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Connecting Minds. Exchanging Ideas.

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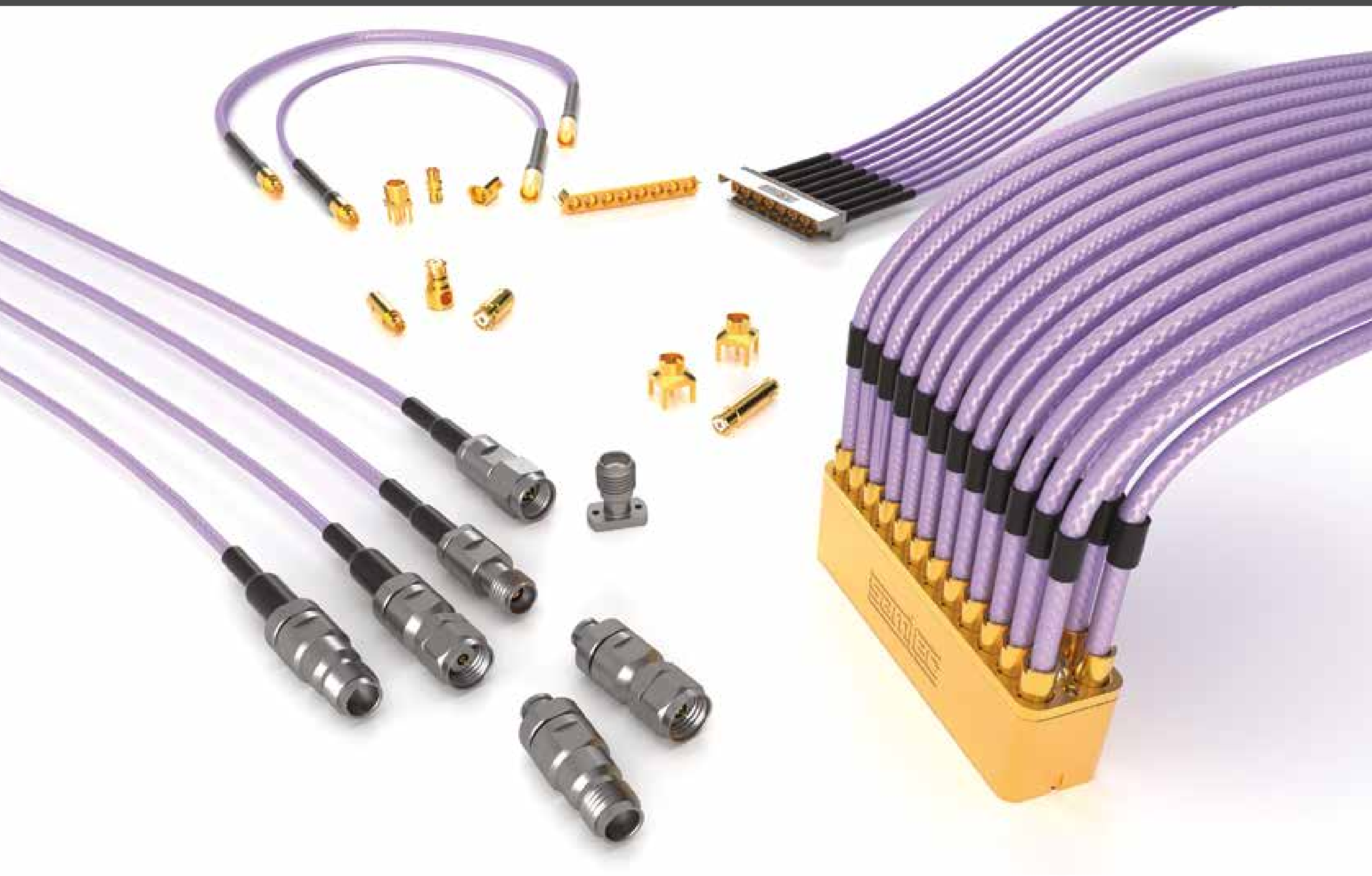
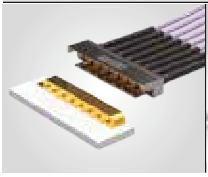
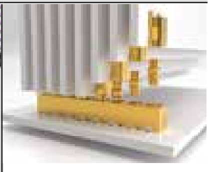
19–24 JUNE 2022

PROGRAM BOOK

IEEE MTT-S IEEE MICROWAVE THEORY & TECHNOLOGY SOCIETY RFIC ARFTG







MICROWAVE WEEK

IS ALL ABOUT CONNECTIONS...

From social media to downloading papers in real time — we've got you covered!

JOIN THE CONVERSATION:

Make sure you're engaging with IMS2022 on our social channels:

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Like us on Facebook: http://www.facebook.com/IEEE.MTTS.IMS

Engage with fellow attendees on LinkedIn:
https://www.linkedin.com/groups/2375668/
(Group Name: IEEE MTT-S International Microwave Symposium (IMS))

https://www.linkedin.com/company/ieee-mtt-s-international-microwave-symposium-ims/?viewAsMember=true

Follow us on YouTube: http://www.youtube.com/user/mttims

Don't forget to use the official IMS hashtag: **#IMS2022**

For the most up to date information visit:
ims-ieee.org/mobile-apps-and-social-media

IMS MICROWAVE WEEK:

There's an app for that! Download papers in real time!

The IMS Microwave Week app is now available in the Apple App Store and Google Play store. Install the app on your Android or iOS device to view the full schedule of Workshops; Technical Lectures; IMS, RFIC, and ARFTG Technical Sessions; Panel Sessions; Social Events; and Exhibition Information. You will be able to download the technical content that you registered for, e.g., IMS and/or RFIC papers, workshop notes; as well as locate exhibitors and explore everything that the show has to offer!

The app now includes an opt-in Social Networking Feature that let's you search for fellow attendees who opted-in to be contacted for networking. Download the app today!

To download the app, search for 'IMS Microwave Week' on the app store for your device or scan a QR code below.

For assistance,
please email:
support@mtt.org

Download on the App Store

ANDROID APP ON Google play

Wireless is available throughout the Colorado Convention Center!

SSID: IMS2022

Password: Denver22

IMS2022 Table of Contents

WELCOME TO IMS2022!

RON GINLEY, IMS2022 GENERAL CHAIR

Welcome to IMS2022 in Denver, Colorado. We are very excited about IMS coming to Denver and have planned a great event for you. We are planning an in-person event, a robust technical program, great social opportunities, and Denver is a wonderful place to visit. Several new innovations have been put into place that will make IMS2022 more informative and valuable for everyone. IMS2022 will be a great chance to re-establish connections and make new ones. Come explore the peaks of microwave engineering!

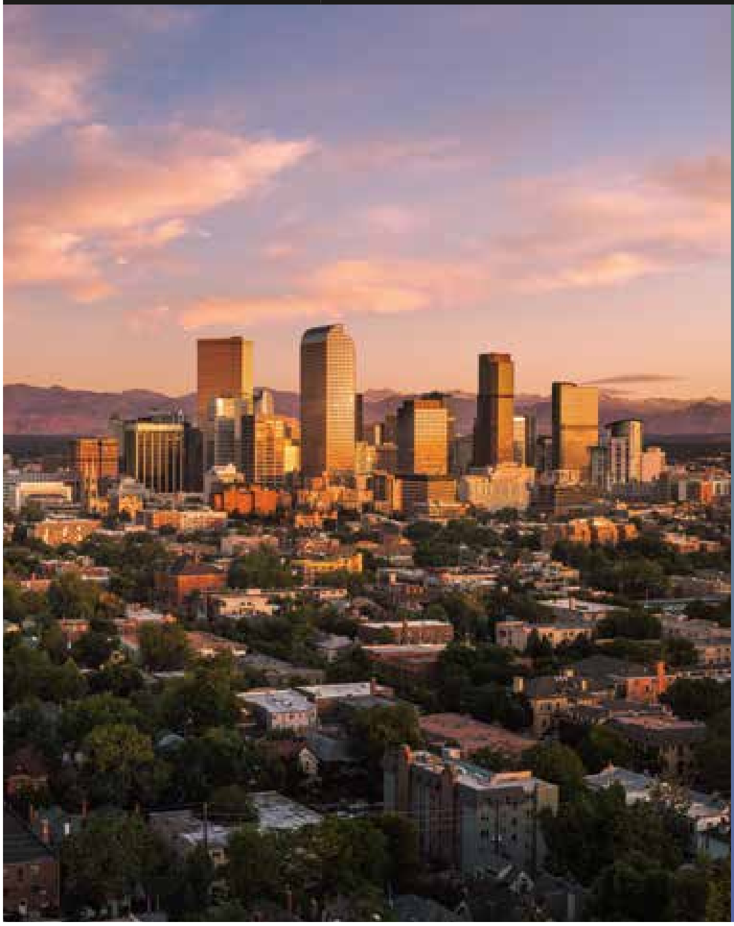
Downtown Denver is a vibrant community. The main hotels are less than six blocks from the Colorado Convention Center. There is a great mix of shops, restaurants and entertainment venues in the area near the Convention Center. Denver is known for having great weather—over 300 days of sunshine a year, and the Rocky Mountains are a short drive away.

The Systems Forum will be new in 2022. This will be a three-day forum that will bring together the latest in telecommunications, radar and space applications. There will be contributions from MTT-S Sister Societies, RFIC and ARFTG. There will be a theme to each main day of IMS. Tuesday is the Connected Future Summit (think 5G, 6G, …) and Quantum Systems Day. Wednesday is Radar and Aerospace Day. Thursday is Phased Arrays and OTA Applications Day. During these days, look for additional Panel Sessions, more Focus Sessions, Technical Lectures, and Socials!

We are also working to increase industry participation in IMS. There will be opportunities for industry-based authors to showcase their work. There will also be opportunities for industry-based authors to mention companies supporting their work and show the company's booth number if they are exhibiting. The trade show will be a great way to connect with suppliers and attendees alike. There are more than 440 companies exhibiting!

We are excited about being live and in-person in Denver. This will be a great opportunity for the microwave community to come together once again. This is also a great opportunity to showcase your work and learn about new technologies. We really look forward to seeing you in Denver in June 2022.

Ron Ginley
IMS2022 General Chair



Coffee Breaks

Sunday	**AM—09:40-10:10**	**Grand Concourse**
	PM—15:10-15:40	**Grand Concourse**
Monday	**AM—09:40-10:10**	**Grand Concourse**
	PM—15:10-15:40	**Grand Concourse**
Tuesday	**AM—09:40-10:10**	**IMS Show Floor**
	PM—15:10-15:40	**IMS Show Floor**
Wednesday	**AM—09:40-10:10**	**IMS Show Floor**
	PM—15:10-15:40	**IMS Show Floor**
Thursday	**AM—09:40-10:10**	**IMS Show Floor**
	PM—15:10-15:40	**Grand Concourse**

EXHIBITION HOURS

Tuesday, 21 June 2022	09:30–17:00
Wednesday, 22 June 2022	09:30–18:00
Thursday, 23 June 2022	09:30–15:00

WELCOME TO DENVER, COLORADO

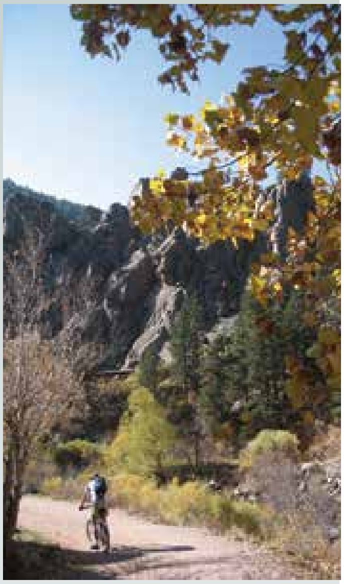
Welcome to Denver, where 300 days of sunshine, a thriving cultural scene, diverse neighborhoods, and natural beauty combine for the world's most spectacular playground. A young, active city at the base of the Colorado Rocky Mountains, Denver's stunning architecture, award-winning dining and unparalleled views are all here, year-round.

Local boosters named the frontier mining camp on the South Platte River "Denver" after Kansas Territorial Governor James Denver in hopes of gaining political favor. Unfortunately, Denver had retired by the time they named the town. There were originally three separate towns, with three separate names, where Denver now stands. In 1859, the other names were dropped in return for a barrel of whiskey to be shared by all. Fittingly enough, the first permanent structure in Denver was a saloon.

By an amazing stroke of good luck, the 13th step on the west side of the Colorado State Capitol Building is exactly 5,280 feet above sea level—one mile high. In Denver's rarified air, golf balls go 10 percent farther. So do cocktails. Alcoholic drinks pack more of a punch than at sea level. The Mile High City is also extremely dry, so it is a good idea to drink more water than usual. With less water vapor in the air at this altitude, the sky really is bluer in Colorado.

Denver is near the mountains, not in them. The Mile High City is located on high rolling plains, 12 miles east of the "foothills," a series of gentle mountains that climb to 11,000 feet. Just beyond is the "Front Range of the Rocky Mountains," a series of formidable snowcapped peaks that rise to 14,000 feet. Denver might not be in the mountains, but the mountains still dominate the city. The picturesque mountain panorama from Denver is 140 miles long. There are 200 visible named peaks including 32 that soar to 13,000 feet and above.

To plan your time in Denver and Colorado visit the ims-ieee.org.



High Altitude Tips!

Denver Really Is Exactly One Mile High

Denver really is a mile high, but most people don't even notice the altitude difference. The air is just thinner and dryer. In fact, many people with respiratory problems move to Denver for the benefits of the dry air. Follow these tips to stay happy and healthy.

Drink Water

Before your trip to Denver, and while you are here, drinking plenty of water is the number one way to help your body adjust easily to our higher altitude. The low humidity in Colorado keeps the air dry, like the desert, so you need about twice as much water here as you would drink at home.

Monitor Your Alcohol Intake

In Denver's rarified air, golf balls go ten percent farther… and so do cocktails. Alcoholic drinks pack more of a wallop than at sea level. It is recommended that you go easy on the alcohol in the mountains and in Denver, as its effects will feel stronger here.

Eat Foods High In Potassium

Foods such as broccoli, bananas, avocado, cantaloupe, celery, greens, bran, chocolate, granola, dates, dried fruit, potatoes and tomatoes will help you replenish electrolytes by balancing salt intake.

Watch Your Physical Activity

The effects of exercise are more intense here. If you normally run 10 miles a day at home, you might try 6 miles in Denver.

Pack For Sun

With less water vapor in the air at this altitude, the sky really is bluer in Colorado. But there's 25 percent less protection from the sun, so sunscreen is a must. Denver receives more than 300 days of sunshine each year (more than San Diego or Miami). Bring sunglasses, sunscreen, lip balm… even in winter.

Dress In Layers

Two days before your trip to Denver, check the weather and use this information to pack appropriately. Because the sun is especially powerful in Denver, it can feel much warmer than the actual temperature during the daytime, but then become very chilly after sundown, particularly in the Spring and Fall. It is best to layer your clothing.

Enjoy Yourself!

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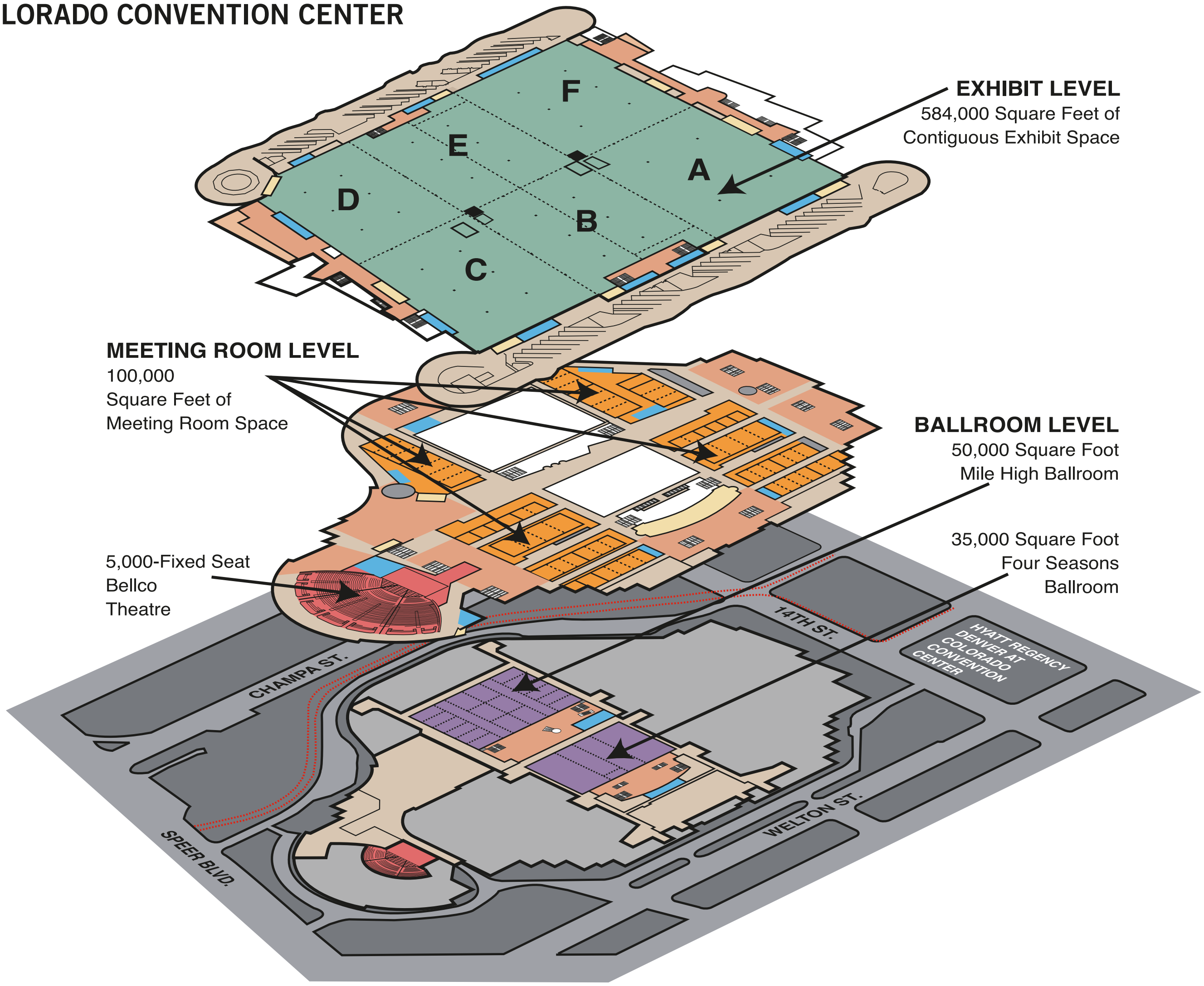
COLORADO CONVENTION CENTER



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100,000
Square Feet of
Meeting Room Space

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35,000 Square Foot
Four Seasons
Ballroom

5,000-Fixed Seat
Bellco
Theatre

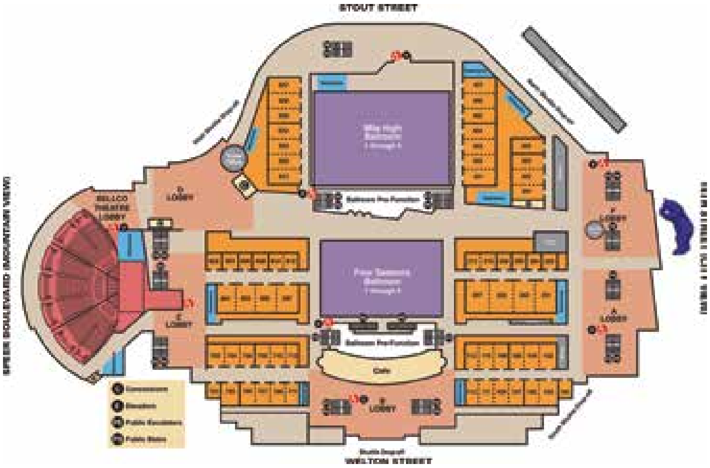
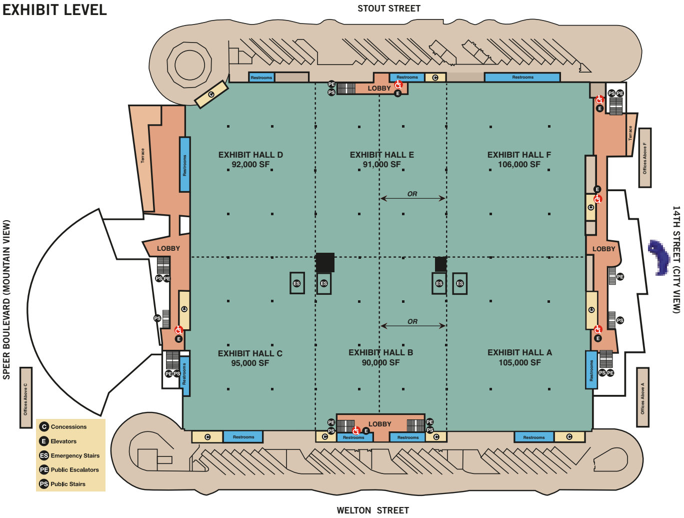


EXHIBIT LEVEL



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SUNDAY WORKSHOPS

08:00 – 17:00 | Sunday, 19 June 2022

	WORKSHOP TITLE	WORKSHOP ABSTRACT
WSA	**Large-Scale Antenna Arrays: Circuits, Architectures, and Algorithms** **Sponsors:** IMS; RFIC **Organizers:** Gernot Hueber, *Silicon Austria Labs*; Renyuan Wang, *BAE Systems*; Subhanshu Gupta, *Washington State Univ.* **ROOMS: 107/109/111/113** **08:00 – 17:00**	Wireless networks have fueled socio-economic growth worldwide and are expected to further advance to enable new applications such as autonomous vehicles, virtual/augmented-reality, and smart cities. Due to shortage of sub-6GHz spectrum, mm-wave frequencies play an important role in the emerging 6G and the communication-on-the-move applications. Given that the propagation loss in the lower mm-wave band needs to be compensated by antenna array gain and densification of base stations with cell radius as small as a hundred meters, radio chipsets need to be power and cost efficient. To make radio chipsets power and cost efficient, state-of-the-art mm-wave-net transceivers are designed with phased antenna array (PAA). As a consequence, signal processing techniques and network protocols for mm-wave-nets are designed under constraints of PAA architectures. Future generations of mm-wave-nets will operate in the upper mm-wave frequency band where more than 10GHz bandwidth can be used to meet the ever-increasing demands. Their realization will demand addressing a completely new set of challenges including wider bandwidths, larger antenna array size, and higher cell density. These new system requirements demand fundamental rethinking of radio architectures, signal processing and networking protocols. Major breakthroughs are thus required in radio front-end architectures to enable coherent combining of wideband mm-wave spectrum, as most commonly adopted PAA-based radios face many challenges in achieving fast beam training, interference suppression, and wideband data communication. Through this workshop, we will look at the fundamental issue of coherent signal combination at these large scales from sub-GHz to sub-THz enabled by a diverse group of speakers with expertise spanning circuits, architecture, algorithms, and applications. The coherent combination will bring out true-time-delay array architectures including recent developments in wideband delay compensation methods with large range-to-resolution ratios. The delay compensation at different points of the receiver chain including RF, baseband, and digital will empower not only traditional wireless communications but also spatial signal processing for direction finding and interference suppression.
WSB	**SWIPT — Simultaneous Wireless Information and Power Transmission for Future IoT Solutions** **Sponsor:** IMS **Organizers:** Alessandra Costanzo, *Università di Bologna*; Nuno Borges Carvalho, *Instituto de Telecomunicações* **ROOMS: 102/104/106** **08:00 – 17:00**	5G and future 6G wireless communications have an objective to massively deploy IoT sensors everywhere; this is important for smart cities, health sensors, space exploration and so on. In this workshop the combination of wireless power transmission, wireless communications and energy harvesting will be presented with clear applications in several use cases. Academics around the world and industry will be presenting their latest developments.
WSC	**Health Aspects of mm-Wave Radiation in 5G and Beyond** **Sponsor:** IMS **Organizers:** Abbas Omar, *OvG Universität Magdeburg*; Ke Wu, *Polytechnique Montréal*; Raafat R. Mansour, *Univ. of Waterloo* **ROOMS: 108/110/112** **08:00 – 17:00**	Utilizing mm-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 do not exceed a 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 do not 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 mm-wave attenuation in water-rich substances characterizing biological tissues. mm-Waves cannot therefore penetrate into biological objects (eg human and animal bodies and plants) more than few millimeters. Health aspects must therefore be investigated within the skin area. Deeper inside the body, mm-waves assume negligible intensities, which are much safer than those of earlier standards (eg 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 (eg ICNIRP, IEEE, and ANSI) allow for harmless radiation levels, and this has been justified by the long-time experience with man-made radiation 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 mm-wave radiation 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 radiation. 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 do not involve nonlinearities. These are macroscopic quantities (spatial moving averages) that average out spatial microscopic details. The averaging window is at most a few hundredths of wavelength wide. Possible changes in critical and sensitive atomic or molecular structures (similar to that existing in eg DNA or nerve cells) cannot considerably exceed the macroscopic average. The latter is a reversible thermal one, as long as the radiated power levels do not exceed those dictated by the Regulatory Agencies (eg FCC in USA).
WSD	**Micro and Nano Technology Challenges to Address 6G Key Performance Indicators** **Sponsors:** IMS; RFIC **Organizers:** Didier Belot, *CEA-LETI*; Wolfgang Heinrich, *FBH* **ROOMS: 201/203** **08:00 – 17:00**	Telecom communities are beginning to prepare the next generation of mobile telecom, the 6G, and present KPIs going to the Tbps, 300GHz carrier frequency, space multiplexing, spectrum agility, dense Massive MIMO, wide bands, and so forth. Serving these challenges, microelectronics communities must re-think their medium term roadmap: what role can CMOS processes play? Is SiGe HBT a good answer to these KPIs? Do we need more exotic technologies such as III-V HBT or HEMT? How to do Heterogeneous Integrations, in a 3D approach? How to integrate antennas and passives?

WORKSHOP ABSTRACT	WORKSHOP TITLE	
The Power Amplifier (PA) continues to be a critical building block in mm-wave communication systems, often dictating the overall system efficiency and can thereby impose constraints on system deployment (eg max phased-array size due to thermal constraints). As such, many publications focus on efficiency enhancement techniques for mm-wave power amplifiers. However, when used in systems targeting “5G and Beyond” applications, transceiver bandwidths must be suitable to meet the high data-rate specifications, and hence, maximum PA efficiency cannot be blindly pursued. Instead, efficiency enhancement techniques must be explored in close consideration of their implications on bandwidth, which is what this workshop aims to explore more deeply. The goal of this workshop is three-fold: 1) familiarize the audience with PA specifications required for next-gen applications, 2) review well-known (and emerging) efficiency enhancement techniques for mm-wave PAs with perspectives on attainable bandwidth, and 3) discuss techniques to enhance bandwidth while maintaining adequate efficiency required for practical systems. The workshop features talks which will highlight PA specifications for two of the forefront “5G and Beyond” applications — radar and large-scale phased-arrays — covering the 20–100+ GHz, along with reference designs suitable for such applications. In addition, there will be discussion on design methodologies for maximizing bandwidth while optimizing efficiency in the context of mm-wave and sub-THz linear amplifiers and mm-wave Doherty amplifiers. Lastly, an emerging efficiency enhancement technique, the sub-harmonic switching amplifier, will also be presented.	**Wideband and High Efficiency mm-Wave CMOS PA Design for 5G and Beyond** **Sponsor:** RFIC **Organizers:** Steven Callender, *Intel*; Sungwon Chung, *Neuralink* **ROOMS: 205/207** **08:00 – 17:00**	**WSE**
Quantum computers hold the promise to perform certain complex calculations that are not solvable even with today’s most powerful supercomputers. Despite the significant progress made in the last decade in the science and engineering of quantum computation systems, several challenges remain before quantum computation can become practically usable. A key challenge relates to system scalability — fault-tolerant quantum computation will likely require thousands or millions of quantum bits (qubits), far beyond the capacity of current prototypes. Today’s most prominent candidate for implementing large-scale systems, the superconducting qubit platform, operates in the microwave regime and is controlled and readout via conventional microwave electronics operating at room temperature. While the current room temperature control and readout approach works for small-scale experiments, it is not scalable to thousands or millions of qubits. The engineering challenges of realizing practical large-scale systems present quantum microwave engineers with new opportunities in microwave modeling, design, and characterization of cryogenic semiconductor and superconductor devices, circuits, and systems. This workshop will address emerging techniques and technologies for quantum information processing, including low-temperature measurements and calibrations, cryogenic packaging and interconnects, monolithic semiconductor-based quantum processors, and quantum-classical interfaces based on cryogenic CMOS and Josephson superconductive electronics.	**Emerging Low-Temperature/Cryogenic Microwave Techniques and Technologies for Quantum Information Processing** **Sponsors:** IMS; RFIC; ARFTG **Organizers:** Alirio Boaventura, *NIST*; Michael Hamilton, *Auburn Univ.* **ROOMS: 401-402** **08:00 – 17:00**	**WSF**
With recent 5G deployment underway, the focus of wireless research is shifting toward 6G, which is expected to have a peak data rate of 1Tb/s and air latency less than 100 microseconds, 50 times the peak data rate and one-tenth the latency of 5G. To achieve Tb/s transmissions in 6G, it is inevitable to utilize the frequency band over 100GHz or sub-THz due to enormous amount of available bandwidth. However, the use of such high frequency bands results in more design challenges of RF circuits including output power, noise, linearity, signal conversion, and high-quality signal source for 6G communications and sensing. In addition, the optimal phased array architecture needs to be carefully analyzed such that the compact and energy-efficient system package can be attained. Moreover, to compensate for the severe mm-wave or sub-THz path loss, a large number of phased array is required to enhance EIRP and SNR while appropriate designs are necessary to establish reliable wireless links and ensure the array performance. Failure in any of these will prevent us from moving forward regarding the development of 6G. In this workshop, the main theme to be discussed concentrates on mm-wave design challenges and solutions for 6G wireless communications, especially targeting RF circuits. The workshop starts with an overview of mm-wave 6G to illustrate the whole picture to the audience. Afterwards, the RF design challenges based on silicon technologies to realize 6G systems are paid more attention while the innovative design techniques are provided such that the advantages of low cost and high-level integration in silicon can be still obtained. For in-depth exploration, being a critical building block in RF front-ends, mm-wave and sub-THz PA is specially under discussion to investigate the design bottlenecks as well as technology limitations, and the potential solutions and technology directions are presented. Besides RF designs, the analysis of phased-array architecture suitable for 6G applications is mentioned while the analog and digital beamforming structures are compared. In this workshop, to overcome the hurdles arising from silicon technologies, a new silicon-compatible III-V technology is introduced to facilitate 6G RF front-end designs. This workshop also covers the mm-wave and sub-THz communication and sensing systems from the top-down perspective for the comprehensive demonstration of 6G realization.	**mm-Wave Design Challenges and Solutions for 6G Wireless Communications** **Sponsor:** RFIC **Organizers:** Hsieh-Hung Hsieh, *TSMC*; Qun Jane Gu, *Univ. of California, Davis*; Tim LaRocca, *Northrop Grumman* **ROOMS: 403-404** **08:00 – 17:00**	**WSG**
The amount of sensing applications at mm-wave frequencies is continuously growing. Most of the applications can be addressed by classical radar techniques, but not all. Additional types of novel energy efficient sensing concepts for near-field imaging arrays and spectroscopy are being investigated. This full-day workshop covers near-field sensing and advanced state of the art radar techniques at mm-wave and THz frequencies. The intention is to showcase the unique applications and innovative concepts for sensing different materials and parameters including vital signs, small motions and distances, permittivity, humidity and gas density, and biomolecules using mm-wave to THz frequencies. The first half of the workshop will focus on various solutions for mm-wave and THz imaging and spectroscopy. For example, real-time THz super-resolution near-field imaging will be discussed, as well as transceivers at THz for gas spectroscopy. Advantages and disadvantages of various sensing approaches will be discussed. In the second half, we will discuss the latest trends and future directions in mm-wave radar systems. We will focus specifically on novel mm-wave radar modulation schemes, advanced system and circuit realizations. The emphasis is on digital radar modulation techniques, such as OFDM, PMCW, spread-spectrum, and their advantages or disadvantages versus classical FMCW radar realizations. The main idea of the workshop is to give an overview on mm-wave and THz sensing concepts and show the future directions for the advanced mm-wave radar transceivers.	**mm-Wave and THz Systems for Near-Field Imaging, Spectroscopy and Radar Sensing Applications** **Sponsor:** RFIC **Organizers:** Omeed Momeni, *Univ. of California, Davis*; Vadim Issakov, *Technische Universität Braunschweig* **ROOMS: 501-502** **08:00 – 17:00**	**WSH**

COLORADO CONVENTION CENTER

SUNDAY WORKSHOPS

08:00 – 17:00 | Sunday, 19 June 2022

WORKSHOP TITLE		WORKSHOP ABSTRACT
WSI	**Advanced Interference Mitigation in Integrated Wireless Transceivers** **Sponsor:** RFIC **Organizers:** Alyosha Molnar, *Cornell Univ.*; Harish Krishnaswamy, *Columbia Univ.*; Jin Zhou, *Univ. of Illinois at Urbana-Champaign* **ROOMS: 503-504** **08:00 – 17:00**	Modern transceivers often rely on many discrete components, such as SAW and BAW filters and duplexers, to protect them from interference. The number of these discrete front-end components is expected to grow further as more bands are made available at RF and mm-wave frequencies, limiting the system cost, form factor and flexibility. Also, while integrated self-interference cancellation has been demonstrated, many challenges remain at the antenna interface and scaling to phased-array and MIMO transceivers. In this workshop, experts from academic and industry will present the state-of-the-art interference mitigation approaches that can be applied to integrated wireless transceivers. Finally, the workshop will conclude with an interactive panel discussion about the potential and limitations of integrated interference mitigation.
WSJ	**System Design Considerations for Advanced Radios** **Sponsor:** RFIC **Organizers:** Oren Eliezer, *Ambiq*; Raja Pullela, *MaxLinear;* Travis Forbes, *Sandia National Laboratories* **ROOMS: 605/607** **08:00 – 17:00**	This workshop will walk you through the steps involved in designing today's complex radios for applications such as infrastructure cellular, Wi-Fi or mm-wave beam forming arrays from a systems perspective. The workshop caters to students, as well as experienced engineers in the industry, with background in RF systems, circuit design or standards, who are interested in expanding the scope of their knowledge beyond the narrow design tasks they may be exposed to. Attendees will learn how system specifications are derived, how we partition design between RF/Analog/Mixed-signal and digital sections to achieve the most optimum solution in terms of size, power, external BOM. You will hear from speakers who are experts in their areas: a mix from industry and academia. Standards related specification and product level requirements that drive architecture or topology choices will be presented. Using Wi-Fi 802.11be emerging standard as an example, we will outline the salient features and how they compare with previous generations. We will address design considerations imposed by the new standard requirements, with particular focus on RF. Presentations focused on base station cellular transceivers will illustrate the differences between narrow-band (mixer-based) and Direct Sampling/Synthesis approaches. Using microwave and mm-wave point to point communication systems, we will go over design aspects such as line-up analysis to arrive at block level specifications. We will present transmit/receive circuit/system challenges in large-scale arrays, followed by approaches towards realizing scalable, digital-intensive large-scale arrays. Design advances in critical building blocks, such as blocker tolerant receivers and ADPLLs will also be discussed. We will present built-in self-calibration techniques and built-in mitigation of self-interference, leading to reduced production testing costs and high production yields. Calibration techniques to overcome impairments such as IQ error or LO offset calibration and Digital Pre-Distortion (DPD) for linearization of power amplifiers will be discussed.
WSK	**Toward Tbps Optical and Wireline Transceivers: a Tutorial for RFIC Designers** **Sponsors:** IMS; RFIC **Organizers:** Bahar Jalali Farahani, *Cisco*; Mahdi Parvizi, *Cisco* **ROOMS: 705/707/709/711** **08:00 – 12:00**	According to the latest report by Global Market Insights Inc. the market valuation of optical communication and networking will cross $30 billion by 2027. The significant revenue comes from the emerging technologies such as IoT (Internet of Things), machine-to-machine networks, AI, cloud-based services, and web-based applications. Several innovations are underway to enhance the wireline and optical transceiver designs so that they can serve the increase in demand and future generations of applications.
WSL	**Wireless Proximity Communication** **Sponsors:** IMS; RFIC **Organizers:** Rocco Tam, *NXP Semiconductors*; Yao-Hong Liu, *IMEC* **ROOMS: 705/707/709/711** **13:30 – 17:00**	Wireless proximity communication provides many unique features over conventional wireless communication such as ultra-high data rate, superior data privacy, energy efficiency, mechanical reliability, precision ranging and bandwidth density. However, those unique features always come with many design trade-offs in system complexity, effective communication distance, energy efficiency and system robustness. In this workshop, we are going to go over several wireless proximity communication techniques such as Mid-Field powering and communication for bio-medical implants, impulse ultra-wide-band and mm-wave. The first and second workshops will introduce the applications in latest UWB standard (IEEE 802.15.4z), and the design trade off in commercial UWB SoC system and circuit design. The third workshop will focus on Mid-Field technology for powering and communication with biomedical neuromodulation implants. This technology offers advantages such as significantly smaller, implanted deeper, implant complexity, patient complication and post-surgical pain. The last workshop presents the overview of solid-state-based mm-wave wireless interconnects from fundamental research to commercialization.
WSM	**Recent Developments in Sub-6GHz PAs and Front-End Modules** **Sponsors:** RFIC; IMS **Organizers:** Alexandre Giry, *CEA-LETI* ; Jennifer Kitchen, *Arizona State Univ.* **ROOMS: 702/704/706** **08:00 – 12:00**	Increasing demand for high data rates, reduced latency, and increased device density are driving the development of 5G wireless systems. 5G spectrum is presently covering sub-7GHz (FR1) and mm-wave bands (FR2, FR3,…). This workshop will bring together experts from academia and industry to highlight recent works and performance trends related to 5G-FR1 Power Amplifiers (PAs) and Front-End Modules (FEMs). Multiband and high linearity requirements, along with the need for higher power and reduced power consumption, make the design of 5G-FR1 PA and FEM highly challenging and critical to overall system performance. Recent trends in Doherty, class F/F^{-1}, multi-stage PAs, and Envelope Tracking PA architectures will be highlighted and insights into different design techniques and integration technologies (CMOS, SOI, GaN) will be presented as pathways to enable the integration of future PAs and FEMs. An introduction to emerging heterogeneous technologies combining high-power GaN with CMOS will also provide the attendees with new directions for next-generation PA design and integration.

SUNDAY WORKSHOPS

08:00 – 17:00 | Sunday, 19 June 2022

	WORKSHOP TITLE	WORKSHOP ABSTRACT
WSN	**Digitally Intensive PAs and Transmitters for RF Communication** **Sponsor:** RFIC **Organizers:** Xun Luo, *UESTC*; Debopriyo Chowdhury, *Broadcom* **ROOMS: 702/704/706** **13:30 – 17:00**	The power amplifiers (PA) and transmitters are the last door in the RF front-end for both the digital and analog kingdoms, one which greatly affects the quality of service (QoS) of the wireless link for modern RF communication, such as 5G, IoT, and beyond. Due to the multi-function trends nowadays, this workshop will showcase the digitally intensive PAs and transmitters, which attract much attention due to their highly reconfigurable nature and rapid development that is on pace with the decreasing scale of CMOS technology. In the first talk, with the aim to powering the next generation of wireless communication, from RF to mm-wave, a series of switched capacitor power amplifiers are discussed. Then, CMOS digital power amplifier and transmitter for efficient signal amplification and beam steering are introduced in the second talk. Next, in the third talk, the all digital transmitter with GaN switching mode power amplifiers with high power efficiency is discussed. Later, digital polar transmitter for impulse-radio ultrawide band communication is introduced in the fourth talk. Finally, the high-performance digital-to-analog converter design towards a digital transmitter is discussed in the fifth talk.
WSO	**Human Body Communications** **Sponsor:** RFIC **Organizers:** Antoine Frappé, *IEMN (UMR 8520)*; François Rivet, *IMS (UMR 5218)*; Fred Lee, *Twenty/Twenty Therapeutics* **ROOMS: 708/710/712** **08:00 – 12:00**	The human body is a new playground for wireless communications to connect health devices or open new services related to information exchange or security. It faces many constraints such as power consumption, quality of service, reliability, and of course being compatible with the human body. The last decade has seen several innovations that exploit the body as a medium to propagate the information efficiently. This workshop proposes a state-of-the-art of up-to-date research on the topic. It starts with an overview of body area networks and pioneering research on communications and power delivery through the body. It is followed by recent developments on broadband human-body communication transceivers for wearable health monitoring. Then, surface-wave capacitive body-coupled communications are introduced and challenges for upper layers and synchronization of nodes are addressed. Finally, intra-body communications using ultrasounds are explored to complete the scope of this workshop.

