2021 IEEE Radio & Wireless Week

FINAL PROGRAM

Virtual Conference

17-22 January, 2021

2021 Radio & Wireless Week Sponsors:

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2021 IEEE Space Hardware and Radio Conference (SHaRC) | 978-1-6654-1583-5/21/$31.00 ©2021 IEEE | DOI: 10.1109/SHARC51853.2021.9375860

Invitation of the General Chair and Co-Chair to the IEEE Radio and Wireless Week

As chair and cochair of IEEE Radio & Wireless Week (RWW) 2021, we would like to welcome you to the virtual series of conferences and events. For this 15th anniversary of RWW, the event will be held "in the cloud" through a virtual platform. Please check the website, www.radiowirelessweek.org, for updates on the conference and technical program, which will feature great ideas and proposals in wireless technology. We hope we can meet you in person, as we have traditionally, as soon as COVID-19 restrictions are lifted for conference gatherings. In the meantime, we look forward to hosting RWW 2021 virtually and meeting you during the event.

RWW, one of the central meetings for the microwave community, will span 6 days from 17 January to 22 January 2021. Typically, RWW is preceded by, and helps to support, the IEEE International Microwave Symposium Technical Program Review Committee meeting and the IEEE Microwave Theory and Techniques Society (MTT-S) Administrative Committee meetings. This year, there will be five colocated conferences as part of RWW, including the 2021 IEEE Radio and Wireless Symposium (RWS), the 21st 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 Con ference on Wireless Sensors and Sensor Networks (WisNet), and the IEEE Space Hardware and Radio Conference (SHaRC).

For 2021, we will follow our customary RWW program, with technical papers presented in standard oral sessions. Five workshops (all lasting half a day) are planned for RWW 2021, along with a short course on digital predistortion and a special track on Monday for IEEE Distinguished Microwave Lecturers. We will also, for the first time, present a Women in Microwaves event, bringing together a panel of professionals in microwave engineering. The plenary session will be held Tuesday morning, with our plenary speakers presenting their interesting and inspiring talks. This year, the plenary will focus on laying the groundwork for 6G communications, quantum computing with microwaves, and the winners of the student competitions will be announced. A special area of our "cloud" platform will be dedicated to RWW and Automatic RF Techniques Group (ARFTG) exhibitors, so please take time to visit them to learn more about the latest software and hardware innovations influencing our field.

Following last year's successful colocation with RWW, the 96th ARFTG meeting will again be held during RWW 2021. ARFTG is the premier conference focused on RF, microwave, and millimeterwave measurements, calibration, and uncertainty.

For the fourth year, the MTT-S and RWW Steering Committee are partnering with the multisociety IEEE Internet of Things (IoT) Initiative to host an IoT summit, "The IoT and Wireless Sensing, With Wireless Sensors, in Wireless Sensor Networks." The meeting will bring together participants from industry, academia, and the public sector to explore the latest IoT technology developments and applications.

Always a highlight, the Student Paper Contest is dedicated to supporting and encouraging students to pursue a career in the wireless area. On Monday morning, all finalists will provide an oral "elevator pitch"-style presentation to a group of judges. In addition, a Young Professionals meeting will include several interesting technical talks.

Finally, we would like to recognize and thank all of those on the RWW 2021 Steering Committee for their volunteer time and effort in helping to bring the event to fruition. The Steering Committee members come from all IEEE Regions, giving RWW 2021 a truly international reach and flavor. We hope to see you "in the cloud" for five days of great technical presentations, discussions, and networking.

RWW2021 General Chair and Co-Chair
Nuno Borges Carvalho and Kevin Chuang

General Chair
Nuno Borges Carvalho

General Co-Chair
Kevin Chuang

Technical Program Chair
Alexander Koelpin

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The 21ST Topical Meeting on Silicon Monolithic Integrated Circuits in RF Systems

Message from the SiRF General Chair:

Welcome to SiRF 2021!

IEEE Topical Meetings on Silicon Monolithic Integrated Circuits in RF Systems (SiRF) have been at the forefront of moving Silicon technologies into microwave and millimeter-wave aplications.

This 21st topical meeting will continue the tradition of spanning a wide scope of topics from silicon-based semiconductor technologies, modelling, circuit design techniques and highly-integrated systems, for such applications as automotive radar, 5G communication, consumer electronics and more. The ever-increasing integration trend from a single-transistor towards building blocks and their integration into System-on-Chip (SoC) or System in Package (SiP) is related to the rapid development of silicon-based technologies. Wherever possible, silicon technologies continue to push the boundaries, replacing IIIV technologies at all levels of system functionality.

Three days of SiRF 2021 would provide an up-to-date snapshot of the state of the art in RF, microwave and mm-wave silicon-based circuits and will inspire developing new ideas. As in previous years, a lineup of excellent world-class invited speakers will provide an insight on the latest developments of circuits and systems in advanced CMOS and an BiCMOS technologies and will give an overview on latest research directions in this field.

Vadim Issakov
SiRF 2021 Conference Chair

SiRF 2021 Technical Program Committee

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Saeed Zeinolabedinzadeh, *Arizona State University*
Technical Program Committee Co-Chair:
Roee Ben-Yishay, *ON Semiconductor*

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Pierre Blondy
Xun Gong
Florian Herrault
Paul Hurwitz
Mehmet Kaynak
Venkata N. Koushik Malladi
Jean-Pierre Raskin
Vikas Shilimkar
Katsuyoshi Washio
Ming-Ta Yang

RF & Mixed-Signal Circuits and Systems
Roee Ben-Yishay
Austin Chen
Aleksey Dyskin
Ankur Guha Roy
Hsieh-Hung Hsieh
Vadim Issakov
Rahul Kodkani
Somnath Kundu
Chien-Nan Kuo
Wei-Min (Lance) Kuo
Herman Jalli Ng
Michael Oakley
Robert Schmid
Hasan Sharifi
Ickhyun Song
Peter Song

Invited Talks
Saeed Zeinolabedinzadeh

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Previous Editions of IEEE RWW
Courtesy of Lyle Photos, Atlanta

RWW Topical Conferences

Power Amplifiers for Radio and Wireless Applications (PAWR)

Interest in power amplifier technology remains at an all time high because of the emergence of new device materials such as GaN that offer improved performance, and the need for ever greater linearity and efficiency by the world's expanding wireless communication infrastructure. Topical Conference on Power Amplifiers for Wireless and Radio Applications (PAWR) will feature power amplifier focused sessions, including the latest advances on power amplifier technology, efficiency enhancement techniques, system analysis, modeling, distortion reduction, an interactive workshop answering questions on power amplifier linearization and efficiency enhancement.

Technical Program Committee:

Distortion Reduction Techniques in RF Power Amplifiers

Juan A. Becerra
Kevin Chuang
Pere L. Gilabert
Peter Kenington
Yunfan Chen
Armando Cova
Allen Katz
Anding Zhu

High Efficiency RF Power Amplifiers

Taylor Barton
José A. García
Wolfgang Heinrich
Chao Lu
Frederick Raab
Ali Tombak
Paolo Enrico de Falco
William Hallberg
Song Lin
Morten Olavsbraaten
David Runton
Kefei Wu

Power Amplifier Modeling and System Analysis

Florinel Balteanu
Vittorio Camarchia
Paolo Colantonio
Murat Eron
Marcn Franco
Ming Ji
Chang-Ho Lee
Stephen Maas
Zoya Popovic
Roberto Quaglia
Tushar Sharama
Filipe Barradas
Robert Caverly
Nathalie Deltimple
Christian Fager
Gary Hau
Bumman Kim
Donald Lie
José Pedro
Francesc Purroy
Patrick Roblin

IEEE Space Hardware and Radio Conference (IEEE SHaRC)

The IEEE Space Hardware and Radio Conference (IEEE SHaRC) addresses new concepts, novel implementations as well as emerging applications for space-based hardware for communications, earth observation, and other novel disruptive services. To meet recent needs, there has been a renaissance of interest and investment in space- and suborbital-based systems especially for high-data-rate communications networks. These new global satellite networks are disruptive, and many applications are feasible: e.g. the creation of a worldwide car-to-car communications network or global sensor & control systems for autonomous vehicles. The IEEE Space Hardware and Radio Conference provides a forum for discussions on this new frontier.

Technical Program Committee:

Applications

Jan Budroweit
Nuno Carvalho
Rudy Emrick
Ramesh Gupta
Holger Maune
Steven Reising
Steven Rosenau
Thomas Royster
Klaus Schilling
Rick Sturdivant

Hardware and Electronics

Goutam Chattopadhyay
Markus Gardill
Jasmin Grosinger
Charlie Jackson
James McSpaddenJames
Thomas Ussmueller
Václav Valenta
Robert Weigel

Wireless Sensors and Sensor Networks (WiSNet)

WiSNet is dedicated to the advancement of wireless sensors for commercial and industrial applications and will be held to specifically focus on the latest developments in these areas of RF Sensors and Sensor Networks. Wireless sensors and sensor networks are critical system components for applications such as: manufacturing, monitoring, safety, positioning, tracking and many others; more generally, they are key elements in the physical layer of Internet of Things eco-system. This year, WiSNet2021 will focused on the latest developments in these areas including sensors and smart sensor networks ranging from UHF, RFID applications to millimeter-wave radar systems and six-port technology. Some emerging topics will be also covered this year, such as Internet of Things hardware, protocols and applications, and wireless sensors applications in wearable computing.

