2022 Radio & Wireless Week Sponsors
IEEE Microwave Theory and Technology Society (MTT-S)

Technical Co-Sponsors:
IEEE Aerospace and Electronic Systems Society (AESS)
IEEE Antennas and Propagation Society (APS)
IEEE Geosciences and Remote Sensing Society (GRSS)

Platinum Industry Sponsor:
Virginia Diodes, Inc. (VDI)

Gold Industry Sponsor:
Analog Devices, Inc (ADI)

www.radiowirelessweek.org
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 is one 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 exhibitions 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 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
WIRELESS SYSTEM AND PROPAGATION MATERIALS:

Emerging Wireless Technologies & Novel Engineered Materials:

Hyun Kyu Chung, Alessandro Cidronali, Ahmad Hoofar, Sangkil Kim, Syed Abdullah Nauroze, Spyridon Pavlidis, Junyu Shen, Hjalmar Sigmansson

Wireless System Architecture and Propagation:

Juan Antonio Becerra, Ugo Dias, Aly Fathy, Paulo Ferreira, Maria J. Madero-Ayora, Chenming Zhou, Pravin Premakhanan

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:

Wasfi Khan, Darush Mirshekar, Jiang Zhu, You Zou, Rashaunda Henderson, Jeremy Muldavin, Edward Niehenke

Passive Components & Packaging:

Roberto Gomez-Garcia, T.-S. Jason Horng, Dimitra Psalti, 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 Deltimeline, Glasco Fontgalland, Minoru Fujishima, Renato Nega, Hiroshi Okazaki, Sergio Pacheco, Xin Wang, Xiwei Wang, Yu Ye

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

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 also 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 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 also 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:
Roei 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:
Memet Kaynak, IHP Microelectronics

Executive Committee:
Ye-Jan Emery Chen, National Taiwan University
Julio Costa, Quorvo
Vadim Issakov, University of Bordeaux
Dietmar Kissingers, Ulm University
Chien-Nan Kuo, National Chiao Tung University
Donald Lie, Texas Tech University
Venkata Koushik Malladi, NXP Semiconductors
Monte Miller, NXP Semiconductors
Sergio Pacheco, Uhnder, Inc.
Nils Pohl, Ruhr-Universitat Bochum
Jae-Sung Rieh, Kook University
Ahmed Cagri Ulusoy, Karlsruhe Institute of Technology
Vaclav Valenta, ESA/ESTEC

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 WP and MTT Space Night events in the Exhibit Hall
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. The 5th IEEE Internet of Things (IoT) Vertical and Topical Summit at RWW 2022 addresses the crucial role that active sensor systems play in IoT, and where their design for sustainability is essential. The summit examines how sensor systems support sustainable sensor systems and other important and emerging 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
- Jasmin Grossinger
- James McSpadden
- Steven Rosenau
- Vaclav Valenta
- Markus Gardill

Mission Concepts, Operations, Regulation, and Standardization:
- Jan Budroweit
- Rudy Emrick
- Charles Jackson
- Thomas Royster
- Zizung Yoon
- Dustin Schroeder

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.

WSNet2022 Technical Program Committee

Wireless Sensors for IoT Communication and Applications:
- Georg Fischer
- Federico Alimenti
- Taiwu Lasri
- Davide Queiro Rodrigues

Wireless Sensors for Radar, Positioning, Tracking, and Imaging:
- Alexander Koelpin
- Changhi Li
- Arne Jacob
- Hendrik Rogier

Wireless Sensors Circuits & System Technologies:
- Alessandra Costanzo
- Joo-Peter Aslund
- Fabian Lurz

WSN Hardware-Software Co-Design:
- Amr Fahim
- Jennifer Williams
- Emanuele Cardillo

Innovations in Wireless Sensor Networks:
- Marco Dionigi
- Luciano Tarricone
- Rahul Khanna

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/.
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 in space.

Talks and Speakers:
Space Mission Design
Martin Drobczyk, DLR, Germany
Space Hardware Design
Jan Budroweit, DLR, Germany
RF Engineering for Space: Lessons 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 2021 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
Andan 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-Terahertz 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
Vadim Issakov, TU Braunschweig, Germany
Sub-Terahertz 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, Irvine, CA, USA

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 5G/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
Prof. Alexandre Giry, Univ. Grenoble Alpes (UGA), CEA-Leti, Grenoble, France
Filter 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 Varukuru, PMTS, Global-Foundries, Bangalore, India
Mo1A-1

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 Blanch, United Monolithic Semiconductors

Speaker: Guillaume Callet, United Monolithic Semiconductor

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-2
Ultra-Linear and High-Efficiency GaN Technology for 5G and Beyond

Author: Jeong-Sun Moon, HRL Laboratories

Speaker: Jeong-Sun Moon, HRL Laboratories
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.

