday, 17 January 2022 5:30PM – 6:30PM
Location: Exhibit Hall – Roman Ballroom

NETWORKING OPPORTUNITIES/LITE RECEPTIONS:

Sunday 16 January 2022 at 5:30 PM before the WiM event – Promenade

Tuesday 18 January 2022 at 5:30 PM before the YP and MTT Space Night events in the Exhibit Hall

RWS 2022 TECHNICAL PROGRAM COMMITTEE

High-speed and Broadband Wireless Technologies:
Upkar Dhaliwal, Jennifer Kitchen, Masaaki Kojima, Jing Wang, Muh-Dey Wei, Dietmar Kissinger, Kevin Chuang

Emerging Wireless Technologies & Novel Engineered Materials:
Hyun Kyu Chung, Alessandro Cidronali, Ahmad Hoorfar, Sangkil Kim, Syed Abdullah Nauroze, Spyridon Pavlidis, Junyu Shen, Hjalti Sigmarsson

Wireless System Architecture and Propagation Channel Modeling:
Juan Antonio Becerra, Ugo Dias, Aly Fathy, Paulo Ferreira, Maria J. Madero-Ayora, Chenming Zhou, Pravin Premakanthan

Wireless Digital Signal Processing and Artificial Intelligence:
Nuno Carvalho, Markus Gardill, Rui Ma, Eiji Okamoto, Arnaldo Oliveira, Ken Kolodziej, Pushkar Kulkarni

Applications to Bio-Medical, Environmental, and Internet of Things:
Chia-Chan Chang, Robert Caverly, Syed Islam, Mohammad-Reza Tofighi, Chau Yuen, Changzhan Gu, Daniel Rodriguez, Jenshan Lin

Antenna Technologies, MIMO and Multi-Antenna Communications:
Wasif Khan, Dariush Mirshekar, Jiang Zhu, You Zou, Rashaunda Henderson, Jeremy Muldavin, Edward Niehenke

Passive Components & Packaging:
Roberto Gomez-Garcia, T.-S. Jason Horng, Dimitra Psychogiou, Yu-Chen Wu, Li Yang, Jong Gwan Yook, Bayaner Arigong, Sai-Wa Wong

MM-Wave to THz Systems & Applications:
Shanthi Bhagavatheeswaran, Yi-Jan (Emery) Chen, David Delrio, Nathalie Deltimple, Glauco Fontgalland, Minoru Fujishima, Renato Negra, Hiroshi Okazaki, Sergio Pacheco, Xin Wang, Xinwei Wang, Yu Ye

SIRF2022 DESCRIPTION

IEEE Topical Meetings on Silicon Monolithic Integrated Circuits in RF Systems have been at the forefront of moving Silicon technologies into microwave, millimeter-wave and THz applications – a development now widely accepted, and of great importance. RF CMOS and Si/SiGe BiCMOS technologies are well established in commercial and defense applications.

SiRF 2022 will mark the 22nd topical meeting on SiRF, with a renewed emphasis on promoting a dialogue between IC designers and researchers promoting non-standard technologies, exploiting the maturity of Silicon processes, but addressing the challenges of tomorrow. The three days of SiRF 2022 will chronicle recent advances in our dynamic field, and provide the platform for developing new ideas, and candid exchange, facilitated by SiRF's single-session format. As in past years, a line-up of reputed invited speakers will stimulate our discussions, with an emphasis on emerging technologies.

SIRF2022 STEERING COMMITTEE

Conference Chair:
Saeed Zeinolabedinzadeh, *Arizona State University*

Technical Program Chair:
Roee Ben-Yishay, *ON Semiconductor*

Technical Program Co-Chair:
Robert Schmid, *Johns Hopkins Applied Physics Lab*

International Liaison - Asia:
Chien-Nan Kuo, *National Chiao Tung University*

International Liaison - Europe:
Mehmet Kaynak, *IHP Microelectronics*

Executive Committee:
Yi-Jan Emery Chen, *National Taiwan University*
Julio Costa, *Qorvo*
Vadim Issakov, *University Magdeburg*
Mehmet Kaynak, *IHP Microelectronics*
Eric Kerherve, *University of Bordeaux*
Dietmar Kissinger, *Ulm University*
Chien-Nan Kuo, *National Chiao Tung University*
Hao Li, *Infineon Technologies*
Donald Lie, *Texas Tech University*
Venkata Koushik Malladi, *NXP Semiconductors*
Monte Miller, *NXP Semiconductors*
Sergio Pacheco, *Uhnder, Inc.*
Nils Pohl, *Ruhr-Universität Bochum*
Jae-Sung Rieh, *Korea University*
Hasan Sharifi, *HRL Labs*
Ahmet Cagri Ulusoy, *Karlsruhe Institute of Technology*
Václav Valenta, *ESA/ESTEC*

SIRF2022 TECHNICAL PROGRAM COMMITTEE

RF, Millimeter-wave and THz Integrated Circuit Front Ends:
Amit Jha, Michael Oakley, Ickhyun Song, Cagri Ulusoy, Robert Schmid, Roee Ben-Yishay, Rahul Kodkani, Austin Chen, Christopher Coen

Wireline Communication Circuits and Silicon-Photonics Integrated Circuits:
Saeed Zeinolabedinzadeh, Juergen Hasch, Vadim Issakov, Aleksey Dyskin, Ankur Guha Roy

High Speed Data Converters & Mixed Signal Circuits:
Wei-Min (Lance) Kuo, Hsieh-Hung Hsieh, Monte Miller, Chien-Nan Kuo, Arindam Sanyal

Devices, Materials, Modeling, and Measurement:
Mehmet Kaynak, Ming-Ta Yang, Katsuyoshi Washio, Julio Costa, Jean-Pierre Raskin, Pierre Blondy, Venkata Malladi, Vikas Shilimkar, Florian Herrault, Xun Gong

RWW TOPICAL CONFERENCES

POWER AMPLIFIERS FOR RADIO AND WIRELESS APPLICATIONS (PAWR)

Interest in Power Amplifiers for Radio and Wireless Applications (PAWR) is continuously increasing because of the advances of new technologies such as GaN that offer improved performance, and the need for ever greater linearity and efficiency by the world's expanding wireless communication infrastructure that is spanning across the spectrum up to mm-waves. Topical Conference PAWR will feature power amplifier focused sessions, including the latest advances on **Advanced Circuit Design and Topologies, Modeling and Characterization, Packaging and Reliability and Linearization and Efficiency Enhancement Techniques.** An interactive workshop dealing with **Behavioral Modelling, Digital Predistortion and Measurement Techniques for High-Frequency Power Devices and Amplifiers is** this time held as a joint event between PAWR and ARFTG.

Besides the focused sessions, a dedicated PAWR panel will be held, addressing a hot topic **Trends in mm-wave solid state technologies for space.** Key industrial players confirmed participation, bringing the audience recent achievements, fresh ideas and new concepts.

PAWR2022 Technical Program Committee

Modeling and Characterization:

Kefei Wu, David Runton, Filipe Barradas, Vittorio Camarchia, Stephen Maas, Jose Pedro, Zoya Popovic, Patrick Roblin, Ehsan Azad

Advanced Circuit Design and Topologies:

Paolo de Falco, Jose A. Garcia, William Hallberg, Wolfgang Heinrich, Chao Lu, Frederick Raab, Paolo Colantonio, Nathalie Deltimple, Bumman Kim, Francesc Purroy

Packaging and Reliability:

Robert Caverly, Florinel Balteanu, Murat Eron, Ming Ji, Chang-Ho Lee, Don Lie

Linearization and Efficiency Enhancement Techniques:

Taylor Barton, Christian Fager, Juan A. Becerra, Wenhua Chen, Armando Cova, Pere Gilabert, Allen Katz, Anding Zhu, Morten Olavsbråten, Kevin Chuang

IEEE SPACE HARDWARE AND RADIO CONFERENCE (IEEE SHaRC)

The IEEE Space Hardware and Radio Conference (IEEE SHaRC) addresses new concepts, novel implementations, as well as emerging applications for space-based hardware for communications, earth observation, and other novel disruptive services. To meet recent needs, there has been a renaissance of interest and investment in space- and suborbital- based systems especially for high-data-rate communications networks. These new global satellite networks are disruptive, rely on new system and subsystem design paradigms, and are an enabler for many novel applications. The IEEE Space Hardware and Radio Conference provides a forum for discussions on this new frontier.

SHARC2022 Technical Program Committee

Systems, Hardware, and Electronics for Space:

Thomas Ussmueller, Nuno Carvalho, Jasmin Grosinger, Ramesh Gupta, James McSpadden, Steven Reising, Steven Rosenau, Rick Sturdivant, Vaclav Valenta, Robert Weigel, Markus Gardill, Federico Clazzer

Mission Concepts, Operations, Regulation, and Standardization:

Jan Budroweit, Goutam Chattopadhyay, Rudy Emrick, Dale Force, Charles Jackson, Holger Maune, Thomas Royster, Klaus Schilling, Zizung Yoon, Sachidananda Babu, Dustin Schroeder, Marwan Younis

WIRELESS SENSORS AND SENSOR NETWORKS (WiSNet)

IWireless sensors and wireless sensor networks are crucial components for manufacturing, structural health, security monitoring, environmental monitoring, smart agriculture, transportation, commercial applications, localization, tracking systems and other important and emerging applications. WiSNet 2022 is intended to stimulate discussion and foster innovation on these components and applications.

WISNET2022 Technical Program Committee

Wireless Sensors for IoT Communication and Applications:

Georg Fischer, Tuami Lasri, Federico Alimenti, Reinhard Feger, Davi Valerio de Queiroz Rodrigues

Wireless Sensors for Radar, Positioning, Tracking, and Imaging:

Alexander Koelpin, Paolo Mezzanotte, Changzhi Li, Zahir Alsulaimawi, Arne Jacob, Mario Pauli, Hendrik Rogier, Valentina Palazzi, Spyridon Daskalakis

Wireless Sensors Circuits & System Technologies:

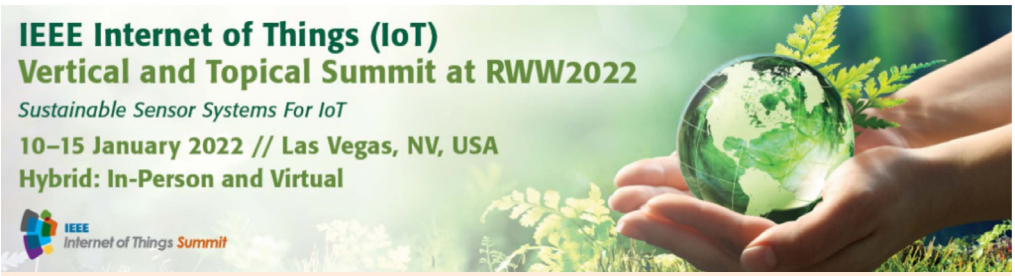
Alessandra Costanzo, Diego Masotti, Wang Wang, J-C Chiao, Serioja Tatu, Fabian Lurz, Guoan Wang

WSN Hardware-Software CoDesign:

Amr Fahim, Manos Tentzeris, Jennifer Williams, Kamal Samanta, Nils Pohl, Emanuele Cardillo

Innovations in Wireless Sensor Networks:

Marco Dionigi, Rahul Khanna, Luciano Tarricone, Maurizio Bozzi, Xianming Qing, Kai-Ten Feng, Xuyu Wang



Sustainable Sensor Systems for IoT

Times: Live Online: 10-15 January, 08:00 – 10:00 (PST); Hybrid: 15 January, 10:00 – 12:00 (PST)

The 5th IEEE Internet of Things (IoT) Vertical and Topical Summit at RWW 2022 addresses the crucial role that active and passive electromagnetic sensor systems play in IoT, and where their design for sustainability is essential. The summit will explore approaches for creating sustainable sensor systems and networks, energy-efficient hardware design, including energy management for long-lived or remote sensor systems, efficient methods for processing sensor data, and finally, a wide range of use cases. The upcoming summit examines how sensor systems support sustainability and how emerging artificial intelligence (AI)-based processing methods can lead to significant improvements in performance and viability. This includes the sensors themselves, the accompanying architectures, supporting infrastructure, and underlying technologies necessary for creating value, such as communications, computing, data storage, and power.

The IoT Summit is a six-day event sponsored by the multi-society IEEE IoT Initiative and MTT. For the convenience of attendees from around the world, the program will be delivered in virtual two-hour sessions each weekday from Monday, the 10th of January to Saturday the 15th of January and two two-hour hybrid sessions (in-person and virtually) on Saturday the 15th of January. The website and program for the summit can be found at **https://rww2022.iot.ieee.org/program/**.

Sunday, 16 January 2022

1:30 - 5:30 PM

RWW Workshop on Space Mission and Hardware Design: From the Idea to a Successful Demonstration in Space

Organizer:

Jan Budroweit, *DLR, Germany*

Abstract:
The half-day workshop aims to introduce the general workflow for space missions as seen from agencies like ESA or DLR and the requirements for a successful development and final operation in space. In this workshop, the topics space mission and hardware design are addressed: talking about critical mission phases, constraints in space hardware design and development and on how common pitfalls can be avoided. Two invited talks are presenting the lessons learned and best practice experience for scientific payloads that have been designed, developed and successfully demonstrated space.

Talks and Speakers:

Space Mission Design
Martin Drobczyk, *DLR, Germany*

Space Hardware Design
Jan Budroweit, *DLR, Germany*

RF Engineering for Space: Lessons Learned from Selected ESA Missions
Václav Valenta, ESA, *The Netherlands*

Lessons Learned on the First ADS-B Receiver in Space
Toni Delovski, *DLR, Germany*

RWW Workshop on AI-Based Radar Technologies

Organizers:

Christoph Baer, *Ruhr University, Bochum, Germany*

Thomas Ussmueller, *University of Innsbruck, Austria*

Abstract:
Artificial Intelligence (AI) appears to be one of the most rapid growing technologies in this decade. Statistics show that for 2019 the AI market experienced a growth of 154%, and is expected to grow until 2025 by more than 140% every year. Therefore, AI technologies found their way into numerous technological branches including Radar based technologies. This Workshop will give a broad overview on the capabilities of AI-based Radar technology starting with basic ideas on perception-action cycle based cognitive radar methods. Further talks will discuss a variety of several applications utilizing AI, including gesture recognition, classification and tracking of vulnerable road users as well as several safety relevant applications. The workshop will close with an open panel discussion on recent achievements and future research directions of AI-based Radar technologies.

