2023 IEEE Radio & Wireless Week

Final Program

Las Vegas, NV, USA · 22-25 January, 2023 · Planet Hollywood Hotel

RWW · RWS · SiRF · WiSNet · PWR · SHaRC

2023 Radio & Wireless Week Sponsors

IEEE Microwave Theory and Techniques Society (MTT-S)

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GREETINGS FROM GENERAL CHAIR OF RADIO & WIRELESS WEEK 2023

General Chair
Alexander Koelpin

Welcome to the 18th IEEE Radio & Wireless Week (RWW), welcome to Las Vegas, Nevada! Directly located at the famous Las Vegas Boulevard at Planet Hollywood Hotel our conference will be stimulated from the international flair, the curiosity to learn new things, and experiencing exciting events together of this worldwide famous resort city.

Over the years, RWW has become a staple in the scientific year of many in the wireless and microwave community. From January 22 to January 25, 2023, it's that time again and researchers from all over the world discuss the latest trends in their scientific areas of expertise in five co-located conferences on the complementary and mutually beneficial topics summarized in the Topical Meeting on Silicon Monolithic Integrated Circuits in RF Systems (SiRF), the IEEE Topical Conference on Power Amplifiers for Wireless and Radio Applications (PAWR), IEEE Topical Conference on Wireless Sensors and Sensor Networks (WiSNet), IEEE Space Hardware and Radio Conference (SHaRC), and Radio and Wireless Symposium (RWS). This construct of complementary sub-conferences covers all relevant and modern areas of radio technology, from theory to components and systems, from kilohertz to terahertz, from communication to sensing and space applications. Integrated circuit technology is as well represented as system level investigations or AI based impairments compensation.

In well-established RWW tradition, scientific findings will be presented in topically clustered oral talks and during interactive poster sessions. Each co-located conference has its focus days: PAWR will be held Monday, SiRF on Monday and Tuesday, WiSNet and SHaRC on Wednesday framed with at least one full track of RWS sessions Monday, Tuesday, and Wednesday. This core technical program is supplemented by four workshops on RF and mmW Devices, Circuits and Systems for Low Earth Orbit Satellite Missions, Radar-based Vital Sign Sensing – the Latest Trends, Health Aspects of Millimeter-Wave Radiations in 5G and Beyond, and a special radar boot camp on D-Band FMCW Radar – Basics and Signal Processing for PhD students and young professionals. For young professionals, in addition, a dedicated hands on workshop on artificial intelligence for wireless communications will be given to allow our young talents to get an insight is this important topic also for the microwave community. Learning new aspects is also the goal of the two short courses on Linearization of Power Amplifiers used in Radio Frequency (RF) Transmitters and PA Characterization/Automation for DPD Metrics and Algorithm Validations.

The new class of MTT-S Distinguished Microwave Lecturers will present their talks during a dedicated track on Monday, which is a perfect opportunity to get a comprehensive overview over interesting topics that may be slightly off the own focus. The new tradition in a panel session of female role models in our community is this time again organized by the Women in Microwave team. Two top-class invited keynote speakers will give an insight in their work during the opening ceremony and plenary session on Tuesday morning, where also the winners of the student paper competition will be awarded. In this paper competition, students evaluated best by the reviewers during paper submission are allowed to present their topic in an "elevator pitch" setting before answering detailed questions of the judges at their posters. The best presented and scientifically most convincing student paper will win the competition.

We are very happy that again for RWW2023 the Automatic Radio Frequency Techniques Group (ARFTG) will co-located their conference, which is the 100th edition of this very successful interest group meeting on RF and microwave test and measurement. Congratulations, dear colleagues, on this success! Besides the ARFTG conference with technical papers and short courses, a joint ARFTG & RWW exhibition will be hosted to give industry the opportunity to present their latest products and sophisticated solution to the community.

As always, the exhibition floor will be the place where networking is in focus, which is also underlined by the industry reception hosted on Monday. Directly after the reception, a joint ARFTG & RWW panel will discuss the topic "The road to D band is full of good intentions" with experts from semiconductor industry and measurement technology enterprises followed by the ARFTG dinner. A second panel session on Beamforming Solutions for Terrestrial and Space Applications will be held on Tuesday evening accompanied by the Space Night event.

Another highlight is the co-located IoT summit, one more of the very successful collaborations of RWW with other interest groups. The 6th IEEE Internet of Things (IoT) Vertical and Topical Summit will focus on Quantum Information Technologies for IoT. As always, IoT summit will be highly interactive with strong involvement of the audience in panel discussions after each session.

A lot of ideas, heart and soul, and time went into organizing RWW2023. This would not have been possible without the tremendous work of the beautiful Steering Committee team. Thank you for all for efforts and volunteering time! Now, it's time to enjoy the result.

Welcome to RWW! Enjoy the conference, meet experts and friends!

Alexander Koelpin, *Hamburg University of Technology*
RWW 2022 General Chair

RWW 2023 STEERING COMMITTEE

General Co-Chair
Changzhi Li

Technical Program Chair
Holger Maune

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

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

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

Finance Chair:
Václav Valenta, *European Space Agency*

Topical Conferences:

PAWR Co-Chairs:
Roberto Quaglia, *Cardiff University*
Vittorio Camarchia, *Politechnico di Torino*

WiSNet Co-Chairs:
Rahul Khanna, *Intel*
Paolo Mezzanotte, *University of Perugia*

SHaRC Co-Chairs:
Markus Gardill, *Brandenburg University of Technology*
Marie Piasecki, *NASA Glenn Research Center*

SiRF Chair:
Roee Ben-Yishay, *Intel*

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

Workshops Chairs:
Venkata Vanukuru, *GlobalFoundries*
Jan Budroweit, *German Space Agency*

Technical Lectures:
Juan A. Becerra, *Universidad de Sevilla*

IoT Summit Liaison:
Charlie Jackson, *Northrop Grumman*
Jasmin Grosinger, *Graz University of Technology*

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

Student Paper Contest Co-Chairs:
Fabian Lurz, *Hamburg University of Technology*
Ken Kolodziej, *MIT Lincoln Laboratory*

University Demo Chair:
Mario Pauli, *Karlsruhe Institute of Technology*

Young Professionals Chair:
Pushkar Bajirao Kulkarni, *Qualcomm*

Publicity & Publications Co-Chairs:
Glauco Fontgalland, *Universidade Federal de Campina Grande*
Roberto Gomez-Garcia, *University of Alcala*
Gregor Lasser, *Chalmers University*

Microwave Magazine Special Issue Editor:
Markus Gardill, *Brandenburg University of Technology*

MTT Transactions Mini Special Issue Editors:
Holger Maune, *Otto-von-Guericke-Universität Magdeburg*

Exhibition/Sponsorships Chair:
Cassandra Carollo, *IEEE MCE*

RWW Executive Committee Chair:
Robert Caverly, *Villanova University*

Conference Management:
Elsie Vega, *IEEE MCE*
Cassandra Carollo, *IEEE MCE*

Visa Letters:
Cassandra Carollo, *IEEE MCE*

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

At Large (Advisors):
Kevin Chuang, *Analog Devices*
Nuno Borges Carvalho, *Universidade de Aveiro*
Rashaunda Henderson, *University of Texas at Dallas*

RWS 2023 TECHNICAL PROGRAM COMMITTEE

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

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

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

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

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

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

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

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

SIRF2023 DESCRIPTION

SiRF2023 will mark the 23rd topical meeting on SiRF, with a renewed emphasis on promoting a dialogue between IC designers and researchers promoting non-standard technologies, exploiting the maturity of Silicon processes, but addressing the challenges of tomorrow. The three days of SiRF2023 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.

SIRF2023 STEERING COMMITTEE

Conference Chair:
Roee Ben-Yishay, *Intel*

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

Technical Program Co-Chair:
Mehmet Kaynak, *IHP Microelectronics*

Publicity Chair:
Ickhyun Song, *Hanyang University*

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

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

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

SIRF2023 TECHNICAL PROGRAM COMMITTEE

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

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

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

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

GREETINGS FROM TPC CHAIR

TPC Chair
Holger Maune

Welcome to IEEE Radio & Wireless Week 2023 (RWW 2023), being held in downtown Las Vegas, at Planet Hollywood Resort & Casino. Each year, the ubiquity of wireless systems in our everyday lives grows through applications that range from safety and security to wearable medical devices. Many advances are being made through research and development in academia and new-product introduction in industry. The Covid-19 pandemic changed our lives and lead to an unforeseen additional increase in data rates. Two years ago, video conferences were used on few occasions. Today, video conferencing is part of everybody's life, from the kindergarten kid up to our senior citizens. The future will bring even more connectivity to our communities, and RWW is part of the development. RWW's technical program encompasses five conferences: the IEEE Radio and Wireless Symposium (RWS); IEEE Topical Meeting on Silicon Monolithic Integrated Circuits in RF Systems (SiRF); IEEE Topical Meeting on Power Amplifiers for Wireless and Radio Applications (PAWR); IEEE Topical Meeting on Wireless Sensors and Sensor Networks (WiSNet); and IEEE Space Hardware and Radio Conference (SHaRC). A total of 180 papers were submitted from 20 countries, of which 80 papers are written by students from around the globe. The TPC selected the most original and innovative papers, leading to an exceptional program for RWW 2023. The technical papers are scheduled from Monday to Wednesday as oral podium presentations or interactive poster presentations. Four workshops have been developed starting on Sunday and ending Monday afternoon with presentations by Distinguished Microwave Lecturers (DMLs) and other invited speakers who will share their knowledge on relevant topics in the wireless field.

The student paper competition continues to be an area of success for RWW, where judges select two student paper winners the Radio & Wireless Week. All student papers are reviewed in the same manner with identical criteria as regularly submitted manuscripts. The finalists will participate in a special event on Monday afternoon in addition to the regular presentation. The winners will be announced at the RWW plenary session on Tuesday.

The 101st ARFTG Microwave Measurement Conference will be co-located with RWW 2023. This time, Measurement Challenges for Emerging RF-to-THz Technologies are in the focus of the conference, which is taking place Monday and Tuesday. The conference is framed by the NIST-ARFTG Short Course on Microwave Measurements on Sunday and a workshop on Wednesday.

We hope the program convinces for a visit of IEEE Radio & Wireless Week 2023 in Las Vegas. For the latest updates on RWW 2023, visit www.radiowirelessweek.org.

Holger Maune
TPC Chair

RWW TOPICAL CONFERENCES

POWER AMPLIFIERS FOR RADIO AND WIRELESS APPLICATIONS (PAWR)

Power amplifiers are often the most critical component of RF/microwave communications systems and consequently the focus of intense research to achieve increased linearity and power efficiency. New forms of power amplification are being developed to meet the needs of the wireless communication equipment industry and the world's demand for greater information transmission. **PAWR2023** will feature tracks on RF/microwave Power Amplifiers. Papers featuring innovative work are solicited in (but not limited to) the following areas of RF/microwave power amplifier technology:

- High Power/Wideband Active Devices
- Power Amplifiers for Mobile, Avionics and Space
- Modeling and Characterization
- Advanced Circuit Design and Topologies
- Green Power Amplifier Technology
- Integration Technology
- Packaging and Reliability
- Linearization and Efficiency Enhancement Techniques
- Applications, Novel Architectures and System Analysis

PAWR2023 Chair
Roberto Quaglia, *Cardiff University*

PAWR2023 Co-Chair
Vittorio Camarchia, *Politechnico di Torino*

PAWR2023 Technical Program Committee

Modeling and Characterization:

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

Advanced Circuit Design and Topologies:

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

Packaging and Reliability:

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

Linearization and Efficiency Enhancement Techniques:

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

IEEE SPACE HARDWARE AND RADIO CONFERENCE (IEEE SHaRC)

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

SHaRC2023 Chair
Markus Gardill, *Julius Maximilians University Würzburg*

SHaRC2023 Co-Chair
Marie Piasecki, *NASA Glenn Research Center*

SHARC2023 Technical Program Committee

Systems, Hardware, and Electronics for Space:

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

Mission Concepts, Operations, Regulation, and Standardization:

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

WIRELESS SENSORS AND SENSOR NETWORKS (WiSNet)

Wireless 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. **WiSNet2023** is intended to stimulate discussion and foster innovation on these components and applications.

WiSNet2023 Chair
Rahul Khanna, *Intel*

WiSNet2023 Co-Chair
Paolo Mezzanotte, *University of Perugia*

WISNET2022 Technical Program Committee

Wireless Sensors for IoT Communication and Applications:

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

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

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

Wireless Sensors Circuits & System Technologies:

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

WSN Hardware-Software CoDesign:

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

Innovations in Wireless Sensor Networks:

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

IEEE Internet of Things Summit

IEEE Internet of Things (IoT) Summit at RWW2023

25 January – 3 February 2023

The 6th IEEE Internet of Things (IoT) Vertical and Topical Summit at RWW2023 is a six-day event. The program will be delivered in two parts. The first part is a hybrid event consisting of two sessions on the afternoon of January 25, 2023, held face to face in Las Vegas, Nevada USA, and virtually live online from remote locations. The second part is a week of virtual live online single daily sessions from January 30 – February 3, 2023.