Technical Program Committee:

IoT Hardware, Protocols and Applications

J-C Chiao
Nils Pohl
Georg Fischer
Luca Roselli

Six Port and Multi-port Technology

Serioja Tatu

Wireless Integrated Sensors, Front-Ends, and Building Blocks

Diego Masotti
Luciano Tarricone
Holger Maune

Wireless Sensors For Communication, Radar, Positioning and Imaging Applications

Federico Alimenti
Spiridon Daskalakis
Reinhard Feger
Alexander Koelpin
Valentina Palazzi
Huei Wang
Alessandra Costanzo
Amr Fahim
Arne Jacob
Tuami Lasri
Thomas Ussmueller

Wireless Sensors for Harsh Environments, Environmental, Health, Home and Commercial Applications

Xianming Qing
Manos Tentzeris

Wireless Sensors for Localization, Tracking, and RFID Technologies

Zahir Alsulaimawi
Rahul Khanna
Paolo Mezzanotte
Hendrik Rogier
Marco Dionigi
Huaping Liu
Mario Pauli
Jennifer Williams

Wireless Sensors Networks, Smart Sensor Systems, and Autonomic Networking

Maurizio Bozzi
Kamal Samanta

Technical Program for 2021 Radio & Wireless Week (RWW)

SUNDAY, 17 JANUARY 2021 (9:30-17:30 ET)

Workshop

6G Research: Challenges and opportunities

Organizers:

Young-Kai (Y.K), *DARPA, USA*
Daquan Huang, *Samsung, USA*

Abstract:

Efficiency and linearity are key features in order to greatly increase the data rate, mm-wave 6G must embrace element level digital beamforming in order to achieve the performance of sub-6 GHz links. However, the wider bandwidth at mm-wave frequencies (400 MHz, 800 MHz, 1200 MHz), and the much smaller space available per unit cell, results in formidable challenges for mm-wave digital beamforming arrays. Along with many other aspects related to 6G, this workshop will discuss the advances in ADCs, PAs and transceivers required to achieve digital beamforming for 6G.

Talks and Speakers:

Digital Beamforming for 6G: Much More than THz Links
Gabriel M. Rebeiz, *University of California San Diego*

Terahertz for 6G: Opportunities and Challenges
Gary Xu, *Samsung Research*

Emerging AI Processing for 6G Radios
Young-Kai (Y.K), *DARPA*

100-300GHz Wireless: Transistors, ICs, Packages and Systems
Mark Rodwell, *University of California Santa Barbara*

Bridging the Gap between Antennas and AI - a 6G Vision
Bodhisatwa Sadhu, *IBM T.J. Watson Research*

Workshop

5G Power Amplifiers

Organizers:
Hua Wang, *Geogia Tech, USA*

Abstract:

The growing demand for high data rate, longer battery life and low latency is pushing the transition from 4G Long-Term Evolution (LTE) to 5G. There is a partition of the 4G/5G RF systems using advanced low feature nodes for 4G/5G modems and transceivers and the other RF and analog functions being integrated into several Front End Modules (FEMs). The FEMs will integrate power amplifiers, switches, couplers, tuners and active acoustic filters. These will cover more than 50 LTE bands from 600MHz to 6GHz as well mmWave. The workshop will cover practical design aspects for 5G FEMS with emphasis for power amplifiers as well the technologies involved into these designs.

Talks and Speakers:

Sub-6GHz 5G Front End Modules for Cellular Applications
Florinel Balteanu, *Skyworks*

Power Amplifiers for 5G mmwave and Automotive Radar
Shafi Syed, *GLOBALFOUNDRIES*

Recent Advances in Microwave Power Amplifiers
Howard Hausman, *RF Microwave Consulting Services, Hofstra University*

Pre-Layout Electro-Thermal Co-Simulation for Accurate Estimation of Thermal Coupling in Power Amplifiers
Ted Anderson, *GLOBALFOUNDRIES*

Workshop

Reflectionless Filters

Organizers:
Shahrokh Saeedi, *Boeing, USA*
Charlie Jackson, *Northrop Grumman Coorporation, USA*

Abstract:

Filters are fundamental signal processing electric components and therefore are crucial building blocks in modern RF/wireless systems. Filters are frequency-selective networks, which are used to remove undesirable-frequency portions of input signals that do not fall within their passband. All filters, ideally, behave like transparent networks to signals with frequency components inside their passband(s). However, not all filters act similarly in their stopband(s). Reflectionless filters are a class of networks which ideally exhibit like always-matched circuits at all ports and at all frequencies. In reflectionless filters, input signals are transferred to another port if they fall inside the passband(s) or are absorbed if appear inside the stopband(s). Hence, all ports' reflection coefficients are always zero. This has led to a resurgence of modern development efforts in absorptive filtering that spans a wide range of approaches and technologies. This workshop review the basics of reflectionless filters and provide examples of recent developments.

Talks and Speakers:

TBA
Matt Morgan, *National Radio Astronomy Observatory*

Avoiding RF Isolators: Reflectionless Microwave Filtering Components for Advanced RF Front-Ends
Roberto Gomez-Garcia[1], Dimitra Psychogiou[2], [1]*University of Alcalá,* [2]*University of Colorado Boulder*

TBA
Juseop Lee, *Korea University*

Workshop

Modeling and Design Tools for Accelerated Design of 5G GaN PAs

Organizer:
Nicholas Miller, *Air Force Research Laboratory, USA*

Abstract:

This workshop will review advances in the nonlinear device modeling and characterization of GaN HEMTs to support the accelerated design of 5G base stations. Both the extraction of ASM-HEMT and MIT Source based model will be discussed. Comparison of measurements with NVNA large-signal measurement results will be reported. Characterization and modeling of traps will be discussed. Finally an embedding ASM-HEMT model for the accelerated design of GaN PAs will be presented.

Talks and Speakers:

Physics-based Compact Modeling of Charge Transport in Ultra-Scaled GaN HEMTs for RF Applications
Shaloo Rakheja, *University of Illinois*

From Poisson Equation to Power Amplifiers: Accurate Non-linear RF Models for GaN with Physics-based ASM-HEMT compact model
Sourabh Khandelwal, *University of Florida*

GaN HEMT Modeling for RF Applications using Advanced Circuit Extraction Tools and Fermi Kinetics Transport
Nicholas Miller, *Air Force Research Laboratory*

ASM-HEMT Embedding Model for Accelerated Design of PAs
Miles Lindquist, P. Roblin and N. Miller, *Ohio State University and Air Force Research Laboratory*

MVSG modeling framework to enable GaN device-circuit co-design for PA applications
Ujwal Radhakrishna, *Texas Instrumentso*

Technical Program for 2021 Radio & Wireless Week (RWW)

SUNDAY, 17 JAN, 2021 (9:30-17:30 ET)

Workshop

Technology for CubeSats and COTS for Space

Organizers:
TBA

Abstract:
CubeSats contributed significantly to the success of "New Space" by setting standards in dimensions, as well as a more recent effect by defining electrical interface standards. By this way launcher adaptors, as well as subsystems or components from different suppliers can be used and integrated at limited efforts. Thus a broad spectrum of parts is available to the CubeSat community and developers can focus on their specific specialties.

CubeSats typically employ commercial of the shelf (COTS) components, taking advantage of most recently technology innovations and extreme miniaturization. Nevertheless, this cannot be done in a naïve way, as the unavoidable space radiation affects the electronics. Appropriate means need to be implemented in order to guarantee required availability and lifetime for the satellites. Here redundancy concepts in combination with fault detection, identification and recovery (FDIR) algorithms based on advanced filtering and control methods are supporting implementation of a reliable system, compensating the higher noise susceptibility of miniaturized systems.

Nowadays functionalities like orbit control by miniature propulsion systems and precise attitude control become available at CubeSat level. This enables data acquisition via distributed, networked sensor systems self-organized in a formation. Related technologies used (relative navigation, inter-satellite links, etc.) and technology perspectives enabled by such formations will be outlined.

Talks and Speakers:

Technology for CubeSats and COTS for Space
Klaus Schilling, *Robotics and Telematics at University Würzburg*

FRIDAY, 22 JAN. 2021 (8:00-9:45 ET)

Short Course

Digital Predistortion

Organizer:
Kevin Chuang, *MaxLinear, MA, USA*

Instructors:
Juan A. Becerra, María J. Madero-Ayora, *Universidad de Sevilla, Spain*

Abstract:
In this short course, the fundamentals underlying the digital predistortion (DPD) concept are explained. It will be shown how the nonlinearities present in communication systems produce both in-band and out-of-band distortion that degrades their performance. This effect will be reviewed in time, frequency, and constellation domains of modulated signals along with commonly employed linearity indicators such as the normalized mean square error, adjacent channel power ratio and error vector magnitude. An important number of modern wireless communication standards employ spectrally efficient modulation schemes such as the orthogonal frequency division multiplexing (OFDM). The generation and demodulation of OFDM signals will be discussed and the challenges posed by their high peak-to-average power ratio will be illustrated. The representation of nonlinear systems with memory by means of the Volterra series will be introduced, involving scenarios for the modeling of a power amplifier and also for its linearization through DPD. In order to train the DPD, two possible architectures will be compared: the indirect learning architecture and the direct learning architecture. The construction of widely-used models as the memory polynomial and generalized memory polynomial will be examined together with the regression of models to identify their coefficients. Based on them, we can exemplify how rapid 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, for which a priori or a posteriori approaches can be followed. Through the a posteriori pruning approach, several coefficient selection techniques that exploit the sparsity in the regression process 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.

Course Syllabus:

-Basics of nonlinearities: effects in time, frequency and constellation domains.

-Orthogonal frequency division multiplexing (OFDM) signals generation. Volterra series in power amplifier (PA) modeling.

-Volterra series and digital predistortion (DPD). Indirect learning (ILA) and direct learning (DLA) architectures.

-Basic models: the memory polynomial (MP) and the generalized memory polynomial (GMP).

