IMS
Connecting Minds. Exchanging Ideas.

INTERNATIONAL MICROWAVE SYMPOSIUM
PROGRAM BOOK

AS OF 10 MAY 2019

2019

RFIC

ARFTG

BOSTON 2019
THE HUB OF MICROWAVES

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MICROWAVE WEEK

IS ALL ABOUT CONNECTIONS...

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- Follow us on Instagram: http://instagram.com/mtt_ims
- 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/
- Follow us on YouTube: http://www.youtube.com/user/mttims

Don't forget to use the official IMS hashtag: **#ims2019**

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; Short Courses; IMS, RFIC, and ARFTG Technical Sessions; Panel Sessions; Social Events; and Exhibition Information. On-site during Microwave Week, 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 Boston 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.

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IMS2019 Table of Contents

GENERAL CHAIRS' **WELCOME**

Mark Gouker and Lawrence Kushner

Boston and the local steering committee are pleased to welcome the microwave world to the 2019 International Microwave Week, featuring the Radio Frequency Integrated Circuit (RFIC) Symposium, the International Microwave Symposium (IMS), the 5G Summit, and the ARFTG Microwave Measurements Conference. The technical presentations and industry exhibits will be held at the Boston Convention and Exhibition Center (BCEC). The social and networking events and opportunities will take place throughout the revitalized Seaport District, home to many museums, shops, restaurants, and nightclubs.

Boston has a rich microwave heritage that continues through today. The Radiation Laboratory run by the Massachusetts Institute of Technology (MIT) during the 1940s made seminal contributions to the emerging microwave engineering field. Much of this knowledge was transferred to surrounding industry and universities in the 1950s. Today, the local steering committee takes pride in balancing the traditions of the IMS with innovative twists to create a great experience for the technical and industry exhibition attendees.This year's symposium continues this philosophy with new features that include:

A SIGNIFICANTLY ENHANCED MOBILE APP with the goal of making this the primary interface to the International Microwave Week.

FOCUS ON STARTUPS AND YOUNG PROFESSIONALS through the introduction of a Startup Pavilion in the Industry Exhibition along with an IP 101 information session, Startup panel session, and Next Top Startup contest. Young professionals will have a lounge specifically to meet and exchange ideas and experiences and a reception at Coppersmith on Tuesday evening.

SIXTY SECOND PRESENTATIONS where interactive forum authors can prerecord an overview of their papers, allowing attendees to get a preview of the paper's content and target the papers of most interest to their work.

INTERACTIVE PANEL SESSIONS with real-time audience participation via the Slido App

SWEET TREATS TUESDAY to welcome attendees to the industry exhibit. Dessert items will be provided during the lunch break, encouraging everyone to come to the exhibit floor for a treat and begin interactions with the industry exhibitors.

HISTORICAL EXHIBIT in addition to the radar-rich permanent collection featuring the Pearl Harbor radar (SCR-270), this year's historical exhibit also includes a small collection of items from the Raytheon archives. This includes a QKS 1300 CFA-Amplitron, the same model as was used to broadcast television signals from the Apollo 11 landing back to Earth, along with a series of World War II-era magnetrons, gaseous rectifier tubes and photos of microwave technology in its early stages. Don't miss this unique opportunity to take a step back in time and re-live Boston's rich microwave history.

The overall format of the International Microwave Week remains the same. The RFIC Symposium begins on Sunday with workshops and concludes Tuesday morning. The 5G Summit, again co-sponsored by MTT-S and ComSoc, picks up on Tuesday afternoon and concludes Tuesday evening with a panel session. The IMS will run Sunday through Friday with the Industry Exhibition taking place Tuesday through Thursday. The ARFTG Microwave Measurements Conference will also begin on Sunday with jointly sponsored workshops on Sunday and Monday, and the technical sessions on Thursday and Friday. In all, there will be over 9,000 attendees from around the world participating in the technical sessions, workshops, and the Industry Exhibition. There will be more than 600 exhibitors showcasing the latest developments in microwave hardware, software, components, and systems.

The International Microwave Symposium will begin with workshops and short courses on Sunday and Monday. The opening plenary session will be held Monday evening featuring a presentation on "The Mind-Body Problem for Intelligent RF," by Dr. William Chappell, Special Assistant to the Director of the Microsystems Technology Office at the Defense Advanced Research Projects Agency (DARPA). This will be followed by the Welcome Reception at the Seaport World Trade Center. The IMS technical sessions will run Tuesday through Thursday, with the closing session on Thursday afternoon featuring Dr. Dina Katabi from MIT describing her work at the intersection of wireless microwave systems and machine learning focused on biological applications, with a talk entitled "Health Monitoring with Machine Learning and Wireless Sensors." The closing celebration reception will be held immediately after. The symposium will conclude with additional workshops held on Friday.

The Industry Exhibition is another centerpiece of the International Microwave Week and will take place on Tuesday through Thursday. In addition to the Sweet Treats Tuesday, the Industry-Hosted Reception will be held Wednesday late afternoon. The exhibition floor will be home to the MicroApps Theater, the Societies' Pavilion, and the new Startup Pavilion. The IMS schedule will include exhibition-only time on Wednesday afternoon to ensure all attendees have an opportunity to interact with and learn about the latest products from the microwave industry exhibitors.

The evenings throughout the week will be filled with social and networking opportunities, both organized and informal, so that you can catch-up with your colleagues from across the globe. The RFIC and IMS Plenary Sessions and Welcome Receptions will be held on their respective Sunday and Monday evenings. At the conclusion of the IMS Plenary Session, attendees will parade down World Trade Center Avenue to the Welcome Reception being held at the historic Commonwealth Pier Headhouse concourse at the Seaport World Trade Center. Built in 1914, the majestic Headhouse concourse provides views that encompass the harbor, downtown and the Seaport District. Join us for entertainment, food, and drink with your fellow attendees.

Tuesday evening will have the young professionals' social event and the amateur radio social. Wednesday evening will have the Women in Microwaves Reception and the Awards Banquet with a dinner talk entitled "Optimus Ride: The Fastest Path to Fully Driverless Mobility Systems" from Optimus Ride CEO Ryan Chin. Thursday evening will have the post-closing session celebration. In addition, there are dozens of restaurants and night spots within walking distance of the BCEC and the IMS hotels for informal and more private gatherings.

Welcome to Boston for IMS2019!

WELCOME TO BOSTON'S SEAPORT

Welcome to Boston and the Seaport District! The BCEC, opened in 2004, symbolizes the city's redevelopment and revitalization of a former salt marsh turned industrial area and our proud home for IMS 2019. Boston is not only a historic city but a very walkable one and with only a few short steps from the BCEC, you are sure to experience the character of Boston. Stroll along the harbor and enjoy the seaside ambience — an active working port with piers, drydocks, fisheries and boats (and some Big Dig artifacts) along with great local food. If you are looking for more, continue up Summer Street to check out some of Boston's Colonial and Revolutionary attractions and well-known modern landmarks. This includes the **Freedom Trail, Boston Common**, the **Public Garden (**and **Swan Boats)**, **Chinatown**, **Black Heritage Trail, Beacon Hill, Back Bay, Copley Square**, the **Prudential Center** and **Newbury Street** shopping. Check out the map on page 8 for additional locations, or for additional walking tours and destinations visit, www.walkboston.org.

No matter where you find yourself in the BCEC, food is just around the corner! In addition to Microwave Week 2019's many amazing food and event offerings discussed by Larry and Mark, Outtakes Quick Cuisine offers packaged sandwiches, pastries, fresh brewed New England® Coffee, quick snacks, and bottled beverages for purchase. With convenient locations in the North Lobby and throughout the building, you don't have to miss one minute IMS 2019.

The Wicked Good Market, also located within the BCEC on Level One West, offers heartier fare for every appetite. Different stations offer a variety of cuisine, from healthy salads to customizable Asian bowls and build-your-own burritos. You can even enjoy a taste of Boston's North End with brick oven pizza or a heaping bowl of pasta.

If you're hungry for more, in addition to being a historic city, Boston is an eater's dream destination and many favorites are just a few minutes walk from the BCEC. From stellar seafood served along waterfront rooftops, grilled steakhouse masterpieces in chic settings, to a burger from the corner pub, you will eat like a king at the Hub of Microwaves. Here is a list of our favorites (✳) open for both lunch and dinner in the Seaport District.

1 Jimmy John's
$ | Sandwich Shop
413 D St. ◗ 0.3 mi.

2 Dunkin' Donuts
$ | Coffee Shop
411 D St. ◗ 0.3 mi.

3 Blue Dragon ✳
$$ | Asian Gastropub
324 A St. ◗ 0.3 mi.

4 Bastille Kitchen
$$$ | French
49 Melcher St. ◗ 0.4 mi.

5 Lucky's Lounge
$$$ | American
355 Congress St. ◗ 0.4 mi.

6 Sportello
$$$ | Italian
348 Congress St. ◗ 0.4 mi.

7 Row 34 ✳
$$$ | Seafood
383 Congress St. ◗ 0.4 mi.

8 Morton's
$$$$ | Steakhouse
2 Seaport Ln. ◗ 0.3 mi.

9 Rosa Mexicano
$$ | Mexican
155 Seaport Blvd. ◗ 0.3 mi.

10 Pastoral ARTisan Pizza + Kitchen + Bar
$$ | Pizza
345 Congress St. ◗ 0.4 mi.

11 The Smoke Shop BBQ
$$ | Barbecue
343 Congress St. ◗ 0.4 mi.

12 Sweetgreen
$ | Salad Shop
372 Congress St. ◗ 0.4 mi.

13 Cosi
$ | Sandwich & Salad
2 Seaport Ln. ◗ 0.3 mi.

14 bartaco ✳
$$ | Taqueria
25 Thomson Pl. ◗ 0.4 mi.

15 City Tap House ✳
$$ | Gastropub
10 Boston Wharf Rd. ◗ 0.4 mi.

16 Larry J's BBQ Cafe
$$ | Barbecue
600 D St. ◗ 0.4 mi.

17 Flour Bakery + Cafe ✳
$$ | Bakery
12 Farnsworth St. ◗ 0.4 mi.

18 Temazcal Tequila Cantina ✳
$$ | Mexican
250 Northern Ave. #2 ◗ 0.4 mi.

19 Legal Test Kitchen
$$$ | Seafood
225 Northern Ave. ◗ 0.4 mi.

20 Barlow's Restaurant
$$ | Gastropub
241 A St. ◗ 0.5 mi.

21 honeygrow
$$ | Noodles & Greens
100 Northern Ave. ◗ 0.5

22 Shake Shack
$$ | Burgers
77 Seaport Blvd. ◗ 0.5 mi.

23 Trillium Brewing Company ✳
$$$ | Gastropub
50 Thomson Pl. ◗ 0.5 mi.

24 Yoki Express
$$ | Sushi Burritos
53 Boston Wharf Rd. ◗ 0.5 mi.

25 Tuscan Kitchen
$$ | Italian
64 Seaport Blvd. ◗ 0.5 mi.

26 Ocean Prime
$$$ | Seafood
140 Seaport Blvd. ◗ 0.4 mi.

27 Legal Harborside
$$$ | Seafood
270 Northern Ave. ◗ 0.5 mi.

28 Del Frisco's Double Eagle Steakhouse
$$$$ | Steakhouse
250 Northern Ave. ◗ 0.5 mi.

29 75 on Liberty Warf
$$ | American
220 Northern Ave. ◗ 0.5 mi.

30 Gather ✳
$$ | American
75 Northern Ave. ◗ 0.5 mi.

31 No Name
$$ | Seafood
15 1/2 Fish Pier St. ◗ 0.5 mi.

32 Yankee Lobster House
$$ | Seafood
300 Northern Ave. ◗ 0.6 mi.

33 wagamama
$$ | Japanese
100 Northern Ave. ◗ 0.5 mi.

34 Aceituna Grill
$ | Mediterranean
57 Boston Wharf Rd. ◗ 0.6 mi.

35 Tikkaway Grill
$ | Indian
55 Boston Wharf Rd. ◗ 0.5 mi.

36 Chipotle
$ | Mexican
51 Boston Wharf Rd. ◗ 0.5 mi.

37 Juice Press
$$ | Juice Shop
109 Seaport Blvd. ◗ 0.5 mi.

38 by CHLOE.
$$ | Vegan
107 Seaport Blvd. ◗ 0.5 mi.

39 Outlook ✳
$$$ | American
70 Sleeper St. ◗ 0.6 mi.

40 Committee ✳
$$ | Mediterranean
50 Northern Ave. ◗ 0.6 mi.

41 Barking Crab ✳
$$ | Seafood
88 Sleeper St. ◗ 0.7 mi.

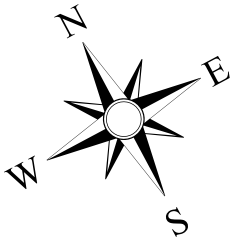
42 Strega Waterfront
$$$ | Italian
1 Marina Park Dr. ◗ 0.7 mi.

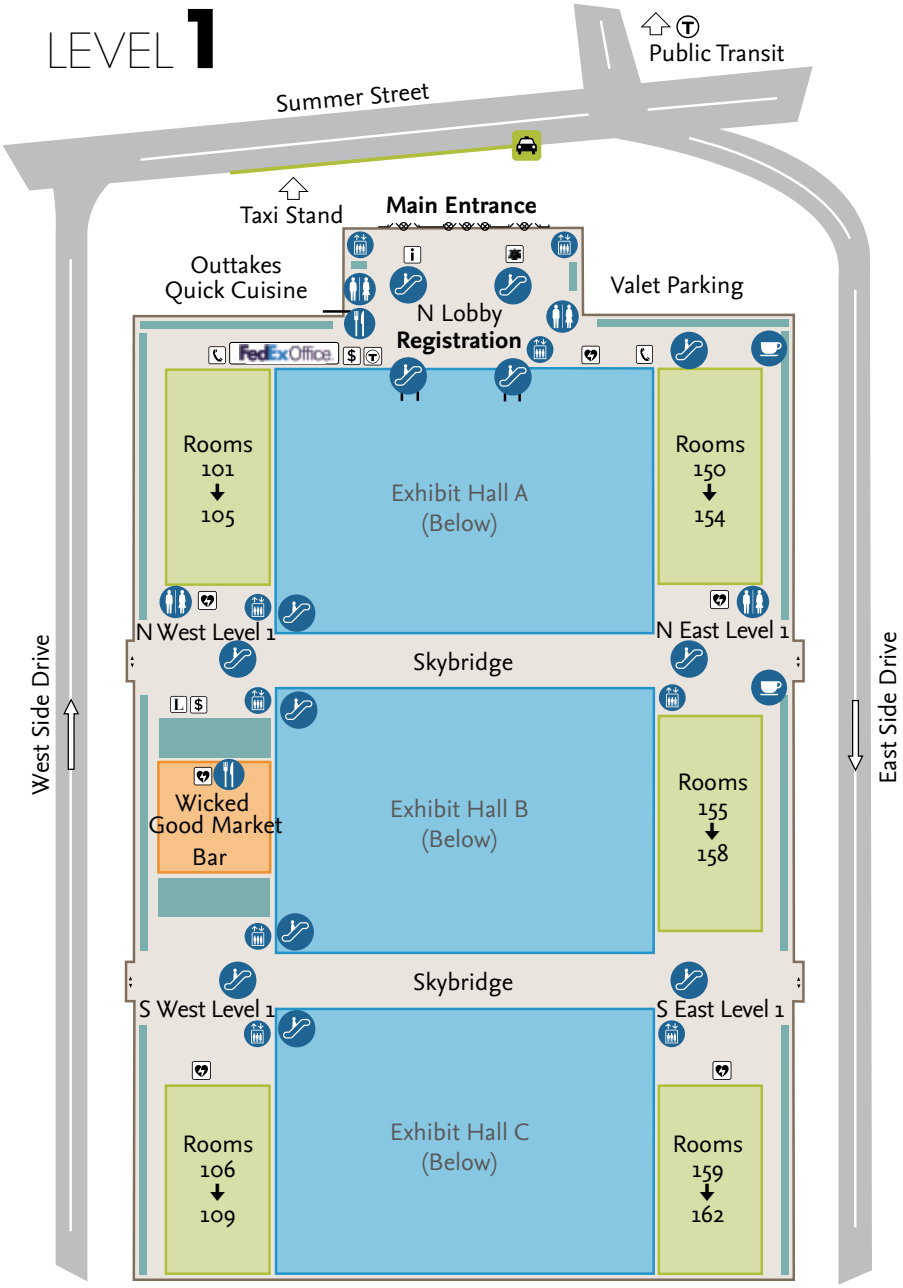
43 Harpoon Brewery and Beer Hall
$ | Brewery
306 Northern Ave. ◗ 0.7 mi.

✳ Denotes a committee favorite.

BOSTON 2019
THE HUB OF MICROWAVES

- Exhibition Hall
- Meeting Room
- Lobby & Public Use
- Food Service Area
- Seating
- Defibrillators
- Elevators
- Escalators
- Family Restrooms
- Food





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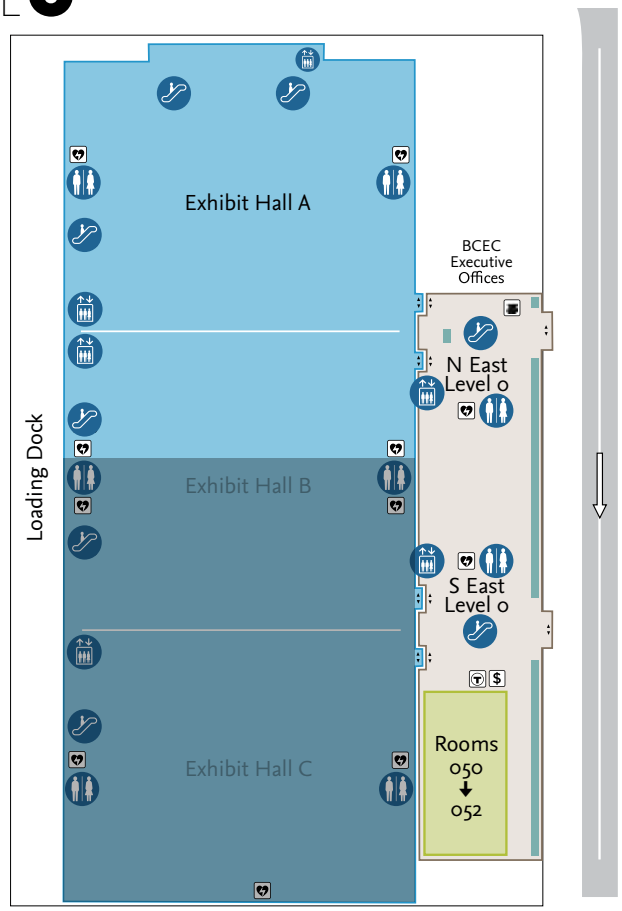

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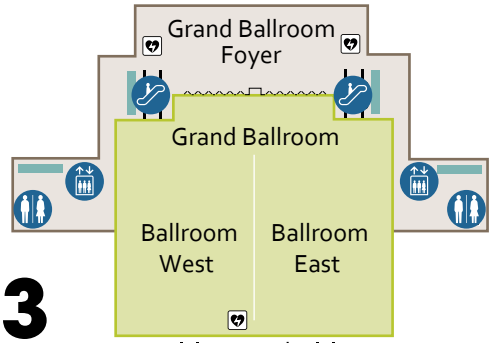