The theme for the IEEE IoT V&T Summit at RWW2023 is "Quantum Information Technologies for IoT"

The Summit is meant to be highly interactive, and each session is composed of three to four speakers and a moderated panel discussion with audience participation. For the final session on Friday, February 3, 2023, we will conduct a virtual roundtable discussion led by a moderator and use both prepared and open questions from the attendees. The Summit seeks to provide a balance of perspectives, and the speakers include experts from industry, government, the research community, and experienced end-users. You can expect the presentations and discussions to address technical, business, and operational issues.

We hope to make the Summit as interactive as possible and look forward to your participation. If you are a policy maker, a strategist, a corporate manager, administrator, product developer, an IoT or mmWave engineer, a technologist, researcher, educator, working in industry, government, or academia, or just curious about IoT, wireless sensors, and communications systems, you will find the summit stimulating and rewarding. We look forward to seeing you online or in Las Vegas.**iot.ieee.org/program/**.

REGISTRATION HOURS:

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

Sunday, 22 January 2023 1:00PM – 6:00PM

Monday, 23 January 2023 7:00AM – 6:00PM

Tuesday, 24 January 2023 7:00AM – 4:00PM

EXHIBIT HOURS:

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

Monday, 23 January 2023 1:00PM – 7:00PM

Tuesday, 24 January 2023 9:00AM – 5:00PM

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

SOCIAL EVENTS:

Joint RWW/ARFTG Welcome Reception

Monday, 23 January 2023 5:30PM – 6:30PM

Location: Exhibit Hall – Roman Ballroom

NETWORKING OPPORTUNITIES/LITE RECEPTIONS:

Sunday 22 January 2023 at 5:30 PM before the WiM event – Promenade

Tuesday 24 January 2023 at 5:30 PM before the YP and MTT Space Night events in the Exhibit Hall

Sunday, 22 January 2023

1:30-5:30 PM

Workshop on RF and mmW Devices, Circuits and Systems for Low Earth

Organizer:
Jan Budroweit, *DLR, Germany*

Abstract:
The half-day workshop will introduce a global coverage of latest RF and mmW devices, circuits and systems that are desired for low Earth orbit (LEO) missions or that already have proven flight heritage in space. Specific topics of this workshops are space system design under consideration of radiation effects, user terminals for new space LEO constellations, LEO based mmW radar concepts for earth science applications and a recap of the CubeSat mission of the technical university Berlin.

Program:

Space System Design under Consideration of Radiation Effects
Jan Budroweit, *DLR*

30 years of satellite development at Technische Universität Berlin
Julian Bartholomäus, *TU Berlin*

LEO based mmWave radar concepts for earth science applications
Srinivas Prasad, *NASA JPL*

User Terminal for new space LEO Constellations
Arnaldo Oliveira, *Universidade de Aveiro*

Workshop on Radar-based vital sign sensing – the latest trends

Organizer:
Fabian Michler, *FAU Erlangen-Nuremberg / Sykno GmbH*

Abstract:
During the past decade, vital sign sensing radars have become a quickly growing research topic in microwave engineering, promising the contactless and therefore patient-friendly measurement of various vital signs. This workshop explains the fundamentals of the research by introducing the underlying physiology of heartbeat and respiration, the resulting body surface movements and vibrations. System design challenges and limitations will be explained on the example of highprecision continuous-wave radars. Moreover, the challenges and outcomes of long-term studies in hospitals and home-care will be shared with the audience. Focused talks provide insights into the latest developments. This includes research in the field of passive sensing systems, which analyze ambient wireless signals, such as Bluetooth or Wi-Fi, to extract vital sign signals. Moreover, a commercial system for microwave-based blood pressure measurement will be presented, including a live demonstration.

Program:

Fundamentals and System Design Challenges for Radar-Based Vital Sign Sensing
Fabian Michler, *University Erlangen-Nuremberg / Sykno GmbH*

Interferometric Radar for Cardiovascular Monitoring
Nils Albrecht, *Hamburg University of Technology*

Observations from using mm-Wave Radars in Hospitals & Long-Term Care Homes
George Shaker, *University of Waterloo*

Passive Radar Sensing for Motion Detection using Ambient Wireless Signals
Aaron Carman, Changzhi Li, *Texas Tech University*

Blood Pressure Monitoring
Nastassia Vysotskaya, *Infineon Technologies*

Workshop on Radar-based vital sign sensing – the latest trends

Organizer:
Timo Jaeschke, *2pi-Labs*

Abstract:
This half-day workshop aims to introduce the general FMCW radar basics in terms of hardware system level design and signal processing for industrial radar applications. First, a general overview of the basic FMCW radar system design objectives and application fields is given. This is followed by an insight into the most critical hardware design challenges and ways to avoid common design mistakes. A lot of examples are given in terms of a state-of-the-art D-Band wideband radar sensor as an example implementation. The second part of the workshop provides a unique hands-on high-end radar experience and you will learn how to process IF signals, extract precise distance measurements from the range-plot signals or how to produce range doppler plots. A lot of Python language programming examples will be provided and live sensor data or live measurements are utilized to create a fun learning experience. This workshop will provide you with a well equipped toolbox for a smooth start into the FMCW radar signal processing world for the next >95 GHz EHF industrial radar generation.

Program:
Timo Jaeschke, *2pi-Labs*

Workshop on Health Aspects of Millimeter-Wave Radiations in 5G and Beyond

Organizers:
Abbas Omar, *Uni Magdeburg*

Abstract:
Utilizing Millimeter Waves in mobile communications has been known to be associated with much lower radiation powers and much shorter communication ranges. This has given rise to what are called "Microcells" and "Picocells", whose coverage areas don't exceed few meters. These cells are responsible for the communication with the User Equipment (UE). Their backhaul communications with high-power Base Stations (BS) are either wired (usually fiber-optical) or in a Line-of-Sight (LOS) scenario. LOS wireless communications don't involve wave-matter interactions, as any LOS obstacle heavily deteriorates the communication quality. Health aspects of 5G and Beyond is therefore limited to the extremely low-power short-range Picocell-UE communication. Another related relevant aspect is the very strong Millimeter-Wave attenuation in water-rich substances characterizing biological tissues. Millimeter-Waves can't therefore penetrate into biological objects (e.g. human and animal bodies and plants) more than few millimeters. Health aspects must therefore be investigated within the skin area. Deeply inside the body, Millimeter Waves assume negligible intensities, which are much safer than those of earlier standards (e.g. 3G and 4G). A group of very competent scientists will talk at this Workshop. These represent Standardization Institutions, academic scientists involved in health issues of electromagnetic radiations, and physicists, who can qualitatively estimate the in-vivo radiation levels and the electromagnetic loss mechanisms dominating the wave-matter interactions in biological substances. The expected results should be very calming for the Public, as it will be shown that the major Standards (e.g. ICNIRP, IEEE, and ANSI) allow for harmless radiation levels, and this has been justified by the long-time experience with man-made radiations in the last decades (Broadcasting and different Wireless Communication modalities). It will also be shown that social-media widely-spread views of "Pseudoscience" and "Conspiracy Theorists" claiming serious health hazards, which are caused generally by Millimeter-Wave radiations and particularly as related to 5G and Beyond, are clearly BASELESS.
To a great extent, these claims are based on mixing up "ionizing" and "nonionizing" radiations. The mechanisms of wave-matter interactions in the latter are fully described by the constitutive parameters "Permittivity", "Permeability", and "Conductivity" for weak and moderate field intensities that don't involve nonlinearities. These are macroscopic quantities (spatial moving averages) that average out spatial microscopic details. The averaging window is at most few hundredths of wavelength wide. Possible changes in critical and sensitive atomic or molecular structures (similar to that existing in e.g. DNA or nerve cells) cannot considerably exceed the macroscopic average. The latter is a reversible thermal one, as long as the radiated power levels don't exceed those dictated by the Regulatory Agencies (e.g. FCC in USA).

Program:
Abbas Omar, *Uni Magdeburg*

7:00-8:00 PM

IEEE Women in Engineering WIE

WOMEN IN MICROWAVES EVENT

DISTINGUISHED WOMEN IN MICROWAVES

Room: Melrose 1 & 2

The Women in Microwaves (WiM) event will spotlight distinguished professionals who have considerably advanced the fields of microwave theory and technology and automatic radio frequency (RF) techniques. Three outstanding presenters will deliver talks describing their respective research fields. Dr. Malgorzata Celuch, QWED, Warsaw, Poland, will present **"Modeling-Based Characterization of Materials From Microwaves to Millimeter Waves."** Prof. Rhonda R. Franklin, University of Minnesota (UMN), Minneapolis, USA, will present **"Advances in Wired and Wireless Interconnect Technology for Microwave and Sub-Millimeter-Wave Applications."** Finally, Prof. Qiaowei Yuan, Tohoku Inst itute of Technology, Miyagi, Japan, will present **"Direction-of-Arrival Estimation and Array Antenna Beamforming With Mutual Coupling."**

MTT-S IEEE MICROWAVE THEORY & TECHNOLOGY SOCIETY

DISTINGUISHED MICROWAVE LECTURERS' TALKS

Organizer: Markus Gardill, ***Brandenburg University of Technology***

Room: Celebrity 5

8:00-11:40 AM

Mo1D-1

Extreme Field Control with Electromagnetic Metasurfaces

Lecturer: Anthony Grbic, ***University of Michigan, USA***

The research area of metamaterials has captured the imagination of scientists and engineers over the past two decades by allowing unprecedented control of electromagnetic fields. The extreme manipulation of fields has been made possible by the fine spatial control and wide range of material properties that can be attained through subwavelength structuring. Research in this area has resulted in devices which overcome the diffraction limit, render objects invisible, and even break time reversal symmetry. It has also led to flattened and conformal optical systems and ultra-thin antennas. This seminar will identify recent advances in the growing area of metamaterials, with a focus on metasurfaces: two dimensional metamaterials. The talk will explain what they are, the promise they hold, and how these field-transforming surfaces are forcing the rethinking of electromagnetic/optical design.

Electromagnetic metasurfaces are finely patterned surfaces whose intricate patterns/textures dictate their electromagnetic properties. Conventional field-shaping devices, such as lenses in prescription eye glasses or a magnifying glass, require thickness (propagation length) to manipulate electromagnetic waves through interference. In contrast, metasurfaces manipulate electromagnetic waves across negligible thicknesses through surface interactions, by impressing abrupt phase and amplitude discontinuities onto a wavefront. The role of the visible (propagating) and invisible (evanescent) spectrum in establishing these discontinuities will be explained. In addition, it will be shown how metasurfaces allow the complete transformation of fields across a boundary, and how this unique property is driving a new generation of ultra-compact electromagnetic and optical devices with unparalleled field control. Metasurfaces will be described that exhibit various field tailoring capabilities including multiwavelength and multifunctional performances and extreme field shaping. In addition, metasurfaces with multi-input to multi-output capabilities will be presented that open new opportunities in adaptive and trainable designs.

Mo1D-2

Multi-Function Multi-Band Reconfigurable High-Q Filters

Lecturer: Raafat R. Mansour, ***University of Waterloo, Canada***

Reconfigurable filters are key components in the development of agile multi-standard receivers. The advent of innovative switched capacitor arrays and switch technologies based on semiconductor SOI, Micro-Electro-Mechanical Systems (MEMS) and Phase Change Material (PCM) technologies permits the development of a new generation of high linearity, low loss, and low power consumption tunable components. This talk starts by addressing the needs for using multi-band and tunable filters in wireless communication systems and in flexible satellite payloads. It then addresses existing tuning technologies, providing a comparison between piezoelectric, Semiconductor, MEMS and PCM tuning elements in terms of linearity, insertion loss, suitability for use at millimeter-wave frequencies and ease of integration with high-Q filters. It outlines major design considerations for tunable filters presenting techniques to realize tunable filters with an absolute constant absolute bandwidth and a constant frequency spacing between transmission zeros, over a wide tuning range. The talk also illustrates examples of tunable filters and diplexers tuned only a by single tuning element, while exhibiting a constant absolute bandwidth. It then addresses approaches for realizing multi-band filters including dual-band and triple-band filters. Finally, it presents techniques for realizing multi-band filters where the various bands are tunable in both center frequency and bandwidth. Very recent work on realizing reconfigurable acoustic filters is also presented.