-Fundamentals of Volterra models: the curse of dimensionality, regression, and a priori versus a posteriori pruning.

-Coefficient selection techniques.

Technical Program for 2021 Radio & Wireless Week (RWW)

MONDAY, 18 JANUARY 2021 (8:00-11:00 ET)

Disitinguished Mirowave Lecture Talk 1

Chip-Scale Wave-Matter Interactions at RF-to-Light Frequencies: Circuits, Systems and Applications

Speaker:
Ruonan Han, *MIT, USA*

Abstract:
Traditional electromagnetic (EM) spectral sensors using integrated circuit technologies (e.g. automotive radars, security imagers, cameras, etc.) are normally based on remote wave scattering or absorption by macroscopic objects at remote distance; the operations are also not selective in wave frequencies. In the past couple of years, a new paradigm of chip-scale EM spectral sensing emerges with features complementary to the above: they utilize various modalities of interactions between EM waves with high-precision frequency control and microscopic particles (molecules, atoms, etc.) with close proximity to the chip. This progress is enabled by the recent advances of silicon devices and processes, as well as the extension of circuit operation frequencies into the terahertz regime. Chip-scale sensing and metrology systems with new capabilities, higher performance and unprecedented affordability now become possible. Examples include THz gas spectroscopy sensors, on-chip "atomic-clock-grade" frequency references, room-temperature CMOS-quantum magnetometers, etc. This talk will present the basic physics of the some wave-matter interactions, key enabling technologies, as well as the designs and prototypes of a few chip systems in the category described above. We will also discuss their potential applications in bio- chemical analysis, wireless networks, PNT (positioning, navigation & timing), security and so on.

Disitinguished Mirowave Lecture Talk 2

Fast Solvers for Electromagnetics-Based Analysis and Design of Integrated Circuits and Systems

Speaker:
Dan Jiao, *Purdue University, USA*

Abstract:
The design of advanced integrated circuits and microsystems from zero to terahertz frequencies calls for fast and accurate electromagnetics-based modeling and simulation. The sheer complexity and high design cost associated with the integrated circuits and microsystems prevent one from designing them based on hand calculation, approximation, intuition, or trial and error. The move towards higher frequencies and heterogeneous technologies stresses the need even more. However, the analysis and design of integrated circuits and microsystems impose many unique challenges on electromagnetic analysis such as exponentially increased problem size and extremely multiscaled system spanning from nano- to centi-meter scales. Prof. Jiao will present recent advances in fast solvers to tackle these challenges.

Disitinguished Mirowave Lecture Talk 3

Silicon-based Millimeter-wave Phased Arrays for 5G: Fundamentals to Future Trends

Speaker:
Bodhisatwa Sadhu, *IBM T. J. Watson, USA*

Abstract:
5G cellular communications use millimeter-wave phased arrays to achieve high data rates and low latency. The majority of the 5G millimeter-wave infrastructure will be partially or completely based on silicon technology. This talk will discuss key aspects of silicon-based millimeter-wave phased-array module design and characterization. It will cover fundamentals of phased arrays, provide an overview of phased array antenna modules using silicon technology, and take a deep dive into an example 5G phased array antenna module. The talk will end with a peek into the future of 5G directional communications.

Disitinguished Mirowave Lecture Talk 4

Towards Universally Programmable Chip-scale THz Source, Sensors and Systems: Bridging the THz and Application gap in the Next Decade

Speaker:
Kaushik Sengupta, *Princeton University, USA*

Abstract:
Silicon-based Terahertz systems is a field that is only about a decade old. In this time, we have seen a phenomenal growth of silicon systems operating at THz frequencies for a wide range of applications in sensing, imaging and communication. It can be argued that both the 'THz gap' and the 'technology and applications gap' is closing in meaningful ways in the THz range. Technologies beyond 100 GHz focusing on sensing, imaging and wireless back-haul links are getting attractive as we enter into a new area of highly dense network of autonomous systems requiring ultra-high speed and reliable links.

In order to move beyond this inflection point as Moore's law continue to slow, I will discuss why we need to look beyond the classical 'device'-level metrics of efficiency and sensitivity of THz sources and detectors towards holistic 'system' level properties such as scalability and programmability. Such properties are critically important for applications in sensing and imaging, as evidenced across sensor fusion technologies across mmWave, IR and optical frequencies. The ultimate programmability in THz sources and sensors is one that can synthesize or receive THz fields with arbitrary configuration and spectrum. In this talk, I will highlight approaches that cut across electromagnetics, circuits, systems and signal processing, to allow for such reconfigurability in THz signal synthesis and sensing, yet realized with devices that are themselves not very efficient. Particularly, we will demonstrate approaches to THz CMOS sensors reconfigurable across the three field properties of spectrum (100 GHz-1000 GHz), beam pattern and polarization, programmable THz metasurfaces with CMOS tiling, and enabling dynamic spectrum shaping and physically secure sub-THz links.

SUN. 17 January

MTT/ARFTG Event

Women in Microwaves

Starting Time: 10:00 ET

Moderator/Organizer:
Jasmin Grosinger, *Graz University of Technology*

Abstract:
At the Women in Microwave (WiM) event, we will put the spotlight on distinguished women in microwaves, who advanced the field of Microwaves Theory and Techniques and the field of Automatic Radio Frequency Techniques considerably.

Distinguished women in microwaves will give a review talk of the specific research topic they are working in and advancing. From today's view, the following distinguished women in microwaves will present their research:

Presenters:
High-Efficiency Amplifiers for Broadband High-PAR Signals
Zoya Popovic, *University of Colorado Boulder*

Energy-Autonomous Localization and Tracking
Alessandra Costanzo, University of Bologna

Metrology for Over-the-Air Tests: Extending the Traceability Path
Kate Remley, *National Institute of Standards and Technology*

Emerging Developments on Integrated SWIPT Receivers
Dominique Schreurs, *KU Leuven*

IEEE T-MTT Mini-Special Issue Announcement!

Calling all authors!

The IEEE Transactions on Microwave Theory and Techniques (IEEE T-MTT) will publish a Mini-Special Issue devoted to the IEEE RWW 2021 Conferences (RWW 2021), tentatively scheduled for the November 2021 issue. Authors of all papers relevant to topics of interest of T-MTT presented at the RWW 2021 Conferences are invited to submit an expanded version of their papers to the Mini-Special Issue. The expanded version requires that the new technical content includes a more in-depth treatment, new results beyond the RWW 2021 paper, or both. More details in https://mtt.org/

Expected publication:
November 2021

MON.-SAT. 11-16 January

Co-Located IoT Summit

"Wireless Sensing, with Wireless Sensors, in Wireless Sensor Networks for IoT Applications (WS3NI)"

A Six-Day Virtual Event

The 4th IEEE Internet of Things (IoT) Vertical and Topical Summit at RWW2021 addresses the important and crucial role that wireless devices play in the IoT ecosystem. The Summit is sponsored by MTT and by the multi-society IEEE IoT Initiative. The focus for the Summit is: "Wireless Sensing, with Wireless Sensors, in Wireless Sensor Networks for IoT Applications (WS3NI)". This year's theme emphasizes three aspects that are unique to wireless devices: (1) their use as sensors and consequently as the primary source of data for analytics in IoT applications and solutions; (2) their use as means of communications that allows the data and information, in either its raw or reduced form, to connect to computing, storage, and analysis platforms, as well as the return communications for executing actionable responses in the IoT control or decision cycle; and (3) the exploitation of networking for co-operative collection and analysis of data from a large number of sensors to create a more comprehensive situational view and understanding of conditions important for specific IoT applications.

IEEE Internet of Things

MON.-FRI. 18-22 January

Co-Located Conference

96th ARFTG Microwave Measurement Symposium

A Four-Day Virtual Event

Out of an abundance of caution amid the ongoing COVID-19 pandemic, the ARFTG Microwave Measurement Symposium takes place on 18th-22nd of January 2021 as a virtual event and is co-located with Radio and Wireless Week

How is ARFTG-96th different from other conferences? All regular presentations will be available for registered attendees a week in advance for viewing at your own convenience. All accepted submissions are presented in oral format. You will have an opportunity to interact with paper authors during live Q&A session scheduled during conference week.

Conference Invited Talks will be live-streamed and Panel Session will be a live event. Do not forget about NIST/ARFTG Short Course and the joint ARFTG/RWW Workshop as well as NVNA and On-Wafer User's Forum's which are key parts of ARFTG-96th Symposium Week.

Abbreviated Program on page 19

ARFTG

WED. 20 January

Young Professionals Panel Session

Time: 09:45 – 11:30 ET

Moderator/Organizer:
Pushkar Kulkarni, *Qualcomm*

With advancements in algorithms and technology, artificial intelligence (AI) and machine learning (ML) has found its way in abundance in practical applications. At RWW however, we will be focusing on how AI/ML techniques are becoming increasingly popular in RF/Microwave System Design and Signal Processing. Mark your program book, tell your friends, and join the RWW2021 Young Professionals session to learn about these exciting topics and opportunities that lie ahead. Please check the website for more information. Young Professionals session is free for IEEE/MTT-S Members.