Mo1B-3
A Polarization Insensitive Frequency Selective Bipanisotropic Surface
Authors: Muhammad Sumair, 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 Moock, 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, Masquaire 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

Mo1B-4
Design of Beam-Steering Kirigami Loop Antennas
Authors: Chieh Deng, National Chung Cheng University; Chia-Chan Chung, 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 Cisnaros, 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.
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 intermode 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.

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 characteristics and system-level PA performance. Finally, it presents advanced PA topologies, such as active device large-signal characteristics and system-level PA performance. Finally, it presents advances in advanced PA topologies.

Mo2B-2
A Novel Miniaturized 100:1 Broadband Balun with a 4:1 Impedance Ratio
Authors: Farshid Tamjid, University of Tennessee; Tzitzei Kevdastovil, The University of Tennessee; Oezlem Kilic, The University of Tennessee; Aly Fathy, University of Tennessee
Speaker: Farshid Tamjid, University of Tennessee

Mo2B-3
Generalized Cascaded Sixthuplets Filters
Author: Wael Fathelbab, Northrop Grumman Corp.
Speaker: Wael Fathelbab, Northrop Grumman Corp.

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

Mo2B-5
Broadband Conductor Backed-CPW to SubstrateIntegrated Slab Waveguide Transition for Ku-Band
Authors: Anil Yayak, University of Alberta; Igor Filanovsky, University of Alberta; Kambez Moez, University of Alberta; Amalendu Patnaik, Indian Institute of Technology Roorkee
Speaker: Anil Yayak, University of Alberta

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

Mo2C-3
A 120-GHz, 1.58-mm2 Multiplying Outphasing Transmitter in 22nm FDSOI
Author: Jeff Shih-Chieh Chien, University of California; James Buckwalter, University of California, Santa Barbara
Speaker: Jeff Shih-Chieh Chien, University of California

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 Kissing, Ulm University; Andrea Malignaggi, IHP Microelectronics
Speaker: Ahmed Gadallah, IHP Microelectronics

Mo2C-5
Wideband Envelope Tracking Power Amplifiers for Mobile Terminals
Authors: Wantao Li, University Politecnica de Catalunya; Gabriel Montoro, University Politecnica de Catalunya; Pere Gilabert, University Politecnica de Catalunya
Speaker: Wantao Li, University Politecnica de Catalunya

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.; Tatsuya Tsuru, Mitsubishi Electric Corp.
Speaker: Kento Saiki, Mitsubishi Electric Corp.

Mo2D-3
25-GHz-Band High Efficiency Stacked-FET Power Amplifier IC with Adaptively Controlled Gate Capacitor in 45-nm SOI CMOS
Authors: Tsuyoshi Sugura, Waseda University; Yoshio Yoshimatsu, Waseda University
Speaker: Tsuyoshi Sugura, Waseda University

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, Institute De Telecomunicacoes; Paolo Colantonio, University of Rome; Anna Picciello, Politecnico di Torino; Roberto Quaglia, Cardiff University; Vaclav Valenta, ESA - European Space Agency; Rocco Gifuni, University of Rome Tor Vergata
Speaker: Vittorio Camarchia, Politecnico di Torino

Mo2D-5
RF Leakage Compensation in Wideband Envelope Tracking Power Amplifiers for Mobile Terminals
Authors: Wantao Li, University Politecnica de Catalunya; Gabriel Montoro, University Politecnica de Catalunya; Pere Gilabert, University Politecnica de Catalunya
Speaker: Wantao Li, University Politecnica de Catalunya
## 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