IMS2022 **QUANTUM WEEK**

The IMS2022 Quantum Week is a special event organized by the MTT-S Quantum Technologies Working Group and is aimed to strengthen collaboration between the MTT-S and quantum communities. There is an array of technical and social activities including plenaries/keynotes, technical sessions, workshops, a bootcamp, and a reception. To encourage attendance from quantum industry, the Quantum Economic Development Consortium (QED-C) will be collocating a meeting with IMS.

Sunday, 19 June	**WSF:** Emerging Low-Temperature/Cryogenic Microwave Techniques and Technologies for Quantum Information Processing Quantum Bootcamp
Monday, 20 June	**WMF:** Superposition and Entanglement: When Microwaves meet Quantum **WMP:** Quantum RF Receivers: Using Rydberg Atoms for Highly Sensitive and Ultra Wideband Electric Field Sensing
Tuesday, 21 June	**Tu1E:** Microwave Technologies for Quantum-System Integration **Tu2E:** Cryogenic Microwave Circuits for Control of Quantum Systems **PL2:** This is the Right Way to Architect the Microwave Control for Quantum Computers! **Tu3E:** Cryogenic Measurement and Characterization for Quantum Systems **IWTU4:** Accelerated Solid State Qubit Pre-Screening **IWTU5:** Mixed-mode/Differential S-parameter Characterization at Cryogenic Temperatures for Quantum Computing Applications **Quantum Reception**
Wednesday, 22 June and Thursday, 23 June	**QED-C (Hyatt Regency Denver)**

QUANTUM BOOT CAMP

08:00 – 12:00 | Sunday, 19 June 2022 | Room: 505–507

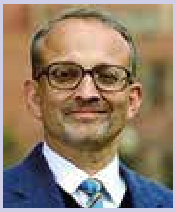
This course will provide an introduction to the basics of quantum engineering, targeting microwave engineers who want to understand how they can make an impact in this emerging field. The intended audience includes new engineers, engineers who may be changing their career path, marketing and sales professionals seeking a better understanding of quantum technology, as well as current university students looking to learn more about the practical aspects of Quantum technology. The format of the Quantum Boot Camp is like that of a short course, with speakers covering quantum engineering basics with a focus on the control and measurement of quantum systems and will conclude with a hands-on introduction to the design of superconducting qubits using modern microwave CAD tools. The boot camp is geared towards making the remainder of quantum-week more accessible to attendees.

Speakers/Instructors:

Thomas McConkey (IBM)	**Kevin O'Brien (MIT)**

RFIC TECHNICAL LECTURE

11:45 – 13:15 | Sunday, 19 June 2022 | Room: 601-603

	LECTURE TITLE	LECTURE ABSTRACT
TL1	**Fundamentals of Noise, and Understanding its Effects on RFICs** **Speaker:** Asad Abidi, *UCLA*	 Even circuit designers who are experienced with low noise design can find it difficult to explain how noise is quantified and analyzed. I will explain the formal methods of quantifying noise and illustrate their use in the design of a variety of common RF circuits. For linear time-invariant circuits such as small-signal amplifiers, noise transfer functions play a key role. For time-varying circuits such as passive mixers and LC oscillators, noise is in many cases injected in discrete time. Methods for the design continue to evolve towards greater simplicity, and I will present some of them. There is seldom a noise optimum in these circuits. It is usually a tradeoff, as I will show, between noise, large-signal linearity, and power dissipation.

RFIC PLENARY SESSION

17:30 – 19:00 | Sunday, 19 June 2022 | Four Seasons Ballroom

The Future of RFIC is Digital

Dr. Curtis Ling, *Chief Technology Officer, MaxLinear*

ABSTRACT: The successful integration of high-performance communication systems in monolithic silicon over the past twenty years is the result of digital circuits becoming an integral part of the analog front end. An important focus of "digital + analog" chip design has been on circuit impairment suppression, which is to say, making analog circuits behave more ideally. Two important examples are the proliferation of direct conversion receivers in high performance applications (to the point of becoming almost passé); and linearization techniques integrated within transceiver signal paths. What will happen as technology scaling continues to feed digital performance without proportional improvements in RF? This talk will briefly examine the evolution and current state of communication systems-on-chips, highlighting the role of digitally-enabled analog in current state of the art; then explore ways in which digital + analog front ends might become increasingly relevant to systems design and network architecture.

BIOGRAPHY: Curtis Ling, Ph.D. is a co-founder of MaxLinear and has served as Chief Technical Officer since April 2006. From March 2004 to July 2006, Dr. Ling served as Chief Financial Officer, and from September 2003 to March 2004, as a co-founder, he consulted for MaxLinear. From July 1999 to July 2003, Dr. Ling served as a principal engineer at Silicon Wave, Inc. From August 1993 to May 1999, Dr. Ling served as a professor at the Hong Kong University of Science and Technology. Dr. Ling received a B.S. in Electrical Engineering from the California Institute of Technology and an M.S. and Ph.D. in Electrical Engineering from the University of Michigan, Ann Arbor.

RFICs into the Roaring 20's: Hot and Cold

Prof. Sorin P. Voinigescu, *Stanley Ho Chair of Microelectronics, Director of the VLSI Research Group, Professor of Electrical and Computer Engineering, University of Toronto*

ABSTRACT: In this talk, I will look ahead to the challenges and research problems RFIC designers will have to address through the end of the decade. With the end of III-V and silicon-based transistor performance scaling in sight, the push for higher operation frequency, bandwidth, data rate, and dynamic range will continue unabated for the main economic drivers in our field: radio, radar sensors, and for the fiberoptic infrastructure that enables all of them. With little fanfare, the baseband of fiberoptic systems is now approaching 100 GHz, higher than 5G and automotive radar carrier frequencies, with over 200 GS/s sampling rate required for ADCs and DACs. Adding AI elements to all these applications may lead us to the "metaverse," but the power consumption of each RFIC function will have to be drastically reduced if we do not wish to melt this "universe." The good news is that the high frequency performance of all transistor technologies improves by ~30% in the cold down to 70 Kelvin and remains excellent at 2 Kelvin. This will open niche markets for RFICs in space and quantum computing which are likely to grow rapidly. Classical computing, data centers, and AI will also greatly benefit from 77 Kelvin operation, improving speed and reducing the power consumption of the classical computation function. I will wrap up with examples of representative RFICs for all these applications and of the research problems that still need solutions.

BIOGRAPHY: Sorin P. Voinigescu is a Professor in the Electrical and Computer Engineering Department at the University of Toronto where he holds the Stanley Ho Chair in Microelectronics and is the Director of the VLSI Research Group. He is an IEEE Fellow and an expert on millimetre-wave, 100+Gbaud integrated circuits and atomic-scale semiconductor device technologies and has an established research and development track record in industry (Nortel, Quake Technologies, Peraso Technologies). He obtained his PhD degree in Electrical and Computer Engineering from the University of Toronto in 1994 and his M.Sc. Degree in Electronics and Telecommunications from the Polytechnical Institute of Bucharest in 1984.

RFIC RECEPTION AND SYMPOSIUM SHOWCASE

Featuring System & Application Demo Forum and Best Student/Industry Paper Showcase | 19:00–21:00 | Sunday, 19 June 2022 | Hyatt Regency Denver, Centennial Ballroom

The RFIC Interactive Reception starts immediately after the Plenary Session and will highlight the Student Paper Awards finalists, the Industry Paper Awards finalists, and the Systems and Applications Forum in an engaging social and technical evening event with food and drinks. Authors of these showcases will present their innovative work, summarized in poster format. Some showcase papers will also offer live demonstrations or be presented via a monitor.

RFIC Student Paper Awards Finalists:

🏵=Showcase Ⓓ=Demonstration

🏵 **A Millimeter-Wave Mixer-First Receiver with Non-Uniform Time-Approximation Filter Achieving >45dB Blocker Rejection** | **RMo1A-1**
Ce Yang, Shiyu Su, Mike Shuo-Wei Chen, *University of Southern California, USA*

🏵 **A Wireless Network of $8.8mm^3$ Bio-Implants Featuring Adaptive Magnetoelectric Power and Multi-Access Bidirectional Telemetry** | **RMo1C-2**
Zhanghao Yu, Wei Wang, Joshua C. Chen, Zhiyu Chen, Yan He, Amanda Singer, Jacob T. Robinson, Kaiyuan Yang, *Rice University, USA*

🏵 **Multi-Beam, Scalable 28GHz Relay Array with Frequency and Spatial Division Multiple Access Using Passive, High-Order N-Path Filters** | **RMo1C-4**
Parham P. Khial, Samir Nooshabadi, Austin Fikes, Ali Hajimiri, *Caltech, USA*

🏵 **A DC-to-18GHz SP10T RF Switch Using Symmetrically-Routed Series-TL-Shunt and Reconfigurable Single-Pole Network Topologies Presenting 1.1-to-3.2dB IL in 0.15μm GaAs pHEMT** | **RMo2B-1**
Zhaowu Wang, Zhenyu Wang, Tao Yang, Yong Wang, *UESTC, China*

🏵 **A Sub-THz CMOS Molecular Clock with 20ppt Stability at 10,000s Based on Dual-Loop Spectroscopic Detection and Digital Frequency Error Integration** | **RMo3A-1**
Mina Kim[1], Cheng Wang[1], Lin Yi[2], Hae-Seung Lee[1], Ruonan Han[1]; *[1]MIT, USA, [2]Jet Propulsion Laboratory, USA*

🏵 **A 2MHz 4–48V VIN Flying-Capacitor Based Floating-Ground GaN DC-DC Converter with Real-Time Inductor Peak-Current Detection and 6μs Load Transient Response** | **RMo3B-5**
Weizhong Chen[1], Chang Yang[1], Lei Chen[2], Ping Gui[1]; *[1]Southern Methodist University, USA[2,] Texas Instruments, USA*

🏵 **A 21.8–41.6GHz Fast-Locking Sub-Sampling PLL with Dead Zone Automatic Controller Achieving 62.7fs Jitter and -250.3dB FoM** | **RMo3C-2**
Wen Chen[1], Yiyang Shu[1], Huizhen Jenny Qian[1], Jun Yin[2], Pui-In Mak[2], Xiang Gao[3], Xun Luo[1]; *[1]UESTC, China, [2]University of Macau, China, [3]Zhejiang University, China*

🏵 **A 38GHz Deep Back-Off Efficiency Enhancement PA with Three-Way Doherty Network Synthesis Achieving 11.3dBm Average Output Power and 14.7% Average Efficiency for 5G NR OFDM** | **RTu1B-1**
Xiaohan Zhang[1], Sensen Li[2], Daquan Huang[2], Taiyun Chi[1]; *[1]Rice University, USA, [2]Samsung, USA*

Ⓓ **An Integrated Reconfigurable SAW-Less Quadrature Balanced N-Path Transceiver for Frequency-Division and Half Duplex Wireless** | **RTu3A-1**
Erez Zolkov, Nimrod Ginzberg, Emanuel Cohen, *Technion, Israel*

Ⓓ **Fully Integrated Ultra-Wideband Differential Circulator Based on Sequentially Switched Delay Line in 28nm FDSOI CMOS** | **RTu3A-4**
Jun Hwang, Byung-Wook Min, *Yonsei University, Korea*

🏵 **E-Band CMOS Built-In Self-Test Circuit Capable of Testing Active Antenna Impedance and Complex Channel Response** | **RTu3B-2**
Seung-Uk Choi, Kyunghwan Kim, Kangseop Lee, Seunghoon Lee, Ho-Jin Song, *POSTECH, Korea*

RFIC Industry Paper Awards Finalists:

🏵=Showcase Ⓓ=Demonstration ★=Finalist Only

Ⓓ **A Linear High-Power Reconfigurable SOI-CMOS Front-End Module for WI-FI 6/6E Applications** | **RMo1B-5**
CEA-Leti, France, D. Parat, A. Serhan, P. Reynier, R. Mourot, A. Giry

Ⓓ **An All-Silicon E-Band Backhaul-on-Glass Frequency Division Duplex Module with >24dBm PSAT & 8dB NF** | **RMo2A-1**
Nokia Bell Labs, USA, Shahriar Shahramian, Michael Holyoak, Mike Zierdt, Joe Weiner, Amit Singh, Yves Baeyens

🏵 **A 0.2–2GHz Time-Interleaved Multi-Stage Switched-Capacitor Delay Element Achieving 448.6ns Delay and $330ns/mm^2$ Area Efficiency** | **RMo3B-1**
Sandia National Laboratories, USA, Travis Forbes, Benjamin Magstadt, Jesse Moody, Andrew Suchanek, Spencer Nelson

🏵 **An F-Band Power Amplifier with Skip-Layer Via Achieving 23.8% PAE in FinFET Technology** | **RMo4A-2**
Intel, USA, Qiang Yu, Jeffrey Garrett, Seahee Hwangbo, Georgios Dogiamis, Said Rami

🏵 **A 2Gb/s 9.9pJ/b Sub-10GHz Wireless Transceiver for Reconfigurable FDD Wireless Networks and Short-Range Multicast Applications** | **RTu3A-3**
[1]Intel, USA, [2]Intel, Mexico, Renzhi Liu[1], Asma Beevi K. T.[1], Richard Dorrance[1], Timothy Cox[1], Rinkle Jain[1], Tolga Acikalin[1], Zhen Zhou[1], Tae-Young Yang[1], Johanny Escobar-Pelaez[2], Shuhei Yamada[1], Kenneth Foust[1], Brent Carlton[1]

Ⓓ **802.11ah Transmitter with -55dBr at ±3MHz and -58dBr at ±20MHz ACLR and 60dB 2nd- Order Harmonic Rejection for 470MHz ~ 790MHz TV White Space Band Devices Newracom, USA** | **RTu4A-1**
Seong-Sik Myoung, Jonghoon Park, Chang Hun Song, Ryun Woo Kim, Jaeyoung Ryu, Jeongki Choi, Hoai-Nam Nguyen, Seungyun Lee, Ilyong Jung, Jong-Han Lim, Sok Kyu Lee

🏵 **Class-C BAW Oscillator Achieving a Close-In FOM of 206.5dB at 1kHz with Optimal Tuning for Narrowband Wireless Systems** | **RTu4B-1**
Texas Instruments, USA, Bichoy Bahr, Danielle Griffith, Ali Kiaei, Thomas Tsai, Ryan Smith, Baher Haroun

★ **DC to 12+GHz, +30dBm OIP3, 7.2dB Noise Figure Active Balun in 130nm BiCMOS for RF Sampling Multi-Gbps Data Converters** | **RMo3B-2**
Texas Instruments, USA, Siraj Akhtar, Gerd Schuppener, Tolga Dinc, Baher Haroun, Swaminathan Sankaran

Systems and Applications Forum Showcase/Demonstrations:

🏵=Showcase Ⓓ=Demonstration

Ⓓ **Miniaturized Wirelessly Powered and Controlled Implants for Vagus Nerve Stimulation** | **RMo1C-3**
University of California, Los Angeles, USA, Iman Habibagahi, Jaeeun Jang, Aydin Babakhani

Ⓓ **A 56.32Gb/s 16-QAM D-Band Wireless Link Using RX-TX Systems-in-Package with Integrated Multi-LO Generators in 45nm RFSOI** | **RMo2A-5**
CEA-Leti, France, Abdelaziz Hamani, Francesco Foglia Manzillo, Alexandre Siligaris, Nicolas Cassiau, Frederic Hameau, Fabrice Chaix, Cedric Dehos, Antonio Clemente, José Luis Gonzalez-Jimenez

	1A-1C	1D-1F	4A-4C
	RMo1A: mm-Wave Transmitters and Receivers for Communication and 5G Applications **Chair:** Hossein Hashemi, *Univ. of Southern California* **Co-Chair:** Jeyanandh Paramesh, *Carnegie Mellon Univ.*	**RMo1B: Cryogenic and Advanced Front-End Circuits** **Chair:** Emanuel Cohen, *Technion, Israel* **Co-Chair:** Ramesh Harjani, *University of Minnesota, USA*	**RMo1C: Emerging Applications of RFICs in Quantum, Biomedical and Communication Systems** **Chair:** Raja Pullela, *MaxLinear, USA* **Co-Chair:** Yao-Hong Liu, *imec, The Netherlands*
08:00	**RMo1A-1: A Millimeter-Wave Mixer-First Receiver with Non-Uniform Time-Approximation Filter Achieving >45dB Blocker Rejection** C. Yang, *Univ. of Southern California*; S. Su, *Univ. of Southern California*; M.S.-W. Chen, *Univ. of Southern California*	**RMo1B-1: A 4.2–9.2GHz Cryogenic Transformer Feedback Low Noise Amplifier with 4.5K Noise Temperature and Noise-Power Matching in 22nm CMOS FDSOI** B. Lin, *Georgia Tech*; H. Mani, *CryoElec*; P. Marsh, *Carbonics*; R. Al Hadi, *Alcatera*; H. Wang, *Georgia Tech*	**RMo1C-1: An Integrated Quantum Spin Control System in 180nm CMOS** K. Omirzakhov, *Univ. of Pennsylvania*; M.H. Idjadi, *Univ. of Pennsylvania*; T.-Y. Huang, *Univ. of Pennsylvania*; S.A. Breitweiser, *Univ. of Pennsylvania*; D.A. Hopper, *Univ. of Pennsylvania*; L.C. Bassett, *Univ. of Pennsylvania*; F. Aflatouni, *Univ. of Pennsylvania*
08:20	**RMo1A-2: A 28GHz/39GHz Dual-Band Four-Element MIMO RX with Beamspace Multiplexing at IF in 65nm CMOS** R. Garg, *Oregon State Univ.*; P. Dania, *Oregon State Univ.*; G. Sharma, *Oregon State Univ.*; A. Dascurcu, *Columbia Univ.*; S. Gupta, *Oregon State Univ.*; H. Krishnaswamy, *Columbia Univ.*; A. Natarajan, *Oregon State Univ.*	**RMo1B-2: A 2.57mW 5.9–8.4GHz Cryogenic FinFET LNA for Qubit Readout** J.-O. Plouchart, *IBM*; D. Yilma, *IBM*; J. Timmerwilke, *IBM*; S. Chakraborty, *IBM*; K. Tien, *IBM*; A. Valdes-Garcia, *IBM*; D. Friedman, *IBM*	**RMo1C-2: A Wireless Network of 8.8mm^3 Bio-Implants Featuring Adaptive Magnetoelectric Power and Multi-Access Bidirectional Telemetry** Z. Yu, *Rice Univ.*; W. Wang, *Rice Univ.*; J.C. Chen, *Rice Univ.*; Z. Chen, *Rice Univ.*; Y. He, *Rice Univ.*; A. Singer, *Rice Univ.*; J.T. Robinson, *Rice Univ.*; K. Yang, *Rice Univ.*
08:40	**RMo1A-3: A Millimeter-Wave Front-End for FD/FDD Transceivers Featuring an Embedded PA and an N-Path Filter Based Circulator Receiver** M. Pashaeifar, *Technische Universiteit Delft*; L.C.N. de Vreede, *Technische Universiteit Delft*; M.S. Alavi, *Technische Universiteit Delft*	**RMo1B-3: A Mixer-First Receiver Frontend with Resistive-Feedback Baseband Achieving 200MHz IF Bandwidth in 65nm CMOS** B. Guo, *CUIT*; H. Wang, *CUIT*; Y. Wang, *Zhengzhou Univ.*; K. Li, *CUIT*; L. Li, *UESTC*; W. Zhou, *UESTC*	**RMo1C-3: Miniaturized Wirelessly Powered and Controlled Implants for Vagus Nerve Stimulation** I. Habibagahi, *Univ. of California, Los Angeles*; J. Jang, *Univ. of California, Los Angeles*; A. Babakhani, *Univ. of California, Los Angeles*
09:00	**RMo1A-4: A Ka-Band Dual Circularly Polarized CMOS Transmitter with Adaptive Scan Impedance Tuner and Active XPD Calibration Technique for Satellite Terminal** D. You, *Tokyo Tech*; Y. Wang, *Tokyo Tech*; X. Fu, *Tokyo Tech*; H. Herdian, *Tokyo Tech*; X. Wang, *Tokyo Tech*; A. Fadila, *Tokyo Tech*; H. Lee, *Tokyo Tech*; M. Ide, *Tokyo Tech*; S. Kato, *Tokyo Tech*; Z. Li, *Tokyo Tech*; J. Pang, *Tokyo Tech*; A. Shirane, *Tokyo Tech*; K. Okada, *Tokyo Tech*	**RMo1B-4: A Feedback-Based N-Path Receiver with Reduced Input-Node Harmonic Response** V.S. Rayudu, *Univ. of Texas at Austin*; K.Y. Kim, *Univ. of Texas at Austin*; D.Z. Pan, *Univ. of Texas at Austin*; R. Gharpurey, *Independent Researcher*	**RMo1C-4: Multi-Beam, Scalable 28GHz Relay Array with Frequency and Spatial Division Multiple Access Using Passive, High-Order N-Path Filters** P.P. Khial, *Caltech*; S. Nooshabadi, *Caltech*; A. Fikes, *Caltech*; A. Hajimiri, *Caltech*
09:20			
09:40	**RMo1A-5: A 8–30GHz Passive Harmonic Rejection Mixer with 8GHz Instantaneous IF Bandwidth in 45RFSOI** A. Ahmed, *Univ. of California, San Diego*; G.M. Rebeiz, *Univ. of California, San Diego*	**RMo1B-5: A Linear High-Power Reconfigurable SOI-CMOS Front-End Module for WI-FI 6/6E Applications** D. Parat, *CEA-LETI*; A. Serhan, *CEA-LETI*; P. Reynier, *CEA-LETI*; R. Mourot, *CEA-LETI*; A. Giry, *CEA-LETI*	

RFIC TECHNICAL SESSIONS | 10:10 – 11:50 | Monday, 20 June 2022 | Colorado Convention Center

	1A-1C	1D-1F	4A-4C
	RMo2A: Multi-Gigabit Transceivers and Modules for Point-to-Point and Emerging Applications **Chair:** Hongtao Xu, *Fudan Univ., China* **Co-Chair:** Qun Jane Gu, *Univ. of California, Davis, USA*	**RMo2B: Power Switches, Amplifiers and Power Dividers for mm-Wave and Sub-THz Applications** **Chair:** Alyssa Apsel, *Cornell Univ., USA* **Co-Chair:** Domine Leenaerts, *NXP Semiconductors, The Netherlands*	**RMo2C: RF and mm-Wave Transmitters** **Chair:** Debopriyo Chowdhury, *Broadcom, USA* **Co-Chair:** Margaret Szymanowski, *Crane Aerospace & Electronics, USA*
10:10	**RMo2A-1: An All-Silicon E-Band Backhaul-on-Glass Frequency Division Duplex Module with >24dBm PSAT & 8dB NF** S. Shahramian, *Nokia Bell Labs*; M. Holyoak, *Nokia Bell Labs*; M. Zierdt, *Nokia Bell Labs*; J. Weiner, *Nokia Bell Labs*; A. Singh, *Nokia Bell Labs*; Y. Baeyens, *Nokia Bell Labs*	**RMo2B-1: A DC-to-18GHz SP10T RF Switch Using Symmetrically-Routed Series-TL-Shunt and Reconfigurable Single-Pole Network Topologies Presenting 1.1-to-3.2dB IL in 0.15µm GaAs pHEMT** Z. Wang, *UESTC*; Z. Wang, *UESTC*; T. Yang, *UESTC*; Y. Wang, *UESTC*	**RMo2C-1: A 4-to-9GHz IEEE 802.15.4z-Compliant UWB Digital Transmitter with Reconfigurable Pulse-Shaping in 28nm CMOS** H. Chen, *SCUT*; Z. Chen, *NewRadio Technology*; R. Ou, *NewRadio Technology*; R. Chen, *NewRadio Technology*; Z. Wu, *SCUT*; B. Li, *SCUT*
10:30	**RMo2A-2: Active Tunable Millimeter-Wave Reflective Surface Across 57–64GHz for Blockage Mitigation and Physical Layer Security** S. Venkatesh, *Princeton Univ.*; H. Saeidi, *Princeton Univ.*; X. Lu, *UM-SJTU Joint Institute*; K. Sengupta, *Princeton Univ.*	**RMo2B-2: A DC–120GHz SPDT Switch Based on 22nm FD-SOI SLVT NFETs with Substrate Isolation Rings Towards Increased Shunt Impedance** M. Rack, *Université catholique de Louvain*; L. Nyssens, *Université catholique de Louvain*; Q. Courte, *Université catholique de Louvain*; D. Lederer, *Université catholique de Louvain*; J.-P. Raskin, *Université catholique de Louvain*	**RMo2C-2: A 23GHz RF-Beamforming Transmitter with >15.5dBm Psat and >21.7% Peak Efficiency for Inter-Satellite Communications** K. Ding, *Technische Universiteit Eindhoven*; D. Milosevic, *Technische Universiteit Eindhoven*; V. Vidojkovic, *Technische Universiteit Eindhoven*; R. van Dommele, *Technische Universiteit Eindhoven*; M. Bentum, *Technische Universiteit Eindhoven*; P. Baltus, *Technische Universiteit Eindhoven*
10:50	**RMo2A-3: A 60GHz Phased Array Transceiver Chipset in 45nm RF SOI Featuring Channel Aggregation Using HRM-Based Frequency Interleaving** A. Dascurcu, *Columbia Univ.*; S. Ahasan, *Columbia Univ.*; A. Binaie, *Columbia Univ.*; K.J. Lu, *Oregon State Univ.*; A. Natarajan, *Oregon State Univ.*; H. Krishnaswamy, *Columbia Univ.*	**RMo2B-3: Analysis and Design of Dual-Peak Gmax-Core CMOS Amplifier in D-Band Embedding a T-Shaped Network** J. Kim, *POSTECH*; C.-G. Choi, *POSTECH*; K. Lee, *POSTECH*; K. Kim, *POSTECH*; S.-U. Choi, *POSTECH*; H.-J. Song, *POSTECH*	**RMo2C-3: A Quadrature-Rotation Phased-Array Transmitter with 15-Bit Phase Tuning and 0/3/6/9/12/15-dB PBOs Efficiency Enhancement** J. Zhou, *UESTC*; H.J. Qian, *UESTC*; B. Yang, *UESTC*; X. Luo, *UESTC*
11:10	**RMo2A-4: A 17Gb/s 10.7pJ/b 4FSK Transceiver System for Point to Point Communication in 65nm CMOS** H. Afzal, *Univ. of California, Davis*; C. Li, *Univ. of California, Davis*; O. Momeni, *Univ. of California, Davis*	**RMo2B-4: 280.2/309.2GHz, 18.2/9.3dB Gain, 1.48/1.4dB Gain-per-mW, 3-Stage Amplifiers in 65nm CMOS Adopting Double-Embedded-Gmax-Core** B. Yun, *KAIST*; D.-W. Park, *Kumoh National Institute of Technology*; C.-G. Choi, *POSTECH*; H.-J. Song, *POSTECH*; S.-G. Lee, KAIST	**RMo2C-4: An E-Band CMOS Direct Conversion IQ Transmitter for Radar and Communication Applications** S. Lee, *POSTECH*; K. Kim, *POSTECH*; K. Lee, *POSTECH*; S. Cho, *POSTECH*; S.-U. Choi, *POSTECH*; J. Lee, *ETRI*; B. Koo, *ETRI*; H.-J. Song, *POSTECH*
11:30			
11:50	**RMo2A-5: A 56.32Gb/s 16-QAM D-Band Wireless Link Using RX-TX Systems-in-Package with Integrated Multi-LO Generators in 45nm RFSOI** A. Hamani, *CEA-LETI*; F. Foglia Manzillo, *CEA-LETI*; A. Siligaris, *CEA-LETI*; N. Cassiau, *CEA-LETI*; F. Hameau, *CEA-LETI*; F. Chaix, *CEA-LETI*; C. Dehos, *CEA-LETI*; A. Clemente, *CEA-LETI*; J.L. Gonzalez-Jimenez, *CEA-LETI*	**RMo2B-5: 4-Way 0.031mm² Switchable Bidirectional Power Divider for 5G mm-Wave Beamformers** A. Franzese, *IHP*; R. Negra, *RWTH Aachen Univ.*; A. Malignaggi, *IHP*	

	1A-1C	1D-1F	4A-4C
	RMo3A: mm-Wave and Sub-THz Circuits and Systems for Radar Sensing and Metrology **Chair:** Vito Giannini, *Uhnder, USA* **Co-Chair:** Vadim Issakov, *Technische Universität Braunschweig, Germany*	**RMo3B: Mixed-Signal Building Blocks for Next-Generation Systems** **Chair:** Subhanshu Gupta, *Washington State Univ., USA* **Co-Chair:** Bahar Jalali Farahani, *Cisco, USA*	**RMo3C: Frequency Generation Techniques for 5G and IoT** **Chair:** Wanghua Wu, *Samsung, USA* **Co-Chair:** Andreia Cathelin, *STMicroelectronics, France*
13:30	**RMo3A-1: A Sub-THz CMOS Molecular Clock with 20ppt Stability at 10,000s Based on Dual-Loop Spectroscopic Detection and Digital Frequency Error Integration** M. Kim, *MIT*; C. Wang, *MIT*; L. Yi, *Jet Propulsion Lab*; H.-S. Lee, *MIT*; R. Han, *MIT*	**RMo3B-1: A 0.2–2GHz Time-Interleaved Multi-Stage Switched-Capacitor Delay Element Achieving 448.6ns Delay and 330ns/mm^2 Area Efficiency** T. Forbes, *Sandia National Laboratories*; B. Magstadt, *Sandia National Laboratories*; J. Moody, *Sandia National Laboratories*; A. Suchanek, *Sandia National Laboratories*; S. Nelson, *Sandia National Laboratories*	**RMo3C-1: Open-Source Fully-Synthesizable ADPLL for a Bluetooth Low-Energy Transmitter in 12nm FinFET Technology** K. Kwon, *Univ. of Michigan*; O. Abdelatty, *Univ. of Michigan*; D.D. Wentzloff, *Univ. of Michigan*
13:50	**RMo3A-2: A Small-Area, Low-Power 76–81GHz HBT-Based Differential Power Detector for Built-In Self-Test in Automotive Radar Applications** Y. Wenger, *Technische Univ. Braunschweig*; H.J. Ng, *Hochschule Karlsruhe*; F. Korndörfer, *IHP*; B. Meinerzhagen, *Technische Univ. Braunschweig*; V. Issakov, *Technische Univ. Braunschweig*	**RMo3B-2: DC to 12+GHz, +30dBm OIP3, 7.2dB Noise Figure Active Balun in 130nm BiCMOS for RF Sampling Multi-Gbps Data Converters** S. Akhtar, *Texas Instruments*; G. Schuppener, *Texas Instruments*; T. Dinc, *Texas Instruments*; B. Haroun, *Texas Instruments*; S. Sankaran, *Texas Instruments*	**RMo3C-2: A 21.8–41.6GHz Fast-Locking Sub-Sampling PLL with Dead Zone Automatic Controller Achieving 62.7fs Jitter and -250.3dB FoM** W. Chen, *UESTC*; Y. Shu, *UESTC*; H.J. Qian, *UESTC*; J. Yin, *Univ. of Macau*; P.-I. Mak, *Univ. of Macau*; X. Gao, *Zhejiang Univ.*; X. Luo, *UESTC*
14:10	**RMo3A-3: A Compact 28nm FD-SOI CMOS 76–81GHz Automotive Band Receiver Path with Accurate 0.2° Phase Control Resolution** A. Le Ravallec, *STMicroelectronics*; P. Garcia, *STMicroelectronics*; J.C. Azevedo Gonçalves, *STMicroelectronics*; L. Vincent, *CIME Nanotech*; J.-M. Duchamp, *G2Elab (UMR 5269)*; P. Benech, *G2Elab (UMR 5269)*	**RMo3B-3: An 11GS/s 2×10b 20–26GHz Modulator Using Segmented Non-Linear RF-DACs and Non-Overlapping LO Signals** V. Åberg, *Chalmers Univ. of Technology*; C. Fager, *Chalmers Univ. of Technology*; R. Hou, *Ericsson Research*; L. Svensson, *Chalmers Univ. of Technology*	**RMo3C-3: A 59fs-rms 35GHz PLL with FoM of -241dB in 0.18µm BiCMOS/SiGe Technology** R. Bindiganavile, *Univ. of Utah*; A. Wahid, *Univ. of Utah*; J. Atkinson, *Univ. of Utah*; A. Tajalli, *Univ. of Utah*
14:30	**RMo3A-4: An E-Band Phase Modulated Pulse Radar SoC with an Analog Correlator** W. Zhou, *Univ. of Minnesota*; Y. Tousi, *Univ. of Minnesota*	**RMo3B-4: A 345µW 1GHz Process and Temperature Invariant Constant Slope-and-Swing Ramp-Based 7-Bit Phase Interpolator for True-Time-Delay Spatial Signal Processors** S. Mohapatra, *Washington State Univ.*; C.-C. Lin, *Washington State Univ.*; M. Chahardori, *Washington State Univ.*; E. Ghaderi, *Washington State Univ.*; M.A. Hoque, *Washington State Univ.*; S. Gupta, *Washington State Univ.*; D. Heo, *Washington State Univ.*	**RMo3C-4: A 14GHz-Band Harmonic Tuned Low-Power Low-Phase-Noise VCO IC with a Novel Bias Feedback Circuit in 40nm CMOS SOI** M. Fang, *Waseda Univ.*; T. Yoshimasu, *Waseda Univ.*
14:50	**RMo3A-5: A 29-to-36GHz 4TX/4RX Dual-Stream Phased-Array Joint Radar-Communication CMOS Transceiver Supporting Centimeter-Level 2D Imaging and 64-QAM OTA Wireless Link** F. Zhao, *Tsinghua Univ.*; W. Deng, *Tsinghua Univ.*; R. Wu, *CAS*; H. Jia, *Tsinghua Univ.*; Q. Wu, *Tsinghua Univ.*; J. Xin, *CAS*; Z. Zeng, *CAS*; Y. Li, *CAS*; Z. Wang, *RITS*; B. Chi, *Tsinghua Univ.*	**RMo3B-5: A 2MHz 4–48V VIN Flying-Capacitor Based Floating-Ground GaN DC-DC Converter with Real-Time Inductor Peak-Current Detection and 6µs Load Transient Response** W. Chen, *Southern Methodist Univ.*; C. Yang, *Southern Methodist Univ.*; L. Chen, *Texas Instruments*; P. Gui, *Southern Methodist Univ.*	**RMo3C-5: A 5G 65nm PD-SOI CMOS 23.2-to-28.8GHz Low-Jitter Quadrature-Coupled Injection-Locked Digitally-Controlled Oscillator** R. Dumont, *STMicroelectronics*; M. De Matos, *IMS (UMR 5218)*; A. Cathelin, *STMicroelectronics*; Y. Deval, *IMS (UMR 5218)*
15:10			

RFIC TECHNICAL SESSIONS | 15:40 – 17:00 | Monday, 20 June 2022 | Colorado Convention Center

	1A-1C	1D-1F	4A-4C
	RMo4A: Power Amplifiers for 100+ GHz Applications **Chair:** Jennifer Kitchen, *Arizona State Univ., USA* **Co-Chair:** Steven Callender, *Intel, USA*	**RMo4B: Switch Technology, CMOS Reliability, and ESD** **Chair:** Alvin Joseph, *GLOBALFOUNDRIES, USA* **Co-Chair:** Edward Preisler, *Tower Semiconductor, USA*	**RMo4C: RF, mm-Wave and Sub-THz VCOs** **Chair:** Teerachot Siriburanon, *Univ. College Dublin, Ireland* **Co-Chair:** Howard C. Luong, *HKUST, China*
15:40	**RMo4A-1: A 22nm FD-SOI CMOS 2-Way D-Band Power Amplifier Achieving PAE of 7.7% at 9.6dBm OP1dB and 3.1% at 6dB Back-Off by Leveraging Adaptive Back-Gate Bias Technique** E. Rahimi, *Keysight Technologies*; F. Bozorgi, *Barkhausen Institut*; G. Hueber, *Silicon Austria Labs*	**RMo4B-1: Advanced 200mm RF SOI Technology Exhibiting 78fs RON×COFF and 3.7V Breakdown Voltage Targeting Sub 6GHz 5G FEM** F. Gianesello, A. Fleury, F. Julien, J. Dura, S. Monfray, S. Dhar, C.A. Legrand, J. Amouroux, B. Gros, L. Welter, SC. Charbuillet, P. Cathelin, E. Canderle, N. Vulliet, E. Escolier, L. Antunes, E. Granger, P. Fornara, C. Rivero, G. Bertrand, P. Chevalier, A. Regnier, D. Gloria, *STMicroelectronics*	**RMo4C-1: An 8.2–10.2GHz Digitally Controlled Oscillator in 28nm CMOS Using Constantly-Conducting NMOS Biased Switchable Capacitor** L. Wang, J. Meier, J. Bastl, T. Lauber, *RWTH Aachen Univ.*; A. Köllmann, *NXP Semiconductors*; U. Möhlmann, *NXP Semiconductors*; M. Hanhart, *RWTH Aachen Univ.*; A. Meyer, *RWTH Aachen Univ.*; C. Nardi, *RWTH Aachen Univ.*; R. Wunderlich, *RWTH Aachen Univ.*; S. Heinen, *RWTH Aachen Univ.*
16:00	**RMo4A-2: An F-Band Power Amplifier with Skip-Layer Via Achieving 23.8% PAE in FinFET Technology** Q. Yu, *Intel*; J. Garrett, *Intel*; S. Hwangbo, *Intel*; G. Dogiamis, *Intel*; S. Rami, *Intel*	**RMo4B-2: Superior Reliability and Low Self-Heating of a 45nm CMOS 39GHz Power Amplifier for 5G mmWave Applications** P. Srinivasan, S. Syed, J.A. Sundaram, S. Moss, S. Jain, P. Colestock, N. Cahoon, A. Bandyopadhyay, F. Guarin, B. Min, M. Gall, *GLOBALFOUNDRIES*	**RMo4C-2: A 14.5–17.9GHz Harmonically-Coupled Quad-Core P-N Class-B DCO with -117.3dBc/Hz Phase Noise at 1MHz Offset in 28nm CMOS** I. Apostolina, *Università di Pavia*; D. Manstretta, *Università di Pavia*
16:20	**RMo4A-3: A 97–107GHz Triple-Stacked-FET Power Amplifier with 23.7dB Peak Gain, 15.1dBm PSAT, and 18.6% PAEMAX in 28nm FD-SOI CMOS** K. Kim, *POSTECH*; K. Lee, *POSTECH*; S.-U. Choi, *POSTECH*; J. Kim, *POSTECH*; C.-G. Choi, *POSTECH*; H.-J. Song, *POSTECH*	**RMo4B-3: Impact of Non-Conducting RF and DC Hot Carrier Stresses on FinFET Reliability for RF Power Amplifiers** X. Ding, *Auburn Univ.*; G. Niu, *Auburn Univ.*; H. Zhang, *MaxLinear*; W. Wang, *MaxLinear*; K. Imura, *MaxLinear*; F. Dai, *Auburn Univ.*	**RMo4C-3: A Compact CMOS 76–82GHz Super-Harmonic VCO with 189dBc/Hz FoM Operating Based on Harmonic-Assisted ISF Manipulation** B. Moradi, *Univ. of California, Irvine*; X. Liu, *Univ. of California, Irvine*; M.M. Green, *Univ. of California, Irvine*; H. Aghasi, *Univ. of California, Irvine*
16:40	**RMo4A-4: A 124–152GHz >15dBm Psat 28nm CMOS PA Using Chebyshev Artificial-Transmission-Line-Based Matching for Wideband Power Splitting and Combining** J. Zhang, *Fudan Univ.*; T. Wu, *Fudan Univ.*; Y. Chen, *Univ. of Macau*; J. Ren, *Fudan Univ.*; S. Ma, *Fudan Univ.*	**RMo4B-4: Device for Protecting High Frequency and High Data Rate Interface Applications in FinFET Process Technologies** S. Parthasarathy, *Analog Devices*; R. Shumovich, *Analog Devices*; J. Salcedo, *Analog Devices*; R. Broughton-Blanchard, *Analog Devices*; J.-J. Hajjar, *Analog Devices*	**RMo4C-4: Sub-THz Switch-Less Reconfigurable Triple-/Push-Push Dual-Band VCO for 6G Communication** S. Oh, *Seoul National Univ.*; J. Kim, *Seoul National Univ.*; J. Oh, *Seoul National Univ.*
17:00			