Guest Speakers :

A Signal Processing Perspective on Modern Machine Learning and Neural Networks
M. Pilanci, *Stanford University*

Intelligent RF System Design using Artificial Intelligence
R. Gentile, *Mathworks*

Artificial Intelligence and Machine Learning for Wireless Communications
J. Kumar Sundararajan, *Qualcomm*

Machine Learning for Automotive RADAR Detection
S. Carpenter, U. Chipengo, *Ansys*

Solving 5G Issues using Artificial Intelligence and Machine Learning
C. Mueth, *Keysight*

MON. 18 January

Joint RWW Student Paper Contest (Live)

Time: 09:45 – 11:15 ET

Student Paper Contest Chairs:
Fabian Lurz, *Hamburg University of Technology*
Holger Maune, *Technical University of Darmstadt*

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 in the live RWW Student Paper Contest Session (Monday, January 18th, 2021, 09:45 – 11:15 ET) and will also present their work in their regular session. Judges will grade the papers and presentations in the following areas: novelty of the research, quality of the oral presentation, quantity and quality of the information presented, preparedness of the presenter and the student's performance in the live Q&A round after the elevator pitch. The two best student papers representing the entire RWW will be awarded at the Plenary Session, which takes place on Wednesday.

Student Paper Finalists:

TH1A-1 RFID Tattoo for COVID-19 Temperature Measuring

TH1A-4 Communication-Less Receiver-Side Resonant Frequency Tuning Method for Magnetically Coupled Wireless Power Transfer Systems

TH2D-2 Massive-MIMO and Digital mm-Wave Arrays on RF-SoCs using FDM for M-Fold Increase in Antennas per ADC/DAC

TH1D-2 S-Band Low Earth Orbit Reconfigurable Small Satellite System for Space Environment Sensing

TH1D-4 Wireless Payload Thermal-Vacuum Testing for Lunar Harsh Environment

TH2C-1 Hand Gesture Recognition Using FMCW Radar in Multi-Person Scenarios

TU1B-4 A Mm-Wave Gm-Assisted Transformer-Based Matching Network 2x2 Phased-Array Receiver for 5G

TU1D-3 A Compact Monostatic Transceiver Topology Using a Diode-Based Mixer

TU2A-3 An Anti-Interference System for Stationary and Moving Interferers

TU2A-4 Dynamic Range Requirements of Digital vs. RF and Tiled Beamforming in mm-Wave Massive MIMO

TU2B-1 A Low-Power Duty-Cycled Impulse-Radio Ultrawideband (IR-UWB) Transmitter with Bandwidth and Frequency Reconfigurability Scheme Designed in 180 nm CMOS Process

TU2C-4 FPGA Implementation of Memory-Based Digital Predistorters with High-Level Synthesis

WE2A-3 Spoofing Attacks to Radar Motion Sensors with Portable RF Devices

WE2D-4 MMIC GaAs X-band Isolator with Enhanced Power Transmission Response

WE2E-2 Experimental Extraction of Thermal Noise γ Factors in a 14-nm RF FinFET technology

WEDNESDAY, 20 JANUARY 2021

Joint RWW/ARFTG Plenary Session

Time: 8:00 - 9:45 ET

Laying the Groundwork for 6G Communications

Abstract: With the deployment of 5G accelerating, it is essential to lay the groundwork for 6G now. In this talk we will explore some of the megatrends driving the need to 6G, as well as some of the unique opportunities that 6G will enable. We will also review the need for coordination between WLAN, 6G and LEO communication to create the seamless, ubiquitous and secure communications network of the future. As the spectrum for 6G data rates is likely to extend beyond 100GHz, we will also review semiconductor device performance for 100GHz-300GHz networks, with a focus on advance SiGe and fully-depleted SOI technologies.

Peter Gammel, ***CTO, MWI Business Unit, GlobalFoundries***

Peter Gammel is vice president and CTO of the Mobile and Wireless Infrastructure BU at GlobalFoundries. He joined the company in 2019. Previously, he was the chief technology officer for Skyworks Solutions, Inc. and also served as chief technology officer and vice president of engineering at SiGe. Prior to this, he was vice president of engineering at Renaissance Wireless and chief technology officer at Advance Nanotech and for Agere Systems' Analog Products Business. He was also a distinguished member of technical staff at Alcatel-Lucent Bell Labs.

Gammel received a bachelor of science in physics and mathematics from Massachusetts Institute of Technology and a Ph.D. in physics from Cornell University.

Quantum Computing with Microwaves

Abstract: Quantum computing offers the potential for an exponential speed-up of certain classes of computational problems, and, as such, the development of a practical quantum computer has been a field of intense research over the past two decades. Yet, it is still early in the development of these systems, as we have just reached the point at which laboratory experiments have shown that quantum computers can outperform classical computers at certain computational tasks. As such, it is an exciting time in the field, analogous to the early days of classical computer development. As microwave engineers there is a tremendous opportunity to contribute to the field, as the control and measurement of most quantum processors is carried-out using microwave techniques. In this talk, I will describe the use of microwaves in quantum computing, with a focus on the superconducting qubit technology which was used to show that a quantum computer is capable of post-classical computation. The talk will be geared toward microwave engineers with no background in quantum computing and will provide a glimpse into the fundamentals, contemporary system architectures, recent experiments, and, finally, major microwave challenges that must be overcome if fault tolerant quantum computing is to become a reality.

Joseph Bardin, University of Amherst

Joseph Bardin received the PhD degree in electrical engineering from the California Institute of Technology in 2009. In 2010, he joined the department of Electrical and Computer Engineering at the University of Amherst, where he is currently a Full Professor. His research group currently focuses on low temperature integrated circuits with applications in radio astronomy and the quantum information sciences. In 2017, he joined the Google Quantum AI team as a visiting faculty researcher and, in addition to his university appointment, he currently serves as a staff research scientist with this team. Professor Bardin was a recipient of a 2011 DARPA Young Faculty Award, a 2014 NSF CAREER Award, a 2015 Office of Naval Research YIP Award, a 2016 UMass Amherst College of Engineering Barbara H. and Joseph I. Goldstein Outstanding Junior Faculty Award, a 2016 UMass Amherst Award for Outstanding Accomplishments in Research and Creative Activity, and a 2020 IEEE MTT-S Outstanding Young Engineer Award.

TUESDAY, 19 JANUARY 2021

RWS Session: TU1A

Antennas 1: Design & Analysis

Chair: Glauco Fontgalland, *Federal University of Campina Grande*
Co-Chair: Jasmin Grosinger, *Graz University of Technology*

Time: 8:00-9.15 ET

TU1A-1 3D-printed High-Directivity H-plane Horn Antenna with High Front-to-Back Ratio Using Soft and Hard Walls

M. R. Naeini, D. van der Weide, University of Wisconsin-Madison, WI, USA

TU1A-2 A Gain-Reconfigurable and Frequency-Beam-Steerable Additively Manufactured Antenna

C. R. Mejias-Morillo, S. LeBlanc, E. A. Rojas-Nastrucci, Embry-Riddle Aeronautical University, FL, USA

TU1A-3 Generalized Technique for Radiation Pattern Modeling of Multibeam Conformal Patch Array Antennas

T. Tang[1], G.R. Branner[1], Hung Tra[1], B. Preetham Kuma[2], [1]University of California Davis, CA, USA, [2]California State University Sacrament, CA, USA

TU1A-4 Non-Foster Matching Circuit Synthesis Using Artificial Neural Networks

Q. Li, T.-Y. Shih, University of Idaho, ID, USA

TU1A-5 Wideband Beam-Steerable Cylindrical Lens Antenna with Compact Integrated Feed Elements

S. Shad, H. Mehrpouya, Boise State University, ID, USA

RWS Session: TU1B

Circuits & Systems 1: mmW and Above

Chair: Sergio Pacheco, *NXP*
Co-Chair: TBA

Time: 8:00-9.30 ET

TU1B-1 A Monolithic-Integrated Broadband Low-Noise Optical Receiver with Automatic Gain Control in 0.25µm SiGe BiCMOS

G. Dziallas[1,2], A. Fatemi[1], A. Malignaggi[1], G. Kahmen[1], [1]IHP – Leibniz-Institut für innovative Mikroelektronik, Germany, [2]Brandenburg Technical University Cottbus, Germany

TU1B-2 A Compact, Single-Supply, DC to 30 GHz GaAs Active Input Match MMIC

G. Lasser, University of Colorado Boulder, CO, USA

TU1B-3 A 60-GHz Receiver Frontend With Gain-Linearity Tuning for FMCW Radar Applications

H. Ghaleb, A. Ferschischi, N. Joram, F. Ellinger, Technische Universität Dresden, Germany

TU1B-4 A Mm-Wave Gm-Assisted Transformer-Based Matching Network 2x2 Phased-Array Receiver for 5G Communication and Radar System (*Student Paper Finalist)*

K.-D. Chu, J. C. Rudel, University of Washington, WA, USA

TU1B-5 Comprehensive Physics-Based Model for Millimeter-Wave Transistor

S. Nouri, S. M. El-Ghazaly, University of Arkansas, AR, USA

TU1B-6 Noise Cancelling LNAs for Millimeter Wave Applications

M. Ghanevati, T. LaRocca, M.Trippett, Northrop Grumman, CA, USA

PAWR Session: TU1C

Power Amplifier Technology and Linearizaton 1

Chair: José C. Pedro, *Universidade de Aveiro*
Co-Chair: Pere Gilabert, *Universitat Politècnica de Catalunya*

Time: 8:00-9.25 ET

TU1C-1 Linearization for Wireless: Challenges and Opportunities *(Invited Talk)*

K. Chuang, MaxLinear, MA, USA

TU1C-2 Mixture of Experts Approach for Behavioral Modeling of RF Power Amplifiers

A. Brihuega[1], M. Abdelaziz[2], L. Anttila[1], Y. Li[3], A. Zhu[3], M. Valkama[1], [1]Tampere University, Finland, [2]Zewail City of Science and Technology, Egypt, [3]University College Dublin, Ireland

TU1C-3 A Bivariate Volterra Series Approach to Modeling and Linearization of Power Amplifiers

C. Crespo-Cadenas, M. J. Madero-Ayora, J. A. Becerra, Universidad de Sevilla, Spain

TU1C-4 Dataset Reduction for Neural Network Based Digital Predistorters under Strong Nonlinearities