<table>
<thead>
<tr>
<th>Time</th>
<th>Title</th>
<th>Authors</th>
<th>Speaker</th>
</tr>
</thead>
<tbody>
<tr>
<td>1:30 PM</td>
<td><strong>Mo3B-1</strong> Noncontact Respiration Detection of Multiple Closely Positioned Subjects with Difference Beamforming</td>
<td>Junjun Xiong, Nanjing University of Science and Technology; Hong Hong</td>
<td>Junjun Xiong, Nanjing University of Science and Technology</td>
</tr>
<tr>
<td>1:50 PM</td>
<td><strong>Mo3B-2</strong> Separation of Multiple Closely Spaced Sources Using Frequency Sweep Single-Channel Continuous Wave Doppler Radar</td>
<td>Khaldoon Ishmael, University of Hawaii; Olga Boric-Lubecke, University of Hawaii</td>
<td>Khaldoon Ishmael, University of Hawaii</td>
</tr>
<tr>
<td>2:10 PM</td>
<td><strong>Mo3B-3</strong> Empirical Mode Decomposition (EMD) for Platform Motion Compensation in Remote Life Sensing Radar</td>
<td>Shekh Md Mahmudul Islam, University Antonio de Nebrija; Lupua Oba, University of Hawaii at Manoa; Victor Lubecke, University of Hawaii</td>
<td>Shekh Md Mahmudul Islam, University Antonio de Nebrija</td>
</tr>
<tr>
<td>2:30 PM</td>
<td><strong>Mo3B-4</strong> Doppler Cardiogram Detection in the Presence of Respiration with a K-band Radar Sensor</td>
<td>Shuqin Dong, Shanghai Jiao Tong University; Changzhan Gu, Shanghai Jiao Tong University; Junfa Mao, Shanghai Jiao Tong University; Lixin Ran, Zhejiang University</td>
<td>Shuqin Dong, Shanghai Jiao Tong University</td>
</tr>
<tr>
<td>2:50 PM</td>
<td><strong>Mo3B-5</strong> Estimation of Driver's Heartbeat Variability by Millimeter Wave Sensor</td>
<td>Ryohei Fukuhara, University of Kitakyushu; Akihito Kajiwara, University of Kitakyushu</td>
<td>Ryohei Fukuhara, University of Kitakyushu</td>
</tr>
</tbody>
</table>

## SIRF Session Mo3C
**DEVICES, MATERIALS, MODELING, AND MEASUREMENT**
Chair: Austin Chen, Peraso Technologies
Co-Chair: Aleks Dyskin, Inxpect
Room: Pompeian III

<table>
<thead>
<tr>
<th>Time</th>
<th>Title</th>
<th>Authors</th>
<th>Speaker</th>
</tr>
</thead>
<tbody>
<tr>
<td>1:30 PM</td>
<td><strong>Mo3C-1</strong> Si Technologies for WiFi Front-end Modules</td>
<td>Tianbing Chen, GlobalFoundries</td>
<td>Invited Speaker</td>
</tr>
<tr>
<td>2:10 PM</td>
<td><strong>Mo3C-2</strong> Nox and Buried PN Junctions Effect on RF Performance of High-Resistivity Silicon Substrates</td>
<td>Maxime Moulin, CEA-LETI; Martin Rack, ICTEAM; Thibaud Fuchet, CEA-LETI; Massimissa Nabat, Université Catholique de Louvain; Zdenek Chalupa, CEA-LETI; Christophe Plantier, CEA-LETI; Frédéric Allibert, Soitec; Fred Gaillard, CEA-LETI; Luis Huitin, CEA-LETI; Jean-Pierre Raskin, Université Catholique de Louvain la Neuve</td>
<td>Maxime Moulin, CEA-LETI</td>
</tr>
<tr>
<td>2:30 PM</td>
<td><strong>Mo3C-3</strong> A Ka Band Power Amplifier with Varactor-Based Analog Predistortion in pMOS-SOI</td>
<td>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</td>
<td>Sravya Alluri, University of California, San Diego</td>
</tr>
</tbody>
</table>

## 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

<table>
<thead>
<tr>
<th>Time</th>
<th>Title</th>
<th>Authors</th>
<th>Speaker</th>
</tr>
</thead>
<tbody>
<tr>
<td>1:30 PM</td>
<td><strong>Mo3D-1</strong> Impact of Multi-tone Stimuli on Optimum Load Characterized Using Wideband Load-pull System</td>
<td>Sanket Chaudhary, University of Aveiro; Nuno Carvalho, University of Aveiro</td>
<td>Nuno Carvalho, University of Aveiro</td>
</tr>
<tr>
<td>1:50 PM</td>
<td><strong>Mo3D-2</strong> Class-if-1: Linearity Enhanced High Efficiency Power Amplifier</td>
<td>Chihao Chu, University College Dublin; Sagar Dhar, University of Calgary; Tushar Sharma, Indian Institute of Technology Bombay; Anding Zhu, University College Dublin</td>
<td>Chihao Chu, University College Dublin</td>
</tr>
<tr>
<td>2:10 PM</td>
<td><strong>Mo3D-3</strong> Closed-Loop DPD with Dynamic Resource Block Scheduling</td>
<td>Peter Pawliuk, Intel Corp.; Benjamin Jann, Intel Corp.</td>
<td>Peter Pawliuk, Intel Corp.</td>
</tr>
<tr>
<td>2:30 PM</td>
<td><strong>Mo3D-4</strong> Strategic Initialization of Genetic Algorithm used in Digital Pre-Distortion of mmWave Power Amplifiers for Hybrid Beamforming</td>
<td>Rahul Mushini, Maynooth University; John Dooley, Maynooth University</td>
<td>Rahul Mushini, Maynooth University</td>
</tr>
</tbody>
</table>