Speakers:

Application Examples of AI-Based Methods in Cognitive Radar
Stefan Brüggenwirth, *Fraunhofer Institute for High Frequency Physics and Radar Techniques FHR, Germany*

Machine-Learning Methods for Radar-Based Gesture Recognition
Nils Pohl, *Ruhr University Bochum, Germany*

Integrated Classification and Tracking of Vulnerable Road Users Using Automotive Radars
Anand Dubey, *University of Erlangen-Nuremberg*
Dr. Fabian Lurz, *Hamburg University of Technology, Germany*

AI- and Nonlinear- Powered Radar Sensing for Activity Detection and Target Tracking
Changzhi Li, *Texas Tech University, USA*

RWW Workshop on Loss-Aware Design in Advanced CMOS/BiCMOS Technologies

Organizer:

Ahmet Cagri Ulusoy, *Karlsruhe Institute of Technology, Germany*

Abstract:
This workshop will focus on advanced circuit design strategies in CMOS and BiCMOS technologies, covering topics such as multiband and wideband LNAs, PAs, VCOs, novel matching design strategies and sub-THz power distributing and combining techniques. Special focus will be put on efficiency enhancement techniques for mm-wave PAs.

Speakers:

Synthesis of Broadband Input Matching and Output Load Network for Wideband mmWave LNA
Taiyun Chi, *Rice University, TX*

Design Techniques for mm-Wave VCOs in Advanced CMOS Technology Nodes
Vadim Issakov, *TU Braunschweig, Germany*

Sub-THz Power Combined Power Amplifiers in SiGe Technologies
Mohamed Eissa, *IHP Microelectronics, Germany*

Efficiency of Impedance Matching Networks in mm-wave Power Amplifiers
Mario Lauritano, *Intel, Germany*

A Systematic Analysis of PA Design Using Lossy Matching Networks
Ahmet Cagri Ulusoy, *Karlsruhe Institute of Technology, Germany*

RWW Workshop on RF Front-End-Modules for 5G

Organizers:

Dr. Florinel Balteanu, *Technical Director, Skyworks Solutions*

Abstract:
Mobile cellular subscribers reached more than 6 billion in 2021 and 5G LTE brings high data capacity as low latency using sub-6GHz and mm-Wave spectrum. The workshop presents the status of 4G/5G LTE RF Front End Modules (RF FEM) and techniques to deliver an over gigabit-per-second data rate such as Carrier Aggregation and MIMO as well Wider Modulation Bandwidth for LTE and mm-Wave spectrum. The high-speed wireless ecosystem which includes 5G LTE and WiFi 6 (802.11ax) which is currently deployed uses two frequency domains: sub 6GHz frequency domain and mm-Wave spectrum. Mm-Wave will be used initially to increase the capacity for backhaul network and allow low latency. Also, the mobile devices started to have new wireless functionality in 6GHz-8.5GHz spectrum such as Ultra-wideband (UWB) for proximity indoor location. The RF FEMs integrate power amplifiers, switches, couplers, tuners, and active acoustic filters. The workshop will cover practical design aspects for 5G FEMS with emphasis for FEM architectures, power amplifiers, switches, and active filters as well the technologies involved into these designs. The workshop will also cover aspects of new 5G LTE integration for envelope tracking and LNA design.

Speakers:

Tunable Power Amplifiers for 5G-FR1 Applications
Dr. Alexandre Giry, *Univ. Grenoble Alpes (UGA), CEA-Leti, Grenoble, France*

Filters and Tunable Materials for 5G
Dr. Senad Bulja, *Tyndall National Institute, Dublin, Ireland*

5G FR2 mmWave Tunable Filters
Professor Gaetan Prigent, *LAAS-CNRS Toulouse, France*

5G Design Techniques for Front End Modules
Dr. Florinel Balteanu, *Technical Director, Skyworks Solutions, Irvine, CA, USA*

HR-SOI for 5G RF Front End Modules
Dr. Venkata Vanukuru, *PMTS, GlobalFoundries, Bangalore, India*

6:00 – 7:30 PM

IEEE Women in Engineering

WOMEN IN MICROWAVES EVENT

DISTINGUISHED WOMEN IN MICROWAVES

Room: Pompeian I

The Women in Microwaves (WiM) event spotlights distinguished women in microwaves who have considerably advanced the fields of Microwaves Theory and Techniques and Automatic Radio Frequency Techniques. Three outstanding presenters will deliver talks describing their respective research fields. Prof. Wenquan Che, South China University of Technology, Guangzhou, will discuss "**How Does a Metasurface Become a Good Antenna.**" Prof. Amelie Hagelauer, Technical University of Munich, Germany, will present "**Integrated Circuits and their Hetero-Integration for Future Radar and Communication Systems.**" Finally, Prof. Rashaunda M. Henderson, University of Texas at Dallas, will talk on "**Integration and Packaging Strategies for Millimeter-Wave CMOS.**"

MTT-S MHz to THz Community

Monday, 17 January 2022

RWW Session Mo1A

DISTINGUISHED MICROWAVE LECTURERS

Chair: Markus Gardill, ***Brandenburg University of Technology Cottbus-Stenftenberg***

Co-Chair: Fabian Lurz, ***Hamburg University of Technology***

Room: Pompeian I

RWS Session Mo1B

ADVANCED ANTENNA TECHNOLOGIES

Chair: Holger Maune, ***Technische University Darmstadt***

Co-Chair: Ifana Mahbub, ***University of North Texas***

Room: Pompeian II

SIRF Session Mo1C

MILLIMETER-WAVE AMPLIFIERS

Chair: Youngho Suh, ***Massachusetts Institute of Technology, Lincoln Laboratory***

Co-Chair: Ickhyun Song, ***Oklahoma Stste University***

Room: Pompeian III

PAWR Session Mo1D

MODELING AND CHARACTERIZATION

Chair: Nuno Carvalho, ***University of Aveiro***

Co-Chair: Václav Valenta, ***European Space Agency***

Room: Pompeian IV

8:00 AM

Mo1A-1

RF Design for Ultra-Low-Power Wireless Communication Systems: Efficiently Miniaturizing and Passively Sensing

Lecturer: Jasmin Grosinger

In this talk, I will present radio frequency (RF) design solutions for wireless sensor nodes to solve sustainability issues in the Internet of things (IoT), which arise due to the massive deployment of wireless IoT nodes on environmental and economic levels. Engineers can apply these RF design solutions to improve the ultra-low-power operation of IoT nodes, avoid batteries' eco-toxicity, and decrease maintenance costs due to battery replacement. The presented solutions offer high integration levels based on system-on-chip and system-in-package concepts in low-cost complementary metal-oxide-semiconductor technologies to limit costs and carbon footprints of these nodes. Within this research context, I will present solutions for ultra-low-power wireless communication systems based on high frequency (HF) and ultra-high frequency (UHF) radio frequency identification (RFID) technologies. In particular, I will present RF design solutions for HF and UHF RFID systems that reveal how to develop passive miniaturized IoT nodes that operate robustly in harsh application environments and how to create batteryless or rather passive IoT nodes, which provide passive sensing capabilities and work robustly in their respective application environment.

Mo1B-1

Overview of Advanced Antenna Concepts for 5G

Authors: Aly Fathy, University of Tennessee; Ozlem Kilic, The University of Tennessee; Abdel, Kareem Moadi, University of Tennessee

Speaker: Aly Fathy, University of Tennessee

Mo1C-1

Compact CMOS transceiver Pixels for Reflection-Mode Active Imaging in Terahertz

Author: Wooyeol Choi, Oklahoma State University

Speaker: Invited Speaker

Mo1D-1

Scalable Non-Linear Electrical Model for Industrial GaN HEMT Technologies up to 50 GHz

Authors: Guillaume Callet, United Monolithic Semiconductors; Seifeddine Fahkfahk, United Monolithic Semiconductors; Christophe Chang, United Monolithic Semiconductors; Valeria Di Giacomo-Brunel, United Monolithic Semiconductors; Laurent Favede, United Monolithic Semiconductors; Hervé Blanck, United Monolithic Semiconductors

Speaker: Guillaume Callet, United Monolithic Semiconductor

8:20 AM

Mo1D-2

Ultra-Linear and High-Efficiency GaN Technology for 5G and Beyond

Author: Jeong-Sun Moon, HRL Laboratories

Speaker: Jeong-Sun Moon, HRL Laboratories

8:40 AM

Mo1A-2

Portable Radar Systems for Life Activity Sensing, Anomaly Detection, and Human Tracking

Lecturer: Changzhi Li

By sensing various life activities with microwave signals, portable radar sensors with state-of-the-art front-end and measurement algorithms have great potential to improve healthcare, security, and human-machine interface. This presentation will first provide an overview of the state-of-the-art smart radar sensors powered by advanced technologies including beamforming, multiple-input and multiple-output (MIMO), synthetic aperture, and deep learning. A

Mo1B-2

A Ka-Band Iris-Loaded Waveguide Slot Antenna With Enhanced Out-of-Band

Authors: Shuai Deng, Jin Li, Tao Yuan

Speaker: Shuai Deng, Shenzhen University

Mo1C-2

A Stacked Transistors CMOS SOI Power Amplifier For 5G Applications

Authors: Zhize Ma, Purdue University; Nathan Conrad, Purdue University; Saeed Mohammadi, Purdue University

Speaker: Zhize Ma, Purdue University

Mo1D-3

Gate Bias Voltage Dependence of Cardiff Admittance Model in Ka-Band GaAs pHEMTs

Authors: Alexander Baddeley, Cardiff University; Ehsan Azad, Cardiff University; Roberto Quaglia, Cardiff University; James Bell, Cardiff University; Paul Tasker, Cardiff University

Speaker: Alexander Baddeley, Cardiff University

few examples based on different sensing front-end architectures will be discussed. In addition, the use of nonlinear technologies for enhanced target identification will be reported. Case studies at this exciting human-microwave frontier will be given on physiological signal sensing, non-contact human-computer interface, driving behavior recognition, indoor localization, and anomaly detection. As smart radar sensors enter the healthcare, automotive, and smart living sectors of daily life, measures to enhance its security against malicious attacks will also be discussed. Finally, this talk will conclude with future industrial and academic R&D outlooks for smart radar sensors.

9:00 AM

Mo1B-3

A Polarization Insensitive Frequency Selective Bianisotropic Surface

Authors: Muhammad Sumaid, RIMMS; Nosherwan Shoaib, RIMMS; Fahad Ahmad, RIMMS; Symeon Nikolaou, Frederick Research Center

Speaker: Symeon Nikolaou, Frederick Research Center

Mo1C-3

A D-Band Power Amplifier with 15 dBm Psat in 0.13 um SiGe BiCMOS Technology

Authors: Ibrahim Kagan Aksoyak, Karlsruhe Institute of Technology; Matthias Moeck, Karlsruhe Institute of Technology; Mehmet Kaynak, IHP Microelectronics; Ahmet Cagri Ulusoy, Karlsruhe Institute of Technology

Speaker: Ibrahim Kagan Aksoyak, Karlsruhe Institute of Technology

Mo1D-4

Accurate Non-Linear Harmonic Simulations at X-band using the ASM-HEMT Model Validated with NVNA Measurements

Authors: Nicholas Miller, Air Force Research Lab; Devin Davis, KBR; Sourabh Khandelwal, Macquarie University; Franz Sischka, SisConsult Engineering Office; Ryan Gilbert, KBR; Michael Elliott, SelectTech Services; Robert Fitch, Air Force Research Lab; Kyle Liddy, Air Force Research Lab; Andrew Green, Air Force Research Lab; Elizabeth Werner, KBR; Dennis Walker, Jr., Air Force Research Lab; Kelson Chabak, Air Force Research Lab

Speaker: Nicholas Miller, Air Force Research Lab

9:20 AM

Mo1B-4

Design of Beam-Steering Kirigami Loop Antennas

Authors: Chieh Deng, National Chung Cheng University; Chia-Chan Chang, National Chung Cheng University

Speaker: Chieh Deng, National Chung Cheng University

Mo1C-4

Active BALUN with 40GHz Bandwidth at 257GHz in 130nm SiGe:C

Authors: Joachim Hebeler, Karlsruhe Institute of Technology; Cagri Ulusoy, Karlsruhe Institute of Technology; Thomas Zwick, Karlsruhe Institute of Technology

Speaker: Joachim Hebeler, Karlsruhe Institute of Technology

Mo1D-5

pHEMT Behavioral Model with Gate-lag Effects Applied to the Dynamic Simulation of Switching Speed

Authors: Bin Li, Skyworks Solutions, Inc.; Andre Metzger, Skyworks Solutions, Inc.; Cristian Cismaru, Skyworks Solutions, Inc.; Ravi Ramanathan, Skyworks Solutions, Inc.; Hal mark Banbrook, Skyworks Solutions, Inc.; Yingying Yang, Skyworks Solutions, Inc.

Speaker: Bin Li, Skyworks Solutions, Inc.

RWW Session Mo2A

DISTINGUISHED MICROWAVE LECTURERS

Chair: Markus Gardill, *Brandenburg University of Technology Cottbus-Stenftenberg*

Co-Chair: Fabian Lurz, *Hamburg University of Technology*

Room: Pompeian I

RWS Session Mo2B

COMPONENTS AND PACKAGING FOR WIRELESS SYSTEMS

Chair: Hjalti Sigmarsson, *University of Oklahoma*

Co-Chair: Roberto Gomez-Garcia, *University of Alcala*

Room: Pompeian II

SIRF Session Mo2C

MILLIMETER-WAVE AND THZ CIRCUIT & SYSTEMS

Chair: Saeed Zeinolabedinzadeh, *Arizona State University*

Co-Chair: Kenneth Kolodziej, *Massachusetts Institute of Technology, Lincoln Laboratory*

Room: Pompeian III

PAWR Session Mo2D

PA CIRCUIT TECHNIQUES

Chair: Roberto Quaglia, *Cardiff University*

Co-Chair: Guillaume Callet, *United Monolithic Semiconductors*

Room: Pompeian IV

10:10 AM

Mo2A-1

Distributed Phased Arrays: Challenges And Recent Progress

Lecturer: Jeffrey Nanzer

There has been significant research devoted to the development of distributed microwave wireless systems in recent years. The progression from large, single-platform wireless systems to collections of smaller, coordinated systems on separate platforms enables significant benefits for radar, remote sensing, communications, and other applications. The ultimate level of coordination between platforms is at the wavelength level, where separate platforms operate as a coherent distributed system. Wireless coherent distributed systems operate in essence as distributed phased arrays, and the signal gains that can be achieved scale proportionally to the number of transmitters squared

Mo2B-1

A K-Band Broadband Binary Phase Shifter

Authors: Michael Brown, Texas Tech University; Changzhi Li, Texas Tech University

Speaker: Michael Brown, Texas Tech University

Mo2C-1

Next Generation mm-Wave Wireless: Thousands of Gb/s Links per Station

Author: Ali Niknejhad, University of California, Berkeley

Speaker: Keynote Speaker

Mo2D-1

Doherty Power Amplifiers for Ka-Band Satellite Downlink

Authors: Anna Piacibello, Politecnico di Torino; Paolo Colantonio, University of Rome; Rocco Giofré, Universita di Roma Tor Vergata; Vittorio Camarchia, Politecnico di Torino

Speaker: Vittorio Camarchia, Politecnico di Torino

multiplied by the number of receivers, providing potentially dramatic increases in wireless system capabilities. Distributed array coordination requires accurate control of the relative electrical states of the nodes. Generally, such control entails wireless frequency synchronization, phase calibration, and time alignment, but for remote sensing operations, phase control also requires high-accuracy knowledge of the relative positions of the nodes in the array to support beamforming.