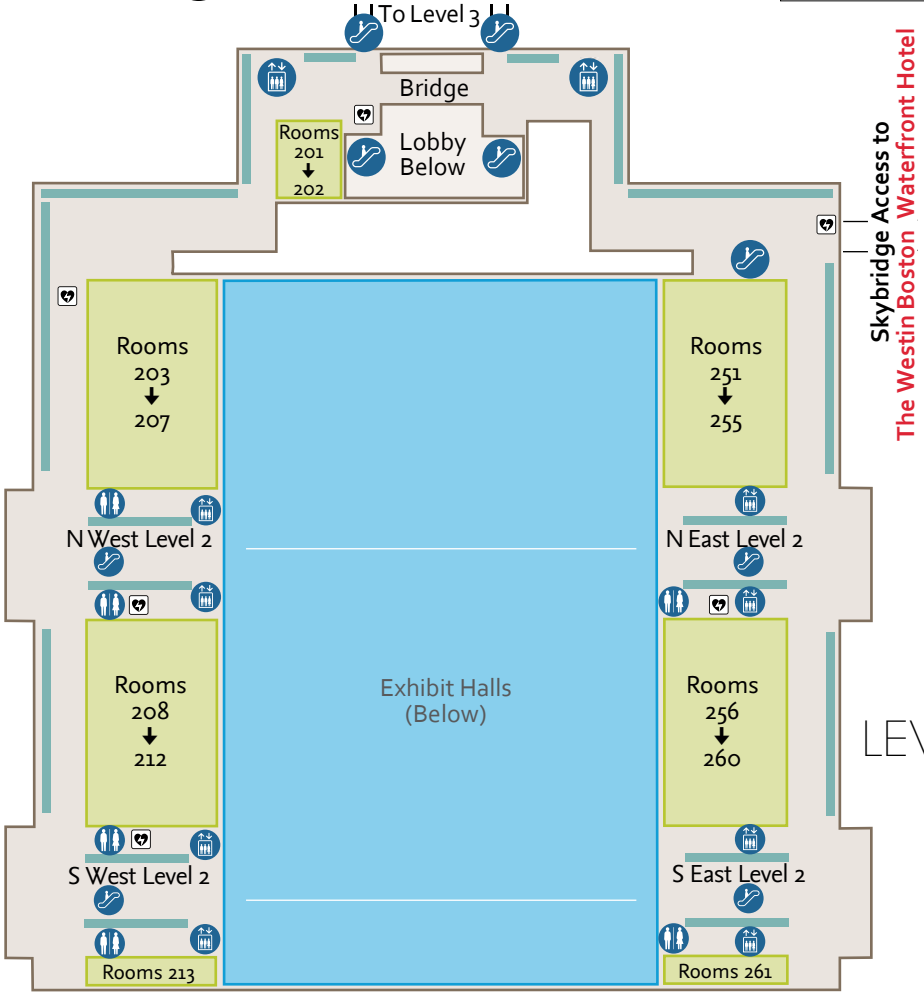

LEVEL 2

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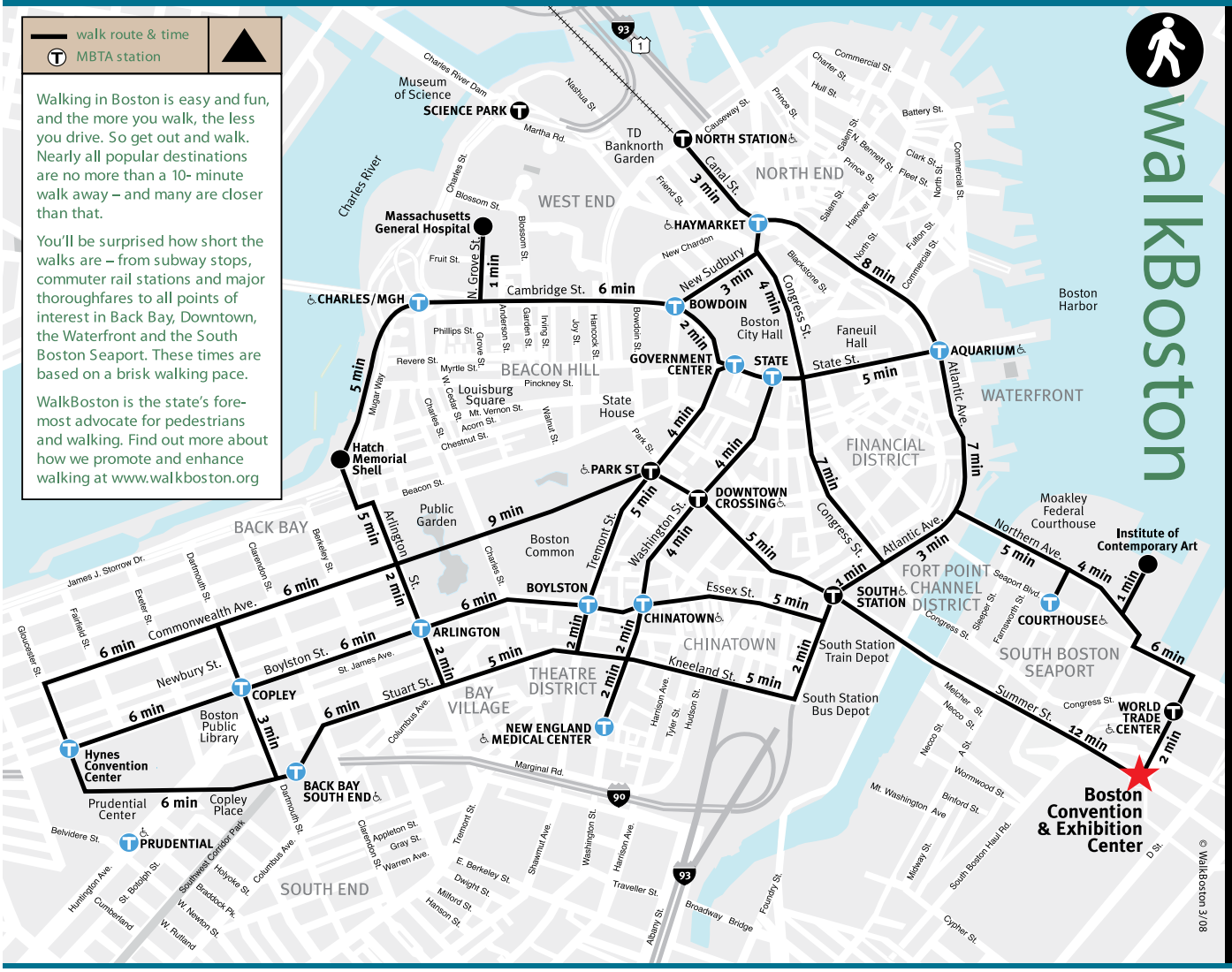
Adam Young
Ming Yu
Qijun Zhang
Hualiang Zhang
Yanzhu Zhao
Anding Zhu

walk route & time
MBTA station

Walking in Boston is easy and fun, and the more you walk, the less you drive. So get out and walk. Nearly all popular destinations are no more than a 10- minute walk away – and many are closer than that.

You'll be surprised how short the walks are – from subway stops, commuter rail stations and major thoroughfares to all points of interest in Back Bay, Downtown, the Waterfront and the South Boston Seaport. These times are based on a brisk walking pace.

WalkBoston is the state's foremost advocate for pedestrians and walking. Find out more about how we promote and enhance walking at www.walkboston.org



walkBoston

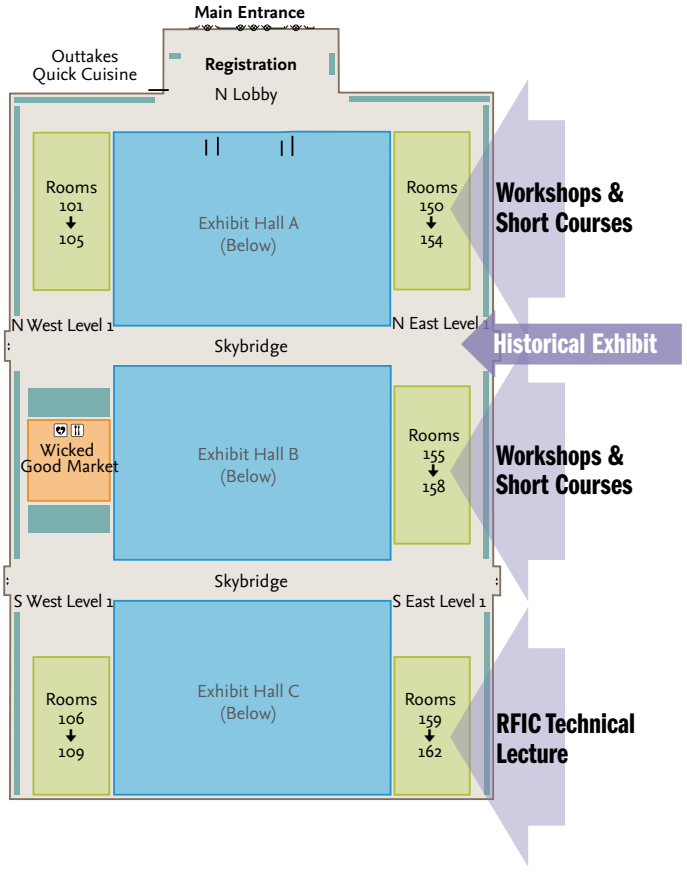
CityRoutes: Fast Ways to Get There

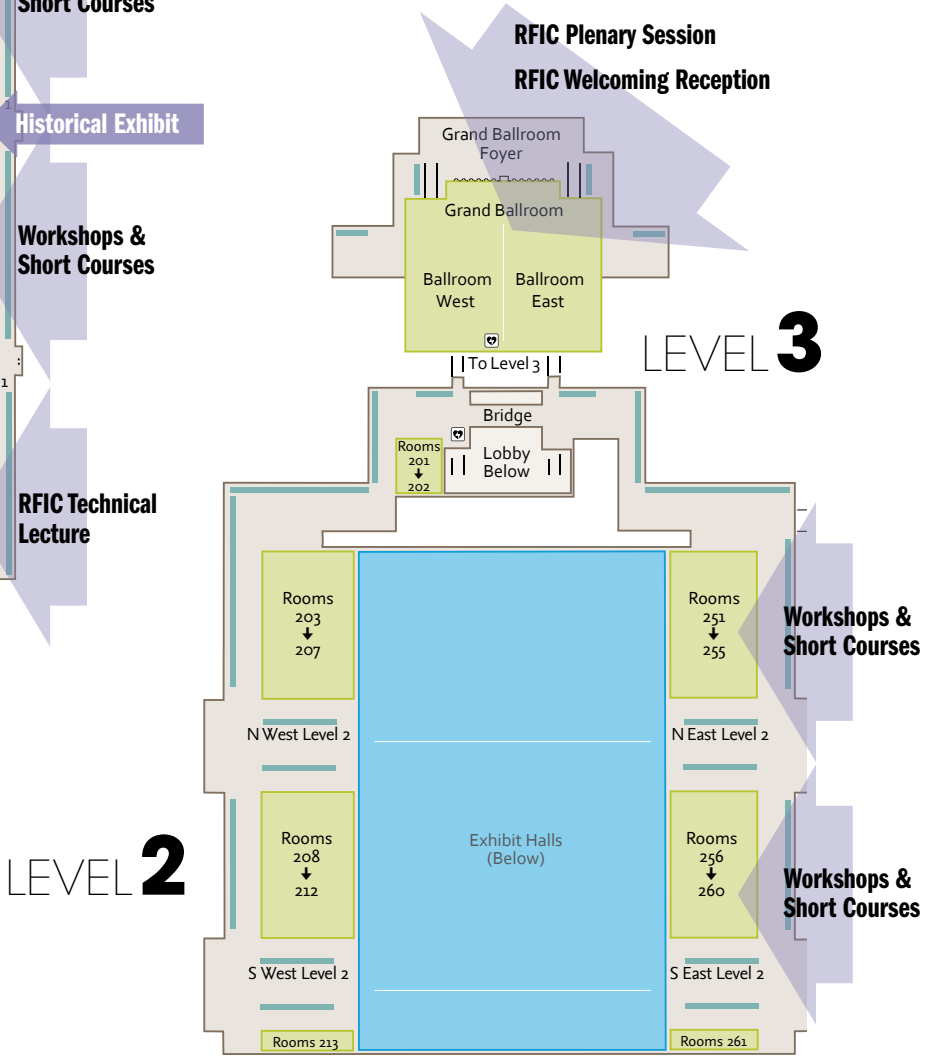
CONFERENCE **HIGHLIGHTS**

SUNDAY

EVENT	TIME
Workshops & Short Courses	08:00 – 17:15
RFIC Technical Lecture	11:45 – 13:15
RFIC Plenary Session	17:30 – 19:00
RFIC Welcoming Reception	19:00 – 21:00

LEVEL 1





WORKSHOP INDEX
SUNDAY WORKSHOPS

BCEC

08:00 – 17:15 SUNDAY, 2 JUNE 2019

Check the website (ims-ieee.org) or the mobile app for the most up-to-date room assignments as well as a detailed listing of workshop speakers and presentations. On-site registration is available for those who didn't pre-register. Workshop hopping within the day is allowed after the first 30 minutes.

	Workshop Title	Workshop Abstract
WSA	**Microwave Materials: Enabling the Future of Wireless Communication** **Sponsor:** IMS **Organizer:** T.M. Wallis, NIST; N.D. Orloff, NIST **08:00 – 17:15** **Room 157A**	The ongoing explosion of commercial telecommunications demands innovation across all aspects of next-generation wireless systems. At the component and device levels, novel materials are critical to new device technologies throughout the microwave and mm-wave frequency range. Novel, functional materials enable reconfigurability, tunability, enhancement of transport, and control of loss. In turn, this functionality enables a wide variety of applications, including tunable filters, adaptive networks, MIMO components, and beam-steering. This workshop explores the role of novel materials in next-generation communications, starting from the properties of isolated "building blocks" and extending to the engineering of complex devices and components. Like the field of microwave materials itself, this workshop will begin with a foundation of materials development and characterization. Materials of interest include ferroelectrics, ferrites, phase change materials, and novel nanomaterials. The workshop will extend to the engineering of components for next-generation wireless systems, with a focus on connecting material properties to performance.
WSB	**RF Circuit Design: Device Technologies for Tomorrow** **Sponsor:** RFIC **Organizer:** F. Rivet, Univ. Bordeaux; T. LaRocca, Northrop Grumman G. Hueber, Silicon Austria Labs **08:00 – 17:15** **Room 151AB**	The 5G and IoT future with enhanced Mobile Broadband (eMBB), ultra-reliable low-latency self-driving car communication and Massive Machine learning are driving RFIC designers to discover and investigate new design techniques using state-of-the-art technology. This workshop will provide the community in-depth understanding of new and underlying FDSOI CMOS capability (extended back biasing, flip-well, etc.), FinFET and GaN technologies, followed by advanced RFIC examples such as high-speed direct RF sampling and 60GHz CMOS. An introduction to emerging 3D and heterogeneous technology combining high-speed InP with digital CMOS for RFIC will provide both the experienced designer and early researchers attendee with a broad and deep overview of technology for next-generation RFIC design.
WSC	**Recent Advances in Integrated Antenna-in-Package and Antenna-on-Chip Technologies and Techniques for 5G, Radar, and Emerging mm-Wave Applications** **Sponsor:** RFIC **Organizer:** E. Balboni, Analog Devices; A. Natarajan, Oregon State University **08:00 – 17:15** **Room 153AB**	Interfacing mm-wave ICs with antennas remains a critical challenge for emerging mm-wave communication, sensor, and radar transceivers. This workshop will focus on the integration of antenna, antenna-arrays and antenna interfaces for microwave and mm-wave sensors and communications applications. The state-of-the-art in Antenna-in-Package (AiP) technology, targeting 5G arrays and 77GHz automotive radar, will be presented. In addition, the workshop will explore emerging Antenna-on-Chip (AoC) approaches focusing on techniques for improved efficiency, bandwidth and manufacturability. Such approaches include combining lenses and superstrates with on-chip antennas, multi-port antennas on high-resistivity substrates as well as micromachining techniques to minimize substrate losses and maximize antenna efficiency and bandwidth. Techniques to further extend system-level performance using antenna-IC co-integration and multi-port driven radiators will also be discussed. Workshop participants should get a very good overview of integrated antenna performance and limitations from this workshop.
WSD	**State-of-the-Art RF Receivers: Leading Edge Industrial Architectures and New Systems on the Horizon** **Sponsor:** RFIC **Organizer:** F. Lee, Verily; R. Harjani, University of Minnesota **13:30 – 17:15** **Room 152**	Four engaging technical leaders from industry and academia will cover the latest in high-performance RF receiver architectures. To frame the workshop, Dr. Jon Strange will present the latest advancements in commercial receiver ICs and wireless systems. The following three speakers will cover receiver techniques on the horizon: Dr. Tong Zhang will share self-interference cancellation techniques in frequency-division-duplex and full-duplex receivers; Dr. Peter Kinget will motivate compressed sensing systems for interference detection; and Dr. Ramesh Harjani will discuss how N-path mixer-first receivers are used for spread-spectrum interference mitigation. Finally, to adjourn the workshop, a short but lively panel discussion will be moderated to discuss the likely future of RF receiver architectures.
WSE	**Analog and RF Hardware Security: Motivation, Challenges, and Solutions** **Sponsor:** RFIC **Organizer:** A. Fayed, The Ohio State University; B. Sadhu, IBM T.J. Watson Research Center; J.J. McCue, AFRL **08:00 – 17:15** **Room 156C**	Powerful design, characterization, and implementation tools of electronic devices have become easier than ever to acquire by commercial and government entities alike. This, along with the know-how of electronic design becoming globally accessible, opens the door to various activities that pose serious security risks. Some of these activities are incentivized only by commercial interests and profit, such as counterfeiting and IP theft, and others are driven by more malicious motives such as spying on, disrupting of, or interfering with the operation of a system. Regardless of the motivation, the question of how to improve the immunity of electronic devices to nefarious activities is a pressing one. This workshop discusses the security challenges associated with the analog, RF, and power portions of electronic systems, their place in the grand scheme of hardware security, why they are particularly vulnerable, how they can be exploited, and potential ways to address their security vulnerabilities.
WSF	**5G mm-Wave to sub-THz Circuit and System Techniques** **Sponsor:** RFIC **Organizer:** P. Busson, STMicroelectronics; M. Wiklund, Qualcomm; D. Belot, CEA-LETI **08:00 – 17:15** **Room 156AB**	For more than a decade mm-Wave has been a technology waiting to take off. We have 5G, radar, 802.11ay and many more product scenarios than when 802.15.3c (WPAN) was drafted. This workshop will present state-of-the-art circuits and techniques for 5G mm-Wave to Sub-THz that are driving product development now and in the near future. Where are we today in terms of circuit design? Which technology, which spectrum allowance, which standardization?

Check the website (ims-ieee.org) or the mobile app for the most up-to-date room assignments as well as a detailed listing of workshop speakers and presentations. On-site registration is available for those who didn't pre-register. Workshop hopping within the day is allowed after the first 30 minutes.