---
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.
**Monday, 17 January 2022**

<table>
<thead>
<tr>
<th>Session</th>
<th>Title</th>
<th>Authors/Speakers</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RWS Session Mo4B</strong></td>
<td><strong>NOVEL WIRELESS SYSTEM CONCEPTS</strong>&lt;br&gt;Chair: Fabian Lurz, Hamburg University of Technology&lt;br&gt;Co-Chair: Changzhi Li, Texas Tech University&lt;br&gt;Room: Pompeian II</td>
<td></td>
</tr>
<tr>
<td><strong>SIRF Session Mo4C</strong></td>
<td><strong>RF AND MILLIMETER-WAVE SIGNAL GENERATION</strong>&lt;br&gt;Chair: Vadim Issakov, Technische University Braunschweig&lt;br&gt;Co-Chair: Youngho Suh, Massachusetts Institute of Technology, Lincoln Laboratory&lt;br&gt;Room: Pompeian III</td>
<td></td>
</tr>
<tr>
<td><strong>PAWR Session Mo4D</strong></td>
<td><strong>DPD TECHNIQUES</strong>&lt;br&gt;Chair: Pere Gilabert, University Politécnica de Catalunya&lt;br&gt;Co-Chair: Patrick Roblin, Ohio State University&lt;br&gt;Room: Pompeian IV</td>
<td></td>
</tr>
<tr>
<td><strong>Mo4B-1</strong></td>
<td><strong>Design of Angle Change Sensor Using Radar Technology</strong>&lt;br&gt;Author: Chia Chan-Chang, National Chung Cheng University&lt;br&gt;Speaker: Chia Chan-Chang, National Chung Cheng University</td>
<td></td>
</tr>
<tr>
<td><strong>Mo4B-2</strong></td>
<td><strong>High-Resolution Direction-of-Arrival Estimation using Distributed Radar Sensors</strong>&lt;br&gt;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&lt;br&gt;Speaker: Jonas Fuchs, Friedrich-Alexander University</td>
<td></td>
</tr>
<tr>
<td><strong>Mo4B-3</strong></td>
<td><strong>A Novel Microwave Architecture for Passive Sensing Applications</strong>&lt;br&gt;Authors: Davi V. Q. Rodrigues, Texas Tech University; Dongyang Tang, Texas Tech University; Changzhi Li, Texas Tech University&lt;br&gt;Speaker: Davi V. Q. Rodrigues, Texas Tech University</td>
<td></td>
</tr>
<tr>
<td><strong>Mo4B-4</strong></td>
<td><strong>Hardware-Software Co-Design of Sub-6 GHz Transceiver for Reconfigurable Prototyping</strong>&lt;br&gt;Authors: Sanghoon Lee, Massachusetts Institute of Technology, Lincoln Laboratory; Kenneth Kolodziej, MIT Lincoln Laboratory&lt;br&gt;Speaker: Kenneth Kolodziej, MIT Lincoln Laboratory</td>
<td></td>
</tr>
<tr>
<td><strong>Mo4C-1</strong></td>
<td><strong>THz Technology: Challenges for Silicon</strong>&lt;br&gt;Author: Imran Mehdi, NASA’s Jet Propulsion Lab&lt;br&gt;Speaker: Invited Speaker</td>
<td></td>
</tr>
<tr>
<td><strong>Mo4C-2</strong></td>
<td><strong>A 60-GHz Super-Regenerative Oscillator with 80 dB Gain in SiGe BiCMOS for FMCW Radar Active Reflectors</strong>&lt;br&gt;Authors: Hatem Ghaleb, Technische University Dresden; Niko Joram, Technische University Dresden; Frank Ellinger, Technische University Dresden&lt;br&gt;Speaker: Hatem Ghaleb, Technische University Dresden</td>
<td></td>
</tr>
<tr>
<td><strong>Mo4C-3</strong></td>
<td><strong>A Millimeter-Wave Ultra-Wideband Polyphase Frequency Doubler With 88% FBW and Inherent Harmonic Cancellation in 22nm FDSOI</strong>&lt;br&gt;Authors: Ahmed Elmenshawi, Rensselaer Polytechnic Institute; Muhammed Wailed Mansha, Rensselaer Polytechnic Institute; Siriam Muralidharan, Analog Devices, Inc.; Mona Hella, Rensselaer Polytechnic Institute&lt;br&gt;Speaker: Ahmed Elmenshawi, Rensselaer Polytechnic Institute</td>
<td></td>
</tr>
<tr>
<td><strong>Mo4C-4</strong></td>
<td><strong>Wideband, Compact and Efficient Frequency Quadrupler for Sub-Harmonic Transceiver in 130 nm SiGe BiCMOS Technology</strong>&lt;br&gt;Authors: Raqibul Hasan, IHP GmbH; Mohamed H. Elsaa, IHP GmbH; Maziej Kucharski, IHP GmbH; Dietmar Kissinger, Ulm University; Herman Ng, Karlsruhe University of Applied Sciences&lt;br&gt;Speaker: Raqibul Hasan, IHP GmbH</td>
<td></td>
</tr>
<tr>
<td><strong>Mo4D-1</strong></td>
<td><strong>Linearity and Efficiency Enhancement Techniques for Satellite Communications</strong>&lt;br&gt;Authors: Tomas Gotthans, Brno University of Technology; Roman Marsalek, Brno University of Technology; Jan Kral, Brno University of Technology; Tomas Urbane, Brno University of Technology&lt;br&gt;Speaker: Tomas Gotthans, Brno University of Technology</td>
<td></td>
</tr>
<tr>
<td><strong>Mo4D-2</strong></td>
<td><strong>Preconditioning the Regression of Power Amplifier Behavioral Models and Digital Predistorters</strong>&lt;br&gt;Authors: Juan Becerra, Universidad de Sevilla; Maria J. Madero-Ayora, Universidad de Sevilla; Elias Marques-Valderama, Universidad de Sevilla; Miguel Nogales, Universidad de Sevilla; Carlos Crespo-Cadenas, Universidad de Sevilla&lt;br&gt;Speaker: Juan Becerra, Universidad de Sevilla</td>
<td></td>
</tr>
<tr>
<td><strong>Mo4D-3</strong></td>
<td><strong>A Descent-Based Estimator for Digital Predistortion (DPD) using Eigenvalue-derived Step Sizes</strong>&lt;br&gt;Author: Richard Braithwaite, Keysight Technologies&lt;br&gt;Speaker: Richard Braithwaite, Keysight Technologies</td>
<td></td>
</tr>
<tr>
<td><strong>Mo4D-4</strong></td>
<td><strong>Acceleration of Digital Pre-Distortion Training Using Selective Partitioning</strong>&lt;br&gt;Authors: Meabh Loughman, University College Dublin; Declan Byrne, Maynooth University; Ronan Farrell, Maynooth University; John Dooley, Maynooth University&lt;br&gt;Speaker: Meabh Loughman, University College Dublin</td>
<td></td>
</tr>
<tr>
<td><strong>Mo4D-5</strong></td>
<td><strong>Gate Diode Current Sensing for Device Temperature Estimation in GaN RF Power Amplifiers</strong>&lt;br&gt;Authors: Gautam Jindal, University of Bristol; Gavin Watkins, Toshiba Corp.; Kevin Morris, University of Bristol; Tommaso Cappello, University of Bristol&lt;br&gt;Speaker: Gautam Jindal, University of Bristol</td>
<td></td>
</tr>
</tbody>
</table>
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