This lecture presents an overview of the challenges involved in distributed phased array coordination, and describes recent progress on microwave technologies that address these challenges. Requirements for achieving distributed phase coherence at microwave frequencies are discussed, including the impact of component non-idealities such as oscillator drift on beamforming performance. Architectures for enabling distributed beamforming are reviewed, along with the relative challenges between transmit and receive beamforming. Microwave and millimeter-wave technologies enabling wireless phase-coherent synchronization are discussed, focusing on technologies for high-accuracy internode ranging, wireless frequency transfer, and high-accuracy time alignment. The lecture concludes with a discussion of open challenges in distributed phased arrays, and where microwave technologies may play a role.

11:00 AM

Mo2A-2

Fundamentals of RF and mm-Wave Power Amplifier Designs

Lecturer: Hua Wang, ***Swiss Federal Institute of Technology Zürich (ETH Zürich), Swiss***

This distinguished lecture talk presents an overview of RF and mm-wave Power Amplifier (PA) designs in silicon, focusing on the fundamentals, design practices, and advanced PA topologies. First, the distinguished lecture talk will introduce PA performance metrics and their impacts on wireless systems. Next, it presents PA device-level designs, including active device large-signal operations, nonlinearity, and stability as well as passive network impedance transformation and power combining. Basic load-/source-pull simulations and biasing techniques will be covered. Then, the talk will go through popular PA classes of linear and switching PAs. The talk will cover a wide variety of advanced PA topologies that enhance bandwidth, efficiency, and linearity. Finally, the distinguished lecture talk will conclude with several PA design examples at RF and mm-Wave frequencies.

10:30 AM

Mo2B-2

A Novel Miniaturized 100:1 Broadband Balun with a 4:1 Impedance Ratio

Authors: Farshid Tamjid, University of Tennessee; Tsotne Kvelashvili, The University of Tennessee; Ozlem Kilic, The University of Tennessee; Aly Fathy, University of Tennessee

Speaker: Farshid Tamjid, University of Tennessee

10:30 AM

Mo2D-2

High Speed and High Efficiency GaN Envelope Amplifier with Source-Floating Half-Bridge Switch

Authors: Kento Saiki, Mitsubishi Electric Corp.; Shuichi Sakata, Mitsubishi Electric Corp.; Yuji Komatsuzaki, Mitsubishi Electric Corp.; Masaomi Tsuru, Mitsubishi Electric Corp.

Speaker: Kento Saiki, Mitsubishi Electric Corp.

10:50 AM

Mo2B-3

Generalized Cascaded Sixtuplets Filters

Author: Wael Fathelbab, Northrop Grumman Corp.

Speaker: Wael Fathelbab, Northrop Grumman Corp.

Mo2C-2

A mm-Wave FMCW Radar RX Frontend in CMOS with Modulated Self-Interference Cancellation Path

Author: Amin Aghighi, Oregon State University; Mostafa Essawy, Oregon State University; Arun Natarajan, Oregon State University

Speaker: Amin Aghighi, Oregon State University

Mo2D-3

25-GHz-Band High Efficiency Stacked-FET Power Amplifier IC with Adaptively Controlled Gate Capacitor in 45-nm SOI CMOS

Authors: Tsuyoshi Sugiura, Waseda University; Toshihiko Yoshimasu, Waseda University

Speaker: Tsuyoshi Sugiura, Waseda University

11:10 AM

Mo2B-4

A Full Ka-Band Compact Coax-to-Waveguide Transition With Shaped Internal Profile and Enhanced Fabrication Process Flexibility

Authors: Zhihong Xu, Shenzhen University; Jin Li, Shenzhen University; Tao Yuan, Shenzhen University

Speaker: Zhihong Xu, Shenzhen University

Mo2C-3

A 120-GHz, 1.58-mm2 Multiplying Outphasing Transmitter in 22nm FDSOI

Author: Jeff Shih-Chieh Chien, University of California, Santa Barbara; James Buckwalter, University of California, Santa Barbara

Speaker: Jeff Shih-Chieh Chien, University of California

Mo2D-4

A GaN MMIC Stacked Doherty Power Amplifier For Space Applications

Authors: Ferdinando Costanzo, University of Rome Tor Vergata; Vittorio Camarchia, Politecnico di Torino; Nuno Carvalho, Instituto De Telecomunicacoes; Paolo Colantonio, University of Rome; Anna Piacibello, Politecnico di Torino; Roberto Quaglia, Cardiff University; Vaclav Valenta, ESA - European Space Agency; Rocco Giofrè, University of Rome Tor Vergata

Speaker: Vittorio Camarchia, Politecnico di Torino

11:30 AM

Mo2B-5

Broadband Conductor Backed-CPW to SubstrateIntegrated Slab Waveguide Transition for Ku-Band

Authors: Anil Nayak, University of Alberta; Igor Filanosky, University of Alberta; Kambiz Moez, University of Alberta; Amalendu Patnaik, Indian Institute of Technology Roorkee

Speaker: Anil Nayak, University of Alberta

Mo2C-4

Performance Comparison of V-band T/R Amplifier Modules in SiGe Technology using Aluminium and Copper Back-end of line

Author: Ahmed Gadallah, IHP Microelectronics; Mohamed Eissa, IHP; Dietmar Kissinger, Ulm University; Andrea Malignaggi, IHP Microelectronics

Speaker: Ahmed Gadallah, IHP Microelectronics

Mo2D-5

RF Leakage Compensation in Wideband Envelope Tracking Power Amplifiers for Mobile Terminals

Authors: Wantao Li, University Politècnica de Catalunya; Gabriel Montoro, University Politècnica de Catalunya; Pere Gilabert, University Politècnica de Catalunya

Speaker: Wantao Li, University Politècnica de Catalunya

Monday, 17 January 2022

RWS Session Mo3B

BIOMEDICAL RADAR FOR PHYSIOLOGICAL MONITORING

Chair: Chian-Chan Chang, ***National Chung Cheng University***

Co-Chair: Aly Fathy, ***University of Tennessee***

Room: Pompeian II

SIRF Session Mo3C

DEVICES, MATERIALS, MODELING, AND MEASUREMENT

Chair: Austin Chen, ***Peraso Technologies***

Co-Chair: Aleks Dyskin, ***Inxpect***

Room: Pompeian III

PAWR Session Mo3D

PA LINEARITY ENHANCEMENT AND DPD

Chair: Vittorio Camarchia, ***Politecnico di Torino***

Co-Chair: Roman Marsalek, ***Brno University of Technology***

Room: Pompeian IV

1:30 PM

Mo3B-1

Noncontact Respiration Detection of Multiple Closely Positioned Subjects with Difference Beamforming

Authors: Junjun Xiong, Nanjing University of Science and Technology; Hong Hong

Speaker: Junjun Xiong, Nanjing University of Science and Technology

Mo3C-1

Si Technologies for WiFi Front-end Modules

Author: Tianbing Chen, GlobalFoundries

Speaker: Invited Speaker

Mo3D-1

Impact of Multi-tone Stimuli on Optimum Load Characterized Using Wideband Load-pull System

Authors: Sanket Chaudhary, University of Aveiro; Nuno Carvalho, University of Aveiro

Speaker: Nuno Carvalho, University of Aveiro

1:50 PM

Mo3B-2

Separation of Multiple Closely Spaced Sources Using Frequency Sweep Single-Channel Continuous Wave Doppler Radar

Authors: Khaldoon Ishmael, University of Hawaii; Olga Boric-Lubecke, University of Hawaii

Speaker: Khaldoon Ishmael, University of Hawaii

1:50 PM

Mo3D-2

Class-iF-1: Linearity Enhanced High Efficiency Power Amplifier

Authors: Chenhao Chu, University College Dublin; Sagar Dhar, University of Calgary; Tushar Sharma, Indian Institute of Technology Bombay; Anding Zhu, University College Dublin

Speaker: Chenhao Chu, University College Dublin

2:10 PM

Mo3B-3

Empirical Mode Decomposition (EMD) for Platform Motion Compensation in Remote Life Sensing Radar

Authors: Shekh Md Mahmudul Islam, University Antonio de Nebrija; Lupua Oba, University of Hawaii at Manoa; Victor Lubecke, University of Hawaii Manoa

Speaker: Shekh Md Mahmudul Islam, University Antonio de Nebrija

Mo3C-2

Nox and Buried PN Junctions Effect on RF Performance of High-Resistivity Silicon Substrates

Authors: Maxime Moulin, CEA-LETI; Martin Rack, ICTEAM; Thibaud Fache, CEA-LETI; Massinissa Nabet, Université Catholique de Louvain; Zdenek Chalupa, CEA-LETI; Christophe Plantier, CEA-LETI; Frédéric Allibert, Soitec; Fred Gaillard, CEA-LETI; Jose Lugo, CEA-LETI; Louis Hutin, CEA-LETI; Jean-Pierre Raskin, Universite Catholique of Louvain la Neuve

Speaker: Maxime Moulin, CEA-LETI

Mo3D-3

A Ka Band Power Amplifier with Varactor-Based Analog Predistortion in pMOS-SOI

Authors: Sravya Alluri, University of California, San Diego; Bagher Rabet, Apple, Inc.; Narek Rostomyan, IQ-Analog Corporation; Vincent Leung, Baylor University; Peter Asbeck, University of California, San Diego

Speaker: Sravya Alluri, University of California, San Diego

2:30 PM

Mo3B-4

Doppler Cardiogram Detection in the Presence of Respiration with a K-band Radar Sensor

Authors: Shuqin Dong, Shanghai Jiao Tong University; Changzhan Gu, Shanghai Jiao Tong University; Junfa Mao, Shanghai Jiao Tong University; Lixin Ran, Zhejiang University

Speaker: Shuqin Dong, Shanghai Jiao Tong University

Mo3C-3

22 nm FD-SOI MOSFET Figures of Merit at High Temperatures upto 175 °C

Authors: Arka Halder, Université Catholique de Louvain; Lucas Nyssens, Université Catholique de Louvain; Martin Rack, Université Catholique de Louvain; Dimitri Lederer, Université Catholique de Louvain; Valeriya Kilchytska, Université Catholique de Louvain; Jean-Pierre Raskin, Universite Catholique of Louvain la Neuve

Speaker: Arka Halder, Université Catholique de Louvain

Mo3D-4

Closed-Loop DPD with Dynamic Resource Block Scheduling

Authors: Peter Pawliuk, Intel Corp.; Benjamin Jann, Intel Corp.

Speaker: Peter Pawliuk, Intel Corp.

2:50 PM

Mo3B-5

Estimation of Driver's Heartrate Variability by Millimeter Wave Sensor

Authors: Ryohei Fukuhara, University of Kitakyushu; Akihiro Kajiwara, University of Kitakyushu

Speaker: Ryohei Fukuhara, University of Kitakyushu

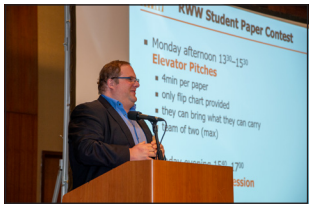
Mo3D-5

Strategic Initialization of Genetic Algorithm used in Digital Pre-Distortion of mmWave Power Amplifiers for Hybrid Beamforming

Authors: Rahul Mushini, Maynooth University; John Dooley, Maynooth University

Speaker: Rahul Mushini, Maynooth University

Joint RWW Student Paper Contest



1:30 PM – 3:10 PM (Student Elevator Pitches)
3:40 PM – 5:20 PM (Student Poster Session)

Student Paper Contest Chairs:

Fabian Lurz, *Hamburg University of Techology*
Holger Maune, *Otto-von-Guericke-Universitat Magdeburg*

The RWW Student Paper Contest provides students with the opportunity to share their work and discuss their results with experts from industry and academia. The contest is open to all students attending the RWW and presenting a paper at one of the topical conferences (RWS, PAWR, WiSNet, SiRF, and SHaRC). Beginning in 2017, the RWW Steering Committee established a new format for the contest, making it a single event for the whole RWW. The finalists will be chosen from all the submitted student papers, and the two best papers representing the entire RWW will be awarded.

All finalists will give a five-minute elevator pitch and present a poster at the Finalists' Interactive Poster Session on Monday afternoon. Judges will grade the papers and presentations in the following areas: novelty of the research, quality of the oral presentation, quality of the poster, quantity and quality of information presented, preparedness of the presenter and the student's performance in the Q&A session. The two best student papers representing the entire RWW will be awarded at the Plenary Session, which takes place on Tuesday.