Mo1D-3

mm-Wave System and Circuit Design for Highly-Integrated Radar Transceivers

Lecturer: Vadim Issakov, ***Technische Universitat Braunschweig, Germany***

There is a growing interest in realization of highly-integrated radar transceivers operating at millimeter-wave (mm-wave) frequencies. The need for high-level integration is driven by the motivation for the products to be competitive on the market, this means implementing more features, offer high digital reconfigurability and enhanced RF functionality, consume a minimal chip area, dissipate less power and achieve a lower price. The trend in integrated mm-wave radar systems goes towards using increasingly higher operating frequencies. Frequencies above 100 GHz are very attractive for realizing multi-channel radar systems, due to possibility of module size reduction thanks to scaling of the antennas.

This talk focusses on system and circuit design considerations for highly-integrated radar transceivers in CMOS and SiGe HBT technologies. The speaker will first provide motivation for realization of radar sensors at mm-wave frequencies by showing the possible applications. Then, frequency band allocations for radar at mm-wave frequencies are discussed. Next, speaker will discuss system level consideration in detail and will present step-by-step system design steps for an integrated fast-chirp FMCW radar transceiver, such as level budget calculation, phase noise considerations, PLL linearity, design of the analog baseband. The system considerations will be systematically translated into specifications of circuit blocks (e.g. LNA, mixer, PA, VCO, analog baseband etc.) of the radar transceiver.

Additionally, digital modulation techniques such as phase-modulated continuous-wave (PMCW) will be discussed and a systematic comparison with FMCW will be given.

Next, technology-dependent considerations and challenges related to critical building blocks are discussed (e.g. phase noise, noise figure, operating frequency, routing density, digital baseband). Then, the speaker will present several design examples of integrated radar transceivers operating at V-band and D-band and will discuss the circuit architectures. The talk is rounded out by a vision on novel modulation techniques and trends in MIMO radar array realizations.

Mo1D-4

Quantum Computing: What Is It, How Does It Work, And What Are The Opportunities For Microwave Engineers?

Lecturer: Joseph Bardin, ***University of Massachusetts Amherst***

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 quantum computing, 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. While the "quantum" aspects of quantum computing will be described, the deeper technical discussion will focus on the specification and design of the microwave control and measurement systems required to operate these systems, using Google's state-of-the-art Sycamore quantum computer as an example. Ongoing research in scalable control and measurement electronics will also be described.

RWS Session Mo1A

COMMUNICATION SYSTEMS

Chair: Vadiom Issakov

Co-Chair: Alexander Kölpin

Room: Melrose 1 & 2

PAWR Session Mo1B

CHARACTERIZATION AND MODELLING

Chair: Vittorio Camarchia

Co-Chair: Valeria Di Giacomo-

Room: Melrose 3

SiRF Session Mo1C

FREQUENCY CONVERTERS AND SYSTEMS

Chair: Austin Chen

Co-Chair: Roee Ben Yishay

Room: Melrose 4

8:00-9:40 AM

Mo1A-1

Investigation and Optimization of Secrecy Capacity for Intelligent Reflective Surfaces-Assisted Secure mmWave Indoor Wireless Communication

Authors: Ozlem Yildiz, New York University Tandon School of Engineering; Mohammad Alavirad, Dell Technologies; Tejinder Singh, Dell Technologies

Mo1A-2

Synchronising Clock and Carrier Frequencies with Low and Coherent Phase Noise for 6G

Authors: Zichuan Zhou, University College London; Dhecha Nopchinda, University College London; Izzat Darwazeh, University College London; Zhixin Liu, University College London

Mo1A-3

Performance Analysis for Coded Wireless Steganography System With OFDM Signaling

Authors: Yuto Hama, Yokohama National University; Kazuaki Hanazawa, Yokohama National University; Hideki Ochiai, Yokohama National University; Junji Shikata, Yokohama National University

Mo1A-4

On radio signatures to mitigate the MAC addresses randomization for Wi Fi analytics in real-world scenarios

Authors: Abraham Pérez-Hernández, Galgus; Maydelis N Barreras-Martín, Galgus; Jesús Fernández-Manzano, Galgus; Pablo Aguilera, Galguse

Mo1B-1

Characterization and modelling

Author: Joel Dunsmore

Mo1B-2

A Novel Cardiff Model Coefficients Extraction Process Based on Artificial Neural Network

Authors: Mengyue Tian, Cardiff University; James J Bell, Cardiff University; Ehsan Azad, Cardiff University; Roberto Quaglia, Cardiff University; Paul J Tasker, Cardiff University

Mo1B-3

Characterization of GaN Power Amplifier Using 5G mm-Wave Modulated Signals

Authors: Lucas Letailleur, Université Gustave Eiffel, CNRS, ESYCOM, F-77454; Martine Villegas, Université Gustave Eiffel, CNRS, ESYCOM, F-77454; Ahmad Al Hajjar, OMMIC; Charles Edoua Kacou, OMMIC

Mo1C-1

RF to Millimeter-Wave N-path Filters and Receivers

Author: Brian Floyd, North Carolina State University

Mo1C-2

A Highly Linear D-Band Broadband Down Conversion Mixer in 22-nm FDSOI CMOS

Authors: Kaan Balaban, Karlsruhe Institute of Technology; Matthias Moeck, Karlsruhe Institute of Technology; Cagri Ulusoy, Karlsruhe Institute of Technology

Mo1C-3

A 42.24 Gb-s Channel Bonding Up-Converter withintegrated multi-LO generation in 45nm CMOS

Authors: Alexandre Siligaris, Université Grenoble-Alpes, CEA-Leti; Pierre Courouve, Université Grenoble-Alpes, CEA-Leti; Guillaume Waltener, Université Grenoble-Alpes, CEA-Leti; Abdelaziz Hamani, University of Grenoble-Alpes France; Cedric Dehos, Université Grenoble-Alpes, CEA-Leti; Jose Luis Gonzalez-Jimenez, Université Grenoble Alpes - CEA, LETI

Mo1C-4

A 60-GHz CMOS Broadband Heterodyne I-Q Up-Converter with Suppressed LO-Feedthrough and Image Leakages

Authors: Kyung Pil Jung, Korea Advanced Institute of Science and Technology; Seung Hun Kim, Samsung Research Korea; Chul Soon Park, Korea Advanced Institute of Science and Technology

RWS Session Mo2A

5G AND THZ COMMUNICATION: COMPONENTS AND CIRCUITS

Chair: Nuno Carvalho

Co-Chair: Holger Maune

Room: Melrose 1 & 2

PAWR Session Mo2B

POWER AMPLIFIERS SOLUTIONS FOR COMMUNICATION SYSTEMS

Chair: Frederick Raab

Co-Chair: Chris Sanabria

Room: Melrose 3

SiRF Session Mo2C

MILLIMETER-WAVE SYSTEMS

Chair: Kamel Haddadi

Co-Chair: Timo Jaeschke

Room: Melrose 4

10:10-11:50 AM

Mo2A-1

Image-Rejection Up--Down-Converter LO Distribution Chain for 5G mm-wave Phased-Array Systems

Authors: Aniello Franzese, IHP GmbH; Nebojsa Maletic, IHP GmbH; Renato Negra, RWTH Aachen University; Andrea Malignaggi, IHP Microelectronics

Mo2A-2

A 38GHz SPDT Traveling Wave Switch with 5A CDM ESD Protection in 45nm PDSOI for 5G System

Authors: Mengfu Di, University of California, Riverside; Weiquan Hao, University of California, Riverside; Zijin Pan, University of California, Riverside; Xunyu Li, University of California, Riverside; Runyu Miao, University of California, Riverside; Albert Wang, University of California, Riverside

Mo2A-3

A Low-Power Push-Push D-Band VCO with 11.6% FTR utilizing Back-gate Control in 22nm FDSOI

Authors: Yasir Shafiullah, University of Oulu; Mikko Hietanen, University of Oulu; Rehman Akbar, University of Oulu; Marko E Leinonen, University of Oulu; Janne Aikio, University of Oulu; Jere Rusanen, University of Oulu; Timo Rahkonen, University of Oulu; Aarno Pärssinen, University of Oulu

Mo2A-4

Infinity Additive Manufacturing of Polarization Maintaining Fibers for THz Communications

Authors: Guofu Xu, Polytechnique Montreal; Kathirvel Nallappan, Polytechnique Montreal; Yang Cao, École Polytechnique de Montréal; Maksim Skorobogatiy, Polytechnique Montreal

Mo2A-5

Characterization of a Flexible Polymer-Based Substrate Material for RF Applications

Authors: Fabian Michler, Friedrich-Alexander-Universität Erlangen-Nürnberg; Jasmin Kolpak, Friedrich-Alexander-Universität Erlangen-Nürnberg; Benedict Scheiner, Friedrich-Alexander-Universität Erlangen-Nürnberg; Robert Weigel, Friedrich-Alexander-Universität Erlangen-Nürnberg; Amelie Hagelauer, Technical University of Munich

Mo2B-1

Power amplifiers solutions

Author: Paul Drexel

Mo2B-2

A 160-GHz, 10-dBm power amplifier for D-band communication in 0.1-µm GaAs pHEMT

Authors: Tatsuya Soma, NEC Corporation; Masaharu Ito, NEC Corporation; Yasushi Wada, NEC Corporation

Mo2B-3

Continuous Inverse Class-F GaN Power Amplifier with 70% Efficiency over 1.4-2 GHz Bandwidth

Authors: Anna Piacibello, Politecnico di Torino; Zhifan Zhang, Politecnico di Torino; Vittorio Camarchia, Politecnico di Torino

Mo2B-4

Broadband Outphasing Power Amplifier Using Doherty-Chireix Continuum in a GaN MMIC Process

Authors: Dominic Mikrut, Ohio State University; Patrick Roblin, Ohio State University; Chenyu Liang, Ohio State University; Shane Smith, SenseICs; Ramy Tantawy, SenseICs

Mo2C-1

Beamformers and Transceivers for mmWave 5G in Silicon Technologies

Author: Erik Ojefors, Sivers Semiconductors

Mo2C-2

CMOS mm-Wave Systems on Chip Technology for Exploring Earth, the Solar System and Space

Author: Adrian Tang, NASA's Jet Propulsion Lab

Mo2C-3

A Wideband Four-Channel SiGe D-Band Transceiver MMIC For TDM MIMO FMCW Radar

Authors: Hakan Papurcu, Ruhr University Bochum; Justin Romstadt, Ruhr University Bochum; Steffen Hansen, Fraunhofer FHR; Christian Krebs, Fraunhofer FHR; Klaus Aufinger, Infineon Technologies AG; Nils Pohl, Ruhr University Bochum

RWS Session Mo3A

BIOMEDICAL APPPLICATION OF MICROWAVES

Chair: Robert Caverly

Co-Chair: Changzhi Li

Room: Melrose 1 & 2

PAWR Session Mo3B

LINEARIZATION AND EFFICIENCY ENHANCEMENT TECHNIQUES

Chair: Pere Gilabert

Co-Chair: Anding Zhu

Room: Melrose 3

SiRF Session Mo3C

OSCILLATORS AND DIVIDERS

Chair: Amit Jha

Co-Chair: Roee Ben Yishay

Room: Melrose 4

1:30-3:10 PM

Mo3A-1

A GaAs LNA MMIC for a Correlation-Dicke Radiometer Internal-Body Temperature Sensor

Authors: Jooeun Lee, University of Colorado; Zoya Popovic, University of Colorado

Mo3A-2

Long-Distance Heart Sound Detection using 122 GHz CW Radar with 3D Printed High-Gain Antennas

Authors: Nils C Albrecht, Hamburg University of Technology; Markus Heyder, Hamburg University of Technology; Marvin Wenzel, Hamburg University of Technology; Dominik Langer, Hamburg University of Technology; Hui Lu, Brandenburg University of Technology; Alexander Koelpin, Hamburg University of Technology

Mo3A-3

Effect of Phase Noise in FMCW and PMCW Radar Systems for Breast Cancer Detection

Authors: Martin Maier, Technische Universität Braunschweig; Finn-Niclas Stapelfeldt, Technische Universität Braunschweig; Vadim Issakov, Technische Universität Braunschweig

Mo3A-4

Portable Real-Time System for Multi-Subject Localization and Vital Sign Estimation

Authors: Vijaysrinivas Rajagopal, University of Tennessee; Abdel-Kareem Moadi, University of Tennessee; Aly Fathy, University of Tennessee; Mongi A Abidi, University of Tennessee

Mo3B-1

Rational Generalized Memory Polynomial for Efficient Predistortion of Wideband Envelope Tracking Amplifiers