COLORADO CONVENTION CENTER

MONDAY WORKSHOPS

08:00 – 17:00 | Monday, 20 June 2022

WORKSHOP TITLE		WORKSHOP ABSTRACT
WMA	**Advanced Manufacturing and Design Techniques for Emerging 3D Microwave and mm-Wave RF Filters** **Sponsors:** IMS **Organizers:** Dimitra Psychogiou, *Univ. College Cork*; Michael Höft, *CAU*; Roberto Gómez-García, *Universidad de Alcalá* **ROOMS: 107/109/111/113** **08:00 – 17:00**	This workshop will focus on recent advances in emerging manufacturing and integration processes for 3D microwave and mm-wave RF filters for the next generation of wireless and satellite communication systems. In particular, the workshop will present new RF design and electromagnetic modeling techniques for new classes of RF filtering components (bandpass/bandstop filters, multi-band filters and multiplexers) based on well-established manufacturing processes such as CNC machining and Si-based microfabrication that enables the realization of RF filters from mm-waves to frequencies in the sub-THz region (eg 700GHz). Furthermore, the workshop will provide an overview of emerging digital additive manufacturing processes such as stereolithography, selective laser sintering for new types of materials such as ceramics, plastics and metals and their application to advanced RF filtering architectures. The potential of these processes for complex geometries as well as for RF filters with advanced RF performance, high-frequency of operation, small form factor and low weight will be discussed in detail. Lastly, the workshop will present new RF design methodologies and novel RF filtering architectures that are uniquely enabled by the manufacturing flexibility of 3D printing that facilitates the realization of unconventional shapes.
WMB	**Advances in SATCOM Phased-Arrays and Constellations for LEO, MEO and GEO Systems** **Sponsors:** IMS **Organizers:** Gabriel M. Rebeiz, *Univ. of California, San Diego* **ROOMS: 102/104/106** **08:00 – 17:00**	There has been a tremendous advance in satellite communications in the past 3 years. First, Starlink (LEO) has sent upwards of 1600 satellites and is now building 5000 user terminals A WEEK (all based on phased-arrays), OneWeb (LEO) has secured $5B of funding and has sent 400 satellites and will be ready for operation in December 2021, Amazon Kuiper is building their LEO constellation as we speak, SES with mPower and their 2000-beam phased-arrays in a MEO constellation can now provide 500 Mbps to thousands of ISP (internet service providers) at the same time, and Viasat and HNS have both launched their GEO Tbps satellites each with 300+ beams. All of these units require advanced phased-arrays on the ground for user terminals and SATCOM-On-the-Move. This workshop will address advances in these low-cost ground terminals and in the LEO/MEO/GEO constellations, and will present the silicon technologies needed for this work.
WMC	**Emerging MIT/PCM Based Reconfigurable Microwave Devices** **Sponsors:** IMS **Organizers:** Atif Shamim, *KAUST*; Gwendolyn Hummel, *Sandia National Laboratories*; Tejinder Singh, *Dell Technologies* **ROOMS: 108/110/112** **08:00 – 17:00**	The extremely crowded and rapidly changing modern spectral environment has significantly increased the demand for highly reconfigurable RF technologies of high performance and small size. While RF switches are key elements in modern wireless communications and defense applications, switch performance has been stagnant for the last decade. With 5G being rapidly implemented and 6G on the horizon, RF systems are moving to the mm-wave bands and the RF loss in fundamental elements such as switches is becoming even more critical. Many commercially available switch technologies have certain issues with at least one of the following: resistive load, capacitive interference, limited bandwidth, low power operation, and/or nonlinearity. Recent work on emerging chalcogenide phase change material (PCM)-based switches has demonstrated a breakthrough innovation and a new class of reconfigurable devices exhibiting high performance, better monolithic and heterogeneous integration capabilities with other switch technologies, exceptional figure of merit, and broadband RF response compared to various commercially available switch technologies. Along with PCMs, metal-insulator transition (MIT) material such as vanadium dioxide based devices have also gained significant interest and researchers around the globe have demonstrated various interesting applications using PCM/MIT including but not limited to tunable mm-wave components, reconfigurable electro-optical components, and resonant sensors. Several research groups and industries are working to mature these technologies for high performance and efficient future wireless systems. This workshop aims to trigger the discussion on emerging PCM/MIT technologies regarding recent innovations, challenges, integration possibilities, limitations, and future trends.
WMD	**Front-End Module Integration and Packaging for 6G and Beyond 100GHz Communication and Radar Systems** **Sponsors:** IMS **Organizers:** Kamal Samanta, *Sony*; Kevin Xiaoxiong Gu, *Metawave* **ROOMS: 201/203** **08:00 – 17:00**	Research and development on mm-wave front-end implementations are expanding to a new frontier beyond 100GHz for emerging 6G communication and radar imaging applications. This proposed workshop covers the latest advancement of packaging and integration technologies for designing and implementing >100GHz front-end modules including in-depth discussions of different substrates, interconnects, antennas, co-design with RFICs, thermal management, system demos/prototypes, and so on. We plan to have 11 experts (5 from university/research institutes; 6 from industry) to present their pioneering works in this area: (1) Prof. Mark Rodwell from UCSB and Director of the SRC/DARPA ComSenTer Wireless Research Center, (2) Dr. Muhammad Furqan from Infineon, (3) Siddhartha Sinha from imec, (4) Dr. Telesphor Kamgaing from Intel, (5) Dr. Alberto Valdes-Garcia from IBM Research, (6) Prof. Wolfgang Heinrich from the Ferdinand-Braun-Institut (FBH), (7) Dr. Augusto Gutierrez-Aitken from Northrop Grumman, (8) Dr. Jon Hacker from Teledyne, (9) Dr. Goutam Chattopadhyay from NASA JPL, (10) Prof. Emmanouil (Manos) M. Tentzeris from Georgia Tech, and (11) Dr. Venkatesh Srinivasan from Texas Instruments.

MONDAY WORKSHOPS

08:00 – 17:00 | Monday, 20 June 2022

WORKSHOP TITLE		WORKSHOP ABSTRACT
WME	**In-Band Full-Duplex Integrated Devices and Systems** **Sponsors:** IMS; RFIC **Organizers:** Kenneth E. Kolodziej, *MIT Lincoln Laboratory*; Timothy M. Hancock, *DARPA* **ROOMS: 205/207** **08:00 – 17:00**	Many wireless systems could benefit from the ability to transmit and receive on the same frequency at the same time, which is known as in-band full-duplex (IBFD) and/or simultaneous transmit and receive (STAR). As this area matures, research is shifting towards reducing device form factors and creating novel self-interference cancellation techniques along with completely-integrated IBFD transceivers. In this workshop, experts from industry, academic and federal research institutions will discuss the various approaches that can be taken to construct IBFD systems and devices in an integrated fashion. Additionally, a mini-panel session is planned where the workshop speakers will debate the answers to questions posed by attendees for an interactive discussion with the audience.
WMF	**Superposition and Entanglement: When Microwaves meet Quantum** **Sponsors:** IMS **Organizers:** Fabio Sebastiano, *Technische Universiteit Delft*; Joseph Bardin, *Google, UMass Amherst* **ROOMS: 401-402** **08:00 – 17:00**	Microwave techniques are central to many modern quantum computing and quantum sensing platforms, ranging from those implemented with superconducting circuits to those relying on trapped ions. For instance, in superconducting technologies, qubits are implemented using nonlinear microwave resonators — which sometimes are frequency tunable — and coupling between qubits is often mediated using tunable LC filter networks. The state of a superconducting quantum processor is controlled using microwave signaling and measured using microwave reflectometry. Similarly, spin-qubit and trapped-ion systems often rely heavily on microwave signaling for their operation. As the culmination of decades of research, quantum computers can now perform certain classes of computations that are impractical using classical supercomputers. While today's quantum computers have largely been enabled by advances in commercial microwave technology, the quest to build these machines has also led to pioneering research that has pushed the limits of microwave amplification, packaging, filtering, and system design. In this workshop, leading researchers will describe progress in microwave technologies as applied to quantum computing and quantum sensing. The workshop is both broad and deep, covering microwave technologies that are used across the quantum computing landscape. At the high level, researchers will describe how microwave techniques are used to control superconducting, spin, and trapped-ion based quantum processors, covering a wide array of topics ranging from how microwave fields can be used in the trapping and manipulation of single ions to modular and SoC-based control systems for next-generation superconducting and spin qubit based quantum computers. The workshop will also contain deep dives into areas such as the systematic design of near-quantum-limited microwave parametric amplifiers, superconducting interconnect and filtering networks, system level quantum-coherent microwave packaging techniques, the cryogenic noise limits of semiconductor amplifiers, and quantum sensor systems leveraging microwave techniques. Central to all talks is the connection between microwave technology and the quantum information sciences.
WMG	**Supply Modulation Techniques: From Device to System** **Sponsors:** IMS **Organizers:** Olof Bengtsson, *FBH*; Roberto Quaglia, *Cardiff Univ.* **ROOMS: 403-404** **08:00 – 17:00**	Power amplifiers for high frequency applications can benefit greatly from the ability to dynamically vary the supply voltage. For example, when spectral efficient signals are used, their large amplitude dynamic generally requires a compromise between linearity and efficiency of the amplifier, leading to poor average efficiency. By applying supply modulation in the form of envelope tracking, the average efficiency can be enhanced significantly. The introduction of GaN technology has enabled highly efficient very fast switch-based supply modulators that are required for the very large instantaneous bandwidth in telecommunication for space and the future 5G systems. With the introductions of 5G the system frequency increase and power per PA is reduced by distributed PA solutions like MIMO. The same is true for space applications but here, the main motivation for the development of efficient solid-state solutions is the transfer from bulky tube based solutions. The large instantaneous bandwidth of the future telecom systems poses a challenge for dynamic supply modulation but the high frequency and reduced power allows for novel integrated solutions with reduced parasitic effects where the modulator and RFPA are integrated on the same chip. This workshop will: introduce the motivations and applications of supply modulation technologies for space and terrestrial telecommunication; discuss how RF transistor technologies affect the requirements of the supply modulator and the effectiveness of supply modulation; show advanced design techniques for the supply modulator and the integration with RF amplifier; present system level solutions including linearization of supply modulation-based amplifier systems. Moreover, two expert talks on supply modulation for dynamic power control in high power ISM systems is also considered and optimized, compact envelope tracking for 3D printers will enable cross-fertilization with fields adjacent to the microwave industry and permit a fruitful exchange of ideas. The organizer's aim is to actively involve the audience in the discussion, in order to provide them with a useful experience. For this reason, an online quiz will involve the audience with questions that can be answered only by interacting with the speakers.
WMH	**RF Large-Signal Transistor Performance Limits Related to Reliability and Ruggedness in Mobile Circuit Applications** **Sponsors:** IMS **Organizers:** Michael Schroter, *Technische Universität Dresden*; Peter Zampardi, *Qorvo* **ROOMS: 505-507** **08:00 – 12:00**	The focus of the workshop is to provide an overview on transistor performance limits in terms of reliably achievable RF output power of various semiconductor technologies that are presently competing for mobile radio-frequency (RF) applications such as 5G, 6G, automotive radar and imaging, operating in the mm-wave frequency range (ie 30GHz to 300GHz). Of particular interest here are power amplifiers, oscillators, Mach-Zehnder-interferometers, and all sorts of RF buffer circuits that drive transistors to their dynamic large-signal limits and are implemented in semiconductor technologies such as III-V HBTs, SiGe HBTs and FDSOI-CMOS. The presentations will explore the presently quite heterogeneous approaches for determining the transistor related safe-operating-area in terms of reliability and ruggedness for designing circuits that are supposed to deliver high output power at high frequencies in mobile applications. The workshop starts with a tutorial on the design specifications of the above mentioned circuits and the corresponding requirements for large-signal dynamic transistor operation up to the mm-wave region. Based on this motivation, several presentations will outline, for each of the technologies, the state-of-the-art of transistor characterization for RF ruggedness as well as the device physics that cause degradation and the modeling approaches for including reliability aspects in process design kits. The workshop concludes with a tutorial on existing measurements methods for large-signal device testing in the mm-wave range.

MONDAY WORKSHOPS

08:00 – 17:00 | Monday, 20 June 2022

WORKSHOP TITLE		WORKSHOP ABSTRACT
WMI	**GaN/GaAs Technology Development and Heterogeneous Integration for Emerging mm-Wave Applications** **Sponsors:** IMS **Organizers:** Guillaume Callet, *UMS*; Ko-Tao Lee, *Qorvo* **ROOMS: 503-504** **08:00 – 17:00**	Recent advances of the GaN/GaAs technology development have enabled RF module switching at extremely high frequency that Si devices cannot withstand. It has shaped the landscape of RF industry and enabled applications in mm-wave frequency bands. In this full-day workshop, 9 talks will be presented from highly-recognized industrial leaders and technical experts across the globe. It covers the major breakthrough from the latest development of GaN/GaAs technology and integration, including 1) heterogeneous integration of GaN/GaAs MMIC, 2) exploratory RF devices for mm-wave, and 3) systems and use-cases of GaN/GaAs technologies. At the closing of the day, an interactive panel session will be conducted between speakers and audiences. It is expected that the workshop can provide a platform for the latest mm-wave technology breakthroughs and a forum to share views.
WMJ	**Microwave Techniques for Coexistence between 5G and Passive Scientific Systems** **Sponsors:** IMS **Organizers:** Albin J. Gasiewski, *Univ. of Colorado Boulder*; Charles Baylis, *Baylor Univ.*; Dimitrios Peroulis, *Purdue Univ.* **ROOMS: 505-507** **08:00 – 12:00**	Passive, scientific microwave systems perform crucial functions: providing early warning to massive populations to protect from hurricanes, winter storms, and other natural disasters, and enabling scientific understanding of astronomical phenomena. The recent addition of fifth-generation (5G) wireless into mm-wave spectral bands near those designated for these sensitive scientific observations, and expected future expansion of wireless communications to additional, higher-frequency bands, has jeopardized the fidelity of these sensing operations due to interference. However, wireless communications connects societies across the globe, and is a key driver of global economic stimulation, and as such must continue to expand while ensuring scientific measurements can continue. This workshop will overview both this challenge and new solutions at the microwave circuit and system levels to provide coexistence between active and passive spectrum-use systems. The workshop begins with specific discussions of a roadmap for developing coexistence between passive scientific and 5G wireless systems from the National Science Foundation and European Space Agency, challenges faced by passive systems, and perspectives from the commercial wireless industry. With this background, the next talks highlight microwave circuit and systems innovations that form promising solutions to this problem, including reconfigurable circuit design for 5G wireless systems, artificially intelligent power amplifier arrays, and a spectral broker for coordination between active and passive spectrum systems. The workshop will conclude with a panel session for extensive audience interaction with all speakers.
WMK	**On-Wafer mm-Wave Measurements** **Sponsors:** IMS; ARFTG **Organizers:** Jian Ding, *Spirit Semiconductor*; Mike Geen, *Filtronic*; Nick Ridler, *NPL*; Xiaobang Shang, *NPL* **ROOMS: 605/607** **08:00 – 17:00**	Accurate on-wafer S-parameter measurement plays an important role in the development of mm-wave integrated circuits for communications and electronics applications. To this end, a group of international experts in this field will share their experience on making reliable on-wafer measurements at high frequencies (eg above 100GHz). The presenters come from different backgrounds — instrumentation manufacturers, metrology institutes, end-users in industry and academia — and so provide different perspectives on this topic. The emphasis of the workshop is on sharing practical tips (ie good practice) so that attendees can subsequently implement such methods in their own workplaces. The workshop will cover topics including calibration techniques, verification methods, guides on design of custom calibration standards, instrumentation, and applications, etc. The workshop includes two panel discussions: (i) an open discussion about the challenges/opportunities/outlooks for research into on-wafer measurements in coming years; and (ii) an opportunity for attendees to describe their own on-wafer measurement problems so that these can be discussed, and hopefully solved, during the workshop.
WML	**Measurement and Modeling of Trapping and Thermal Effects of GaN HEMT Microwave PA Technology** **Sponsors:** IMS; ARFTG **Organizers:** Nicholas Miller, *AFRL*; Sourabh Khandelwal, *Macquarie Univ.* **ROOMS: 702/704/ 706** **08:00 – 17:00**	Gallium nitride (GaN) high electron mobility transistors (HEMTs) are an excellent technology for various microwave power amplifier applications due to the underlying semiconductor's wide bandgap, high breakdown voltage and large peak electron velocity. A key bottleneck to the technology's widespread and long-term adoption into commercial and military applications is its inherent electrical reliability. The physical mechanisms of GaN HEMT electrical degradation are largely unresolved and actively under investigation. In this full-day workshop, international experts in the fields of microwave measurements, trap characterization, thermal characterization, reliability characterization, GaN HEMT nonlinear modeling, trap modeling, and TCAD modeling will present state-of-the-art research. This interactive workshop aims to inform and excite the attendees on the advances in multiple aspects of this technology. Starting with a GaN technology overview, the planned talks will inform the audience about measurement and characterization of this technology including the complex thermal, charge trapping, and long-term degradation phenomenon in these devices. The next part of the workshop covers the modeling and simulation research in GaN. Starting with an overview of modeling challenges in GaN devices, the workshop will cover the latest industry standard compact models and advances in TCAD-based modeling of GaN devices.

MONDAY WORKSHOPS

08:00 – 17:00 | Monday, 20 June 2022

WORKSHOP TITLE		WORKSHOP ABSTRACT
WMM	**Hands-On Phased Array Beamforming Using Open Source Hardware and Software** **Sponsors:** IMS **Organizers:** Jon Kraft, *Analog Devices* **ROOMS: 705/707/709/711** **08:00 – 12:00**	Phased array communications and radar systems are finding increased use in a variety of applications. This places a greater importance on training engineers and rapidly prototyping new phased array concepts. However, both those imperatives have historically been difficult and expensive. But a recent open source offering, the ADALM-PHASER, allows real beamforming hardware to be used for education, project proposals, and product development. This workshop will introduce that offering with lectures and hands on labs covering: software defined radio (SDR), phased array beamforming (steering angle and beam formation), antenna impairments (side lobes/tapering, grating lobes, beam squint, quantization sidelobes), Monopulse tracking implementation, and simple radar algorithm design. Each of these topics will be addressed with a short lecture, followed by the participants using the ADALM-PHASER hardware to directly explore the lecture topic.
WMN	**AI/ML-Based Signal Processing for Wireless Channels** **Sponsors:** IMS **Organizers:** Young-Kai Chen, *II-VI* **ROOMS: 705/707/709/711** **08:00 – 12:00**	Digital signal processing (DSP) is the critical element to adapt dynamic wireless propagation media and mitigate nature and man-made impairments. Today's model-based DSP techniques function well in the stationary wireless channel, which can be easily disrupted by the random events such as in-band interference, noise and non-stationary fading channels. Emerging AI/ML techniques have demonstrated unique capability to capture and mitigate these corner cases. These AI/machine learning techniques can significantly enhance the processing capability better than the legacy model-banded DSP techniques. This workshop will illustrate several recent advances in AI-ML-based signal processing techniques to mitigate impairments, such as non-stationary channel fading, interference, and noise, in wireless channels to enable robust wireless communication and radar applications.
WMO	**Commercial Applications of Medical RF, Microwave and mm-Wave Technology** **Sponsors:** IMS **Organizers:** Changzhan Gu, *SJTU*; Jessi Johnson, *Altruem Consulting*; Perry Li, *Abbott*; Pingshan Wang, *Clemson Univ.* **ROOMS: 708/710/712** **08:00 – 12:00**	Systems that utilize RF, microwave and mm-wave energy are becoming increasingly important in the commercial medical device world. In the design of new medical devices, the use of high-frequency electromagnetics must be considered. For example, an implant such as a pacemaker should not require surgically-based battery replacement, but should be wirelessly rechargeable. A neurostimulator should be configurable and controllable by a phone or tablet. A vital sign sensor should allow for non-contact measurements to maximize comfort and usability. Wearable medical sensors should stream data wirelessly to a central location for display and analysis by medical professionals. These examples are just a few of the reasons why RF, microwave and mm-wave devices are of increasing importance and can be routinely found in government approved medical devices around the world. As RF, microwave and mm-wave technology rapidly advances in the academic and commercial environment, it will continue to be adapted toward medical applications in new and interesting ways. Please join our panel of industry experts for an interactive discussion about the in-roads that high-frequency approaches have made in the medical device space. Example applications include high-power RF/microwave ablation for cancer and cardiac applications, radar-based vital-sign sensing, in-body or on-body communication systems, wireless-power techniques, and cell detection and characterization. Panelists will share their perspective on both the current state-of-the-art, as well as future applications of this invaluable technology. In addition to technical content, unique considerations for the industry such as clinical study development, the regulatory approval process and the marketing of medical devices will be discussed.
WMP	**Quantum RF Receivers: Using Rydberg Atoms for Highly Sensitive and Ultra Wideband Electric Field Sensing** **Sponsors:** IMS **Organizers:** Chris Holloway, *NIST*; Shane Verploegh, *ColdQuanta* **ROOMS: 708/710/712** **08:00 – 12:00**	In the past 10 years, there has been a great push in the development of a fundamentally new International System of Units (SI) traceable approach to electric field sensing. Atom-based measurements allow for this direct SI-traceability, and as a result, usage of Rydberg atoms (traceable through Planck's constant) have greatly matured via measurement techniques and sensor head developments. Current Rydberg atom sensors have the capability of measuring amplitude, polarization, and phase of RF fields. Promising benefits of this quantum technology for RF receivers are the extremely large tuning range from DC fields to the submillimeter range, high selectivity in the instantaneous RF bandwidth from the nature of atomic transitions at each frequency choice, and the frequency-independent size of the sensor head. Applications of these sensors include SI-traceable E-field probes, voltage standards, power sensors, microwave radiometers, direction of arrival estimation, radar and communication receivers with amplitude, frequency, and phase modulated signal discrimination, and many others. This workshop will give an overview and summarize this new technology, discuss various applications, and pathways to commercialization.

Wireless is available throughout the Colorado Convention Center!

SSID: IMS2022 **Password: Denver22**

RF BOOT CAMP

08:00 – 16:45 | Monday, 20 June 2022 | Room: 601–603

This one-day course is ideal for newcomers to the microwave world, such as technicians, new engineers, college students, engineers changing their career paths, as well as marketing and sales professionals looking to become more comfortable in customer interactions involving RF and Microwave circuit and system concepts and terminology.

The format of the RF Boot Camp is similar to that of a workshop or short course, with multiple presenters from industry and academia presenting on a variety of topics including:

- **The RF/Microwave Signal Chain**
- **Network Characteristics, Analysis and Measurement**
- **Fundamentals of RF Simulation**
- **Impedance Matching Basics**
- **Spectral Analysis and Receiver Technology**
- **Signal Generation**
- **Modulation and Vector Signal Analysis**
- **Microwave Antenna Basics**
- **RFMW Application Focus**

This full-day course will cover real-world, practical, modern design and engineering fundamentals needed by technicians, new engineers, engineers wanting a refresh, college students, as well as marketing and sales professionals. Experts within industry and academia will share their knowledge of: RF/Microwave systems basics, simulation and network design, network and spectrum analysis, microwave antenna and radar basics. Attendees completing the course will earn 2 CEUs. Course outline and speaker bios can be found at ims-ieee.org and on the mobile app.

IEEE FELLOWS

CLASS OF 2022

THE IEEE GRADE OF FELLOW is conferred by the Board of Directors upon a person with an extraordinary record of accomplishments in any of the IEEE fields of interest. The total number selected in any one year does not exceed one-tenth of one percent of the total voting Institute membership. The accomplishments that are being honored have contributed importantly to the advancement or application of engineering, science and technology, bringing the realization of significant value to society. Fellow grade is effective 1 January 2022. Fellows will be recognized at the IMS Plenary Session tonight at 17:30-19:00 in the Four Seasons Ballroom.

EVALUATED BY MTT-S	
Dominique Baillargeat	*for contributions to developments of nanomaterials for RF packaging and sensors*
James Buckwalter	*for contributions to high-efficiency millimeter-wave power amplifiers and optical transceivers in SOI technologies*
Wenquan Che	*for contributions to planar transmission line structures for microwave passive components*
Alessandra Costanzo	*for contributions to nonlinear electromagnetic co-design of RF and microwave circuits*
Apostolos Georgiadis	*for contributions to designs of RF energy harvesting circuits*
Jeffrey Hesler	*for contributions to development of terahertz components and instrumentation*
Slawomir Koziel	*for contributions to modeling and optimization of microwave devices and circuits*
Moriyasu Miyazaki	*for leadership in developments of airborne active-phased-array radars and satellite communication microwave subsystems*
Anh-Vu Pham	*for contribution to organic packaging technologies*
Christopher Rodenbeck	*for contributions to radar microsystems for ultrawideband and millimeter-wave applications*
Daniel van der Wiede	*for contributions to ultrafast terahertz electronics and biomedical applications of microwave technologies*
Christian Waldschmidt	*for contributions to millimeter wave automotive radar sensors*
Anding Zhu	*for contributions to behavioral modeling and digital predistortion of RF power amplifiers*
EVALUATED BY OTHER IEEE SOCIETIES/COUNCILS	
Hongsheng Chen	*for contributions to electromagnetic metamaterial and invisibility cloak*
Tommaso Isernia	*for contributions on antennas synthesis and inverse scattering problems*
Mikko Valkama	*for contributions to physical layer signal processing in radio systems*
Xiuyin Zhang	*for contributions to the design of filtering antennas*
Jiang Zhu	*for contributions to antenna design for wireless communications*

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TECHNICAL LECTURE

12:00 – 13:30 | Monday, 20 June 2022 | Room: 501-502

	LECTURE TITLE	LECTURE ABSTRACT
TL2	**Electromagnetic Fundamentals Underlying Health Impact of Millimeter-Wave Radiations** **Speaker:** Abbas Omar, *Univ. of Magdeburg*	Millimeter Wave mobile communication (5G and beyond) has been 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 a few millimeters. 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. This Technical Lecture aims to comprehensively review the relevant electromagnetic fundamentals underlying the wave-matter interaction involved in any eventual health hazard which might be associated with millimeter-wave radiation. Basic related aspects include the following: • Direct health hazards must involve either chemical reactions or thermal/mechanical destruction of cells/tissues. This must be accompanied by energy transfer from the electromagnetic wave to the biological substances. • Indirect hazards include overloading the biological mechanisms involved in the body thermoregulation. • Thermal effects involve rise of temperature, an increase in the magnitude of atomic/molecular lattice vibrations. Chemical reactions (e.g., burning) will only occur if the temperature increase exceeds a certain limit. Otherwise, the rise is reversible, regulated to steady state by the blood circulation within the body. • Non-ionizing waves are wavelengths that are much larger than the atomic/molecular scale, a continuous spatial distribution of the 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). Millimeter Waves and even Tera-Hertz Waves belong to this category. • Ionizing radiation has wavelengths comparable to the interatomic or intermolecular spaces and an electromagnetic wave quantization approach makes sense. Wave-matter interactions can be explained using the discrete representation of the waves, photons, which are ensembles of energy packages highly localized in time and space. A single photon carries energy proportional to its frequency which, e.g., can be fully transferred to and result in electrical destruction of a molecular bond. Ionizing radiation only occurs at frequencies much higher than that of ultraviolet light and therefore is not applicable to the millimeter-wave case. • Use of a photon representation to describe Millimeter Waves would require the photon spatial extent to be of the same order of magnitude as the wavelength and a photon collision would necessarily involve millions of atoms/ molecules (as if swimming in it). A single chemical bond could not absorb the entire photon energy.

RFIC PANEL SESSION

12:00 – 13:30 Monday, 20 June 2022 Room: 2C-3C

Industry vs. Academia: Who is Leading Whom?

PANEL ORGANIZERS AND MODERATORS: Hossein Hashemi, *Univ. of Southern California;* **Oren Eliezer,** *Ambiq*

PANELISTS:

Andreia Cathelin, *STMicroelectronics;* **Vadim Issakov,** *Technische Universität Braunschweig;* **Waleed Khalil,** *The Ohio State Univ.;* **Ali Niknejad,** *Univ. of California, Berkeley;* **Joy Laskar,** *Maja Systems;* **Stefano Pellerano,** *Intel*

ABSTRACT: This panel debates the roles of academia and industry in shaping the future of RFIC design. Given the increased complexity of modern RF integrated systems and the need for well trained RFIC engineers, the panel raises the question of who should lead RFIC research. If the industry is to take the lead, what is the role of universities and who should pay for training graduate students? Should academics move to other research domains? What should be done to prevent them from being lured away from universities and into financially rewarding industry careers? Are there fundamental RFIC research challenges that academics can still tackle for the next generation RF systems given the increasing complexities in design and fabrication of advanced RFICs?

The panel, formed of industry experts, university professors and those who crossed the line between academic and industry careers, will look at past, current and future RFIC research, education, and support models with the audience's participation.

THREE MINUTE THESIS 14:00 – 16:00 Monday, 20 June 2022 Room: 4D-4F

In its sixth year, the IMS2022 3MT competition is designed to stimulate interest in the wide range of applications of microwave technology. Contestants will make a presentation of three minutes or less, supported only by one static slide, in a language appropriate to a non-specialist audience. The winners of the 3MT competition will receive their prizes at the IMS2022 Closing Session on Thursday, 23 June 2022.

ORGANIZERS/CO-CHAIRS: John Bandler, *Senior Advisor*

Aline Eid, 2022 3MT® Co-Chair

Jimmy Hester, 2022 3MT® Co-Chair

Erin Kiley, Member

Daniel Tajik, Member

THIS YEAR'S FINALISTS ARE:

Which Way Is Up?
Tu1C-1 Ajibayo Adeyeye, *Georgia Institute of Technology*

You Are Close! Set Sail with the Crew SYNC.
We1D-3 Víctor Ángel Ardila Acuña, *Universidad de Cantabria*

Automotive Radars: It's the Journey that Matters, Not the Destination.
RMo4C Ioanna Apostolina, *Univ. of Pavia*

Lowest Rate Operations at the Spectral "Beach Front Property"
Th2B-4 Gokhan Ariturk, *Univ. of Oklahoma*

Cool it! Minimizing Noise in Microwave Readout Amplifiers
Tu3E-3 Shai Bonen, *Univ. of Toronto*

Making Cyclists Visible: A Safety Vest for Microwaves.
We2F-2 Tobias T. Braun, *Ruhr Univ. Bochum*

Integrable Energy Harvesting
Tu3C-2 Nathan Chordas-Ewell, *SUNY Buffalo*

Saving Your Battery Life
We1E-2 Chenhao Chu, *Univ. College Dublin*

Low-Power Electronics for Future Quantum Computers.
We4D-2 Sayan Das, *Univ. of Massachusetts, Amherst*

Overcoming a World Without Translators
Th2A-2 Ricardo Figueiredo, *Universidade de Aveiro*

Safer Intersections for Our Phones
Tu4B-1 Alden Fisher, *Purdue Univ.*

Towards Detecting EM Attack on Silicon ICs by Simple On-chip Circuit Components
We3C-3 Archisman Ghosh, *Purdue Univ.*

Efficient THz Generator
TUIF1-8 Alexander Possberg, *Univ. of Duisburg-Essen*

More Than Just Noise—Making Bits Fly
Tu4D-3 Florian Probst, *Friedrich-Alexander-Universität Erlangen-Nürnberg*

Ultrafast Optical Analysis Tool for Microwave Signals
Th1C-4 Connor Rowe, *Institut National de la Recherche Scientifique*

Detective Microwave in Pursuit of Any Microplastic Clue
Tu4B-4 Maziar ShafieiDarabi, *Univ. of Waterloo*

Flexible Electronics Help Our World Lose Weight
WEIF2-3 Xiaolin Wang, *Tokyo Institute of Technology*

Using Quantum Computing to Solve Large Electromagnetic Equations
TUIF1-3 Louis Zhang, *Univ. of Toronto*

Digital mmWave Radar, the Infrastructure of the Digital Era
Mo3A-4 Wen Zhou, *Univ. of Minnesota*

IMS INDUSTRY SHOWCASE

16:00 – 17:30 | Monday, 20 June 2022 | Mile High Ballroom Pre-Function Space

Join us before the IMS Plenary Session for the Industry Showcase where selected speakers will present their work.

PAPER TITLE	**SPEAKER**
A W-band, 92-114 GHz, real-time spectral efficient radio link demonstrating 10 Gbps peak rate in field trial | **We2G-2**	Mikael Horberg, *Ericsson*
Fast Simultaneous Characterization of all Analog Phased Array Elements | **Th1F-4**	Michael Foegelle, *ETS-Lindgren*
15 to 72 GHz Closed-Loop Impairment Corrected mm-Wave Delay_x0002_ Locked IQ Modulator for 5G Applications | **We3G-4**	Isaac Martinez, *Keysight Technologies*
Dynamically Reconfigurable Metasurface Antennas for Mobile Connectivity in 5G Non-Terrestrial Networks | **Th3E-4**	Ryan Stevenson, *Kymeta Corporation*
Rydberg Atom Electrometry: a Near-Field Technology for Complete Far-Field Imaging in Seconds | **Th1F-2**	James Shaffer, *Quantum Valley Ideas Laboratory*
A 1024-Element Ku-Band SATCOM Phased-Array Transmitter With 39.2-dBW EIRP and ± 53o Beam Scanning | **Th2F-6**	Jui-Hung Chou, *Rapidtek*
Multi-channel Schottky-gate BRIDGE HEMT Technology for Millimeter-Wave Power Amplifier Applications | **Tu4E-4**	Keisuke Shinohara, *Teledyne Scientific*
A Fully-Integrated CMOS System-on-Chip Ku Band Radiometer System for Remote Sensing of Snow and Ice | **Th3F-3**	Adrian Tang, *UCLA/JPL*

IMS PLENARY SESSION

17:30 – 19:00 | Monday, 20 June 2022 | Four Seasons Ballroom

A Quantum Technology Landscape

IMS KEYNOTE SPEAKER:

Prof. Dana Z. Anderson, *ColdQuanta, Inc.* and *The JILA Institute & Dept. of Physics, Univ. of Colorado*

ABSTRACT: The revolution promised by quantum computing sits on the horizon but in fact is just one of many ‘revolutions’ that will be enabled by quantum technologies. Extracting quantum behavior typically means working with systems that are cold: a millionth of a degree above absolute zero temperature might seem terribly cold, but it is now routinely achieved with ensembles of atoms using laser cooling and related techniques. Clocks utilizing ultracold atoms have demonstrated performance that is more than 10,000 times more precise than today’s world timekeepers. Consider timekeeping as the harbinger of more quantum things to come —technology poised to impact timekeeping, sensing, communications, networking, in addition to computing. This talk centers specifically on quantum technology based on atoms, whose quantum character is being utilized in electromagnetic field detection (particularly RF), inertial sensing for navigation, and numerous other applications, not to mention new devices, such as the atomtronic transistor. This talk will emphasize the critical need for microwave engineering to design and control these new quantum-enhanced circuits. One hears a lot about “quantum” these days: I will explain many of the commonly used terminology such as “superposition” and “entanglement” to describe what is meant by the phrase “quantum advantage” in practical terms.

BIOGRAPHY: Prof. Dana Z. Anderson received his Ph.D. in quantum optics working under Prof. Marlan Scully. His thesis research centered on fundamental principles of ring laser gyroscopes. As a postdoctoral fellow at Caltech he carried out work on the prototype laser interferometer gravitational observatory (LIGO). He is currently a Fellow of the JILA Institute at the University of Colorado and a Professor of the Department of Physics and the Department of Electrical, Computer and Energy and Engineering at the University. He is an applied physicist working in the areas of quantum optics, atomic physics, and precision measurement. His research includes the development of atom based inertial sensors, quantum communications systems, quantum computing, quantum emulators, and atomtronics (the atom analog of electronics). Prof. Anderson has published over 100 refereed papers, holds several patents, and has received several awards including a Presidential Young Investigator award, a Sloan Foundation Fellowship, a Humboldt Research Award, the Optical Society of America’s R.W. Wood Prize for his pioneering work on optical neural networks, the CO-LABS Governor’s Award for foundational contributions ultracold matter technology, and the Willis Lamb Prize for Excellence in Quantum Optics and Electronics.

Prof. Anderson is also Founder and CTO of ColdQuanta, Inc., a company that develops and manufactures cold and ultracold matter-based quantum technology covering a broad spectrum of systems, from clocks to quantum computers, including a system currently operating on the International Space Station under NASA’s Cold Atom Laboratory (CAL) mission.

Space, Changing the Way We Live, Enabled by Microwave Innovations

IMS KEYNOTE SPEAKER:

Gregory E. Edlund, *Lockheed Martin Space Systems Company*

ABSTRACT: Space is becoming the high ground for many missions and applications that are revolutionizing the way we live. The space industry is in the midst of dramatic advancement of applications, markets, and demand supporting global situational awareness (including weather, climate and earth science), communications, missile defense, positioning navigation and timing, and exploration. This mandates small, low weight, low power consumption electronics, with a continual push for lower cost and reduced development and test schedules. For this unprecedented challenge, Lockheed Martin is introducing next-generation space vehicles and payloads that include advanced multi-beam Electronically Steerable Arrays (ESA), multi-channel System-in-Package (SiP) and signal-processing RF units accentuated with flexible, advanced digital signal processors. Microwave engineering is at the forefront of these applications and this talk will address the challenges associated with operating in the harsh environment of space and the development and testing of custom MMICs and new RF Photonic Integrated circuits to support these applications.

BIOGRAPHY: Greg Edlund is the Vice President and Chief Architect at Lockheed Martin Space Systems Company. He is responsible for understanding the mission priorities and industry landscape to set the vision and strategy for enterprise subsystem and product roadmaps. Prior to his current role Greg led the RF Payload Center of Excellence at Lockheed Martin Space Systems Company. Greg brings over 38 years of leadership and experience working at The Aerospace Corporation, as an independent Consultant, at Northrop Grumman, and at Lockheed Martin. Prior to Lockheed Martin he was with Northrop Grumman Aerospace Systems where he worked in program management, new business, and engineering space solutions across DoD, commercial, civil and restricted efforts. He also supported integrated air/space solutions, and the development and execution of several airborne platforms.

Prior to Northrop Grumman, Greg worked as an independent consultant developing business and capture strategies for Commercial, Military and Restricted space business areas. Greg also consulted with the US government focused on advancing the future DoD, civil and restricted communications architectures and specifically the initiation of the TSAT program. Greg started his career with The Aerospace Corporation, where he supported the DoD, civil and national space programs. He managed the MILSATCOM advanced plans group, a communications subdivision directorate and opened The Aerospace Corporation's Washington, DC Field Office.

IMS WELCOME RECEPTION

19:00 – 21:00

Monday, 20 June 2022

Denver Performing Arts Complex in the Sculpture Park and Galleria

IMS2022 starts with a welcome event on Monday for all attendees, which will be hosted at the Denver Performing Arts Complex in the Sculpture Park and Galleria immediately following the IMS2022 Plenary Session. Join us for a beverage in the beer garden as we kick off the week!