D. López-Bueno, P. L. Gilabert, G, Montoro, Universitat Politècnica de Catalunya, Spain

SiRF Session: TU1D

mm-Wave Integrated Radar Sensors

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

Time: 8:00-9.10 ET

TU1D-1 MM-Wave Radar Systems on Silicon Chip: Principles, Waveforms, Realisations and Applications (*Invited Paper*)

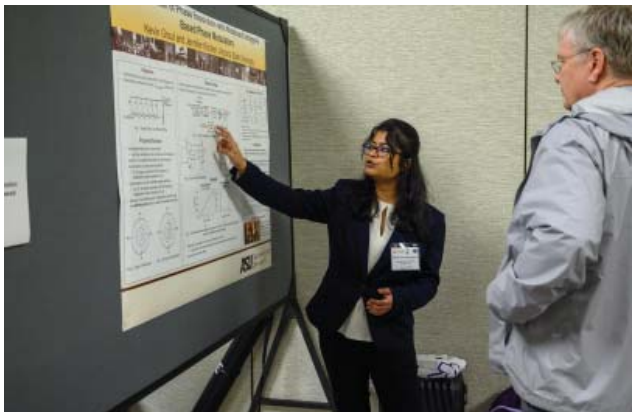
C. Vaucher[1,2], Alexander Yarovoy[1], [1]Delft University of Technology, The Netherlands, [2]NXP Semiconductors, The Netherlands

TU1D-2 Low-Power 60 GHz Receiver with an Integrated Analog Baseband for FMCW Radar Applications in 28 nm CMOS Technology

R. Ciocoveanu[1], V. Issakov[1,2], [1]Infineon Technologies AG, Germany, [2]Otto-von-Guericke University, Germany

TU1D-3 A Compact Monostatic Transceiver Topology Using a Diode-Based Mixer (*Student Paper Finalist)*

B. Sene[1,2], H. Knapp[1], D. Reiter[1,2], N. Pohl[2], [1]Infineon Technologies AG, Germany, [2]Ruhr-University Bochum, Germany



RWW2020 Interactive Session-
Courtesy of Lyle Photos, Atlanta

TUESDAY, 19 JANUARY 2021

PAWR Session: TU1E

Characterization and Measurement Based PA Design Techniques

Chair: Václav Valenta, *ESA/ES-TEC*
Co-Chair: Osman Ceylan, *Maury Microwave Corporation*

Time: 8:00-9.45 ET

TU1E-1 Measurement and Characterization of High Power Devices for mmW Application

O. Ceylan, J. Urbonas, T. Buber, Maury Microwave Coorporation, CA, USA

TU1E-2 Two-Tone Intermodulation Performance of a 300 GHz Power Amplifier MMIC

B. Schoch[1], A. Tessmann[2], A. Leuther[2], P. Szriftgiser[3], G. Ducournau[3], I. Kallfass[1], [1]University of Stuttgart, Germany, [2]Fraunhofer Institute for Applied Solid State Physics, Germany, [3]University of Lille, France

TU1E-3 Mixed-Mode Active Load-Pull Using one Single-Ended Device-Under-Test

K. Buisman[1,2], J.-R. Perez-Cisneros[2], W. Hallberg[3], D. Nopchinda[4], P. J. Zampardi[5], [1]University of Surrey, UK, [2]Chalmers University of Technology, Sweden, [3]Qamcom IPR Technology AB, Sweden, [4]University College London, UK, [5]Qorvo, Inc., CA, USA

TU1E-4 An Active Load-Pull Technique to Emulate Outphasing Power Amplifiers

J.-R. Perez-Cisneros[1], W. Hallberg[2], K. Buisman[1,3], [1]Chalmers University of Technology, Sweden, [2]Qamcom IPR Technology AB, Sweden, [3]University of Surrey, UK

TU1E-5 Measurement Uncertainty Analysis and Power Amplifier Design with Uncertainty Added S-parameter

O. Ceylan, T. Buber, G. Esposito, Maury Microwave Coorporation, Canada

RWS Session: TU2A

Antennas 2: Smart Antennas

Chair: Markus Gardill, *University of Würzburg*
Co-Chair: Erick Djoumessi, *Intel*

Time: 9.45-11:00 ET

TU2A-1 Ka-Band Offset Spherical Reflector Antenna Fed by Dual-CP Horn Array with Switched Multiple-Beams

G. Mishra, S. K. Sharma, San Diego State University, CA, USA

TU2A-2 Switched Beam SIW Horn Arrays at 60 GHz for 360° Chip-to-Chip Communications

P. Baniya, K. L. Melde, University of Arizona, AZ, USA

TU2A-3 An Anti-Interference System for Stationary and Moving Interferers (*Student Paper Finalist*)

F. Tamjid,T. Kvelashvili, O. Kilic, A. E. Fathy, The University of Tennessee, TN, USA

TU2A-4 Dynamic Range Requirements of Digital vs. RF and Tiled Beamforming in mm-Wave Massive MIMO (*Student Paper Finalist*)

A. A. Farid, M. Abdelghany, U. Madhow, M. J. W. Rodwel, University of California Santa Barbara, CA, USA

RWS Session: TU2B

Circuits and Systems 2: Microwave to mmWave

Chair: Robert H. Caverly, *Villanova University*
Co-Chair: TBA

Time: 9.45-11:00 ET

TU2B-1 A Low-Power Duty-Cycled Impulse-Radio Ultrawideband (IR-UWB) Transmitter with Bandwidth and Frequency Reconfigurability Scheme Designed in 180 nm CMOS Process (*Student Paper Finalist*)

D. K. Biswas, I. Mahbub, University of North Texas, TX, USA

TU2B-2 A Low-Power Integrating and Sampling Demodulator for 3-5 GHz IR-UWB Applications

D. Schrüfer[1], J. Röber[2], A. Schwarzkopf[2], T. Rabenstein[2], T. Mai[1], R. Weigel[1], [1]Friedrich-Alexander-University Erlangen-Nuremberg, Germany, [2]eesy-IC GmbH, Germany

TU2B-3 System-level Performance Analysis of High-Data-Rate Frequency-to-Amplitude Converter based CPFSK Transceiver at 60 GHz

Y. Wang, M.-D. Wei, R. Negra, RWTH Aachen University, Germany

TU2B-4 Gallium Nitride Monolithic Microwave Integrated Circuits for Compact Ka-Band Earth Science Remote Sensing Frontend

A. Fung[1], J. Hoffman[1], L. Samoska[1], M. Soria[1], A. Peralta[1], S. Sin[1], R. Lin[1], M. Tsai[1], C. S. Chae[1], S. Brown[1], S. Misra[1], E. Im[1], S. Chen[2], Y. Cao[2], [1]Jet Propulsion Laboratory, CA, USA, [2]Qorvo Inc, TX, USA

TU2B-5 Vector Modulator Phase Shifters in 130-nm SiGe BiCMOS Technology for 5G Applications

A. Franzese[1], M. H. Eissa[1], D. Kissinger[2], A. Malignaggi[1], [1]IHP-Leibniz-Institut fur innovative Mikroelektronik, Germany, [2]Ulm University, Germany

PAWR Session: TU2C

Power Amplifier Technology and Linearizaton 2

Chair: Anding Zhu, *University College Dublin*
Co-Chair: Roberto Quaglia, *University of Cardiff*

Time: 9.45-11.25 ET

TU2C-1 GaN Long-Term Memory Compensation: Understanding the Device Physics to Achieve Better System Performance (*Invited Paper*)

J. C. Pedro, T. R. Cunha, F. E. Barradas, L. C. Nunes, Universidade de Aveiro, Portugal

TU2C-2 Recursive Pre-Distorter for Hardware Efficient Digital Pre-Distortion

D. Byrne, R. Farrell, J. Dooley, Maynooth University, Ireland

TU2C-3 Peak Limited Digital Predistortion of a RF Power Amplifier using a Closed Loop Estimator

R. Neil Braithwait, Keysight Technologies, CA, USA

TU2C-4 FPGA Implementation of Memory-Based Digital Predistorters with High-Level Synthesis (*Student Paper Finalist*)

W. Li, E. Guillena, G. Montoro, P. L. Gilabert, Universitat Politècnica de Catalunya, Spain

TU2C-5 Investigation of Power Amplifier Performance Under Load Mismatch Conditions (*Student Paper*)

R. Argaez-Ramirez, J.-R. Pérez-Cisneros, C. Fager, Chalmers University of Technology, Sweden

TUESDAY, 19 JANUARY 2021

SiRF Session: TU2D

mm-Wave Circuits towards THz

Chair: Ahmet Cagri Ulusoy, *Karlsruhe Institute of Technology*
Co-Chair: TBA

Time: 9:45-11.20 ET

TU2D-1 Scalable Standing Wave Integrated Circuits for Power Generation, Radiation and Beam Steering at mm-Wave and Terahertz Spectrum (*Invited Paper)*

O. Momeni, University of California Davis, CA, USA

TU2D-2 Towards Universally Programmable Chip-scale THz Source, Sensors and Systems: Bridging the THz and Application gap in the Next Decade (*Invited Paper)*

K. Sengupta, Princeton University, NJ, USA

TU2D-3 A 314-344 GHz Frequency Doubler with Driving Stage and 1dBm Psat in SiGe BiCMOS Technology

S. Breun[1], A.-M. Schrotz[1], M. Dietz[1], V. Issakov[2], R. Weigel[1], [1]Friedrich-Alexander University Erlangen-Nuremberg, Germany, [2]Otto-von-Guericke-University, Germany