**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

**Tu1A-2**

Correlation Technologies for OTA Testing of Mobile Devices: Power-Density Measurement
Authors: Sidina Wane, EV Technologies
Speaker: Sidina Wane, EV Technologies

**Tu1A-3**

28 GHz RF front – End Module Packageusing Photosensitive Glass
Authors: Hyun-Je Chang, Korea Electronics Technology Institute; Ja-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

**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

**Tu1A-5**

Silicon Integrated Broadband Dual Frequency Comb-based Microwave Detector for Material Characterization
Authors: Elif Kaya, Texas A&M University; Kamran Entesar, Texas A&M University
Speaker: Elif Kaya, Texas A&M University

**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

**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 Raddah, Chalmers Teknika Högskolan; Huai elegance Bao, Chalmers University of Technology; Thomas Eriksson, Chalmers University of Technology
Speaker: Christian Fager, Chalmers University of Technology

**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; Juanzhong Zhang, Samsung Research America
Speaker: Jin Yuan, Samsung Research America

**SIRF Session Tu1C**

**WIRELINE COMMUNICATION CIRCUITS AND SILICON-PHOTONICS INTEGRATED CIRCUITS**

Chair: Kenneth Kolodka, Massachusetts Institute of Technology, Lincoln Laboratory
Co-Chair: Valim Issakov, Technische University Braunschweig
Room: Pompeian III

**Tu1C-1**

Silicon Photonics for Optical Phased Arrays & Optical Signal Processing
Author: Hossein Hashemi, University of Southern California
Speaker: Keynote Speaker