Student Paper Competition Finalists

PAPER NUMBER	TITLE	SPEAKER
Mo1B-2	A Ka-Band Iris-Loaded Waveguide Slot Antenna With Enhanced Out-of-Band Suppression	Deng Shuai
Mo2C-2	A mm-Wave FMCW Radar RX Frontend in CMOS with Modulated Self-Interference Cancellation Path	Aghighi Amin
Mo2D-5	RF Leakage Compensation in Wideband Envelope Tracking Power Amplifiers for Mobile Terminals	Li Wantao
Mo3C-3	22 nm FD-SOI MOSFET Figures of Merit at high temperatures upto 175 °C	Halder Arka
Mo3D-2	Class-iF-1: Linearity Enhanced High Efficiency Power Amplifier	Chu Chenhao
Mo4C-3	A Millimeter-Wave Ultra-Wideband Polyphase Frequency Doubler With 88% FBW and Inherent Harmonic Cancellation in 22nm FDSOI	Elmenshawi Ahmed
Tu1C-4	An 80-Gbps Distributed Driver with Two-Tap Feedforward Equalization in 45-nm CMOS SOI	Valenzuela Luis
Tu2C-4	Ultra-Wideband Frequency Doubler with Differential Outputs in SiGe BiCMOS	Bohn Christian
Tu3B-3	A 50 Gbps 49 mW CMOS Analog Multiplexer for a DAC Bandwidth Tripler	Kawahara Keisuke
Tu3D-1	Wireless Power Transfer Sensing Approach for Milk Adulteration Detection Using Supervised Learning	Vallejo-Montoya Natalia
We1A-2	Influence of Self-Interference in a Radar System for a Correlation Based True-Speed-Over-Ground Estimation Approach	Reissland Torsten
We2A-2	SMCW Radar for Low IF Sensing Applications	Rodriguez Daniel
We2B-3	High-Fidelity Simulation of a Pico Satellite Link	Werner Lennart
We3A-1	A Light Weight 3x3 Switched Polarity URA Antenna and Receive System for Direction Finding	Depold Andreas

RWS Session Mo4B

NOVEL WIRELESS SYSTEM CONCEPTS

Chair: Fabian Lurz, *Hamburg University of Technology*

Co-Chair: Changzhi Li, *Texas Tech University*

Room: Pompeian II

SIRF Session Mo4C

RF AND MILLIMETER-WAVE SIGNAL GENERATION

Chair: Vadim Issakov, *Technische University Braunschweig*

Co-Chair: Youngho Suh, *Massachusetts Institute of Technology, Lincoln Laboratory*

Room: Pompeian III

PAWR Session Mo4D

DPD TECHNIQUES

Chair: Pere Gilabert, *University Politècnica de Catalunya*

Co-Chair: Patrick Roblin, *Ohio State University*

Room: Pompeian IV

3:40 PM

Mo4B-1

Design of Angle Change Sensor Using Radar Technology

Author: Chia Chan-Chang, National Chung Cheng University

Speaker: Chia Chan-Chang, National Chung Cheng University

Mo4C-1

THz Technology: Challenges for Silicon

Author: Imran Mehdi, NASA's Jet Propulsion Lab

Speaker: Invited Speaker

Mo4D-1

Linearity and Efficiency Enhancement Techniques for Satellite Communications

Authors: Tomas Gotthans, Brno University of Technology; Roman Marsalek, Brno University of Technology; Jan Kral, Brno University of Technology; Tomas Urbanec, Brno University of Technology

Speaker: Tomas Gotthans, Brno University of Technology

4:00 PM

Mo4D-2

Preconditioning the Regression of Power Amplifier Behavioral Models and Digital Predistorters

Authors: Juan Becerra, Universidad de Sevilla; Maria J. Madero-Ayora, Universidad de Sevilla; Elías Marqués-Valderrama, Universidad de Sevilla; Miguel Nogales, Universidad de Sevilla; Carlos Crespo-Cadenas, Universidad de Sevilla

Speaker: Juan Becerra, Universidad de Sevilla

4:20 PM

Mo4B-2

High-Resolution Direction-of-Arrival Estimation using Distributed Radar Sensors

Authors: Jonas Fuchs, Friedrich-Alexander University, Erlangen Nürnberg; Alexander Kasper, Friedrich-Alexander University, Erlangen Nürnberg; Maximilian Lübke, Friedrich-Alexander University, Erlangen Nürnberg; Anand Dubey, Friedrich-Alexander University, Erlangen Nürnberg; Fabian Lurz, Hamburg University of Technology

Speaker: Jonas Fuchs, Friedrich-Alexander University

Mo4C-2

A 60-GHz Super-Regenerative Oscillator with 80 dB Gain in SiGe BiCMOS for FMCW Radar Active Reflectors

Authors: Hatem Ghaleb, Technische University Dresden; Niko Joram, Technische University Dresden; Frank Ellinger, Technische University Dresden

Speaker: Hatem Ghaleb, Technische University Dresden

Mo4D-3

A Descent-Based Estimator for Digital Predistortion (DPD) using Eigenvalue-derived Step Sizes

Author: Richard Braithwaite, Keysight Technologies

Speaker: Richard Braithwaite, Keysight Technologies

4:40 PM

Mo4B-3

A Novel Microwave Architecture for Passive Sensing Applications

Authors: Davi V. Q. Rodrigues, Texas Tech University; Dongyang Tang, Texas Tech University; Changzhi Li, Texas Tech University

Speaker: Davi V. Q. Rodrigues, Texas Tech University

Mo4C-3

A Millimeter-Wave Ultra-Wideband Polyphase Frequency Doubler With 88% FBW and Inherent Harmonic Cancellation in 22nm FDSOI

Authors: Ahmed Elmenshawi, Rensselaer Polytechnic Institute; Muhammad Waleed Mansha, Rensselaer Polytechnic Institute; Sriram Muralidharan, Analog Devices, Inc.; Mona Hella, Rensselaer Polytechnic Institute

Speaker: Ahmed Elmenshawi, Rensselaer Polytechnic Institute

Mo4D-4

Acceleration of Digital Pre-Distortion Training Using Selective Partitioning

Authors: Meabh Loughman, University College Dublin; Declan Byrne, Maynooth University; Ronan Farrell, Maynooth University; John Dooley, Maynooth University

Speaker: Meabh Loughman, University College Dublin

5:00 PM

Mo4B-4

Hardware-Software Co-Design of Sub-6 GHz Transceiver for Reconfigurable Prototyping

Authors: Sanghoon Lee, Massachusetts Institute of Technology, Lincoln Laboratory; Kenneth Kolodziej, MIT Lincoln Laboratory

Speaker: Kenneth Kolodziej, MIT Lincoln Laboratory

Mo4C-4

Wideband, Compact and Efficient Frequency Quadrupler for Sub-Harmonic Transceiver in 130 nm SiGe BiCMOS Technology

Authors: Raqibul Hasan, IHP GmbH; Mohamed H. Eissa, IHP GmbH; Maciej Kucharski, IHP GmbH; Dietmar Kissinger, Ulm University; Herman Ng, Karlsruhe University of Applied Sciences

Speaker: Raqibul Hasan, IHP GmbH

Mo4D-5

Gate Diode Current Sensing for Device Temperature Estimation in GaN RF Power Amplifiers

Authors: Gautam Jindal, University of Bristol; Gavin Watkins, Toshiba Corp.; Kevin Morris, University of Bristol; Tommaso Cappello, University of Bristol

Speaker: Gautam Jindal, University of Bristol

Tuesday, 18 January 2022

RWS Session Tu1A

EMERGING WIRELESS TECHNOLOGIES & MEASUREMENT TECHNIQUES

Chair: Ifana Mahbub, *University of North Texas*

Co-Chair: Changzhan Gu, *Shanghai Jiao Tong University*

Room: Pompeian I

RWS Session Tu1B

FOCUS/SPECIAL SESSION - mMIMO BEAMFORMING FOR 5G AND BEYOND IN INDUSTRY

Chair: Youngho Suh, *Massachusetts Institute of Technology, Lincoln Laboratory*

Room: Pompeian II

SIRF Session Tu1C

WIRELINE COMMUNICATION CIRCUITS AND SILICON-PHOTONICS INTEGRATED CIRCUITS

Chair: Kenneth Kolodziej, *Massachusetts Institute of Technology, Lincoln Laboratory*

Co-Chair: Valim Issakov, *Technische University Braunschweig*

Room: Pompeian III

8:00 AM

Tu1A-1

Calibrated and Frequency Traceable D-Band FMCW Radar for VNA-like S-Parameter Measurements

Authors: Timo Jaeschke, 2p, Labs GmbH; Simon Kueppers, 2p, Labs GmbH; Nils Pohl, Ruhr University Bochum; Jan Barowski, Ruhr University Bochum

Speaker: Timo Jaeschke, 2p, Labs GmbH

Tu1B-1

Comparison of Co-located and Distributed MIMO for Indoor Wireless Communication

Authors: Christian Fager, Chalmers University of Technology; Simon Rimborg, Chalmers University of Technology; Emma Rådahl, Chalmers Tekniska Högskola; Husileng Bao, Chalmers University of Technology; Thomas Eriksson, Chalmers University of Technology

Speaker: Christian Fager, Chalmers University of Technology

Tu1C-1

Silicon Photonics for Optical Phased Arrays & Optical Signal Processing

Author: Hossein Hashemi, University of Southern California

Speaker: Keynote Speaker

8:20 AM

Tu1A-2

Correlation Technologies for OTA Testing of Mobile Devices: Power-Density Measurement

Author: Sidina Wane, EV Technologies

Speaker: Sidina Wane, EV Technologies

Tu1B-2

Distributed FD-MIMO (D-FD-MIMO): from Concept to Field Test

Authors: Jin Yuan, Samsung Research America; Yu Liu, Samsung Research America; Yeqing Hu, Samsung Research America; Gary Xu, Samsung Research America; Jianzhong Zhang, Samsung Research America

Speaker: Jin Yuan, Samsung Research America

8:40 AM

Tu1A-3

28 GHz RF front – End Module Packageusing Photosensitive Glass

Authors: Hyun-Je Chang, Korea Electronics Technology Institute; Ik-Jong Bae, Korea Electronics Technology Institute; Ju-Yong Lee, Korea Electronics Technology Institute; Jong-Gwan Yook, Korea University; Jong-Min Yook, Korea Electronics Technology Institute

Speaker: Hyun-Je Chang, Korea Electronics Technology Institute

Tu1B-3

Recent Studies on Massive MIMO Technologies for 5G Evolution and 6G

Authors: Satoshi Suyama, NTT DoCoMo, Inc.; Tatsuki Okuyama, NTT DoCoMo, Inc.; Nobuhide Nonaka, NTT DoCoMo, Inc.; Takahiro Asai, NTT DoCoMo, Inc.

Speaker: Satoshi Suyama, NTT DoCoMo, Inc.

Tu1C-2

A 45RFSOI DC to 32 GHz Bandwidth Inductorless Low Power Amplifier

Author: Ghita Yaakoubi Khbiza, CEA-LETI; Baudouin Martineau, CEA-LETI; Jose Luis Gonzalez-Jimenez, University Grenoble Alpes CEA-LETI; Benjamin Blampey, CEA

Speaker: Ghita Yaakoubi Khbiza, CEA-LETI

9:00 AM

Tu1A-4

Ultra-Compact K-band Microwave Terminations

Authors: Vincent Laur, Lab-STICC; Azar Maalouf, Lab-STICC; Alexis Chevalier, Lab-STICC; Paul Laurent, Lab-STICC; Gautier Zinkiewicz, Lab-STICC

Speaker: Vincent Laur, Lab-STICC

Tu1C-3

A 30 GHz 4.2 mW 105 fsec Jitter Sub-Sampling PLL with 1deg Phase Shift Resolution in 65 nm CMOS

Author: Itamar Melamed, Technion - Israel Institute of Technology; Emanuel Cohen, Technion - Israel Institute of Technology

Speaker: Itamar Melamed, Technion - Israel Institute of Technology

9:20 AM

Tu1A-5

Silicon Integrated Broadband Dual Frequency Comb-based Microwave Detector for Material Characterization

Authors: Elif Kaya, Texas A&M University; Kamran Entesari, Texas A&M University

Speaker: Elif Kaya, Texas A&M University

9:20 AM

Tu1C-4

An 80-Gbps Distributed Driver with Two-Tap Feedforward Equalization in 45-nm CMOS SOI

Author: Luis Valenzuela, University of California, Santa Barbara; James Dalton, University of California, Santa Barbara; Aaron Maharry, University of California, Santa Barbara; Ghazal Movaghar, University of California, Santa Barbara; Hector Andrade, University of California, Santa Barbara; Clint Schow, University of California, Santa Barbara; James Buckwalter, University of California, Santa Barbara

Speaker: Luis Valenzuela, University of California, Santa Barbara

Joint RWW/ARFTG Plenary Session

10:10 AM – 12:00 PM

Artificial Intelligence and Machine Learning for the Era of Hyperconnected IoT Devices

We are at the cusp of an Era of Hyperconnectivity and Hyperscale Computing, fueled by billions of devices in the Internet of Things (IoT) and its industrial sibling, the Industrial IoT (IIOT). Ericsson predicts that data traffic through commercial networks grows to 164 exabytes per month in 2025. Video already accounted for 63% of the traffic of 2019's 33 exabytes per month and will become 76% of the estimated 164 exabytes per month in 2025. At that time, 5G adoption could reach 2.8 billion subscriptions, and 5G population coverage is forecast at 55%. Seagate and IDC predict storage in the "global datasphere" to grow to 175 zettabytes by 2025, up from 45 zettabytes in 2019.

This presentation will discuss requirements for designing systems on chips (SoCs) and systems enabling the era of Hyperconnectivity. Specifically, we will and introduce solutions that the Electronic Design Automation (EDA) industry provides today for Artificial intelligence (AI) and machine learning (ML), as well as trends to address future challenges. In addition, we will also discuss how AI/ML technologies increase development productivity and optimize EDA design processes.

Specifically, we will discuss enabling processor and design IP and high-level synthesis to enable optimized circuitry for AI/ML algorithms. Furthermore, we will introduce the requirements for optimized AI/ML designs and specific verification tools for this design category. Advanced node and low power implementation are vital to linking verification to SoC implementation, and we will discuss particular optimizations and 3DIC and Chiplet based integration and analysis. To utilize AI/ML for EDA, we will introduce trends and experiences using AI/ML for formal verification, simulation, and implementation.

Frank Schirrmeister is senior group director, solutions & ecosystem at Cadence. He leads a team translating customer challenges in the hyperscale, communications, consumer, automotive, aerospace/defense, industrial, and healthcare vertical domains into specific requirements and solutions. In addition, his team focuses on cross-product technical solutions such as 5G, artificial intelligence, machine learning, safety, security, digital twins, and partner collaborations. Frank holds a Dipl.-Ing. in electrical engineering from the Technical University of Berlin, Germany. Before joining Cadence, Frank held senior engineering and product management positions in embedded software, semiconductor, and system development, both in Europe and the United States.

6G: Is it really DC to Daylight?

By the time of this ARFTG event, the primary group driving 5G standardization will have finished the scoping of the 2nd update (Rel-18) to the implementable 5G standard. 5G brought new capabilities to commercial radio systems placing new demands on RF measurement. These include things like "massive MIMO": active transceiver-chain and antenna systems that adapt to user need, physical location and movement, and user-density; taking new radio bands mainstream—everything from 3-7GHz to 28-52. These drove the need for complex measurements of active systems, wide bandwidths with complex modulation, and so much integration that over-the-air is the only feasible (and indeed the only standardized) technique to make some measurements. But even though most Rel-16 capabilities are not yet in production networks, the industry is in active dialogue and research on the sixth generation. 6G presentations are full of glorious descriptions of how wireless will improve society. While this all may be true, we technologists have plenty of work to do to ensure the system works. Like 5G, realizing 6G will take far more than simply adding new frequency bands and increasing the related bandwidths. This talk will cover an overview of the 6G vision and then dive into a few examples of how this vision will impact RF, microwave, and millimeter-wave systems and the associated challenges of measurements. Some of these are obvious (but difficult) next steps, like radio information bandwidths of at least 15 GHz, and some are not-so-obvious like AI-driven real-time determination of waveform and modulation schemes. I will attempt to cover examples that span DC-to-Daylight issues and show that analogy as closer to reality than what we have seen before.