Workshop Abstract	Workshop Title	
Complex electronic-photonic integrated systems for fiber optical communication applications are now produced commercially at high volume. In particular, the silicon photonic integrated system ecosystem, including foundry processes, design tools, packaging, has greatly matured over the past few years. The silicon photonic market alone is estimated to be worth $500M in 2018, $1B in 2020, and over $2B by 2024 [Source: Yole Développement]. A large number of other applications can benefit from electronic-photonic integrated systems, in particular within the silicon photonic technology platform. Three-dimensional (3D) cameras, already used in iPhone X, can become mainstream in smartphones. Solid-state infrared lidars can enable low-cost sensors for self-driving cars and drones. Electronic-photonic integrated sensors may be used in biomedical applications. This workshop brings some of the prominent researchers from academic and industrial research labs to cover the latest advancements of electronic-photonic integrated systems with emphasis on sensors.	**Electronic-Photonic Integrated Systems for Lidar and Sensing** **Sponsor:** RFIC **Organizer:** H. Hashemi, University of Southern California; H. Krishnaswamy, Columbia University **08:00 – 17:15** **Room 150**	WSG
It is suggested that 5G communications will be comprised of a combination of the existing cellular and ISM bands in the sub-6GHz spectrum, along with near mm-wave bands (e.g., K and Ka) and mm-wave bands (e.g., W and V). This workshop focuses on power amplifier and transmitter designs and architectures in the sub-6GHz spectrum that can include highly digital architectures (DPAs, charge-based TX), as well as architectural innovation (e.g., Cartesian combiners and magnetic free circulators). To explore the pathways that will enable 5G communications, the workshop will highlight recent trends in PAs and transmitters that can be used to enable digital beamforming, multi-beam TX, and enhance energy efficiency and linearity. Additionally, we will explore the emerging topics of co-existence and simultaneous transmit and receive.	**Power Amplifier and Transmitter Designs for Emerging sub-6GHz 5G Communications** **Sponsor:** RFIC **Organizer:** J.S. Walling, Tyndall National Institute; D. Chowdhury, Broadcom **08:00 – 17:15** **Room 157BC**	WSH
The 5G and IoT future with enhanced Mobile Broadband (eMBB), Ultra-Reliable and Low Latency Communications (URLLC) and massive Machine Type Communications (mMTC) is open for new applications in high volume deployment that will benefit from 5G's ultra-fast networks and real-time responsiveness, such as mMTC for solar-powered nodes (street-light) or other innovations to help city-wide infrastructure, or device-to-device public safety communications without a need for cellular coverage. Novel applications and network techniques demand that RFIC designers discover and investigate new designs to allow the high volume of use-cases based on and beyond 5G. The motivation of this workshop is to capture what is the state at the edge of IoT technology, what is the demand of the industry in the context of innovation, as well, what are circuit and architectural concepts that are demanded or enforced by 5G IoT standardization. We focus especially on RFIC circuits design and technologies competing for today's and tomorrow's applications in 5G IoT.	**Design Challenges in 5G IoT** **Sponsor:** RFIC **Organizer:** Y.H. Liu, Holst Centre; H.M. Lavasani, Qualcomm; G. Hueber, Silicon Austria Labs **08:00 – 17:15** **Room 254AB**	WSI
As the field of quantum computing continues to grow, numerous opportunities will emerge for RFIC designers to contribute. For instance, quantum processors are typically interfaced to using microwave control and readout, and, for the field to continue to succeed, these interfaces must be simplified and integrated. The goal of this workshop is, first to provide enough background so that the need for RFIC designers is clear, and then to describe the current state-of-the-art in quantum computing hardware as well as where the field is heading. The workshop will begin with a tutorial designed to introduce RF circuit designers to the field of quantum computing. Following this, world experts will present research spanning a wide range of topics including CMOS-compatible qubit technology, quantum limited amplification, microwave qubit readout, CMOS RFICs for quantum computing, and system-level challenges related to building a practical quantum computer.	**Quantum Computing for RFIC Engineers: Concepts, Devices, Systems, and Opportunities** **Sponsor:** RFIC **Organizer:** J.C. Bardin, UMass Amherst; M. Babaie, Technische Universiteit Delft **08:00 – 17:15** **Room 259AB**	WSJ
There is a growing demand for high data rate, short-range communications to support near-future 5G networks and wireless broadband networks (WLAN), with speculation that 50 billion mm-wave wireless devices will be deployed worldwide by 2024. These transceivers will require mm-wave power amplifiers (PAs) that operate at frequencies well above 10GHz and support wide instantaneous bandwidths. This workshop brings together experts from academia and industry to highlight recent works and performance trends in mm-Wave PAs; detail advanced architectures and design concepts using silicon CMOS, FINFETs, and GaN; discuss techniques to maintain high PA efficiency at mm-Wave while meeting the stringent 5G linearity requirements; and introduce new PA architectures to achieve broadest reported bandwidths. Additionally, this workshop examines process technology and assembly limitations for delivering power at these high frequencies, with comparisons between silicon, GaN, and GaAs processes.	**Efficient mm-Wave Power Amplifier Design for 5G and Wireless Broadband Transmitters** **Sponsor:** RFIC **Organizer:** J. Kitchen, Arizona State University; O. Eliezer, PHAZR; D.Y.C. Lie, Texas Tech University **08:00 – 17:15** **Room 252AB**	WSK
Future applications, such as 5G, SatCom, AR/VR and radar imaging, need a large-scale array system. Such a system requires highly integrated RFICs for the growing channel number, easy system integration and cost/area optimization. This workshop addresses key design challenges in components, integration and overall system in such systems. The focus would be on manufacturing friendly techniques for interfacing mm-wave arrays with antennas both for single-element and large-scale arrays, and will also help to understand evolution from Phased Arrays to MIMO Arrays.	**Integrated Phased Array ICs for 5G and Beyond** **Sponsor:** RFIC **Organizer:** E. Afshari, University of Michigan; H. Xu, Fudan University **08:00 – 17:15** **Room 257AB**	WSL
Autonomous driving has the potential to revolutionize not only transportation but also the entire society. Every year, more than a million lives are cut short due to traffic accidents. Autonomous driving could significantly reduce these fatalities and improve the quality of life for millions of commuters. The intelligence behind such technology based on artificial intelligence and machine learning will rely on a number of advanced sensors and connectivity nodes generating and processing large amounts of data. This workshop will delve into the latest technologies that enable self-driving cars, focusing on sensing and connectivity and their impact on RFIC requirements and design.	**Sensors and Connectivity Enabling Autonomous Cars** **Sponsor:** RFIC **Organizer:** M. Ali, Uhnder; R. Han, MIT; H. Hedayati, MACOM **08:00 – 17:15** **Room 158**	WSM

SHORT COURSE INDEX

SUNDAY SHORT COURSES

BCEC

08:00 – 17:15 SUNDAY, 2 JUNE 2019

Check the website (ims-ieee.org) or the mobile app for the most up-to-date room assignments. On-site registration is available for those who didn't pre-register.

	Short Course Title	Short Course Abstract
SSA	**The Dynamics, Bifurcation, and Practical Stability Analysis/ Design of Nonlinear Microwave Circuits and Networks** **Organizer:** A. Suarez, University of Cantabria; C. Silva, The Aerospace Corporation **08:00 – 17:15** **Room 251**	This full-day course addresses the fundamental topic of stability in nonlinear microwave circuits and networks (MCNs), covering concepts, qualitative analysis, simulation, and engineering design. The many unique qualitative behaviors possible in common nonlinear MCNs will be illustrated, as well as the fundamental means by which these behaviors can abruptly arise with parameter changes (termed a bifurcation). Course attendees will learn about steady-state solutions, identify instability problems through small- and large-signal stability analysis, and understand dynamical mechanisms responsible for instabilities. The primary approaches for stability analysis (classical to advanced) will be presented and compared. Practical examples of instability, stability analysis, and stabilization design will be presented for MCNs such as power amplifiers, frequency multipliers/dividers, and voltage-controlled oscillators. Finally, the vast research area on harnessing nonlinear dynamics for engineering purposes will be surveyed, providing a glimpse into future nonlinear designs. The course will include video/ hardware demonstrations and several live stability analysis sessions using ADS.
SSB	**Build a 1GHz FMCW Radar in a Day** **Organizer:** D.S. Ricketts, NCSU **08:00 – 17:15** **Room 256**	In this practical short course you will learn the system design of a frequency modulated continuous wave (FMCW) radar. After a short theory lecture, you will participate in teams to design and build a working radar at 1GHz. Each participant will design one component of the radar and then assemble the radar as a team for testing at the end of the day. The participants will build a power amplifier, low-noise amplifier, rat-race coupler and mixer. Baseband signal generation and components will be provided. No prior experience is needed, other than general microwave engineering knowledge.

RFIC TECHNICAL LECTURE

ROOM 160ABC BCEC

11:45 – 13:15 SUNDAY, 2 JUNE 2019

Fundamentals of mm-Wave IC Design in CMOS

Ali Niknejad, Professor, *University of California, Berkeley*

ABSTRACT:

CMOS technology advances have enabled CMOS to operate in the mm-wave spectrum, opening the potential for low cost consumer applications of mm-wave technology including ultra-high-speed networking, gigabit mobile communication, for example 5G New Radio (NR), and automotive radar for enhanced safety and autonomous driving vehicles. Making CMOS operate in the mm-wave bands requires more than a transistor, as passive devices play an equally important role in making the performance of such devices realizable. This tutorial will review key performance metrics for key building blocks (gain, low noise, power) and how to realize such performance using a modern CMOS technology node. Electromagnetic co-design of active and passive circuits and utilization is emphasized in the tutorial.

PLENARY SPEAKER 1

The Digital Future of RFICs

Dr. Greg Henderson, Senior Vice President Automotive, Communications and Aerospace & Defense, *Analog Devices*

ABSTRACT:

Through significant advances in RFIC technology that have shrunk form factors and price points, high complexity RF, Microwave, and Millimeter wave solutions for communications and sensing are reaching the point of ubiquity. Large, complex multi-antenna and phased array solutions that previously only government organizations could justify have become the basis of modern wireless communications and automotive radar. Cars include millimeter-wave radar technology as a standard feature and 77-GHz radar is playing a critical role in the autonomous vehicle revolution. Wireless bandwidth has grown from a trickle to a torrent and high channel count, multi-antenna systems are the key enabler for 5G, whose impact is predicted to extend beyond enabling that torrent of mobile data to revolutionizing industries as varied as agriculture, automotive, healthcare, and industrial.

To date, most of the advances in RFIC technology have largely been driven by the industry moving to high volume advanced geometry CMOS processes and massive increases in system-on-chip integration of complete antenna-to-bits signal chains. Since these are not the most friendly process technologies for traditional RF and microwave circuit blocks, the advances of tomorrow need new RF signal chain and circuit block architectures that exploit the strengths of advanced CMOS processes, while mitigating the disadvantages. This talk will show how such novel architectures and circuit innovations are enabled through leverage of high-performance digital capabilities, resulting in important performance advances that in fact exceed what could be obtained from traditional "RF friendly" process technologies. The talk will show how digitally-assisted-and-enabled RFICs are enabling the future of wireless sensing and communications with real world examples for applications like 5G and automotive radar.

PLENARY SPEAKER 2

Do the Networks of the Future Care About the Materials of the Past?

Dr. Ir. Michael Peeters, Program Director Connectivity+Humanized Technology, *imec*

ABSTRACT:

The traffic in today's networks, 4G, 5G, mobile or otherwise, seems to be following nicely the exponential expectations projected each year. On the one hand, this is driven by and drives further CMOS scaling for the digital processing of information; on the other hand, this has pushed communication channels to use ever wider bandwidths. Unfortunately, not only the individual endpoint throughputs are increasing, but the amount of endpoints and their capabilities is skyrocketing as well. Moreover, capacity as a KPI is being complemented by reliability and latency as use-cases branch out beyond the traditional human-centric communications and entertainment into e.g. industrial automation, AR/VR and autonomous vehicles.

This is creating a perfect storm at the interface of the analog and digital world, where traditional scaling does not necessarily buy you performance; physical dimensions are dictated not by atom sizes but by quarter-wavelengths of one kind or another; and speeds seem to all be converging at a point where switching frequencies venture far into the super-100GHz territory. For the first time in history, this is true for chip-to-chip, board-to-board, rack-to-rack, datacenter-to-datacenter, fiber and mobile wireless access systems.

Across the design space, this (finally!) has generated renewed interested into solution spaces that are less obvious, or were considered distinctly niche only a couple years ago. We take a look at how we can tackle this, not only from an RFIC circuit design space, but also how new network capacity, reliability and latency requirements can drive technology choices for the next 10 years. This includes novel design and integration options for III-V, more exotic telluride and graphene approaches, but also dielectrics, ceramics and nanostructured materials.

RFIC WELCOME RECEPTION FEATURING INDUSTRY SHOWCASE AND STUDENT PAPER AWARD FINALISTS

GRAND BALLROOM FOYER BCEC

19:00 – 21:00 SUNDAY, 2 JUNE 2019

INDUSTRY SHOWCASE

An 802.11ba 495µW -92.6dBm-Sensitivity Blocker-Tolerant Wake-Up Radio Receiver Fully Integrated with Wi-Fi Transceiver | **RTu1F-1**

Renzhi Liu[1], Asma Beevi K.T.[1], Richard Dorrance[1], Deepak Dasalukunte[1], Mario A. Santana Lopez[2], Vinod Kristem[1], Shahrnaz Azizi[1], Minyoung Park[1], Brent R. Carlton[1]

[1]Intel, USA, [2]Intel, Mexico

Reconfigurable 60-GHz Radar Transmitter SoC with Broadband Frequency Tripler in 45nm SOI CMOS | **RMo1C-2**

Wooram Lee, Tolga Dinc, Alberto Valdes-Garcia

IBM T.J. Watson Research Center, USA

22nm Fully-Depleted SOI High Frequency Noise Modeling up to 90GHz Enabling Ultra Low Noise Millimetre-Wave LNA Design | **RMo1B-4**

L.H.K. Chan[1], S.N. Ong[1], W.L. Oo[1], K.W.J. Chew[1], Chi Zhang[2], Abdellatif Bellaouar[2], W.H. Chow[1], T. Chen[2], R. Rassel[2], J.S. Wong[1], C.K. Lim[1], C.W.F. Wan[1], J. Kim[1], W.H. Seet[1], David L. Harame[3]

[1]GLOBALFOUNDRIES, Singapore, [2]GLOBALFOUNDRIES, USA, [3]Research Foundation CUNY, USA

A 26dBm 39GHz Power Amplifier with 26.6% PAE for 5G Applications in 28nm Bulk CMOS | **RTu1E-1**

Kaushik Dasgupta, Saeid Daneshgar, Chintan Thakkar, James Jaussi, Bryan Casper

Intel, USA

Direct Digital Synthesizer with 14GS/s Sampling Rate Heterogeneously Integrated in InP HBT and GaN HEMT on CMOS | **RMo2C-5**

Steven Eugene Turner, Mark E. Stuenkel, Gary M. Madison, Justin A. Cartwright, Richard L. Harwood, Joseph D. Cali, Steve A. Chadwick, Michael Oh, John T. Matta, James M. Meredith, Justin M. Byrd, Lawrence J. Kushner

BAE Systems, USA

Excellent 22FDX Hot-Carrier Reliability for PA Applications | **RMo1B-3**

T. Chen[1], Chi Zhang[1], W. Arfaoui[2], Abdellatif Bellaouar[1], S. Embabi[1], G. Bossu[2], M. Siddabathula[2], K.W.J. Chew[3], S.N. Ong[3], M. Mantravadi[1], K. Barnett[1], J. Bordelon[1], R. Taylor[1], S. Janardhanan[1]

[1]GLOBALFOUNDRIES, USA, [2]GLOBALFOUNDRIES, Germany, [3]GLOBALFOUNDRIES, Singapore

A 1.04–4V, Digital-Intensive Dual-Mode BLE 5.0/IEEE 802.15.4 Transceiver SoC with Extended Range in 28nm CMOS | **RTu1F-5**

Nam-Seog Kim[1], Myoung-Gyun Kim[1], Ashutosh Verma[2], Gyungseon Seol[1], Shinwoong Kim[1], Seokwon Lee[1], Chilun Lo[1], Jaeyeol Han[1], Ikkyun Jo[1], Chulho Kim[1], Chih-Wei Yao[2], Jongwoo Lee[1]

[1]Samsung, Korea, [2]Samsung, USA

A High Efficiency 39GHz CMOS Cascode Power Amplifier for 5G Applications | **RMo4A-1**

Hyun-chul Park, Byungjoon Park, Yunsung Cho, Jaehong Park, Jihoon Kim, Jeong Ho Lee, Juho Son, Kyu Hwan An, Sung-Gi Yang

Samsung, Korea

A Low Power Fully-Integrated 76–81GHz ADPLL for Automotive Radar Applications with 150MHz/µs FMCW Chirp Rate and -95dBc/Hz Phase Noise at 1MHz Offset in FDSOI | **RTuIF-6**

Ahmed R. Fridi[1], Chi Zhang[1], Abdellatif Bellaouar[1], Man Tran[2]

[1]GLOBALFOUNDRIES, USA, [2]Mantric Technology, Canada

X-Band NMOS and CMOS Cross-Coupled DCO's with a "Folded" Common-Mode Resonator Exhibiting 188.5dBc/Hz FoM with 29.5% Tuning Range in 16-nm CMOS | **RMo3C-2**

R. Levinger, D. Ben-Haim, I. Gertman, S. Bershansky, R. Levi, J. Kadry, G. Horovitz

FinFet Intel, Israel

STUDENT PAPER AWARD FINALISTS

A 4×4×4-mm³ Fully Integrated Sensor-to-Sensor Radio Using Carrier Frequency Interlocking IF Receiver with -94dBm Sensitivity | **RTu1F-3**

Li-Xuan Chuo[1], Yejoong Kim[1], Nikolaos Chiotellis[1], Makoto Yasuda[2], Satoru Miyoshi[3], Masaru Kawaminami[2], Anthony Grbic[1], David Wentzloff[1], Hun-Seok Kim[1], David Blaauw[1]

[1]University of Michigan, USA, [2]Mie Fujitsu Semiconductor, Japan, [3]Fujitsu Electronics, USA

A 24–43GHz LNA with 3.1–3.7dB Noise Figure and Embedded 3-Pole Elliptic High-Pass Response for 5G Applications in 22nm FDSOI | **RTu1E-2**

Li Gao, Gabriel M. Rebeiz

University of California, San Diego, USA

A 77dB-SFDR Multi-Phase-Sampling 16-Element Digital Beamformer with 64 4GS/s 100MHz-BW Continuous-Time Band-Pass ADCs | **RMo4C-3**

Rundao Lu, Sunmin Jang, Yun Hao, Michael P. Flynn

University of Michigan, USA

A Sub-mW All-Passive RF Front End with Implicit Capacitive Stacking Achieving 13dB Gain, 5dB NF and +25dBm OOB-IIP3 | **RMo2B-4**

Vijaya Kumar Purushothaman, Eric Klumperink, Berta Trullas Clavera

Bram Nauta University of Twente, The Netherlands

Enhanced Passive Mixer-First Receiver Driving an Impedance with 40dB/Decade Roll-Off, Achieving +12dBm Blocker-P1dB, +33dBm IIP3 and Sub-2dB NF Degradation for a 0dBm Blocker | **RMo3B-1**

Sashank Krishnamurthy, Ali M. Niknejad

University of California, Berkeley, USA

A Quadrature Class-G Complex-Domain Doherty Digital Power Amplifier | **RTu2F-1**

Shih-Chang Hung, Si-Wook Yoo, Sang-Min Yoo

Michigan State University, USA

A Coupler-Based Differential Doherty Power Amplifier with Built-In Baluns for High mm- Wave Linear-Yet-Efficient Gbit/s Amplifications | **RMo4A-5**

Huy Thong Nguyen, Hua Wang

Georgia Tech, USA

A 350mV Complementary 4–5GHz VCO Based on a 4-Port Transformer Resonator with 195.8dBc/Hz Peak FOM in 22nm FDSOI | **RMo3C-1**

Omar El-Aassar, Gabriel M. Rebeiz University of California, San Diego, USA

A 39GHz 64-Element Phased-Array CMOS Transceiver with Built-In Calibration for Large- Array 5G NR | **RTu2E-2**

Yun Wang[1], Rui Wu[1], Jian Pang[1], Dongwon You[1], Ashbir Aviat Fadila[1], Rattanan Saengchan[1], Xi Fu1, Daiki Matsumoto[1], Takeshi Nakamura[1], Ryo Kubozoe[1], Masaru Kawabuchi[1], Bangan Liu[1], Haosheng Zhang[1], Junjun Qiu[1], Hanli Liu[1], Wei Deng[1], Naoki Oshima[2], Keiichi Motoi[2], Shinichi Hori[2], Kazuaki Kunihiro[2], Tomoya Kaneko[2], Atsushi Shirane[1], Kenichi Okada[1]

[1]Tokyo Institute of Technology, Japan, [2]NEC, Japan

A 24.5–43.5GHz Compact RX with Calibration-Free 32–56dB Full-Frequency Instantaneously Wideband Image Rejection Supporting Multi-Gb/s 64-QAM/256-QAM for Multi-Band 5G Massive MIMO | **RTu2E-1**

Min-Yu Huang[1], Taiyun Chi[2], Fei Wang[1], Sensen Li[1], Tzu-Yuan Huang[1], Hua Wang[1]

[1]Georgia Tech, USA, [2]Speedlink Technology, USA

A 51.5–64.5GHz Active Phase Shifter Using Linear Phase Control Technique with 1.4° Phase Resolution in 65-nm CMOS | **RMo2A-1**

Tianjun Wu, Chenxi Zhao, Huihua Liu, Yunqiu Wu, Yiming Yu, Kai Kang

UESTC, China

A 6.5-GHz Cryogenic All-Pass Filter Circulator in 40-nm CMOS for Quantum Computing Applications | **RMo2C-3**

Andrea Ruffino[1], Yatao Peng[1], Fabio Sebastiano[2], Masoud Babaie[2], Edoardo Charbon[1]