REBECCA TODD

Sponsored By:

AMPLITECH GROUP

1A-1C

RTu1A: mm-Wave and Wide Band Low-Noise CMOS Amplifiers

Chair: Hao Gao, *Silicon Austria Labs, Austria*
Co-Chair: Marcus Granger-Jones, *Qorvo, USA*

08:00

RTu1A-1: 28GHz Compact LNAs with 1.9dB NF Using Folded Three-Coil Transformer and Dual-Feedforward Techniques in 65nm CMOS

X. Huang, *Tsinghua Univ.*; H. Jia, *Tsinghua Univ.*; W. Deng, *Tsinghua Univ.*; Z. Wang, *RITS*; B. Chi, *Tsinghua Univ.*

08:20

RTu1A-2: 22–33GHz CMOS LNA Using Coupled-TL Feedback and Self-Body Forward-Bias for 28GHz 5G System

Y.-S. Lin, *National Chi Nan Univ.*; K.-S. Lan, *National Chi Nan Univ.*

08:40

RTu1A-3: A Capacitor Assisting Triple-Winding Transformer Low-Noise Amplifier with 0.8–1.5dB NF 6–12GHz BW ±0.75dB Ripple in 130nm SOI CMOS

T. Zou, *Fudan Univ.*; H. Xu, *Fudan Univ.*; Y. Wang, *Fudan Univ.*; W. Liu, *Fudan Univ.*; T. Han, *CASIC IT Academy*; Z. Wang, *Archiwave Microelectronics*; N. Li, *Archiwave Microelectronics*; M. Tian, *CASIC IT Academy*; W. Zhu, *CASIC IT Academy*; N. Yan, *Fudan Univ.*

09:00

RTu1A-4: An LNA with Input Power Match from 6.1 to 38.6GHz, the Noise-Figure Minimum of 1.9dB, and Employing Back Gate for Matching

M. Radpour, *Univ. of Calgary*; L. Belostotski, *Univ. of Calgary*

09:20

09:40

1D-1F

RTu1B: Efficiency Enhancement Techniques for Power Amplifiers

Chair: SungWon Chung, *Neuralink, USA*
Co-Chair: Alexandre Giry, *CEA-Leti, France*

RTu1B-1: A 38GHz Deep Back-Off Efficiency Enhancement PA with Three-Way Doherty Network Synthesis Achieving 11.3dBm Average Output Power and 14.7% Average Efficiency for 5G NR OFDM

X. Zhang, *Rice Univ.*; S. Li, *Samsung*; D. Huang, *Samsung*; T. Chi, *Rice Univ.*

RTu1B-2: A Polar Doherty SCPA with 4.4° AM-PM Distortion Using On-Chip Self-Calibration Supporting 64-/256-/1024-QAM

H. Tang, *UESTC*; H.J. Qian, *UESTC*; B. Yang, *UESTC*; T. Wang, *UESTC*; X. Luo, *UESTC*

RTu1B-3: A Compact Single Transformer Footprint Hybrid Current-Voltage Digital Doherty Power Amplifier

J. Lee, *Georgia Tech*; D. Jung, *Georgia Tech*; D. Munzer, *Georgia Tech*; H. Wang, *Georgia Tech*

RTu1B-4: An Eight-Core Class-G Switched-Capacitor Power Amplifier with Eight Power Backoff Efficiency Peaks

B. Qiao, *Oregon State Univ.*; A.V. Kayyil, *Oregon State Univ.*; D.J. Allstot, *Oregon State Univ.*

NEW FOR IMS2022! THE SYSTEMS FORUM

A New Initiative at IMS2022 Highlighting MTT Activities of Interest to System Engineers

- Additional outlet for system-level research
- Tap into areas of local activity (Denver: defense, 5G/6G, quantum, phased arrays, etc.)
- Draw in additional participants

The Systems Forum will overlay the regular technical program by arranging technical content along thematic "Days:"

TUESDAY
Connected Future Summit and Quantum Systems

WEDNESDAY
Radar and Aerospace

THURSDAY
Phased Arrays and Over-the-Air

Activities will be related to the thematic topic areas

- Panel Sessions
- Focus Sessions
- IEEE Microwave Magazine overview papers
- Interactive Forum Plenary Posters with well-known presenters
- Receptions

A small gear symbol on an activity denotes it is part of the Systems Forum. Systems Forum activities by day are shown below.

Activity	Tuesday June 21	Tuesday June 21	Wednesday June 22	Thursday June 23
	Conn. Future Summit	Quantum Systems Day	Radar & Aerospace Day	Phased Arrays & OTA Day
AM1: 08:00-09:40	**Keynote:** Smart Cities and Our Connected Future	**Keynote:** Engineering Quantum Systems of Superconducting Qubits	**Keynote:** Recent Radar Advances and Their Impact	**Keynote:** Calibrating RF/Microwave Front Ends in Multichannel Receiver and Transmitter Systems
	Session 1: The Connected Future	**Tu1E Focus Session:** Microwave Technologies for Quantum-System Integration	**We1F Focus Session:** Radar from Space to Ground (and Below) - The synergy between commercial, government, and metrology applications	**TH1F Focus Session w/ARFTG:** Efficient Characterization and Test of Phased Array
AM2: 10:10-11:50	**Session 2:** Spectrum, Standards and Innovation **Fireside Chat:** Non-Terrestrial Networks: Cellular in space	**Tu2E:** Cryogenic Microwave Circuits for Control of Quantum Systems	**We2F:** Advanced Concepts for 77 GHz Radar	**Th2F:** Antenna Systems for 5G and SATCOM Applications
Lunch 12:00-13:30	**Panel Session w/RFIC:** Race to the Next G – Ride the mmWave or Wave Goodbye!	**Panel Session:** This is the Right Way to Architect the Microwave Control for a Quantum Computer!	**Panel Session:** Small Satellites and Constellations: Who Will be the Winners of the New Race to Space?	**Panel Session w/ARFTG:** Modern Phased Arrays and OTA Testing: A Design or a Measurement Challenge?
PM1: 13:30-15:10	**Session 3:** Next-Generation Technologies	**Tu3E Focus Session:** Cryogenic Measurement and Characterization for Quantum Information Systems	**We3F Focus Session:** Cognitive Radar	**Th3F Focus Session:** Advances in Integrated Transceivers for beamforming and RADAR Applications
				Phased Arrays and OTA Reception at the Interactive Forum: Plenary Poster, Phased Array Posters
PM2: 15:40-17:00	**Session 4:** 6G Challenges **Panel Session:** "Will flexibility and digital bottlenecks break 6G?" **Connected Future Summit Reception (17:00-17:45)**	**Quantum Reception at the Interactive Forum:** Plenary Poster, Quantum Posters, Hardware demos	**We4F:** Advanced Radar Imaging and Signal Processing	**IMS2022 Closing Session**
			Radar Reception w/Interactive Forum: Plenary Poster, Radar Posters, Hardware demos	

Microwave Field, Device & Circuit Techniques | Passive Components | Active Components | Systems & Applications | Emerging Technologies & Applications | Focus & Special Sessions

	401-402	403-404	501-502	503-504
	Tu1A: Advances in Synthesis and Design Techniques for Non-Planar Filters **Chair:** Simone Bastioli, *RS Microwave* **Co-Chair:** Antonio Morini, *Università Politecnica delle Marche*	**Tu1B: Advances in Numerical and Computational Techniques for Simulation and Design Optimization Dedicated to Tapan Sarkar** **Chair:** Erin Kiley, *Massachusetts College of Liberal Arts* **Co-Chair:** José E. Rayas-Sánchez, *ITESO*	**Tu1C: Advances in RFID Technologies** **Chair:** Victor M. Lubecke, *Univ. of Hawaii at Manoa* **Co-Chair:** Alessandra Costanzo, *Università di Bologna*	**Tu1D: Advanced Frequency Synthesis** **Chair:** Amit Jha, *Qualcomm* **Co-Chair:** Jahnavi Sharma, *Intel*
08:00 08:10	**Tu1A-1: New Triple-Resonance Configurations Using Stubbed Waveguide Dual-Mode Cavities** Simone Bastioli, *RS Microwave;* Richard Snyder, *RS Microwave*	**Tu1B-1: Electromagnetic Time Kurtosis for Time-Reversal Source Reconstruction with Band-Limited Signals** X.-Y. Feng, *Dalhousie Univ.*; Z. Chen, *Fuzhou Univ.*; J. Li, *Fuzhou Univ.*; J. Cai, *Fuzhou Univ.*; J.-C. Liang, *Southeast Univ.*	**Tu1C-1: Ultra-Long-Range Dual Rotman Lenses-Based Harmonic mmID's for 5G/mm-Wave IoT Applications** C.A. Lynch III, *Georgia Tech*; A. Adeyeye, *Georgia Tech*; A. Eid, *Georgia Tech*; J. Hester, *Atheraxon*; M.M. Tentzeris, *Georgia Tech*	**Tu1D-1: A Low Phase Noise 28GHz VCO Using Transformer-Based Q-Enhanced Active Impedance Converter** Md.A. Hoque, *Washington State Univ.*; M. Chahardori, *Washington State Univ.*; M.A. Mokri, *Washington State Univ.*; S. Mohapatra, *Washington State Univ.*; D. Kar, *Washington State Univ.*; D. Heo, *Washington State Univ.*
08:20 08:30	**Tu1A-2: Synthesis of Extracted-Zero Filters** Giuseppe Macchiarella, *Politecnico di Milano - Dipartimento di Elettronic;* Stefano Tamiazzo, *CommScope;* Simone Bastioli, *RS Microwave;* Richard Snyder, *RS Microwave*	**Tu1B-2: H-Matrix Accelerated Direct Matrix Solver Using Chebyshev-Based Nyström Boundary Integral Equation Method** J. Hu, *Univ. of Southern California*; E. Sever, *Gebze Technical Univ.*; O. Babazadeh, *Univ. of Manitoba*; R. Gholami, *Mentor Graphics*; V. Okhmatovski, *Univ. of Manitoba*; C. Sideris, *Univ. of Southern California*	**Tu1C-2: An Efficient Algorithm to Determine the Operational Range of Near-Field On-Body UHF RFID Systems** A. Felaco, *Ghent Univ.*; K.Y. Kapusuz, *Ghent Univ.*; H. Rogier, *Ghent Univ.*; D. Vande Ginste, *Ghent Univ.*	**Tu1D-2: A Picosecond Ultrafast Pulse Generation Featuring Switchable Operation Between Monocycle and Doublet Pulses** M. Rahman, *Polytechnique Montréal*; K. Wu, *Polytechnique Montréal*
08:40 08:50	**Tu1A-3: Novel Synthesis for Generalized Strongly Coupled Resonator Triplet Filters with Self-Suppressed Spikes** Y. Zeng, *CUHK*; Y. Yang, *Xidian Univ.*; M. Yu, *CUHK*	**Tu1B-3: Hybrid Geometrical Optics and Uniform Asymptotic Physical Optics for Rapid and Accurate Practical GRIN Lens Design** W. Wang, *Univ. of Notre Dame*; J. Chisum, *Univ. of Notre Dame*	**Tu1C-3: Gesture Recognition Using Chipless RFID Tag Held in Hand** Z. Ali, *LCIS (EA 3747)*; N. Barbot, *LCIS (EA 3747)*; E. Perret, *LCIS (EA 3747)*	**Tu1D-3: A W-Band Wide Locking Range Divide-by-Three Injection-Locked Frequency Divider in 40nm CMOS** W.-C. Chang, *National Tsing Hua Univ.*; H.-C. Chang, *National Tsing Hua Univ.*; F.-C. Chang, *National Tsing Hua Univ.*; J.Y.-C. Liu, *National Tsing Hua Univ.*
09:00 09:10	**Tu1A-4: Synthesis Guidelines for Acoustic Wave Standalone Ladder Filters with Dual-Band Responses** L. Acosta, *Univ. Autònoma de Barcelona*; E. Guerrero, *Univ. Autònoma de Barcelona*; J. Verdú, *Univ. Autònoma de Barcelona*; P. de Paco, *Univ. Autònoma de Barcelona*	**Tu1B-4: Applications of Double Mapping for Design Reutilization** G. B., *IIT Roorkee*; R.R. Mansour, *Univ. of Waterloo*	**Tu1C-4: A Novel Dual-Band and Bidirectional Nonlinear RFID Transponder Circuitry** P. Pahlavan, *Univ. of Florida*; N. Ebrahimi, *Univ. of Florida,* Shah Zaib Aslam, *Univ. of Florida*	**Tu1D-4: A Hybrid Pulling Mitigation Synthesizer for NB-IoT Transmitter** N. Mahalingam, *SUTD*; H. Liu, *SUTD*; Y. Wang, *SUTD*; K.S. Yeo, *SUTD*; C.-I. Chou, *Realtek Semiconductor*; H.-Y. Tsai, *Realtek Semiconductor*; K.-H. Liao, *Realtek Semiconductor*; W.-S. Wang, *Realtek Semiconductor*; K.-U. Chan, *Realtek Semiconductor*; Y.-H. Lin, *Realtek Semiconductor*
09:20 09:30	**Tu1A-5: Synthesis of the Double-Ladder Topology with Arbitrary Bandwidths and Dual-Band Response** J. Verdú, *Univ. Autònoma de Barcelona*; M. Faura, *Univ. Autònoma de Barcelona*; L. Acosta, *Univ. Autònoma de Barcelona*; E. Guerrero, *Univ. Autònoma de Barcelona*; C. Caballero, *Univ. Autònoma de Barcelona*; P. de Paco, *Univ. Autònoma de Barcelona*	**Tu1B-5: System Simulation Through Behavioral Model with Embedded Equation Solver for the Prediction of the Linearized Power Amplifier Performances at the Design Stage** S. Hernandez, *AMCAD Engineering*; E. Gatard, *Wupatec*; C. Maziere, *AMCAD Engineering*; W. Saabe, *AMCAD Engineering*; P.-E. Lavergne, *Wupatec*; E. Ngoya, *XLIM (UMR 7252)*	**Tu1C-5: Enhanced Two-Way Communication for Battery-Free Wireless Sensors: SWIPT with IM3 Backscattering** Y. Qaragoez, *KU Leuven*; S. Pollin, *KU Leuven*; D. Schreurs, *KU Leuven*	**Tu1D-5: An Approach for Compensating Reciprocal Mixing and Close-In Phase Noise Distortion** W. Namgoong, *SUNY Albany*
09:40				

4D-4F

Tu1E: Microwave Technologies for Quantum-System Integration

Chair: Nizar Messaoudi, *Keysight Technologies*

Co-Chair: Sorin P. Voinigescu, *Univ. of Toronto*

08:00

Tu1E-1: Keynote: Engineering Quantum Systems of Superconducting Qubits

William Oliver, *Massachusetts Institute of Technology*

08:10

08:20

Tu1E-2: Superconducting Microwave Interconnect Technologies for Quantum and Cryogenic Systems

M.C. Hamilton, *Auburn Univ.;* B. Yelamanchili, *Auburn Univ.;* A. Shah, *Auburn Univ.;* S.E. Peek, *Auburn Univ.;* S. Bankson, *Auburn Univ.;* C.C. Tillman, *Auburn Univ.*

08:30

08:40

Tu1E-3: Prospects for Parametric Amplifiers in Large-Scale Superconducting Quantum Computing

J. Aumentado, *NIST*

08:50

09:00

Tu1E-4: High-Fidelity RF/Microwave-Based Universal Control of Trapped Ion Qubits

R. Srinivas, *NIST*; S.C. Burd, *NIST*; H.M. Knaack, *NIST*; R.T. Sutherland, *LLNL*; A. Kwiatkowski, *NIST*; S. Glancy, *NIST*; E. Knill, *NIST*; D.J. Wineland, *NIST*; D. Leibfried, *NIST*; A.C. Wilson, *NIST*; D.T.C. Allcock, *NIST*; D.H. Slichter, *NIST*

09:10

09:20

09:30

09:40

RFIC STUDENT FORUMS

10:10 – 11:00 | Tuesday, 21 June 2022 | Room: 1A-1C

Student Industry CHIPS Forum

ORGANIZER: Jennifer Kitchen, *Arizona State Univ.*

PANELISTS:

Alessandro Piovaccari, *Universit. di Bologna;* **Gary Xu,** *Samsung Research America;* **Jeremy Dunworth,** *Qualcomm;* **Andreia Cathelin,** *STMicroelectronics;* **Shahriar Shahramian,** *Nokia Bell Labs;* **Nadine Collaert,** *imec*

The snowball effect of the COVID-19 pandemic has led to an alarming global shortage of integrated circuits chips and severe disruptions in almost any product that relies on the semiconductor supply chain. On the other hand, we have witnessed radically increasing public attention and government/industry investments on semiconductor technologies, as demonstrated by the CHIPS Act in the EU and USA. While the semiconductor industry may envision an explosive growth in the next decade, tech industry leaders are struggling to attract and retain talent.

This student panel event invites industry leaders to present the new technology trends in the semiconductor industry and their Big-Picture visions related to RFICs. The purpose of this student panel is to educate graduate and undergraduate students about the RF semiconductor industry and encourage them to join the fast-growing field of RFICs.

RFIC STUDENT FORUMS

11:05 – 11:55 | Tuesday, 21 June 2022 | Room: 1A-1C

Student Entrepreneurship Forum

ORGANIZER: Vadim Issakov, *Technische Universität Braunschweig*

PANELISTS:

Arun Natarajan, *MixComm;* **Bogdan Staszewski,** *Equal1;* **Patrick Chiang,** *PhotonIC Technologies;* **Yang Xu,** *InnoPhase;* **Wouter Steyaert,** *Tusk IC*

Startup companies emerging from cutting-edge academic research have always been an integral component of the semiconductor industry and its continuous growth. However, to many students, there is lack of education on entrepreneurship careers and what it takes to achieve a successful semiconductor startup company.

This student panel invites entrepreneurs in our RFIC community to share their startup experiences and stories. The purpose is to educate graduate students regarding entrepreneurship in the RFIC field and its associated challenges and opportunities.

10:10
10:20
10:30
10:40
10:50
11:00
11:10
11:20
11:30
11:40
11:50

401-402

Tu2A: Advances in Non-Planar Filter Technologies

Chair: Cristiano Tomassoni, *Università di Perugia*

Co-Chair: Xun Gong, *Univ. of Central Florida*

Tu2A-1: Dual-Pol Quadruple Ridge Resonator Filter with Transmission Zeros

M.A. Fuentes-Pascual, *Univ. Politècnica de València*; M. Guglielmi, *Univ. Politècnica de València*; V.E. Boria, *Univ. Politècnica de València*; M. Baquero-Escudero, *Univ. Politècnica de València*

Tu2A-2: Dual-Band Filters Based on Dual-Mode Ellipsoidal Cavities

E. López-Oliver, *Università di Perugia*; C. Tomassoni, *Università di Perugia*

Tu2A-3: Compact Ultra-Wideband Cavity Filter Based on Suspended Ceramic Resonators in Additive Manufacturing

P. Vallerotonda, *RF Microtech*; F. Cacciamani, *RF Microtech*; L. Pelliccia, *RF Microtech*; C. Tomassoni, *Università di Perugia*; G. Cannone, *SIAE MICROELETTRONICA*; V. Tornielli di Crestvolant, *ESA-ESTEC*

Tu2A-4: 3D-Printed Compact Waveguide Filters Based on Slanted Ridge Resonators

F. Romano, *Università di Pavia*; N. Delmonte, *Università di Pavia*; C. Tomassoni, *Università di Perugia*; L. Perregrini, *Università di Pavia*; M. Bozzi, Università di Pavia

403-404

Tu2B: A Retrospective and a Vision of Future Trends in RF and Microwave Design Optimization Dedicated to Vittorio Rizzoli

Chair: José E. Rayas-Sánchez, *ITESO*

Co-Chair: Qi-Jun Zhang, *Carleton Univ.*

Tu2B-1: The Synergy Between Optimization and Time Domain Electromagnetics — Past Evolution and Future Possibilities

W.J.R. Hoefer, *Univ. of Victoria*

Tu2B-2: Analytical Expressions for Field-based Response Sensitivity Analysis and Their Application in Microwave Design and Imaging

Natalia Nikolova, *McMaster Univ.*; Romina Kazemivala, *McMaster Univ.*

Tu2B-3: EM-Driven Tolerance Optimization of Compact Microwave Components Using Response Feature Surrogates

A. Pietrenko-Dabrowska, *Gdansk Univ. of Technology*; S. Koziel, *Reykjavik Univ.*; J.W. Bandler, *McMaster Univ.*; J.E. Rayas-Sánchez, *ITESO*

Tu2B-4: Surrogate-Based Design and Tuning Methods for RF/Microwave Devices

Y. Yu, *SUSTech*; Z. Zhang, *SUSTech*; Q.S. Cheng, *SUSTech*; B. Liu, *Univ. of Glasgow*; Y. Wang, *Univ. of Birmingham*

Tu2B-5: Recent Advances and Future Trends in Neuro-TF for EM Optimization

F. Feng, *Tianjin Univ.*; Q. Guo, *Tianjin Univ.*; Q.-J. Zhang, *Carleton Univ.*

Tu2B-6: System-Level Measurement-Based Design Optimization by Space Mapping Technology

J.E. Rayas-Sánchez, *ITESO*; J.W. Bandler, *McMaster Univ.*

Tu2B-7: Recent Advances on Aggressive Space Mapping Techniques for Waveguide Filters Design and Tuning

J.C. Melgarejo, *Univ. Politècnica de València*; J. Ossorio, *Univ. Politècnica de València*; D. Rubio, *Univ. Politècnica de València*; S. Cogollos, *Univ. Politècnica de València*; M. Guglielmi, *Univ. Politècnica de València*; V.E. Boria, *Univ. Politècnica de València*

501-502

Tu2C: Advances in RF Sensors

Chair: Thomas Ussmueller, *Universität Innsbruck*

Co-Chair: Hamed Rahmani, *IBM T.J. Watson Research Center*

Tu2C-1: Interferometric Motion Sensing with a Single-Channel Radar Sensor Based on a Novel Calibration-Free Phase Demodulation Technique

Wei Xu, *Shanghai Jiao Tong Univ.*; Changzhan Gu, *Shanghai Jiao Tong Univ.*; Jun-Fa Mao, *Shanghai Jiaotong Univ.*

Tu2C-2: A Noise-Immune Motion Sensing Technique with Low-IF CW Radars

J. Liu, *SJTU*; F. Tong, *SJTU*; C. Gu, *SJTU*; J. Mao, *SJTU*

Tu2C-3: Vibration Sensing Using Doppler-Modulated Chipless RFID Tags

A. Azarfar, *LCIS (EA 3747)*; N. Barbot, *LCIS (EA 3747)*; E. Perret, *LCIS (EA 3747)*

Tu2C-4: High Resolution Ultra-Violet Radiation Detection Using TNT-Integrated Wireless Passive Microwave Resonator

M.C. Jain, *Univ. of British Columbia*; M. Alijani, *Univ. of British Columbia*; B.D. Wiltshire, *Univ. of British Columbia*; J.M. Macak, *Brno Univ. of Technology*; M.H. Zarifi, *Univ. of British Columbia*

Tu2C-5: A Machine Learning Enabled mmWave RFID for Rotational Sensing in Human Gesture Recognition and Motion Capture Applications

A. Adeyeye, *Georgia Tech*; C. Lynch, *Georgia Tech*; J. Hester, *Atheraxon*; M.M. Tentzeris, *Georgia Tech*

503-504

Tu2D: Advanced mm-wave Frequency Conversion and Control Circuits

Chair: Austin Chen, *Peraso, Inc.*

Co-Chair: Stephen Maas, *Nonlinear Technologies*

Tu2D-1: A 1-170-GHz Distributed Down-Converter MMIC in a 35-nm Gate-Length InGaAs mHEMT Technology

Fabian Thome, *Fraunhofer IAF*; Sandrine Wagner, *Fraunhofer IAF*; Arnulf Leuther, *Fraunhofer IAF*

Tu2D-2: A 27–57GHz Down-Conversion Mixer with Bulk Injection Technique

Q. Dong, *Zhejiang Univ.*; L. Qiu, *Zhejiang Univ.*; S. Wang, *Zhejiang Univ.*; H. Gao, *Zhejiang Univ.*; K. Zhao, *Zhejiang Univ.*; Z. Qian, *Zhejiang Univ.*; J. Chen, *Zhejiang Univ.*; Y.-C. Kuan, *NYCU*; Q.J. Gu, *Univ. of California, Davis*; C. Song, *Zhejiang Univ.*; Z. Xu, *Zhejiang Univ.*

Tu2D-3: An E-Band Subradix Active Phase Shifter with <0.69° RMS Phase Error and 16dB Attenuation in 28nm CMOS

K. Zhao, *Zhejiang Univ.*; L. Qiu, *Zhejiang Univ.*; J. Chen, *Zhejiang Univ.*; Q. Dong, *Zhejiang Univ.*; Y.-C. Kuan, *NYCU*; Q.J. Gu, *Univ. of California, Davis*; C. Song, *Zhejiang Univ.*; Z. Xu, *Zhejiang Univ.*

Tu2D-4: A DC–50GHz DPDT Switch with >27dBm IP1dB in 45nm CMOS SOI

Y. Liu, *Georgia Tech*; J. Park, *Georgia Tech*; H. Wang, *Georgia Tech*

Tu2D-5: Compact, High-Isolation 110–140GHz SPST and SPDT Switches Using a 250nm InP HBT Process

J.S.-C. Chien, *Univ. of California, Santa Barbara*; J.F. Buckwalter, *Univ. of California, Santa Barbara*

4D-4F

Tu2E: Cryogenic Microwave Circuits for Control of Quantum Systems

Chair: Joseph Bardin, *Google, UMass Amherst*

Co-Chair: Luca Pierantoni, *Università Politecnica delle Marche*

10:10

Tu2E-1: Josephson Junctions Based Low Temperature Superconducting Phase Shifter for X- and K-Band using MIT-LL SFQ5ee Process

Navjot Khaira, *Univ. of Waterloo*; Tejinder Singh, *Univ. of Waterloo*; Raafat Mansour, *Univ. of Waterloo*

10:20

10:30

Tu2E-2: Cryogenic Decade-Passband Superconducting Integrated Diplexer

A.A. Babenko, *NIST*; G. Lasser, *Univ. of Colorado Boulder*; N.E. Flowers-Jacobs, *NIST*; J.A. Brevik, *NIST*; A.E. Fox, *NIST*; Z. Popovic, *Univ. of Colorado Boulder*; P.D. Dresselhaus, *NIST*

10:40

10:50

Tu2E-3: Cryogenic Wideband Quadrature Hybrid Couplers Implemented in a Low Temperature Superconductor Multilayer Process

N.K. Khaira, *Univ. of Waterloo*; T. Singh, *Univ. of Waterloo*; R.R. Mansour, *Univ. of Waterloo*

11:00

11:10

Tu2E-4: Cryogenic Compact Low-Power 60GHz Amplifier for Spin Qubit Control in Monolithic Silicon Quantum Processors

M. Spasaro, *Aarhus Univ.*; S. Bonen, *Univ. of Toronto*; G. Cooke, *Univ. of Toronto*; T. Jager, *Univ. of Toronto*; T.D. Nhut, *Aarhus Univ.*; D. Sufrà, *Aarhus Univ.*; S.P. Voinigescu, *Univ. of Toronto*; D. Zito, *Aarhus Univ.*

11:20

11:30

Tu2E-5: Cryogenic Compact mm-Wave Broadband SPST Switch in 22nm FDSOI CMOS for Monolithic Quantum Processors

T.D. Nhut, *Aarhus Univ.*; S. Bonen, *Univ. of Toronto*; G. Cooke, *Univ. of Toronto*; T. Jager, *Univ. of Toronto*; M. Spasaro, *Aarhus Univ.*; D. Sufrà, *Aarhus Univ.*; S.P. Voinigescu, *Univ. of Toronto*; D. Zito, *Aarhus Univ.*

11:40

11:50

Attention all Young Professionals (YP's)!

Whether you're still navigating your graduate studies, have just kick-started your career or have already taken your deep dive, we've got you covered! At IMS2022, you'll find a variety of events designed to take you to the peak of your microwave career:

- Step out of your niche and broaden your knowledge on microwave applications with our Industry Panel Sessions, a unique chance to discuss with the experts from a variety of fields
- Mingle with the MTT-S Publications Editors in Chief during our exclusive Editors in Chief Reception—limited attendance, grab your spot!
- Network with your peers in a relaxed setting at our Networking Reception for Young Professionals
- Develop yourself with our Career and Technical Presentations

And have some fun!

- Join the RF Interference Fox Hunt, where you will work as a team to find RF signals hidden throughout the area
- Compete in our Cornhole Tournament
- Visit our Young Professionals Lounge to charge up between sessions, relax and find out what more we have in store for you!

Viewhouse Eatery, Bar and Rooftop | 19:00 – 21:00 | Tuesday, 21 June 2022

Young Professionals Reception

Sponsored By:

Microwaves&RF

Schedule of YP Events (subject to change)

Tuesday, 21 June	Wednesday, 22 June	Thursday, 23 June
YP Lounge Open		
	09:00 – 11:00 Cornhole Tournament **	09:00 – 10:00 How Does a Spectrum Auction Work?
		10:00 – 11:30 RF Interference Fox Hunt **
	14:00 – 15:00 What is a Patent?	14:00 – 15:00 Impact of Globalization and Remote Working on Career Progression of Young Engineers
15:00 – 16:00 Panel Session: Your Next Professional Step	15:00 – 16:00 Wireless Technology: From Landline to xG	15:00 – 16:00 Interplanetary Communication: Communicating Off-Planet
16:00 – 17:00 Panel Session: World of Radar		
17:30 – 18:30 YP-Exclusive Reception with IEEE Editors-in-Chief *(Spots Limited)* **		
19:00 – 21:00 YP Evening Reception at ViewHouse Eatery, Bar and Rooftop *(Must be 21+)* **		

IEEE youngprofessionals

INDUSTRY WORKSHOPS 08:00 – 17:00 Tuesday, 21 June 2022

SESSION CODE	TIME & LOCATION	TITLE AND ABSTRACT	SPEAKER/S, AFFILIATION
IWTU1	08:00 – 9:40 Room: 205/207	**24-44 GHz Up-Down Converter Design Accelerator Ecosystem** mmWave is the new frontier in RF design. There are many advantages of working at these frequencies and more opportunity as more bands are opened for different applications. There are also many difficulties, especially for those that do not have a lot of experience. Richardson RFPD has made available a 24-44 GHz up-down converter design accelerator to help alleviate some of those difficulties. It can be used to help demonstrate a concept to your customer, to start your algorithm development, or as a reference design. The workshops goal is to demonstrate and to show its applications.	Larry Hawkins, *Richardson RFPD*
IWTU2	10:10 – 11:50 Room: 205/207	**New Workflows for Integrated 5G Phased-Array Antenna System Design** Advances in front-end RFIC electronics and highly integrated RF PCB designs are making it possible to adopt phased-array systems for commercial mmWave applications. This workshop explores recent developments in mmWave technology from the perspective of EM simulation, in-situ circuit simulation, phased-array synthesis, and RF PCB design. The system requirements that drive antenna/front-end architectural decisions for mmWave applications, antenna optimization, and array configuration and generation will be discussed and the use of RF system design software for link budget analysis will be demonstrated.	David Vye, *Cadence*
IWTU3	13:30 – 15:10 Room: 205/207	**Novel 5G Measurement Techniques in Diverse Environments** 5G and emerging wireless technologies are being considered in a wide range of spectrum bands to support a significantly increased user density. With the industry's adoption of multi-user MIMO, massive MIMO, and mmWave in emerging wireless systems, several worldwide industries and standards bodies face new measurement challenges in NR OTA testing to verify products meet intended performance parameters demanded by diverse technological requirements. Applications in diverse environments, such as commercial aircraft and base stations, will be reviewed. Experts and active contributors to the 5G wireless industry standards committees will review these challenges and propose novel solutions.	Aurelian Bria, *Ericsson;* Dennis Lewis, *Boeing;* Michael Foegelle, *ETS-Lindgren*
IWTU4	15:40 – 17:00 Room: 205/207	**Accelerated Solid State Qubit Pre-Screening** Until recently, quantum engineers operating devices at milli-Kelvin temperatures are faced with the difficulties and inconveniences of long development cycles. The major bottlenecks include time-consuming wire bonding, expensive packaging processes prior to device cooldown, and long cooldown times for dilution refrigerators. This workshop presents an integrated measurement solution for Pre-Screening qubit devices, allowing quantum engineers to eliminate wire-bonding and packaging from cryogenic test processes and to provide critical qubit performance parameters at 50 mK, thus streamlining device deployment, and reducing the time for development cycles.	Nizar Messaoudi, *Keysight Technologies;* Jack DeGrave, *FormFactor*
IWTU5	13:30 – 15:10 Room: 403/404	**Mixed-Mode/Differential S-Parameter Characterization At Cryogenic Temperatures For Quantum Computing Applications** 2-port S-parameter characterization of wafer-level devices at cryogenic temperatures has a relatively long history; however, there has been considerably less work on differential/mixed-mode S-parameter characterization in these environments. With the emergence of cryogenic temperature microwave systems for quantum computing, there is increasing interest in high frequency integrated circuit design with differential signaling for cold environments. Here we will discuss the instrumentation, probes, calibrations, and environmental consideration for wafer-level characterization of differential devices at cryogenic temperatures and magnetic fields.	David Daughton, Nizar Messaoudi, Suren Singh, *Lake Shore Cryotronics, Keysight Technologies*

STUDENT DESIGN COMPETITIONS 09:00 – 17:00 Tuesday, 21 June 2022 Room: 705/707

All attendees are invited to the annual IMS Student Design Competitions on Tuesday, 21 June 2022. Students have been busy over the past several months designing and building solutions to the challenging engineering problems presented in the six student design competitions listed below. Judges will measure the students' designs at this event to determine the winners of the various competitions. Come to this event to cheer on the students, celebrate their hard work, and learn about their innovative designs.

SESSION CODE	TOPIC
SDC1	**Design of a Self-Interference Cancellation Coupler**
SDC2	**Packaged C-band Filter**
SDC3	**VHF High-Efficiency Power Amplifier at 50MHz**
SDC4	**High-Efficiency Power Amplifier**
SDC5	**High-Sensitivity Motion Sensing Radar**
SDC6	**Measurement and Extraction of Device Parameters of an RF Transistor**

PANEL SESSION 12:10 – 13:20 Tuesday, 21 June 2022 Room: 2C–3C

This is the Right Way to Architect the Microwave Control for Quantum Computers!

PANEL ORGANIZERS:
Mark Gouker, *MIT Lincoln Laboratory;* **Vadim Issakov**, *Technical Univ. of Braunschweig, Germany*

PANELISTS:
Joe Bardin, *Univ. of Massachusetts and Google;* **Stefano Pellerano**, *Intel;* **Oleq Mukhanov**, *Seeqc;* **Bogdan Staszewski**, *Equal1.Labs Inc.;* **Glenn Jones**, *Rigetti Computing*

ABSTRACT: Precise control of the qubits is an essential, yet relatively immature, aspect in the development of quantum computers and is particularly difficult for cryogenic systems. This panel will debate the very different approaches being explored for microwave control signals of the qubits: CMOS vs. superconducting circuits; on the qubit plane vs. a higher temperature stage, etc. The panelists will describe their current approach and the path they intend to take as they scale to larger qubit circuits. The session will include participation from researchers at: Google, Intel, Seeqc, and Equal1.

IMS/RFIC JOINT PANEL SESSION 12:00 – 13:30 Tuesday, 21 June 2022 Room: 4A–4C

Race to the Next G – Ride the mmWave or Wave Goodbye!

PANEL ORGANIZERS AND MODERATORS:
François Rivet, *Univ. of Bordeaux;* **Aida Vera Lopez,** *Intel*

PANELISTS:
Khurram Muhammad, *Samsung Research America;* **Shahriar Shahramian**, *Nokia-Bell Laboratories;* **Omar Bakr**, *Tarana Wireless Inc;* **Jon Strange**, *MediaTek Inc.;* **Emilio Calvanese Strinati**, *CEA LETI;* **Mike Noonen**, *MixComm Inc.;* **Reza Arefi**, *Intel*

ABSTRACT: A Millimeter-Wave (mmW) 5G promises high capacity and low latency by tapping into the wide bandwidth available in the Ka-band. Although there are practical limitations when using such band for non-line-of-sight communication as well as difficulty in realizing energy-efficient and cost-effective circuitry, mobile operators and technology companies have been making considerable investments in developing and deploying mmW equipment, while few continue to bid on the C-band and are willing to pay tens of billions for a 160MHz slice in it. Is now a good time to pause and reevaluate or is the global deployment of 5G mmW networks inevitable? What has the user experience with 5G networks been so far and what are the expectations for 6G and beyond? Do mmW mobile communications make engineering and economic sense and should we push for even higher bands (THz) in the next G? This panel of international experts from various industry sectors and academia will discuss the technical practicality and economics of 5G mmW deployment, and assess the potential for use of even higher frequency bands (D-band and above) in next generation communications.

CONNECTED FUTURE SUMMIT 08:00 – 18:00 Tuesday, 21 June 2022 Room: 505–507

The Connected Future Summit will review core technologies for future wireless networks along with their human and societal impacts. Topics include smart cities, connected transportation, unmanned aerial vehicles, reconfigurable devices and beamsteering, and the need for a holistic approach to 6G. Special features include a panel session on overcoming bottlenecks in 6G and a fireside chat with experts on non-terrestrial networks.

SPEAKERS:

Keynote: Dessa Bokides, *NEOM*
Upkar Dhaliwal, *Future Wireless Technologies*
Joyti Sharma, *Verizon Wireless*
Peter Burke, *University of California Irvine*
Francesco Grilli, *Qualcomm Inc.*
Carmel Ortiz, *Intelsat Corp.*
Lizy Paul, *Lockheed Martin Corp.*
Reza Arefi, *Intel Corp.*
Khurram Muhammad, *Samsung Research America*
Shariar Shahramian, *Nokia-Bell Labs*
Emilio Calvanese, *CEA-France*
Jon Strange, *MediaTek Inc.*
Omar Bakr, *Tarana Wireless*
Mike Noonen, *MixComm*
Dr. Naveen Yanduru, *Renesas Electronics*
Holger Maune, *University Magdeburg*
Charlie Zhang, *Samsung Research America*
Aarno Pärssinen, *University of Oulu*
Christian Fager, *Chalmers University of Technology*
Raghu M. Rao, *AMD Xilinx*
Timothy O'Shea, *DeepSig*

Sponsored By:

RF Globalnet

To view the complete schedule please visit https://ims-ieee.org/connectedfuturesummit or reference the mobile app.