Authors: Paul Draxler, Stonecrest Consulting; Martin Navaroli, MaXentic Technologies, LLC; Dane J Malangone, MaXentric Technologies, LLC; Edward Falcon, MaXentric Technologies, LLC; Eric Brown, MaXentric Technologies, LLC; Jonmei J Yan, MaXentric Technologies, LLC

Mo3B-2

Frequency-Dependent DPD Linearization for Load-Mismatched Mobile Terminal PAs Operating Under Dynamic Resource Block Allocation

Authors: Wantao Li, University Politècnica de Catalunya; Gabriel Montoro, University Politècnica de Catalunya; Yan Guo, HiSilicon; Pere L. L Gilabert, University Politècnica de Catalunya

Mo3B-3

Sparse Regression of Power Amplifier Behavioral Models with a Stagewise Doubly Orthogonal Matching Pursuit

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

Mo3B-4

Efficiency versus linearity trade-off in an S-band class-AB power amplifier

Authors: Zhifan Zhang, Politecnico di Torino; Anna Piacibello, Politecnico di Torino; Vittorio Camarchia, Politecnico di Torino

Mo3B-5

A 3.7-4.2GHz MMIC Doherty Power Amplifier Linearized over 500MHz Instantaneous Bandwidth

Authors: Alexis Courty, Ampleon; Christophe Quindroit, Ampleon; Jean-Jacques Bouny, Ampleon; Pierre Ferris, Ampleon; Pablo Rochas, Ampleon; Xavier Moronval, Ampleon

Mo3C-1

ADPLL's – once you go digital you probably won't go back

Authors: Run Levinger, Intel Corporation; Evgeny Shumaker, Intel Corporation; Aryeh Farber, Intel Corporation; Sergey Bershansky, Intel Corporation; Rotem Banin; Ashoke Ravi; Gil Horovitz, Intel Corporation; Ofir Degani, Intel Corporation

Mo3C-2

A Tunable SiGe BiCMOS Quadrature LO Source with 31% Tuning Range for L, C and X-band Space-borne Remote Sensing

Authors: Maciej J Kucharski, SIRC; Maciej Klemm, SIRC; Radosław Piesiewicz, SIRC; Vaclav Valenta, European Space Agency

Mo3C-3

Low Power CMOS VCO Using an 8-shaped Transformer

Authors: Ho-Chang Lee, National Taiwan University of Science and Technology; sheng-lyang jang, National Taiwan University of Science and Technology; Ren-Xiang Yang, National Taiwan University of Science and Technology

Mo3C-4

A Low Power 100 GHz Static CML Frequency Divider in 0.18 µm SiGe BiCMOS Technology

Authors: Hao-Yu Chien, University of California, Los Angeles; Christopher Chen, University of California, Los Angeles; Jason Woo, University of California, Los Angeles; Sudhakar Pamarti, University of California, Los Angeles; Chih-Kong Ken Yang, University of California, Los Angeles; Mau-Chung Frank Chang, University of California, Los Angeles

RWS Session Mo4A

RADAR SIGNAL PROCESSING AND CHANNEL ESTIMATION

Chair: Markus Gardill

Co-Chair: Arnaldo Oliveira

Room: Melrose 1 & 2

PAWR Session Mo4B

Late News

Chair: Patrick Roblin

Co-Chair: Anna Piacibello

Room: Melrose 3

SiRF Session Mo4C

DEVICE MODELING

Chair: Mehmet Kaynak

Co-Chair: Austin Chen

Room: Melrose 4

3:40-5:20 PM

Mo4A-1

Out-of-Distribution Detection for Radar-based Gesture Recognition Using Metric-Learning

Authors: Thomas Stadelmayer, Friedrich-Alexander-Universität Erlangen-Nürnberg; Lorenzo Servadei, Infineon Technologies AG; Avik Santra, Infineon Technologies AG; Robert Weigel, Friedrich-Alexander-Universität Erlangen-Nürnberg; Fabian Lurz, Technische Universität Hamburg

Mo4A-2

Automotive Radar Channel Simulation based on a High-Resolution Backscattering Model of a Motorcyclist

Authors: Sevda Abadpour, Karlsruhe Institute of Technology (KIT)-IHE; Mario Pauli, Karlsruhe Institute of Technology (KIT)-IHE; Xueyun Long, Karlsruhe Institute of Technology (KIT)-IHE; Thomas Zwick, Karlsruhe Institute of Technology

Mo4A-3

Accurate Heart Beat Detection with Doppler Radar using Bidirectional GRU Network

Authors: Hui Lu, Brandenburg University of Technology; Markus Heyder, Hamburg University of Technology; Marvin Wenzel, Hamburg University of Technology; Nils C Albrecht, Hamburg University of Technology; Dominik Langer, Hamburg University of Technology; Alexander Koelpin, Hamburg University of Technology

Mo4A-4

Prediction and Simulation of FMCW Radar Hand Gesture Detection based on Captured 3D Motion Data

Authors: Christopher Williams, Texas Tech University; Changzhi Li, Texas Tech University

Mo4A-5

Quantization Effects in a CNN-based Channel Estimator

Authors: Fábio L Coutinho, Instituto De Telecomunicacoes; Hugerles S Silva, Instituto De Telecomunicacoes; Petia Georgieva, University of Aveiro; Arnaldo R Oliveira, University of Aveiro

Mo4B-1

A Comparison Study on the Broadband Performance of Load-Modulated Architectures using Nonlinear Embedding at 20 GHz

Authors: Dominic Mikrut, Ohio State University; Patrick Roblin, Ohio State University; Miles Lindquist, Ohio State University; Nicholas C Miller, Air Force Research Laboratory; David Frey, CAES

Mo4B-2

A Reliable 5G Stacked Power Amplifier in 45nm CMOS Technology

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

Mo4B-3

Extending the Inverse Model Range of Applicability for Efficient Predistortion of Wideband Envelope Tracking Amplifiers

Authors: Paul Draxler, Stonecrest Consulting; Martin Navaroli, MaXentic Technologies, LLC; Dane J Malangone, MaXentric Technologies, LLC; Edward Falcon, MaXentric Technologies, LLC; Eric Brown, MaXentric Technologies, LLC; Jonmei J Yan, MaXentric Technologies, LLC

Mo4B-4

High-Efficiency Watt-Level E-band GaN Power Amplifier with a Compact Low-loss Combiner

Authors: Bharath kumar Cimbili, Fraunhofer Institute for Applied Solid State Physics; Christian Friesicke, Fraunhofer Institute for Applied Solid State Physics; Friedbert van Raay, Fraunhofer Institute for Applied Solid State Physics; Sandrine Wagner, Fraunhofer Institute for Applied Solid State Physics; Mingquan Bao, Ericsson; Ruediger Quay, Fraunhofer Institute for Applied Solid State Physics

Mo4C-1

RF figures of merit of polysilicon trap-rich layers formed locally by ion amorphization and nanosecond laser annealing

Authors: Martin Perrosé, Université Grenoble Alpes - CEA, LETI; Pablo acosta alba, Université Grenoble Alpes - CEA, LETI; Maxime Moulin, CEA-LETI; Emmanuel Augendre, Université Grenoble Alpes - CEA, LETI; Jose Lugo, Université Grenoble Alpes - CEA, LETI; Jean-Pierre Raskin, Universite Catholique of Louvain la Neuve; Shay Reboh, Université Grenoble Alpes - CEA, LETI

Mo4C-2

Buried PN Junctions Impact on the Performances of an Inductor at RF Frequencies in the presence of Parasitic Surface Conduction

Authors: Thibaud Fache, CEA-LETI; Maxime Moulin, CEA-LETI; Ismael Charlet, CEA-LETI; Zdenek Chalupa, CEA-LETI; Jean-Pierre Raskin, University Catholiqué de Louvain; Frédéric Allibert, Soitec; Christophe Plantier, CEA-LETI; Fred Gaillard, CEA-LETI; Louis Hutin, CEA-LETI

Mo4C-3

22-nm FDSOI CMOS Noise Modeling and Analysis in mm-Wave Frequency Range

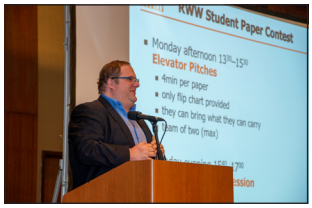
Authors: Quang Huy Le, Fraunhofer-Gesellschaft; Dang Khoa Huynh, Fraunhofer IPMS; Steffen Lehmann, GLOBALFOUNDRIES; Zhixing Zhao, GLOBALFOUNDRIES; Christoph Schwan, GLOBALFOUNDRIES; Thomas Kaempfe, Fraunhofer-Gesellschaft; Matthias Rudolph, Brandenburg University of Technology

Mo4C-4

Simulation of Built-In Test Equipments based on Avalanche Noise Diodes: Ka-band LNA Case Study

Authors: Guendalina Simoncini, University of Perugia; Federico Alimenti, University of Perugia

Joint RWW Student Paper Contest



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

Student Paper Contest Chairs:

Fabian Lurz, *Hamburg University of Techology*
Ken Kolodziej, *MIT Lincoln Laboratory*

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

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

Student Paper Competition Finalists

PAPER NUMBER	TITLE	SPEAKER
Tu3A-1	The Anglet: An E/H-plane Bent, 90-Degree Twisted, TE101/TM110-Mode Singlet Building Block	Chad Bartlett
We3B-3	Optimizing the Coupling Factor of a Tapped Delay Line for Analog Radar Target Simulation	Kai Braungardt
Mo4B-4	High-Efficiency Watt-Level E-band GaN Power Amplifier with a Compact Low-loss Combiner	Bharath kumar Cimbili
We4B-1	Low-cost Software-Defined Radio System with Deterministic RX to TX Delay Using Timestamps	Christian Dorn
Tu3C-1	Monolithically Integrated Optoelectronic Transmitter based on Segmented Mach-Zehnder Modulator in EPIC 250 nm BiCMOS Technology	Festim Iseini
We1A-2	Chip-embedded Glass Interposer for 5G Applications	Xingchen Li
Mo3B-2	Frequency-Dependent DPD Linearization for Load-Mismatched Mobile Terminal PAs Operating Under Dynamic Resource Block Allocation	Wantao Li
Mo4A-3	Accurate Heart Beat Detection with Doppler Radar using Bidirectional GRU Network	Hui Lu
Mo4C-1	RF figures of merit of polysilicon trap-rich layers formed locally by ion amorphization and nanosecond laser annealing	Martin Perrosé
Tu3C-2	Automatic Tuning of Microwave Silicon Photonic Ring Resonators	Ramy Rady
We4B-2	Theoretical Limits and Interpolation based Improvements of a Correlation Based True-Speed-Over-Ground Estimation	Torsten Reissland
Mo4A-1	Out-of-Distribution Detection for Radar-based Gesture Recognition Using Metric-Learning	Thomas Stadelmayer
Tu1B-4	A Low-Power V-Band CW Radar Transceiver with Vector Modulator for Leakage Cancellation	Batuhan Sutbas
We3B-1	Full Polarimetric Antenna System for Automotive Radar	Alessandro Tinti
We2A-5	Ultra-Wide Bandwidth Substrate Integrated Waveguide Fed Vivaldi Antenna in D-Band Using Glass Interposer	Lakshmi Narasimha Vijay Kumar

RWS Session Tu1A

ADVANCED TUNABLE SOURCES AND FILTERS

Chair: Holger Maune

Co-Chair: Roberto Gomez G.

Room: Melrose 1 & 2

RWS/SiRF Session Tu1B

RF FRONTEND TECHNOLOGIES

Chair: Jan Budroweit

Co-Chair: Václav Valenta

Room: Melrose 3

SiRF Session Tu2C

SEMICONDUCTOR DEVICE TECHNOLOGIES AND INTEGRATION

Chair: Rob Schmid

Co-Chair: Mehmet Kaynak

Room: Melrose 4

8:00-9:40 AM

Tu1A-1

A ROM-Less DDS with Single Current-Switch Array Using Self-Adjusting Two-Step Integrator

Authors: Haruki Shibue, Ritsumeikan University; Hideyuki Nosaka, Ritsumeikan University

Tu1A-2

Dynamic Filtering with Time-Varying Transmission Lines

Authors: Sean Chen, University of California, Los Angeles; Yuanxun Ethan Wang, University of California, Los Angeles

Tu1A-3

A mmWave Transformer Based VCO-Divider for wideband Frequency Synthesizers in 22nm FDSOI

Authors: NAZMUS SAQUIB, Rensselaer Polytechnic Institute; Ahmed Elmenshawi, Rensselaer Polytechnic Institute; Mona Hella, Rensselaer Polytechnic Institute

Tu1A-4

A Signal Generator and Down-Conversion Mixer - TIA Unit for a 5.8-GHz FMCW Receiver in 65nm CMOS

Authors: Navid Naseh, Texas A&ampM University; Mohammad Ghaedi Bardeh, Texas A&ampM University; Kamran Entesari, Texas A&ampM University

Tu1A-5

A Compact Circuit Model for Frequency-Selective Limiters with Strong Field Nonuniformity

Authors: Qian Gao, University of California, Los Angeles; Yuanxun Ethan Wang, UCLA

Tu1B-1

Divide-by-4 Injection-Locked Frequency Divider Using Dual Linear Mixer Technique

Authors: Yo-Sheng Lin, National Chi Nan University; Chung-Ta Huang, National Chi Nan University; Yu-Cian Peng, National Chi Nan University

Tu1B-2

E-Band Active Upconverter Module with Tunable LO Feedthrough

Authors: Benjamin Schoch, University of Stuttgart; Dominik Wrana, University of Stuttgart; Laura Manoliu, Universität Stuttgart; Michael Kuri, Fraunhofer Institute for Applied Solid State Physics; Sandrine Wagner, Fraunhofer Institute for Applied Solid State Physics; Axel Tessmann, Fraunhofer Institute for Applied Solid State Physics; Ingmar Kallfass, University of Stuttgart

Tu1B-3

Digital Front End Transceiver Technology for Wireless Infrastructure

Authors: Kevin Chuang, Analog Devices, Inc.; Hossein Yektaii, Analog Devices, Inc.; Claire Masterson, Analog Devices, Inc.; Chris Mayer, Analog Devices, Inc.