**Tu1C-2**

A 45RFSOI DC to 32 GHz Bandwidth Inductorless Low Power Amplifier
Authors: Ghita Yaakoubi Khbiza, CEA-LETI; Baudouin Martinneau, CEA-LETI; Jose Luis Gonzalez-Jimenez, University Grenoble Alpes CEA-LETI; Benjamin Blampey, CEA
Speaker: Ghita Yaakoubi Khbiza, CEA-LETI

**Tu1C-3**

An 80-Gbps Distributed Driver with Two-Tap Feedforward Equalization in 45-nm CMOS SOI
Authors: Luis Valenzuela, University of California, Santa Barbara; James Dalton, University of California, Santa Barbara; Aaron Mathur, 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
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.

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.
Tuesday, 18 January 2022

SIRF Session Tu2C

1:30 PM
Tu2C-1
Antenna-in-Package (AiP) Solutions and 3D Integrated Antennas for mmWave and THz Wireless Applications
Author: Ivan Nölpe, Fraunhofer-Gesellschaft

Speaker: Invited Speaker

2:10 PM
Tu2C-2
A 3 x Sub-Sampling Mixer for a 77 GHz Automotive Radar Receiver in 28 nm FD-SOI CMOS Technology
Authors: Alexandre Flete, LAAS-CNRS; Christophe Vuillon, 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-Ya Hsu, AMICCOM Electronics Corporation, Ltd.; Chun-Yuan Huang, AMICCOM Electronics Corporation, Ltd.; Chien-Nan Kao, 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

1:30 – 3:10 PM

Tu2E-1
Short-Range Full-Duplex Real-Time Wireless Link for IEEE
Authors: Dominik Wrotny, Institute of Robot Power Semiconductor Systems; Yigal Lehia, SIKLU Communications Ltd; Laurence John, Fraunhofer Institute for Applied Solid State Physics; Benjamin Schuch, Institute of Robot Power Semiconductor Systems; Axel Tesmann, Fraunhofer Institute for Applied Solid State Physics; Ingmar Kallfass, Institute of Robot 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; Zhongcon Xu, Shenzhen University; Shuai Dong, 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; Lian Ran, Zhejiang University

Tu2E-4
Linearity Optimisation for Multi-Bit Parallel Digital Power Amplifier
Authors: Jiting Ma, University of Bristol; Manish Nair, University of Bristol; Gavin Watford, 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; Ya-Sheng Lin, National Chi Nan University; Chung-Ta Huang, National Chi Nan University

Tu2E-8
A 295-337 GHz 2.5 dBm Psat Gascode-Based Frequency Doubler in SiGe BiCMOS Technology
Authors: Saichun Brun, University of Erlangen-Nuremberg; Albert-Marcol Schrötz, University of Erlangen-Nuremberg; Markus Dietz, University of Erlangen-Nuremberg; Vadim Isakov, Technische Universität Braunschweig; Robert Weigel, University of Erlangen-Nuremberg

Tu2E-9
Push-Push VCO with PN- and Pout-Enhanced Off-State Parallel FETs
Authors: Jh-Sheng Lin, National Chi Nan University; Chung-Ta Huang, National Chi Nan University; Jin-Fa Chung, Feng Chia University; Ya-Chung Lin, National Chi Nan University

Tu2E-10
A High-Sensitivity Magnetic-Field Resonant Probe Based on Embedded Stripline Structure
Authors: Yifen Lu, Shanghai Jiao Tong University; Li Wen, Shanghai Jiao Tong University; Changchuan Gu, Shanghai Jiao Tong University; Liang-keng Wu, Shanghai Jiao Tong University; Jian-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 Linearisation using 20-DDP and Out-of-Band IM3 Cancellation Signal Injection
Authors: Nimir Ginzburg, Technion - Israel Institute of Technology; Tomer Gioloni, 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-Marcol Schrötz, University of Erlangen-Nuremberg; Saichun Brun, University of Erlangen-Nuremberg; Vadim Isakov, 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; Tsushuki Kojo-Akimou, Mitsubishi Electric Research Labs; Ao Yamashita, Mitsubishi Electric Corporation; Hisayuki Nakamizo, Mitsubishi Electric Corporation

Tu2E-15
AM-PM Characterization of Wideband Power Amplifiers
Authors: Anna Picciulla, Politecnico di Torino; Guglielmo De Filippo, Politecnico di Torino; Jian Liu, Shanghai Jiao Tong University; Deny J. O. Rodrigues, Texas Tech University; Changzhan Li, Texas Tech University