[1]EPFL, Switzerland, [2]Technische Universiteit Delft, The Netherlands

CONFERENCE **HIGHLIGHTS** MONDAY

EVENT	TIME
RFIC Technical Sessions	08:00 - 17:15
Workshops & Short Courses	08:00 – 17:15
RF Boot Camp	08:00 – 16:30
RFIC Panel Session	12:00 – 13:15
Three Minute Thesis Competition	14:00 – 16:00
IMS Plenary Session	17:30 – 19:00
IMS Welcome Reception	19:30 – 21:00

252AB

RMo1A: RF Receiver Building Blocks

Chair: Edmund Balboni, Analog Devices
Co-Chair: Domine Leenaerts, NXP Semiconductors

08:00

RMo1A-1: A 1.2–2.8GHz Tunable Low-Noise Amplifier with 0.8–1.6dB Noise Figure

H. Gao, Technische Universiteit Eindhoven; Z. Song, Technische Universiteit Eindhoven; Z. Chen, Technische Universiteit Eindhoven; D.M.W. Leenaerts, Technische Universiteit Eindhoven; P.G.M. Baltus, Technische Universiteit Eindhoven

08:20

RMo1A-2: A 28-GHz CMOS LNA with Stability-Enhanced G_m-Boosting Technique Using Transformers

S. Kong, ETRI; H.-D. Lee, ETRI; S. Jang, ETRI; J. Park, ETRI; K.-S. Kim, ETRI; K.-C. Lee, ETRI

08:40

RMo1A-3: Ka-Band CMOS Absorptive SP4T Switch with One-Third Miniaturization

B. Suh, Yonsei University; B.-W. Min, Yonsei University

09:00

RMo1A-4: A Compact, High-Power, 60GHz SPDT Switch Using Shunt-Series SiGe PIN Diodes

Y. Gong, Georgia Tech; J.W. Teng, Georgia Tech; J.D. Cressler, Georgia Tech

09:20

09:40

254AB

RMo1B: Advanced Devices, Characterization, and Modeling for Millimeter-Wave Applications

Chair: Alvin Joseph, GLOBALFOUNDRIES
Co-Chair: Edward Preisler, TowerJazz

RMo1B-1: Low-Cost, High-Gain Antenna Module Integrating a CMOS Frequency Multiplier Driver for Communications at D-Band

F. Foglia Manzillo, CEA-LETI; J.L. Gonzalez-Jimenez, CEA-LETI; A. Clemente, CEA-LETI; A. Siligaris, CEA-LETI; B. Blampey, CEA-LETI; C. Dehos, CEA-LETI

RMo1B-2: Scalable Analytical Model of 1.7THz Cut-Off Frequency Schottky Diodes Integrated in 55nm BiCMOS Technology

V. Gidel, STMicroelectronics; F. Gianesello, STMicroelectronics; P. Chevalier, STMicroelectronics; G. Avenier, STMicroelectronics; N. Guitard, STMicroelectronics; V. Milon, STMicroelectronics; M. Buczko, STMicroelectronics; C.-A. Legrand, STMicroelectronics; C. Luxey, Polytech'Lab (EA 7498); G. Ducournau, IEMN (UMR 8520)

RMo1B-3: Excellent 22FDX Hot-Carrier Reliability for PA Applications

T. Chen, GLOBALFOUNDRIES; C. Zhang, GLOBALFOUNDRIES; W. Arfaoui, GLOBALFOUNDRIES; A. Bellaouar, GLOBALFOUNDRIES; S. Embabi, GLOBALFOUNDRIES; G. Bossu, GLOBALFOUNDRIES; M. Siddabathula, GLOBALFOUNDRIES; K.W.J. Chew, GLOBALFOUNDRIES; S.N. Ong, GLOBALFOUNDRIES; M. Mantravadi, GLOBALFOUNDRIES; K. Barnett, GLOBALFOUNDRIES; J. Bordelon, GLOBALFOUNDRIES; R. Taylor, GLOBALFOUNDRIES; S. Janardhanan, GLOBALFOUNDRIES

RMo1B-4: 22nm Fully-Depleted SOI High Frequency Noise Modeling up to 90GHz Enabling Ultra Low Noise Millimetre-Wave LNA Design

L.H.K. Chan, S.N. Ong, W.L. Oo, K.W.J. Chew, C. Zhang, A. Bellaouar, W.H. Chow, T. Chen, GLOBALFOUNDRIES; R. Rassel, J.S. Wong, C.K. Lim, C.W.F. Wan, J. Kim, W.H. Seet, GLOBALFOUNDRIES; D.L. Harame, Research Foundation CUNY

RMo1B-5: 22nm Ultra-Thin Body and Buried Oxide FDSOI RF Noise Performance

O.M. Kane, CEA-LETI ; L. Lucci, CEA-LETI ; P. Scheiblin, CEA-LETI ; S. Lepilliet, IEMN (UMR 8520); F. Danneville, IEMN (UMR 8520)

257AB

RMo1C: Millimeter-Wave Radar and Imaging Systems

Chair: Shahriar Shahramian, Nokia Bell Labs
Co-Chair: Jane Gu, University of California, Davis

RMo1C-1: A 76–81GHz FMCW Transceiver with 3-Transmit, 4-Receive Paths and 15dBm Output Power for Automotive Radars

Z. Duan, USTC; D. Pan, USTC; B. Wu, ECRIEE; Y. Wang, ECRIEE; B. Liao, ECRIEE; D. Huang, Tsinghua University; Y. Wu, CETC 24; D. Xu, CETC 24; H. Xu, CETC 24; W. Lv, ECRIEE; Y. Dai, ECRIEE; P. Li, ECRIEE; Y. Wang, Tsinghua University; F. Lin, USTC

RMo1C-2: Reconfigurable 60-GHz Radar Transmitter SoC with Broadband Frequency Tripler in 45nm SOI CMOS

W. Lee, IBM T.J. Watson Research Center; T. Dinc, IBM T.J. Watson Research Center; A. Valdes-Garcia, IBM T.J. Watson Research Center

RMo1C-3: A 94GHz 2×2 Phased-Array FMCW Imaging Radar Transceiver with 11dBm Output Power and 10.5dB NF in 65nm CMOS

D. Huang, Tsinghua University; L. Zhang, Tsinghua University; H. Zhu, CAEP; B. Chen, CAEP; Y. Tang, CAEP; Y. Wang, Tsinghua University

RMo1C-4: X/Ku-Band Four-Channel Transmit/Receive SiGe Phased-Array IC

P. Saha, Analog Devices; S. Muralidharan, Analog Devices; J. Cao, Analog Devices; O. Gurbuz, Analog Devices; C. Hay, Analog Devices

RMo1C-5: Ultra-Wideband 8–45GHz Transmitter Front-End for a Reconfigurable FMCW MIMO Radar

M. Sakalas, Technische Universität Dresden; S. Li, Technische Universität Dresden; N. Joram, Technische Universität Dresden; P. Sakalas, Technische Universität Dresden; F. Ellinger, Technische Universität Dresden

Coffee / Snacks 09:40 – 10:10

252AB

RMo2A: 5G and Millimeter-Wave Beamforming Building Blocks

Chair: Ruonan Han, MIT
Co-Chair: Abdellatif Bellaouar, GLOBALFOUNDRIES

10:10

RMo2A-1: A 51.5–64.5GHz Active Phase Shifter Using Linear Phase Control Technique with 1.4° Phase Resolution in 65-nm CMOS

T. Wu, UESTC; C. Zhao, UESTC; H. Liu, UESTC; Y. Wu, UESTC; Y. Yu, UESTC; K. Kang, UESTC

10:30

RMo2A-2: Digitally-Assisted 27–33GHz Reflection-Type Phase Shifter with Enhanced Accuracy and Low IL-Variation

J. Xia, University of Waterloo; M. Farouk, University of Waterloo; S. Boumaiza, University of Waterloo

10:50

RMo2A-3: A 21 to 30-GHz Merged Digital-Controlled High Resolution Phase Shifter-Programmable Gain Amplifier with Orthogonal Phase and Gain Control for 5-G Phase Array Application

W. Zhu, Tsinghua University; W. Lv, ECRIEE; B. Liao, ECRIEE; Y. Zhu, ECRIEE; Y. Dai, ECRIEE; P. Li, ECRIEE; L. Zhang, Tsinghua University; Y. Wang, Tsinghua University

11:10

RMo2A-4: A 20–43GHz VGA with 21.5dB Gain Tuning Range and Low Phase Variation for 5G Communications in 65-nm CMOS

T. Wu, UESTC; C. Zhao, UESTC; H. Liu, UESTC; Y. Wu, UESTC; Y. Yu, UESTC; K. Kang, UESTC

11:30

RMo2A-5: A 26-GHz Vector Modulator in 130-nm SiGe BiCMOS Achieving Monotonic 10-b Phase Resolution without Calibration

I. Kalyoncu, Sabanci University; A. Burak, Sabanci University; M. Kaynak, IHP; Y. Gurbuz, Sabanci University

11:50

254AB

RMo2B: Digitally Assisted Front-Ends for Emerging Wireless Applications

Chair: Debo Chowdhury, Broadcom
Co-Chair: Oren Eliezer, PHAZR

RMo2B-1: A 20–32GHz Digital Quadrature Transmitter with Notched-Matching and Mode-Switch Topology for 5G Wireless and Backhaul

H.J. Qian, UESTC; Y. Shu, UESTC; J. Zhou, UESTC; X. Luo, UESTC

RMo2B-2: A Wideband Digital Polar Transmitter with Integrated Capacitor-DAC-Based Constant-Envelope Digital-to-Phase Converter

T. Li, Fudan University; L. Xiong, Fudan University; Y. Yin, Fudan University; Y. Liu, Fudan University; H. Min, Fudan University; N. Yan, Fudan University; H. Xu, Fudan University

RMo2B-3: A 5GHz to 6GHz CMOS Transmitter for Full-Duplex Wireless with Wideband Digital Cancellation

N. Ginzberg, Technion; D. Regev, Toga Networks; G. Tsodik, Toga Networks; S. Shilo, Toga Networks; D. Ezri, Toga Networks; E. Cohen, Technion

RMo2B-4: A Sub-mW All-Passive RF Front End with Implicit Capacitive Stacking Achieving 13dB Gain, 5dB NF and +25dBm OOB-IIP3

V.K. Purushothaman, University of Twente; E. Klumperink, University of Twente; B. Trullas Clavera, University of Twente; B. Nauta, University of Twente

RMo2B-5: A 0.3-to-1.3GHz Multi-Branch Receiver with Modulated Mixer Clocks for Concurrent Dual-Carrier Reception and Rapid Compressive-Sampling Spectrum Scanning

G. Han, Columbia University; T. Haque, Columbia University; M. Bajor, Columbia University; J. Wright, Columbia University; P.R. Kinget, Columbia University

257AB

RMo2C: RF-Inspired Emerging Technologies and Applications

Chair: Fabio Sebastiano, Technische Universiteit Delft
Co-Chair: Renyuan (Ryan) Wang, BAE Systems

RMo2C-1: A 0.5–20GHz RF Silicon Photonic Receiver with 120 dB·Hz$^{2/3}$ SFDR Using Broadband Distributed IM3 Injection Linearization

N. Hosseinzadeh, University of California, Santa Barbara; A. Jain, University of California, Santa Barbara; K. Ning, University of California, Santa Barbara; R. Helkey, University of California, Santa Barbara; J.F. Buckwalter, University of California, Santa Barbara

RMo2C-2: A 65nm CMOS Continuous-Time Electro-Optic PLL (CT-EOPLL) with Image and Harmonic Spur Suppression for LIDAR

A. Binaie, Columbia University; S. Ahasan, Columbia University; H. Krishnaswamy, Columbia University

RMo2C-3: A 6.5-GHz Cryogenic All-Pass Filter Circulator in 40-nm CMOS for Quantum Computing Applications

A. Ruffino, EPFL; Y. Peng, EPFL; F. Sebastiano, Technische Universiteit Delft; M. Babaie, Technische Universiteit Delft; E. Charbon, EPFL

RMo2C-4: Design Considerations for Spin Readout Amplifiers in Monolithically Integrated Semiconductor Quantum Processors

M.J. Gong, U. Alakusu, S. Bonen, M.S. Dadash, S.P. Voinigescu, University of Toronto; L. Lucci, D.L. Harame, GLOBALFOUNDRIES; H. Jia, L.E. Gutierrez, W.T. Chen, R.R. Mansour, University of Waterloo; D.R. Daughton, Lake Shore Cryotronics; G.C. Adam, S. Iordănescu, M. Păşteanu, A. Müller, IMT Bucharest; N. Messaoudi, Keysight Technologies

RMo2C-5: Direct Digital Synthesizer with 14GS/s Sampling Rate Heterogeneously Integrated in InP HBT and GaN HEMT on CMOS

S.E. Turner, BAE Systems; M.E. Stuenkel, BAE Systems; G.M. Madison, BAE Systems; J.A. Cartwright, BAE Systems; R.L. Harwood, BAE Systems; J.D. Cali, BAE Systems; S.A. Chadwick, BAE Systems; M. Oh, BAE Systems; J.T. Matta, BAE Systems; J.M. Meredith, BAE Systems; J.M. Byrd, BAE Systems; L.J. Kushner, BAE Systems

RFIC Panel Session at Lunchtime — See Page 23

252AB

RMo3A: Millimeter-Wave Integrated Subsystems

Chair: Pierre Busson, STMicroelectronics
Co-Chair: Mona Hella, Rensselaer Polytechnic Institute

13:30

RMo3A-1: A 1V 54–64GHz 4-Channel Phased-Array Receiver in 45nm RFSOI with 3.6/5.1dB NF and -23dBm IP1dB at 28/37mW Per-Channel

H. Chung, University of California, San Diego; Q. Ma, University of California, San Diego; G.M. Rebeiz, University of California, San Diego

13:50

RMo3A-2: A Fully Integrated 60GHz 10Gb/s QPSK Transceiver with Digital Transmitter and T/R Switch in 65nm CMOS

Z. Song, Tsinghua University; J. Lin, Tsinghua University; Y. Li, Tsinghua University; J. Ye, Tsinghua University; R. Ma, Tsinghua University; B. Chi, Tsinghua University

14:10

RMo3A-3: A 60GHz Polarization-Duplex TX/RX Front-End with Dual-Pol Antenna-IC Co-Integration in SiGe BiCMOS

Y. Liu, Oregon State University; A. Natarajan, Oregon State University

14:30

RMo3A-4: A 180-GHz Super-Regenerative Oscillator with up to 58dB Gain for Efficient Phase Recovery

H. Ghaleb, Technische Universität Dresden; C. Carlowitz, FAU Erlangen-Nürnberg; D. Fritsche, Technische Universität Dresden; C. Carta, Technische Universität Dresden; F. Ellinger, Technische Universität Dresden

14:50

RMo3A-5: A Broadband Direct Conversion Transmitter/Receiver at D-Band Using CMOS 22nm FDSOI

A.A. Farid, University of California, Santa Barbara; A. Simsek, University of California, Santa Barbara; A.S.H. Ahmed, University of California, Santa Barbara; M.J.W. Rodwell, University of California, Santa Barbara

15:10

254AB

RMo3B: Blocker Tolerance and Interference Cancellation

Chair: Leon van den Oever, Qualcomm
Co-Chair: Andre Hanke, Intel

RMo3B-1: Enhanced Passive Mixer-First Receiver Driving an Impedance with 40dB/Decade Roll-Off, Achieving +12dBm Blocker-P1dB, +33dBm IIP3 and Sub-2dB NF Degradation for a 0dBm Blocker

S. Krishnamurthy, University of California, Berkeley; A.M. Niknejad, University of California, Berkeley

RMo3B-2: A Code-Domain RF Signal Processing Front-End for Simultaneous Transmit and Receive with 49.5dB Self-Interference Rejection, 12.1dBm Receive Compression, and 34.3dBm Transmit Compression

H. AlShammary, University of California, Santa Barbara; C.W. Hill, University of California, Santa Barbara; A. Hamza, University of California, Santa Barbara; J.F. Buckwalter, University of California, Santa Barbara

RMo3B-3: A CMOS 0.5–2.5GHz Full-Duplex MIMO Receiver with Self-Adaptive and Power-Scalable RF/Analog Wideband Interference Cancellation

Y. Cao, University of Illinois at Urbana-Champaign; J. Zhou, University of Illinois at Urbana-Champaign

RMo3B-4: A 0.5-to-3.5GHz Self-Interference-Canceling Receiver for In-Band Full-Duplex Wireless

A. Ershadi, Texas A&M University; K. Entesari, Texas A&M University

RMo3B-5: A Baseband-Matching-Resistor Noise-Canceling Receiver Architecture to Increase In-Band Linearity Achieving 175MHz TIA Bandwidth with a 3-Stage Inverter-Only OpAmp

A.N. Bhat, University of Twente; R. van der Zee, University of Twente; S. Finocchiaro, Texas Instruments; F. Dantoni, Texas Instruments; B. Nauta, University of Twente

257AB

RMo3C: High-Performance Energy-Efficient Oscillators and Frequency Synthesizers

Chair: Wanghua Wu, Samsung
Co-Chair: Piero Andreani, Lund University

RMo3C-1: A 350mV Complementary 4–5GHz VCO Based on a 4-Port Transformer Resonator with 195.8dBc/Hz Peak FOM in 22nm FDSOI

O. El-Aassar, University of California, San Diego; G.M. Rebeiz, University of California, San Diego

RMo3C-2: X-Band NMOS and CMOS Cross-Coupled DCO's with a "Folded" Common-Mode Resonator Exhibiting 188.5dBc/Hz FoM with 29.5% Tuning Range in 16-nm CMOS FinFet

R. Levinger, Intel; D. Ben-Haim, Intel; I. Gertman, Intel; S. Bershansky, Intel; R. Levi, Intel; J. Kadry, Intel; G. Horovitz, Intel

RMo3C-3: A 18.2–29.3GHz Colpitts VCOs Bank with -119.5dBc/Hz Phase Noise at 1MHz Offset for 5G Communications

F. Quadrelli, Infineon Technologies; F. Panazzolo, Infineon Technologies; M. Tiebout, Infineon Technologies; F. Padovan, Infineon Technologies; M. Bassi, Infineon Technologies; A. Bevilacqua, Università di Padova

RMo3C-4: A 9.6mW Low-Noise Millimeter-Wave Sub-Sampling PLL with a Divider-Less Sub-Sampling Lock Detector in 65nm CMOS

H. Wang, University of California, Davis; O. Momeni, University of California, Davis

RMo3C-5: A -40-dBc Integrated-Phase-Noise 45-GHz Sub-Sampling PLL with 3.9-dBm Output and 2.1% DC-to-RF Efficiency

S. Lee, Hiroshima University; K. Takano, Hiroshima University; S. Hara, NICT; R. Dong, Hiroshima University; S. Amakawa, Hiroshima University; T. Yoshida, Hiroshima University; M. Fujishima, Hiroshima University

Coffee / Snacks 15:10 – 15:40

252AB

RMo4A: Millimeter-Wave PAs for 5G and Phased Arrays

Chair: Patrick Reynaert, Katholieke Universiteit Leuven
Co-Chair: Margaret Szymanowski, NXP Semiconductors

15:55

RMo4A-1: A High Efficiency 39GHz CMOS Cascode Power Amplifier for 5G Applications

H.-C. Park, Samsung; B. Park, Samsung; Y. Cho, Samsung; J. Park, Samsung; J. Kim, Samsung; J.H. Lee, Samsung; J. Son, Samsung; K.H. An, Samsung; S.-G. Yang, Samsung

16:15

RMo4A-2: A Compact E-Band PA with 22.37% PAE 14.29dBm Output Power and 26dB Power Gain with Efficiency Enhancement at Power Back-Off

L. Chen, Tsinghua University; L. Zhang, Tsinghua University; L. Zhang, Tsinghua University; Y. Wang, Tsinghua University

16:35

RMo4A-3: An E-Band Compact Power Amplifier for Future Array-Based Backhaul Networks in 22nm FD-SOI