Roger Nichols' 37 years of engineering and management experience in wireless test and measurement at Hewlett-Packard, Agilent Technologies, and Keysight spans roles in marketing, manufacturing, and R&D. He has managed projects, programs, and departments beginning with analog cellular radio, evolving to 6G, and on every standard in between. He has been directing Keysight's 5G program since 2014, and Keysight's 6G program since 2019. He is also the director of Keysight's work in wireless standards.

Roger holds a BSEE from the University of Colorado, Boulder.

SIRF Session Tu2C

RF AND MILLIMETER-WAVE COMPONENTS

Chair: Mehmet Kaynak, ***Innovations for High Performance Microelectronics***

Co-Chair: Roee Ben-Yishay, ***ON Semiconductor***

Room: Pompeian III

1:30 PM

Tu2C-1

Antenna-in-Package (AiP) Solutions and 3D Integrated Antennas for mmWave and THz Wireless Applications

Author: Ivan Ndip, Fraunhofer-Gesellschaft

Speaker: Invited Speaker

2:10 PM

Tu2C-2

A ×3 Sub-Sampling Mixer for a 77 GHz Automotive Radar Receiver in 28 nm FD-SOI CMOS Technology

Authors: Alexandre Flete, LAAS-CNRS; Christophe Viallon, LAAS-CNRS, Université de Toulouse, CNRS, UT3; Philippe Cathelin, STMicroelectronics; Thierry Parra, LAAS-CNRS, Université de Toulouse, CNRS, UT3

Speaker: Alexandre Flete, LAAS-CNRS

2:30 PM

Tu2C-3

A 48-55 dB Full-Band Image Rejection RF Down-Converter IC with Automatic I/Q Self-Test Calibration for LEO Satellite Communications

Authors: Chien-Chia Ma, National Yang Ming Chiao Tung University; Kuan-Yu Hsu, AMICCOM Electronics Corporation., Ltd.; Chun-Yuan Huang, AMICCOM Electronics Corporation., Ltd.; Chien-Nan Kuo, National Yang Ming Chiao Tung University

Speaker: Chien-Chia Ma, National Yang Ming Chiao Tung University

2:50 PM

Tu2C-4

Ultra-Wideband Frequency Doubler with Differential Outputs in SiGe BiCMOS

Authors: Christian Bohn, Karlsruhe Institute of Technology; Mehmet Kaynak, IHP GmbH; Thomas Zwick, Karlsruhe Institute of Technology; Cagri Ulusoy, Karlsruhe Institute of Technology

Speaker: Christian Bohn, Karlsruhe Institute of Technology

RWW Technical Lecture

Room: Virtual

1:30 – 3:10 PM

Mobile Broadband Connectivity in 6G: What Needs to be Improved?

Lecturer: Prof. Emil Björnson, ***Linköping University, Sweden***

Abstract:
The world is becoming increasingly digitalized and connected, and mobile broadband connectivity is the backbone of this development. The demand for capacity and expectations on service quality is constantly increasing, which calls for continuous technological evolution. The wireless technology is developed in cycles; a new generation is developed during each decade and then deployed during the next decade. The roll-out of 5G networks is happening as we speak; however, the research community has already shifted focus towards 6G, the sixth generation of mobile network technology. There is an abundance of visions and exciting new technologies being proposed, much more than can possibly make it into 6G. So what is most likely to happen?

In this short course, we will take a look at the wireless evolution and focus on mobile broadband applications, where the service quality is characterized by the data speed and traffic capacity. How is it improved in 5G? How much faster must wireless technology become and what are the most important bottlenecks? We will discuss which factors determine the data speed and how those factors might be improved in the future, including which new innovative solutions are on the drawing table. Lessons from the past will be combined with visions for the future, to determine what problems 6G must address and what the viable solutions are. The course will cover different multiplexing methods, multiple antenna technology, and the implications of using different frequency bands.

Session Tu2E

JOINT RWW INTERACTIVE FORUM PAPERS

Chair: Rashaunda Henderson, ***University of Texas at Dallas***

Co-Chair: Ifana Mahbub, ***University of North Texas***

Room: Roman Ballroom

1:30 – 3:10 PM

Tu2E-1

Short-Range Full-Duplex Real-Time Wireless Link for IEEE

Authors: Dominik Wrana, Institute of Robust Power Semiconductor Systems; Yigal Leiba, SIKLU Communications Ltd; Laurenz John, Fraunhofer Institute for Applied Solid State Physics; Benjamin Schoch, Institute of Robust Power Semiconductor Systems; Axel Tessmann, Fraunhofer Institute for Applied Solid State Physics; Ingmar Kallfass, Institute of Robust Power Semiconductor Systems

Tu2E-2

A 97-GHz-Band High-Gain 8 x 8 Waveguide Slot Array Antenna

Authors: Zeng-Pei Zhong,Shenzhen University; Jin Li, Shenzhen University; Zhihong Xu, Shenzhen University; Shuai Deng, Shenzhen University; Tao Yuan, Shenzhen University

Tu2E-3

A V-band Doppler Radar Sensor for Biomotion detection

Authors: Marcel Balle, Zhejiang University; Chengkai Zhu, Zhejiang University; Bin Zhang, Zhejiang University; Lixin Ran, Zhejiang University

Tu2E-4

Linearity Optimisation for Multi-Bit Parallel Digital Power Amplifier

Authors: Jiteng Ma, University of Bristol; Manish Nair, University of Bristol; Gavin Watkins, Toshiba Corporation; Kevin Morris, University of Bristol; Mark Beach, University of Bristol

Tu2E-5

Noninverting Single-Spiral Power Divider and Its QC and Balun

Authors: Bo-Shun Chen, National Chi Nan University; Yo-Sheng Lin, National Chi Nan University; Chung-Ta Huang, National Chi Nan University

Tu2E-8

A 295-337 GHz 2.5 dBm Psat Cascode-Based Frequency Doubler in SiGe BiCMOS Technology

Authors: Sascha Breun, University of Erlangen-Nuremberg; Albert-Marcel Schrotz, University of Erlangen-Nuremberg; Marco Dietz, University of Erlangen-Nuremberg; Vadim Issakov, Technische Universität Braunschweig; Robert Weigel, University of Erlangen-Nuremberg

Tu2E-9

Push-Push VCO with PN- and Pout-Enhanced Off-State Parallel FETs

Authors: Yo-Sheng Lin, National Chi Nan University; Chung-Ta Huang, National Chi Nan University; Jin-Fa Chang, Feng Chia University; Yu-Ching Lin, National Chi Nan University

Tu2E-10

A High-Sensitivity Magnetic-Field Resonant Probe Based on Embedded Stripline Structure

Authors: Yifan Lu, Shanghai Jiao Tong University; Li Wen, Shanghai Jiao Tong University; Changzhan Gu, Shanghai Jiao Tong University; Lin-sheng Wu, Shanghai Jiao Tong University; Jun-fa Mao, Shanghai Jiao Tong University

Tu2E-11

Period Doubling and Subharmonic Generation in PIN Diode Control Circuits

Author: Robert Caverly, Villanova University

Tu2E-12

Carrier Aggregation Transmitter Linearization using 2D-DPD and Out-of-Band IM3 Cancellation Signal Injection

Authors: Nimrod Ginzberg, Technion - Israel Institute of Technology; Tomer Gidoni, Tel-Aviv University; Emanuel Cohen, Technion - Israel Institute of Technology

Tu2E-13

A 220-325 GHz Subharmonic Receiver with 14.8 dB Peak Conversion Gain for FMCW Radar in SiGe BiCMOS Technology

Authors: Albert-Marcel Schrotz, University of Erlangen-Nuremberg; Sascha Breun, University of Erlangen-Nuremberg; Vadim Issakov, Technische Universität Braunschweig; Marco Dietz, University of Erlangen-Nuremberg; Robert Weigel, University of Erlangen-Nuremberg

Tu2E-14

A Modular 1D-CNN Architecture for Real-time Digital Pre-distortion

Authors: Udara De Silva, Mitsubishi Electric Research Labs; Rui Ma, Mitsubishi Electric Research Labs; Toshiaki Koike-Akino, Mitsubishi Electric Research Labs; Ao Yamashita, Mitsubishi Electric Corporation; Hideyuki Nakamizo, Mitsubishi Electric Corporation

Tu2E-15

AM-PM Characterization of Wideband Power Amplifiers

Authors: Anna Piacibello, Politecnico di Torino; Jorge Julian Moreno Rubio, Universidad Pedagogica y Tecnologica de Colombia; Roberto Quaglia, Cardiff University; Vittorio Camarchia, Politecnico di Torino

Tu2E-18

Separation of Simultaneous Multi-Person Noncontact Physical Activity Signals Using Frequency-Modulated Continuous-Wave Radars

Authors: Victor Gabriel R. Varela, Texas Tech University; Davi V. Q. Rodrigues, Texas Tech University; Changzhi Li, Texas Tech University

Tu2E-19

BiCMOS IQ Transceiver with Array-on-Chip for D-Band Joint Radar-Communication Applications

Authors: Wael A. Ahmad, IHP Microelectronics; Maciej Kucharski, IHP GmbH; Herman J. Ng, Karlsruhe University of Applied Sciences; Dietmar Kissinger, Ulm University

Tu2E-20

A 197 FoMT VCO with 34% Tuning Range for 5G Applications in 45nm SOI Technology

Authors: Yahia Z. Ibrahim, Cairo University; Mohamed A. Abdalla, Cairo University, EECE department; Ahmed N. Mohieldin, Faculty of Engineering, Galala University

Tu2E-21

A W-Band SiGe-HBT Colpitts VCO for Millimeter-Wave Applications with an Analog Tuning Range of 12%

Authors: Eren Vardarli, Technische Universitaet Dresden; Markus Müller, Technische Universitaet Dresden; Michael Schröter, Technische Universitaet Dresden

Tu2E-22

Low Leakage RF Coaxial Connectors and Board-to-Board Connectors with Radiation Emission Control

Authors: Yu-Jiun Ren, General Microwave Technologies, Chih-Kang Sun, Electric Connector Technology, Robert Litzlbeck, Electric Connector Technology

Tuesday, 18 January 2022

RWS Session Tu3A

ANTENNA AND ARRAY TECHNOLOGIES FOR WIRELESS SYSTEMS

Chair: Nuno Carvalho, *Instituto De Telecomunicacoes*

Co-Chair: Rashaunda Henderson, *University of Texas at Dallas*

Room: Pompeian I

RWS Session Tu3B

HIGH-SPEED AND HIGH-CAPACITY WIRELESS TECHNOLOGIES

Chair: Jennifer Kitchen, *Arizona State University*

Co-Chair: Negra Renato, *RWTH Aachen University*

Room: Pompeian II

SIRF Session Tu3C

PASSIVE COMPONENTS IN INTEGRATED CIRCUITS

Chair: Austin Chen, *Peraso Technologies*

Co-Chair: Mehmet Kaynak, *Innovations for High Performance Microelectronics*

Room: Pompeian III

RWS Session Tu3D

WIRELESS TECHNOLOGY FOR IoT, RADAR, AND HEALTHCARE

Chair: Markus Gardill, *Universität Würzburg*

Co-Chair: Changzhi Li, *Texas Tech University*

Room: Pompeian IV

3:40 PM

Tu3A-1

Novel Beam Control Technology for Practical Applications of Far-Field Wireless Power Transfer

Author: Naoki Shinohara, Kyoto University

Speaker: Naoki Shinohara, Kyoto University

Tu3B-1

Digital Predistortion for 5G MIMO Transmitters Using Machine Learning

Author: Anding Zhu-University College Dublin

Speaker: Anding Zhu-University College Dublin

Tu3C-1

Epitaxial AlScN Thin Films for Acoustic Filter Applications

Author: Azadeh Ansari, Georgia Institute of Technology

Speaker: Invited Speaker

Tu3D-1

Wireless Power Transfer Sensing Approach for Milk Adulteration Detection Using Supervised Learning

Authors: Natalia Vallejo-Montoya, Texas Tech University; Daniel Rodriguez, Texas Tech University; Changzhi Li, Texas Tech University

Speaker: Natalia Vallejo-Montoya, Texas Tech University

4:00 PM

Tu3D-2

Continuous Blood Pressure Estimation Using Millimeter Wave Radar

Authors: Ryota Kawasaki, University of Kitakyushu; Akihiro Kajiwara, University of Kitakyushu

Speaker: Ryota Kawasaki, University of Kitakyushu

4:20 PM

Tu3A-2

Design and Simulation of UWB Phased Array Antenna For Wireless Power Transfer to Micro Aerial Vehicle (MAV) Through Beam Steering

Authors: Adnan Patwary, University of North Texas; Ifana Mahbub, University of North Texas

Speaker: Adnan Patwary, University of North Texas

Tu3B-2

Fourier-Domain DAC-based Hybrid Transmitter for Wireless Communication in 28 GHz 5G bands

Authors: Oner Hanay-RWTH Aachen University; Erkan Bayram-RWTH Aachen University; Danie Stracke-RWTH Aachen University; Patrick Döll-RWTH Aachen University; Renato Negra-RWTH Aachen University

Speaker: Oner Hanay-RWTH Aachen University

Tu3C-2

Empirical Study on the Applicability of Two-Port Deembedding Techniques for Characterization of Four-Port Asymmetric Devices

Authors: Martin Maier, Technische University Braunschweig; Maciej Wojnowski, Infineon Technologies AG; Vadim Issakov, Technische University Braunschweig

Speaker: Martin Maier, Technische University Braunschweig

Tu3D-3

A Scalable Matching Mechanism for Online Heterogeneous Positioning Fusion System

Authors: Chung-Yuan Chen, National Taiwan University; Ruey-Beei Wu, National Taiwan University

Speaker: Chung-Yuan Chen, National Taiwan University

4:40 PM

Tu3A-3

A Hybrid Algorithm for Sparse Antenna Array Optimization of MIMO Radar

Authors: Chen Feng, Nanjing University of Science and Technology; Haojian Ye, Nanjing University of Science and Technology; Hong Hong, Nanjing University of Science and Technology; E Wang, Xiangya Hospital Central South University; Xiaohua Zhu, Nanjing University of Science and Technology

Speaker: Chen Feng, Nanjing University of Science and Technology

Tu3B-3

A 50 Gbps 49 mW CMOS Analog Multiplexer for a DAC Bandwidth Tripler

Authors: Keisuke Kawahara, Tokyo University of Science; Joe Sawada, Tokyo University of Science; Takumi Kamo, Tokyo University of Science; Yohtaro Umeda, Tokyo University of Science; Kyoya Takano, Tokyo University of Science

Speaker: Keisuke Kawahara, Tokyo University of Science

Tu3C-3

A V-Band Nine-State CMOS-MEMS Phase Shifter MMIC

Authors: Yi-Chen Liu, National Chung Cheng University; Meng-Hsuan Lin, National Chung Cheng University; Chia-Chan Chang, National Chung Cheng University