Tu2E-19
BICMOS IQ Transceiver with Array-on-Chip for D-Band Joint Radar-Communication Applications
Authors: Nael A. Ahmed, IHP Microelectronics; Maciej Kucharchik, 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: Yash Z. Ibrahim, Cairo University; Mohamed A. Abdalla, Cairo University; EEECE department; Ahmed N. Mahfoud, 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, Technical University Dresden, Markus Müller, Technische Universität Dresden; Michael Schröter, Technische Universität Dresden

Tu2E-22
Low Leakage RF Coaxial Connectors and Board-to-Board Connectors with Radiation Emission Control
Authors: Yu-Jun Ren, General Microwave Technologies; Chih-Kang Sun, Electric Connector Technology; Robert Litzbeck, 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

**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  

---

**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; Ifiona Malimbah, University of North Texas  
**Speaker:** Adnan Patwary, University of North Texas  

---

**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  

### 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

**Tu3B-1**  
**Digital Predistortion for 5G MIMO Transmitters Using Machine Learning**  
**Author:** Anding Zhu-University College Dublin  
**Speaker:** Anding Zhu-University College Dublin  

---

**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 Doll-RWTH Aachen University; Renato Negra-RWTH Aachen University  
**Speaker:** Oner Hanay-RWTH Aachen University  

---

**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  

---

**Tu3B-4**  
**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  

### 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

**Tu3C-1**  
**Epitaxial AlScN Thin Films for Acoustic Filter Applications**  
**Author:** Azadeh Ansari, Georgia Institute of Technology  
**Speaker:** Invited Speaker  

---

**Tu3C-2**  
**Four-Port Asymmetric Devices Techniques for Characterization of Two-Port Deembedding**  
**Authors:** Martin Maier, Technische Universität Braunschweig; Maciej Wojnowski, Infineon Technologies AG; Vadim Issakov, Technische Universität Braunschweig  
**Speaker:** Martin Maier, Technische Universität Braunschweig  

---

**Tu3C-3**  
**A Scalable Matching Mechanism for Online Heterogeneous Positioning Fusion System**  
**Authors:** Chung-Yuan Chen, National Taiwan University; Ruey-Beeti Wu, National Taiwan University  
**Speaker:** Chung-Yuan Chen, National Taiwan University  

### 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

**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  
**Speaker:** Natalia Vallejo-Montoya, Texas Tech University  

---

**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  

---

**Tu3D-3**  
**Simulation of FMCW and M-Sequence Ground Penetrating Radar Systems**  
**Authors:** Jonathan Platt, University of Alabama; Yang-Ki Hong, University of Alabama; Huyen Won, University of Alabama; Oukunle Olaniyan, University of Alabama; Minyong Choi, University of Alabama; Joohan Lee, Korea Polar Research Institute  
**Speaker:** Huyen Won, University of Alabama  

---

**Tu3D-4**  
**A Scalable Matching Mechanism for Online Heterogeneous Positioning Fusion System**  
**Authors:** Chung-Yuan Chen, National Taiwan University; Ruey-Beeti Wu, National Taiwan University  
**Speaker:** Chung-Yuan Chen, National Taiwan University
Tuesday, 18 January 2022

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 Kamada, 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

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

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
Title: Correcting nonlinear distortion of wideband modulated signals using new frequency domain methods
Speaker: Sam Kusano, Keysight, USA
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 generation is not yet possible 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 5G NR 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
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 Roorkee, India
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
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, output phasing PAs or load modulated balanced amplifiers) can boost power efficiency but at the price of presenting worse linearity 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
Abstract:
The generality requirement of advanced RF power amplifier designs, demands load-pull data under various conditions such as frequency, input power, and DC bias voltage which can be very time-consumming. 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 Göttmanns, VUT, Czech Republic
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.
<table>
<thead>
<tr>
<th>Session</th>
<th>Title</th>
<th>Abstract</th>
<th>Speaker</th>
<th>Room</th>
</tr>
</thead>
<tbody>
<tr>
<td>We1A-1</td>
<td>Grid Mapping and Synthetic Aperture Radar Based on Millimeter-Wave MIMO Radar for Automotive and UAV-Borne Applications</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>We1A-2</td>
<td>Influence of Self-Interference in a Radar System for a Correlation Based True-Speed-Over-Ground Estimation Approach</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>We1A-3</td>
<td>Signal Processing for Low-Power and Low-Cost Radar Systems in Bicycle Safety Applications</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>We1A-4</td>
<td>RF-Tag-Referenced Structural Displacement Measurements With Multiple Moving Interferers</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>We1B-1</td>
<td>Applying Radio Regulations to Ensure the Success of Your Small Satellite Mission</td>
<td>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.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>We1B-2</td>
<td>In-Orbit Performance of the Narrowband Intersatellite Mission S-NET</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>We1B-3</td>
<td>The Frequency Allocations in Remote Sensing (FARS) Technical Committee of the IEEE Geoscience and Remote Sensing Society (GRSS) and its Activities</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>We1B-4</td>
<td>Development of an IEEE Standard to Assess Interference on Remote Sensing Frequency Bands</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Wednesday, 19 January 2022