U. Çelik, Katholieke Universiteit Leuven; P. Reynaert, Katholieke Universiteit Leuven

16:55

RMo4A-4: An E-Band Fully-Integrated True Power Detector in 28nm CMOS

V. Qunaj, Katholieke Universiteit Leuven; P. Reynaert, Katholieke Universiteit Leuven

17:15

RMo4A-5: A Coupler-Based Differential Doherty Power Amplifier with Built-In Baluns for High mm-Wave Linear-Yet-Efficient Gbit/s Amplifications

H.T. Nguyen, Georgia Tech; H. Wang, Georgia Tech

17:35

254AB

RMo4B: Receiver Circuits in CMOS-SOI Technology

Chair: Kamran Entesari, Texas A&M University
Co-Chair: Danilo Manstretta, Università di Pavia

15:55

RMo4B-1: VSWR Robust Linearizer to Improve Switch IMD by >20dB

T. Meier, RF Innovation; A. Mehmood, RF Innovation; J. Kaps, RF Innovation

16:15

RMo4B-2: A Blocker-Tolerant Two-Stage Harmonic-Rejection RF Front-End

F. Ul Haq, Aalto University; M. Englund, Huawei Technologies; Y. Antonov, Aalto University; K. Stadius, Aalto University; M. Kosunen, Aalto University; K.B. Östman, Nordic Semiconductor; K. Koli, Huawei Technologies; J. Ryynänen, Aalto University

16:35

RMo4B-3: A Low Noise Figure 28GHz LNA in 22nm FDSOI Technology

C. Zhang, GLOBALFOUNDRIES; F. Zhang, GLOBALFOUNDRIES; S. Syed, GLOBALFOUNDRIES; M. Otto, GLOBALFOUNDRIES; A. Bellaouar, GLOBALFOUNDRIES

16:55

RMo4B-4: A 1.7-dB Minimum NF, 22–32GHz Low-Noise Feedback Amplifier with Multistage Noise Matching in 22-nm SOI-CMOS

B. Cui, University of Waterloo; J.R. Long, University of Waterloo; D.L. Harame, GLOBALFOUNDRIES

17:15

17:35

257AB

RMo4C: Mixed Signal Circuits for High Speed RF and Optical Transceivers

Chair: Antoine Frappé, ISEN Lille
Co-Chair: Raja Pullela, MaxLinear

15:55

RMo4C-1: A 112-GS/s 1-to-4 ADC Front-End with More than 35-dBc SFDR and 28-dB SNDR up to 43-GHz in 130-nm SiGe BiCMOS

X.-Q. Du, Universität Stuttgart; M. Grözing, Universität Stuttgart; A. Uhl, Universität Stuttgart; S. Park, Universität Stuttgart; F. Buchali, Nokia Bell Labs; K. Schuh, Nokia Bell Labs; S.T. Le, Nokia Bell Labs; M. Berroth, Universität Stuttgart

16:15

RMo4C-2: A Dual-28Gb/s Digital-Assisted Distributed Driver with CDR for Optical-DAC PAM4 Modulation in 40nm CMOS

Q. Liao, Chinese Academy of Sciences; S. Hu, Fudan University; J. He, Chinese Academy of Sciences; B. Yin, Fudan University; PY. Chiang, Fudan University; J. Liu, Chinese Academy of Sciences; N. Qi, Chinese Academy of Sciences; N. Wu, Chinese Academy of Sciences

16:35

RMo4C-3: A 77dB-SFDR Multi-Phase-Sampling 16-Element Digital Beamformer with 64 4GS/s 100MHz-BW Continuous-Time Band-Pass $\Delta\Sigma$ ADCs

R. Lu, University of Michigan; S. Jang, University of Michigan; Y. Hao, University of Michigan; M.P. Flynn, University of Michigan

16:55

RMo4C-4: A Wideband Digitally Controllable RFIC with Gain and Wavelength Tunability and Built-In Self Test Functionalities for Optical Transceiver Modules in FTTx Applications

S. Lakshminarayanan, Technische Universität Darmstadt; H. Malhotra, Technische Universität Darmstadt; D. Navara, DEV Systemtechnik; N. Reiss, DEV Systemtechnik; K. Hofmann, Technische Universität Darmstadt

17:15

RMo4C-5: A Compact Single-Ended Dual-Band Receiver with Crosstalk and ISI Reductions for High-Density I/O Interfaces

J. Du, University of California, Los Angeles; J. Zhou, University of California, Los Angeles; X.S. Wang, University of California, Los Angeles; C.-H. Wong, University of California, Los Angeles; H.-N. Chen, TSMC; C.-P. Jou, TSMC; M.-C.F. Chang, University of California, Los Angeles

17:35

Check the website (ims-ieee.org) or the mobile app for the most up-to-date room assignments as well as a detailed listing of workshop speakers and presentations. On-site registration is available for those who didn't pre-register. Workshop hopping within the day is allowed after the first 30 minutes.

	Workshop Title	Workshop Abstract
WMA	**Exploratory Semiconductor Devices for the 5G mm-Wave Era and Beyond** **Sponsor:** IMS **Organizer:** G. Callet, UMS; K.T. Lee, IBM T.J. Watson Research Center **08:00 – 17:15** **Room 151AB**	Over the past decades, the RF/microwave community has expanded and benefited from the rapid development of the semiconductor industry. Advances in exploratory materials and structures have enabled devices switching at higher frequency, while keeping a compact form factor and increasing energy efficiency. These devices are now reaching the level of industrial maturity to meet the requirements for 5G power applications at mm-wave frequencies and beyond. In this one-day workshop, nine invited talks from semiconductor experts, academic researchers and the global end-users will be presented. The workshop will cover all key aspects of advanced technologies for 5G, including 1) mm-wave GaN devices and integration, 2) ultra broadband RF SoC, 3) integration for RF transceivers, and 4) wafer-level packaging for high frequency devices. It will give the attendees a comprehensive exposure to the latest 5G technological solutions and breakthrough.
WMB	**Low Phase Noise Oscillator and Frequency Synthesizer Techniques** **Sponsor:** IMS **Organizer:** A. Chenakin, Anritsu; A.P.S. Khanna, National Instruments **08:00 – 17:15** **Room 152**	Frequency synthesis plays a key role in virtually all present-day commercial, industrial and test and measurement systems. State-of-the-art low-noise frequency synthesis is a particularly important technical asset to high-speed telecommunications, efficient management of the wireless spectrum and high-resolution imaging. Overall performance of various technologies depends on, and is often limited by, phase and amplitude noise fluctuations in oscillators and frequency synthesizers. This full-day workshop will focus on modern low phase noise oscillator and frequency synthesizer techniques. The RF/microwave industry feels persistent pressure to deliver higher performance, higher functionality, smaller size, lower power consumption and lower cost synthesizer designs. Various synthesizer architectures along with their main characteristics will be analyzed. The new market demands, design challenges and possible solutions will be discussed. In respect to phase noise performance, synthesizer designers primarily rely on ovenized crystal oscillators (OCXO), which will be reviewed in detail. Longer-term major breakthroughs are expected operating the reference with other physical principles or materials. For example, the phase noise exceeding -170dBc/Hz at 10kHz offset at 10GHz output for a sapphire resonator based oscillator has been reported. These quality expectations will dramatically change conceptual approaches for building new synthesizers or even the whole way of thinking about this problem. State-of-the-art low-phase-noise oscillator techniques including sapphire loaded cavity oscillators, optoelectronic and atomic methods will also be covered.
WMC	**5G: mm-Wave Power Amplifiers & Technology Benchmarking** **Sponsor:** IMS; RFIC **Organizer:** D. Belot, CEA-LETI; E. Kerhervé, IMS (UMR 5218) **08:00 – 17:15** **Room 153AB**	5G spectrum is presently open world-wide to sub-6GHz and mm-Wave bands at 26GHz, 28GHz, and other bands at 40GHz, 60GHz (V) and 71-86GHz (E) are under evaluation in most parts of the world. Different power amplifier architectures and process technology approaches are in competition to cover these 5G opened bands. This workshop will benchmark the state-of-the-art power amplifier techniques targeting mm-Wave frequency for 5G applications, and will present the status of different processes addressing the Power Amplifier applications such as silicon based, III-V, GaN and InP technologies. Finally we will discuss the match between these technologies' specificities and the different 5G application requests.
WMD	**Measurement and Design Techniques for Next-Generation Communication Systems** **Sponsor:** IMS; ARFTG **Organizer:** A. Raffo, Università di Ferrara; P. Roblin, Ohio State University **08:00 – 17:15** **Room 156AB**	The design of future communication systems poses several challenges in terms of required bandwidth, power, efficiency, and costs. The workshop aims at discussing how these challenges can be tackled by adopting skills and techniques that, although acquired by the microwave community, are still too fragmented. More specifically, the workshop will focus on measurements, which are a crucial step at each design level, from semiconductor devices to circuits and systems. Speakers will show how a deep understanding of the measurement quality is of critical importance and remains an unavoidable step for the design of the next-generation microwave circuits and systems. Emphasis will be placed on wideband measurements accounting for new modulation techniques. Finally, different examples of circuit and system designs oriented to 5G and IoT applications will be presented. It will be emphasized how simulations and measurements merge together in modern design techniques to give rise to first-pass design strategies.
WME	**mm-Wave Power Amplifier Design Innovations** **Sponsor:** IMS; RFIC **Organizer:** E. Niehenke, Niehenke Consulting; R. Quay, Fraunhofer IAF; J. Pierro, Telephonics **08:00 – 17:15** **Room 160ABC**	Millimeter-waves have found uses for radar, communications, and most recently in 5G applications and beyond. Power amplifiers are limiting components due to their energy consumption, bandwidth limitation, and gain limitation. This workshop will focus on recent innovations in power amplifier IC design techniques with specific emphasis on their realization at mm-wave frequencies. These include design and layout techniques for efficiency enhancement, linearity improvements, thermal management, memory effects, and bandwidth and gain extension. Many of these state-of-the-art improvements can be linked to power amplifier device technology whose great variety will be covered including SOI, GaN, GaAs , SiGe, and CMOS as those differ drastically in their active and passive capabilities and available design features.
WMF	**Measurement Challenges in Over-The-Air Testing** **Sponsor:** IMS; ARFTG **Organizer:** J. Martens, Anritsu; N.B. Carvalho, Universidade de Aveiro **08:00 – 17:15** **Room 156C**	As radio integration proceeds apace for 5G, satellite and other applications, over-the-air testing requirements are increasing dramatically. This workshop covers topics related to both measurement fundamentals (spatial data fusion, calibration and synchronization concerns, traceability, etc.), to the structure and measurement requirements of the subsystems being analyzed and to more advanced topics (e.g., MIMO test beds, higher order measurements such as EVM). Even simple transmission phase measurements versus position/angle can be a challenge with disjoint frequency converters and path characteristics changing over the modulation bandwidth. Nonlinear characterization (including emulated load pull) is increasingly needed for the embedded power amplifiers in these systems. Some subsystems under test may employ multibeam scanning or element-level predistortion that require additional characterization considerations. Attendees at this workshop will hear some of the latest thinking in OTA measurements and procedures and how some recent changes in integrated radio/system designs will further influence the measurement landscape.

Check the website (ims-ieee.org) or the mobile app for the most up-to-date room assignments as well as a detailed listing of workshop speakers and presentations. On-site registration is available for those who didn't pre-register. Workshop hopping within the day is allowed after the first 30 minutes.

Workshop Abstract	Workshop Title	
5G Front-End Modules (FEM) for below 6GHz and at mm-wave frequencies pose daunting design challenges to fit within the phased-array antenna element spacing constraints. The challenge is to create solutions that will meet or exceed electrical, mechanical, thermal and cost requirements for both the UE and BS use cases. The close proximity of components points to the need for optimized design to achieve signal integrity and reduced insertion losses imposed by interconnects and packaging techniques at the chip, module, and board levels. This workshop will address design and manufacturing techniques by bringing together the subject matter experts from the IEEE EPS and the MTT-S communities. The workshop will highlight advances in the 2.5D/3D multichip module (MCM) integration from leading Outsourced Assembly and Test (OSAT) foundries, advanced materials, Antenna in Package (AiP) versus Antenna On Chip (AoC) trades, novel integrated circuits, beam-forming techniques, and EDA tools for co-engineering to realize high-performance 5G FEMs.	**Advanced Packaging Technologies for High-Performance 5G Front-End Modules** **Sponsor:** IMS **Organizer:** K.K. Samanta, Sony Europe; T. Lee, The Boeing Company; H. Chang, ASE **08:00 – 11:50** **Room 157BC**	WMG
Next generation applications, including 5G and beyond, demand integration of higher speed and bandwidth RF functions into smaller volumes, yet with unprecedented levels of power and cost. For addressing these, mm-Wave and Terahertz have found an ever-increasing interest. However, as frequency increases, conventional integration lacks the geometric and interconnecting resolution, and the interconnection parasitic and losses between ICs add up quickly. The 3D heterogeneous integration technologies, employing precise wafer-scale/ lithographic integration of III-V with Si semiconductors are demonstrating high suitability for these requirements. This workshop will discuss the current trends and state-of-the-art developments in 3D heterogeneously integrated multifunction circuits and modules, including integrating InP-HBT on Si/BiCMOS, and GaN-HEMT and InP-HBT on SiGe BiCMOS. Improved InP HBT integrated circuit process, BiCMOS controlled InP HBT oscillator for mm-Wave and THz beamforming, novel materials, and thermo-mechanical challenges will be discussed. Further, this workshop will present advanced micromachined and 3D-FOWLP integration and packaging covering 70GHz to THz.	**Recent Advancement and Trends in 3D Heterogeneous Integration for mm-Wave 5G and Terahertz** **Sponsor:** IMS **Organizer:** K.K. Samanta, Sony Europe; W. Hong, POSTECH **13:30 – 17:15** **Room 157BC**	WMH
RFID technology is today widely deployed in industrial and commercial environments with mature hardware concepts. Nevertheless, recent research demonstrates substantial potential to boost especially the achievable accuracy for RFID based localization systems and high-speed communication networks. These advances are primarily enabled through the combination of powerful digital signal processing (DSP) techniques with flexible reader hardware based on software-defined radios. Thus the most promising DSP techniques will be covered: Based on high performance wideband software defined radio platforms with modern self-interference cancellation techniques, novel modulation formats optimized for RFID scenarios in order to boost data rate as well as ranging capability will be explored. Finally, combining several nodes with unprecedented performance into a complete RFID-based communication network enables novel localization techniques, e.g., for autonomous indoor navigation. The workshop brings together all major DSP-based approaches in order to push forward their application in practice and to explore mutual benefits of their combination.	**Digital Signal Processing for Radio Frequency Identification** **Sponsor:** IMS **Organizer:** M. Ferdik, Universität Innsbruck; T. Ussmueller, Universität Innsbruck; C. Carlowitz, FAU Erlangen-Nürnberg **08:00 – 17:15** **Room 158**	WMI
The Workshop addresses important challenges faced by the notions of reciprocity, time-reversal symmetry and sensitivity to defects in wave propagation and field transport by discussing disruptive ways in which devices and circuits are employed enabling new functionalities at high frequencies. Reciprocity can be broken, and nonreciprocal components can be built in CMOS using linear periodically time-varying circuits. Acoustic wave based integrated circuits will be described leading to time correlations and multipath equalizations directly at RF with almost no noise penalty. Various types of circulators for full-duplex and 5G mm-wave applications will be reported. Nonreciprocity considerations include one-way transport of electrons with certain spin in crystals such as topological insulators, magnetic heterostructures such as giant interfacial interaction and voltage-controlled magnetic anisotropy, magnet-free nonreciprocal and topological devices and metamaterials based on spatio-temporal modulation, self-biased magnon crystals, two-dimensional layered materials with no magnetic bias as applied to plasmonic isolators and nonreciprocal leaky-wave antennas.	**Advanced Nonreciprocal Technologies for High-Frequency Applications based on Novel Approaches and Nanoscale Concepts** **Sponsor:** IMS **Organizer:** D. Pavlidis, Boston University; Y.E. Wang, University of California, Los Angeles **08:00 – 17:15** **Room 157A**	WMJ
The workshop aims to explore challenges and benefits of design and integration of RF/microwave devices that employ novel magnetic materials and fabrication techniques. We will focus on materials with built-in magnetization that facilitate the realization of self-biased magnetic-based components, and non-linear magnetization processes for advanced signal processing. Integration of magnetic components on semiconductor-based platforms will be discussed, including material deposition, fabrication, and packaging methods as they relate to integrated magnetic devices. Micro- and nanomachining, hetero-epitaxial integration, and conventional solid-state chemistry approaches will be considered. The cutting-edge and comprehensive multi-physics-based modeling approaches and the corresponding experimental data for both linear and non-linear magnetic devices, e.g., RF circulators, isolators, frequency selective limiters, and signal-to-noise enhancers, will be presented. Factors limiting such RF/microwave performance criteria as bandwidth, dynamic range, noise figure, intermodulation distortion, and temperature stability will be discussed along with methods to overcome these limitations and improve the performance of such devices.	**RF Integrated Magnetics – Devices, Integration and Applications** **Sponsor:** IMS **Organizer:** D. Psychogiou, University of Colorado at Boulder; M. Geiler, Metamagnetics **08:00 – 17:15** **Room 161**	WMK

MONDAY SHORT COURSES

BCEC

08:00 – 17:15 MONDAY, 3 JUNE 2019

Check the website (ims-ieee.org) or the mobile app for the most up-to-date room assignments. On-site registration is available for those who didn't pre-register.

	Short Course Title	Short Course Abstract
SMA	**Demystifying Noise Parameter Measurements and Model Extraction** **Organizer:** L. Dunleavy, Modelithics; S. Dudkiewicz, Maury Microwave **08:00 – 17:15** **Room 150**	In modern communications systems, receivers are required to detect and receive very small signals, and at the same time not add a significant level of noise, otherwise the information contained within the signals may be overpowered and become unusable. In order to minimize the amount of added noise, low-noise circuit design becomes critical, and highly effective designs begin with accurate noise parameters or noise models. Noise parameters measurements and noise model extraction are extremely sensitive techniques, and the measurement/extraction system can itself become the dominant contributor of noise if the system is not calibrated accurately. Therefore understanding the sources of error, and using the best techniques and practices, is critical when attempting to accurately characterize noise parameters and extract a noise model. This short course aims to demystify noise parameter measurements and model extraction, and includes topics such as: an introduction to noise figure and noise parameter concepts; noise parameter calibration; measurement and extraction techniques and best practices; how to validate noise parameter data; an in-depth review of critical variables that affect the accuracy of noise parameter measurements; noise parameter de-embedding; and noise model theory and extraction.

RF BOOTCAMP

ROOM 259AB BCEC

08:00 – 16:30 MONDAY, 3 JUNE 2019

This one day course is ideal for newcomers to the microwave world, such as technicians, new engineers, college students, engineers changing their career path, as well as marketing and sales professionals looking to become more comfortable in customer interactions involving RF & 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
Device Modeling and Impedance Matching Basics
Spectral Analysis and Receiver Technology
Signal Generation
Modulation and Vector Signal Analysis
Microwave Antenna Basics
Introduction to Radar and Radar Measurements

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 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. Space is limited, so register early before we sell-out. Additional information including registration details, course outline and speaker bios can be found at ims-ieee.org or using the mobile app.

RFIC PANEL SESSION

ROOM 162AB BCEC

12:00 – 13:15 MONDAY, 3 JUNE 2019

The Internet of Things (IoT) – back to the future, or no future?

ORGANIZERS AND MODERATORS: **Oren Eliezer**, *PHAZR*
Debopriyo Chowdhury, *Broadcom*

ABSTRACT:

Well... It's been four years since our RFIC 2015 lunchtime panel "The Internet of Things (IoT) – What's All the Hype?", so has the market for IoT devices been exploding since then or did the hype burst? Four more years into the future – what will it look like? How will the accelerated introduction of 5G and the developments in 'big data' and artificial intelligence (AI) affect it? Can we be hopeful as RFIC designers that it will provide us with endless employment and research opportunities?

Come equipped with your own outlook and questions and join the debate with the panel of experts from the industry and academia. Hear what IoT RF industry leaders from Amazon, NXP and Silicon Labs say, as well as the experts' opinions from CSEM (Swiss Center for Electronics and Microtechnology) and Shanghai Quanray Electronics. There won't be a better place to have your lunch!