Tu1B-4

Vector Modulator Based Leakage Cancellation Technique for CW Radar Transceiver Frontends

Authors: Batuhan Sutbas, IHP Microelectronics; Mohamed H Eissa, IHP Microelectronics; Gerhard Kahmen, IHP Microelectronics

Tu1B-5

HBT Power Detector utilizing an Ultra-compact Transformer-based Coupler for 5G BIST

Authors: Enrico Jimenez Tuero, IHP Microelectronics; Aniello Franzese, IHP GmbH; Andrea Malignaggi, IHP Microelectronics

Tu1C-1

Enabling next generation wireless and wireline communications with RF foundry technology

Authors: Roda Kanawati, Tower Partners Semiconductor Company; Kurt Moen, Tower Partners Semiconductor Company; Ed Preisler, Tower Partners Semiconductor Company; Hidetoshi Kawasaki, Tower Partners Semiconductor Company; Stan Phillips, Tower Partners Semiconductor Company; Allan Calvo, Tower Partners Semiconductor Company; Rula Badarneh, Tower Partners Semiconductor Company; Lina Guo, Tower Partners Semiconductor Company; Samir Chaudhry, Tower Partners Semiconductor Company; Marco Racanelli, Tower Partners Semiconductor Company

Tu1C-2

Heterogenous integration Technologies

Author: Subramanian Iyer, University of California, Los Angeles

Tu1C-3

Performance Trade-Off of RFSOI Switches Under Scaled Bias Conditions

Authors: Siddhartha Dhar, STMicroelectronics; Stephane Monfray, STMicroelectronics; Frederic Gianesello, STMicroelectronics; Franck Julien, STMicroelectronics; Julien Dura, STMicroelectronics; Charles-Alex Legrand, STMicroelectronics; Julien Amouroux, STMicroelectronics; Bernadette Gros, STMicroelectronics; Loic Welter, STMicroelectronics; Clement Charbuillet, STMicroelectronics; Philippe Cathelin, STMicroelectronics; Elodie Canderle, STMicroelectronics; Nathalie Vulliet, STMicroelectronics; Emmanuel Escolier, STMicroelectronics; Lucas Antunes, STMicroelectronics; Eric Rouchouze, STMicroelectronics; Pascal Fornara, STMicroelectronics; Christian Rivero, STMicroelectronics; Guillaume Bertrand, STMicroelectronics; Pascal Chevalier, STMicroelectronics; Arnaud Regnier, STMicroelectronics; Daniel Gloria, STMicroelectronics; Alain Fleury, STMicroelectronics; Siddhartha Dhar, STMicroelectronics; Siddhartha Dhar, STMicroelectronics

Joint RWW/ARFTG Plenary Session

10:10 AM – 12:00 PM

Microwave Acoustic Filters for Wireless Communications: Recent Developments and Innovations

Amelie Hagelaue
Professor at Technical University Munich, Co-Director of the Fraunhofer Research Institution for Microsystems and Solid-State Technologies

For 30 years the success of microwave acoustics, mainly in mobile phones, has been unstoppable. A lot of effort has been spent to reduce the number of SAW/BAW devices, or ideally, completely remove them. However, no competitive technology providing the same performance at the same size and cost exists today. Thus, the trend is going in the opposite direction, driven by the demand for ever higher data rates and the desire to use the same phone in all parts of the world. The number of acoustic wave devices in a mobile phone is increasing with each new generation of communication standards. In this talk recent developments and innovations for microwave acoustic filters are presented. Those developments are novel architectures, new materials and advanced modeling techniques.

Prof. Amelie Hagelauer received the Dipl.-Ing. degree in mechatronics and the Dr.-Ing. degree in electrical engineering from Friedrich-Alexander-University Erlangen-Nuremberg, Erlangen, Germany, in 2007 and 2013, respectively. In November 2007, she joined the FAU Institute for Electronics Engineering, where she researched on BAW resonators and filters toward her Ph.D. degree. Since 2013, she has been focusing on SAW/BAW and RF MEMS components, as well as on microwave integrated circuits for frontends. From 2016 to 2019, she had been leading a Research Group on electronic circuits and from August 2019 to September 2021 she was Full Professor at the University of Bayreuth, Germany. In September 2021, she has joined the Technical University Munich as Full Professor and became the Co-Director of the Fraunhofer Research Institution for Microsystems and Solid State Technologies EMFT. She has been engaged in research and development of microwave theory and technology, electronic circuits and systems, and communication and sensing systems. In these fields, she has authored or coauthored more than 140 peer-reviewed publications. She acted as a Guest Editor for a special issue of the IEEE Transactions on Microwave Theory and Techniques on the topic RF Frontends for Mobile Radio and is now an Associate Editor of the IEEE Transactions on Microwave Theory and Techniques.

Future trends in RF and wireless test capabilities from 5G to 6G and beyond

Charles Schroeder

Measurements, and the science behind them, are key to the design of modern electromechanical systems. And while the devices we're designing are evolving rapidly, the instruments making these key measurements of performance have been slower to evolve. In general, the size of the instruments we all use hasn't changed in decades. And the internal architectures, still heavily reliant on PC-based hardware and software components, have reached their limits. It's time for a re-thinking, not just of the hardware and software architectures of instrumentation, but of how instruments are used as a part of the design process.

Roger Nichols' 37 years of engineering As an NI Fellow, Charles Schroeder works across the company on key business and technology-driven initiatives. He consults with executive leaders and department heads, including those from marketing, sales, and R&D, to drive the company's strategic direction, development, and future growth. With a focus on long-term innovation best practices and processes, he currently leads NI's efforts to find ground-breaking solutions to the test challenges introduced by the adoption of 6G and next generation wireless technologies.

Since joining NI in 1995, Charles Schroeder has held various positions, including vice president of product marketing for RF and wireless communications and leadership roles across the RF, modular instruments, DAQ, and IMAQ Vision product lines. He holds bachelor's and master's degrees in electrical engineering from Texas A&M University.

SIRF Session Tu2C

MILLIMETER-WAVE AND SUB-TERAHERTZ CIRCUITS

Chair: Chris Coen

Co-Chair: Alexander Haag

Room: Melrose 4

1:30-3:10 PM

Tu2C-1

Scaling of on-chip CMOS radiating arrays above 200 GHz

Author: Eran Socher, Tel-Aviv University

Tu2C-2

An Active Reflection Phase Shifter with High Gain for Reconfigurable Reflectarrays above 0.24 THz

Authors: Ekaterina Kunakovskaya, Karlsruhe Institute of Technology; Cagri Ulusoy, Karlsruhe Institute of Technology

Tu2C-3

A Differential SiGe HBT Doherty Power Amplifier for Automotive Radar at 79 GHz

Authors: Jan Schoepfel, Ruhr University Bochum; Holger Rücker, IHP GmbH; Nils Pohl, Ruhr University Bochum

Tu2C-4

Thermal Analysis and Design of a Ka-Band Power Amplifier in 130 nm SiGe BiCMOS

Authors: Alexander Haag, Karlsruhe Institute of Technology; Mehmet Kaynak, IHP Microelectronics; Ahmet Cagri Ulusoy, Karlsruhe Institute of Technology

Short Course

Room: Melrose 3

1:30 – 2:30 PM

Power Amplifier Characterization/ Automation for Digital Predistortion (DPD) Metrics and Algorithm Validations

Lecturer: Anis Ben Arfi, Analog Devices

The imminent deployment of 5G networks combined with challenging technical specifications requires new and agile methods to optimize and validate the RF solutions. Particularly, developers of 5G RF Power Amplifiers (PAs) and front-end module technology often face difficult trade-off between device linearity and efficiency. To address the increased bandwidth and power efficiency requirements of 5G systems, today's Small Cell and MIMO PAs are pushed to operate at non-linear regions. Hence, the need for Digital Pre-Distortion (DPD) to correct for the non-linearity and preserve the highly-efficient PA operation. The design of these efficient PAs needs to follow critical criteria to ensure linearizability (i.e the PA's ability to be linearized by applying predistortion). For this reason, at ADI, we perform a thorough PA characterization to verify the aforementioned criteria. However, PA characterization is a delicate and lengthy routine which needs to be automated. In fact, we are looking to evaluate significant number of PAs provided by ADI costumers and partner PA vendors. The PA characterization's main purpose is to ensure that ADI DPD algorithms can handle the large set of PAs used by our customers. With the increasing number of new PAs to be tested, an automation of the PA characterization process becomes necessary in order to perform this characterization in shorter time periods.

The first part of this short course, will lay the foundation of the PA behavior and the DPD metrics used to evaluate its linearizability. Afterwards, the PA characterization process will be presented along with examples of PA reports provided by ADI to customers.

The second part of the short course will touch on the automated test-bench solution developed to perform power and frequency sweeps. The setup was developed using LabView to automate the test equipment and perform RF pulsed and modulated measurements. Similarly, the KeySight PNA-X automation work will be introduced. The PNA-X is used to measure the PA gain flatness over frequency, AM/AM, AM/PM and two-tone response. Finally, the short course will showcase the performance obtained using ADI transceiver boards linearizing various PAs and will discuss the best practices to obtain accurate results

Session ????

INTERACTIVE FORUM POSTER SESSION

Chair: ??????????

Co-Chair: ??????????

Room: Celebrity Ballroom

1:30 – 3:10 PM

Tu1

A Planar V-Band Antenna for Wideband Radar and Communication on Low-Cost PCB Substrate

Authors: Sebastian Peters, Friedrich-Alexander-Universität Erlangen-Nürnberg; Samira Faghih-Naini, Friedrich-Alexander-Universität Erlangen-Nürnberg; Stefan Erhardt, Friedrich-Alexander-Universität Erlangen-Nürnberg; Torsten Reissland, University of Erlangen-Nuremberg; Robert Weigel, Friedrich-Alexander-Universität Erlangen-Nürnberg

Tu2

An RFID sensing method based on magnetic control antenna coupling

Authors: Yang Pan, Zhejiang University; Xingyu Liu, Zhejiang University; Yuting Wu, Zhejiang University; Peiying Lin, Zhejiang University; Zhouyi Wu, Zhejiang University; jiangtao huangfu, Zhejiang University

Tu3

A Wideband Dual-Polarized Antenna Designed for Antenna-in-Package (AiP)

Authors: Wei-Lun Hsu, National Chung Cheng University; Yuan-Chun Lin, National Chung Cheng University; Kuo-Hung Cheng, National Chung Cheng University; Shih-Cheng Lin, National Chung Cheng University; Chia-Chan Chang, National Chung Cheng University; Sheng-Fuh Chang, National Chung Cheng University

Tu4

Consideration of Nonlinear Effects in Different Receiver Architectures for Use in Passive Radar Systems

Authors: Marie Horlbeck, Friedrich-Alexander-Universität Erlangen-Nürnberg; Benedict Scheiner, Friedrich-Alexander-Universität Erlangen-Nürnberg; Robert Weigel, Friedrich-Alexan, Hamburg University of Technology

Tu5

Indoor Wireless Localization of UncooperativeSources Using a Ray Tracing Model

Authors: Richard T Clark, Pacific Northwest National Laboratory; Andrew W Engel, Pacific Northwest National Laboratory; Trey E Shenk, Pacific Northwest National Laboratory; David M Sheen, Pacific Northwest National Laboratory

Tu6

A High-Linearity 10-GHz-ERBW 3-to-7-GS-s Voltage-to-Time Converter with Built-In S-H