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

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 Lutz, Hamburg University of Technology
Speaker: Fabian Michler, Friedrich-Alexander University Erlangen Nürnberg

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

We2A-3
Radar-Based Velocity Estimation Using Three-Dimensional Cross-Correlation
Authors: Martin Scherhäuf, Linz Center of Mechatronics GmbH; Kurt Pichler, Linz Center of Mechatronics GmbH; Georg Keințec, Primetals Technologies Austria GmbH
Speaker: Martin Scherhäuf, Linz Center of Mechatronics GmbH

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

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

SHAARC 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

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.

We2B-2
Exomars 2022 X-Band Lander Radioscience Instrument LaRa
Author: Lieven Thomassen, Antwerp Space
Speaker: Lieven Thomassen, Antwerp Space

We2B-3
High-Fidelity Simulation of a Pico Satellite Link
Authors: Lennart Werner, Julius Maximilians Universitae Wurzburg; Cedric Liman, Julius Maximilians Universitae Wurzburg; Markus Gardill, Universität Würzburg
Speaker: Lennart Werner, Julius Maximilians Universitae Wurzburg

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

We2B-5
Ka/Q Dual Band Linearizer
Authors: Allen Katz, The College of New Jersey; Robert Gray, Linearizer Technology Inc.; Roger Dervall, 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

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
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

We3A-2
Evaluation of Embedded Algorithms for a Six-Port-Based Frequency Measurement System
Authors: Benedict Scheiner, Friedrich-Alexander University Erlangen Nürnberg; Florian Graf, Friedrich-Alexander University Erlangen Nürnberg; Fabian Mühlcr, 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

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 Grzczynski, AGH University of Science and Technology
Speaker: Kamil Staszek, AGH University of Science and Technology

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 Sabato, University of Perugia; Valentina Palazzi, University of Perugia; Giordano Cicioni, University of Perugia; Federico Alimenti, University of Perugia; Paolo Mezzanotte, University of Perugia; Luca Roelli, University of Perugia
Speaker: Guendalina Simoncini, University of Perugia
Wednesday, 19 January 2022

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

We4A-1
Sub-Nanosecond Pulse Technology Applied to Millimetre-Wave TDoA-Based Geolocation
Authors: Christoph Loyez, University of Lille; Michael Bouquet, University of Valenciennes; Nathalie Rolland, University of Lille; Kamel Haddadi, University of Lille
Speaker: Kamel Haddadi, University of Lille
3:40 PM

We4A-2
Effect of Slot Type Identification on Frame Length Optimization
Authors: Hamed Kenawy, Dialog Semiconductor; Georgi Gaydadjiev, Intel Corp.
Speaker: Hamed Kenawy, Dialog Semiconductor
4:00 PM

We4A-3
An Empirical Study on Automotive Wireless Harness with Millimeter-wave Radio
Authors: Ryo Yamada, University of Kitakyushu; Akhiru Kajiwara, University of Kitakyushu
Speaker: Ryo Yamada, University of Kitakyushu
4:20 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
4:40 PM

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 Guven, North Carolina State University; Mihail Sichitiu, North Carolina State University; Haujuy Dai, North Carolina State University; Arupjoti Bhuyan, Idaho National Lab
Speaker: Kairui Du, North Carolina State University
4:40 PM

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 Guven, North Carolina State University
Speaker: Ender Ozturk, North Carolina State University
5:00 PM

We4B-3
Radiofrequency Propagation Effect on Linearization for Earth-Space Satellite Links
Authors: Kevin Chuang, Analog Devices
Speaker: Kevin Chuang, Analog Devices
5:00 PM

We4B-4
Comparative Analysis of Behavioral Modeling for Wireless Radio Systems
Authors: 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; Fumioi Madhara, Waseda University
Speaker: Hiroto Yamada, Waseda University
5:00 PM

We4A-1
Microwave Sensing in the Modern Society
Speaker: Kamel Haddadi, University of Lille, France
RF and microwave techniques and instrumentation 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 instrumentation 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 specially 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.

We4B-1
DDP and Sparse Estimation
Speaker: Prof. Juan A. Becerra and Prof. Maria 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.

21
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

EXHIBITORS
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

Entrance

5  8
4  9
3 10
2 11
14 23
15 22
16 21
17 20
Seating for 40

Stage
8'x16'