401-402

Tu3A: Reconfigurable Multi-Mode Resonators and Filters

Chair: Roberto Gómez-García, *Universidad de Alcalá*

Co-Chair: Xun Gong, *Univ. of Central Florida*

13:30 **Tu3A-1: Inset Resonators and Their Applications in Fixed/Reconfigurable Microwave Filters**

13:40 A. Widaa, *CAU*; C. Bartlett, *CAU*; M. Höft, *CAU*

13:50 **Tu3A-2: A Tunable Filter with Extended Tuning Range Based on Switched Dual Resonance Cavities**

14:00 M.M. Fahmi, *DRDC*; D.S. Ghadri, *Univ. of Waterloo*; R.R. Mansour, *Univ. of Waterloo*

14:10 **Tu3A-3: Tunable Multi-Band Non-Reciprocal Bandpass Filters**

14:20 D. Simpson, *Univ. of Colorado Boulder*; P. Vryonides, *Frederick Research Center*; S. Nikolaou, *Frederick Research Center*; D. Psychogiou, *Univ. College Cork*

14:30 **Tu3A-4: A Low-Loss Reconfigurable Plasma Impedance Tuner for Real-Time, Frequency-Agile, High-Power RF Applications**

14:40 J. Roessler, *Baylor Univ.*; A. Fisher, *Purdue Univ.*; A. Egbert, *Baylor Univ.*; Z. Vander Missen, *Purdue Univ.*; T. Van Hoosier, *Baylor Univ.*; C. Baylis, *Baylor Univ.*; M.A. Khater, *Purdue Univ.*; D. Peroulis, *Purdue Univ.*; R.J. Marks II, *Baylor Univ.*

14:50 **Tu3A-5: Reconfigurable Filtering Attenuator with Continuously Tunable Center Frequency and Amplitude**

15:00 Z. Wei, *UESTC*; S. Chen, *UESTC*; X. Zhu, *UESTC*; P.-L. Chi, *National Chiao Tung Univ.* ; R. Xu, *UESTC*; T. Yang, *UESTC*

15:10

501-502

Tu3C: Rectenna and Signal Design for RF Power Transmission and Energy Harvesting

Chair: Prof. Dieff Vital, *The Univ. of Illinois, Chicago*

Co-Chair: Kenjiro Nishikawa, *Kagoshima Univ.*

Tu3C-1: Rectifier Circuit for 5G mm-Wave Energy Harvesting Using Capacitor Boosted Cross-Coupled Topology in 65nm CMOS

T. Elazar, *Tel Aviv Univ.*; E. Shaulov, *Tel Aviv Univ.*; E. Socher, *Tel Aviv Univ.*

Tu3C-2: A W-Band Rectifier Design Based on GCPW

N. Chordas-Ewell, *SUNY Buffalo*; Z. Li, *SUNY Buffalo*; J.H. Choi, *SUNY Buffalo*; D. Ren, *NXP Semiconductors*; R. Wu, *NXP Semiconductors*

Tu3C-3: Improving Wireless Power Transfer Efficiency with DC/DC Boost Charger by Multi-Sine Excitation at 5.8 GHz

Marco Passafiume, *Univ. of Florence*; Giovanni Collodi, *Dept. Information Engineering, Univ. of Florence*; Alessandro Cidronali, *Dept. Information Engineering, Univ. of Florence*

Tu3C-4: Wideband Stacked Metamaterial for a Compact and Efficient Dual-Band Wireless Power Transfer

X. Jiang, *Kyushu Univ.*; R.K. Pokharel, *Kyushu Univ.*; A. Barakat, *Kyushu Univ.*; K. Yoshitomi, *Kyushu Univ.*

Tu3C-5: Mutual Power Optimization of Photovoltaics and Wireless Power Transfer for Space Based Solar Power

A. Ayling, *Caltech*; A. Wu, *Caltech*; A. Hajimiri, *Caltech*

503-504

Tu3D: HF/VHF/UHF Power Amplifiers and Systems

Chair: Marc Franco, *Qorvo*

Co-Chair: Robert H. Caverly, *Villanova Univ.*

Tu3D-1: A 5 kW, 110V GaN on SiC Transistor for L Band Pulsed Applications

J. Custer, *Integra Technologies*; G. Formicone, *Integra Technologies*; J. Burger, *Integra Technologies*; J. Walker, *Integra Technologies*

Tu3D-2: Synthesis of Broadband Differential Loading Networks for High-Efficiency Power Amplifiers

R.A. Beltran, *Ophir RF*

Tu3D-3: A GaN HF-Band Power Amplifier Using Class-D Topology for Jupiter Ice Penetrating Radar

T. Shenoy, *Jet Propulsion Lab*; R. Johnson, *Jet Propulsion Lab*; J. Tanabe, *Jet Propulsion Lab*; R. Beauchamp, *Jet Propulsion Lab*; L. Yam, *Jet Propulsion Lab*; Y. Gim, *Jet Propulsion Lab*; D. Heyer, *Jet Propulsion Lab*; J. Plaut, *Jet Propulsion Lab*

Tu3D-4: Design of an HF-VHF Ice Penetrating Synthetic Aperture Radar

J.D. Hawkins, P.V. Brennan, *Univ. College London*; K.W. Nicholls, *British Antarctic Survey*; L.B. Lok, *Univ. College London*

Tu3D-5: Analog VHF IQ Receiver with Low IF

R. Campbell, *Portland State Univ.*; K. Dahn, *Portland State Univ.*

Tu3D-6: 200W Outphasing Amplifier System for 650MHz

F.H. Raab, *Green Mountain Radio Research*

4D-4F

Tu3E: Cryogenic Measurement and Characterization for Quantum Systems

Chair: Fabio Sebastiano, *Technische Universiteit Delft*

Co-Chair: Evan Jeffrey, *Google*

Tu3E-1: Measurement Techniques for Superconducting Microwave Resonators Towards Quantum Device Applications

C.R.H. McRae, *Univ. of Colorado Boulder*

Tu3E-2: A Cryogenic On-Chip Noise Measurement Procedure with ±1.4-K Measurement Uncertainty

F. Heinz, *Fraunhofer IAF*; F. Thome, *Fraunhofer IAF*; A. Leuther, *Fraunhofer IAF*; O. Ambacher, *Fraunhofer IAF*

Tu3E-3: Cryogenic Characterization of the High-Frequency and Noise Performance of SiGe HBTs from DC to 70 GHz and Down to 2 K

Shai Bonen, *Univ. of Toronto*; Gregory Cooke, *Univ. of Toronto*; Thomas Jager, *Univ. of Toronto*; Apurv Bharadwaj, *Univ. of Toronto*; Suyash Pati Tripathi, *Univ. of Toronto*; Didier Celi, *STMicroelectronics*; Pascal Chevalier, *STMicroelectronics*; Peter Schvan, *Ciena, Corp.*; Sorin Voinigescu, *Univ. of Toronto*

Tu3E-4: Fully Automatic 4K Cryogenic Probe Station for DC and Microwave Measurements on 150mm and 200mm Wafers

J.T. West, *High Precision Devices*; A. Kurlej, *MIT Lincoln Laboratory*; A. Wynn, *MIT Lincoln Laboratory*; C. Rogers, *High Precision Devices*; M.A. Gouker, *MIT Lincoln Laboratory*; S.K. Tolpygo, *MIT Lincoln Laboratory*

RFIC TECHNICAL SESSIONS 13:30 – 15:10 Tuesday, 21 June 2022 Colorado Convention Center

1A-1C

RTu3A: Circuits and Techniques for Full Duplex Transceivers

Chair: Roxann Broughton-Blanchard, *Analog Devices, USA*

Co-Chair: Mohyee Mikhemar, *Broadcom, USA*

13:30

RTu3A-1: An Integrated Reconfigurable SAW-Less Quadrature Balanced N-Path Transceiver for Frequency-Division and Half Duplex Wireless

E. Zolkov, *Technion*; N. Ginzberg, *Technion*; E. Cohen, *Technion*

13:50

RTu3A-2: A 0.5–4GHz Full-Duplex Receiver with Multi-Domain Self-Interference Cancellation Using Capacitor Stacking Based Second-Order Delay Cells in RF Canceller

C. Wang, *Fudan Univ.*; W. Li, *Fudan Univ.*; F. Chen, *Fudan Univ.*; W. Zuo, *Fudan Univ.*; Y. Pu, *Fudan Univ.*; H. Xu, *Fudan Univ.*

14:10

RTu3A-3: A 2Gb/s 9.9pJ/b Sub-10GHz Wireless Transceiver for Reconfigurable FDD Wireless Networks and Short-Range Multicast Applications

R. Liu, *Intel*; A.B.K. T., *Intel*; R. Dorrance, *Intel*; T. Cox, *Intel*; R. Jain, *Intel*; T. Acikalin, *Intel*; Z. Zhou, *Intel*; T.-Y. Yang, *Intel*; J. Escobar-Pelaez, *Intel*; S. Yamada, *Intel*; K. Foust, *Intel*; B. Carlton, *Intel*

14:30

RTu3A-4: Fully Integrated Ultra-Wideband Differential Circulator Based on Sequentially Switched Delay Line in 28nm FDSOI CMOS

J. Hwang, *Yonsei Univ.*; B.-W. Min, *Yonsei Univ.*

14:50

RTu3A-5: A C-Band Commutated-LC-Negative-R Delay Circuit with Harmonic Power Recycling Achieving 1.5ns Delay, 1.4GHz BW, and 6dB IL

S. Ming, *Univ. of Illinois at Urbana-Champaign*; R. Islam, *Univ. of Illinois at Urbana-Champaign*; J. Zhou, *Univ. of Illinois at Urbana-Champaign*

15:10

1D-1F

RTu3B: mm-Wave/THz Devices and BIST/Calibration, and Circuits for Emerging Applications

Chair: Mona Hella, *Rensselaer Polytechnic Institute, USA*

Co-Chair: Fabio Sebastiano, *Technische Universiteit Delft, The Netherlands*

RTu3B-1: LNFET Device with 325/475GHz fT/fMAX and 0.47dB NFMIN at 20GHz for SATCOM Applications in 45nm PDSOI CMOS

S.V. Khokale, *GLOBALFOUNDRIES*; T. Ethirajan, *GLOBALFOUNDRIES*; H.K. Kakara, *GLOBALFOUNDRIES*; B. Humphrey, *GLOBALFOUNDRIES*; K. Shanbhag, *GLOBALFOUNDRIES*; V. Vanukuru, *GLOBALFOUNDRIES*; V. Jain, *GLOBALFOUNDRIES*; S. Jain, *GLOBALFOUNDRIES*

RTu3B-2: E-Band CMOS Built-In Self-Test Circuit Capable of Testing Active Antenna Impedance and Complex Channel Response

S.-U. Choi, *POSTECH*; K. Kim, *POSTECH*; K. Lee, *POSTECH*; S. Lee, *POSTECH*; H.-J. Song, *POSTECH*

RTu3B-3: Millimeter-Wave VNA Calibration Using a CMOS Transmission Line with Distributed Switches

J.-C. Chien, *National Taiwan Univ.*

RTu3B-4: Multi-Tone Frequency Generator for Gate-Based Readout of Spin Qubits

M. Ouvrier-Buffet, *CEA-LETI*; A. Siligaris, *CEA-LETI*; J.L. Gonzalez-Jimenez, *CEA-LETI*

RTu3B-5: A Dual-Antenna, 263GHz Energy Harvester in CMOS for Ultra-Miniaturized Platforms with 13.6% RF-to-DC Conversion Efficiency at -8dBm Input Power

M.I.W. Khan, *MIT*; E. Lee, *MIT*; N.M. Monroe, *MIT*; A.P. Chandrakasan, *MIT*; R. Han, *MIT*

The NIST Atomic Clock—Learn How it Works While Building Your Own NIST Time Receiver

IMS Show Floor, System Demo Zone (Booth 11100)

09:30 – 17:00

Tuesday, 21 June 2022

Come build a NIST atomic clock receiver at IMS. This interactive experience will teach you how the NIST atomic clock works and how its radio synchronization transmits the time around the US. You will then have the opportunity to build your own NIST radio receiver from scratch! The radio will be built at several stations, each of which teach you the operation of a portion of the radio and allow you to assemble that portion at the station. After you complete all the stations, your board will be fully assembled and you can test it out. No better place to get a clean signal than 31 miles from the source of the signal!

David S. Ricketts received the PhD in Electrical Engineering from Harvard University. He is currently a Full Professor of Electrical and Computer Engineering at North Carolina State University. His scientific research focuses on emerging microwave and analog circuits and systems from 1 Mhz to 300 GHz. His work has appeared in Nature and in numerous IEEE conferences and journals. He is the author of the two books on jitter in high-speed electronics and electrical solitons. He is the recipient of the NSF CAREER Award, the DARPA Young Faculty Award and the George Tallman Ladd research award and is a Harvard Innovation Fellow. In addition as a teacher he is the recipient of the 2009 Wimmer Faculty Teaching Fellow at Carnegie Mellon University, 2013 Harvard University Bok Center Teaching Award and the 2021 William F. Lane Outstanding Teaching award at NCSU. Since 2015, Prof. Ricketts has taught experiential hand-on workshops on building a QAM Radio and a FMCW RADAR across the globe at all of the major microwave conferences.

HAM Radio Hidden Transmitter Hunt and Social

Centennial Ballroom G-H, Hyatt Regency

19:00 – 21:00

Tuesday, 21 June 2022

The Ham Radio Social at IMS2022 will include a Hidden Transmitter Hunt, organized and run by a female team of students/young professionals. We will start with a short presentation and demonstration of the equipment, divide up into small teams and attempt to locate two different types of hidden RF sources. All radio amateurs and other interested IMS participants are cordially invited to attend the event.

MICROAPPS

09:30 – 17:00 | Tuesday, 21 June 2022 | IMS Show Floor: Booth 9110

SESSION CODE	TIME	TITLE	SPEAKER/S, AFFILIATION
TUMA1	09:30 – 9:45	10 GHz Dielectric-Resonator-Based Surface Scanners for the Imaging of Microwave, 5G, and Energy Materials	Marzena Olszewska-Placha, Malgorzata Celuch, Janusz Rudnicki, *QWED Sp. z o.o.*
TUMA2	09:45 – 10:00	Designing Waveguide Microwave Filters Using Automatic 3D Modelling and AI Optimization	Diamond Liu, *SynMatrix Technologies*
TUMA3	10:00 – 10:15	Dielectric Constant Measurement Up to 330 GHz, Super Repeatable with Simple Operation	Yoshiyuki Yanagimoto, *EM Labs Inc.*
TUMA4	10:15 – 10:30	Embedding of Active ICs into Thin Film Circuits — Enabling High Density Hybrid Integration	Michele Stampanoni, *Cicor Group*
TUMA5	10:30 – 10:45	Frequency Equalization Through Rapid and Customizable Design Approach	Mo Hasanovic, *Smiths Interconnect Inc.*
TUMA6	10:45 – 11:00	From Design to Real RF Device — Connecting EDA Simulation and Hardware Test	Markus Loerner, *Rohde & Schwarz GmbH & Co KG*
TUMA7	11:00 – 11:15	Investigate RF Power Amplifier Linearization Benefits in EDA— Including a Comparison to Hardware Test	Markus Loerner, *Rohde & Schwarz GmbH & Co KG*
TUMA8	11:15 – 11:30	Is It Difficult to Synchronize Fractional PLLs? Not Anymore!	Unal Kudret, *Analog Devices, Inc.*
TUMA9	11:30 – 11:45	Reducing Complexity in Calibration with a Measuring Receiver with Integrated Phase Noise Tester	Wolfgang Wendler, *Rohde & Schwarz GmbH & Co KG*
TUMA10	11:45 – 12:00	The Effect of Semiconductor Laser Thermal Transfer in Relation to AuSn Preform Thickness	Jenny Gallery, *Indium Corporation*
TUMA11	12:00 – 12:15	The Industry's First, Low Loss, 3D Printable Photopolymer RF Material	John Coonrod, *Rogers Corporation*
TUMA12	12:15 – 12:30	Virtuoso PDK Support in Microwave Office for Silicon MMIC Design and Heterogenous Technology Integration	David Vye, Gus Dallman, *Cadence*
TUMA13	12:30 – 12:45	A Guide to Full Autonomous Operation Using MLTRL Calibration On and Off the Wafer	Gavin Fisher, *FormFactor*
TUMA14	12:45 – 13:00	Accelerated Periodic Structure Simulation Utilizing Reusable Sub-Structures	Ralf Ihmels, *Mician GmbH*
TUMA15	13:00 – 13:15	Addressing Performance and Reliability Concerns with Thermal Analysis for RF Power Applications	David Vye, *Cadence*
TUMA16	13:15 – 13:30	Addressing Thermal Challenges in High Speed and High-Power Microwave Devices	Dustin Kendig, *Microsanj*
TUMA17	13:30 – 13:45	An Overview of Copper Foil, How It's Made, Roughness Effects and RF–HSD Influences	John Coonrod, *Rogers Corporation*
TUMA18	13:45 – 14:00	Best Practices for Mitigating the Shortcomings of Common Chip Scale Packaging Processes	Craig Blanchette, *BAE Systems*; Darby Davis, *Gel-Pak*
TUMA19	14:00-14:15	D-Band FMCW Radar for VNA-like S-Parameter Measurements	Timo Jaeschke, Simon Kueppers, Jan Barowski, *2pi-Labs GmbH;* Lukas Piotrowsky, *Ruhr Univ. Bochum*
TUMA20	14:15-14:30	IEEE Low-Earth-Orbit (LEO) Satellites; Systems	Jan Budroweit, *German Aerospace Center;* Markus Gardill, *Brandenburg Univ. of Technology;* Witold Kinsner, *Univ. of Manitoba;* Mahjeda Ali, *IEEE*
TUMA21	14:30 – 14:45	Challenges of Automatic Fixture Removal (AFR) in Cryogenic Environments	David Daughton, Scott Yano, *Lake Shore Cryotronics*; Andy Owen, *Keysight Technologies*
TUMA22	14:45 – 15:00	Chambers and Positioners for 5G Emissions Testing	Jari Vikstedt, *ETS-Lindgren*
TUMA23	15:00 – 15:15	De-embedding Test Fixtures for High Data-Rate VNA Signal Integrity Measurements	Rich Pieciak, *Rohde & Schwarz GmbH & Co KG*
TUMA24	15:15 – 15:30	De-embedding Test Fixtures for RF & Microwave Components	Rich Pieciak, *Rohde & Schwarz GmbH & Co KG*
TUMA25	15:30 – 15:45	How to Get Consistent Millimeter-Wave Performance Using Grounded Coplanar Waveguide	John Coonrod, *Rogers Corporation*
TUMA26	15:45 – 16:00	Impedance Matched Interconnects with Aerosol Jet for Millimeter-Wave RF Devices	Don Novotny, *Optomec*
TUMA27	16:00 – 16:15	Improving Lossy Media Reflection Measurements with a Portable Network Analyzer	Subbaiah Pemmaiah, *Copper Mountain Technologies*
TUMA28	16:15 – 16:30	Materials Characterization and Assessment for 5G-mmWave Applications	Malgorzata Celuch, *QWED*; Say Phommakesone, *Keysight Technologies*
TUMA29	16:30 – 16:45	Minimize the Impact that Test Fixturing Has on Your Test Results	Lawrence Wilson, *Rohde & Schwarz GmbH & Co KG*
TUMA30	16:45 – 17:00	New Power Measurement Techniques for Today's Demanding RF World	Lawrence Wilson, *Rohde & Schwarz GmbH & Co KG*

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IMS STUDENT PAPER COMPETITION

THIS YEAR'S IMS STUDENT PAPER COMPETITION FINALISTS:

A Wideband Two-Way Digital Doherty Transmitter in 40nm CMOS | Th03C_2
Student Finalist: Mohammadreza Beikmirza, *Delft Univ. of Technology*
Advisor: Morteza S. Alavi, *Delft Univ. of Technology*

Miniaturized 28 Ghz Packaged Bandpass Filter with High Selectivity and Wide Stopband Using Multi-Layer Pcb Technology | We02A_6
Student Finalist: Yunbo Rao, *Univ. of Electronic Science and Technology of China*
Advisor: Xun Luo, *Univ. of Electronic Science and Technology of China*

Design and Implementation of a 3.9-to-5.3 GHz 65 nm Cryo-CMOS LNA with an Average Noise Temperature of 10.2 K | We04D_2
Student Finalist: Sayan Das, *Univ. of Massachusetts, Amherst*
Advisor: Joseph Bardin, *Univ. of Massachusetts Amherst*

33 GHz Overmoded Bulk Acoustic Resonator | Th02B_1
Student Finalist: Zachary Schaffer, *Carnegie Mellon Univ.*
Advisor: Gianluca Piazza, *Carnegie Mellon Univ.*

Deep Learning Enabled Inverse Design of 30-94 GHz Psat, 3dB SiGe PA Supporting Concurrent Multi-band Operation at Multi-Gbps | We02C_1
Student Finalist: Zheng Liu, *Princeton Univ.*
Advisor: Kaushik Sengupta, *Princeton Univ.*

Josephson Junctions Based Low Temperature Superconducting Phase Shifter for X- and K-Band using MIT-LL SFQ5ee Process | Tu02E_1
Student Finalist: Navjot Khaira, *Univ. of Waterloo*
Advisor: Raafat R. Mansour, *Univ. of Waterloo*

Load-Modulation-Based IMD3 Cancellation for Millimeter-Wave Class-B CMOS Power Amplifiers Achieving EVM<1.2% | We02E_1
Student Finalist: Masoud Pashaeifar, *Delft Univ. of Technology*
Advisor: Morteza S. Alavi, *Delft Univ. of Technology*

Fused-Silica Stitch-Chips with Compressible Microinterconnects for Embedded RF/mm-Wave Chiplets | We03B_3
Student Finalist: Ting Zheng, *Georgia Institute of Technology*
Advisor: Muhannad S. Bakir, *Georgia Institute of Technology*

860 μW Terahertz Power Generation from Graded Composition InGaAs Photoconductive Nanoantennas | Th01C_2
Student Finalist: Ping-Keng Lu, *Univ. of California, Los Angeles*
Advisor: Mona Jarrahi, *Univ. of California, Los Angeles*

A 190-to-220GHz 4-bit Passive Attenuator with 1.4dB Insertion Loss and Sub-0.34dB RMS Amplitude Error using Magnetically Switchable Coupled-Lines in 0.13-μm CMOS Technology | We04G_4
Student Finalist: Nengxu Zhu, *Tianjin Univ.*
Advisor: Fanyi Meng, *Tianjin Univ.*

INTERACTIVE FORUM SESSION & QUANTUM DAY RECEPTION

15:10 – 17:00 | Tuesday, 21 June 2022 | Room: 2A–3B

Chairs: Justus Brevik, Robert Horansky, Akim Babenko, *NIST*

TUIF1-1: Plenary Poster: Control and Readout of a Superconducting Qubit Using a Photonic Link

Florent Lecocq, *National Institute of Standards and Technology*; Frank Quinlan, *National Institute of Standards and Technology*; Jason Horng, *National Institute of Standards and Technology*; Katarina Cicak, *National Institute of Standards and Technology*; Jose Aumentado, *National Institute of Standards and Technology*; Scott Diddams, *National Institute of Standards and Technology*; John Teufel, *National Institute of Standards and Technology*

TUIF1-2: VHF-UHF EMI Source Tracking Experiments

R. Campbell, *Portland State Univ.*; N. Fellows, *Portland State Univ.*; K. Dickens, *Portland State Univ.*; A. Rugani, *Portland State Univ.*

TUIF1-3: Quantum Method for Scaling the Finite Element Based Quantum Solutions of Electromagnetic Problems

L. Zhang, *Univ. of Toronto*; Q.-J. Zhang, *Carleton Univ.*

TUIF1-5: Low-Loss On-Chip Passive Circuits Using C4 Layer for RF, mmWave and Sub-THz Applications

Q. Yu, *Intel*; G.-S. Kim, *Intel*; J. Garrett, *Intel*; D. Thomson, *Intel*; G.C. Dogiamis, *Intel*; N. Monroe, *MIT*; R. Han, *MIT*; Y. Ma, *Intel*; J. Waldemer, *Intel*; Y.S. Nam, *Intel*; G. Beltran, *Intel*; V.B. Neeli, *Intel*; S. Ravikumar, *Intel*; S. Rami, *Intel*; C. Pelto, *Intel*; E. Karl, *Intel*

TUIF1-6: Compact W-Band Silicon-Micromachined Filters with Increased Fabrication Robustness

O. Glubokov, *KTH*; M. Mehrabi Gohari, *KTH*; J. Campion, *KTH*; J. Oberhammer, *KTH*

TUIF1-7: On the Drain-to-Source Capacitance of Microwave FETs in Triode Region

J.L. Gomes, *Universidade de Aveiro*; L.C. Nunes, *Universidade de Aveiro*; J.C. Pedro, *Universidade de Aveiro*

TUIF1-8: An Injection-Lockable InP-DHBT Source Operating at 421GHz with -2.4dBm Output Power and 1.7% DC-to-RF Efficiency

A. Possberg, *Universität Duisburg-Essen*; F. Vogelsang, *Ruhr-Universität Bochum*; N. Pohl, *Ruhr-Universität Bochum*; M. Hossain, *FBH*; H. Yacoub, *FBH*; T.K. Johansen, *Technical Univ. of Denmark*; W. Heinrich, *FBH*; N. Weimann, *Universität Duisburg-Essen*

TUIF1-9: GaN Characterization Method Towards Linearizability Prediction

A. Issaoun, *Ampleon*

TUIF1-10: Miniaturized Dual-Band TM-Mode Dielectric Filter and Its Reconfiguration Capabilities

A. Widaa, *CAU*; M. Höft, *CAU*

TUIF1-11: Low-Directivity High-Gain Rectenna Array for Improving Power-Harvesting Efficiency on 5.8GHz Batteryless Transponder

M. Passafiume, *Università di Firenze*; M. Righini, *Università di Firenze*; G. Collodi, *Università di Firenze*; A. Cidronali, *Università di Firenze*

TUIF1-12: Study on Power Conversion Efficiency of Rectenna Array with Deformed Flat-Top Beam for Microwave Power Transmission

N. Takabayashi, *Kyoto Univ.*; N. Shinohara, *Kyoto Univ.*; T. Mitani, *Kyoto Univ.*

	401-402	403-404	501-502	503-504
	Tu4A: Integrated Filters in the GHz and Sub-THz Range **Chair:** Julien Lintignat, *XLIM (UMR 7252)* **Co-Chair:** Hjalti H. Sigmarsson, *Univ. of Oklahoma*	**Tu4B: Components for Advanced Systems and Applications** **Chair:** Kenneth Mays, *Boeing* **Co-Chair:** Damla Dimlioglu, *Cornell Univ.*	**Tu4C: Low-Frequency Wireless Power Transfer and Harvesting Systems** **Chair:** Dieff Vital, *Univ. of Illinois at Chicago* **Co-Chair:** Nuno Borges de Carvalho, *Universidade de Aveiro*	**Tu4D: Advanced High-Speed Mixed-Signal Circuits For Optical and mm-Wave Systems** **Chair:** Srinivasan Gopal, *Broadcom Corporation* **Co-Chair:** Hermann Boss, *Rohde & Schwarz*
15:40 15:50	**Tu4A-1: A 31-Tap Reconfigurable Analog FIR Filter Using Heterogeneously Integrated Polystrata Delay-Lines** E. Wagner, *Northrop Grumman*; T. LaRocca, *Northrop Grumman*; M. Verderber, *Nuvotronics*; C. Rezende, *Nuvotronics*; P. May, *Nuvotronics*	**Tu4B-1: A DC to 110GHz Plasma Switch** A. Fisher, *Purdue Univ.*; T.R. Jones, *Univ. of Alberta*; D. Peroulis, *Purdue Univ.*	**Tu4C-1: Experimental Demonstration of Nonlinear Metasurfaces for High-Performance Low-Cost Near-Field Base Station** J.V. de Almeida, *Polytechnique Montréal*; X. Gu, *Polytechnique Montréal*; M.M. Mosso, *PUC-Rio*; C.A.F. Sartori, *Universidade de São Paulo*; K. Wu, *Polytechnique Montréal*	**Tu4D-1: 160-GSa/s-and-Beyond 108-GHz-Bandwidth Over-2-Vppd Output-Swing 0.5-µm InP DHBT 2:1 AMUX-Driver for Next Generation Optical Communications** Romain Hersent, *III-V Lab*; Agnieszka Konczykowska, *III-V Lab*; Filipe Jorge, *III-V Lab*; Fabrice Blache, *III-V Lab*; Virginie Nodjiadjim, *III-V Lab*; Muriel Riet, *III-V Lab*; Colin Mismer, *III-V Lab*; Jérémie Renaudier, *Nokia Bell Labs*
16:00 16:10	**Tu4A-2: An Inductor-Less All-Passive Higher-Order N-Path Filter Based on Rotary Clocking in N-Path Filters** M. Khorshidian, *Columbia Univ.*; S.L.N. Garimella, *Columbia Univ.*; A. Nagulu, *Columbia Univ.*; H. Krishnaswamy, *Columbia Univ.*	**Tu4B-2: A Four-Port Circulating Duplexer for Simultaneous Transmit Receive Wireless Operation** D. Regev, *Toga Networks*; N. Ginzburg, *Technion*; E. Zolkov, *Technion*; E. Loebl, *Technion*; I. Melamed, *Technion*; S. Shilo, *Toga Networks*; D. Ezri, *Toga Networks*; E. Cohen, *Technion*	**Tu4C-2: Capacitive Coupler for Wireless Power Transfer to Intravascular Implant Devices** Masaya Tamura, *Toyohashi Univ. of Technology*; Takamasa Segawa, *Toyohashi Univ. of Technology*; Marimo Matsumoto, *Toyohashi Univ. of Technology*	**Tu4D-2: An Energy-Efficient, 60Gbps Variable Transimpedance Optical Receiver in a 90nm SiGe HBT Technology** L.A. Valenzuela, G. Movaghar, J. Dalton, N. Hosseinzadeh, H. Andrade, A. Maharry, C.L. Schow, J.F. Buckwalter, *Univ. of California, Santa Barbara*
16:20 16:30	**Tu4A-3: A Miniaturized Differential CMOS BPF with High Selectivity and Improved In-Band Flatness Based on Transformer-Type Resonators** K. Li, *UESTC*; B. Liu, *UESTC*; P.-L. Chi, *National Chiao Tung Univ.*; Y. Wang, *UESTC*; T. Yang, *UESTC*	**Tu4B-3: E-Band Power Forward and Divider Switch for On-Chip Reconfigurable and Scalable Arrays** K.-J. Choi, *Yonsei Univ.*; B.-W. Min, *Yonsei Univ.*	**Tu4C-3: Power Supply to Multiple Sensors and Leakage Field Analysis Using Cavity Resonance-Enabled Wireless Power Transfer** S. Akai, *Toyohashi Univ. of Technology*; H. Saeki, *Murata Manufacturing*; M. Tamura, *Toyohashi Univ. of Technology*	**Tu4D-3: An Area Efficient Low-Power mmWave PRBS Generator in FDSOI** F. Probst, *FAU Erlangen-Nürnberg*; A. Engelmann, *FAU Erlangen-Nürnberg*; M. Dietz, *FAU Erlangen-Nürnberg*; V. Issakov, *Technische Univ. Braunschweig*; R. Weigel, *FAU Erlangen-Nürnberg*
16:40 16:50	**Tu4A-4: Dual-Band Patch Filter 180/270GHz on BiCMOS 55nm** M. Wehbi, *TIMA (UMR 5159)*; M. Margalef-Rovira, *IEMN (UMR 8520)*; C. Durand, *STMicroelectronics*; S. Lepilliet, *IEMN (UMR 8520)*; A.L.C. Serrano, *Universidade de São Paulo*; P. Ferrari, *TIMA (UMR 5159)*	**Tu4B-4: Passive Disposable Microwave Sensor for Online Microplastic Contamination Monitoring** M. Shafiei, *Univ. of Waterloo*; Z. Abbasi, *Univ. of Calgary*; C.L. Ren, *Univ. of Waterloo*	**Tu4C-4: Low Magnetic Loss Metamaterial Based Miniaturized WPT System for Biomedical Implants** S. Alshhawy, *Kyushu Univ.*; A. Barakat, *Kyushu Univ.*; R.K. Pokharel, *Kyushu Univ.*; K. Yoshitomi, *Kyushu Univ.*	
17:00				

4D-4F

Tu4E: Next-Generation mm-Wave GaN Technologies and MMICs for 5G/6G and DoD Applications

Chair: Jeong-sun Moon, *HRL Laboratories*

Co-Chair: David Brown, *BAE Systems*

15:40

Tu4E-1: Emerging Millimeter-Wave Device Technology — Next Generation GaN and Beyond

T.E. Kazior, *DARPA*; G.M. Jones, *Advanced Research Consultants*; T.-H. Chang, *HetInTec*

16:00

Tu4E-2: Improved N-Polar GaN mm-Wave Linearity, Efficiency, and Noise

M. Guidry, P. Shrestha, W. Liu, B. Romanczyk, N. Hatui, C. Wurm, R.R. Karnaty, H. Li, E. Ahmadi, S. Keller, J.F. Buckwalter, *Univ. of California, Santa Barbara*

16:20

Tu4E-3: ScAlN-GaN Transistor Technology for Millimeter-Wave Ultra-High Power and Efficient MMICs

E.M. Chumbes, *Raytheon*; J. Logan, *Raytheon*; B. Schultz, *Raytheon*; M. DeJarld, *Raytheon*; M. Tahhan, *Raytheon*; N. Kolias, *Raytheon*; M. Hardy, *U.S. Naval Research Laboratory*; M. Ancona, *U.S. Naval Research Laboratory*; D. Meyer, *U.S. Naval Research Laboratory*

16:40

Tu4E-4: Multi-Channel Schottky-Gate BRIDGE HEMT Technology for Millimeter-Wave Power Amplifier Applications

K. Shinohara, C. King, D. Regan, E. Regan, A. Carter, A. Arias, J. Bergman, M. Urteaga, B. Brar, *Teledyne Scientific & Imaging*; Y. Cao, *Qorvo*; A. Xie, *Qorvo*; E. Beam, *Qorvo*; C. Lee, *Qorvo*

17:00

Tu4E-5: Highly-Linear and Efficient mm-Wave GaN HEMTs and MMICs

J.-S. Moon, *HRL Laboratories*; B. Grabar, *HRL Laboratories*; J. Wong, *HRL Laboratories*; J. Tai, *HRL Laboratories*; E. Arkun, *HRL Laboratories*; D.V. Morales, *HRL Laboratories*; C. Dao, *HRL Laboratories*; S. Bharadwaj, *HRL Laboratories*; D. Fanning, *HRL Laboratories*; N. Venkatesan, *Univ. of Notre Dame*; P. Fay, *Univ. of Notre Dame*

1A-1C

RTu4A: Emerging Wireless Communications

Chair: David D. Wentzloff, *Univ. of Michigan, USA*

Co-Chair: Arun Paidimarri, *IBM T.J. Watson Research Center, USA*

15:40

RTu4A-1: 802.11ah Transmitter with -55dBr at ±3MHz and -58dBr at ±20MHz ACLR and 60dB 2nd-Order Harmonic Rejection for 470MHz - 790MHz TV White Space Band Devices

S.-S. Myoung, *Newracom*; J. Park, *Newracom*; C.H. Song, *Newracom*; R.W. Kim, *Newracom*; J. Ryu, *Newracom*; J. Choi, *Newracom*; H.-N. Nguyen, *Newracom*; S. Lee, *Newracom*; I. Jung, *Newracom*; J.-H. Lim, *Newracom*; S.K. Lee, *Newracom*

16:00

RTu4A-2: A 915MHz 19μW Blocker-Enhanced Wake-Up Receiver with Frequency-Hopping Two-Tone Modulation Achieving 53dB Tolerance to In-Band Interference

H. Ren, *Fudan Univ.*; D. Ye, *Fudan Univ.*; B. Chen, *Fudan Univ.*; X. Jin, *Fudan Univ.*; W. Gong, *Fudan Univ.*; R. Xu, *Fudan Univ.*; C.-J.R. Shi, *Univ. of Washington*

16:20

RTu4A-3: A 320μW Receiver with -58dB SIR Leveraging a Time-Varying N-Path Filter

M. Moosavifar, *Univ. of Michigan*; Y.K. Cherivirala, *Univ. of Michigan*; D.D. Wentzloff, *Univ. of Michigan*

16:40

RTu4A-4: A 26-to-33GHz Time-Modulated Spectral-Spatial Mapping MIMO Receiver Array with Concurrent Steerable Multi-Beams Using Only One Beamformer and One Single-Wire Interface

T.-Y. Huang, *Georgia Tech*; B. Lin, *Georgia Tech*; N.S. Mannem, *Georgia Tech*; H. Wang, *Georgia Tech*

1D-1F

RTu4B: Building Blocks for Next Generation Frequency Synthesis

Chair: Joseph D. Cali, *Raytheon, USA*

Co-Chair: Ehsan Afshari, *University of Michigan, USA*

15:40

RTu4B-1: Class-C BAW Oscillator Achieving a Close-In FOM of 206.5dB at 1kHz with Optimal Tuning for Narrowband Wireless Systems

B. Bahr, *Texas Instruments*; D. Griffith, *Texas Instruments*; A. Kiaei, *Texas Instruments*; T. Tsai, *Texas Instruments*; R. Smith, *Texas Instruments*; B. Haroun, *Texas Instruments*

16:00

RTu4B-2: A 5.1dBm 127–162GHz Frequency Sextupler with Broadband Compensated Transformer-Based Baluns in 22nm FD-SOI CMOS

S. Li, *Tsinghua Univ.*; W. Chen, *Tsinghua Univ.*; X. Li, *Tsinghua Univ.*; Y. Wang, *Univ. of Michigan*

16:20

RTu4B-3: A Digital-to-Time Converter Based on Crystal Oscillator Waveform Achieving 86fs Jitter in 22nm FD-SOI CMOS

X. Chen, *Univ. College Dublin*; T. Siriburanon, *Univ. College Dublin*; Z. Wang, *MCCI*; J. Du, *Univ. College Dublin*; Y. Hu, *Univ. College Dublin*; A. Zhu, *Univ. College Dublin*; R.B. Staszewski, *Univ. College Dublin*

16:40

RTu4B-4: Highly Accurate Frequency Quadrupler Based LO Phase Shifter Achieving 0.29° RMS Phase Error for Wideband E-Band Beamforming Receiver

K. Lee, *POSTECH*; C.-G. Choi, *POSTECH*; K. Kim, *POSTECH*; S. Lee, *POSTECH*; S.-U. Choi, *POSTECH*; J. Lee, *ETRI*; B. Koo, *ETRI*; H.-J. Song, *POSTECH*

17:00

IMS TECHNICAL SESSIONS | 08:00 – 09:40 | Wednesday, 22 June 2022 | Colorado Convention Center

Microwave Field, Device & Circuit Techniques | Passive Components | Active Components | Systems & Applications | Emerging Technologies & Applications | Focus & Special Sessions

	401-402	403-404	501-502	503-504
	We1A: High-Density Integration of Transmission Line Structures **Chair:** Jay McDaniel, *Univ. of Oklahoma* **Co-Chair:** Jason Soric, *Raytheon*	**We1B: Advances in High Frequency Device Modeling** **Chair:** Shahed Reza, *Sandia National Laboratories* **Co-Chair:** Rob Jones, *BAE Systems*	**We1C: Advanced 5G Wireless System Architectures and Underlying Over-the-Air Characterization Techniques** **Chair:** Kenneth E. Kolodziej, *MIT Lincoln Laboratory* **Co-Chair:** Arnaldo S.R. Oliveira, *Universidade de Aveiro*	**We1D: Nonlinear Analysis and Design of Microwave Signal Generation and Processing Circuits** **Chair:** Fabrizio Bonani, *Politecnico di Torino* **Co-Chair:** Almudena Suárez, *Universidad de Cantabria*
08:00 08:10	**We1A-1: Multilayer Composite Right/Left-Hand Transmission Line with Ultra-Wideband and Miniaturized Characteristics** M. Jia, *UESTC*; Y. Dong, *UESTC*; J. Zhang, *UESTC*; X. Luo, UESTC	**We1B-1: Back-Gate Lumped Resistance Effect on AC Characteristics of FD-SOI MOSFET** Martin Vanbrabant, *Univ. Catholiqué de Louvain*; Lucas Nyssens, *UCLouvain*; Valeriya Kilchytska, *Université catholique de Louvain*; Jean-Pierre Raskin, *Université Catholique de Louvain*	**We1C-1: Air-Induced PIM Cancellation in FDD MIMO Transceivers** Vesa Lampu, *Tampere Univ.*; Lauri Anttila, *Tampere Univ.*; Matias Turunen, *Tampere Univ.*; Marko Fleischer, *Nokia*; Jan Hellmann, *Nokia*; Mikko Valkama, *Tampere Univ.*	**We1D-1: Nonlinear Analysis of Oscillators Based on a Slow-Wave Structure for Phase-Noise Reduction** M. Pontón, *Universidad de Cantabria*; S. Sancho, *Universidad de Cantabria*; A. Herrera, *Universidad de Cantabria*; A. Suárez, *Universidad de Cantabria*
08:20 03:30	**We1A-2: Multilayer GCPW-to-AFSIW Transition for High-Performance Systems on Substrate** Jean-Charles Henrion, *Univ. of Bordeaux*; Anthony Ghiotto, *Univ. of Bordeaux*; Tifenn Martin, *Univ. of Bordeaux*; Jean-Marie Pham, *Univ. of Bordeaux*; Petronilo Martin-Iglesias, *Keplerlaan 1, 2201 AZ Noordwijk, Pays-Bas*; Christophe Goujon, *Direction générale de l'armement*; Laurent Carré, *ACTIA Telecom*	**We1B-2: Statistical Modeling of Manufacturing Variability in GaN HEMT I-V Characteristics with ASM-HEMT** F. Chavez, *Macquarie Univ.*; N.C. Miller, *AFRL*; D.T. Davis, *AFRL*; S. Khandelwal, *Macquarie Univ.*	**We1C-2: Virtual Receiver Matrix for Future Multifunction Wireless Systems** S.A. Keivaan, *Polytechnique Montréal*; P. Burasa, *Polytechnique Montréal*; K. Wu, *Polytechnique Montréal*	**We1D-2: Quadrature Harmonic Self-Oscillating Mixer for Multifunction Wireless Communication and Sensing Systems** Y. Bigdeli, *Polytechnique Montréal*; P. Burasa, *Polytechnique Montréal*; K. Wu, *Polytechnique Montréal*
08:40 08:50	**We1A-3: Substrate-Integrated Hybrid Metallo-Dielectric Waveguide for Millimeter-Wave and Terahertz Applications** C. Liu, *Polytechnique Montréal*; K. Wu, *Polytechnique Montréal*	**We1B-3: 200W GaN PA Design Based on Accurate Multicell Transistor Modeling** V. Vadalà, *Università di Milano-Bicocca*; A. Raffo, *Università di Ferrara*; G. Bosi, *Università di Ferrara*; A. Barsegyan, *Integra Technologies*; J. Custer, *Integra Technologies*; G. Formicone, *Integra Technologies*; J. Walker, *Integra Technologies*; G. Vannini, *Università di Ferrara*	**We1C-3: Over-The-Air Test Method for Evaluation of 5G Millimeter Wave Devices Under 3D Spatially Dynamic Environment from Single Feeder** D.R. Paredes, *Silicon Austria Labs*; M.A. Beach, *Univ. of Bristol*; M. Rumney, *Rumney Telecom*	**We1D-3: Nonlinear Analysis of an Injection-Locked Oscillator Coupled to an External Resonator** Victor Ardila, *Univ. of Cantabria*; Franco Ramirez, *Univ. of Cantabria*; Almudena Suarez, *Univ. of Cantabria*
09:00 09:10	**We1A-4: Compact Interference Based Microstrip Single-Pole Double-Throw Utilizing Liquid Crystal Phase Shifter** D. Wang, *Technische Univ. Darmstadt*; E. Polar, *Technische Univ. Darmstadt*; H. Tesmer, *Technische Univ. Darmstadt*; R. Jakoby, *Technische Univ. Darmstadt*	**We1B-4: Neural Network Based GaN HEMT Modelling for Millimeter Wave Power Amplifiers** K. Nishiguchi, *Sumitomo Electric Industries*; T. Kawasaki, *Sumitomo Electric Industries*; M. Tanomura, *Sumitomo Electric Industries*	**We1C-4: Proof-of-Concept of Millimeter-wave RF Beamforming Transmitter Architecture Employing Frequency-Multiplier-Based Up-converters** Ahmed Ben Ayed, *Univ. of Waterloo*; Ifrah Jaffri, *Univ. of Waterloo*; Patrick Mitran, *Univ. of Waterloo*; Slim Boumaiza, *Univ. of Waterloo*; Ali Darwish, *United States Army Research Laboratory*	**We1D-4: Noise Analysis for Six-Port Radars with Schottky Diode Detectors** F. Michler, *FAU Erlangen-Nürnberg*; B. Scheiner, *FAU Erlangen-Nürnberg*; R. Weigel, *FAU Erlangen-Nürnberg*; F. Lurz, *Technische Universität Hamburg*
09:20 09:30	**We1A-5: Integrated Low-Loss Planar Goubau Lines on Glass Interposer for 6G Wireless Applications** X. Jia, *Georgia Tech*; M. Swaminathan, *Georgia Tech*		**We1C-5: Over-the-Air Digital Predistortion of 5G FR2 Beamformer Array by Exploiting Linear Response Compensation** M. Mengozzi, *Univ. of Bologna*; G.P. Gibiino, *Univ. of Bologna*; A.M. Angelotti, *Univ. of Bologna*; C. Florian, *Univ. of Bologna*; A. Santarelli, *Univ. of Bologna*	
09:40	**We1A-6: Analysis of Electro-Thermal Characterization of Substrate Integrated Suspended Line** S. Meng, *Tianjin Univ.*; K. Ma, *Tianjin Univ.*; Y. Wang, *Tianjin Univ.*			