PANELISTS: **Fari Assaderaghi**, *NXP Semiconductors;* **Min Hao**, *Shanghai Quanray Electronics & Fudan Univ.*; **Alessandro Piovaccari**, *Silicon Labs;* **Alain Serge Porret**, *Swiss Center for Electronics and Microtechnology;* **Chirag Bhavsar**, *Amazon*

THREE MINUTE THESIS

ROOM 256 BCEC

14:00 – 16:00 MONDAY, 3 JUNE 2019

(3MT®) COMPETITION

In its third year, the IMS2019 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. In 2019, the 3MT® competition received 150 submissions, of which 83 were accepted to the technical program at IMS, and 23 were designated as 3MT® finalists. We encourage all IMS2019 attendees to come to our briefing session from 09:00-10:30, and our coaching session from 10:30-12:00, both in the same venue as the competition.

The winners of the 3MT® competition will receive their prizes at the IMS2019 Closing Ceremony on Thursday, 6 June 2019.

JUDGES: **Samiya Alkhairy, Carey Goldberg, Tamar Melman, Robert Pinsky, Ron Renaud**

MASTER OF CEREMONIES: **SHERRY HESS**, *AWR Group, NI*

Flexible Electronics: The Future for Electronic Devices
Th3B Yepu Cui, Georgia Institute of Technology

Space Radar for Exploring Cold and Dark Places
We2G Adrian Tang, Jet Propulsion Laboratory

A Radar that Doesn't Disturb Other Radars
ThIF1 Frida Stroembeck, Chalmers University of Technology

Combining 3-D Printing and Nanomaterials: Cheaper and Smarter Electronics
Th1E Yuxiao He, Michigan State University

Rock in the Future of 5G
We3F Zhijian Hao, Georgia Institute of Technology

The Mystery of Quantum Computers
Tu3E Benjamin Lienhard, Massachusetts Institute of Technology

Wall-E: A Smart Wall that Talks Back
Th3B Syed Abdullah Nauroze, Georgia Institute of Technology

Unveiling the Hidden Universe
Tu2D Mohsen Hosseini, University of Massachusetts, Amherst

A "Smart" Solution to Hand-Grip and Battery-Life Issues of Mobile Handsets
Th2H Haifeng Lyu, University of Central Florida

Honey, I Shrunk the Antenna!
Tu1D Jean Paul Santos, University of California, Los Angeles

A Tarantula's View of the Wireless 5G Power Web around Us
Th2G Aline Eid, Georgia Institute of Technology

Towards Etch-a-Sketch Electronics
Tu3A Alex Watson, Air Force Research Laboratory

Chameleon Antenna: 360 Degree in One Piece
ThIF1 Dongyin Ren, State University of New York at Buffalo

Energy Harvesting: Realization of Infinite Batteries
Th3B Tong-Hong Lin, Georgia Institute of Technology

Efficient and Reliable Radio Systems for 5G
Tu1D Tushar Sharma, Princeton University

Radar Sensor for Contactless Heartbeat and Respiration Monitoring and People Localization
Tu2C Marco Mercuri, imec

All-in-One Mobile Device
Tu1A Pei-Ling Chi, National Chiao Tung University

Future Adaptable Communication and Radar Components
Tu1A Alexander Pham, University of Oklahoma

Making Materials Smart Using Microwaves
We3G Muhammad Akram Karimi, King Abdullah University of Science and Technology

3D Printing 5G Electronics!
Th2B Mohamed Mounir Abdin, University of South Florida

Revolutionizing Remote Charging of On-Body Devices via Microwave Recycling
Th2G Dieff Vital, Florida International University

Shaping our Electronic Future with Liquid Metal
Th3B Valentina Palazzi, University of Perugia

Magnetic Nanowires for Communications and Nanomedicine
Th1E Yali Zhang, University of Minnesota, Twin Cities

IMS PLENARY SESSION

GRAND BALLROOM BCEC

17:30 – 19:00 MONDAY, 3 JUNE 2019

Join as we kickoff the IMS with welcoming remarks, an overview of the exciting events for the week, recognition of the 2019 IEEE awards recipients (including the newly elevated IEEE MTT-S Fellows), and Dr. Chappell's keynote address that will help set the tone for the forward-looking technical presentations and exhibtions to follow throughout the week.

The Mind and Body of Intelligent RF

Dr. William Chappell, Special Assistant to the Director, *Defense Advanced Research Projects Agency (DARPA)*

ABSTRACT: Dr. Chappell's address, "The Mind and Body of Intelligent RF," will focus on what's needed in the physical layer (hardware) to keep up with the ambitions for the intersection of artificial intelligence (AI) and the RF spectrum. He will review the outcomes of the ongoing DARPA challenge, Spectrum Collaboration Challenge (SC2), which is exploring the use of intelligent RF to parse a fixed spectrum allocation without a spectrum manager or predetermined rules. The challenge uses radios to explore the intelligence, i.e. a mind, required to autonomously interact. While this is primarily a digital challenge, the outcomes are important for the IMS community in terms of the desired radios that will be needed. The radio front end that dynamically interacts with the physical world, i.e. the body, will be different than today›s radios which follow a previously determined script. As one of the DARPA performers in the challenge has put it, "The spirit is willing but the flesh is weak."

Dr. William Chappell is Special Assistant to the Director, Defense Advanced Research Projects Agency (DARPA). In his previous position as Director of the Microsystems Technology Office (MTO) since June 2014, he focused the office on key thrusts important to national security. These thrusts include ensuring unfettered use of the electromagnetic spectrum, building an alternative business model for acquiring advanced DoD electronics that feature built-in trust, and developing circuit architectures for next-generation machine learning. MTO creates the MEMS, photonic, and electronic components needed to gracefully bridge the divide between the physical world in which we live and the digital realm where our information resides. In 2018, he led the initiation of the Electronics Resurgence Initiative, a 1.5 billion dollar initiative focused on the building blocks of next generation electronics.

Prior to his role as MTO director, Dr. Chappell managed DARPA programs on adaptable radio frequency (RF) systems and low-cost antenna array technologies. These technologies included the development of phase change switches for adaptable RF systems, the "RF FPGA" concept, and fully digital array systems with direct digital sampling at each element.

Before joining DARPA, Dr. Chappell served as a professor in the Electrical and Computer Engineering department of Purdue University, where he led the Integrated Design of Electromagnetically-Applied Systems (IDEAS) Laboratory and received numerous research and teaching awards. Dr. Chappell's research focused on high-frequency components, specifically the unique integration of RF and microwave components based on electromagnetic analysis. This research ranged from advanced RF sensors (such as mass spectrometry and radar), advanced packaging, and filter design.

Dr. Chappell received his Bachelor of Science (summa cum laude), Master of Science, and Doctorate of Philosophy degrees in Electrical Engineering, all from the University of Michigan.

IEEE FELLOWS

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. Sixteen MTT-S members who were evaluated by our Society were elected to the grade of Fellow, effective 1 January 2019:

IEEE FELLOWS	
Dr. Pierre Blondy (MTT)	*for contributions to radio frequency micro electromechanical systems*
Prof. Richard Campbell (MTT)	*for contributions to millimeter and terahertz wafer-probe technology*
Dr. Nitin Jain (MTT)	*for leadership in the development of physics-based models for mm-wave System-on-Chip ICs*
Prof. Mona Jarrahi (MTT)	*for contributions to terahertz technology and microwave photonics*
Dr. Miroslav Micovic (MTT)	*for contributions to gallium nitride electronics*
Prof. Yuanxun Ethan Wang (MTT)	*for contributions to time-varying and nonlinear electromagnetic devices and systems*
Prof. Qing-xin Chu (AP)	*for contributions to compact wideband antennas*
Prof. Dejan Filipovic (AP)	*for contributions to frequency-independent and wideband antennas*
Prof. Christophe Fumeaux (AP)	*for contributions to resonant dielectric-loaded antennas*
Prof. Fan Yang (AP)	*for contributions to surface electromagnetics for antennas*
Prof. Roy Choudhury (COM)	*for contributions to wireless network protocols and indoor localization*
Prof. Hiroshi Ito (ED)	*for contributions to high-speed photodiodes for millimeter and terahertz wave generation*
Prof. Lijun Jiang (EM)	*for contributions to broadband computational electromagnetic methods*
Dr. Friedhelm Caspers (IM)	*for contributions to charged particle accelerators*
Prof. Chee Wei Wong (PHO)	*for contributions to silicon nanophotonics*
Prof. Hossein Hashemi (SSC)	*for development of radio-frequency and optical phased-array integrated circuits*

WELCOME RECEPTION

SEAPORT WORLD TRADE CENTER HEADHOUSE

19:30 – 21:00 MONDAY, 3 JUNE 2019

At the conclusion of the Plenary Session, the attendees will parade down World Trade Center Avenue to the Welcome Reception being held at the historic Commonwealth Pier Headhouse Concourse at the Seaport World Trade Center. Built in 1914, the majestic Headhouse Concourse provides views that encompass the harbor, downtown and the Seaport District. Street performers will provide entertainment. Join us for food and drink with your fellow attendees.

Come experience New England favorites like Lobstarolls and Chowda, and have a wicked good time.

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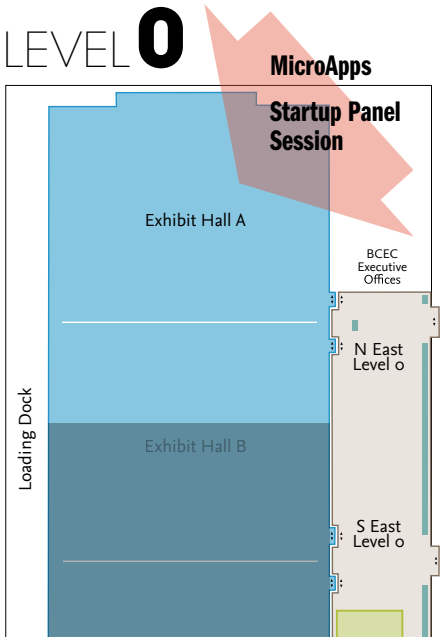
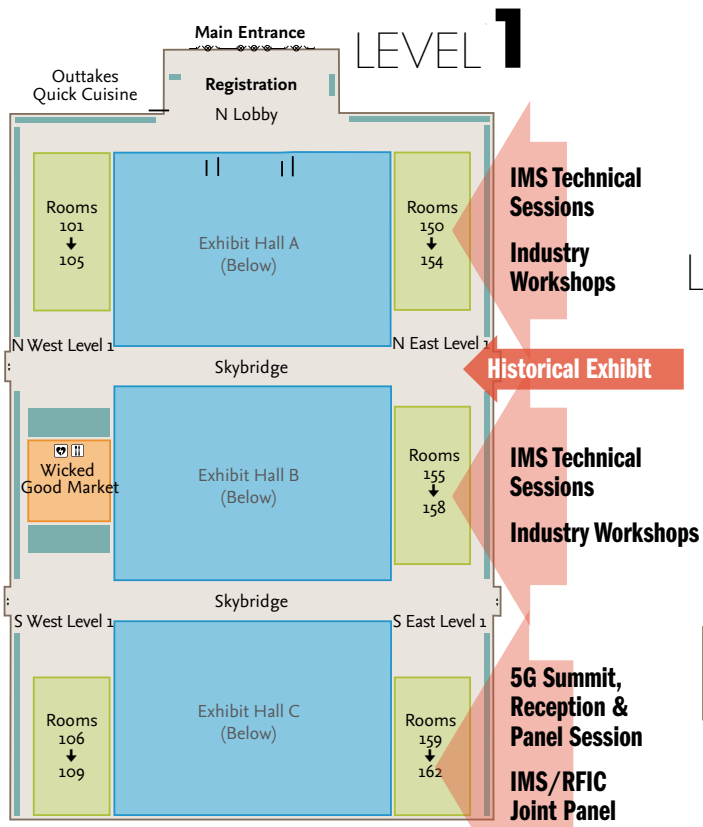
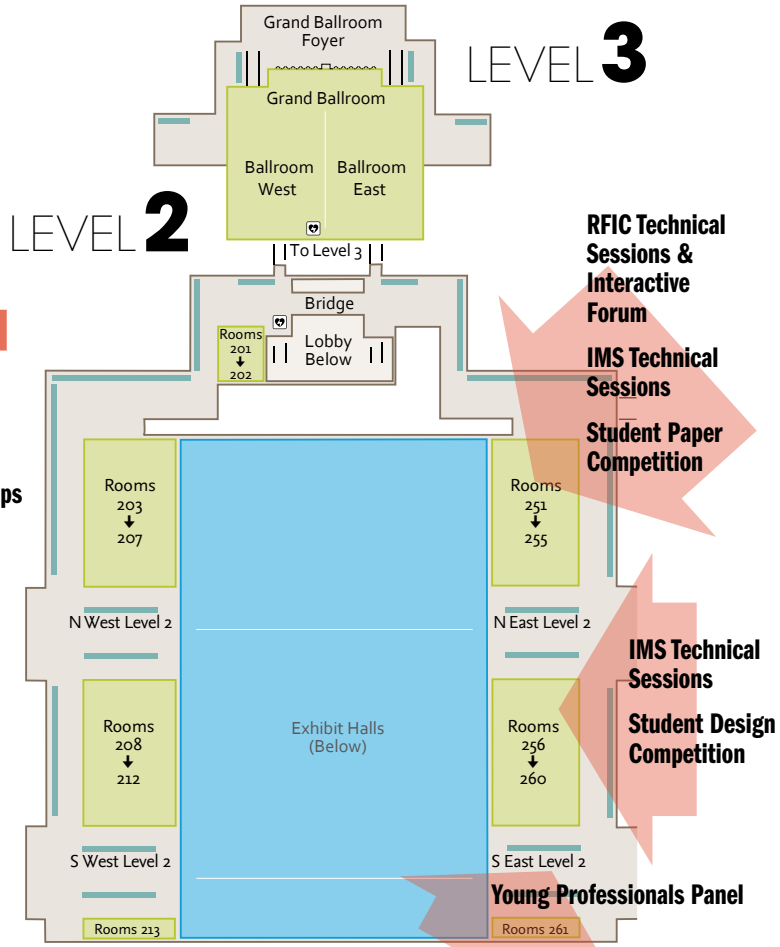
CONFERENCE HIGHLIGHTS

TUESDAY

EVENT	TIME
RFIC Technical Sessions	08:00 – 11:30
IMS Technical Sessions	08:00 – 17:15
IMS Student Design Competition	09:00 – 17:00
MicroApps	09:45 – 15:30
Industry Workshops	10:00 – 17:15
IMS Student Paper Competition	10:10 – 11:50
IMS/RFIC Joint Panel	12:00 – 13:50
5G Summit, Reception & Panel Session	13:30 – 18:45
RFIC Interactive Forum	13:30 – 15:10
Startup Panel Session	15:45 – 17:00
Rump Session	17:00 – 18:30
Young Professionals Panel	17:30 – 19:00
HAM Radio Social	18:30 – 20:30
Young Professionals Reception	19:30 – 21:30







Young Professionals Reception: Coppersmith

Ham Radio Social: Westin Boston Waterfront Harbor Ballroom

151AB

Tu1A: Tunable and Active Filters

Chair: Roberto Gómez-García, Universidad de Alcalá
Co-Chair: Rafaat Mansour, University of Waterloo

08:00

Tu1A-1: Frequency/Code-Domain Filtering Using Walsh-Function Sequence Based N-Path Filters

M. Johnson, Oregon State University; A. Agrawal, Intel; A. Natarajan, Oregon State University

08:10

08:20

Tu1A-2: A 1.16–3.89-GHz Tunable Six-Channel Diplexer with Compact Size and High Isolation

P.-L. Chi, National Chiao Tung University; C.-K. Chiou, National Chiao Tung University

08:30

08:40

Tu1A-3: A Non-Reciprocal Microstrip Bandpass Filter Based on Spatio-Temporal Modulation

X. Wu, University of California, Davis; M. Nafe, University of California, Davis; A. Alvarez Melcón, Universidad Politécnica de Cartagena; J.S. Gómez-Díaz, University of California, Davis; X. Liu, University of California, Davis

08:50

09:00

Tu1A-4: Balanced-Balanced Tunable Filtering LNA Using Evanescent-Mode Resonators

M.F. Hagag, Military Technical College; M. Abu Khater, PSUT; D. Peroulis, Purdue University

09:10

09:20

Tu1A-5: Electronically Reconfigurable Doublet in Dual-Mode Coaxial SIW

S. Sirci, Universitat Politècnica de València; M.A. Sánchez-Soriano, Universidad de Alicante; J.D. Martínez, Universitat Politècnica de València; V.E. Boria, Universitat Politècnica de València

09:30

Tu1A-6: Continuously-Tunable Substrate Integrated Waveguide Bandpass Filter Actuated by Liquid Metal

A.H. Pham, University of Oklahoma; S. Saeedi, University of Oklahoma; H.H. Sigmarsson, University of Oklahoma

09:40

153AB

Tu1B: Novel Techniques and Effects in Wave Propagation, Scattering, and Modeling

Chair: Jan Machac, Czech Technical Unversity in Prague
Co-Chair: James Skala, Georgia Tech

Tu1B-1: Analysis of Anisotropic Inhomogeneous Dielectric Waveguides with Discrete Mode Matching Method

V. Kamra, DLR; A. Dreher, DLR

Tu1B-2: Enhancement of Phase Shifting Nonreciprocity in Normally Magnetized Ferrite Metamaterial Lines Using Slow Wave Structure Based on Spoof Surface Plasmon

K. Okamoto, T. Ueda, Kyoto Inst. Tech.; T. Itoh, UCLA

Tu1B-3: A Generalized Segmentation Algorithm for Planar Resonant Structures with Discrete Components

I. Erdin, Celestica; R. Achar, Carleton U.

Tu1B-4: Non-Periodic Metasurface for Retroreflection of Circularly Polarized Wave

C. Tao, University of California, Los Angeles; T. Itoh, University of California, Los Angeles

Tu1B-5: Experimental Active Cloaking of a Metallic Polygonal Cylinder

P. Ang, University of Toronto; G.V. Eleftheriades, University of Toronto

Tu1B-6: Excitation of the Zenneck Wave by a Tapered Line Source

F. Mesa, Universidad de Sevilla; D.R. Jackson, University of Houston

156AB

Tu1C: Advances in Material Characterization and Processing

Chair: Freek van Straten, MACOM
Co-Chair: Vadim Yakovlev, Worcester Polytechnic Institute

Tu1C-1: Macroscopic Models of Thin Conductive Layers: Systematic Evaluation for Microwave Heating and Shielding Applications

M. Celuch, QWED; K. Wilczynski, Warsaw University of Technology; M. Olszewska-Placha, QWED

Tu1C-2: Ka-Band Compact Scalar Network Analyzer Dedicated to Resonator-Based Measurements of Material Properties

J. Cuper, Warsaw University of Technology; M. Rytel, Warsaw University of Technology; T. Karpisz, Warsaw University of Technology; A. Pacewicz, Warsaw University of Technology; B. Salski, Warsaw University of Technology; P. Kopyt, Warsaw University of Technology

Tu1C-3: Enhanced-Resolution Material Imaging with Dielectric Resonators: A New Implicit Space-Domain Technique

M. Celuch, QWED; W. Gwarek, QWED; A. Wieckowski, QWED

Tu1C-4: A 2D Model of a Triple Layer Electromagnetic Heat Exchanger with Porous Media Flow

A.A. Mohekar, Worcester Polytechnic Institute; B.S. Tilley, Worcester Polytechnic Institute; V.V. Yakovlev, Worcester Polytechnic Institute

Tu1C-5: Design and Development of a Novel Self-Igniting Microwave Plasma Jet for Industrial Applications

A. Sadeghfam, Heuermann HF-Technik; A. Sadeghi-Ahangar, Heuermann HF-Technik; A. Elgamal, FH Aachen; H. Heuermann, Heuermann HF-Technik

157BC

Tu1D: HF / VHF / UHF Technology and Applications

Chair: Frederick Raab, Green Mountain Radio Research
Co-Chair: Marc Franco, Qorvo

Tu1D-1: Broadband Outphasing Transmitter Using Class-E Power Amplifiers

R.A. Beltran, Ophir RF

Tu1D-2: UHF Class E/F_2 Outphasing Transmitter for 12dB PAPR Signals

D. Vegas, Universidad de Cantabria; J.-R. Perez-Cisneros, Universidad de Cantabria; M.N. Ruiz, Universidad de Cantabria; J.A. García, Universidad de Cantabria