Authors: Lachlan Cuskelly, University of Calgary; Dhruv Bhaskar, University of Calgary; Leonid Belostotski, University of Calgary

Tu7

Study of High Frequency Nonlinear Memory Effect on Doherty Power Amplifiers Linearization Performances for 5G Applications

Authors: Christophe Quindroit, Ampleon; Pablo Rochas, Ampleon; Nelsy Monsauret, Ampleon; Alexis Courty, Ampleon

Tu8

Driver's vital-signs monitoring with a single 60GHz sensor

Author: Ryota Kawasaki, University of Kitakyushu

Tu9

Dual-Core mm-Wave VCO with Enhanced Second Harmonic Extraction by Mode Separation

Authors: Meghana Kadam, Technische Universität Braunschweig; Fabio Padovan, Infineon Technologies AG; Vadim Issakov, Technische Universität Braunschweig

TU10

A Hybrid Technique to Increase Throughput of the Streaming Spectrum Sensor

Author: Dylan J Gormley, National Aeronautics and Space Administration

Tu11

Compact Half-Mode Triple-Band Bandpass Filter by using Stepped Impedance Resonators with Grounding Via Holes

Authors: Ceyhun Karpuz, Pamukkale University; Pınar Ozturk Ozdemir, Air Force Academy National Defence University; Hasan H Balık, Yildiz Technical University; Adnan Gorur, Nigde Omer Halisdemir Univ

Tu12

Substrate Integrated Waveguide Balun Bandpass Filter with Controllable Transmission Zeros for C Band Application

Authors: Ceyhun Karpuz, Pamukkale University; Gulfem Balasu Firat Unuk, Pamukkale University; Pınar Ozturk Ozdemir, Air Force Academy National Defence University; Ali Kursad Gorur, Nevsehir Haci Bektas Veli University

Tu13

Compact Wilkinson Power Dividers Based on Narrow Slits Loaded Transmission Lines

Authors: Ceyhun Karpuz, Pamukkale University; Ali Kursad Gorur, Nevsehir Haci Bektas Veli University; Mehmet Cakir, Pamukkale University; Adnan Gorur, Nigde Omer Halisdemir Univ

RWS Session Tu3A

FILTERS AND POWER DIVIDERS

Chair: Roberto Gomez G.

Co-Chair: Changzhi Li

Room: Melrose 1 & 2

RWS Session Tu3B

WIRELESS COMMUNICATION SYSTEMS

Chair: Jasmin Grosinger

Co-Chair: Mario Pauli

Room: Melrose 3

SiRF Session Tu3C

INTEGRATED PHOTONICS AND PHOTONIC ELECTRONIC CIRCUITS

Chair: Rob Schmid

Co-Chair: Saeed Zeinolabedinzadeh

Room: Melrose 4

3:40-5:20 PM

Tu3A-1

The Anglet: An E-H-plane Bent, 90-Degree Twisted, TE101-TM110-Mode Singlet Building Block

Authors: Chad Bartlett, University of Kiel; Michael Höft, University of Kiel

Tu3A-2

Design and Characterization of Bandpass Filter with Multiple Zeros on Glass Interposer for 6G Applications

Authors: Xingchen Li, Georgia Institute of Technology; Xiaofan Jia, Georgia Institute of Technology; Serhat Erdogan, Georgia Institute of Technology; Madhavan Swaminathan, Georgia Institute of Technology

Tu3A-3

A Compact Reconfigurable Filtering PIN Diode

Authors: Behrooz Rezaee, Graz University of Technology; Hossein Sarbandi Farahani, Graz University of Technology; Wolfgang Bösch, IHF- TU Graz

Tu3A-4

A Full Ka-Band Low-Loss and Monolithically 3-D Printed Dual-Polarized Waveguide Power Divider Based on Shaped Double-Ridged Bøifot Junction

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

Tu3A-5

A mm-wave RC PPF Quadrature Network with Gain Boosting in 22nm CMOS FDSOI

Authors: Mohammad Ghaedi Bardeh, Texas A&M University; Navid Naseh, Texas A&ampM University; Jierui Fu, Texas A&M University; Jeyanandh Paramesh, Texas A&M University; Kamran Entesari, Texas A&M University

Tu3B-1

Design and Analysis of a RF Front-End Receiver System Based on Multi-Layer Organic Filtering for Sub-6GHz Mobile Communication Applications

Authors: Armin Schuster, Friedrich-Alexander-Universität Erlangen-Nürnberg; Stefan Erhardt, Friedrich-Alexander-Universität Erlangen-Nürnberg; Torsten Reissland, Friedrich-Alexander-Universität Erlangen-Nürnberg; Robert Weigel, Friedrich-Alexander-Universität Erlangen-Nürnberg

Tu3B-2

Improving Coding Efficiency in All-digital Transmitters

Authors: Samuel S Pereira, Universidade de Aveiro; Luís F Almeida, University of Aveiro; Arnaldo R Oliveira, University of Aveiro; Nuno Carvalho, University of Aveiro; Paulo Monteiro, University of Aveiro

Tu3B-3

Transceiver Setup for Joint Communication and Sensing Applications in V-Band

Authors: Samira Faghih-Naini, Friedrich-Alexander-Universität Erlangen-Nürnberg; Sebastian Peters, Friedrich-Alexander-Universität Erlangen-Nürnberg; Thomas Kurin, Friedrich-Alexander-Universität Erlangen-Nürnberg; Stefan Erhardt, Friedrich-Alexander-Universität Erlangen-Nürnberg; Torsten Reissland, University of Erlangen-Nuremberg; Robert Weigel, Friedrich-Alexander-Universität Erlangen-Nürnberg

Tu3B-4

True Time Delay-based Alignment for All-digital Beamforming Transmitters

Authors: Luís Filipe Almeida, University of Aveiro; Samuel S Pereira, University of Aveiro; Ivo Rodrigues, University of Aveiro; Ricardo Correia, University of Aveiro; Miguel Drummond, University of Aveiro; Arnaldo R Oliveira, University of Aveiro; Nuno Carvalho, University of Aveiro

Tu3C-1

Monolithically Integrated Optoelectronic Transmitter based on Segmented Mach-Zehnder Modulator in EPIC 250 nm BiCMOS Technology

Authors: Festim Iseini, IHP Microelectronics; Mesut Inac, IHP Microelectronics; Andrea Malignaggi, IHP Microelectronics; Anna Peczek, IHP Microelectronics; Gerhard Kahmen, IHP Microelectronics

Tu3C-2

Automatic Tuning of Microwave Silicon Photonic Ring Resonators

Authors: Ramy Rady, Texas A&M University; Christi K Madsen, Texas A&M University; Samuel Palermo, Texas A&M University; Kamran Entesari, Texas A&M Univ.

Tu3C-3

Tunable and Highly Power Efficient Traveling Wave Amplifier in SiGe BiCMOS for Optical Modulators

Authors: Mesut Inac, IHP Microelectronics; Falk Korndoerfer, IHP Microelectronics; Friedel Gerfers, Technische Universitat Berlin; Andrea Malignaggi, IHP Microelectronics

Tuesday, 24 January 2023

5:30-7:30 PM

PANEL SESSION

BEAMFORMING SOLUTIONS FOR TERRESTRIAL AND SPACE APPLICATIONS

(part of SHaRC Space Nigh event)

Organizer: Václav Valenta from European Space Agency

More than 110 year ago, the very first phased array with beam-steering capability was introduced by K. F. Braun during his Nobel prize lecture. This concept has given basis to many communication and radar system. Although we've gained vast, over a century long experience in developments of phased-arrays, large-volume and economically viable commercial solutions started to emerge only during the last decade. The latter has been enabled through maturing and affordability of silicon technologies, advances in packaging, making commercial phased arrays available to anyone.

Today, multibeam active antennas play the key role in many modern terrestrial and SATCOM systems, allowing for high throughput, flexibility and connectivity worldwide.

Recognised experts and scientists from both academia and industry worldwide have been invited to join this panel. Capabilities of today's beamforming solutions will be discussed together with challenges and trends in beamforming for 5G, terrestrial and spaceborne SATCOM.

Panellists

- **Siriram Muralidharan**, *RF Design Engineering manager at Analog Devices*
- **Francois Martin**, *Head of ASIC Business Development Space, ST Microelectronics*
- **Ryan Jennings,** *Vice president of SATCOM and system engineer at Anokiwave*
- **Tumay Kanar,** *Senior manager for mm-wave IC design and product marketing at Renesas*
- **Jose Luis Flores,** *Microwave and RF design engineer at Celestia UK*

RWS Session We1A

ADVANCED PASSIVE COMPONENTS AND PACKAGING METHODS

Chair: Charlie Jackson

Co-Chair: Robert Caverly

Room: Melrose 1 & 2

WisNet Session We1B

RF-MILLIMETER-WAVE SENSING SYSTEMS

Chair: Wooyeol Choi

Co-Chair: Paolo Mezzanotte

Room: Melrose 3

SHaRC Session We1C

SYSTEMS, HARDWARE, AND ELECTRONICS FOR SPACE

Chair: Markus Gardill

Co-Chair: Marie Piasecki

Room: Melrose 4

8:00-9:40 AM

We1A-1

A Power-Efficient Compact Ku-Band System-on-Antenna Module with Chip-First Package Integration

Authors: Xenofon Konstanti, Michigan State University; John D Albrecht, Michigan State University; Premjeet Chahal, Michigan State University; John Papapolymerou, Michigan State University

We1A-2

Chip-embedded Glass Interposer for 5G Applications

Authors: Xingchen Li, Georgia Institute of Technology; Xiaofan Jia, Georgia Institute of Technology; Kyoung-sik Moon, Georgia Institute of Technology; Joon Woo Kim, Georgia Institute of Technology; Aadit Pandey, Georgia Institute of Technology; Anthony Chiu, QORVO, Inc.; Andrew A Ketterson, QORVO, Inc.; Madhavan Swaminathan, Georgia Institute of Technology

We1A-3

Patterned Multi-Material Die Attach Process Using Aerosol-Jet Printing

Authors: Wesley Spain, Michigan State University; John Papapolymerou, Michigan State University; Prem Chahal, Michigan State University; John Albrecht, Michigan State University

We1A-4

3D Printed Acoustical Hybrid and Applications Based on the Microwave Case

Author: Charles Jackson, 3DA&ampM LLC

We1B-1

RF-millimeter-wave sensing systems 2D Imaging of a Drone Using a Millimeter-Wave Fast Chirp MIMO Radar Based on Khatri-Rao Product Virtual Array Processing

Authors: Kenshi Ogawa, National Defense Academy of Japan; Masashi Kurosaki, National Defense Academy of Japan; Ryohei Nakamura, National Defense Academy of Japan; Hisaya Hadama, National Defense Academy of Japan

We1B-2

24-GHz Frequency Scanning Doppler Vibrometer

Authors:: Giordano Cicioni, University of Perugia; Raffaele Salvati, University of Perugia; Roberto Vincenti Gatti, University of Perugia; Valentina Palazzi, University of Perugia; Paolo Mezzanotte, University of Perugia; Luca Roselli, University of Perugia; Federico Alimenti, University of Perugia

We1B-3

2-Way Localization of RFID Tags

Authors: Jasmin Walk, University of Innsbruck; Thomas Ussmueller, University of Innsbruck

We1B-4

318-EA338

Violin Gesture Recognition Using FMCW Radars

Authors: Hannah Y Gao, Texas Tech University; Christopher Williams, Texas Tech University; Victor G Rizzi Varela, Texas Tech University; Changzhi Li, Texas Tech University

We1B-5

Experimental Study on Multiple Drone Detection Using a Millimeter-wave Fast Chirp MIMO Radar

Authors: Masashi Kurosaki, National Defense Academy of Japan; Kenshi Ogawa, National Defense Academy of Japan; Ryohei Nakamura, National Defense Academy of Japan; Keiji Jimi, Gunma University; Hisaya Hadama, National Defense Academy of Japan

We1C-1

Low-Noise Block Downconverter based on COTS and SIW Filters for Ku-band Cubesat Transponders

Authors: Giulia Orecchini, University of Perugia; Giacomo Schiavolini, University of Perugia; Paolo Mezzanotte, University of Perugia; Simone Pauletto, Picosats s.r.l.; Andrea Loppi, Picosats s.r.l; Andrea Beltramello, Picosats s.r.l.; Federico Dogo, Picosats s.r.l.; Davide Manià, Picosats s.r.l.; Valentina Palazzi, University of Perugia; Guendalina Simoncini, University of Perugia; Luca Roselli, University of Perugia; Anna Gregorio, Picosats s.r.l.; Mario Fragiacomo, Picosats s.r.l.; Federico Alimenti, University of Perugia

We1C-2

Demonstration of a Switched Wideband GaN High-Power Amplifier for Future Space Missions

Authors: Rainee N Simons, NASA Glenn Research Center; Joseph A Downey, NASA Glenn; Bryan L Schoenholz, NASA Glenn; Marie Piasecki, NASA; Nang T Pham, NASA Glenn Research Center; Mansoor K Siddiqui, Northrop Grumman Corporation; Ralph G Bonnin, Northrop Grumman Aerospace Systems

We1C-3

Versatile Linearized Miniature TWTAs for Phased Arrays in Space

Authors: Allen Katz, The College of New Jersey; Roger Dorval, Linear Space Technology; Robert Gray, Linear Space Technology; Christopher H Tenev, Linear Space Technology

We1C-4

A Highly Integrated and Software-Controlled L to Ka-Band Front-End for SDRs in space applications

Authors: Jan Budroweit, DLR; Felix Eichstaedt, German Aerospace Center; Ferdinand Stehle, DLR e.V.