PAWR Session: TU2E

High Efficiency PA Designs

Chair: Christian Fager, *Chalmers University of Technology*
Co-Chair: Vittorio Camarchia, *Politecnico di Torino*

Time: 9.45-11.25 ET

TU2E-1 GaN-on-Diamond Power Amplifiers in 2021: RF, Linearity, and Thermal Data (*Invited Paper)*

F. Ejeckam, K. Kong, AKASH Systems, CA, USA

TU2E-2 A 3.5GHz High Power GaN Hybrid Doherty Power Amplifier with Dynamic Input Power Splitting for Enhanced Power Added Efficiency at Backoff

J. Romero Lopera[1], J. Mayock[2], Q.Sun[2], M. Gadringer[1], W.Bosch[1], E. Leitgeb[1], [1]TU Graz, Austria, [2]VIPER RF, UK

TU2E-3 3.3-3.6 GHz Phase Exploited Doherty Power Amplifier with Parallel Load Combining Network

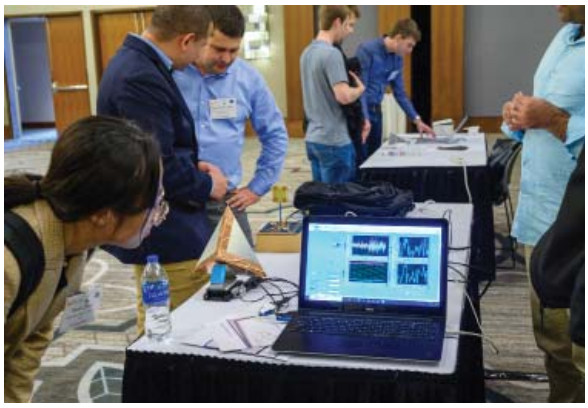
D. Roychowdhury, J. Kitchen, Arizona State University, AZ, USA

TU2E-5 A Ka Band 2-Stage Linear Doherty Amplifier with 23dBm Psat and 29% 6dB-Backoff PAE in pMOS-SOI

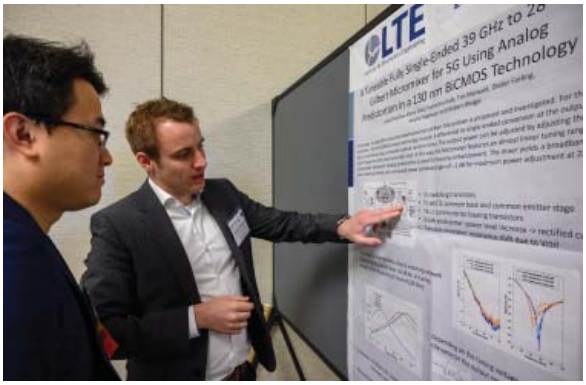
S. Alluri, N. Rostomyan, P. Asbeck, University of California San Diego, CA, USA

TU2E-4 Outphasing Class-E/F2 Power Amplifier using a Quadrature Hybrid as Non-Isolating Combiner

A. Cordero, M. N. Ruiz, D. Vegas, J. A. García, University of Cantabria, Spain



RWW2020 Demo Track,
Courtesy of Lyle Photos, Atlanta



Student Finalist RWW2020
Courtesy of Lyle Photos, Atlanta

RWW2020 Welcome Reception-
Courtesy of Lyle Photos, Atlanta

WEDNESDAY, 20 JANUARY 2021

RWS Session: WE2A

Microwave Sensing & Radar

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

Time: 9.45-11:25 ET

WE2A-1 A Radio-Frequency-Based Propellant Slosh Sensor for Spacecraft Tanks

D. Sommer, N. Moline, E. A. Rojas-Nastrucci, Embry-Riddle Aeronautical University, FL, USA

WE2A-2 Experimental Evaluation of Millimeter-Wave FMCW Radar Ranging Precision

W. A. Ahmad, A. Ergintav, IHP - Leibniz-Institut fur innovative Mikroelektronik, Germany

WE2A-3 Spoofing Attacks to Radar Motion Sensors with Portable RF Devices (*Student Paper Finalist*)

D. Rodríguez, J. Wang, C. Li, Texas Tech University, TX, USA

WE2A-4 A Novel Iterative Method to Estimate the Soil Complex Permittivity from Measurement and Simulation Modeling

M. M. Alves[1], M. T. de Melo[1], L. R. G. S. Lourenço Novo[1], L. H. A. de Medeiros[1], M. S. Coutinho[1], D. C. P. Barbos[1], R. G. M. dos Santos[1], V. L. Tarragó[1], H. B. D. T. Lott Neto[2], P. H. R. P. Gama[3], [1]Universidade Federal de Pernambuco, Brazil, [2]Sistemas de Transmissão Nordeste S/A, Brazil, [3]Instituto Avançado de Tecnologia e Inovação, Brazil

RWS Session: WE2B

Cognitive, Adaptive and DSP Systems

Chair: Markus Gardill, *University of Würzburg*
Co-Chair: TBA

Time: 9.45-11:25 ET

WE2B-1 28GHz Cooperative Digital Beamforming for 5G Advanced System on an SDR Platform

Y. Fujii, T. Iye, K. Tsuda, A. Tanibayashi, Kozo Keikaku Engineering, inc., Japan

WE2B-2 Dyadic Allpass Notch Filter Architecture and Design

Y. Wang, S. R. Velazquez, Innovation Digital, LLC, CA, USA

WE2B-3 Phase-based Doppler Disambiguation in TDM and BPM MIMO FMCW Radars

C. Liu, H. A. Gonzalez, B. Vogginger, C. G. Mayr, Technische Universität Dresden, Germany

WE2B-4 Distortion Compensation Method on SC-FDE Modulation using for 42-GHz band UHDTV Wireless Camera

F. Yamagishi, Y. Matsusaki, T. Shimazaki, T. Nakagawa, N. Iai, Japan Broadcasting Corporation, Japan

WE2B-5 On the BER Analysis of OFDM Receivers Against Phase Noise Imperfection

B. Sen Aselsan A.S.,Turkey

WiSNeT Session: WE2C

RFID Sensors, Sensor Tags and Localization

Chair: Amr Fahim, *University of California Riverside*
Co-Chair: Alessandra Costanzo, *University of Bologna*

Time: 9.45-11:25 ET

WE2C-1 On-the-fly Adaptation of Backscatter Modulator Impedances Using Digitally-Tuned Capacitors

J. D. Rosenthal, M. S. Reynolds, University of Washington, WA, USA

WE2C-2 Analysis of Design Trade-Offs in Ultra-Low-Power FSK Receivers for Phase-Based Ranging

M. Moosavifar, D. Wentzloff,University of Michigan, MI, USA

WE2C-3 A 50.7-Bit Retransmission-Based Chipless RFID Tag With Miniaturized Resonators

R. E. Ghiri, K. Entesari,Texas A&M University, TX, USA

WE2C-4 Optimization of a High Frequency Radio Frequency Identification System for Tool Recognition in a Metal Environment

M. Fischer, D. Mair, G. Saxl, T. Ussmueller, University of Innsbruck, Austria

WE2C-5 Support Application for Configuring Optimal Relay Nodes in Wireless Sensor Networks

E. Oda,K. Kawauchi, T. Hamasaki, Hiroshima Institute of Technology, Japan

SiRF Session: WE2D

Building Blocks for Communication Systems

Chair: Saeed Zeinolabedinzadeh, *Arizona State University*
Co-Chair: TBA

Time: 9:45-11.10 ET

WE2D-1 Innovative Trends in MW Front Ends (*Invited Paper*)

W. Boesch, Graz University of Technology, Austria

WE2D-2 A 60 GHz Low Power Integrated Quasi-Circulator in 22 nm FDSOI Technology

M. V. Thayyil, J. Pliva, M. Cui, N. Joram, F. Ellinger, Technische Universität Dresden, Germany

WE2D-3 A 5.4GHz 0.65dB NF 6dBm IIP3 MGTR LNA in 130nm SOI CMOS

A. Jha[1], J. Zheng[2], C. Masse[2], P. Hurwitz[2], S. Chaudhry[2], [1]Renesas Electronics America, CA, USA, [2]Tower Semiconductor, CA, USA

WE2D-4 MMIC GaAs X-band Isolator with Enhanced Power Transmission Response (*Student Paper Finalist*)

A. Ashley[1], G. Lasser[1], Z. Popovic[1], A. Madanayake[2], D. Psychogiou[1], [1]University of Colorado Boulder, CO, USA, [2]Florida International University, FL, USA

SiRF Session: WE2E

Device Modeling and Characterization Techniques

Chair: Venkata Malladi, *NXP Semiconductors*
Co-Chair: TBA

Time: 9:45-11.10 ET

WE2E-1 SiGe and SOI Technologies for mmWave Applications (*Invited Paper*)

N. Cahoon, Globalfoundries, USA

WE2E-2 Experimental Extraction of Thermal Noise γ Factors in a 14-nm RF FinFET technology (*Student Paper Finalist)*

X. Ding, G. Niu, A. Zhang, W. Cai, K. Imur, Auburn University, AL, USA

WE2E-3 Frequency Sensitivity of Integrated Oscillators to Nearby Conductors

A. Jha[1], Kenneth K. O.[2], [1]Renesas Electronics America, USA, [2]University of Texas Dallas, TX, USA

WE2E-4 Layout Optimization of Short De-embedding Structure for Accurate On-Chip Inductor Characterization

K. T. Muhammed Shafi, V. Baipadi, V. Vanukuru, GLOBALFOUNDRIES, India

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THURSDAY, 21 JANUARY 2021

RWS Session: TH1A

RFID, Wireless Power Tranfer and Near-Field Systems

Chair: Nuno Borges Carvalho, *Universidade de Aveiro*
Co-Chair: Jasmin Grosinger, *Graz University of Technology*