Tu1D-3: A Baseband Feedback Approach to Linearization of a UHF Power Amplifier

W. Sear, University of Colorado Boulder; T.W. Barton, University of Colorado Boulder

Tu1D-4: Novel High Efficiency Power Amplifier Mode Using Open Circuit Harmonic Loading

T. Sharma, Princeton University; S.K. Dhar, University of Calgary; R. Darraji, University of Calgary; D.G. Holmes, NXP Semiconductors; V. Mallette, Focus Microwaves; J.K. Jones, NXP Semiconductors; F.M. Ghannouchi, University of Calgary

Tu1D-5: High Efficiency Bandwidth Electrically Small Antennas for Compact Wireless Communication Systems

J.P. Santos, F. Fereidoony, M. Hedayati, Y.E. Wang, University of California, Los Angeles

Tu1D-6: Design of a Voltage-Controlled Programmable-Gain Amplifier in 65-nm CMOS Technology

H. Liu, SUTD; X. Zhu, UTS; M. Lu, SUTD; K.S. Yeo, SUTD

252AB

RTu1E: Special Session: 5G Circuits and Systems

Chair: Tim LaRocca, Northrop Grumman
Co-Chair: Hongtao Xu, Fudan University

08:00

RTu1E-1: A 26dBm 39GHz Power Amplifier with 26.6% PAE for 5G Applications in 28nm Bulk CMOS

K. Dasgupta, Intel; S. Daneshgar, Intel; C. Thakkar, Intel; J. Jaussi, Intel; B. Casper, Intel

08:10

08:20

RTu1E-2: A 24–43GHz LNA with 3.1–3.7dB Noise Figure and Embedded 3-Pole Elliptic High-Pass Response for 5G Applications in 22nm FDSOI

L. Gao, University of California, San Diego; G.M. Rebeiz, University of California, San Diego

08:30

08:40

RTu1E-3: A 4-Element 28GHz Millimeter-Wave MIMO Array with Single-Wire Interface Using Code-Domain Multiplexing in 65nm CMOS

M. Johnson, Oregon State University; A. Dascuru, Columbia University; K. Zhan, Oregon State University; A. Galioglu, Columbia University; N. Adepu, Columbia University; S. Jain, Oregon State University; H. Krishnaswamy, Columbia University; A. Natarajan, Oregon State University

08:50

09:00

RTu1E-4: A 16-Element Phased-Array CMOS Transmitter with Variable Gain Controlled Linear Power Amplifier for 5G New Radio

Y. Cho, Samsung; W. Lee, Samsung; H.-C. Park, Samsung; B. Park, Samsung; J.H. Lee, Samsung; J. Kim, Samsung; J. Lee, Samsung; S. Kim, Samsung; J. Park, Samsung; S. Park, Samsung; K.H. An, Samsung; J. Son, Samsung; S.-G. Yang, Samsung

09:10

09:20

RTu1E-5: A 37–40GHz Phased Array Front-End with Dual Polarization for 5G MIMO Beamforming Applications

A. Guha Roy, Intel; O. Inac, Intel; A. Singh, Intel; T. Mukatel, Intel; O. Brandelstein, Intel; T.W. Brown, Intel; S. Abughazaleh, Intel; J.S. Hayden III, Intel; B. Park, Intel; G. Bachmanek, Intel; T.-Y.J. Kao, Intel; J. Hagn, Intel; S. Dalmia, Intel; D. Shoham, Intel; B. Davis, Intel; I. Fisher, Intel; R. Sover, Intel; A. Freiman, Intel; B. Xiao, Intel; B. Singh, Intel

09:30

254AB

RTu1F: Energy-Efficient Wake-Up Receivers and IoT Transceivers

Chair: Renaldi Winoto, Mojo Vision
Co-Chair: Yuan-Hung Chung, MediaTek

RTu1F-1: An 802.11ba 495µW -92.6dBm-Sensitivity Blocker-Tolerant Wake-Up Radio Receiver Fully Integrated with Wi-Fi Transceiver

R. Liu, Intel; Asma Beevi K.T., Intel; R. Dorrance, Intel; D. Dasalukunte, Intel; M.A. Santana Lopez, Intel; V. Kristem, Intel; S. Azizi, Intel; M. Park, Intel; B.R. Carlton, Intel

RTu1F-2: A -80.9dBm 450MHz Wake-Up Receiver with Code-Domain Matched Filtering Using a Continuous-Time Analog Correlator

V. Mangal, Columbia University; P.R. Kinget, Columbia University

RTu1F-3: A 4×4×4-mm³ Fully Integrated Sensor-to-Sensor Radio Using Carrier Frequency Interlocking IF Receiver with -94dBm Sensitivity

L.-X. Chuo, University of Michigan; Y. Kim, University of Michigan; N. Chiotellis, University of Michigan; M. Yasuda, Mie Fujitsu Semiconductor; S. Miyoshi, Fujitsu Electronics; M. Kawaminami, Mie Fujitsu Semiconductor; A. Grbic, University of Michigan; D. Wentzloff, University of Michigan; H.-S. Kim, University of Michigan; D. Blaauw, University of Michigan

RTu1F-4: A 55nm SAW-Less NB-IoT CMOS Transceiver in an RF-SoC with Phase Coherent RX and Polar Modulation T

XP.S. Tseng, MediaTek; W. Yang, MediaTek; M.J. Wu, MediaTek; L.M. Jin, MediaTek; D.P. Li, MediaTek; E.C. Low, MediaTek; C.H. Hsiao, MediaTek; H.T. Lin, MediaTek; K.H. Yang, MediaTek; S.C. Shen, MediaTek; C.M. Kuo, MediaTek; C.L. Heng, MediaTek; G.K. Dehng, MediaTek

RTu1F-5: A 1.04–4V, Digital-Intensive Dual-Mode BLE 5.0/IEEE 802.15.4 Transceiver SoC with Extended Range in 28nm CMOS

N.-S. Kim, Samsung; M.-G. Kim, Samsung; A. Verma, Samsung; G. Seol, Samsung; S. Kim, Samsung; S. Lee, Samsung; C. Lo, Samsung; J. Han, Samsung; I. Jo, Samsung; C. Kim, Samsung; C.-W. Yao, Samsung; J. Lee, Samsung

09:40

Coffee / Snacks 09:30 – 10:30 | Exhibit Show Floor

151AB

Tu2A: Reconfigurable Filters with Transfer Function and Stopband Reconfiguration Capability

Chair: Hjalti Sigmarsson, University of Oklahoma
Co-Chair: Xiaoguang Liu, University of California, Davis

10:10 – 10:30
Tu2A-1: Multi-Band Bandpass Filters with Multiple Levels of Transfer-Function Reconfigurability
D. Simpson, University of Colorado Boulder; R. Gómez-García, Universidad de Alcalá; D. Psychogiou, University of Colorado Boulder

10:30 – 10:50
Tu2A-2: A Tunable Coaxial Filter with Minimum Variations in Absolute Bandwidth and Q Using a Single Tuning Element
Gowrish B., University of Waterloo; R.R. Mansour, University of Waterloo

10:50 – 11:10
Tu2A-3: A 2.2–3.4GHz Constant Bandwidth High-Selectivity Tunable Filter Based on Dual-Mode SIW Resonators
M. Abdelfattah, Purdue University; D. Peroulis, Purdue University

11:10 – 11:30
Tu2A-4: Miniaturized Reconfigurable Dual-Band Bandstop Filter with Independent Stopband Control Using Folded Ridged Quarter-Mode Substrate Integrated Waveguide
T.R. Jones, University of Alberta; M. Daneshmand, University of Alberta

11:30 – 11:50
Tu2A-5: A Programmable Bandpass Filter with Simultaneously Reconfigurable Working Frequency and Bandwidth
R. Zhang, Purdue University; L. Yang, Universidad de Alcalá; R. Gómez-García, Universidad de Alcalá; D. Peroulis, Purdue University

153AB

Tu2B: Time- and Frequency-Domain Numerical Modelling for Advanced Applications

Chair: Vladimir Okhmatovski, University of Manitoba
Co-Chair: Zhizhang (David) Chen, Dalhousie University

10:10 – 10:30
Tu2B-1: 3D Finite-Difference Time-Domain (FDTD) Modeling of Nonlinear RF Thin Film Magnetic Devices
Z. Yao, H. Cui, Y.E. Wang, UCLA

10:30 – 10:50
Tu2B-2: Time-Reversal Reconstructions of Clustered Sources and Diagnosis of Faulty Antenna Elements in Three Dimensions
J.C. Liang, UESTC; Z.D. Chen, Dalhousie University; J.F. Wang, H.P. Zhao, C. Peng, Z. Liu, UESTC

10:50 – 11:10
Tu2B-3: Rapid Inverse Modeling of Integrated Circuit Layout in Both Frequency and Time Domain
L. Xue, Purdue University; D. Jiao, Purdue University

11:10 – 11:30
Tu2B-4: Efficient Uncertainty Quantification of FDTD Based Microwave Circuit Models with Multiple Design Parameters
X. Zhang, University of Toronto; K.-A. Liu, University of Toronto; C.D. Sarris, University of Toronto

11:30 – 11:50
Tu2B-5: Pre-Corrected Tensor Train Algorithm for Current Flow Modelling in 2D Multi-Conductor Transmission Lines
Z. Chen, University of Manitoba; S. Zheng, University of Manitoba; Q. Cheng, NTU; A. Yucel, NTU; V. Okhmatovski, University of Manitoba

11:30 – 11:50
Tu2B-6: Localizing Sparse Direct Solvers for Circuit Simulations
R.J. Adams, University of Kentucky; O.T. Wilkerson, University of Kentucky; J.C. Young, University of Kentucky; I. Chowdhury, ANSYS; W. Theil, ANSYS

Tu2B-7: Explicit Matrix-Free Time-Domain Method in Unstructured Meshes
K. Zeng, Purdue University; D. Jiao, Purdue University

156AB

Tu2C: Advancement in Biomedical Radar Technology

Chair: Changzhi Li, Texas Tech University
Co-Chair: Chung-Tse Michael Wu, Rutgers University

10:10 – 10:30
Tu2C-1: A 100-GHz Double-Sideband Low-IF CW Doppler Radar in 65-nm CMOS for Mechanical Vibration and Biological Vital Sign Detections
X. Ma, Southeast University; Y. Wang, Southeast University; W. Song, Southeast University; X. You, Southeast University; J. Lin, University of Florida; L. Li, Southeast University

10:30 – 10:50
Tu2C-2: A Spectrum-Efficient FSK Radar Solution for Stationary Human Subject Localization Based on Vital Sign Signals
J. Wang, Texas Tech University; T. Karp, Texas Tech University; J.-M. Muñoz-Ferreras, Universidad de Alcalá; R. Gómez-García, Universidad de Alcalá; C. Li, Texas Tech University

10:50 – 11:10
Tu2C-3: Digital Linear Discrete FMCW Radar for Healthcare Applications
M. Mercuri, IMEC; Y.-H. Liu, IMEC; S. Sheelavant, IMEC; S. Polito, IMEC; T. Torfs, IMEC; C. Van Hoof, IMEC

11:10 – 11:30
Tu2C-4: Noncontact Multi-Target Vital Sign Detection Using Self-Injection-Locked Radar Sensor Based on Metamaterial Leaky Wave Antenna
Y. Yuan, Rutgers University; C. Lu, Taiwan Tech; A.Y.-K. Chen, California State University, Northridge; C.-H. Tseng, Taiwan Tech; C.-T.M. Wu, Rutgers University

11:30 – 11:50
Tu2C-5: Phase-Demodulation Based Human Identification for Vital-SAR-Imaging in Pure FMCW Mode
G. Zhang, NJUST; J. Yan, NJUST; H. Chen, NJUST; H. Hong, NJUST; H. Zhao, NJUST; C. Gu, NJUST; X. Zhu, NJUST; C. Li, Texas Tech University

157BC

Tu2D: Advanced Components for Low-Noise Applications — Dedicated to Hatsuaki Fukui

Chair: Shirin Montazeri, Qualcomm
Co-Chair: Luciano Boglione, U.S. Naval Research Laboratory

10:10 – 10:30
Tu2D-1: A 12.5mW Packaged K-Band CMOS SOI LNA with 1.5dB NF
A.H. Aljuhani, University of California, San Diego; G.M. Rebeiz, University of California, San Diego

10:30 – 10:50
Tu2D-2: A Switched-Capacitor RF Receiver Exploiting MOS Parametric Amplification to Reduce NF
K. Badiyari, IIT Guwahati; N. Nallam, IIT Guwahati

10:50 – 11:10
Tu2D-3: A 0.4–1.2GHz SiGe Cryogenic LNA for Readout of MKID Arrays
M. Hosseini, UMass Amherst; W.-T. Wong, UMass Amherst; J.C. Bardin, UMass Amherst

11:10 – 11:30
Tu2D-4: W-Band LNA MMICs Based on a Noise-Optimized 50-nm Gate-Length Metamorphic HEMT Technology
F. Thome, Fraunhofer IAF; A. Leuther, Fraunhofer IAF; F. Heinz, Fraunhofer IAF; O. Ambacher, Fraunhofer IAF

11:30 – 11:50
Tu2D-5: A 183-GHz Schottky Diode Receiver with 4dB Noise Figure
M. Anderberg, Omnisys Instruments; P. Sobis, Omnisys Instruments; V. Drakinskiy, Chalmers University of Technology; J. Schleeh, Low Noise Factory; S. Dejanovic, Omnisys Instruments; A. Emrich, Omnisys Instruments; J. Stake, Chalmers University of Technology

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

252AB

RTu2E: Special Session: 5G Millimeter-Wave Beamforming Systems

Chair: Bodhisatwa Sadhu, IBM T.J. Watson Research Center

Co-Chair: Arun Natarajan, Oregon State University

RTu2E-1: A 24.5–43.5GHz Compact RX with Calibration-Free 32–56dB Full-Frequency Instantaneously Wideband Image Rejection Supporting Multi-Gb/s 64-QAM/256-QAM for Multi-Band 5G Massive MIMO

M.-Y. Huang, Georgia Tech; T. Chi, Speedlink Technology; F. Wang, Georgia Tech; S. Li, Georgia Tech; T.-Y. Huang, Georgia Tech; H. Wang, Georgia Tech

RTu2E-2: A 39GHz 64-Element Phased-Array CMOS Transceiver with Built-In Calibration for Large-Array 5G NR

Y. Wang, R. Wu, J. Pang, D. You, A.A. Fadila, R. Saengchan, X. Fu, A. Shirane, K. Okada, Tokyo Institute of Technology; D. Matsumoto, T. Nakamura, R. Kubozoe, M. Kawabuchi, B. Liu, H. Zhang, J. Qiu, H. Liu, W. Deng, Tokyo Institute of Technology; N. Oshima, K. Motoi, S. Hori, K. Kunihiro, T. Kaneko, NEC

RTu2E-3: A 24.2–30.5GHz Quad-Channel RFIC for 5G Communications Including Built-In Test Equipment

D. Dal Maistro, C. Rubino, M. Caruso, M. Tiebout, I. Maksymova, M. Ilic, P. Thurner, M. Zaghi, K. Mertens, Infineon Technologies; S. Vehovc, E. Schatzmayr, M. Druml, R. Druml, M. Mueller, M. Anderwald, J. Wuertele, U. Rueddenklau, Infineon Technologies

RTu2E-4: A Highly Linear 28GHz 16-Element Phased-Array Receiver with Wide Gain Control for 5G NR Application

Y. Yoon, Samsung; K.H. An, Samsung; D. Kang, Samsung; K. Kim, Samsung; S. Lee, Samsung; J.S. Jang, Samsung; D. Minn, Samsung; B. Suh, Samsung; J. Lee, Samsung; J. Kim, Samsung; M. Kim, Samsung; J.H. Lee, Samsung; S.T. Choi, Samsung; J. Son, Samsung; S.-G. Yang, Samsung

254AB

RTu2F: Broadband, Reconfigurable, and Multimode PAs and Transmitters

Chair: Oleh Krutko, Xilinx

Co-Chair: Jeffrey Walling, Tyndall National Institute

RTu2F-1: A Quadrature Class-G Complex-Domain Doherty Digital Power Amplifier

S.-C. Hung, Michigan State University; S.-W. Yoo, Michigan State University; S.-M. Yoo, Michigan State University

RTu2F-2: A Frequency Tuneable Switched-Capacitor PA in 65nm CMOS

Z. Bai, University of Utah; A. Azam, University of Utah; J.S. Walling, University of Utah

RTu2F-3: A Broadband High-Efficiency SOI-CMOS PA Module for LTE/LTE-A Handset Applications

A. Serhan, CEA-LETI ; D. Parat, CEA-LETI ; P. Reynier, CEA-LETI ; R. Berro, CEA-LETI ; R. Mourot, CEA-LETI ; C. De Ranter, Huawei Technologies; P. Indirayanti, Huawei Technologies; M. Borremans, Huawei Technologies; E. Mercier, CEA-LETI ; A. Giry, CEA-LETI

RTu2F-4: A 27GHz Adaptive Bias Variable Gain Power Amplifier and T/R Switch in 22nm FD-SOI CMOS for 5G Antenna Arrays

C. Elgaard, Ericsson; S. Andersson, Ericsson; P. Caputa, Ericsson; E. Westesson, Ericsson; H. Sjöland, Ericsson

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

Joint IMS/RFIC Panel Session at Lunchtime – See Page 33

Sweet Treats Tuesday 12:30 – 13:30 | Exhibit Show Floor

STUDENT DESIGN COMPETITIONS

ROOM 258ABC BCEC

09:00 – 17:00 TUESDAY, 4 JUNE 2019

All attendees are invited to the 15th annual IMS Student Design Competitions. Students have been busy over the past several months designing and building solutions to the challenging engineering problems presented in the 11 student design competitions listed below. Judges will measure the students' designs at this event to determine the winners of the various competitions. With 130+ students registered across 50+ teams, this lively event is bound to be filled with teamwork and friendly competition. Come to this event to cheer on the students, celebrate their hard work, and learn about their innovative designs.

#	Title	09:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00
1	Carrier Aggregation BAW Quadplexer Module								
2	High-Performance Optoelectronic Oscillator								
3	High Efficiency Power Amplifier								
4	Videos at a Fancy Bar Counter: Sub-Six 5G Flexible Low-Interference Receiver								
5	Four-Channel Switchable/Reconfigurable Filter Bank								
6	Power Amplifier Linearization through Digital Pre-Distortion (DPD)								
7	Wearable/Frugal Microwave Energy Harvesting								
8	High-Sensitivity Motion Sensing Radar								
9	High-Efficiency Power Amplifier for 1.8 MHz								
10	Adaptive Relay Transceiver								
11	Backscatter Radio								

MICROAPPS SCHEDULE 09:45 – 15:30 TUESDAY, 4 JUNE 2019

MicroApps offers a wicked lot of information in 15 minutes! These presentations of application notes target the working engineer or technician and are color coded by general topic area below. On the exhibition floor, it's free, and it will make you "smahtter." Come see us at the MicroApps Theater.