Speaker: Chia-Chan Chang, National Chung Cheng University

Tu3D-4

Simulation of FMCW and M-Sequence Ground Penetrating Radar Systems

Authors: Jonathan Platt, University of Alabama; Yang-Ki Hong, University of Alabama; Hoyun Won, University of Alabama; Olakunle Olaniyan, University of Alabama; Minyeong Choi, University of Alabama; Joohan Lee, Korea Polar Research Institute

Speaker: Hoyun Won, University of Alabama

Tuesday, 18 January 2022

5:00 PM

Tu3A-4

Triple-Band (Dedicated Short-Range Communication, 5G, 6G) Antenna for Vehicle Telematics

Authors: Briana Bryant, University of Alabama; Yang-Ki Hong, University of Alabama; Hoyun Won, University of Alabama

Speaker: Hoyun Won, University of Alabama

Tu3B-4

A 60 GHz-band S/H CMOS IC for Direct RF Undersampling Receiver

Authors: Tomoyuki Furuichi, Tohoku University; Nagahiro Yoshino, Tohoku University; Mizuki Motoyoshi, Tohoku University; Suguru Kameda, Tohoku University; Noriharu Suematsu, Tohoku University

Speaker: Tomoyuki Furuichi, Tohoku University

Tu3C-4

Spiral-TL-Based Compact Ka-Band SPDT Switch and Power Divider

Authors: Yo-Sheng Lin, National Chi Nan University; Chung-Ta Huang, National Chi Nan University; Bo-Shun Chen, National Chi Nan University; Jin-Fa Chang, Feng Chia University

Speaker: Yo-Sheng Lin, National Chi Nan University

3:40 PM

DEMO TRACK PRESENTATIONS

TUESDAY 18 JANUARY 2022, 3:40 PM – 5:00 PM

EXHIBITION HALL

Chair: Mario Pauli, Karlsruhe Institute of Technology

Guest Speakers:

Radar-based Gesture Control for Playing Tetris
T. Stadelmayer, University of Erlangen-Nuremberg, C. Will, Infineon Technologies AG

A Far-field Wireless Power Transfer System for Micro Areal Vehicles (MAVs) Using Pulse Based Ultrawideband Signal and Electro-mechanical Beam Steering
A. B. Patwary, R. Mahin, O. Madera and I. Mahbub, University of North Texas, Denton

D-Band FMCW Radar for VNA-like S-Parameter and Material Measurements
T. Jaeschke, S. Kueppers, 2pi LABS GmbH , N. Pohl, J. Barowski, Ruhr-University Bochum

1:30PM - 4:00PM

YOUNG PROFESSIONALS PROGRAM

APPLICATIONS OF ARTIFICIAL INTELLIGENCE/MACHINE LEARNING IN RF, MICROWAVE AND SIGNAL PROCESSING

Moderator/Organizer: Pushkar Kulkarni, Qualcomm

Advancements in algorithms and technology are driving use of artificial intelligence (AI)/machine learning (ML) in abundance in practical applications. At Radio Wireless Week (RWW) 2022 however, we will be focusing on how AI/ML techniques are becoming increasingly popular in RF/Microwave System Design and Signal Processing. Recognized experts from both academia and industry have been invited to present fresh ideas and new concepts to the curious minds. Mark your calendar, tell your friends, and join the YP session to learn about these emerging, exciting topics and opportunities that lie ahead.

Guest Speakers:

A Signal Processing Perspective on Modern Machine Learning and Neural networks
Prof. Mert Pilanci, Stanford University

Intelligent RF System Design using Artificial Intelligence
Rick Gentile, Mathworks

High Fidelity Physics Simulation-Based Convolutional Neural Network for Automotive Radar Target Classification Using Micro-Doppler
Dr. Ushemadzoro Chipengo, Ansys

Machine Learning for Wireless Communications
Dr. Taesang Yoo, Qualcomm

3:30PM - 4:00PM

LIVE Q/A SESSION

Room: MicroApps Theatre

6:00 PM

MTT SPACE NIGHT

Moderator/Organizer: Markus Gardill, Maximilian Scardelletti

Room: Pompeian II

Join us for this premier event to launch the Space-Hardware and Radio Conference (SHaRC) 2022 within IEEE Radio Wireless Week! In a relaxed evening atmosphere accompanied by complimentary beverages, we would like to bring together the MTT-S space community and anyone who is interested to welcome you to SHaRC and introduce the formation of a society-wide IEEE future direction project on low-earth-orbit satellites. Two exciting keynote presentations will introduce you to next-generation developments in the field of satellite communications. Finally, the progress of the exciting MTT-Sat challenge will be presented and the Phase-III award winners will be selected. Looking forward to seeing you at MTT Space Night!

Guest Speakers:

Development and Ground Demonstration of a Satellite Communication Terminal for Future Space Missions
Marie Piasecki, NASA Glenn Research Center (GRC)

Enabling Integrated Circuit Technologies for Next Generation Satcom Internet Connectivity
Tumay Kanar, Senior Manager, mm-Wave IC Design, Renesas Electronics

Joint ARFTG – RWW 2022 Workshop

8:00 AM – 12:00 PM

Behavioral Modelling, Digital Predistortion (DPD) and Measurement Techniques for High-Frequency Power Devices and Amplifiers

Organizer: Roberto Quaglia, *Cardiff University, UK*, QuagliaR@cardiff.ac.uk

Co-Organizer: Patrick Roblin, *Ohio State University*, roblin.1@osu.edu

Abstract:

This workshop consists of a series of talks from prominent international research groups, providing a comprehensive overview of the latest advancements in the measurement, modeling and linearization techniques used for accurate device characterization and conditioning of complex transmitters.

These novel techniques focus on optimizing the resources needed for model extraction and signal conditioning, without compromising the accuracy of the models and correction algorithms, in order to minimize the costs (time, hardware, firmware) and achieve sustainable techniques to support high frequency systems of the next generations.

Title: Correcting nonlinear distortion of wideband modulated signals using new frequency domain methods

Speaker: Sam Kusano, Keysight, USA
osamu_kusano@keysight.com

Abstract:

This presentation will discuss important aspects of digital predistortion, and present new, state-of-the-art methods to evaluate and extract the quality of test signal generated at power levels where such signal generators are not useful due to their internal distortion. Distortion-less wideband modulated test signals are generated at high power using a new frequency domain method, called spectral digital pre-distortion (Spectral DPD). This technique extends the power range of signal generators, reducing the need for booster power amplifiers to achieve a good linearity, high-power signal for test. Attendees of the workshop will learn about a new technique first creates a short slice of the modulated waveform for fast and accurate linearization of the signal at the reference plane. Then, using a pre-distorted waveform created by spectral DPD, a generic memory-polynomial DPD model is identified. This model is then applied to the original waveform to generate a pre-distorted waveform, providing a linearized test signal. An example 5GNR test signal is demonstrated for linearization. In the workshop presentation, detailed procedure of the spectral DPD and measurement result will be discussed.

Title: Digital Predistortion of 5G Massive MIMO Wireless Transmitters Using OTA Data Acquisition

Speaker: Anding Zhu, University College Dublin, Ireland
anding.zhu@ieee.org

Abstract:

In this presentation, we will discuss digital predistortion (DPD) architectures for massive MIMO wireless transmitters using a real-time single-channel over-the-air (OTA) data acquisition loop. The proposed data acquisition strategy captures OTA signals from a fixed location and indirectly identifies the nonlinear behavior of power amplifiers (PAs) in the array, as well as their combined signals in the far-field direction. The DPD can therefore be effectively constructed without direct measurement at PA output or at user end. The proposed linearization solution can run in real-time and thus does not interfere with data transmission in the MIMO transmitters. It also can achieve robust performance when mutual coupling occurs between antenna elements. A novel low-dimensional feature-based model generation for multi-user MIMO transmitters using OTA data has also been introduced. By identifying the shared properties of different PAs among multiple RF chains, the DPD can be updated quickly and efficiently in response to the dynamic configurations in the transmitter, such as power level or beam angle changes. Simulation and experimental results demonstrate that the proposed DPD approach achieves excellent linearization performance with low complexity, making itself a promising linearization solution for 5G massive MIMO transmitters.

Title: Low complexity predistortion techniques for power amplifiers in multiple input multiple output transmitters

Speaker: Meenakshi Rawat, IIT Rookee, India
meenakshirawat_uofc@yahoo.ca

Abstract:

This talk discusses two aspects of predistortion techniques. First talk demonstrates the scheme for extending operating frequency range of a sub-6-GHz range transmitter with the help of frequency quadrupler using two cascaded frequency doubler to millimeter wave (mm-wave). Since the generated harmonics of the frequency doubler is applied to second doubler for mm-wave signal generation, this results in severe distortions and bandwidth expansion of the transmitted signal, which limits the use of such frequency up-conversion method. The signal quality at mmWave level is enhanced using predistortion technique. In addition, this talk describes amalgamation of adaptive dual-input RF predistorter and digital predistorter techniques as a solution to numerical stability problem in digital predistortion for high order MIMO transmitters. It is established with over-the-air-transmission measurement and simulations results that proposed solutions provides a practical low complexity solution for PA nonlinearity in high order MIMO systems.

Title: Digital predistortion for multiple-input, single output power amplifiers

Speaker: Pere Gilabert, Polytechnic University of Catalonia, Spain
plgilabert@tsc.upc.edu

Abstract:

Digital predistortion (DPD) can overcome, or at least mitigate, the efficiency versus linearity trade-off in power amplifiers (PAs). Alternative amplification topologies to the linear but power inefficient PAs operating as controlled current sources, have been widely proposed. For example, amplification architectures based on dynamic supply modulation (e.g., envelope tracking) or dynamic load modulation (e.g., Doherty PAs, outphasing PAs or load modulated balanced amplifiers) can boost power efficiency but at the price of presenting worse linear behavior. This talk will focus on the necessary digital baseband signal processing, including but not limited to linearization, to guarantee linearity specifications in high efficient amplification topologies based on dynamic load or dynamic supply strategies that include multiple-input, single output (MISO) power amplifiers. In this context, the necessity of MISO DPD linearizers to compensate for all the unwanted distortion effects that appear at the PA output will be also discussed.

Title: Latest Cardiff model developments

Speakers: Ehsan Azad, Paul Tasker, Cardiff University, UK
azadem@cardiff.ac.uk
tasker@cardiff.ac.uk

Abstract:

The generality requirement of advanced RF power amplifier designs, demands load-pull data under various variables such as frequency, input power, and DC bias voltage which can be very time-consuming. Therefore, it is critical to adopt a strategy to reduce the measurement intensity and in doing so, reduce measurement time. One approach to reducing the density of the required load-pull data is to use an accurate and reliable nonlinear behavioral model to interpolate the data. Cardiff University's Cardiff behavioral model is one of the industry-leading nonlinear behavioral models. Its polynomial mathematical formulation was initially developed around a limited operational domain about a large signal operating point, for example at a fixed DC bias level, RF input drive and frequency.To expand the generality of the Cardiff model, variables such as frequency and input drive level have been previously included in the model's formulation. The focus of this workshop is on the recent development of the Cardiff model's formulation to include the DC bias. The new DC-dependent Cardiff model's formulation is capable of accurately interpolate the load-pull data with respect to DC bias; hence, significantly reducing the density of load-pull data over a wide range of DC bias points.

Title: Digital and analog predistortion for energy-constrained terminals

Speakers: Roman Maršálek, Tomáš Götthans, VUT, Česká republika
Romanmarsaler@vut.cz

Abstract:

As the bandwidths of transmitted signals are continuously increasing, not only the adaptation of digital predistorter (DPD) becomes more computationally complex, but also the power dissipation of the feedback observation receiver represents more and more substantial portion of the overall transmitter energy. A variety of techniques have been proposed recently to reduce the computational burden of DPD adaptation algorithm, including several kinds of sample selection approaches, or methods employing the change of statistics as the signal propagates through the nonlinear device. This talk will provide an overview and practical examples of selected state-of-the-art techniques designed with aim to reduce the complexity of digital predistorter adaptation. Moreover, the digital predistortion will be compared to its continuous-time counterpart – the analog predistortion with digital parameter tuning.

WisNet Session We1A

ADVANCED RADAR SENSING TECHNOLOGIES I

Chair: Paolo Mezzanotte, *University of Perugia*

Co-Chair: Alessandra Costanzo, *University of Bologna*

Room: Pompeian I

SHaRC Session We1B

SHARC #1: MISSIONS, OPERATIONS, REGULATION, AND STANDARDIZATION

Chair: Jan Budroweit, *German Aerospace Center*

Co-Chair: Charlie Jackson, *Northrop Grumman Corp.*

Room: Pompeian II

RWW WORKSHOP ON SILICON TECHNOLOGIES FOR SATCOM

Organizer: Tumay Kanar, *Sr Manager, mm-wave IC Design at Renesas Electronics*

Room: ????

8:00 AM

We1A-1

Grid Mapping and Synthetic Aperture Radar Based on Millimeter-Wave MIMO Radar for Automotive and UAV-Borne Applications

Authors: Christian Waldschmidt, University of Ulm; Timo Grebner, University of Ulm

Speaker: Christian Waldschmidt, University of Ulm

We1B-1

Applying Radio Regulations to Ensure the Success of Your Small Satellite Mission

Author: Jorge Ciccorossi, International Technological University

Speaker: Jorge Ciccorossi, International Technological University

8:40 AM

We1A-2

Influence of Self-Interference in a Radar System for a Correlation Based True-Speed-Over-Ground Estimation Approach

Authors: Torsten Reissland, University of Erlangen-Nuremberg; Fabian Michler, Friedrich-Alexander University Erlangen Nürnberg; Robert Weigel, University of Erlangen-Nuremberg; Alexander Koelpin, Hamburg University of Technology; Fabian Lurz, Hamburg University of Technology

Speaker: Torsten Reissland, University of Erlangen-Nuremberg

We1B-2

In-Orbit Performance of the Narrowband Intersatellite Mission S-NET

Authors: Zizung Yoon, Technische Universität Berlin; Walter Frese, Technische Universität Berlin; Enrico Stoll, Technische Universität Berlin

Speaker: Zizung Yoon, Technische Universität Berlin

9:00 AM

We1A-3

Signal Processing for Low-Power and Low-Cost Radar Systems in Bicycle Safety Applications

Authors: Christian Dorn, University of Bayreuth; Thomas Kurin, Friedrich-Alexander University Erlangen Nürnberg; Stefan Erhardt, Friedrich-Alexander University Erlangen Nürnberg; Fabian Lurz, Hamburg University of Technology; Amelie Hagelauer, University of Bayreuth

Speaker: Christian Dorn, University of Bayreuth

We1B-3

The Frequency Allocations in Remote Sensing (FARS) Technical Committee of the IEEE Geoscience and Remote Sensing Society (GRSS) and its Activities

Author: Paolo de Matthaeis, IEEE-GRSS

Speaker: Paolo de Matthaeis, IEEE-GRSS

9:20 AM

We1A-4

RF-Tag-Referenced Structural Displacement Measurements With Multiple Moving Interferers

Authors: Davi V. Q. Rodrigues, Texas Tech University; Changzhi Li, Texas Tech University

Speaker: Davi V. Q. Rodrigues, Texas Tech University

We1B-4

Development of an IEEE Standard to Assess Interference on Remote Sensing Frequency Bands

Author: Roger Oliva, IEEE; Paolo de Matthaeis, IEEE Geoscience and Remote Sensing Society; Ryo Natsuaki, Univeristy of Tokio

Speaker: Roger Oliva, IEEE

8:00 AM - 12:00 PM

Abstract:

The latest advancements in lower-earth-orbit (LEO) satellite constellation technology demonstrates a promising path for a high speed and low latency connectivity across the globe. Long-term success of these constellations heavily depends on large scale commercial availability of ground terminals. Average cost of a conventional phased array panel will need to scale down by a few orders of magnitude and it will require a completely new approach on system implementation. This target can only be achieved by much higher integration both at the system and RF front-end level. Silicon content in RF front-end will increase significantly and become a key enabler for highly integrated systems.