Time: 8.00-9:30 ET

TH1A-1 RFID Tattoo for COVID-19 Temperature Measuring (*Student Paper Finalist)*

T. M. Silveira[1], P. Pinho[2], [1]N. B. Carvalho, [1]Universidade de Aveiro, Portugal, [2]Instituto Sup. de Eng. de Lisboa, Portugal

TH1A-2 A Tile-based 8×8 Triangular Grid Array Beamformer for 5.7 GHz Microwave Power Transmission

K. Arai, K. Wang, M. Toshiya, M. Higaki, K. Onizuka, Toshiba Corp., Japan

TH1A-3 BER Analysis and Optimization of Direct Antenna Modulation for Magnetic Induction Communication

R. Chapman, M. Prince, H. Guo, Norfolk State University, VA, USA

TH1A-4 Communication-Less Receiver-Side Resonant Frequency Tuning Method for Magnetically Coupled Wireless Power Transfer Systems (*Student Paper Finalist)*

K. Matsuura, D. Kobuchi, Y. Narusue, H. Morikaw, The University of Tokyo, Japan

TH1A-5 EC Model for WPT and NFC Systems Interoperability Analysis

K. R. Fischbacher[1], L. Gortschacher[1], E. Merlin[2], U. Muhlmann[2], F. Amtmann[2], P. Priller, W. Bosch[1], J. Grosingen[1], [1]Graz University of Technology, Austria, [2]NXP Semiconductors Austria, Austria, [3]AVL LIST GmbH, Austria

TH1A-6 Hybrid Dual Band Radio Frequency and Solar Energy Havesting System for Making Battery-less Sensing Nodes

M. Hamza, M. Rehman, A. Riaz, Z. Maqsood, W. T. Khan, Lahore University of Management Sciences; Pakistan

RWS Session: TH1B

Wireless Networks

Chair: Kevin Chuang, *MaxLinear*
Co-Chair: TBA

Time: 8.00-9:15 ET

TH1B-1 Base Station Selection Method for RAT-Dependent TDOA Positioning in Mobile Network

N. Tsumachi, T. Ohseki, K. Yamaza, KDDI Research, Inc., Japan

TH1B-2 Analysis of VANET Wireless Networking Technologies in Realistic Environments

M. N. Tahir[1], M. Katz[2], U. Rashid[3], [1]Finnish Meteorological Intitute, Arctic Space Center, Finland, [2]University of Oulu, Finland, [3]University of Helsinki, FInland

TH1B-3 Throughput Performance Prediction Approach for Wi-Fi Site Surveys

A. Tatsuta, Y. Shimazaki, T. Emura, T. Asada, T. Hamabe, Panasonic Coorporation, Japan

TH1B-4 Towards the Flexible and Efficient Implementation of the 5G-NR RAN Physical Layer

F. D. L. Coutinho, J. D. Domingues, P. M. C. Marques, S. S. Pereira, H. S. Silva, A. S. R. Oliveira, Universidade de Aveiro, Portugal

TH1B-5 Portfolio Theory in Millimeter-Wave Coordinated Multi-Point Transmission

L. Cheng, B. A. Huberman, M. Xu, Next-Gen Systems CableLabs, CO, USA

WiSNeT Session: TH1C

Wireless Sensor Network: Localization and Sensing Applications

Chair: Rahul Khanna, *Intel*
Co-Chair: TBA

Time: 8:00-9:15 ET

TH1C-1 Transfer Learning of Wi-Fi FTM Responder Positioning with NLOS Identification

H.-W. Chan, A. I-Chi Lai, R.-B. Wu, National Taiwan University, Taiwan

TH1C-2 RF Energy Harvesting from GFSK-Modulated BLE Signal

G. Paolini[1], Y. Murillo[2], S. Claessen[2], D. Masotti[1], S. Pollin[2], A. Costanzo[1], D. Schreurs[2], [1]University of Bologna, Italy, [2]KU Leuven, Belgium

TH1C-3 Wireless Sensor Network with Mesh Topology for Carbon Dioxide Monitoring in a Winery (*Student Paper)*

J. Nelson, C. Andoh, A. Comia, L. Echeveria, J. Hopkins, M. Maniti, T. Pierce, University of California Davis, CA, USA

TH1C-4 A Supercapacitor Powered Radar Sensor Node for Lamination into Wind Energy Rotor Blades

T. Kurin[1], S. Erhardt[1], R. Weigel[1], F. Lurz[2], [1]Friedrich-Alexander-University Erlangen-Nuremberg, Germany, [2]Hamburg University of Technology, Germany

TH1C-5 Multi-Detector Deep Neural Network for High Accuracy Wi-Fi Fingerprint Positioning

C.-Y. Chen, A. I-Chi Lai, R.-B. Wu, National Taiwan University, Taiwan

SHaRC Session: TH1D

Satellite System Concepts and Testing

Chair: Charlie Jackson, *Northrop Grumman Corporation*
Co-Chair: Holger Maune, *TU Darmstadt*

Time: 8:00-9:15 ET

TH1D-1 Efficient Data Uploads to Satellite Formations by Rateless Codes and Adaptive Tracking

A. Freimann[1], T. Petermann[1], K. Schilling[1], H. Döbler[2], B. Scheuermann[2], [1]University of Wurzburg, Germany, [2]Humboldt University of Berlin, Germany

TH1D-2 S-Band Low Earth Orbit Reconfigurable Small Satellite System for Space Environment Sensing (*Student Paper Finalist)*

N. Miguélez-Gómez,C. R. Mejias-Morillo, E. A. Rojas-Nastrucci, Embry-Riddle Aeronautical University, FL, USA

TH1D-3 Extended Ground Station Concept and its Impact on the In-Orbit Communication with the Four-Nano-Satellite Formation NetSat

A. Kleinschrodt[1],T.Horst[2], E. Jager[1], A. Freimann[2], S. Dombrovski[1], R. Haber[1], K. Schilling[1,2], [1]Zentrum für Telematik, Germany, [2]Julius-Maximilians-Universität, Germany

TH1D-4 Wireless Payload Thermal-Vacuum Testing for Lunar Harsh Environment (*Student Paper Finalist)*

J. I. Sahr, D. Posada, N. Miguélez-Gómez, D. Korczyk, K. Pepin, J. Parkhurst, C. W. Hays, T. Henderson, E. A. Rojas-Nastrucci, Embry-Riddle Aeronautical University, FL, USA

TH1D-5 Modeling A Loop Back Test For Radar Phased Array Digital Receiver Exciters Using Pytho

J. Mortensen, M. Wicker, University of Colorado Colorado Spring, CO, USA

THURSDAY, 21 JANUARY 2021

SiRF Session: TH1E

High-Frequency Circuits and Systems for 5G towards 6G

Chair: Vadim Issakov, *University Magdeburg*
Co-Chair: TBA

Time: 8:00-9.25 ET

TH1E-1 IC, Package, and System Technologies for 140GHz MIMO Hubs and 210/280GHz MIMO Backhaul Links (*Invited Paper*)

M. Rodwell[1], A. Ahmed[1], A. Farid[1], U. Solyu[1], M. Seo[1,2], [1]University of California Santa Barbara, USA, [2]Sungkyunkwan University, Korea

TH1E-2 28GHz RX Frontends with Sub-harmonic-based mm-wave LO Generation in 16nm FinFET

B. Jann[1,3], S. Jain[1,2], A. Ravi[3], S. Patnaik[4], A. Natarajan[1], [1]Oregon State University, OR, USA, [2]Apple Inc., USA, [3]Intel Corp., [4]USA, Amazon, USA

TH1E-3 A 25-37 GHz VCO Employing Stacked-Coupled Switched Inductor and Co-Tuned Buffer in 55nm CMOS for Multi-band 5G mmW Applications

R. Wang[1], J. Li[1], C. Shi[1], J. Chen[2], R. Zhan[1], [1]East China Normal University, China, [2]University of Houston, TX, USA

TH1E-4 85 fs RON×COFF and CP1dB@28GHz > 25dBm Innovative PIN Diode Integrated in 55 nm BiCMOS Technology Targeting mmW 5G and 6G Front End Module

O. Foissey[1], F. Gianesello[1], V. Gidel[1,2], C. Durand[1], A. Gauthier[1], N. Guitard[1], P. Chevalier[1], M. Hello[1], J. Azevedo-Goncalves[1], D. Gloria[1], V. Velayudhan[3], J. Lugo[1],STMicroelectronic, France, Univ. Nice Sophia-Antipolis, France, CEA-LETI, France

RWS Session: TH2A

Passive Components and Packaging

Chair: Roberto Gómez-García, *University of Alcalá*
Co-Chair: TBA

Time: 9.45-11:00 ET

TH2A-1 Additively Manufactured Interdigital Filters for Ultra-Wideband Radar

F. Rodriguez-Morales[1], B. Brown[2], A. Sutton[3], M. Leu[3], F. Liou[3], S. Garrison[4], A. Wolf[2], [1]University of Kansas, KS, USA, [2]Honeywell FM&T, MO, USA, [3]Missouri University of S&T, MO, USA, [4]Sandia National Lab, NM, USA

TH2A-2 Balanced-Circuit-Based Dual-Band Bandpass Filter With Symmetrical Reflectionless Behavior

M. Fan[1], K. Song[1], L. Yang[2], R. Gómez-García[2], [1]University of Electronic Science and Technology of China, China, [2]University of Alcalá, Spain

TH2A-3 Impact of Surface Effects on RF Switching PIN Diodes

B. Stephanson, R. H. Caverly, Villanova University, PA, USA

TH2A-4 Lumped Element High Precision X-Band Bandpass Filter with Through Silicon Via (TSV) Integrated Passive Device (IPD) Technology