We1C-5

Towards Wireless Ranging and Synchronization using CubeSat Software-Defined Radio Subsystems

Authors: Markus Gardill, Brandenburg University of Technology; Dominik Pearson, Center for Telematics; Julian Scharnagl, Center for Telematics; Klaus Schilling, Zentrum für Telematik

Wednesday, 25 January 2023

RWS Session We2A

WIDEBAND & TUNABLE mmWAVE ANTENNAS

Chair: Jeremy Muldavin

Co-Chair: Holger Maune

Room: Melrose 1 & 2

WisNET Session We2B

WIRELESS SENSORS CIRCUITS & SYSTEM

Chair: Thomas Ußmüller

Co-Chair: Rahul Khanna

Room: Melrose 3

SHaRC Session We2C

MISSION CONCEPTS, OPERATIONS, REGULATIONS, AND STANDARDIZATION

Chair: Jan Budroweit

Co-Chair: Charlie Jackson

Room: Melrose 4

10:10-11:50 AM

We2A-1

Compact and Broadband 300 GHz Three-Element On-Chip Patch Antenna

Authors: Tim Pfahler, Friedrich-Alexander-Universität Erlangen-Nürnberg; Martin Vossiek, Friedrich-Alexander-Universität Erlangen-Nürnberg; Jan Schür, Friedrich-Alexander-Universität Erlangen-Nürnberg

We2A-2

A Tunable Array Element Based on Liquid Crystals for Holographic Beam-Steering Antennas

Authors: Peng-Yuan Wang, University of Duisburg-Essen; Andreas Rennings, University of Duisburg-Essen; Daniel Erni, University of Duisburg-Essen

We2A-3

A Compact 3-D-Printing-Compatible Dual-Polarized Spherical Resonator Antenna With Improved Bandwidth and Reliability

Authors: Shuai Deng, Shenzhen University; Jin Li, Shenzhen University; Tao Yuan, Shenzhen University

We2A-4

An mmWave FZP-Based Phased Array

Authors: Qiangli Xi, Zhejiang University; Bin Zhang, Zhejiang University; Lixin Ran, Zhejiang University

We2A-5

Ultra-Wide Bandwidth Substrate Integrated Waveguide Fed Vivaldi Antenna in D-Band Using Glass Interposer

Authors: Lakshmi Narasimha Vijay Kumar, Georgia Institute of Technology; Madhavan Swaminathan, Georgia Institute of Technology

We2B-1

State-Recovery Protocol for URLLC Applications in 5G Systems

Authors: Anas Alsoliman, University of California, Irvine; Forough S Abkenar, University of California, Irvine; Marco Levorato, University of California, Irvine

We2B-2

A novel method for determining the degree of hydrogen loading of LOHC using cavity based permittivity measurements

Authors: Nico Weiss, Hamburg University of Technology; Alexander Koelpin, Hamburg University of Technology; Irina Wiemann, Friedrich-Alexander-Universität Erlangen-Nürnberg; Eberhard Schluecker, Friedrich-Alexander-Universität Erlangen-Nürnberg

We2B-3

An Energy Efficient LoRa-based Multi-Sensor IoT Network for Smart Agriculture System

Authors: Shivakant Mishra, University of Colorado; Sanjeet Nayak, IIITDM Kancheepuram; Ramnarayan Yadav, IITRAM, Ahmedabad

We2B-4

A Simple Low Jitter Wireless Triggering and Unidirectional Communication System

Authors: Andreas Depold, Friedrich-Alexander-Universität Erlangen-Nürnberg; Christian Dorn, Technical University of Munich; Robert Weigel, Friedrich-Alexander-Universität Erlangen-Nürnberg; Fabian Lurz, Hamburg University of Technology

We2B-5

A Wireless Lightweight System Node for Energy Efficient Beehive Sensing

Authors: Thomas Kurin, Friedrich-Alexander-Universität Erlangen-Nürnberg; Marie Horlbeck, Friedrich-Alexander-Universität Erlangen-Nürnberg; Timo Maiwald, Friedrich-Alexander-Universität Erlangen-Nürnberg; Robert Weigel, Friedrich-Alexander-Universität Erlangen-Nürnberg; Fabian Lurz, Hamburg University of Technology

We2C-1

A Digital Testbed for Autonomous Spacecraft Communication Services

Authors: Aaron Smith, National Aeronautics and Space Administration; Elmer W Brown, Case Western Reserve University; Francis Merat, Case Western Reserve University

We2C-2

Evaluating an HDL-based multi-channel ADS-B receiver on a highly integrated SDR platform for space application

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

We2C-3

Multi-Mission Operations at Technische Universität Berlin through the example of TUBIN

Authors: Julian Bartholomäus, Technische Universitat Berlin; Philipp Werner, Technische Universität Berlin; Enrico Stoll, Technische Universität Berlin

We2C-4

CubeSat Platform Integrated UHF-VHF Antennas

Authors: Yu-Jiun Ren, General Microwave Technologies; Chien-Hsun Chen, Electric Connector Technology

Wednesday, 25 January 2023

Short Course

Room: Melrose 1 & 2

1:30-2:30 PM

Linearization of Power Amplifiers used in Radio Frequency (RF) Transmitters

Lecturer: R. Neil Braithwaite, Keysight Technologies

This short course reviews techniques used to linearize nonlinear power amplifiers (PAs) used in wireless transmission. It begins with an overview of wireless communications including data throughput and the key components within a transmitter. The primary focus is on the power amplifier, which often behaves in a nonlinear fashion.

Compensation for PA nonlinearities, referred to as linearization, is covered in more detail. This includes the measurement of PA nonlinearities, models of nonlinearities (referred to as behavioral modelling), as well as digital and analog linearization. Digital predistortion is discussed along with estimator structures that make the compensation adaptive. Analog techniques reviewed include feedforward compensation and analog predistortion. Comparisons are made between the linearization approaches.

WisNET Session We3B

HARDWARE TECHNOLOGIES FOR RADAR SYSTEMS

Chair: Timo Jaeschke

Co-Chair: Changzhi Li

Room: Melrose 3

1:30-3:10 PM

We3B-1

Full Polarimetric Antenna System for Automotive Radar

Authors: Alessandro Tinti, Huawei Technologies Duesseldorf GmbH; Simon Tejero Alfageme, Huawei Technologies Duesseldorf GmbH; Sergio Duque Biarge, Huawei Technologies Duesseldorf GmbH; Nils Pohl, Ruhr University Bochum

We3B-2

Hardware technologies for radar systems

Wireless Passive Radar Sensing Based on Discrete LNA-Mixer Co-Optimization and Fast-Startup Baseband Amplifier

Authors: Aaron B Carman, Texas Tech University; Changzhi Li, Texas Tech University

We3B-3

Optimizing the Coupling Factor of a Tapped Delay Line for Analog Radar Target Simulation

Authors: Kai Braungardt, Karlsruhe Institute of Technology; Axel Diewald, Karlsruhe Institute of Technology; Benjamin Nuss, Karlsruhe Institute of Technology; Thomas Zwick, Karlsruhe Institute of Technology

We3B-4

A Dual-Purpose All Digital RF Transmitter with a Feed-Forward Efficiency Enhancement Scheme

Author: Bulent Sen, ASELSAN, INC.

We3B-5

Range Resolution Improvement in FMCW Radar Through VCO's Nonlinearity Compensation

Authors: Max A Vasconcelos, Texas Tech University; Prateek Nallabolu, Texas Tech University; Changzhi Li, Texas Tech University

YOUNG PROFESSIONALS EVENT

Room: ????

1:00-4:00 PM

Hands-on Workshop:
AI for Wireless/RF Communications

Organizers: Pushkar Kulkarni, Qualcomm and Mehernaz Savai, MathWorks

Speakers: Mehernaz Savai and Sekhar Sekharan, MathWorks

AI is being applied in Wireless and RF to develop smarter ways to model physical layers, optimize performance of wireless systems and networks, and address new 6G design challenges.

In this hands-on workshop, you will learn how to apply principles of AI (machine learning, deep learning, domain-specific processing) to Wireless Communication workflows.

This interactive hands-on session will include the following:

- Familiarize yourself with AI tools in MATLAB (no prior knowledge of MATLAB is needed)
- Create and evaluate necessary components to succeed in AI modeling, by implementing an example of Modulation Classification
- Deep dive into a complete AI workflow using an example application for 5G Channel Estimation

The final segment of this workshop is a presentation where you will learn to apply deep learning techniques to RF system design. We will look at the design of the Digital Pre-distortion (DPD) of the transmitted signal. You will learn how to generate test signals, develop, train and test a neural network as a DPD.

Short Course

Room: Melrose 1 & 2

3:30-4:30 PM

Wave-Matter Interaction at Millimeter-Wave Frequencies

Lecturer: Prof. Abbas Omar, University of Magdeburg, Germany

Millimeter Wave mobile communication (5G and beyond) is associated with much lower radiation power and much shorter communication range. Millimeter Wavelengths suffer from very strong attenuation in water-rich substances limiting penetration into biological objects (e.g., human and animal bodies and plants) to just few tenths of a millimeter. Deeper inside the body the intensity is negligible making for greater safety compared to early mobile standards (3G and 4G). However, the safety of millimeter-wave radiation for 5G and beyond remains a public concern.

The physical concepts underlying the wave-matter interaction, particularly at millimeter-wave frequencies, are reviewed and discussed in this talk. Health hazard associated with electromagnetic wave exposures are then discussed. These can generally be categorized in ionizing and non-ionizing effects. Health impact of millimeter-wave exposures belong to the latter, and therefore can be either the direct increase in the body temperature or the indirect overloading of the biological processes responsible for the body thermal regulation.

Ionizing radiations are best described by quantizing the related electromagnetic field and dealing with the wave-matter interaction as collisions between highly localized photons and the material atoms, molecules, and/or chemical bonds. On the other hand, at wavelengths that are much larger than the atomic/molecular scale, a continuous spatial distribution of the electromagnetic wave is an adequate mathematical representation. The wave power-density is described by the Poynting vector, and the power transfer from the wave to the biological substances can be calculated with high precision using the concept of constitutive parameters (conductivity, permittivity, and permeability). These are macroscopic spectral quantities (moving spatial averages), which cannot account for special treatment of specific molecular-scale structures similar to that of, e.g., DNA strand. Millimeter Waves and even Tera-Hertz Waves belong to this category.