This workshop will outline the advanced practices and techniques on the system level and address the key integrated circuit technologies for silicon-based phased array RF front-ends by demonstrating how integration in silicon enables low-cost implementation for commercially available ground terminals for next generation satcom networks.

Enabling Integrated Circuit Technologies for Next Generation Satcom Internet Connectivity

Speaker: Dr. Tumay Kanar, Sr Manager, mm-wave IC Design at Renesas Electronics, USA

Benefits and challenges of using RF silicon for SATCOM applications

Speaker: Bill Agar, Design Manager, ViaSat, USA

Silicon technologies for delivering connectivity from space

Speaker: Alexandros Margomenos, Deputy Director, Globalfoundries, USA

45RFSOI RF transceivers in KU and KA bands for phased array applications in Satellite Coms

Speaker: Zoran Janosevic, RFIC Lead, Satixfy, UK

WisNet Session We2A

ADVANCED RADAR SENSING TECHNOLOGIES II

Chair: Alexander Koelpin, *Technische Universität Hamburg*

Co-Chair: Emmanouil Tentzeris, *Georgia Institute of Technology*

Room: Pompeian I

SHaRC Session We2B

SHARC #2: SYSTEMS, HARDWARE, AND ELECTRONICS FOR SPACE

Chair: Markus Gardill, *Brandenburg University of Technology Cottbus-Senftenberg*

Co-Chair: Maximilian Scardelletti, *NASA Glenn Research Center*

Room: Pompeian II

10:10 AM

We2A-1

Digital Frequency Control Loop for Continuous-Wave and Stepped-Frequency Radars

Authors: Fabian Michler, Friedrich-Alexander University Erlangen Nürnberg; Marcel Neugebauer, Friedrich-Alexander University Erlangen Nürnberg; Benedict Scheiner, Friedrich-Alexander University Erlangen Nürnberg; Robert Weigel, Friedrich-Alexander University Erlangen Nürnberg; Fabian Lurz, Hamburg University of Technology

Speaker: Fabian Michler, Friedrich-Alexander University Erlangen Nürnberg

We2B-1

5G Learning to Fly! 5G Non-Terrestrial Networks Challenges

Author: Reiner Stuhlfauth, Rohde & Schwarz USA, Inc.

Speaker: Reiner Stuhlfauth, Rohde & Schwarz USA, Inc.

10:30 AM

We2A-2

SMCW Radar for Low IF Sensing Applications

Authors: Daniel Rodriguez, Texas Tech University; Natalia Vallejo-Montoya, Texas Tech University; Changzhi Li, Texas Tech University

Speaker: Daniel Rodriguez, Texas Tech University

We2B-2

Exomars 2022 X-Band Lander Radioscience Instrument LaRa

Author: Lieven Thomassen, Antwerp Space

Speaker: Lieven Thomassen, Antwerp Space

10:50 AM

We2A-3

Radar-Based Velocity Estimation Using Three-Dimensional Cross-Correlation

Authors: Martin Scherhäufl, Linz Center of Mechatronics GmbH; Kurt Pichler, Linz Center of Mechatronics GmbH; Georg Keintzel, Primetals Technologies Austria GmbH

Speaker: Martin Scherhäufl, Linz Center of Mechatronics GmbH

We2B-3

High-Fidelity Simulation of a Pico Satellite Link

Authors: Lennart Werner, Julius Maximilians Universitaet Wuerzburg; Cedric Liman, Julius Maximilians Universitaet Wuerzburg; Markus Gardill, Universität Würzburg

Speaker: Lennart Werner, Julius Maximilians Universitaet Wuerzburg

11:10 AM

We2A-4

Advantages of Utilizing Higher-order Response for a Harmonic Radar

Authors: Rita Abad Lima, Texas Tech University; Ashish Mishra, Texas Tech University; Changzhi Li, Texas Tech University

Speaker: Rita Abad Lima, Texas Tech University

We2B-4

Evaluation of a GNURadio-based Multi-Channel ADS-B Receiver Implemented on a Highly Integrated SDR Platform for Space Application

Authors: Felix Eichstaedt, German Aerospace Center; Jan Budroweit, German Aerospace Center

Speaker: Felix Eichstaedt, German Aerospace Center

11:30 AM

We2A-5

Quality of Service Based Radar Resource Management for Interference Mitigation

Authors: Sebastian Durst, Fraunhofer Institute for High Frequency Physics and Radar Techniques FHR; Pascal Marquardt, Fraunhofer Institute for High Frequency Physics and Radar Techniques FHR; Stefan Brüggenwirth, Fraunhofer Institute for High Frequency Physics and Radar Techniques FHR

Speaker: Sebastian Durst, Fraunhofer Institute for High Frequency Physics and Radar Techniques FHR

We2B-5

Ka/Q Dual Band Linearizer

Authors: Allen Katz, The College of New Jersey; Robert Gray, Linearizer Technology Inc.; Roger Dorval, Linearizer Technology Inc; Paul Drexler, Linearizer Technology Inc

Speaker: Allen Katz, The College of New Jersey

RWW WORKSHOP ON RECENT ADVANCES IN mmWAVE PHASED ARRAYS

Organizer: Dr. Gary Xu, *VP, Samsung Research America*

Room: Virtual

8:00 AM - 12:00 PM

Abstract:
The latest advancements in lower-earth-orbit (LEO) satellite constellation technology demonstrates a promising path for a high speed and low latency connectivity across the globe. Long-term success of these constellations heavily depends on large scale commercial availability of ground terminals. Average cost of a conventional phased array panel will need to scale down by a few orders of magnitude and it will require a completely new approach on system implementation. This target can only be achieved by much higher integration both at the system and RF front-end level. Silicon content in RF front-end will increase significantly and become a key enabler for highly integrated systems.

This workshop will outline the advanced practices and techniques on the system level and address the key integrated circuit technologies for silicon-based phased array RF front-ends by demonstrating how integration in silicon enables low-cost implementation for commercially available ground terminals for next generation satcom networks.

Enabling Successful mmWave 5G and SATCOM Deployments Through High-Performance Phased Arrays: From Power Amplifiers Through Packaging to Algorithms

Speaker: Dr. Harish Krishnaswamy, CTO, Mixcomm, USA

mmWave phased arrays and systems for 6G

Speaker: Dr. Gary Xu, VP, Samsung Research America, USA

SATCOM Ground Terminal Phased Arrays

Speaker: Dr. Saeed Khosrowbeygi, SMTS, Globalfoundries, USA

Challenges and Opportunities of Frontend Electronics in MmWave Phased Array

Speaker: Hua Wang, Professor, Dept of IT&EE, ETH Zurich, Switzerland

WisNet Session We3A

ADVANCED CIRCUITS AND SYSTEMS FOR WIRELESS SENSORS

Chair: Changzhi Li, *Texas Tech University*

Co-Chair: Thomas Ussmueller, *University of Erlangen-Nuremberg*

Room: Pompeian I

RWS Session We3B

ADVANCED PASSIVE COMPONENTS

Chair: Robert Caverly, *Villanova University*

Co-Chair: Dr. Timo Jaeschke, *2pi-Labs GmbH*

Room: Pompeian II

RWW TECHNICAL LECTURES

Room: Virtual

RWW TECHNICAL LECTURES

Room: Pompeian III

1:30 PM

We3A-1

A Light Weight 3x3 Switched Polarity URA Antenna and Receive System for Direction Finding

Authors: Andreas Depold, Friedrich-Alexander University Erlangen Nürnberg; Christian Dorn, University of Bayreuth; Stefan Erhardt, Friedrich-Alexander University Erlangen Nürnberg; Robert Weigel, Friedrich-Alexander University Erlangen Nürnberg; Fabian Lurz, Hamburg University of Technology

Speaker: Andreas Depold, Friedrich-Alexander University Erlangen Nürnberg

We3B-1

Two-Layered Microstrip Diplexer Based on High-Selectivity Wideband Bandpass Filters

Authors: Li Yang, University of Alcala; Roberto Gomez-Garcia, University of Alcala

Speaker: Roberto Gomez-Garcia, University of Alcala

1:50 PM

We3A-2

Evaluation of Embedded Algorithms for a Six-Port-Based Frequency Measurement System

Authors: Benedict Scheiner, Friedrich-Alexander University Erlangen Nürnberg; Florian Gräf, Friedrich-Alexander University Erlangen Nürnberg; Fabian Michler, Friedrich-Alexander University Erlangen Nürnberg; Robert Weigel, Friedrich-Alexander University Erlangen Nürnberg; Fabian Lurz, Hamburg University of Technology

Speaker: Benedict Scheiner, Friedrich-Alexander University Erlangen Nürnberg

2:10 PM

We3A-3

Wideband Six-Port Reflectometer Incorporating 4 × 4 Butler Matrix and Non-Matched Power Detectors

Authors: Cezary Szczepanski, AGH University of Science and Technology; Kamil Staszek, AGH University of Science and Technology; Slawomir Gruszczynski, AGH University of Science and Technology

Speaker: Kamil Staszek, AGH University of Science and Technology

We3B-2

60 GHz SIW Filter with 1.7 dB of Insertion Loss and 7 ps Added Jitter on OOK Modulated Signal

Authors: Alexandre Berthier, University of Bordeaux; Anthony Ghiotto, University of Bordeaux; Eric Kerherve, University of Bordeaux; Lionel Vogt, STMicroelectronics

Speaker: Alexandre Berthier, University of Bordeaux

2:30 PM

We3A-4

Zero-Power Vibration Sensor for Wireless Harmonic Systems based on a Reflection-type Phase Shifter and a Piezoelectric Transducer

Authors: Guendalina Simoncini, University of Perugia; Raffaele Salvati, University of Perugia; Valentina Palazzi, University of Perugia; Giordano Cicioni, University of Perugia; Federico Alimenti, University of Perugia; Paolo Mezzanotte, University of Perugia; Luca Roselli, University of Perugia

Speaker: Guendalina Simoncini, University of Perugia

We3B-3

Performance Optimization of a Slot Antenna using Bayesian Optimization

Authors: Shunsuke Yamamoto, Kyushu University; Kohei Takegami, Kyushu University; Haruichi Kanaya, Kyushu University

Speaker: Shunsuke Yamamoto, Kyushu University

Radio Transmitters and DPD-based Linearization: Fundamentals and Latest Advance

Speaker: Prof. Mikko Valkama and Dr. Lauri Anttila, Tampere University, Finland

This short course aims to give an overview of the fundamentals and recent advances in radio transmitters and digital predistortion linearization. The first part of the course focuses on radio transmitters, in terms of fundamental operating principles and architectures, performance quantification, and latest advances. First, traditional radio transmitter principles such as the Cartesian, polar, and outphasing/LINC, as well as some of their extensions, are presented and reviewed. Switching transmitter principles are discussed, and the important class of time-based transmitters, which enables single-chip integration and power-efficient operation, is highlighted. We also describe the fundamentals of nonlinear distortion and its quantification in transmitters, as well as important transmitter quality metrics related to linearity and efficiency.

Digital predistortion (DPD) linearization is the second main topic of the course. The fundamentals of PA behavioral modeling are first reviewed, including AM/AM and AM/PM based, LUT based, and parametric models. DPD models based on polynomials, LUTs, and piecewise models, are introduced, along with parameter learning architectures and concepts. Finally, we discuss advanced topics such as multi-band DPD and DPD for MIMO/multi-antenna transmitters, in which the implementation and numerical complexity aspects are crucial due to the growing dimensions of the problem.

Wearable Systems and Antennas for Wireless Communication 5G, IOT and Medical Systems

Speaker: Dr. Albert Sabban, Ort Braude College, Israel

Wearable systems and antennas are used in wireless Communication systems, wearable medical systems, IoT and 5G systems. Communication, medical and cellular industry is in continuous growth in the last few years. Low profile compact antennas are crucial in the development of Communication and Wearable systems.

Several small Passive and Active wearable systems and antennas will be presented in the course. Design considerations, computational results, and measured results on the human body of several compact wideband printed antennas with high efficiency will be presented in the course.

The course presents new concepts and designs of passive and active small antennas for Communication and Medical systems and applications such as sport systems, hiper LAN and GPS.