K. R. Shin, K. Eilert, ON Semiconductor, USA

TH2A-5 X-Band Transmitter Leakage Canceller for FMCW Radar Application

M. Mahdi, M. Darwish, H. Tork, A. A. Eltager, Military Technical College, Egypt

RWS Session: TH2B

Wireless Channels

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

Time: 9.45-10:15 ET

TH2B-1 Spatially Resolved Multi-Transmitter Ka-Band Channel Measurements for Receiver Localization

A. Schultze, S. Wittig, W. Keusgen, Fraunhofer Heinrich Hertz Institute, Germany

TH2B-2 Wireless Channel and Electromagnetic Environments for Through-the-earth (TTE) Communications in an Underground Coal Mine

C. Zhou, N. Damiano, National Institute for Occupational Safety and Health, PA, USA

WiSNeT Session: TH2C

Wireless Sensors for Communication: Antennas, Radar and Positioning

Chair: Paolo Mezzanotte, *University of Perugia*
Co-Chair: Jeniffer Williams, *Intel*

Time: 9.45-11:00 ET

TH2C-1 Hand Gesture Recognition Using FMCW Radar in Multi-Person Scenarios (*Student Paper Finalist)*

D. V. Q. Rodrigues, C. Li, Texas Tech University, TX, USA

TH2C-2 Velocity Estimation Based on Two-Dimensional Cross-Correlation of Radar Signals

M. Scherhäuf[1], H. Haderer[2], A. Stelzer[3], [1]Linz Center of Mechatronics GmbH, Austria, [2]Inras GmbH, Austria, [3]Johannes Kepler University Linz, Austria

TH2C-3 Range Doppler Migration Synthesis for Realistic Radar Target Simulation

A. Diewald, T. Antes, B. Nuss, M. Pauli, T. Zwick, Karlsruhe Institute of Technology, Germany

TH2C-4 Effects of Target Displacement on Single-Snapshot DOA Estimation in Automotive Radar

H. Liu[1,2], J.Fuchs[1], T. Horn[2], M. Gardill[3], [1]Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany, [2]InnoSenT GmbH, Germany, [3]Julius-Maximilians-Universität Würzburg, Germany,

TH2C-5 Intermodulation Radar with Dynamic Fundamental Tone Cancellation for Linearity Improvement

D. Tang, A. Mishra, C. Li, Texas Tech University, TX, USA

SHaRC Session: TH2D

Antennas & RF-Front-ends for Satellite Applications

Chair: Holger Maune, *TU Darmstadt*
Co-Chair: Charlie Jackson, *Northrop Grumman Coorporation*

Time: 9:45-11:00 ET

TH2D-1 High-Speed FPGA-Based Payload Computer for an In-Orbit Verification of a 71-76 GHz Satellite Downlink

L. Manoliu[1], B. Schoch[1], M. Koller[1], J. Wieczorek[2], S. Klinkner[1], I. Kallfass[1], [1]University of Stuttgart, Germany, [2]Thales Alenia Space Deutschland, Germany

TH2D-2 Massive-MIMO and Digital mm-Wave Arrays on RF-SoCs using FDM for M-Fold Increase in Antennas per ADC/DAC (*Student Paper Finalist*)

N. Akram[1], A. Madanayake[1], S. B. Venkatakrishnan[1], J. L. Volakis[1], D. Psychogiou[2], T. L Marzetta[3], T. S. Rappaport[3], [1]Florida International University, FL, USA, [2]University of Colorado Boulder, CO, USA, [3]New York University, NY, USA

TH2D-3 X-band Phased Array Antenna with Integrated TR Modules for Re-entry Spacecraft

Y. J. Ren, G. Yang, General Microwave Technologies, Inc., CA, USA

TH2D-4 Design of X- and Ka-Band Reflectarray Antennas for Interceles-tial Communication Using CubeSat Relay

N. Virushabados, N. Mahjabeen, H. S. P. Baksh, R. Henderson, University of Texas at Dallas, TX, USA

TH2D-5 Dual Mode Phased Array Antenna using Silicon RFICs based Integrated Beamforming Network

C. Laffey[1], S. K. Sharma[1], R. Farkouh[2], J.-C. S. Chieh[2], [1]San Diego State University, CA, USA, [2]Naval Information Warfare Center Pacific, CA, USA

SiRF Session: TH2E

Emerging SiRF Applications

Chair: Vadim Issakov, *University Magdeburg*
Co-Chair: TBA

Time: 9.25-11.45 ET

TH2E-1 Towards a Quantum Computer on a Chip (*Invited Paper*)

R. Staszewski, University College Dublin, Ireland

TH2E-2 Broadband Pulse-Based THz Sources and Detectors in Silicon and their Applications (*Invited Paper*)

A. Babakhani, University of California Los Angeles, CA, USA

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WiSNeT Session: FR1A

Six-Port and Multi-Port Technology

Chair: Alexander Koelpin,
Hamburg University of Technology
Co-Chair: TBA

Time: 8:00-8:45 ET

FR1A-1 Wideband Five-Port Reflectometer

Y. Ostapovets, S. Koryciak, K. Stasze, AGH University of Science and Technology, Germany

FR1A-2 Low-Cost Six-Port for High-Volume Frequency Measurement Systems in the 2.4 GHz ISM-Band

B. Scheiner[1], F. Probst[1], F. Michler[1], R. Weigel[1], A. Koelpin[2], F. Lurz[2], [1]Friedrich-Alexander University Erlangen-Nuremberg, Germany, [2]Hamburg University of Technology, Germany

FR1A-3 Optimization of 16-QAM for Mitigating Impairments in 60 GHz Six-port Receivers

R. M. Evina[1], C. Hannachi[2], S. Ovidiu[1] Tatu, [1]INRS-Énergie Matériaux Télécommunications, Canada, [2]Université de Sorbonne, France

RWS Session: FR1B

Late News

Chair: Robert H. Caverly,
Villanova University
Co-Chair: TBA

Time: 9.45-11:25 ET

FR1B-1 A Reflection Type Phase Shifter for Reconfigurable Reflectarrays at 240 GHz

Ekaterina Kunakovskaya, A.Cagri Ulusoy, Karlsruhe Institute of Technology, Germany

FR1B-2 A Planar Quasi Yagi-Uda Antenna Designed For Liquid Crystal Based End-Fire Phased Arrays

D. Wang, M. Nickel, P. Schumacher, E. Polat, H. Tesmer, R. Jakoby, H. Maune, Technische Universität Darmstadt, Germany

FR1B-3 UV Illumination Effects on AlGaN/GaN HEMTs for Tunable RF Oscillators

S. Stein, M. Robbins, P. Reddy, R. Collazo, S. Pavlidis, North Carolina State University, NC, USA

FR1B-4 A Wireless 60 GHz Data Link using a Phasor Rotator Based Costas Loop

C. Heine[1], V. Lammert[2], V. Issakov[3], D. Kissinger[1], [1]Ulm University, Germany, [2]Infineon Technologies AG, Germany, [3]University of Magdeburg, Germany

FR1B-5 A 60-GHz Variable Gain Amplifier with Phase-Compensated Variable Attenuator

G. H. Park, J. K. Kwon, D. M. Kang, C. S. Park, Korea Advanced Institute of Science and Technology, Korean

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96th ARFTG MICROWAVE MEASUREMENT SYMPOSIUM

- ABBREVIATED PROGRAM -

MONDAY, 18 JANUARY 2021 - FRIDAY, 22 JANUARY 2021

General Co-Chairs: Rusty Myers, Andrej Rumiantsev
Technical Program Co-Chairs: Jeffrey Jargon, Peter Aaen

Monday, January 18th, 2021

NIST-ARFTG Short Course on Microwave Measurements
9:45 am - 11:15 am ET **First live Q&A** (Live)
8:00 pm - 9:30 pm ET **Second live Q&A** (Live)
NVNA Users Forum
11:30 am - 12:30 am ET **Session with Q&A** (Live)

Tuesday, January 19th, 2021

9:45 am - 10:25 am ET **Invited Talk: Modulation Analysis – A Novel Way to Characterize Components under Modulated Operating Conditions** (Live)
Jan Verspecht (Keysight Technologies)
10:25 am - 10:40 am ET **ARFTG Business meeting** (Live)
10:40 am - 11:15 am ET **Session A Q&A** (Live)

Wednesday, January 20th, 2021

8:00 am - 9:45 am ET **RWW/ARFTG Plenary Keynote** (Live)
9:45 am – 10:45 am ET **Panel Session: Uncertainty in mmWave Over-the-Air Test** (Live)
Moderated by Dylan Williams (NIST) and Kate Remley (NIST)
10:45 am - 11:15 am ET **Session B Q&A** (Live)
11:30 am - 12:30 am ET **MicroAps**

Thursday, January 21st, 2021

9:45 am – 10:25 am ET **Invited Talk: Traceability and Uncertainty – What Are They? And Why Do We Need Them?** (Live)
Nick Ridler (National Physical Laboratory)
10:25 am - 10:40 am ET **Keithley Award Ceremony** (Live)
10:40 am - 11:15 am ET **Session C Q&A** (Live)
ARFTG On-Wafer Users Forum
11:30 am - 12:30 am ET **Session with Q&A** (Live)

Friday January 22nd, 2021

8:00-12:00 am ET **Joint ARFTG/RWW-2021 Workshop: Modeling and Design Tools for Accelerated Design of 5G GaN PAs**
Organizers: Nicholas Miller (AFRL), Patrick Roblin (Ohio State University)

ARFTG Event
Courtesy of Lyle Photos, Atlanta