1A - 1C	1D-1F	4D-4F	
We1E: High Power GaN RF and Microwave Power Amplifiers **Chair:** Nestor Lopez, *MIT Lincoln Laboratory* **Co-Chair:** Michael Roberg, *Qorvo*	**We1F: Radar from Space to Ground (and Below) — The Synergy Between Commercial, Government, and Metrology Applications** **Chair:** Nils Pohl, *Ruhr Univ. Bochum*	**We1G: mm-Wave and Terahertz Power Amplifiers and Front-End Modules** **Chair:** Taiyun Chi, *Rice Univ.* **Co-Chair:** Joe Qiu, *U.S. Army Research Office*	
We1E-1: A 700–2800MHz Switchless Class-G Power Amplifier with Two-Quadrant Modulation for Back-Off Efficiency Improvement X. Chen, *Tsinghua Univ.*; M. Zhao, *Tsinghua Univ.*; W. Chen, *Tsinghua Univ.*; Z. Feng, *Tsinghua Univ.*	**We1F-1: Keynote: Recent Radar Advances and Their Impact** Joseph Guerci, *Information Systems Labs, Inc.*	**We1G-1: A Compact SiGe Stacked Common-Base Dual-band PA with 20/18.8dBm Psat at 36/64 GHz Supporting Concurrent Modulation** Zheng Liu, *Princeton Univ.*; Emir Ali Karahan, *Princeton Univ.*; Kaushik Sengupta, *Princeton Univ.*	08:00 08:10
We1E-2: Investigation of Input Nonlinearity in Sequential Load Modulated Balanced Amplifiers C. Chu, *Univ. College Dublin*; T. Sharma, *Renesas Electronics*; S.K. Dhar, *Renesas Electronics*; R. Darraji, *Ericsson*; A. Zhu, *Univ. College Dublin*	**We1F-2: Upgrading the HUSIR Radar for Deep-Space Satellite Imaging** M.D. Abouzahra, *MIT Lincoln Laboratory*; M.E. MacDonald, *MIT Lincoln Laboratory*; R.K. Lee, *MIT Lincoln Laboratory*; D.L. Grimes, *MIT Lincoln Laboratory*; B.H. Simakauskas, *MIT Lincoln Laboratory*; N. Lopez, *MIT Lincoln Laboratory*; C. Eckert, *MIT*; J.M. Usoff, *MIT Lincoln Laboratory*	**We1G-2: A 150–175GHz 30dB S21 G-Band Power Amplifier with 0.25W Pout and 15.7% PAE in a 250nm InP HBT Technology** Z. Griffith, *Teledyne Scientific & Imaging*; M. Urteaga, *Teledyne Scientific & Imaging*; P. Rowell, *Teledyne Scientific & Imaging*; L. Tran, *Teledyne Scientific & Imaging*	08:20 03:30
We1E-3: Intrinsically Mode-Reconfigurable Load-Modulation Power Amplifier Leveraging Transistor's Analog-Digital Duality N.B. Vangipurapu, *Univ. of Central Florida*; H. Lyu, *Univ. of Central Florida*; Y. Cao, *Univ. of Central Florida*; K. Chen, *Univ. of Central Florida*	**We1F-3: Influence of Soil Moisture on the Detection of Buried Objects Using an Airborne GPSAR** A. Grathwohl, *Universität Ulm*; B. Arendt, *Technische Hochschule Ulm*; T. Walter, *Technische Hochschule Ulm*; C. Waldschmidt, *Universität Ulm*	**We1G-3: A 2-Stage, 140GHz Class-B Power Amplifier Achieving 22.5% PAE at 17.3dBm in a 250nm InP HBT Technology** E. Lam, *Univ. of California, Santa Barbara*; K. Ning, *Univ. of California, Santa Barbara*; A. Ahmed, *Univ. of California, Santa Barbara*; M. Rodwell, *Univ. of California, Santa Barbara*; J.F. Buckwalter, *Univ. of California, Santa Barbara*	08:40 08:50
We1E-4: A 17.3–20.3GHz Doherty Power Amplifier with 14W Saturated Output Power and 28% PAE at 6dB OPBO in 150nm GaN Technology E. Richard, *UMS*; T. Huet, *UMS*; H. Moula Karimdjy, *UMS*; M. Camiade, *UMS*; C. Chang, *UMS*; V. Serru, *UMS*; F. Fernandez, *Thales*; J. Suedois, *Thales*; I. Davies, *ESA-ESTEC*; V. Valenta, *ESA-ESTEC*	**We1F-4: Frequency-Domain Characterization of Millimeter-Wave FMCW Signal Based on a Precisely Synchronized NVNA Measurement Setup** Y. Zhang, *NIM*; D. Wu, *CATARC*; H. Gao, *NIM*; Z. He, *NIM*; M. Nie, NIM	**We1G-4: A Compact, 114GHz, High-Efficiency Power Amplifier in a 250nm InP HBT Process** J.S.-C. Chien, *Univ. of California, Santa Barbara*; J.F. Buckwalter, *Univ. of California, Santa Barbara*	09:00 09:10
We1E-5: A 50W CW 1–6GHz GaN MMIC Power Amplifier Module with Greater Than 30% Power Added Efficiency M. Roberg, *Qorvo*; J. Zhang, *Qorvo*; R. Flynt, *Qorvo*; M. Irvine, *Qorvo*	**We1F-5: Sparse Processing for Driver Respiration Monitoring Using In-Vehicle mmWave Radar** Y. Rong, *Arizona State Univ.*; K.V. Mishra, *U.S. Army Research Laboratory*; D.W. Bliss, *Arizona State Univ.*	**We1G-5: GaN-on-Si Ka-Band Single-Chip Front-End MMIC for Earth Observation Payloads** P.E. Longhi, *Università di Roma "Tor Vergata"*; F. Costanzo, *Università di Roma "Tor Vergata"*; L. Pace, *Università di Roma "Tor Vergata"*; W. Ciccognani, *Università di Roma "Tor Vergata"*; S. Colangeli, *Università di Roma "Tor Vergata"*; R. Giofrè, *Università di Roma "Tor Vergata"*; R. Leblanc, *OMMIC*; F. Vitobello, *REA*; E. Limiti, *Università di Roma "Tor Vergata"*	09:20 09:30 09:40

Microwave Field, Device & Circuit Techniques | Passive Components | Active Components | Systems & Applications | Emerging Technologies & Applications | Focus & Special Sessions

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401-402

We2A: Advancements in Planar and Substrate Integrated Filters and Multiplexers

Chair: Christopher Galbraith, *MIT Lincoln Laboratory*

Co-Chair: Dimitra Psychogiou, *Univ. College Cork*

We2A-1: Design of In-Line Filter With Cross-Couplings Paths and Source Loaded Dangling Resonator Produced Transmission Zeros

Y. Wu, *Tianjin Univ.*; K. Ma, *Tianjin Univ.*; Y. Wang, *Tianjin Univ.*

We2A-2: Dual-Band SIW Filter with Widely Separated Passbands Based on TE101 and TE301 Modes

Y. Zhu, *UESTC*; Y. Dong, *UESTC*; X. Luo, *UESTC*; J. Bornemann, *Univ. of Victoria*

We2A-3: Miniaturized Tri-Band Bandpass Filter with Wide Stopband Using Stacked-Coupled SIDGS Resonators

Y. Zhou, *UESTC*; D. Tang, *UESTC*; Y. Rao, *UESTC*; Y. Dong, *UESTC*; X. Luo, *UESTC*

We2A-4: A Compact K-/Ka-Band Diplexer with Dual-Mode Folded SIW Cavities

N. Sielck, *Technische Universität Hamburg*; A. Sieganschin, *Technische Universität Hamburg*; K. Erkelenz, *Technische Universität Hamburg*; A.F. Jacob, *Technische Universität Hamburg*

We2A-5: Miniaturized Quarter-Mode SIW Filters Loaded by Dual-Mode Microstrip Resonator with High Selectivity and Flexible Response

Lin Gu, Yuandan Dong, Xun Luo, *Univ. of Electronic Science and Technology of China*

We2A-6: Miniaturized 28 GHz Packaged Bandpass Filter with High Selectivity and Wide Stopband Using Multi-Layer PCB Technology

Yunbo Rao, *Univ. of Electronic Science and Technology of China*; Huizhen Qian, *Univ. of Electronic Science and Technology of China*; Jie Zhou, *Univ. of Electronic Science and Technology of China*; Yuandan Dong, *Univ. of Electronic Science and Technology of China*; Xun Luo, *Univ. of Electronic Science and Technology of China*

403-404

We2B: Advances in the Characterization of Microwave and mm-Wave Materials and Components

Chair: David R. Jackson, *Univ. of Houston*

Co-Chair: Costas D. Sarris, *Univ. of Toronto*

We2B-1: Limitations and Importance of EM Models for On-Wafer High Frequency Performance Evaluation

N. Mahjabeen, *Univ. of Texas at Dallas*; Y. Zhang, *Univ. of Minnesota*; A. Dave, *Univ. of Minnesota*; J. Um, *Univ. of Minnesota*; A. Harpel, *Univ. of Minnesota*; B. Stadler, *Univ. of Minnesota*; R.R. Franklin, *Univ. of Minnesota*; R. Henderson, *Univ. of Texas at Dallas*

We2B-2: Generation of High-Order Modes in Sub-THz Dielectric Waveguides by Misalignment of the Transition Structure

S. Smirnov, *KTH*; N. Xenidis, *KTH*; J. Oberhammer, *KTH*; D.V. Lioubtchenko, *KTH*

We2B-3: A Mode-Matching-Based Technique for Electromagnetic Characterization of Anisotropic Materials in Cylindrical Waveguides

R.R. Rodrigues, *PUC-Rio*; V.B. Cosenza, *PUC-Rio*; G.S. Rosa, *PUC-Rio*; R.A. Penchel, *Universidade de São Paulo*

We2B-4: Modeling Thick Metal in Forward Volume Spin Wave Transducers

Max Robbins, *Univ. of Notre Dame*; David Connelly, *Univ. of Notre Dame*; Jonathan Chisum, *Univ. of Notre Dame*

501-502

We2C: AI/ML for RF and mm-Wave Applications

Chair: Rui Ma, *MERL*

Co-Chair: Abhijit Chatterjee, *Georgia Tech*

We2C-1: Deep Learning Enabled Inverse Design of 30-94 GHz Psat, 3dB SiGe PA Supporting Concurrent Multi-band Operation at Multi-Gbps

Zheng Liu, *Princeton Univ.*; Emir Ali Karahan, *Princeton Univ.*; Kaushik Sengupta, *Princeton Univ.*

We2C-2: An On-Chip Accelerator with Hybrid Machine Learning for Modulation Classification of Radio Frequency Signals

K. Jung, *Georgia Tech*; J. Woo, *Georgia Tech*; S. Mukhopadhyay, *Georgia Tech*

We2C-3: RF Fingerprinting of LoRa Transmitters Using Machine Learning with Self-Organizing Maps for Cyber Intrusion Detection

M. Nair, *Univ. of Bristol*; T. Cappello, *Univ. of Bristol*; S. Dang, *Univ. of Bristol*; V. Kalokidou, *Univ. of Bristol*; M.A. Beach, *Univ. of Bristol*

We2C-4: Design and Optimization of T-Coil-Enhanced ESD Circuit with Upsampling Convolutional Neural Network

Z. Li, *Univ. of Toronto*; A. Chan Carusone, *Univ. of Toronto*

We2C-5: A Novel Convolutional-Autoencoder Based Surrogate Model for Fast S-Parameter Calculation of Planar BPFs

R. Shibata, *Saitama Univ.*; M. Ohira, *Saitama Univ.*; Z. Ma, *Saitama Univ.*

We2C-6: Zeroth-Order Optimization for Varactor-Tuned Matching Network

M. Pirrone, *Univ. of Colorado Boulder*; E. Dall'Anese, *Univ. of Colorado Boulder*; T. Barton, *Univ. of Colorado Boulder*

We2C-7: Closed-Loop Antenna Impedance Tuning via Transfer Function Learning for 5G sub-6GHz User Equipment

Taha Yekan, *Samsung Semiconductor, Inc.*; Donghoon Lee, *Samsung Semiconductor, Inc.*; Pranav Dayal, *Samsung Semiconductor, Inc.*; Walid Y. Ali-Ahmad, *Samsung Semiconductor, Inc.*

1A - 1C

We2E: Advanced Linearization Techniques for PAs and MIMO Transmitters

Chair: Anding Zhu, *Univ. College Dublin*

Co-Chair: Pere L. Gilabert, *Universitat Politècnica de Catalunya*

We2E-1: Load-Modulation-Based IMD3 Cancellation for Millimeter-Wave Class-B CMOS Power Amplifiers Achieving EVM<1.2%

Masoud Pashaeifar, *Delft Univ. of Technology*; Leo de Vreede, *Delft Univ. of Technology*; Morteza Alavi, *Delft Univ. of Technology*

We2E-2: Load-Mismatch Tracking Digital Predistortion for Mobile-Terminal Power Amplifiers

X. Liu, *Tsinghua Univ.*; W. Chen, *Tsinghua Univ.*; W. Chen, *Huawei Technologies*; Y. Guo, *Huawei Technologies*; Z. Feng, *Tsinghua Univ.*

We2E-3: Mixture of Experts Neural Network for Modeling of Power Amplifiers

A. Fischer-Bühner, *Nokia Bell Labs*; A. Brihuega, *Nokia* ; L. Anttila, *Tampere Univ.*; M.D. Gomony, *Nokia Bell Labs*; M. Valkama, *Tampere Univ.*

We2E-4: Hardware-Efficient Implementation of Piece-Wise Digital Predistorters for Wideband 5G Transmitters

M. Almoneer, *Univ. of Waterloo*; H. Barkhordar-pour, *Univ. of Waterloo*; P. Mitran, *Univ. of Waterloo*; S. Boumaiza, *Univ. of Waterloo*

We2E-5: An Intermodulation Distortion Oriented 256-Element Phased-Array Calibration for 5G Base Station

Y. Aoki, *Samsung*; Y. Kim, *Samsung*; Y. Hwang, *Samsung*; H. Kang, *Samsung*; S. Kim, *Samsung*; A.-S. Ryu, *Samsung*; S.-G. Yang, *Samsung*

IMS TECHNICAL SESSIONS 10:10 -11:50 Wednesday, 22 June 2022 Colorado Convention Center

1D-1F

We2F: Advanced Concepts for 77GHz Radar

Chair: Wael A. Ahmad, *Keysight Technologies*

Co-Chair: Alexander Koelpin, *Technische Universität Hamburg*

We2F-1: W-Band Active Repeater Arrays and Cognitive Receivers for OFDM Radar Networks

T. Liu, *Univ. of Toronto*; H.Y. Hsu, *Univ. of Toronto*; J. Hasch, *Robert Bosch*; S.P. Voinigescu, *Univ. of Toronto*

We2F-2: A Harmonic Automotive Radar for Bicycle Detection with RFID Tags at 79/158GHz

T.T. Braun, *Ruhr-Universität Bochum*; J. Schöpfel, *Ruhr-Universität Bochum*; C. Schweer, *Ruhr-Universität Bochum*; N. Pohl, *Ruhr-Universität Bochum*

We2F-3: High Angular Resolution Digital Beamforming Based on Combination of Linear Prediction and 1D-CLEAN for Automotive MIMO Radar

M.Q. Nguyen, *Johannes Kepler Universität Linz*; R. Feger, *Johannes Kepler Universität Linz*; D. Amarilda, *ZF Friedrichshafen*; M. Pichler-Scheder, *LCM*; A. Stelzer, *Johannes Kepler Universität Linz*

We2F-4: Efficient Bandwidth Enhanced Multirate Radar Target Simulation

G. Körner, *FAU Erlangen-Nürnberg*; C. Birkenhauer, *FAU Erlangen-Nürnberg*; P. Stief, *FAU Erlangen-Nürnberg*; C. Carlowitz, *FAU Erlangen-Nürnberg*; M. Vossiek, *FAU Erlangen-Nürnberg*

We2F-5: Design of a Wideband E-Band Radar Frontend for a Novel Incoherent Self-Mixing Radar Principle

J. Wörmann, *Univ. Stuttgart*; S. Ebeling, *Univ. Stuttgart*; B. Schoch, *Univ. Stuttgart*; I. Kallfass, *Univ. Stuttgart*

4D-4F

We2G: mm-Wave and Terahertz System Demonstrations and Concepts

Chair: William R. Deal, *Northrop Grumman*

Co-Chair: Wooram Lee, *Penn State Univ.*

We2G-1: A 140GHz CMOS RFSOI Transmit-Receive Phased-Array Wireless Link with 11–12Gbps and 16 and 64-QAM Operation

S. Li, *Univ. of California, San Diego*; G.M. Rebeiz, *Univ. of California, San Diego*

We2G-2: A W-Band, 92–114GHz, Real-Time Spectral Efficient Radio Link Demonstrating 10Gbps Peak Rate in Field Trial

M. Hörberg, B. Madeberg, D. Sjöberg, H. Zirath, K. Bitsikas, K. Kravariotis, S. Tsapalis, *Ericsson*; M. Gavell, *Gotmic*; G. Granström, *Gotmic*; R. Lövblom, *Gotmic*; D. Siomos, *OTE Group*; S. Agneessens, *Ericsson*; J. Hansryd, *Ericsson*

We2G-3: A 100GHz Fully Integrated FMCW Imaging Radar in 110nm CMOS with Fundamental Oscillation Above fmax/2 for Drywall Inspection

M. Tavakoli Taba, *Univ. of Michigan*; S.M.H. Naghavi, *Univ. of Michigan*; M. Aseeri, *KACST*; E. Afshari, *Univ. of Michigan*

We2G-4: Measuring the 557GHz Water Vapor Absorption Line with Radar Speckle Averaging

K.B. Cooper, *Jet Propulsion Lab*; B.J. Drouin, *Jet Propulsion Lab*; O. Pradhan, *Jet Propulsion Lab*; J.V. Siles, *Jet Propulsion Lab*; R. Rodriguez Monje, *Jet Propulsion Lab*; D.J. Nemchick, *Jet Propulsion Lab*; R.J. Dengler, *Jet Propulsion Lab*; L.K. Tamppari, *Jet Propulsion Lab*

We2G-5: 60Gbps 108GHz 16-QAM Dielectric Waveguide Interconnect with Package Integrated Filters

G.C. Dogiamis, *Intel*; T.W. Brown, *Intel*; N. Prabhu Gaunkar, *Intel*; Y.S. Nam, *Intel*; T.S. Rane, *Intel*; S. Ravikumar, *Intel*; V.B. Neeli, *Intel*; J.C. Chou, *Intel*; S. Rami, *Intel*

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WOMEN IN MICROWAVES (WIM)

Wednesday, 22 June 2022 | 18:00 – 21:00

Chambers Grant Salon, Opera House, Denver Performing Arts Complex

Join us for a fun evening at IMS hosted by Women in Microwaves (WIM)!! This event welcomes all members of IMS to promote collaboration, with a spotlight on the work of female RF engineers and researchers.

The evening starts with a technical poster session over snacks and open wine/beer bar. Join all attendees in a fun and creative group Smith chart painting contest, to be turned into a MTT tee-shirt or poster. Get to know your fellow WIM members in a friendly bingo game designed to help you network with some of our brightest up-and-coming female RF engineers and researchers.

We hope to see all IMS2022 attendees there (WIM, MIM and others)!

Sponsored By:

Microwaves&RF

INDUSTRY WORKSHOPS 08:00 – 17:00 Wednesday, 22 June 2022

SESSION CODE	TIME & LOCATION	TITLE AND ABSTRACT	SPEAKER/S, AFFILIATION
IWWE1	08:00 – 9:40 Room: 205/207	**Broadband Over Temperature Measurement Optimization For On Wafer Test** We will highlight the best methods for setting up, calibrating, and evaluating measurement performance in coaxial and waveguide bands spanning WR15 (75 GHz) to WR1 (1100 GHz) over a broad (-40 to 125c) temperature range. A novel out single sweep measurement from 900 Hz to 220 GHz will be shown along with detailed complete automation of these measurements Hany programming examples using WinCalXE software will be demonstrated automating data measurement and analysis for on wafer measurements. We also evaluate system stability and performance. A very convenient approach is discussed to allow safe and convenience band swaps and probe installation.	Gavin Fisher, *FormFactor*
IWWE2	10:10 – 11:50 Room: 205/207	**From Design to Manufacturing; mmWave IC and Heterogeneous RF Integration in One Design Flow** The need to design and produce smaller, less expensive, and increasingly complex devices is the mantra of our industry. This has led to designs in smaller, more complex packages, smaller process nodes, and the use of multiple IC technologies, all within a shorter design cycle. This workshop will consider recent developments in EDA software that address the challenges of adopting advanced node silicon and heterogenous packaging technology for RF to mmWave applications.	Michael Thompson, Ron Pongratz *Cadence*
IWWE3	13:30 – 15:10 Room: 205/207	**Latest RF Frontend Topologies Including Olmba Measurement-Aided Design** 5G is here. The focus is on improving systems and enhancing capabilities. This drives the integration of components, extending bandwidth coverage per RF channel and improving energy efficiency. We will look at enhanced filter and amplifier design and testing. Load Modulated Balanced Amplifier (LMBA) structures offer typically Doherty levels of efficiency with increased bandwidth. The workshop will provide an overview of the latest technologies and requirements of RF frontends. Experts from test and measurement and industry partners will provide solutions that meet demanding requirements and help to develop latest LMBA topologies using a measurement-aided approach.	Diamond Liu, *SynMatrix Technologies;* Gareth Lloyd, *Rohde & Schwarz;* Salvatore Finocchiaro, *QORVO, Inc.*
IWWE4	15:40 – 17:00 Room: 205/207	**0.03-6 GHz Up/Down Converter + FPGA (BytePipe) Toolbox for Matlab and Simulink** We will demonstrate and discuss the BytePipe Toolbox for Matlab and Simulink which provides a set of tools for interfacing, modeling, and targeting designs using the BytePipe RF System on Module. The device interfaces will provide control and data streaming using MATLAB System Objects and Simulink Blocks. The control interface allows for configuration of components included in the Software Development Kit. This includes support for configuration of the ADI ADRV9002 Agile Transceiver and Xilinx ZynqMP Baseband Processor functions. Individual settings can be configured independently or as a whole. Design support includes filter/profile wizards, and tools commonly used in modem design.	Larry Hawkins, *Richardson RFPD*

Have You Had Your Shoes Shined Yet?

Get your shoes freshly shined outside the Exhibition Hall A entrance! Shoeshines are a time-honored tradition. Stop by and relax your feet. You will walk away looking and feeling great!

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PANEL SESSION

12:10 – 13:20 | Wednesday, 22 June 2022 | Room: 2C–3C

The Trend of Tiny AI: Will Ultra-Low-Power Fully-Integrated Cognitive Radios Become a Reality?

PANEL ORGANIZERS:
Jasmin Grosinger, *Graz Univ. of Technology;* **Oren Eliezer,** *Apogee Semiconductor;* **Ke Wu,** *Polytechnique Montreal;* **J.-C. Chiao,** *Southern Methodist Univ.*

PANELISTS:
Alyssa B. Apsel, *Cornell Univ.;* **Nuno Borges Carvalho,** *Univ. of Aveiro;* **Scott Hanson,** *Ambiq;* **Gernot Hueber,** *Silicon Austria Labs;* **Tim Kwang-Ting Cheng,** *Hong Kong Univ. of Science and Technology*

ABSTRACT: The trend of tiny AI eventually paves the way towards realizing fully-integrated cognitive radios on energy-constrained devices, making Mitola's vision a reality. Currently, tiny AI-based devices operate at mW power consumption. Will uW power consumption become a reality? Will eventually cognitive radios exploiting tiny AI become a reality? In this panel, experts from multiple disciplines and IEEE societies will debate these questions and visions.

PANEL SESSION

12:10 – 13:20 | Wednesday, 22 June 2022 | Room: 4A–4C

Small Satellites and Constellations: Who Will Be the Winners of the New Race to Space?

PANEL ORGANIZERS:
Markus Gardill, *Brandenburg Univ. of Technology;* **Steven Reising,** *Colorado State Univ.;* **Jan Budroweit,** *German Aerospace Center (DLR)*

PANELISTS:
Klaus Schilling, *Zentrum fuer Telematik (Center for Telematics);* **Jorge Ciccorossi,** *International Telecommunication Union (ITU);* **William Blackwell,** *MIT Lincoln Laboratory;* **Sachidananda Babu,** *NASA Earth Science Technology Office;* **Andreas Knopp,** *Universität der Bundeswehr München*

ABSTRACT: There is a true spirit of optimism in the current development of small satellites for low-earth-orbit. Entirely new opportunities have been created for education, science, and industry. Well-known examples range from the plethora of CubeSat projects to several announced or deployed mega-constellations. Nevertheless, how will the anticipated intensive use of LEO affect the environment and the frequency spectrum usage, and how can a sustainable and fair-share use of resources be ensured? Let's talk about this in our panel of leading experts from Small Businesses & Startups, Science and Education, Space Agencies, Communication, Regulation, and Space Debris.

Professional Headshots on the IMS Show Floor!

Join us in Booth 2000 to get a complimentary headshot photo.

Hours: Tuesday, Wednesday, and Thursday
11:50-13:00

During the Industry Hosted Reception on Wednesday
17:00-18:00

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IMS TECHNICAL SESSIONS | 13:30 –15:10 | Wednesday, 22 June 2022 | Colorado Convention Center

Microwave Field, Device & Circuit Techniques | Passive Components | Active Components | Systems & Applications | Emerging Technologies & Applications | Focus & Special Sessions

	401-402	403-404	501-502	503-504
	We3A: Advances in Passive Devices Dedicated to Roberto Sorrentino **Chair:** Bayaner Arigong, *Florida State Univ.* **Co-Chair:** Hualiang Zhang, *UMass Lowell*	**We3B: Advances in Interconnects** **Chair:** Rhonda Franklin, *Univ. of Minnesota* **Co-Chair:** Georgios Dogiamis, *Intel*	**We3C: Towards Physically Secure Communication and Computation** **Chair:** John Hu, *Oklahoma State Univ.* **Co-Chair:** Shreyas Sen, *Purdue Univ.*	**We3D: LNAs and Receivers at W-band and Beyond** **Chair:** Pekka Kangaslahti, *Jet Propulsion Laboratory* **Co-Chair:** Roee Ben-Yishay, *Intel*
13:30 13:40	**We3A-1: High-Q On-Chip Capacitors Featuring "Self-Inductance Cancellation" for RF and mm-Wave Applications** Arian Rahimi, *Intel Corp.*; Pratheesh Somarajan, *Intel Corp.*; Qiang Yu, *Intel Corp.*; Jeffrey Garrett, *Intel Corp.*; Said Rami, *Intel Corp.*; Kalyan Kolluru, *Intel Corp.*	**We3B-1: Detachable Terahertz Chip-to-Chip Interconnectors** H.-Y. Tsao, *Univ. of Virginia*; Y. Wang, *Univ. of Virginia*; R.M. Weikle, *Univ. of Virginia*; A.W. Lichtenberger, *Univ. of Virginia*; N.S. Barker, *Univ. of Virginia*	**We3C-1: A Quantitative Analysis of Physical Security and Path Loss with Frequency for IBOB Channel** Arunashish Datta, *Purdue Univ.*; Mayukh Nath, *Purdue Univ.*; Baibhab Chatterjee, *Purdue Univ.*; Shovan Maity, *Quasistatics*; Shreyas Sen, *Purdue Univ.*	**We3D-1: A W/F-Band Low-Noise Power Amplifier GaN MMIC with 3.5–5.5-dB Noise Figure and 22.8–24.3-dBm Pout** F. Thome, *Fraunhofer IAF*; P. Brückner, *Fraunhofer IAF*; S. Leone, *Fraunhofer IAF*; R. Quay, *Fraunhofer IAF*
13:50 14:00	**We3A-2: Millimeter-Wave High Q-Factor Sixteenth Mode SIW Cavity Resonator Implemented in 0.18μm CMOS Technology** S.K. Thapa, *Kyushu Univ.*; R.K. Pokharel, *Kyushu Univ.*; B. Chen, *Kyushu Univ.*; T. Fukuda, *Kyushu Univ.*; A. Barakat, *Kyushu Univ.*	**We3B-2: Fan-Out Wafer Level Packaging of GaN Traveling Wafer Amplifier** D. Schwantuschke, *Fraunhofer IAF*; E. Ture, *Fraunhofer IAF*; T. Braun, *Fraunhofer IZM*; T.D. Nguyen, *Fraunhofer IZM*; M. Wöhrmann, *Fraunhofer IZM*; M. Pretl, *Rohde & Schwarz*; S. Engels, *Rohde & Schwarz*	**We3C-2: Detection of Rogue Devices Using Unintended Near and Far-Field Emanations with Spectral and Temporal Signatures** Md.F. Bari, *Purdue Univ.*; M. Roy Chowdhury, *Purdue Univ.*; B. Chatterjee, *Purdue Univ.*; S. Sen, *Purdue Univ.*	**We3D-2: A Flip-Chip 180GHz Receiver in 40nm CMOS** H.-S. Chen, *National Tsing Hua Univ.*; Y.-L. Hu, *National Tsing Hua Univ.*; W.-C. Chang, *National Tsing Hua Univ.*; J.Y.-C. Liu, National Tsing Hua Univ.
14:10 14:20	**We3A-3: A 16:1 Bandwidth Planar Balun with Low Common Mode Impedance** D. Gustafsson, *Ericsson*; P. Ingelhag, *Ericsson*; K. Andersson, *Ericsson*; T. Dahl, *Ericsson*; R. Lindman, *Ericsson*; R. Lundqvist, *Ericsson*	**We3B-3: Fused-Silica Stitch-Chips with Compressible Microinterconnects for Embedded RF/mm-Wave Chiplets** T. Zheng, *Georgia Tech*; M.S. Bakir, *Georgia Tech*	**We3C-3: Electromagnetic Analysis of Integrated On-Chip Sensing Loop for Side-Channel and Fault-Injection Attack Detection** Archisman Ghosh, *Purdue Univ.*; Mayukh Nath, *Purdue Univ.*; Debayan Das, *Purdue Univ.*; Santosh Ghosh, *Intel Corp.*; Shreyas Sen, *Purdue Univ.*	**We3D-3: A Fully-Differential 146.6–157.4GHz LNA Utilizing Back Gate Control to Adjust Gain in 22nm FDSOI** P.J. Artz, *Technische Universität Berlin*; P. Scholz, *Technische Universität Berlin*; T. Mausolf, *IHP*; F. Gerfers, *Technische Universität Berlin*
14:30 14:40	**We3A-4: Rectangular Waveguide Radial Combiners Based on Curvilinear Matching Sections** M.M. Fahmi, *DRDC*; R.R. Mansour, *Univ. of Waterloo*	**We3B-4: High-integration and Low-cost Transmitter Packaging Solution for 0.2 THz SiP Application Using HTCC Technology** Bo Yu, Zhigang Wang, *Univ. of Electronic Science and Technology of China*; Peng Wu, *Chinese Academy of Sciences*; Oupeng Li, Hua Cai, Jia He, Guangjian Wang, *Huawei Technologies Co., Ltd.*; Ruimin Xu, *Univ. of Electronic Science and Technology of China*	**We3C-4: Metamaterial-Enabled 2D Directional Modulation Array Transmitter for Physical Layer Security in Wireless Communication Links** S. Vosoughitabar, *Rutgers Univ.*; A. Nooraiepour, *Rutgers Univ.*; W.U. Bajwa, *Rutgers Univ.*; N. Mandayam, *Rutgers Univ.*; C.-T.M. Wu, *Rutgers Univ.*	**We3D-4: Experimental Characterization of Temperature-Dependent Microwave Noise of Discrete HEMTs: Drain Noise and Real-Space Transfer** B. Gabritchidze, *Caltech*; K. Cleary, *Caltech*; J. Kooi, *Jet Propulsion Lab*; I. Esho, *Caltech*; A.C. Readhead, *Caltech*; A.J. Minnich, *Caltech*
14:50 15:00	**We3A-5: Novel Waveguide Connectors to Simplify Microwave and Millimeter-Wave Component Packaging** Y. Shu, *Eravant*; L. Ren, *Eravant*	**We3B-5: 110GHz Nanowire-Based Integrated Via Technology for 3D Silicon Integration** Y. Zhang, *Univ. of Minnesota*; J. Um, *Univ. of Minnesota*; N. Mahjabeen, *Univ. of Texas at Dallas*; B. Stadler, *Univ. of Minnesota*; R. Henderson, *Univ. of Texas at Dallas*; R.R. Franklin, *Univ. of Minnesota*	**We3C-5: RF-PSF: Zero-Trust Radio Frequency Process Specific Functions as Process Distinction Method** Md.F. Bari, *Purdue Univ.*; B. Chatterjee, *Purdue Univ.*; L. Duncan, *KBR*; S. Sen, *Purdue Univ.*	
15:10				

IMS TECHNICAL SESSIONS 13:30 –15:10 Wednesday, 22 June 2022 Colorado Convention Center

Microwave Field, Device & Circuit Techniques | Passive Components | Active Components | Systems & Applications | Emerging Technologies & Applications | Focus & Special Sessions

1A - 1C

We3E: New Advances in RF Circuits and Systems

Chair: John Papapolymerou, *Michigan State Univ.*
Co-Chair: Linda Katehi, *Texas A&M Univ.*

We3E-1: High Density Integration/ Multi-Function Assemblies, Photonics, and mm-Wave Components

A. Gutierrez-Aitken, *Northrop Grumman*

We3E-2: A 4GHz Digital Class-E Outphasing PA

T. Hoffmann, *FBH*; L. Schellhase, *FBH*; W. Heinrich, *FBH*; A. Wentzel, *FBH*

We3E-3: An X/Ku Dual-Band GaAs MMIC Power Amplifier with Integrated Load Impedance Sensing

D.T. Donahue, *Univ. of Colorado Boulder*; P. Zurek, *Univ. of Colorado Boulder*; Z. Popovic, *Univ. of Colorado Boulder*; T. Barton, *Univ. of Colorado Boulder*

We3E-4: Three-Dimensional Active Incoherent Millimeter-Wave Imaging Using Noise Pulse Integration

S. Vakalis, *Michigan State Univ.*; J.R. Colon-Berrios, *Michigan State Univ.*; J.A. Nanzer, *Michigan State Univ.*

We3E-5: A High Bandwidth Energy Efficient Linear Transimpedance Amplifier for Short-Range 100GBd PAM-4 Applications

C. Bohn, *KIT*; A.Ç. Ulusoy, *KIT*

1D-1F

We3F: Cognitive Radar

Chair: Joe Guerci, *Information Systems Laboratories*

We3F-1: Cognitive Radar Tracking with Spectrum Sensing and Prediction

K. Bell, *Metron*; B. Shapo, *Metron*

We3F-2: Joint Design of Radar Transmit-Receive Pair in Highly Reverberating and Congested Environments

A. Aubry, *Università di Napoli Federico II*; S. De Fenza, *Università di Napoli Federico II*; A. De Maio, *Università di Napoli Federico II*

We3F-3: A Fast Impedance Tuner Implementation in a Cognitive Radar for Synchronous Real-Time Optimization in a Congested Environment

J. Roessler, *Baylor Univ.*; A. Egbert, *Baylor Univ.*; T. Van Hoosier, *Baylor Univ.*; S. Seguin, *Baylor Univ.*; A. Martone, *ARL*; C. Baylis, *Baylor Univ.*; R.J. Marks II, *Baylor Univ.*

We3F-4: Radar Concepts for Inline Non-Destructive Testing

D. Nuessler, *Fraunhofer FHR*; C. Krebs, *Fraunhofer FHR*; A. Froehly, *Fraunhofer FHR*; S. Gütgemann, *Fraunhofer FHR*

4D-4F

We3G: mm-Wave and Terahertz Signal Generation

Chair: Richard Al Hadi, *Alcatera*
Co-Chair: Ahmed Gadallah, *IHP*

We3G-1: A 237–263GHz CMOS Frequency Doubler with 0.9dBm Output Power and 2.87% Power Efficiency Based on Harmonic Matched Gmax-Core

B.-T. Moon, *KAIST*; B. Yun, *KAIST*; S.-G. Lee, *KAIST*

We3G-2: A 250–300GHz Frequency Multiplier-by-8 Chain in SiGe Technology

A. Gadallah, *IHP*; M.H. Eissa, *IHP*; T. Mausolf, *IHP*; D. Kissinger, *Universität Ulm*; A. Malignaggi, *IHP*

We3G-3: 61.5GHz Energy-Efficient Super-Regenerative Oscillator with Tunable Quench Duty Cycle

A. Ferschischi, *Technische Universität Dresden*; H. Ghaleb, *Technische Universität Dresden*; C. Carta, *Technische Universität Dresden*; F. Ellinger, *Technische Universität Dresden*

We3G-4: 15 to 72GHz Closed-Loop Impairment Corrected mm-Wave Delay-Locked IQ Modulator for 5G Applications

I. Martinez, *Keysight Technologies*

We3G-5: A Coherent 233–243GHz Scalable 1D Array in 28nm Bulk CMOS Using Sub-Harmonic Inter-Element Leakage

S. Londhe, *Tel Aviv Univ.*; E. Socher, *Tel Aviv Univ.*

13:30
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15:10

Don't Miss the Industry Hosted Reception on Wednesday, 22 June from **17:00–18:00** on the IMS Show Floor!