WisNet Session We4A

INNOVATIONS IN WIRELESS SENSOR NETWORKS

Chair: Rahul Khanna, *Intel Corp.*

Co-Chair: Luciano Tarricone, *University of Salento*

Room: Pompeian I

RWS Session We4B

WIRELESS SYSTEM AND PROPAGATION CHANNEL MODELING

Chair: Kevin Chuang, *Analog Devices*

Co-Chair: Anding Zhu, *University College Dublin*

Room: Pompeian II

RWW TECHNICAL LECTURES

Room: Pompeian III

RWW TECHNICAL LECTURES

Room: Virtual

3:40 PM

We4A-1

Sub-Nanosecond Pulse Technology Applied to Millimetre-Wave TDoA-Based Geolocation

Authors: Christophe Loyez, University of Lille; Michael Bocquet, University of Valenciennes; Nathalie Rolland, University of Lille; Kamel Haddadi, University of Lille

Speaker: Kamel Haddadi, University of Lille

We4B-1

60 GHz Outdoor Propagation Measurements and Analysis Using Facebook Terragraph Radios

Authors: Kairui Du, North Carolina State University; Omkar Mujumdar, North Carolina State University; Ozgur Ozdemir, North Carolina State University; Ender Ozturk, North Carolina State University; Ismail Guvenc, North Carolina State University; Mihail Sichitiu, North Carolina State University; Huaiyu Dai, North Carolina State University; Arupjyoti Bhuyan, Idaho National Lab

Speaker: Kairui Du, North Carolina State University

4:00 PM

We4A-2

Effect of Slot Type Identification on Frame Length Optimization

Authors: Hamed Kenawy, Dialog Semiconductor; Georgi Gaydadjiev, University of Groningen

Speaker: Hamed Kenawy, Dialog Semiconductor

We4B-2

Ray Tracing Analysis of Sub-6 GHz and mmWave Indoor Coverage with Reflecting Surfaces

Authors: Ender Ozturk, North Carolina State University; Fatih Erden, North Carolina State University; Kairui Du, North Carolina State University; Chethan Anjinappa, North Carolina State University; Ozgur Ozdemir, North Carolina State University; Ismail Guvenc, North Carolina State University

Speaker: Ender Ozturk, North Carolina State University

4:20 PM

We4A-3

An Empirical Study on Automotive Wireless Harness with Millimeter-wave Radio

Authors: Ryo Yamada, University of Kitakyushu; Akihiro Kajiwara, University of Kitakyushu

Speaker: Ryo Yamada, University of Kitakyushu

We4B-3

Radiowave Propagation Effect on Linearization for Earth-Space Satellite Links

Author: Kevin Chuang, Analog Devices

Speaker:Kevin Chuang, Analog Devices

4:40 PM

We4A-4

Desktop Positioning Based on Artificial Magnetic Coordinates

Authors: Qiongni Tang, Zhejiang University; Qian Zhang, Zhejiang University; Chengkai Zhu, Zhejiang University; Bin Zhang, Zhejiang University; Lixin Ran, Zhejiang University

Speaker: Qiongni Tang, Zhejiang University

We4B-4

Comparative Analysis of Behavioral Modeling for Wireless Radio Systems

Author: Kevin Chuang, Analog Devices

Speaker:Kevin Chuang, Analog Devices

5:00 PM

We4B-5

System Capacity Analysis of Asynchronous FBMC and OFDM Systems in the Presence of Adjacent Channel Interference and Multipath Fading

Authors: Hiroto Yamada, Waseda University; Hirofumi Suganuma, Waseda University; Fumiaki Maehara, Waseda University

Speaker: Hiroto Yamada, Waseda University

Microwave Sensing in the Modern Society

Speaker: Kamel Haddadi, University of Lille, France

RF and microwave techniques and instrumentations have been widely described in the literature to address electrical or/and dielectric characterization of devices and materials. Thanks to its high potential, microwave nondestructive testing and evaluation (MNDT&E) has attracted industry in a wide range of sensing applications at different scales of dimensions. MNDT&E of materials is an important science that involves the development of RF and microwave instrumentations including sensors/probes, methods and calibration techniques to extract the quantities of interest from the measured signals, applications including detection of cracks, defects, dielectric homogeneities, characterization of complex permittivity. MNDT&E refers to alternating signals or electromagnetic waves in the frequency range 300 MHz – 300 GHz. The spatial resolution mainly governed by the wavelength of operation is theoretically limited by the diffraction limit, i.e. half free-space wavelength. Thanks to their penetrations in non-metallic materials, MNDT&E techniques have advantages over established NDT techniques.

The course is specifically aimed for beginners who intended to have a basic understanding of MNDT&E.

This course will review the foundations including wave to material interaction, microwave instrumentation, measurement methods and applications.

DPD and Sparse Estimation

Speaker: Prof. Juan A. Becerra and Prof. María J. Madero, Universidad de Sevilla, Spain

In this short course, the basics underlying the digital predistortion (DPD) concept and coefficient selection will be explained. The ever-increasing need of higher data rates in wireless communications pushes the standards to include techniques such as the orthogonal frequency division multiplexing (OFDM) and carrier aggregation (CA) for an efficient spectrum usage. Since OFDM signals are characterized by a high peak-to-average power ratio (PAPR), their use with power amplifiers (PA) poses a problem in levels near saturation, where the device presents the highest power efficiency. DPD arises as a promising solution to this challenge.

The design of the DPD relies on a behavioral model that voraciously resembles the inverse function of the PA. A discussion on the construction of Volterra-based model structures and how they are related to circuit-model knowledge will be covered in this course. Widely-used models such as the generalized memory polynomial will be put into context. The impact of I/Q modulator impairments on the models will be also considered. Special emphasis is placed on the regression considering sparse signal processing techniques for the selection of the most relevant regressors and computational complexity reduction. In order to train the DPD, direct learning architecture will be introduced.

It will be exemplified how rapidly the number of coefficients grows as the nonlinear order and memory depth are increased, a problem referred to as the curse of dimensionality. This leads to the idea of pruning the model structures in order to reduce their complexity. Regression of Volterra models will be also discussed from the numerical point of view, considering regularization techniques such as Ridge regression and other preconditioning methods. Based on sparse signal processing, several coefficient selection algorithms will be analyzed to provide a reduced-order model with equivalent accuracy.

Throughout this short course, the explanations will be covered theoretically and with sample code to provide practical hands-on experience.

98th ARFTG Microwave Measurement Conference

Non-Linear Methods and Measurements

Monday, January 17th

1:10 PM – 2:30 PM	**ARFTG Conference - Session A**	Florentine I

Session A: Microwave, mm-wave Measurement for Circuits, Devices and Systems

1:10 PM – 1:40 PM	Invited (Erik Luther)
1:40 PM - 1:50 PM	Q&A
1:50 PM – 2:10 PM	Correcting nonlinear distortion of wideband modulated signals using new frequency domain methods
2:10 PM - 2:30PM	Quantifying Noise Floor and Trace Noise in VNA Measurements for the WR-15 Waveguide Band

3:10 PM – 3:40 PM	**Break & Exhibits**	Roman Ballroom /Exhibit Hall
3:40 PM – 4:40 PM	**ARFTG Conference - Session B**	Florentine I

Session B: On wafer, in-fixture and waveguide environment calibration techniques

3:40 PM – 4:00PM	On the Influence of Metal Chucks in Wideband On-Wafer Measurements
4:00 PM – 4:20PM	Improving The Reliability of The Multiline TRL Calibration Algorithm
4:20 PM – 4:40PM	Repeatability of 220 - 330 GHz Variable Waveguide Attenuator and Frequency Extenders for 6G Measurements

Tuesday January 18th

8:30 AM - 9:40 AM	**ARFTG Conference - Session C**	Florentine I

Session C: (Set moderator to activate Q&A)

8:30 AM - 8:40 AM	Contactless in-situ probe tilt adjustment on co-planar devices
8:40 AM - 8:50 AM	Self-interference cancellation in Full-Duplex MIMO System
9:00 AM - 9:10 AM	Generating Wide Bandwidth Signals by Coherently Combining Vector Signal Generator Outputs
9:10 AM - 9:20 AM	Probe Measurement System for Surface Mount Devices at Radio Frequencies
9:20 AM - 9:40 AM	Mixer Residual Phase Noise Measurements Using Clock-locked DDS Sources and Receivers

Joint ARFTG/RWW	**Keynote Session**	Florentine II - IV
1:50 PM - 3:10 PM	**ARFTG Conference - Session D**	Florentine I

Session D: Other areas of RF and mm-wave measurements

1:50 PM - 2:10 PM	Measurement Method for Beam Steer Execution Time
2:10 PM - 2:30 PM	Complex Permittivity Measurement of Liquids Using Half Mode Corrugated Substrate Integrated Waveguide Structure
2:30 PM - 3:10 PM	Jim Booth

3:40 pm – 5:00 pm	**ARFTG Conference - Session E**	Florentine I

Panel session on Non-linear techniques from fundamental to harmonic environment, challenges and opportunities.

Industry Exhibits

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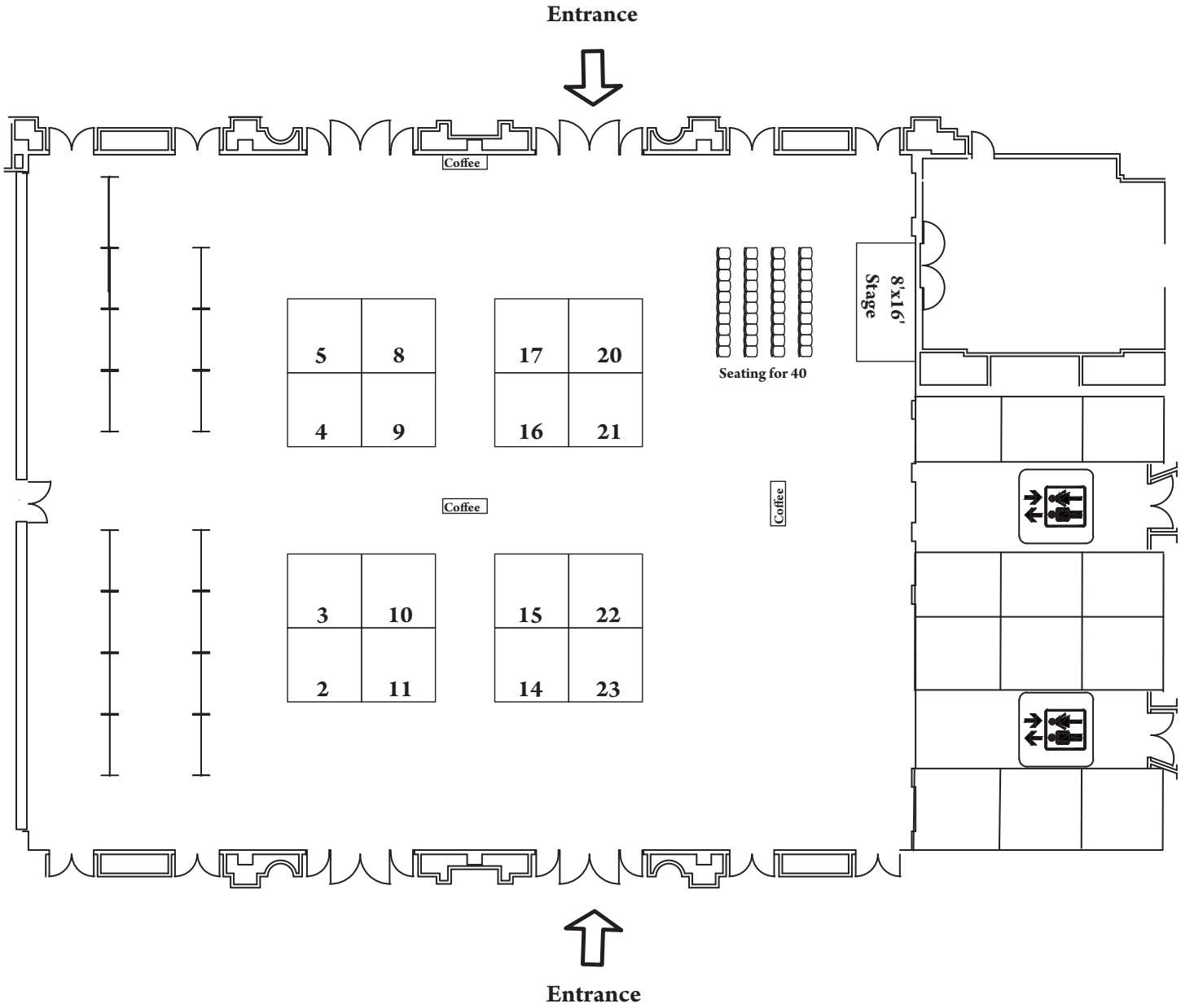
Advanced Test Equipment – Booth 9
BroadWave Technologies, Inc – Booth 22
IHP GmbH
Junkosha Inc – Booth 15
Keysight Technologies – Booth 21
Maury Microwave – Booth 16
Virginia Diodes, Inc. – Booth 10
IEEE - Geoscience and Remote Sensing Society (GRSS) – Booth 11
IEEE - Microwave Theory and Techniques Society (MTT-S) – Booth 14
IEEE - IMS Conference – Booth 23

Demos – Booths 5, 8, 17 Student Competition – Booth 20

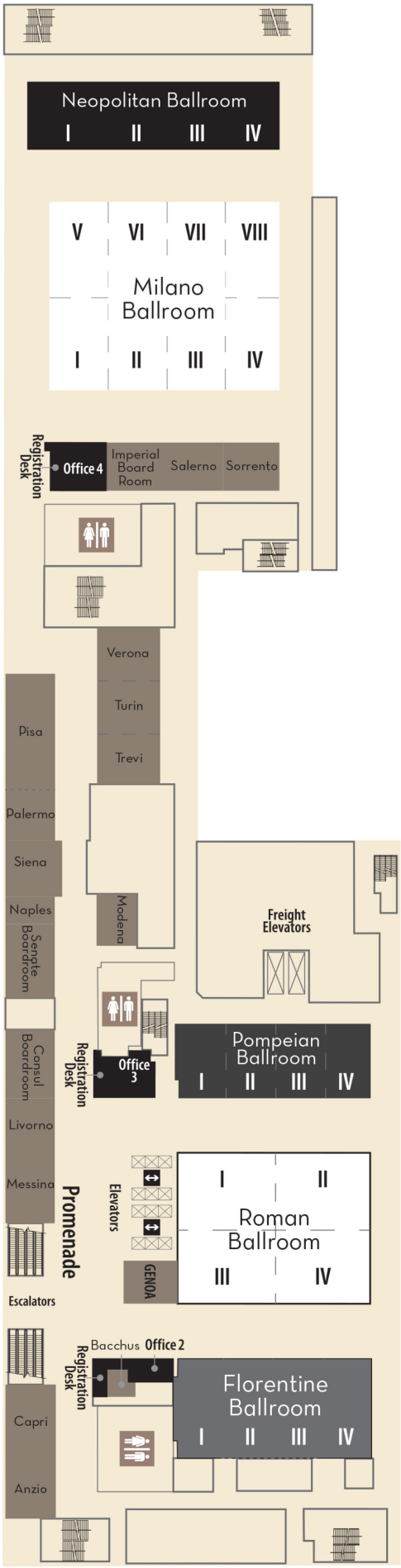
Roman Ballroom I-IV



Hotel Map


GEORGIO ARMANI
OLIVES
OLIVES


CAESARS PALACE


Neopolitan Ballroom
I II III IV
V VI VII VIII
Milano Ballroom
I II III IV
Registration Desk
Office 4
Imperial Board Room
Salerno
Sorrento
Verona
Turin
Trevi
Pisa
Palermo
Siena
Naples
Modena
Freight Elevators
Senate Boardroom
Consul Boardroom
Registration Desk
Office 3
Pompeian Ballroom
I II III IV
Livorno
Messina
Promenade
Elevators
I II
Roman Ballroom
III IV
GENOA
Escalators
Bacchus
Office 2
Registration Desk
Florentine Ballroom
I II III IV
Capri
Anzio