WisNET Session We4B

RADAR SYSTEMS & SOFTWARE DEFINED RADIOS

Chair: Václav Valenta

Co-Chair: Markus Gardill

Room: Melrose 3

3:40-5:20 PM

We4B-1

Low-cost Software-Defined Radio System with Deterministic RX to TX Delay Using Timestamps

Authors: Christian Dorn, Technical University of Munich; Andreas Depold, Friedrich-Alexander-Universität Erlangen-Nürnberg; Fabian Lurz, Hamburg University of Technology; Amelie Hagelauer, Fraunhofer EMFT

We4B-2

Theoretical Limits and Interpolation based Improvements of a Correlation Based True-Speed-Over-Ground Estimation

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

We4B-3

Quality of service based radar resource management for synchronisation problems

Authors: Tobias Müller, Fraunhofer FHR; Sebastian Durst, Fraunhofer FHR; Pascal Marquardt, Fraunhofer FHR; Stefan Brüggenwirth, Fraunhofer FHR

100th ARFTG Microwave Measurement Symposium – Abbreviated Program

100th ARFTG Microwave Measurement Conference

MEASUREMENT CHALLENGES FOR EMERGING RF-TO-THZ TECHNOLOGIES

Sunday, January 22nd

7:00 am - 8:00 am	Continental Breakfast	Sunset 4
8:00 am - 5:00 pm	**ARFTG / NIST Short Course**	Sunset 5/6
9:45 am - 10:15 am	Break	
12:00 pm - 1:00 pm	Short Course Lunch	Sunset 4
2:50 pm - 3:20 pm	Break	

Monday January 23rd

7:00 am - 8:00 am	Continental Breakfast	Rotunda/Celebrity Ballroom Foyer
8:00 am - 12:00 pm	**ARFTG / NIST Short Course**	**Sunset 5/6**
9:00 am - 10:30 am	**NVNA Users Forum**	**Wilshire AB**
9:40 am - 10:10 am	Break	Rotunda/Celebrity Ballroom Foyer
10:30 am - 12:00 pm	**On-Wafer Users Forum**	**Wilshire A/B**
12:00 pm - 1:00 pm	Short Course Lunch	Sunset 4
1:00 pm – 1:10 pm	**ARFTG Conference Welcome**	**Celebrity 5**
1:00 pm – 7:00 pm	RWW/ARFTG Exhibition	Celebrity Ballroom
1:10 pm – 2:40 pm	**ARFTG Conference (Session I)**	**Celebrity 5**
2:40 pm – 3:00 pm	**ARFTG Business Meeting**	**Celebrity 5**
3:00 pm – 3:40 pm	Break – Exhibits	Celebrity Ballroom
3:40 pm – 5:00 pm	**ARFTG Conference (Session II)**	**Celebrity 5**
5:30 pm – 6:30 pm	**RWW/ARFTG Joint Reception**	**Celebrity Ballroom**
6:30 pm – 7:30 pm	**PAWR/ARFTG Joint Panel**	**Celebrity 5**
7:30 pm – 9:30 pm	**ARFTG Awards Dinner**	**Wilshire AB**

Tuesday January 24th

7:00 am - 8:00 am	Continental Breakfast	Rotunda/Celebrity Ballroom Foyer
8:00 am - 9:40 am	**ARFTG Conference (Session III)**	**Celebrity 5**
8:00 am - 5:00 pm	RWW/ARFTG Exhibition	Celebrity Ballroom
9:40 am – 10:10 am	Break – Exhibits	Celebrity Ballroom
10:10 am – 12:00 pm	**RWW/ARFTG Joint Plenary (Session IV)**	**Celebrity 6-8**
12:00 pm - 1:00 pm	Break for Lunch (No lunch provided)	
1:00 pm - 3:00 pm	**ARFTG Conference (Session V)**	**Celebrity 5**
1:30 pm - 3:40 pm	**RWW & ARFTG Interactive Forums**	**Celebrity Ballroom**
3:00 pm - 3:40 pm	Break – Interactive Forum & Exhibits	Celebrity Ballroom
3:40 pm - 5:00 pm	**ARFTG Conference (Session VI)**	**Celebrity 5**
5:00 pm - 5:15 pm	**ARFTG Conference Close**	**Celebrity 5**

Wednesday January 25th

7:00 am - 8:00 am	Continental Breakfast	Rotunda/Celebrity Ballroom Foyer
8:00 am - 12:00 pm	**ARFTG Workshop**	**Celebrity 5**
8:00 am - 9:30 am	IEEE P2822 Meeting	Wilshire AB
9:40 am - 10:10 am	Break	Rotunda/Celebrity Ballroom Foyer
9:30 am - 1:30 pm	IEEE P3136 Meeting	Wilshire AB
1:30 pm - 3:00 pm	IEEE P???? Meeting (TBD)	Wilshire AB
3:00 pm - 5:00 pm	IEEE P???? Meeting (TBD)	Wilshire AB

Industry Exhibits

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Virginia Diodes, Inc.

SPONSOR

BNC Berkeley Nucleonics Corp

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KEYSIGHT TECHNOLOGIES

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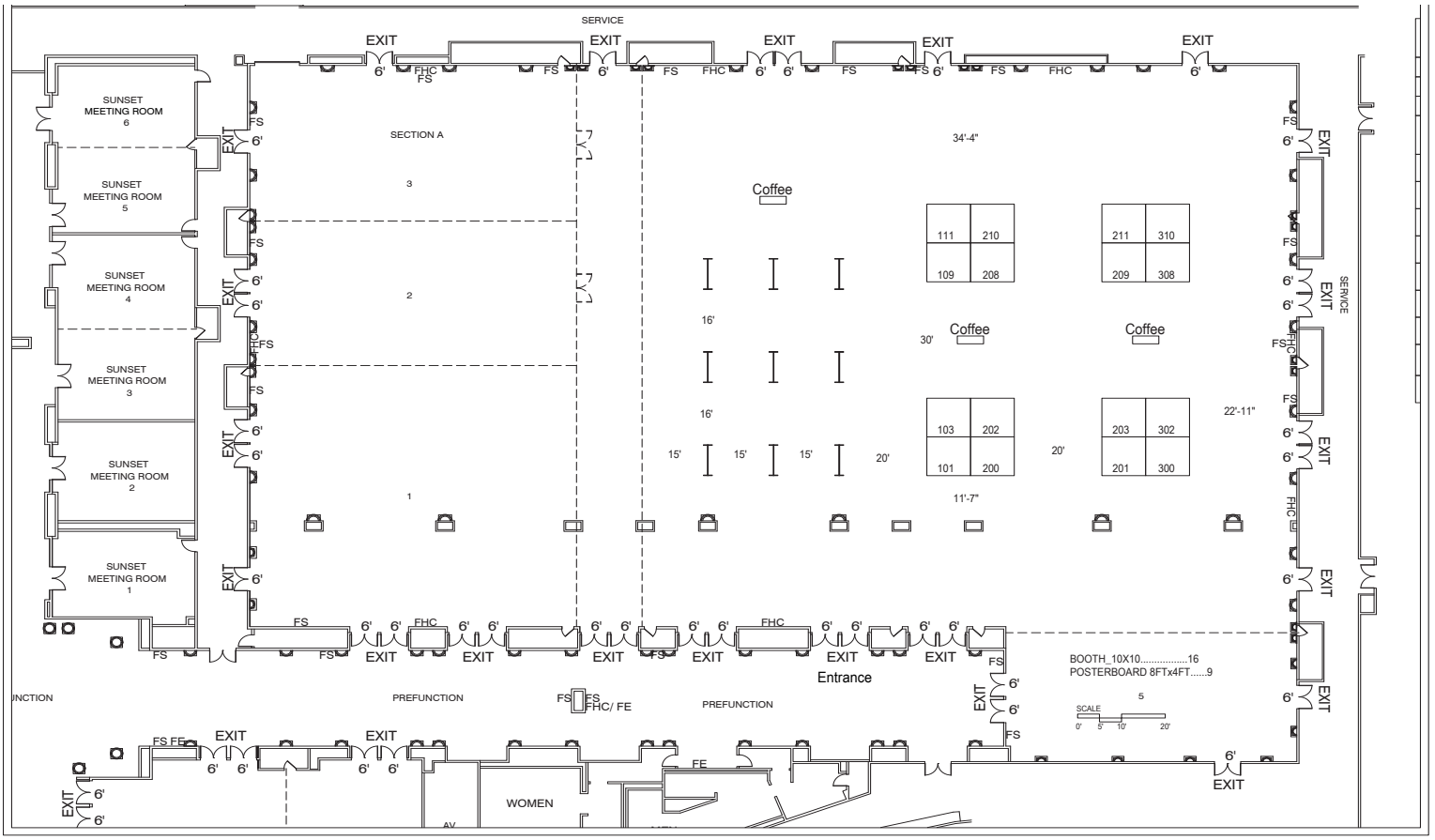
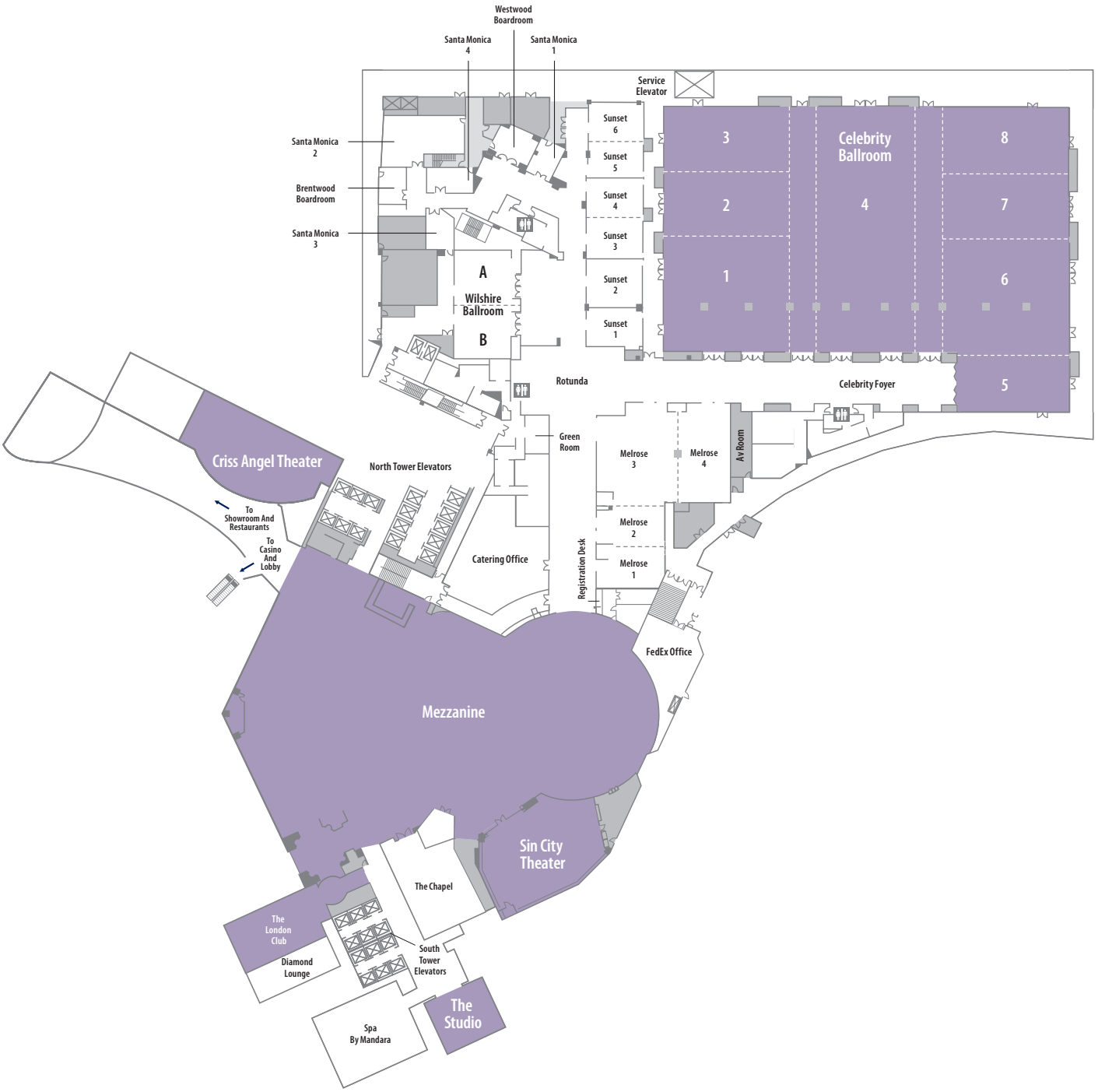
EXHIBITORS	BOOTH #
Advanced Test Equipment Corp.	101
Anritsu	
Berkeley Nucleonics Corporation	310
BroadWave Technologies, Inc.	302
Copper Mountain Technologies	201
Eravant	203
Junkosha, Inc.	200
Keysight Technologies	111
Maury Microwave Corp.	208
Microsanj	308
Mitsubishi Electric US	209
MPI Corporation	210
Microwave Theory and Technology Society (MTT-S)	N/A
Qorvo (no exhibit)	N/A
Rohde & Schwarz USA Inc.	202
SPINNER GmbH	103
Virginia Diodes, Inc.	10

Room Celebrity Ballroom



Hotel Map


Westwood Boardroom
Santa Monica 4
Santa Monica 1
Service Elevator
Santa Monica 2
Brentwood Boardroom
Santa Monica 3
Sunset 6
Sunset 5
Sunset 4
Sunset 3
Sunset 2
Sunset 1
3
Celebrity Ballroom
8
2
4
7
1
6
5
A
Wilshire Ballroom
B
Rotunda
Celebrity Foyer
Criss Angel Theater
North Tower Elevators
Green Room
Melrose 3
Melrose 4
Av Room
To Showroom And Restaurants
To Casino And Lobby
Melrose 2
Melrose 1
Catering Office
Registration Desk
FedEx Office
Mezzanine
Sin City Theater
The Chapel
The London Club
Diamond Lounge
South Tower Elevators
The Studio
Spa By Mandara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