IMS TECHNICAL SESSIONS 15:40 – 17:00 Wednesday, 22 June 2022 Colorado Convention Center

Microwave Field, Device & Circuit Techniques | Passive Components | Active Components | Systems & Applications | Emerging Technologies & Applications | Focus & Special Sessions

	401-402	403-404	501-502	503-504
	We4A: Advances in mm-Wave Passive Components & Systems **Chair:** Holger Maune, *OvG Universität Magdeburg* **Co-Chair:** Srinivas Prasad Mysore Nagaraja, *Jet Propulsion Laboratory*	**We4B: Advanced Manufacturing and Novel Substrates** **Chair:** Premjeet Chahal, *Michigan State Univ.* **Co-Chair:** Valentina Palazzi, *Università di Perugia*	**We4C: Advanced System Architectures and Concepts** **Chair:** Kavita Goverdhanam, *U.S. Army CCDC C5ISR Center* **Co-Chair:** Ruochen Lu, *Univ. of Texas at Austin*	**We4D: Advances in Low-Power CMOS Low Noise Amplifiers (LNAs)** **Chair:** Shirin Montazeri, *Google* **Co-Chair:** Edward Niehenke, *Niehenke Consulting*
15:40 15:50	**We4A-1: A 300-GHz Band Chip-to-Waveguide Transition on Proton-Irradiated Standard 65nm CMOS Si Substrate for Flip-Chip Packaging Implementation** H. Herdian, *Tokyo Tech*; T. Inoue, *SHI-ATEX*; M. Sogabe, *SHI-ATEX*; A. Shirane, *Tokyo Tech*; K. Okada, *Tokyo Tech*	**We4B-1: Integrated and Miniaturized Quasi Yagi D-Band Antenna in Glass Interposer** S. Erdogan, *Georgia Tech*; K.-S.J. Moon, *Georgia Tech*; M. Kathaperumal, *Georgia Tech*; M. Swaminathan, *Georgia Tech*	**We4C-1: 2–8 GHz Interference Detector with 1.1 µs Response** Mohammad Abu Khater, *Purdue Univ.*; Dimitrios Peroulis, *Purdue Univ.*	**We4D-1: A 3.2mW 2.2–13.2GHz CMOS Differential Common-Gate LNA for Ultra-Wideband Receivers** L. Zhang, *Univ. of California, Davis*; N.L.K. Nguyen, *Univ. of California, Davis*; J. Chen, *Univ. of California, Davis*; O. Momeni, *Univ. of California, Davis*; X. Liu, *SUSTech*
16:00 16:10	**We4A-2: A Ka-Band Wideband Monolithically Metallic 3-D Printed Turnstile Junction Orthomode Transducer with Shaped Internal Profile** S. Chen, *Shenzhen Univ.*; J. Li, *Shenzhen Univ.*; Z. Xu, *Shenzhen Univ.*; T. Yuan, *Shenzhen Univ.*	**We4B-2: Flexible and Scalable Additively Manufactured Tile-Based Phased Arrays for Satellite Communication and 5G mmWave Applications** K. Hu, *Georgia Tech*; G. Soto-Valle, *Georgia Tech*; Y. Cui, *Georgia Tech*; M.M. Tentzeris, *Georgia Tech*	**We4C-2: A 140–500GHz CMOS THz Spectroscope with 1MHz Resolution Based on Multi-Branch Rotational Symmetric Sensing Surface** C. Pi, *UESTC*; H.J. Qian, *UESTC*; T. Wang, *UESTC*; J. Zhou, *UESTC*; Z. Deng, *UESTC*; Y. Shu, *UESTC*; X. Luo, *UESTC*	**We4D-2: Design and Implementation of a 3.9-to-5.3GHz 65nm Cryo-CMOS LNA with an Average Noise Temperature of 10.2K** S. Das, *UMass Amherst*; S. Raman, *UMass Amherst*; J.C. Bardin, *Google, UMass Amherst*
16:20 16:30	**We4A-3: A Dual-Band Feed Network for Highly Integrated K-/Ka-Band Phased Array Front-Ends** K. Erkelenz, *Technische Universität Hamburg*; N. Sielck, *Technische Universität Hamburg*; A.F. Jacob, *Technische Universität Hamburg*	**We4B-3: Additively Manufactured Slotted Waveguides for THz Applications** A. Hofmann, *FAU Erlangen-Nürnberg*; K. Lomakin, *FAU Erlangen-Nürnberg*; M. Sippel, *FAU Erlangen-Nürnberg*; G. Gold, *FAU Erlangen-Nürnberg*	**We4C-3: Noninvasive Continuous Blood Pressure Monitoring Based on Wearable Radar Sensor with Preliminary Clinical Validation** L. Wen, *SJTU*; S. Dong, *SJTU*; Z. Zhang, *Shanghai General Hospital*; C. Gu, *SJTU*; J. Mao, *SJTU*	**We4D-3: Sub-mW 30GHz Variable-Gain LNA in 22nm FDSOI CMOS for Low-Power Tapered mm-Wave 5G/6G Phased-Array Receivers** M. Spasaro, *Aarhus Univ.*; D. Zito, *Aarhus Univ.*
16:40 16:50	**We4A-4: Dual-Resonance mmWave Antenna Matching Network Comprised of Separated Ground Layers and Via Posts for Adjustable Return Current Path Modification** Y. Youn, *POSTECH*; J. Choi, *LG Innotek*; B. Kim, *POSTECH*; W. Hwang, *POSTECH*; W. Hong, *POSTECH*	**We4B-4: 3D Printed Wideband High-Power X-Band Radial Combiner** N. Lopez, *MIT Lincoln Laboratory*; A.E. Fathy, *Univ. of Tennessee*; M.D. Abouzahra, *MIT Lincoln Laboratory*; J. Blandford, *MIT Lincoln Laboratory*; R. Kazemi, *Univ. of Tennessee*; C.J. Bauder, *Univ. of Tennessee*; C. Eckert, *MIT*	**We4C-4: Measurement of Displacement Motions Based on Unsynchronized Bandpass Sampling with a Low-IF Doppler Radar** F. Tong, *SJTU*; J. Liu, *SJTU*; C. Gu, *SJTU*; J. Mao, *SJTU*	**We4D-4: An Ultra-Low Power E-band Low Noise Amplifier with Three Stacked Current Sharing Amplification Stages in 28-nm CMOS** Liang Qiu, *Zhejiang Univ.*; Jiabing Liu, *Zhejiang Univ.*; Qianyi Dong, *Zhejiang Univ.*; Zhihao Lv, *Zhejiang Univ.*; Kailong Zhao, *Zhejiang Univ.*; Shengjie Wang, *Zhejiang Univ.*; Yen-Cheng Kuan, *National Chiao Tung Univ.* ; Q. Jane Gu, *Univ. of California, Davis*; Xiaopeng Yu, *Zhejiang Univ.*; Chunyi Song, *Zhejiang Univ.*; Zhiwei Xu, *Zhejiang Univ.*
17:00				

1D-1F

We4F: Advanced Radar Imaging and Signal Processing

Chair: Suresh Venkatesh, *Princeton Univ.*
Co-Chair: Rudy Emrick, *Northrop Grumman*

We4F-1: A 75GHz Dynamic Antenna Array for Real-Time Imageless Object Detection via Fourier Domain Filtering

D. Chen, *Michigan State Univ.*; S. Vakalis, *Michigan State Univ.*; J.A. Nanzer, *Michigan State Univ.*

We4F-2: Incoherent Point Spread Function Estimation and Multipoint Deconvolution for Active Incoherent Millimeter-Wave Imaging

Jorge Colon-Berrios, *Michigan State Univ.*; Stavros Vakalis, *Michigan State Univ.*; Daniel Chen, *Michigan State Univ.*; Jeffrey Nanzer, *Michigan State Univ.*

We4F-3: Received Signal Strength Estimation in Indoor Environment using High Frequency Rytov Approximation

Amartansh Dubey, *Hong Kong Univ. of Science and Technology*; Samruddhi Deshmukh, *The Hong Kong Univ. of Science and Technology*; Dingfei Ma, *The Hong Kong Univ. of Science and Technology*; Ross Murch, *The Hong Kong Univ. of Science and Technology*

We4F-4: A 300–1300MHz Single Antenna Digital-FMCW Ground Penetrating Radar for the Mars Science Helicopter with Switched-Gain Calibration to Improve Dynamic Range

A. Tang, *Jet Propulsion Lab*; E. Decrossas, *Jet Propulsion Lab*; Y. Gim, *Jet Propulsion Lab*; R. Beauchamp, *Jet Propulsion Lab*; S. Culaclii, *Jet Propulsion Lab*

We4F-5: Thickness Profile Estimation of Fluid-Carrying Non-Metallic Pipes

M.B. Shah, *NYIT*; Y. Gao, *NYIT*; M. Ravan, *NYIT*; R.K. Amineh, *NYIT*

4D-4F

We4G: mm-Wave and Terahertz Integrated Circuits and Components

Chair: Theodore Reck, *Virginia Diodes*
Co-Chair: Lei Liu, *Univ. of Notre Dame*

We4G-1: High-Gain 670-GHz Amplifier Circuits in InGaAs-on-Insulator HEMT Technology

Laurenz John, Axel Tessmann, Arnulf Leuther, Thomas Merkle, Hermann Massler, Sebastien Chartier, *Fraunhofer Institute for Applied Solid State Physics*

We4G-2: Wideband Switchable-Capacitor Loaded Differential Phase Shifter with Lattice Structures

S. Kwon, *Yonsei Univ.*; M. Jung, *Univ. of California, San Diego*; B.-W. Min, *Yonsei Univ.*

We4G-3: A New 77GHz Sampling Mixer in 28nm FD-SOI CMOS Technology for Automotive Radar Application

A. Flete, *STMicroelectronics*; C. Viallon, *LAAS-CNRS*; P. Cathelin, *STMicroelectronics*; T. Parra, *LAAS-CNRS*

We4G-4: A 190-to-220GHz 4-Bit Passive Attenuator with 1.4dB Insertion Loss and Sub-0.4dB RMS Amplitude Error Using Magnetically Switchable Coupled-Lines in 0.13µm CMOS Technology

N. Zhu, *Tianjin Univ.*; F. Meng, *Tianjin Univ.*

15:40
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16:00
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16:20
16:30
16:40
16:50
17:00

INTERACTIVE FORUM SESSION & RADAR/AEROSPACE DAY RECEPTION

WEIF2 | 15:10 – 17:00 | Room: 2A–3B

Chairs: Akim Babenko, Justus Brevik , Robert Horansky, *NIST*

WEIF2-1: Plenary Poster: Earth Observation with Microwave Radiometers – Miniaturization and AI-based Solutions

Pekka Kangaslahti, Shannon Brown, Javier Bosch-Lluis, Sid Misra, Sharmila Padmanabhan, *Jet Propulsion Lab*; Bill Deal, *Northrop Grumman Corp.*

WEIF2-10: Characterization and Estimation of EVM Hump Based on Transmitter AM-AM and AM-PM Characteristics

S. Farsi, *Meta*; Y. Wang, W. Ali-Ahmad, *Samsung*

WEIF2-11: Analysis and Experiments of the Impact of Frequency Ramp Nonlinearity on Range Resolution and Accuracy in LFMCW Radars

Z. Zhang, J. Liu, C. Gu, J. Mao, *SJTU*

WEIF2-12: 5.8GHz Highly Sensitive and Linear Doppler Radar Using Digital Self-Injection-Locking Technology

W.-C. Su, C.-H. Chang, T.-S. Horng, S.-H. Yu, *National Sun Yat-sen Univ.*

WEIF2-13: Cost-Efficient Baseband DPD for Hybrid MIMO Systems with Shallow Learning Artificial Neural Networks

P. Jueschke, T. Stedile-Ribeiro, *Nokia*; G. Fischer, *FAU Erlangen-Nürnberg*

WEIF2-2: Accumulative Mill Rolled Pd Foil Based H_2 Getter for Improving Microwave Device Reliability

H. Xia, J. Vriens, D. DeWire, *Hermetic Solutions Group*

WEIF2-3: A Flexible Implementation of Ka-Band Active Phased Array for Satellite Communication

X. Wang, D. You, X. Fu, H. Lee, *Tokyo Tech*; Z. Li, *Tokyo Tech*; D. Awaji, *Fujikura*; J. Pang, A. Shirane, H. Sakamoto, K. Okada, *Tokyo Tech*

WEIF2-4: Tunable MMIC Negative Group Delay Transversal Filter-Based Negative Capacitor in 0.1-µm GaAs pHEMT Technology

M. Zhu, *Rutgers Univ.*; A.Y.-K. Chen, *California State Univ., Northridge*; C.-T.M. Wu, *Rutgers Univ.*

WEIF2-5: Compact Asymmetrical Voltage-Mode Doherty PA with 30% Bandwidth and 80W Output Power

E. Heidebrecht, R. Negra, *RWTH Aachen Univ.*

WEIF2-6: Ultra-Wideband Microstrip to Substrate Integrated Waveguide (SIW) Vertical Transition

A. Zerfaine, T. Djerafi, *INRS-EMT*

WEIF2-7: A Novel High Power Plastic Quad Flat No-Lead Package Structure for RF GaN Applications

S.-C. Hsiao, J.-C. Chiu, P.-K. Tseng, Y.-C. Lai, C.-W. Huang, *WIN Semiconductors*

WEIF2-8: Reducing FDD MMU Form Factor with Active Cancellation

K. Muhammad, J. Yuan, S. Zhang, C. Tarver, X. Xu, Y. Liu, J. Li, J. Moon, M. Tonnemach, G. Xu, J. Zhang, *Samsung*

WEIF2-9: 10W High Efficiency GaN-Si MMIC Power Amplifier for 17.3–20.2GHz Onboard Satellite Use

P. Colantonio, *Università di Roma "Tor Vergata"*; M. Lopez, L. Cabria, *TTI Norte*; F. Vitobello, *REA*; R. Giofrè, *Università di Roma "Tor Vergata"*

IMS INDUSTRY PAPER HARDWARE DEMONSTRATIONS

Room: 2A-3B | 15:40-17:00

New this year, the IMS Industry Paper Hardware Demos is an opportunity for invited authors to provide a live demonstration of their research. It is co-located with the Interactive Forum.

Paper Title	Speaker/s, Affiliation
System Simulation Through Behavioral Model with Embedded Equation Solver for the Prediction of the Linearized Power Amplifier Performances at the Design Stage | **Tu1B-5**	Silvia Hernandez, *AMCAD Engineering*
Silicon Micromachined Metrology Components for 0.5-1.1 THz | **TU1F1-6**	James Campion, *KTH*
Novel Waveguide Connectors to Simplify Microwave and Millimeterwave Component Packaging | **We3A-5**	Yonghui Shu, *Eravant*
A Novel OTA Near-Field Measurement Approach Suitable for 5G mmWave Wideband Modulated Tests | **Th1F-3**	Thomas Deckert, *National Instruments*

MICROAPPS

09:30 – 17:00 | Wednesday, 22 June 2022 | IMS Show Floor: Booth 9110

SESSION CODE	TIME	TITLE	SPEAKER/S, AFFILIATIONS
WEMA31	09:30 – 9:45	Passive Circuit Analysis and Model Development for Silicon Chips Using EMX 3D Planar Solver	Nikolas Provatas, *Cadence*
WEMA32	09:45 – 10:00	Phase Noise Measurements from Advanced R&D to Production	Matt Maxwell, *Rohde & Schwarz*
WEMA33	10:00 – 10:15	Realtime VNA Measurement Uncertainty Accuracy	Rich Pieciak, *Rohde & Schwarz GmbH & Co KG*
WEMA34	10:15 – 10:30	RF Filters for Space Applications	Tim Brauner, *Knowles Precision Devices*
WEMA35	10:30 – 10:45	Selecting Microwave Electromechanical Switches for ATE Applications	Krzysztof Ciezarek, *Microwave Products Group*
WEMA36	10:45 – 11:00	Single Sweep Broadband S-Parameter Measurements to mm-wave for Semiconductor Transistor and IC Test to 220 GHz	Gavin Fisher, *FormFactor*
WEMA37	11:00 – 11:15	Summing Power: Power Combining Trade-Offs and Requirements	Shaun Moore, *TRM Microwave*
WEMA38	11:15 – 11:30	TFLE-Thin Film Lumped Elements Reflective and Non-Reflective Filtering Solutions	Rafi Hershtig, *K&L Microwave*
WEMA39	11:30 – 11:45	VNA Application Solutions for S-parameter Measurements in Large Test Setups	Navneet Kataria, *Anritsu Co.*
WEMA40	11:45 – 12:00	VSWR, Return Loss, and the Best Directivity Money Can Buy	Doug Jorgesen, *Marki Microwave*
WEMA41	12:00 – 12:15	10MHz–30GHz USB-Configurable Front-End Module	Sidina Wane, *eV-Technologies*; Joel Kirshman, *StarWave-US LLC*
WEMA42	12:15 – 12:30	16-port RF-mmW USB-Controlled Switch Matrix and Correlator	Sidina Wane, *eV-Technologies*; Joel Kirshman, *StarWave-US LLC*
WEMA43	12:30 – 12:45	A New Miniature Atomic Clock for Ruggedized C5ISR Applications	Stavros Melachroinos, *Orolia*
WEMA44	12:45 – 13:00	Fast Switching, High Performance PLL and Quadband VCO Frequency Synthesizer	Kieran Barrett, *Analog Devices, Inc.*
WEMA45	13:00 – 13:15	GaN Nonlinear Large Signal Model — A Necessary Tool for 1st Pass Power Amplifier Design Success	Yueying Liu, *Cree Semiconductor*
WEMA46	13:15 – 13:30	Microwave Signal Generators with Improved Phase Noise and Frequency Stability	Alexander Chenakin, Suresh Ojha, Sadashiv Phadnis, *Anritsu Company*
WEMA48	13:45 – 14:00	PA Design Using Nonlinear Embedding Models	Chris DeMartino, *Modelithics*
WEMA49	14:00 – 14:15	XMA: Advancements Within Quantum Enabling RF Technologies and Challenges Moving Forward	Del Pierson, *XMA Corporation*
WEMA50	14:15 – 14:30	Aerogel Film as a Microwave Substrate	John Gardner, *Blueshift*
WEMA51	14:30 – 14:45	Single Connection Frequency Converter Measurements	Rich Pieciak, *Rohde & Schwarz GmbH & Co KG*
WEMA52	14:45 – 15:00	5G NR Challenges and Trends in RFFE Design	Peter Bacon, *pSemi, a Murata Company*
WEMA53	15:00 – 15:15	5G Private and Non-Terrestrial Network Design	Paul Moakes, *CommAgility*
WEMA54	15:15 – 15:30	A New MIMO Over-the-Air Test Methodology using Dynamic Channel Models and Link Adaptation	Michael Foegelle, *ETS-Lindgren*
WEMA55	15:30 – 15:45	Achieve Best EVM Performance for Modulated Signals in the Millimeter Wave Range	Melanie Mauersberger, *Rohde & Schwarz*
WEMA56	15:45 – 16:00	Achieving Multi Gbps Data Rates in Non-terrestrial Applications	Tudor Williams, *Filtronic*
WEMA57	16:00 – 16:15	Automatic Configuration of Modulation Quality Measurements for DVB-S2(X) and -RCS2 Signals	Florian Ramian, *Rohde & Schwarz GmbH & Co KG*
WEMA58	16:15 – 16:30	Characterize Faster Phased Array Antennas Over-The-Air Using Fast Continuous Scanning	Gerardo Orozco, *NI (National Instruments)*
WEMA59	16:30 – 16:45	Cutting Through the "Fog" to Join High-Bandwidth Edge Sensors with the Secure Cloud Using the Latest SoC Technology	Bob Muro, *Mercury Systems*
WEMA60	16:45 – 17:00	DC to 64Gbps Micro Relay with Integrated Driver, A Simplified Solution to Increase Productivity	Eric Carty, *Analog Devices*

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MTT-S AWARDS BANQUET 18:30 - 21:00 Wednesday, 22 June 2022 Hyatt Regency Denver, Capitol Ballroom

We are delighted to introduce the 2022 recipients of MTT-S Society Awards. Congratulations to all the awardees for being recognized for their outstanding contributions to the field of microwave theory and techniques, significant achievements in their career, or distinguished services to the society. The MTT-S Awards Banquet program includes dinner, entertainment, and technical and service awards presented by the MTT-S Awards Committee.

MTT-S AWARDS	2022 AWARD RECIPIENTS AND DESCRIPTIONS
Microwave Career Award recognizes a career of meritorious achievement and outstanding technical contribution by an individual in the field of microwave theory and techniques.	**Wolfgang J. R. Hoefer**—for a career of leadership, meritorious achievement, creativity and outstanding contributions in the field of microwave theory and techniques.
Microwave Pioneer Award recognizes an individual or a team not exceeding three persons having made outstanding pioneering technical contributions that advance microwave theory and techniques, which are described in an archival paper published at least 20 years prior to the year of the award.	**Kenneth Carr**—for outstanding contributions in the field of microwave theory and techniques.
Distinguished Service Award recognizes an individual who has given outstanding service for the benefit and advancement of the MTT Society.	**Madhu S. Gupta**—for outstanding contributions in the field of microwave theory and techniques.
Distinguished Educator Award recognizes a distinguished educator in the field of microwave engineering and science who best exemplifies the special human qualities of Fred Rosenbaum, who considered teaching a high calling and demonstrated his dedication to the Society through tireless service.	**Ke Wu**— for outstanding achievements as an educator, mentor, and role model of microwave engineers and engineering students.
Microwave Application Award Recognizes an individual or team of no more than five individuals for an outstanding application of microwave theory and techniques, which has been reduced to practice nominally 10 years before the award.	**Matthew A. Morgan**—for the creation of a new class of reflectionless filters.
Outstanding Young Engineer Award recognizes an outstanding young MTT-S member who has distinguished him/herself through achievement(s), which may be technical (within the MTT-S Field of Interest), may be exemplary service to the MTT-S, or may be a combination of both.	**Anthony Ghiotto**—for outstanding early career achievements in substrate integrate waveguide technologies and exemplary service to the society.
	Xun Luo—for outstanding early career achievements in the field of microwave passive and integrated circuits with applications in wireless communication.
	Bodhisatwa Sadhu—for outstanding early career contributions to RF and millimeter-wave circuits and systems.
	Alexis Zamora—for outstanding early career contributions to the solid-state terahertz field.

MTT-S BEST PAPER AWARDS

Microwave Prize recognizes, on an annual basis, the most significant contribution by a published paper to the field of interest of the MTT-S. The Microwave Prize is the Society's oldest Award.	**S. Zhang, R. Lu, H. Zhou, S. Link, Y. Yang, Z Li, K. Huang, X. Ou, and S. Gong**—for their paper "Surface Acoustic Wave Devices using Lithium Niobate on Silicon Carbide", *IEEE Transactions on Microwave Theory and Techniques*, vol. 68, no. 9, pp. 3653-3666, September 2020.
MCWL "Tatsuo Itoh" Award recognizes, on an annual basis, the most significant contribution in a paper published in the *IEEE Microwave and Wireless Component Letters*.	**O. El-Aassar, and G. Rebeiz**—for their paper "A 120-GHz Bandwidth CMOS Distributed Power Amplifier with Multi-Drive Intra-Stack Coupling", *IEEE Microwave and Wireless Components Letters*, vol. 30, no. 8, pp. 782-785, August 2020.
T-TST Best Paper Award recognizes, on an annual basis, the most significant contribution in a paper published in the *IEEE Transactions on Terahertz Science and Technology*.	**L. John, A. Tessmann, A. Leuther, P. Neininger, T. Merkle, and T. Zwick**—for their paper "Broadband 300-GHz Power Amplifier MMICs in InGaAs mHEMT Technology," *IEEE Transactions on Terahertz Science and Technology*, vol. 10, no. 3, pp. 309-320, May 2020.
IEEE Microwave Magazine Best Paper Award recognizes, on an annual basis, the most significant contribution in a paper published in the *IEEE Microwave Magazine*.	**J.C. Bardin, D. Sank, O. Naaman, and E. Jeffrey**—for their paper "Quantum Computing: An Introduction for Microwave Engineers," *IEEE Microwave Magazine*, vol. 21, no. 8, pp. 24-44, August 2020.

ADVANCED PRACTICE AND **INDUSTRY** PAPER COMPETITIONS

The Advanced Practice Paper Competition (APPC) recognizes outstanding technical contributions that apply to practical applications. All finalist papers are on advanced practices and describe an innovative RF/microwave design, integration technique, process enhancement, and/or combination thereof that results in significant improvements in performance and/or in time to production for RF/microwave components, subsystems, or systems.

The Industry Paper Competition (IPC) recognizes outstanding technical contributions from industry sources. All finalist papers are from the RF/microwave industry and describe innovation of a product or system application that potentially has the highest impact on an RF/microwave product and/or system which will significantly benefit the microwave community and society at large.

ADVANCED PRACTICE PAPER FINALISTS:

Th2F: A 32-Element 28/39 GHz Dual-Band Dual-Beam 5G Phased-Array with 40 dBm EIRP and Simultaneous 64 QAM Operation
Authors: Shufan Wang, *Univ. of California*; San Diego; Gabriel Rebeiz, *Univ. of California, San Diego*

We2A: Miniaturized 28 GHz Packaged Bandpass Filter with High Selectivity and Wide Stopband Using Multi-Layer PCB Technology
Authors: Yunbo Rao, *Univ. of Electronic Science and Technology of China*; Huizhen Qian, *Univ. of Electronic Science and Technology of China*; Jie Zhou, *Univ. of Electronic Science and Technology of China*; Yuandan Dong, *Univ. of Electronic Science and Technology of China*; Xun Luo, *Univ. of Electronic Science and Technology of China*

We2C: Deep Learning Enabled Inverse Design of 30-94 GHz Psat-3dB SiGe PA Supporting Concurrent Multi-Band Operation at Multi-Gbps
Authors: Zheng Liu, *Princeton Univ.*; Emir Ali Karahan, *Princeton Univ.*; Kaushik Sengupta, *Princeton Univ.*

INDUSTRY PAPER FINALISTS:

We1E: A 50W CW 1-6 GHz GaN MMIC Power Amplifier Module with Greater than 30% Power Added Efficiency
Authors: Michael Roberg, *QORVO, Inc.*; Jason Zhang, *QORVO, Inc.*; Robert Flynt, *QORVO, Inc.*; Matthew Irvine, *QORVO, Inc.*

Tu4A: A 31-Tap Reconfigurable Analog FIR Filter Using Heterogeneously Integrated Polystrata Delay-Lines
Authors: Eric Wagner, *Northrop Grumman Corp.*; Tim LaRocca, *Northrop Grumman Corp.*; Mark Verderber, *Nuvotronics*; Carlos Rezende, *Nuvotronics*; Peter May, *Nuvotronics*

Th1B: A Reconfigurable SAW Resonator Using Monolithically Integrated Switches
Authors: Arash Fouladi Azarnaminy, *Univ. of Waterloo*; Aminat Oyiza Suleiman, *Institut National de la Recherche Scientifique*; Mohamed Chaker, *Institut National de la Recherche Scientifique*; Raafat Mansour, *Univ. of Waterloo*

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	401-402	403-404	501-502	1A - 1C
	Th1A: Microwave Interaction and Characterization of Biological and Semiconductor Materials **Chair:** Chung-Tse Michael Wu, *Rutgers Univ.* **Co-Chair:** Malgorzata Celuch, *QWED*	**Th1B: Advances in SAW and Acoustic Components Technology** **Chair:** Pierre Blondy, *XLIM (UMR 7252)* **Co-Chair:** Songbin Gong, *Univ. of Illinois at Urbana-Champaign*	**Th1C: Microwave and Terahertz Photonics** **Chair:** Mona Jarrahi, *Univ. of California, Los Angeles* **Co-Chair:** David Harame, *SUNY Polytechnic Institute*	**Th1E: Compound Semiconductor Power Amplifiers** **Chair:** Charles F. Campbell, *Qorvo* **Co-Chair:** Zoya Popović, *Univ. of Colorado Boulder*
08:00 08:10	**Th1A-1: Effect of Treatment for Abandoned DBS Leads on RF-Induced Heating During 1.5T MRI** R. Guo, *Univ. of Houston*; W. Hu, *Univ. of Houston*; J. Zheng, *Univ. of Houston*; C.J. Ballard, *Univ. of Houston*; D. Herrera, *Univ. of Houston*; J. Chen, *Univ. of Houston*	**Th1B-1: A Reconfigurable SAW Resonator Using Monolithically Integrated Switches** A. Fouladi Azarnaminy, *Univ. of Waterloo*; A.O. Suleiman, *INRS-EMT*; M. Chaker, *INRS-EMT*; R.R. Mansour, *Univ. of Waterloo*	**Th1C-1: Terahertz Generation from a Bias-Free, Telecommunication-Compatible Photoconductive Emitter Realized on a Silicon Substrate** P.-K. Lu, *Univ. of California, Los Angeles*; Y. Zhao, *Univ. of California, Los Angeles*; D. Turan, *Univ. of California, Los Angeles*; X. Jiang, *Univ. of California, Los Angeles*; M. Jarrahi, *Univ. of California, Los Angeles*	**Th1E-1: A DC–170GHz InP Distributed Amplifier Using Transmission Line Loss Compensation Technique** P.T. Nguyen, *Univ. of California, Davis*; N.L.K. Nguyen, *Univ. of California, Davis*; A.N. Stameroff, *Keysight Technologies*; A.-V. Pham, *Univ. of California, Davis*
08:20 03:30	**Th1A-2: Dosimetry Performances of a MultiWell-Plate-Based Near-Field RF Applicator for the Investigation of EM Impact on Biological Cells** A. Moscatiello, *LAAS-CNRS*; B. Cerdan, *LAAS-CNRS*; C. Gironde, *Anti Oxidant Power*; C. Furger, *Anti Oxidant Power*; D. Dubuc, *LAAS-CNRS*; K. Grenier, *LAAS-CNRS*	**Th1B-2: Acoustic Delay Lines in Thin-Film Lithium Niobate on Silicon Carbide** S. Cho, *Univ. of Texas at Austin*; Y. Wang, *Univ. of Texas at Austin*; J. Kramer, *Univ. of Texas at Austin*; K. Nguyen, *Univ. of Texas at Austin*; R. Lu, *Univ. of Texas at Austin*	**Th1C-2: 860μW Terahertz Power Generation from Graded Composition InGaAs Photoconductive Nanoantennas** P.-K. Lu, *Univ. of California, Los Angeles*; D. Turan, *Univ. of California, Los Angeles*; M. Jarrahi, *Univ. of California, Los Angeles*	**Th1E-2: A Ku/K/Ka-Band GaAs MMIC Load-Modulated Amplifier with a Negative Group Delay Output Network** N. Mullins, *Univ. of Colorado Boulder*; Y. Vega, *L3Harris*; T. Sonnenberg, *Univ. of Colorado Boulder*; Z. Popovic, *Univ. of Colorado Boulder*
08:40 08:50	**Th1A-3: Measuring Yeast Cell Heterogeneity with a Microwave Flow Cytometer** N. Dahal, *Clemson Univ.*; J. Osterberg, *Clemson Univ.*; T. Caldwell, *Clemson Univ.*; R. Divan, *Argonne National Lab*; S. Harcum, *Clemson Univ.*; P. Wang, *Clemson Univ.*	**Th1B-3: SAW Duplexer with High Isolation Based on Rejection Resonator and Cross Coupled Capacitor** H. Xue, *UESTC*; Y. Dong, *UESTC*	**Th1C-3: Fiber-Optic THz Wireless Uplink with Remote Down-Conversion by Optical Carriers Transmitted from Central Office** S. Cho, *POSTECH*; S.-R. Moon, *ETRI*; M. Sung, *ETRI*; S.-H. Cho, *ETRI*; H.-J. Song, *POSTECH*	**Th1E-3: 2.8–3.8GHz Broadband InGaP/GaAs HBT Doherty Power Amplifier IC for 5G New Radio Handset** H. Oh, W. Choi, H. Koo, J. Shin, Y. Chen, H. Jeon, Y. Choi, H. Jung, J. Hwang, Y. Yang, *Sungkyunkwan Univ.*
09:00 09:10	**Th1A-4: Sensing of Muscular Mouse Cells C2C12 from Seed Out to Electroporation — A Conceptional Study** M. Paravicini, *Technische Univ. Darmstadt*; M. Milden, *Technische Univ. Darmstadt*; D. Birnstengel, *Technische Univ. Darmstadt*; M. Schüßler, *Technische Univ. Darmstadt*; R. Jakoby, *Technische Univ. Darmstadt*; M.C. Cardoso, *Technische Univ. Darmstadt*; C. Hessinger, *Technische Univ. Darmstadt*	**Th1B-4: Silicon-SAW Resonators and Delay Lines Based on Sub-Micron Lithium Niobate and Amorphous Silicon** Y. Yang, *HKUST*; L. Gao, *Univ. of Illinois at Urbana-Champaign*; S. Gong, *Univ. of Illinois at Urbana-Champaign*	**Th1C-4: Photonic-Enabled Real-Time Spectrogram Analysis of Sub-Nanosecond Microwave Events Over a 40GHz Instantaneous Bandwidth** C.M.L. Rowe, *INRS-EMT*; B. Crockett, *INRS-EMT*; J. Azaña, *INRS-EMT*	**Th1E-4: Broadband 100-W Ka-Band SSPA Based on GaN Power Amplifiers** Philipp Neininger, Laurenz John, Martin Zink, Dirk Meder, Michael Kuri, Axel Tessmann, Christian Friesicke, *Fraunhofer Institute for Applied Solid State Physics*; Michael Mikulla, Rüdiger Quay, *Fraunhofer Institute for Applied Solid State Physics*, Thomas Zwick, *Karlsruhe Institute of Technology*
09:20 09:30	**Th1A-5: Irradiated Silicon for Microwave and Millimeter Wave Applications** Jerzy Krupka, *Warsaw Univ. of Technology*; Bartlomiej Salski, *Warsaw Univ. of Technology*; Tomasz Karpisz, *Warsaw Univ. of Technology*; Pawel Kopyt, *Warsaw Univ. of Technology*; Leif Jensen, *Topsil GlobalWafers A/S*; Marcin Wojciechowski, *Central Office of Measures*		**Th1C-5: A Large Signal Equivalent Circuit Modeling and Enhanced RF Output Power of PIN Photodiodes** J. Li, *UESTC*; F. You, *UESTC*; M. Ma, *UESTC*; C. Shen, *UESTC*; Y. Wang, *UESTC*; Y. Chen, *UESTC*; C. He, *UESTC*; X. Zhang, *UESTC*; S. He, *UESTC*	**Th1E-5: A 100W W-Band GaN SSPA** Jason Soric, *Raytheon Company*; Nicholas Kolias, *Raytheon Technologies*; Jeffrey Saunders, *Raytheon Technologies*; Jeffrey Kotce, *Raytheon Technologies*; Andrew Brown, *Raytheon Technologies*; Christopher Rodenbeck, *U.S. Naval Research Laboratory*; Ronald Gyurcsik, *Raytheon Technologies*
09:40				

1D-1F

Th1F: Efficient Characterization and Test of Phased-Array Antenna Systems: Is it Really a Nightmare?*

Chair: Marc Vanden Bossche, *National Instruments*

Co-Chair: Matt Spexarth, *National Instruments*

08:00

Th1F-1: Keynote: Calibrating RF/Microwave Front Ends in Multichannel Receiver and Transmitter Systems

Mike Jones, *Analog Devices, Inc.*

08:10

08:20

Th1F-2: Rydberg Atomic Electrometry: A Near-Field Technology for Complete Far-Field Imaging in Seconds?

D. Booth, *Quantum Valley Ideas Laboratories*; K. Nickerson, *Quantum Valley Ideas Laboratories*; S. Bohaichuk, *Quantum Valley Ideas Laboratories*; J. Erskine, *Quantum Valley Ideas Laboratories*; J.P. Shaffer, *Quantum Valley Ideas Laboratories*

03:30

08:40

Th1F-3: A Novel OTA Near-Field Measurement Approach Suitable for 5G mmWave Wideband Modulated Tests

M. Löhning, *National Instruments*; T. Deckert, *National Instruments*; V. Kotzsch, *National Instruments*; M. Vanden Bossche, *National Instruments*

08:50

09:00

Th1F-4: Fast Simultaneous Characterization of All Analog Phased Array Elements

M.D. Foegelle, *ETS-Lindgren*

09:10

09:20

Th1F-5: Preliminary System Integration and Performance Features for an S-Band, Dual-Polarized, All-Digital Phased Array Radar

C. Fulton, *Univ. of Oklahoma*; N. Goodman, *Univ. of Oklahoma*; M. Yeary, *Univ. of Oklahoma*; R. Palmer, *Univ. of Oklahoma*; H.H. Sigmarsson, *Univ. of Oklahoma*; J. McDaniel, *Univ. of Oklahoma*

09:30

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09:40

Systems Pavilion Participants

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	401-402	403-404	501-502	1A - 1C
	Th2A: Measurement and Instrumentation Techniques for Evolving Standards in Future Technologies* **Chair:** Jon Martens, *Anritsu* **Co-Chair:** Gian Piero Gibiino, *Università di Bologna*	**Th2B: Recent Advances in Acoustic Resonators and Filters** **Chair:** Amelie Hagelauer, *Technische Universität München* **Co-Chair:** Brice Ivira, *Broadcom*	**Th2C: Nano-Devices and their High Frequency Applications** **Chair:** Luca Pierantoni, *Università Politecnica delle Marche* **Co-Chair:** Davide Mencarelli, *Università Politecnica delle Marche*	**Th2E: Recent Advances in Microwave Semiconductor Technology Dedicated to Dick Sparks** **Chair:** Tony G. Ivanov, *U.S. Army Research Laboratory* **Co-Chair:** Julio Costa, *Qorvo*
10:10 10:20	**Th2A-1: 3D Chip-Level Broadband Measurement Technique for Radiated EM Emission** Y.-C. Chang, *NARLabs-TSRI*; J. Wang, *National Tsing Hua Univ.*; T.-Y. Lin, *NARLabs-TSRI*; C.-P. Hsieh, *NARLabs-TSRI*; Y. Huang, *Univ. of Liverpool*; S.S.H. Hsu, *National Tsing Hua Univ.*; D.-C. Chang, *NARLabs-TSRI*	**Th2B-1: 33 GHz Overmoded Bulk Acoustic Resonator** Zachary Schaffer, *Carnegie Mellon Univ.*; Pietro Simeoni, *Carnegie Mellon Univ.*; Gianluca Piazza, *Carnegie Mellon Univ.*	**Th2C-1: 28nm Neck Width Graphene Geometric Diode for THz Harvesting** H. Wang, *KAUST*; A. Shamim, *KAUST*	**Th2E-1: Time Dependence of RF Losses in GaN-on-Si Substrates** Pieter Cardinael, *Université Catholique de Louvain*; Sachin Yadav, *IMEC*; Ming Zhao, *IMEC*; Martin Rack, *Université Catholique de Louvain*; Dimitri Lederer, *Université Catholique de Louvain*; Nadine Collaert, *IMEC*; Bertrand Parvais, *IMEC*; Jean-Pierre Raskin, *Université Catholique de Louvain*
10:30 10:40	**Th2A-2: Linearity Metrics and Signal Statistics — The Need for Standards** R. Figueiredo, *Universidade de Aveiro*; N. Carvalho, *Universidade de Aveiro*	**Th2B-2: Miniaturized Ultrawide Bandwidth WiFi 6E Diplexer Implementation Using XBAW RF Filter Technology** S. Gupta, *Akoustis*; E. Mehdizadeh, *Akoustis*; K. Cheema, *Akoustis*; J.B. Shealy, *Akoustis*	**Th2C-2: Self-Consistent and Full-Wave Analysis of Carbon-Nanotube Matrices for Multi-Channel Charge Confinement** D. Mencarelli, *Università Politecnica delle Marche*; G.M. Zampa, *Università Politecnica delle Marche*; C.H. Joseph, *Università Politecnica delle Marche*; L. Pierantoni, *Università Politecnica delle Marche*	**Th2E-2: Channel Thickness Impact on the Small- and Large-Signal RF Performance of GaN HEMTs on Si with a cGaN Back-Barrier** R. ElKashlan, *IMEC*; A. Khaled, *IMEC*; R. Rodriguez, *IMEC*; S. Yadav, *IMEC*; U. Peralagu, *IMEC*; A. Alian, *IMEC*; N. Collaert, *IMEC*; P. Wambacq, *IMEC*; B. Parvais, *IMEC*
10:50 11:00	**Th2A-3: A 110 GHz Comb Generator in a 250 nm InP HBT Technology** Jerome Cheron, Dylan Williams, Richard Chamberlin, *National Institute of Standards and Technology*; Miguel Urteaga, *Teledyne Scientific*; Paul Hale, Rob Jones, Ari Feldman, *National Institute of Standards and Technology*	**Th2B-3: Neural Network-Aided Spurious Modes Optimization Targeting Lithium Niobate MEMS Resonators** L. Colombo, *Northeastern Univ.*; L. Baldesi, *Northeastern Univ.*; T. Melodia, *Northeastern Univ.*; M. Rinaldi, *Northeastern Univ.*	**Th2C-3: Towards 500GHz Non-Volatile Monolayer 6G Switches** M. Kim, *UNIST*; G. Docournau, *IEMN (UMR 8520)*; S. Skrzypczak, *IEMN (UMR 8520)*; P. Szriftgiser, *PhLAM (UMR 8523)*; S.J. Yang, *Univ. of Texas at Austin*; N. Wainstein, *Technion*; K. Stern, *Technion*; H. Happy, *IEMN (UMR 8520)*; E. Yalon, *Technion*; E. Pallecchi, *IEMN (UMR 8520)*; D. Akinwande, *Univ. of Texas at Austin*	**Th2E-3: On the Influence of Transistor Dimensions on the Dispersive Behavior in AlGaN/GaN HEMT-Based PAs and Robust LNAs** S. Krause, *FBH*; C. Zervos, *Technion*; P. Beleniotis, *Brandenburgische Technische Universität*; D. Ritter, *Technion*; M. Rudolph, *Brandenburgische Technische Universität*; W. Heinrich, *FBH*
11:10 11:20	**Th2A-4: Silicon Micromachined Metrology Components for 0.5–1.1THz** J. Campion, *TeraSi*; B. Beuerle, *TeraSi*	**Th2B-4: Wideband Hybrid Acoustic-Electromagnetic Filters with Prescribed Chebyshev Functions** G. Ariturk, *Univ. of Oklahoma*; N.R. Almuqati, *Univ. of Oklahoma*; Y. Yu, *Texas Instruments*; E.T.-T. Yen, *Texas Instruments*; A. Fruehling, *Texas Instruments*; H.H. Sigmarsson, *Univ. of Oklahoma*	**Th2C-4: Inverted Scanning Microwave Microscopy of a Vital Mitochondrion in Liquid** Afifa Azman, Gianluca Fabi, Eleonora Pavoni, Christopher Joseph, *Univ. Politecnica delle Marche*; Niccolo Pini, Tiziana Pietrangelo, *Università "G. D'Annunzio"*; Luca Pierantoni, Antonio Morini, Davide Mencarelli, Andrea Di Donato, *Univ. Politecnica delle Marche*; James Hwang, *Cornell Univ.*; Marco Farina, *Univ. Politecnica delle Marche*	**Th2E-4: Diamond Schottky p-i-n Diodes: DC, Small-Signal and Large-Signal Behavior for RF Applications** V. Jha, *Arizona State Univ.*; H. Surdi, *Arizona State Univ.*; F. Koeck, *Arizona State Univ.*; R.J. Nemanich, *Arizona State Univ.*; S.M. Goodnick, *Arizona State Univ.*; T.J. Thornton, *Arizona State Univ.*
11:30 11:40	**Th2A-5: WG29/WR7 Band Thermoelectric Power Sensor Characterization Using Microcalorimetry Technique** M. Celep, *NPL*; G.N. Phung, *PTB*; F. Ziadé, *LNE*; D. Stokes, *NPL*; J. Rühaak, *PTB*; K. Kuhlmann, *PTB*; D. Allal, *LNE*	**Th2B-5: S-Band High Passive Gain Resonant Transformers Based on Aluminum Nitride FBAR Resonators** Y.-M. Huang, *National Tsing Hua Univ.*; C.-Y. Chang, *National Tsing Hua Univ.*; T.-H. Hsu, *National Tsing Hua Univ.*; Y. Ho, *VIS*; Y.-H. Chen, *VIS*; Y.R. Pradeep, *VIS*; R. Chand, *VIS*; S.-S. Li, *National Tsing Hua Univ.*; W. Fang, *National Tsing Hua Univ.*; M.-H. Li, *National Tsing Hua Univ.*	**Th2C-5: Integrated CNT Aerogel Absorbers for Sub-THz Waveguide Systems** P.A. Drózdz, *Polish Academy of Sciences*; J. Campion, *KTH*; N. Xenidis, *KTH*; A. Krajewska, *Polish Academy of Sciences*; A. Przewloka, *Polish Academy of Sciences*; S. Smirnov, *KTH*; M. Haras, *Polish Academy of Sciences*; A. Nasibulin, *Aalto Univ.*; D.V. Lioubtchenko, *Polish Academy of Sciences*	**Th2E-5: Long-Term Large-Signal RF Reliability Characterization of SiGe HBTs Using a Passive Impedance Tuner System** C. Weimer, *Technische Universität Dresden*; E. Vardarli, *Technische Universität Dresden*; G.G. Fischer, *IHP*; M. Schröter, *Technische Universität Dresden*
11:50				

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1D-1F

Th2F: Antenna Systems for 5G and SATCOM Applications Dedicated to Ferdo Ivanek

Chair: Robin Garg, *MediaTek, Inc.*
Co-Chair: Julio Navarro, *Boeing*

10:10

Th2F-1: 16–52GHz 5G Transmit and Receive 64-Element Phased-Arrays with 50–51.7dBm Peak EIRP and Multi-Gb/s 64-QAM Operation

10:20

A. Alhamed, *Univ. of California, San Diego*; G. Gultepe, *Univ. of California, San Diego*; G.M. Rebeiz, *Univ. of California, San Diego*

10:30

Th2F-2: A Ka-Band Transmit Phased-Array Antenna-in-Package for SATCOM-on-the-Move User Terminals

10:40

A. Raeesi, *Univ. of Waterloo*; N. Ghafarian, *Univ. of Waterloo*; W.M. Abdel-Wahab, *Univ. of Waterloo*; A. Palizban, *Univ. of Waterloo*; A. Ehsandar, *Univ. of Waterloo*; E. Alian, *Univ. of Waterloo*; M.-R. Nezhad-Ahmadi, *Univ. of Waterloo*; S. Safavi-Naeini, *Univ. of Waterloo*

10:50

Th2F-3: Implementation and Far-Field Calibration of an 8×8 37–40GHz Phased Array with Vivaldi Aperture

11:00

G. Lasser, *Univ. of Colorado Boulder*; A. Samaiyar, *Ansys*; G.R. Friedrichs, *Univ. of Colorado Boulder*; L.B. Boskovic, *Univ. of Colorado Boulder*; M.A. Elmansouri, *Univ. of Colorado Boulder*; D.S. Filipovic, *Univ. of Colorado Boulder*

11:10

Th2F-4: Dual-Input Digital Predistortion of Millimeter-Wave RF Beamforming Arrays Driven by Two Non-Contiguous Intra-Band Signals

11:20

A. Ben Ayed, *Univ. of Waterloo*; Y. Cao, *Univ. of Waterloo*; P. Mitran, *Univ. of Waterloo*; S. Boumaiza, *Univ. of Waterloo*

11:30

Th2F-5: A 32-Element 28/39GHz Dual-Band Dual-Beam 5G Phased-Array with 40dBm EIRP and Simultaneous 64 QAM Operation

11:40

S. Wang, *Univ. of California, San Diego*; G.M. Rebeiz, *Univ. of California, San Diego*

Th2F-6: A 1024-Element Ku-Band SATCOM Phased-Array Transmitter with 39.2dBW EIRP and ±53° Beam Scanning

11:50

Y.-H. Wang, *Rapidtek*; J.-H. Chou, *Rapidtek*; W.-J. Lin, *Rapidtek*

MICROAPPS

09:30 – 13:30 | Thursday, 23 June 2022 | IMS Show Floor: Booth 9110

SESSION CODE	TIME	TITLE	SPEAKER/S, AFFILIATION
THMA61	09:30 – 09:45	Highly Accurate RF System Modeling	Chris DeMartino, *Modelithics*
THMA62	09:45 – 10:00	High-Performance or Low-Cost Signal Generation: Why Accept That Trade-Off?	Bob Buxton, *Boonton*
THMA63	10:00 – 10:15	High-Rate Sample Clocks for Wideband RF Systems	Raymond Baker, *Richardson RFPD*
THMA64	10:15 – 10:30	Improve Speed for Modulated Test in Characterization and Production	Markus Loerner, *Rohde & Schwarz USA, Inc.*
THMA65	10:30 – 10:45	Improving RF Performance for Base Transceiver Stations and Automotive Designs with Highly Reliable, High Power Handling, Ultra-Low Insertion Loss RF Switches	Joe Simanis, *Nisshinbo Micro Devices*
THMA66	10:45 – 11:00	Need sub-10fs RMS Jitter Signal Generation: Translation Loops	Unal Kudret, *Analog Devices, Inc.*
THMA67	11:00 – 11:15	The Technical Challenges of Employing GaN and How to Overcome Them	Tudor Williams, *Filtronic*
THMA68	11:15 – 11:30	Using Commercial Instruments to Record and Playback Interference Signals	Alejandro Buritica, Andrew Cobas, *Tektronix*
THMA69	11:30 – 11:45	Performance of Marki Microwave Components in Quantum Information Systems	Harley Berman, *Marki Microwave*
THMA70	11:45 – 12:00	Strategies for Enabling Quantum Development with Test and Measurement from 77K down to milli-Kelvin	Jack DeGrave, *FormFactor*
THMA71	12:00 – 12:15	Tunable and Fixed Filtering Solutions Enhances Dynamic Range and Flexibility of 4G-5G-LTE Characterization Measurements	Rafi Hershtig, *K&L Microwave*
THMA72	12:15 – 12:30	WIPL-D Domain Decomposition Solver: 12 Million Unknowns – One Server – One Day	Miodrag Tasic, *Univ. of Belgrade,* Branko Kolundzija, *WIPL-D*
THMA73	13:00 – 13:30	Drawing for winners of IMS2022 Mini Golf Classic!	

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401-402

Th3A: MHz-to-THz Instrumentation for Biological Measurements and Healthcare Applications

Chair: Olga Boric-Lubecke, *Univ. of Hawaii at Manoa*

Co-Chair: Tomislav Markovic, *Univ. of Zagreb*

13:30

Th3A-1: A 0.43g Wireless Battery-less Neural Recorder with On-chip Microelectrode Array and Integrated Flexible Antenna

13:40

Hengying Shan, *Purdue Univ.*; John Peterson III, *Purdue Univ.*; Nathan Conrad, *Purdue Univ.*; Yu Tang, *Purdue Univ.*; Yuhang Zhu, *Purdue Univ.*; Shabnam Ghotbi, *Purdue Univ.*; Sutton Hathorn, *Purdue Univ.*; Alexander Chubykin, *Purdue Univ.*; Saeed Mohammadi, *Purdue Univ.*

13:50

Th3A-2: UHF-Dielectrophoresis Signatures as a Relevant Discriminant Electromagnetic Biomarker of Colorectal Cancer Stem Cells

14:00

E. Lambert, *XLIM (UMR 7252)*; E. Barthout, *CAPTuR (EA 3842)*; R. Manczak, *XLIM (UMR 7252)*; S. Sadaa, B. Bessette, M. Mathonnet, F. Lalloué, *CAPTuR (EA 3842)*; C. Dalmay, A. Pothier, *XLIM (UMR 7252)*

14:10

Th3A-3: Contactless Measurement of Human Systolic Time Intervals based on Differential Doppler Cardiogram in Clinical Environment

14:20

Shuqin Dong, *Shanghai Jiao Tong Univ.*; Li Wen, *Shanghai Jiao Tong Univ.*; Zhi Zhang, *Shanghai General Hospital*; Changzhan Gu, *Shanghai Jiao Tong Univ.*; Junfa Mao, *Shanghai Jiao Tong Univ.*

14:30

Th3A-4: Multi-Target Concurrent Vital Sign and Location Detection Using Super-Regenerative Oscillator-Based Metamaterial Pulsed Radar

14:40

Y. Yuan, *Rutgers Univ.*; C.-T.M. Wu, *Rutgers Univ.*

14:50

Th3A-5: Multi-Subject Heart Rate Estimation and Real-Time Tracking Using a mmWave Radar and Trace Carving Algorithm

15:00

C.J. Bauder, *Univ. of Tennessee*; A.-K. Moadi, *Univ. of Tennessee*; M. Joshi, *Univ. of Tennessee*; A.E. Fathy, *Univ. of Tennessee*

15:10

403-404

Th3B: Emerging Phase-Change and SIW Technologies for mm-Wave to Sub-THz Applications

Chair: John Ebel, *AFRL*

Co-Chair: Tejinder Singh, *Dell Technologies*

Th3B-1: A W-Band Photoconductive Evanescent-Mode Waveguide Switch

T.R. Jones, *Univ. of Alberta*; A. Fisher, *Purdue Univ.*; D.W. Barlage, *Univ. of Alberta*; D. Peroulis, *Purdue Univ.*

Th3B-2: Off-State Stability of Phase-Change Material RF-Switches

N. Le Gall, *XLIM (UMR 7252)*; I. Bettoumi, *XLIM (UMR 7252)*; C. Hallepee, *XLIM (UMR 7252)*; P. Blondy, *XLIM (UMR 7252)*

Th3B-3: Chalcogenide GeTe-Based Non-Volatile Switched K-Band Tunable Reflective Load for Reconfigurable RF Circuits

T. Singh, *Univ. of Waterloo*; R.R. Mansour, *Univ. of Waterloo*

Th3B-4: AFSIW Y-Junction Circulator for High-Power Handling New Space Applications

I. Marah, *Cobham Microwave*; A. Ghiotto, *IMS (UMR 5218)*; A. Verger, *Cobham Microwave*; J.-M. Pham, *IMS (UMR 5218)*

501-502

Th3C: Silicon Based Digital Power Amplifier Architectures

Chair: Mark P. van der Heijden, *NXP Semiconductors*

Co-Chair: Sushil Kumar, *Marki Microwave*

Th3C-1: A Large Dynamic Range Reconfigurable Interpolation Digital Transmitter for NB-IoT Applications

Nagarajan Mahalingam, Hang Liu, Yisheng Wang, Kiat Seng Yeo, *Singapore Univ. of Technology and Design*; Chien-I Chou, Hung-Yu Tsai, Kun-Hsun Liao, Wen-Shan Wang, Ka-Un Chan, Ying-Hsi Lin, *Realtek Semiconductor Corp.*

Th3C-2: A Wideband Two-Way Digital Doherty Transmitter in 40nm CMOS

M. Beikmirza, *Technische Universiteit Delft*; Y. Shen, *Technische Universiteit Delft*; L.C.N. de Vreede, *Technische Universiteit Delft*; M.S. Alavi, *Technische Universiteit Delft*

Th3C-3: A 39W Fully Digital Wideband Inverted Doherty Transmitter

R. Bootsman, *Technische Universiteit Delft*; Y. Shen, *Technische Universiteit Delft*; D. Mul, *Technische Universiteit Delft*; M. Rousstia, *Ampleon*; R. Heeres, *Ampleon*; F. van Rijs, *Ampleon*; J. Gajadharsing, *Ampleon*; M.S. Alavi, *Technische Universiteit Delft*; L.C.N. de Vreede, *Technische Universiteit Delft*

1A - 1C

Th3E: Reconfigurable RF Systems for 5G mm-Wave Communications

Chair: Holger Maune, *OvG Universität Magdeburg*

Co-Chair: Nathan Orloff, *NIST*

Th3E-1: Slow-Wave MEMS Phase Shifter with Liquid Crystal for Reconfigurable 5G

L. Gomes, *Universidade de São Paulo*; D. Wang, *Technische Univ. Darmstadt*; G. Palomino, J. Lé, *Universidade de São Paulo*; R. Jakoby, *Technische Univ. Darmstadt*; H. Maune, *OvG Universität Magdeburg*; P. Ferrari, *RFIC-Lab (EA 7520)*; A.L.C. Serrano, G.P. Rehder, *Universidade de São Paulo*

Th3E-2: A 18–50GHz Two-Phase Mixer-First Receiver Front-End in 45-nm SOI

A.A. Nawaz, *Michigan State Univ.*; S.-C. Hung, *Michigan State Univ.*; M. Hodek, *Michigan State Univ.*; J.D. Albrecht, *Michigan State Univ.*; A.Ç. Ulusoy, *Michigan State Univ.*

Th3E-3: Reconfigurable Millimeter-Wave Power Amplifiers in GaN and SOI Using Passive Load Modulation

R.R. Karnaty, *Univ. of California, Santa Barbara*; S.-M. Chang, *Univ. of California, Santa Barbara*; J.F. Buckwalter, *Univ. of California, Santa Barbara*

Th3E-4: Dynamically Reconfigurable Metasurface Antennas for Mobile Connectivity in 5G Non-Terrestrial Networks

A. Bautista, *Kymeta*; R. Stevenson, *Kymeta*; M. Sazegar, *Kymeta*; T. Schlichter, *Fraunhofer IIS*; T. Heyn, *Fraunhofer IIS*

Th3E-5: A Configurable Architecture for Efficient Sparse FIR Computation in Real-Time Radio Frequency Systems

J. Seo, *Georgia Tech*; M. Mukherjee, *Georgia Tech*; N. Mizanur Rahman, *Georgia Tech*; J. Tong, *Georgia Tech*; C. DeLude, *Georgia Tech*; T. Krishna, *Georgia Tech*; J. Romberg, *Georgia Tech*; S. Mukhopadhyay, *Georgia Tech*

1D-1F

Th3F: Advances in Integrated Transceivers for Beamforming and RADAR Applications

Chair: Jonathan P. Comeau, *Anokiwave*
Co-Chair: Najme Ebrahimi, *Univ. of Florida*

13:30

Th3F-1: A 28GHz Butler Matrix Based Switched Beam-Forming Network with Phase Inverting Switch for Dual-Port Excitation in 28nm CMOS

Y. Lee, *Yonsei Univ.*; B. Suh, *Samsung*; B.-W. Min, *Yonsei Univ.*

13:40

13:50

Th3F-2: A 1.9dB NF K-Band Temperature-Healing Phased-Array Receiver Employing Hybrid Packaged 65nm CMOS Beamformer and 0.1µm GaAs LNAs

Dixian Zhao, Peng Gu, Jiajun Zhang, Yongran Yi, Mengru Yang, Chenyu Xu, *Southeast Univ.*; Yuan Chai, Huiqi Liu, Pingyang He, Na Peng, *Chengdu Xphased Technology Company Ltd.*; Liangliang Liu, Xiangxi Yan, *Purple Mountain Laboratories*; Xiaohu You, *Southeast Univ.*

14:00

14:10

Th3F-3: A Fully-Integrated CMOS System-on-Chip Ku Band Radiometer System for Remote Sensing of Snow and Ice

A. Tang, *Univ. of California, Los Angeles*; Y. Kim, *Stevens Institute of Technology*; M.-C.F. Chang, *Jet Propulsion Lab*

14:20

14:30

Th3F-4: A 94GHz FMCW Radar Transceiver with 17dBm Output Power and 6.25dB NF in 65nm CMOS

Z. Song, *UESTC*; Y. Yu, *UESTC*; C. Zhao, *UESTC*; X. Zhang, *UESTC*; J. Zhu, *UESTC*; J. Guo, *UESTC*; H. Liu, *UESTC*; Y. Wu, *UESTC*; K. Kang, *UESTC*

14:40

14:50

15:00

15:10


EVAN SEMON

99TH ARFTG MICROWAVE MEASUREMENT CONFERENCE

NVNA USERS' FORUM

Thursday, 23 June 2022 | 15:30 – 16:45 | Hyatt Regency Denver

ORGANIZER: Patrick Roblin

ON-WAFER USERS' FORUM

Thursday, 23 June 2022 | 16:45 – 18:00 | Hyatt Regency Denver

ORGANIZER: Andrej Rumiantsev

PANEL SESSION

12:10 - 13:20 | Thursday, 23 June 2022 | Room: 2C–3C

Wearables – Our Life Depends on Them!

PANEL ORGANIZERS:

Ke Wu, *Ecole Polytechnique in Montreal;* **J.-C. Chiao,** *Southern Methodist Univ.*

PANELISTS:

Manos Tentzeris, *Georgia Tech;* **Yang Hao,** *Queen Mary Univ. of London;* **Patrick Mercier,** *Univ. of California, San Diego;* **Ilja Ocket,** *IMEC Belgium;* **Colin Drummond,** *Case School of Engineering School of Medicine*

ABSTRACT: Wearables with convenience, comfort, ubiquitousness, and modularity can provide essential or critical functions to keep us healthy and save lives. They involve multidisciplinary efforts, collaborations, and partnerships in sensing, communication, materials, networking, and system integration. Experts from various disciplines from multiple IEEE societies will talk about the current R&D progress, issues, and challenges in this panel.

PANEL SESSION

12:10 - 13:20 | Thursday, 23 June 2022 | Room: 4D-4F

Modern Phased Arrays and OTA Testing: A Design or a Measurement Challenge?*

** Co-Sponsored by ARFTG*

PANEL ORGANIZERS:

Gerardo Orozco, *National Instruments;* **Thomas Williamson,** *Georgia Tech Research Institute;* **Jeffrey Jargon,** *National Institute of Standards and Technology;* **Jon Martens,** *Anritsu*

PANELISTS:

Matt Little, *Ball Aerospace;* **Sidina Wane,** *eV-Technologies;* **Caleb Fulton,** *Univ. of Oklahoma;* **Michael Foegelle,** *ETS-Lindgren;* **Cesar Lugo,** *L3Harris;* **Rob Horansky,** *National Institute of Standards and Technology*

ABSTRACT: This panel addresses current and future challenges regarding over the air (OTA) characterization, measurement, and calibration of modern phased arrays. We will discuss various repeatable, practical, and economic methods for addressing challenges presented by emerging technology. We will draw on a breadth of knowledge from academia, the defense and aerospace industry, and the cellular industry to speak to the diversity of array technology for 5G, 6G, satellite-borne arrays, and radar.

TECHNICAL LECTURE

13:30 – 15:10 | Thursday, 23 June 2022 | Room: 4A–4C

	LECTURE TITLE	LECTURE ABSTRACT
TL4	**Semiconductor Electronics for High Power/High Speed Reconfigurable RF and Microwave Electronics** **Speaker:** Robert Caverly, *Villanova Univ.*	The microwave and RF design engineer always seeks to develop a design that will meet specifications the first time that the circuit is fabricated. To do so requires that as many elements and phenomenon as possible associated with the control devices and circuit be accurately modeled. In the case of the microwave and RF semiconductor control circuits, accurate modeling of the solid-state control components over frequency, voltage, current and power is key to successful control system design. This talk will cover material that will provide the RF and microwave design engineer insight into the physical operation and modeling of PIN diodes and field-effect transistors (FETs) as control components and their use in microwave and RF control circuits. The talk will cover basic RF and microwave control circuits for reconfigurable electronics, and then focus on linear and nonlinear models for PIN diode, MESFET and MOSFET control elements to implement these circuits. The talk will conclude with control circuit examples using these models for use in reconfigurable RF and microwave electronics.

INTERACTIVE FORUM SESSION & PHASED ARRAYS AND OTA DAY RECEPTION

13:30 – 15:30

Thursday, 23 June 2022

Room: 2A–3B

Chairs: Akim Babenko, Justus Brevik, Robert Horansky, *NIST*

THIF3-1: Plenary Poster: Full-Duplex Phased Arrays: Multi-Function Applications and Enabling Technologies

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

THIF3-2: A 40Gbps QAM-16 Communication Link Using a 130nm SiGe BiCMOS Process

F. Strömbeck, Y. Yan, Z.S. He, H. Zirath, *Chalmers Univ. of Technology*

THIF3-3: An Octave Bandwidth Spatial Power Combiner with Supply Voltage Control

L. Marzall, C. Nogales, G. Lasser, Z. Popovic, *Univ. of Colorado Boulder*

THIF3-4: Laser-Based Noncontact Blood Pressure Estimation Using Human Body Displacement Waveforms

Y. Oyamada, T. Koshisaka, *Kyoto Univ.*; G. Stankaitis, *Univ. of Hawaii at Manoa*; S.M.M. Islam, *Univ. of Dhaka*; V.M. Lubecke, O. Boric-Lubecke, *Univ. of Hawaii at Manoa*; T. Sakamoto, *Kyoto Univ.*

THIF3-5: Time Domain-Based Reflectometry Measurements for 3D Printed Graded Index Dielectrics

P. Bluem, R.G. Rojas, B. Duncan, D. Beck, *MIT Lincoln Laboratory*

THIF3-6: Reference Measurements of Error Vector Magnitude

P. Manurkar, *Univ. of Colorado Boulder*; C.P. Silva, *Aerospace*; J. Kast, *Colorado School of Mines*; R.D. Horansky, D.F. Williams, K.A. Remley, *NIST*

THIF3-7: Investigations on Direction of Arrival and Range Estimation with a Switched Beam Antenna Architecture Implementing Space and Frequency Division Multiple Access

A. Cidronali, G. Collodi, S. Maddio, M. Passafiume, G. Pelosi, *Università di Firenze*

THIF3-8: 180GHz Low-Loss Copper Nanowire CPW Interconnects

A. Dave, Y. Zhang, *Univ. of Minnesota*; N. Mahjabeen, *Univ. of Texas at Dallas*; A. Harpel, *Univ. of Minnesota*; R. Henderson, *Univ. of Texas at Dallas*; B. Stadler, R.R. Franklin, *Univ. of Minnesota*

THIF3-9: On the Influence of Electrode Thickness in the Spurious Mode Reduction of Lithium Niobate-On-Insulator SH_0 Acoustic Wave Resonators

E. Guerrero, L. Acosta, *Univ. Autònoma de Barcelona*; C. Caballero, J. Verdú, *Univ. Autònoma de Barcelona*; A. Guerrero, *IMB-CNM*; X. Borrisé, *ICN2*; J. Esteve, *IMB-CNM*; P. de Paco, *Univ. Autònoma de Barcelona*

THIF3-10: Low-Bias-Complexity Ku-Band GaN MMIC Doherty Power Amplifier

G. Naah, *Università di Roma "Tor Vergata"*; A. Piacibello, V. Camarchia, *Politecnico di Torino*; P. Colantonio, R. Giofrè, *Università di Roma "Tor Vergata"*

THIF3-11: Long-Range Vital Sign Monitoring by Using a W Band Heterogeneously Integrated FMCW Radar Sensor

Y.-S. Huang, X. Yang, L. Zhou, C. Gu, J. Mao, *SJTU*

THIF3-12: Waveguide Iris Sensor with Thermal Modulation for Non-Intrusive Flow Rate Measurements

O. Niksan, A. Shah, M.H. Zarifi, *Univ. of British Columbia*

INDUSTRY WORKSHOPS

10:10 – 15:10

Thursday, 23 June 2022

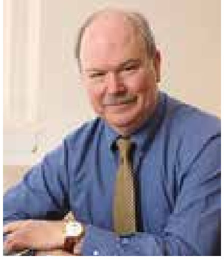
SESSION CODE	TIME & LOCATION	TITLE AND ABSTRACT	SPEAKER/S, AFFILIATION
IWTH2	10:10 – 11:50 Room: 205/207	**Emerging EMC Requirements for 5G mmWave Device Measurements** Achieving electromagnetic compatibility (EMC) for 5G devices is dependent upon the existence of achievable and appropriate regulatory requirements along with meaningful test methods for demonstrating compliance. This workshop will investigate new developments in test methods, focused on meeting the regulatory requirements of the FCC but with global application, with presentations focused on wireless coexistence and radiated emissions test methods. An overview of wireless coexistence measurements and challenges is presented followed by a focus on automotive applications. This is followed by an overview of emerging radiated emissions test methods and research on utilizing a reverberation methodology for faster TRP measurements.	Garth D'Abreu, *ETS-Lindgren;* Jason Coder, *NIST;* Aurelian Bria, *Ericsson;* Jari Vikstedt, *ETS-Lindgren*
IWTH3	13:30 – 15:10 Room: 205/207	**Materials Characterization and Assessment for 5G/mmWave Applications** The Workshop discusses the iNEMI 5G benchmarking activity of materials' characterization techniques relevant to 5G/mmWave applications. Four measurement methods (SCR, SPDR, BCDR, FPOR) have been identified and tested in a round-robin of 10 sample kits (including Precision Teflon, COP, and fused silica) circulated between 10 laboratories. The experimental results will be presented and the physics of the measurement process will be illustrated with FDTD, FEM, and MoM simulations. The Workshop comprises four 15-minute lectures (5G industry needs; benchmarked methods and EM insight; round-robin results; best practices and recommendations) followed by 45-minute hands-on exercises and 15-minute discussion.	Malgorzata Celuch, *QWED Sp. z o.o.;* Say Phommakesone, *Keysight Technologies;* Marzena Olszewska-Placha, *QWED Sp. z o.o.;* Urmi Ray, *iNEMI;* Nate Orloff, Lucas Enright, *NIST*

IMS CLOSING SESSION | 15:30 – 17:00 | Thursday, 23 June 2022 | Four Seasons Ballroom

Learning from the Lightning: How Nikola Tesla Formulated a Scheme for Wireless Power in Colorado Springs

IMS KEYNOTE SPEAKER:

Prof. W. Bernard Carlson, Vaughan Professor of Humanities, *Department of Engineering and Society, Univ. of Virginia and TechInnovate, National Univ. of Ireland Galway*



ABSTRACT: Nikola Tesla [1856-1943] is frequently celebrated for inventing a practical AC motor and for contributing to early radio technology through his plans to transmit power wirelessly around the world. This lecture will trace how Tesla developed his wireless technology from 1890 to 1905, with an emphasis on what he learned in 1899 when he operated an experimental station in Colorado Springs. Since his station was located on Colorado's Front Range, Tesla was able to watch thunderstorms as they moved out of the Rockies and across the Great Plains and to study the ground currents generated by lightning strikes. These observations allowed Tesla to confirm his theory of how to transmit energy through the earth's crust but at the same time he failed to challenge or disconfirm this theory, a failure that limited his subsequent efforts to perfect his ambitious plan for wireless power. Nonetheless, while in Colorado Tesla perfected his understanding of how to tune his transmitting and receiving circuits, thus laying the groundwork for future development of radio technology.

BIOGRAPHY: Bernie Carlson is the Joseph L. Vaughan Professor of Humanities and lectures in the TechInnovate program at the National Univ. of Ireland Galway. Bernie studied history and physics as an undergraduate at Holy Cross College, earned his Ph.D. in the history and sociology of science at the Univ. of Pennsylvania, and did his postdoctoral work at the Harvard Business School. He has written widely on invention and innovation as well as on the role of technology in the rise and fall of civilizations. His books include *Innovation as a Social Process: Elihu Thomson and the Rise of General Electric, 1870-1900* (Cambridge Univ. Press, 1991) and *Technology in World History*, 7 volumes (Oxford Univ. Press, 2005). His most recent book, *Tesla: Inventor of the Electrical Age* (Princeton Univ. Press, 2013) has been translated into nine languages. In addition to his books, Bernie has filmed 36 lectures on "Understanding the Inventions that Changed the World" for The Great Courses. He is a regular contributor to Forbes.com, writing on innovation and the modern economy. Bernie has been the recipient of the IEEE History Fellowship and winner of both the SHOT-IEEE History Prize and the Middleton Award in Electrical History. With the IEEE, he has served on the advisory board of Spectrum and chaired the History Committee.

Automatic RF Techniques Group | 08:00 - 17:00 | Friday, 24 June 2022 | Centennial Ballroom, Hyatt Regency Denver

99TH ARFTG MICROWAVE MEASUREMENT CONFERENCE

From Fundamental to Cutting-Edge Microwave Measurement Techniques to Support 6G and Beyond

08:00– 08:10 | Welcome to the 99th ARFTG Conference — Introduction

Conference Co-Chairs: Jeffrey Jargon and Marco Spirito
TPC Co-Chairs: Andrej Rumiantsev and Marc Vanden Bossche

08:10-08:50

Keynote: Characterizing Cryogenic Josephson Microwave Sources for Communications and Quantum Information
Alirio S. Boaventura (NIST)*

Session A: Enabling Wideband Characterization Techniques

Session Chair: Patrick Roblin

A–1 **08:50 – 09:10**	**VNA-Based Testbed for Accurate Linearizability Testing of Power Amplifiers Under Modulated Signals** Nizar Messaoudi, *Keysight Technologies**; Ahmed Ben Ayed, *Univ. of Waterloo*; Jean-Pierre Teyssier, *Keysight Technologies*; Slim Boumaiza, *Nil*
A–2 **09:10–09:30**	**Wideband Vector Corrected Measurements on a Modified Vector Network Analyzer, VNA System** Christoph Schulze, *Ferdinand-Braun-Institut**; Wolfgang Heinrich, *Ferdinand-Braun-Institut*; Joel Dunsmore, *Keysight Technologies*; Olof Bengtsson, *Ferdinand-Braun-Institut, Leibniz-Institut für Höchstfrequenztechnik*

09:30–11:00 | BREAK – EXHIBITS AND INTERACTIVE FORUM

Session B: mmWave Over-the-Air Characterization

Session Chair: Rusty Myers

B–1 **11:00–11:20**	**Traceable mmWave Modulated-Signal Measurements for OTA Test** Joshua M. Kast, *Colorado School of Mines**; Paritosh Manurkar, *Univ. of Colorado Boulder*; Kate Remley, *NIST*; Rob Horansky, *NIST*; Dylan Williams, *NIST*
B–2 **11:20–11:40**	**On Coupling-related Distortion Behavior in mm-Wave Phased Arrays** Jon Martens, *Anritsu**
B–3 **11:40–12:00**	**D-band Free Space Dielectric Characterization of a Low-Cost Ultradense Microdiamond Composite for Heat Spreading** Shu-Ming Chang, *UCSB**; Chelsea Swank, *UCSD*; Andrew Kummel, *UCSD*; Muhannad Bakir, *Georgia Tech*; Mark Rodwell, *UCSB*; James Buckwalter, *UCSB*

12:00–13:30 | AWARDS LUNCHEON

Session C: Non-Linear, Large-Signal and VNA Techniques

Session Chair: Mauro Marchetti

C–1 **13:30–13:50**	**Local-Oscillator Third-Harmonic Injection for Improved Broadband Mixer Linearity** Akim A. Babenko, *Anritsu**; Jon Martens, *Anritsu*
C–2 **13:50–14:10**	**Surmounting W-band Scalar Load-Pull Limitations Using the ASM-HEMT Model for Millimeter-Wave GaN HEMT Technology Large-Signal Assessment** Nicholas C. Miller, *Air Force Research Laboratory**; Michael Elliott, *SelectTech Services*; Ryan Gilbert, *KBR*; Erdem Arkun, HRL Laboratories; Daniel Denninghoff, *HRL Laboratories*
C–3 **14:10–14:30**	**Impact of Broadband Modulation in Active Load-Pull On-Wafer Measurements of GaN HEMTs** Alberto Maria Angelotti, *Univ. of Bologna**; Gian Gibiino, *Univ. di Bologna*; Troels Nielsen, *Keysight Technologies, Inc.*; Alberto Santarelli, *Univ. of Bologna*; Jan Verspecht, *Keysight Technologies, Inc.*
C–4 **14:30–14:50**	**Effective AM/AM and AM/PM Curves Derived from EVM Measurements on Constellations** Jacques B. Sombrin, *TESA Laboratory**

14:50–16:00 | BREAK – EXHIBITS AND INTERACTIVE FORUM

Session D: On-Wafer Techniques

Session Chair: Leonard Hayden

D-1 **16:00–16:20**	**Parasitic Coupling Effects in Coplanar Short Measurements** Gia Ngoc Phung, *Physikalische Technische Bundesanstalt**; Uwe Arz, *Physikalisch-Technische Bundesanstalt, PTB*
D-2 **16:20–16:40**	**Extending the Open-Short De-embedding Frequency via M1 On-Wafer Calibration Approaches** Ciro Esposito, *TU Dresden**
D-3 **16:40–17:00**	**Wideband mm-Wave Integrated Passive Tuners for Accurate Characterization of BiCMOS Technologies** Marc Margalef-Rovira, *IEMN Laboratory**; Caroline Maye, *IEMN Laboratory*; Sylvie Lepilliet, *IEMN Laboratory*; Daniel Gloria, *STMicroelectronics*; Guillaume Ducournau, *IEMN Laboratory*; Christophe Gaquiere, *MC2-Technologies*

Interactive Forum

Session Chair: Marc Vanden Bossche

P-1 **09:30–15:40**	**Demonstration of Non-invasive Probing of CMOS Devices with Aluminum Pads at Frequencies up to 500 GHz** Ryo Sakamaki, *National institute of Advanced Industrial Science and Technology**; Ryoko Kishikawa, *National Institute of Advanced Industrial Science and Technology*; Seitaro Kon, *AIST*; Yuya Tojima, *AIST*; Ichiro Somada, *Mitsubishi Electric Company*; Shunpei Matsui, *Hiroshima Univ.*; Gakuto Taoka, *Hiroshima Univ.*; Takeshi Yoshida, *Hiroshima Univ.*; Shuhei Amakawa, *Hiroshima Univ.*; Minoru Fujishima, *Hiroshima Univ.*
P-2 **09:30–15:40**	**Determination of the Coplanar Waveguide Propagation Constant via Non-contact, On-wafer Measurements in WR1.5 Band** Mitch Wallis, *NIST**; Charles Little, *NIST*; Richard Chamberlin, *NIST*; George Burton, *NIST*; Nathan Orloff, *NIST*; Christian Long, *NIST*; Kubilay Sertel, *TeraProbes Inc*
P-3 **09:30–15:40**	**A Single-Element CMOS-LRRM VNA Electronic Calibration Technique** Jun-Chau Chien, *National Taiwan Univ.**; Ali Niknejad, *Univ. of California Berkeley*
P-4 **09:30–15:40**	**The w-plane as a Graphical Representation of Sampler Configuration in a Sampled-Network Reflectometer** Devon Donahue, *Univ. of Colorado Boulder**; Taylor Barton, *Univ. of Colorado Boulder*
P-5 **09:30–15:40**	**Single-Sweep vs. Banded Characterizations of a D-band Ultra-Low-Loss SiC Substrate Integrated Waveguide** Lei Li, *Cornell Univ.**

Closing Notes – End of 99th ARFTG Conference

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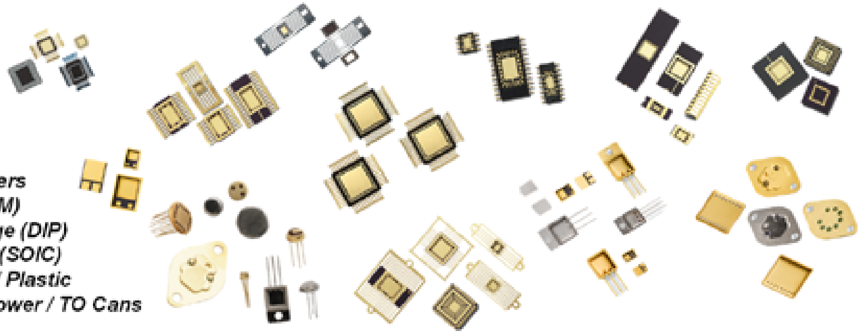

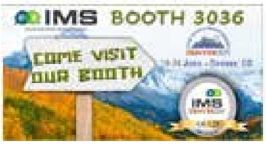
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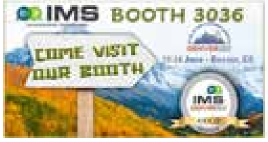
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