START TIME	TITLE	SPEAKER/S
09:45	5G Array Design Using FDTD	Scott Langdon, Jeffrey Barney – Remcom Inc.
10:00	5G Bbox: Beamforming System Built For R&D And mmWave Production Lines	Chueh-Jen Lin, Su-Wei Chang – TMY Technology, Inc.
10:15	800 MHz Wide Real-Time Spectrum Analysis For Detection of Extremely Short Events In the ns Range With a POI Of 0.46µs	Wolfgang Wendler – Rohde & Schwarz USA, Inc.
10:30	A Simplified Doherty Amplifier Design Process Using Behavioral Models	Mauro Marchetti – Anteverta-mw
10:45	Active Low Pass Filters For Phase Locked Loops	Ian Collins – Analog Devices, Inc.
11:00	Address The Power and Area Constraints In 5G Massive-MIMO Systems With Highly Integrated, Wideband And JESD204C Compliant 4T4R2F RF Transceiver Tunable From 600MHz To 6GHz	Satish Uppathil, Russell Hoppenstein – Texas Instruments
11:15	Advanced Synthesis, EM Simulation, and Additive Manufacturing Accelerate IoT Antenna Development	John Dunn, David Vye, Derek Linden – AWR Group, National Instruments
11:30	An 10-40 GHz Chipset For mmWave Imaging and Other Wideband Receive Applications	Jim Ryan, Eamon Nash – Analog Devices
11:45	An Alternative To Form In Place EMI Gaskets	Mazen Shehaiber – 3Gmetalworx Inc.
12:00	Antenna-In Package Design: Where Are My Connectors? – From Conducted To OTA	Markus Loerner – Rohde & Schwarz USA, Inc.
12:15	Assessing The Accuracy Of Keysight Sys-Parameters	Eamon Nash – Analog Devices
12:30	Beamforming Measurements	Markus Loerner – Rohde & Schwarz USA, Inc.
12:45	Behavioral Modelling Flow For Accurate RF and Microwave System Simulation	Zacharia Ouardirhi – MCAD Engineering
13:00	Benefits Of Noise Sources For Over the Air Testing With Enclosures	Matthew Diessner – Noisecom
13:15	Best Practices In Wafer-Level Millimeterwave And THz Testing	Anja Paula – Rohde & Schwarz USA, Inc.
13:30	Signal Source Needs For Measuring High Gain Systems, Important Considerations For Achieving Meaningful Data	Suresh Ojha, Alexander Chenakin – Anritsu Corporation
13:45	Characterizing Pulse Recovery Time Of Receivers and Amplifiers	Anja Paula – Rohde & Schwarz USA, Inc.
14:00	Common Mistakes With Noise/Noise Parameter Measurements And How To Avoid Them	Sathya Padmanabhan – Maury Microwave Corp.
14:15	Components For 5G — What Is New?	Markus Loerner – Rohde & Schwarz USA, Inc.
14:30	Critical Material Properties For 5G PCB Applications	John Coonrod – Rogers Corp.
14:45	Demystifying Phase Coherent Signal Generation	Lawrence Wilson – Rohde & Schwarz USA, Inc.
15:00	Designing A 5G mmwave Beamformer — a System Perspective	Ritabrata Bhattacharya, Vikas Aggarwal, Taranjit Kukal, Jagdish Lohani – Cadence Design Systems; Sankaran Aniruddhan – Indian Institute of Technology, Madras
15:15	Designing a Narrowband 28-GHz Bandpass Filter For 5G Applications	David Vye – AWR Group, National Instruments, Dan Swanson – DGS Associates

Circuit & System design | Test & Measurement | CAD and Modeling | Devices | Manufacturing, Materials

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IMS STUDENT PAPER COMPETITION

ROOM 253ABC BCEC

10:10 – 11:50 TUESDAY, 4 JUNE 2019

The Technical Paper Review Committee has identified the following students as Finalists in this year's Student Paper Competition. Finalists will be presenting their papers at the Student Paper Competition's Interactive Forum (SPC-IF) in addition to their regular presentation. All attendees are encouraged to stop by the SPC-IF and interact with these promising students, in addition to seeing them in their regular speaking sessions.

THIS YEAR'S SPC FINALISTS ARE:

An Unambiguous Phase-Based Algorithm for Single-Digit Micron Accuracy Distance Measurements using FMCW Radar | We1G
Student Finalist: Lukas Piotrowsky, Ruhr University Bochum
Advisor: Nils Pohl, Ruhr University Bochum

Rapid Inverse Modeling of Integrated Circuit Layout in Both Frequency and Time Domain | Tu2B
Student Finalist: Li Xue, Purdue University
Advisor: Dan Jiao, Purdue University

A 90–98 GHz 2×2 Phased-Array Transmitter with High Resolution Phase Control and Digital Gain Compensation | We2D
Student Finalist: Bingzheng Yang, University of Electronic Science and Technology of China
Advisor: Xun Luo, University of Electronic Science and Technology of China

Single-Crystalline ScAlN Surface Acoustic Wave Resonators with Large Figure of Merit ($Q \times k_t^2$) | We3F
Student Finalist: Zhijian Hao, Georgia Institute of Technology
Advisor: Azadeh Ansari, Georgia Institute of Technology

Multi-Band Bandpass Filters with Multiple Levels of Transfer-Function Reconfigurability | Tu2A
Student Finalist: Dakotah Simpson, University of Colorado at Boulder
Advisor: Dimitra Psychogiou, University of Colorado at Boulder

Electronically Re-writable Chipless RFID Tag Using Solid State Metal-Insulator-Metal Switches on Paper Substrate | Tu4F
Student Finalist: Jayakrishnan Methapettyparambu Purushothama, Université Grenoble Alpes
Advisor: Dr. Etienne Perret, Grenoble Institute of Technology

A Silicon Based 4.5-GHz Near-Field Capacitive Sensing Imaging Array | We3G
Student Finalist: Jia Zhou, University of California, Los Angeles
Advisor: Frank Chang, University of California, Los Angeles

Fully Inkjet-Printed Multi-Layer Tunable Origami FSS Structures with Integrated Thermal Actuation Mechanism | Th3B
Student Finalist: Syed Abdullah Nauroze, Georgia Institute of Technology
Advisor: Manos M. Tentzeris, Georgia Institute of Technology

A Broadband Dual-Polarized Terahertz Direct Detector in a 0.13-µm SiGe HBT Technology | We1D
Student Finalist: Marcel Andree, University of Wuppertal
Advisor: Ullrich Pfeiffer, University of Wuppertal

A Scalable High Gain and Large Beamwidth mm-Wave Harvesting Approach for 5G-powered IoT | Th2G
Student Finalist: Aline Eid, Georgia Institute of Technology
Advisor: Manos M. Tentzeris, Georgia Institute of Technology

A Fully Integrated C-band GaN MMIC Doherty Power Amplifier with High Gain and High Efficiency for 5G Application | We1H
Student Finalist: Guansheng Lv, Tsinghua University
Advisor: Wenhua Chen, Tsinghua University

An Inductorless, 0.5mA/15fJ, Small Footprint, SiGe BiCMOS Quasi-Current-Mode Logic Family for Highly Parallelized, 40-GHz Clock SAR ADCs | We3B
Student Finalist: Peter Hermansen, University of Toronto
Advisor: Sorin P. Voinigescu, University of Toronto

A Scalable Circularly-Polarized 256-Element Ka-Band Phased-Array SATCOM Transmitter with ±60° Beam Scanning and 34.5 dBW EIRP | Th1C
Student Finalist: Kevin Kai Wei Low, University of California, San Diego
Advisor: Gabriel M. Rebeiz, University of California, San Diego

Wide-band Blazed Grating for All Polarizations | Tu4A
Student Finalist: Haozhan Tian, University of California, Los Angeles
Advisor: Tatsuo Itoh, University of California, Los Angeles

A mm-Wave Quadrature Down-Conversion Mixer Based on a Six-Port Junction in 130-nm SiGe BiCMOS | Tu3D
Student Finalist: Vincent Rieß, Technische Universitaet Dresden
Advisor: Frank Ellinger, Technische Universitaet Dresden

Compact Quasi-Elliptic and Highly Selective AFSIW Filter with Multilayer Cross-Coupling | We3A
Student Finalist: Tifenn Martin, University of Bordeaux
Advisor: Anthony Ghiotto, University of Bordeaux

Compact Wideband Marchand Balun with Amplitude and Phase Compensation Shield | We1A
Student Finalist: Xiaohui Liu, University of Electronic Science and Technology of China
Advisor: Xun Luo, University of Electronic Science and Technology of China

High-Power Terahertz Generation from Bias-Free, Telecommunication-Compatible Photoconductive Nanoantennas | We3D
Student Finalist: Deniz Turan, University of California, Los Angeles
Advisor: Mona Jarrahi, University of California, Los Angeles

Space Mapping for Tuning Microwave Waveguide Filters | Tu4B
Student Finalist: Juan Carlos Melgarejo Lermas, Universitat Politècnica de València
Advisor: Vicente Enrique Boria Esbert, Universitat Politècnica de València

W-band Measurements of Low-Loss Dielectrics with a Fabry-Perot Open Resonator | ThIF1
Student Finalist: Tomasz Karpisz, Warsaw University of Technology
Advisor: Barlomiej Salski, Warsaw University of Technology

Leakage Phase Noise Mitigation for Monostatic FMCW Radar Sensors using Carrier Transmission | Th1D
Student Finalist: André Dürr, Ulm University
Advisor: Christian Waldschmidt, Ulm University

A 38-GHz-Band Power Amplifier with Analog Pre-Distortion for 1600-MHz Transmission Bandwidth 64-QAM OFDM Modulated Signal | Tu3H
Student Finalist: Yu-Chun Chen, National Taiwan University
Advisor: Tian-Wei Huang, National Taiwan University

Cyclostationary Noise Analysis of Superregenerative Oscillators | We1B
Student Finalist: Silvia Hernández, University of Cantabria
Advisor: Almudena Suárez Rodríguez, University of Cantabria

A 12.5-mW Packaged K-Band CMOS SOI LNA with 1.5 dB NF | Tu2D
Student Finalist: Abdurrahman Aljuhani, University of California, San Diego
Advisor: Gabriel M. Rebeiz, University of California, San Diego

Exploiting Graphene Quantum Capacitance in Subharmonic Parametric Downconversion | Th1E
Student Finalist: Mohamed Saeed Elsayed, RWTH Aachen University
Advisor: Renato Negra, RWTH Aachen University

Monolithic PCM Based Miniaturized T-type RF Switch for Millimeter Wave Redundancy Switch Matrix Applications | We2F
Student Finalist: Tejinder Singh, University of Waterloo
Advisor: Raafat R. Mansour, University of Waterloo

INDUSTRY WORKSHOPS

BCEC

10:00 – 17:15 TUESDAY, 4 JUNE 2019

Industry workshops cover contemporary topics spanning the state of the art in RF, microwave, and mm-wave areas. These two-hour workshops include in-depth technical presentations from and discussions with experts in the industry. On-site registration is available. Don't miss this opportunity to expand your knowledge and interact with colleagues in these very relevant fields!

SESSION TIME	ROOM #	SESSION TITLE	EVENT COMPANY	SPEAKERS
10:00 – 12:00	152	Breakthroughs in Wideband Millimeter-wave Power Amplifier Test	Keysight Technologies	Jan Verspecht, Osamu Kusano
	156C	Modern RF front end design and test	Rohde & Schwarz	Markus Loerner
	157A	Arbitrary Waveform Generation – The Basics	Keysight Technologies	Mark Roberts
	158	Phase-Noise Theory and Measurement Workshop	Keysight Technologies	Brooks Hanley, Richard Hoft, Joanne Mistler
13:00 – 15:00	152	Automotive Radar IQ Data Simulation for Performance Analysis	MathWorks, Inc.	Honglei Chen, Rick Gentile
	156C	Using Active Hot Parameters and X-Parameters to Improve Active Device Measurements Accuracy	Keysight Technologies	Dr. Joel Dunsmore
	157A	Introduction to RF and Microwave Filters	Modelithics, Inc., AWR Group, National Instruments, DGS Associates	Larry Dunleavy, John Dunn, Dan Swanson
	158	System-Level Analysis and Modeling Of RF and MW Circuits Exhibiting Non Linearity and Multi-Scale Time Constants	AMCAD Engineering	Wissam Saabe, Tony Gasseling
15:15 – 17:15	152	EM Simulation for RFIC Silicon and Glass-Based Technologies: Issues, Tips, and Tricks	AWR Group, National Instruments	John Dunn
	156C	Clock and LO Components in 5G Base Stations – Performance Parameters and Test Solutions	Rohde & Schwarz	Martin Stumpf
	157A	Accurate EM-circuit co-design of antenna systems	Optenni Ltd	Jaakko Juntunen
	158	SiGe BiCMOS Technologies for Radar Applications	IHP GmbH, Silicon Radar	Renè Scholz, Herman Jalli Ng, Wolfgang Winkler, Mehmet Kaynak, Matthias Wietstruck

JOINT IMS-RFIC PANEL

ROOM 162AB BCEC

12:00 – 13:15 TUESDAY, 4 JUNE 2019

Will Artificial Intelligence (AI) and Machine Learning (ML) Take Away My Job as an RF/Analog Designer?

ORGANIZERS AND MODERATORS: **Osama Shanaa**, *MediaTek*
Francois Rivet, *University of Bordeaux*

PANELISTS: **Ron Rohrer**, *Southern Methodist University;* **Taylor Hogan**, *Cadence Design Systems, Inc.;* **Modi Sankalp**, *MathWorks, Inc.;* **Thomas Rondeau**, *Defense Advanced Research Projects Agency;* **Paul Franzon**, *North Carolina State University*

ABSTRACT:

Machine learning (ML) and artificial intelligence (AI) are no longer futuristic concepts. They are already making their mark not only in applications that are purely data-analytics related, but also in communications, transportation, navigation, autonomous driving, finance, e-commerce, gaming, and many more fields. For example, ML/AI have already replaced humans in driving cars/trucks and in store cash registers. With AI also entering our territory of RF system and IC development, should we expect that our jobs as 'conventional' designers will soon be taken away? What will future RF systems and ICs be like, with AI being incorporated in them, as well as in the tools used to design them? Our distinguished panelists from academia, DARPA, CAD/EDA, and RF industries will debate what we may expect to see in the near and distant future, and how we should prepare ourselves for the inevitable realities. You do not want to miss this!

TUESDAY

151AB

Tu3A: Tunable/Reconfigurable Electromagnetic Structures

Chair: Christian Damm, Universität Ulm
Co-Chair: Jason Soric, Raytheon

13:30 – 13:40
Tu3A-1: Demonstration of Dual-Band Nonreciprocal Composite Right/Left-Handed Transmission Lines with Unidirectional Wavenumber Vectors
T. Kaneda, Kyoto Institute of Technology; T. Ueda, Kyoto Institute of Technology; T. Itoh, University of California, Los Angeles

13:50 – 14:10
Tu3A-2: Miniaturized Tunable Phase Shifter Using a Periodically Loaded Ridged Half-Mode Substrate Integrated Waveguide
E.T. Der, University of Alberta; T.R. Jones, University of Alberta; M. Daneshmand, University of Alberta

14:10 – 14:20
Tu3A-3: Liquid Crystal Phase Shifter Based on Nonradiative Dielectric Waveguide Topology at W-Band
E. Polat, R. Reese, M. Jost, M. Nickel, C. Schuster, R. Jakoby, H. Maune, Technische Universität Darmstadt

14:30 – 14:40
Tu3A-4: Enabling Reconfigurable All-Liquid Microcircuits via Laplace Barriers to Control Liquid Metal
A.M. Watson, Air Force Research Laboratory; K. Elassy, UH Mánoa; T. Leary, Air Force Research Laboratory; M.A. Rahman, UH Mánoa; A. Ohta, UH Mánoa; W. Shiroma, UH Mánoa; C.E. Tabor, Air Force Research Laboratory

14:50 – 15:00
Tu3A-5: A Wideband Frequency-Tuning Method Using Magnetically Actuated Mechanical Tuning of a SIW Resonator
T.H. Lee, Polytechnique Montréal; J.J. Laurin, Polytechnique Montréal; K. Wu, Polytechnique Montréal

153AB

Tu3B: Behavioral and Statistical Device Modeling Techniques

Chair: Fabrizio Bonani, Politecnico di Torino
Co-Chair: Arvind Sharma, AKSH Research

13:30 – 13:40
Tu3B-1: Behavioural Model Extraction Using Novel Multitone Active Load-Pull
A. Al-Rawachy, Mosul University; T. Husseini, Al-Furat Al-Awsat Technical University; J. Benedikt, Cardiff University; J.J. Bell, Cardiff University; P.J. Tasker, Cardiff University

13:50 – 14:10
Tu3B-2: Global Behavioural Model Generation Using Coefficients Interpolation
T. Husseini, Al-Furat Al-Awsat Technical University; A. Al-Rawachy, Mosul University; J. Benedikt, Cardiff University; J.J. Bell, Cardiff University; P.J. Tasker, Cardiff University

14:10 – 14:20
Tu3B-3: Linking X Parameters to Physical Simulations for Design-Oriented Large-Signal Device Variability Modeling
S. Donati Guerrieri, Politecnico di Torino; F. Bonani, Politecnico di Torino; G. Ghione, Politecnico di Torino

14:30 – 14:40
Tu3B-4: A Quasi-Physical Large-Signal Statistical Model for 0.15µm AlGaN/GaN HEMTs Process
Z. Wen, UESTC; S. Mao, UESTC; Y. Wu, UESTC; R. Xu, UESTC; B. Yan, UESTC; Y. Xu, UESTC

156AB

Tu3C: Novel Microwave Technologies for Biomedical Diagnostics

Chair: Cristiano Palego, Bangor University
Co-Chair: Arnaud Pothier, XLIM (UMR 7252)

13:30 – 13:40
Tu3C-1: Ingestible Bioelectronics: A Packaged, Bio-Molecular, Fluorescence-Based Sensor Array with Ultra-Low-Power Wireless Interface
C. Zhu, Princeton University; L. Hong, Princeton University; H. Yang, Princeton University; K. Sengupta, Princeton University

13:50 – 14:10
Tu3C-2: Broadband Scanning Microwave Microscopy of a Biological Cell with Unprecedented Image Quality and Signal-to-Noise Ratio
X. Jin, Lehigh University; M. Farina, Università Politecnica delle Marche; X. Wang, Lehigh University; G. Fabi, Università Politecnica delle Marche; X. Cheng, Lehigh University; J.C.M. Hwang, Lehigh University

14:10 – 14:20
Tu3C-3: Thermoacoustic Image-Guided Focused Microwave Therapy for Enhanced Breast Cancer Treatment
S. Saraswat, University of Arizona; C.P. Karunakaran, University of Arizona; J. Tak, University of Arizona; H. Zhao, University of Arizona; W. Ahmad, University of Arizona; R.S. Witte, University of Arizona; H. Xin, University of Arizona

14:30 – 14:40
Tu3C-4: Ultra-High Frequencies Continuous Biological Cell Sorting Based on Repulsive and Low Dielectrophoresis Forces
T. Provent, R. Manczak, XLIM (UMR 7252); S. Saada, HCP (EA 3842); C. Dalmay, XLIM (UMR 7252); B. Bessette, G. Begaud, S. Battu, HCP (EA 3842); P. Blondy, XLIM (UMR 7252); M.O. Jauberteau, F. Lalloué, HCP (EA 3842); A. Pothier, XLIM (UMR 7252)

14:50 – 15:00
Tu3C-5: Concept of a Microwave Heating Array Along with IR Radiometry for Measuring Regional Blood Perfusion
M.-R. Tofighi, Pennsylvania State University; A. Attaluri, Pennsylvania State University

157BC

Tu3D: Advances in Frequency Conversion Techniques

Chair: Chinchun Meng, National Chiao Tung University
Co-Chair: Hiroshi Okazaki, NTT DoCoMo

13:30 – 13:40
Tu3D-1: A mm-Wave Quadrature Down-Conversion Mixer Based on a Six-Port Junction in 130-nm SiGe BiCMOS
V. Rieß, Technische Universität Dresden; D. Fritsche, Technische Universität Dresden; P. Stärke, Technische Universität Dresden; C. Carta, Technische Universität Dresden; F. Ellinger, Technische Universität Dresden

13:50 – 14:10
Tu3D-2: V-Band Sub-Harmonic Gate-Pumped Resistive Mixer with a 180° Hybrid Using an In-Phase Power Divider Merging with an Out-of-Phase Marchand Balun
W.L. Chang, National Chiao Tung University; C. Meng, National Chiao Tung University; G.-W. Huang, NDL

14:10 – 14:20
Tu3D-3: A Single-Path Reconfigurable Frequency Multiplier for 28/39GHz Dual-Band Transceivers
R. Ben Yishay, ON Semiconductor; D. Elad, ON Semiconductor

14:30 – 14:40
Tu3D-4: A 1.5-dB Insertion Loss, 34-dBm P_{1dB} Power Modulator with 46% Fractional Bandwidth in 45-nm CMOS SOI
C. Hill, University of California, Santa Barbara; A. Hamza, University of California, Santa Barbara; H. AlShammary, University of California, Santa Barbara; J.F. Buckwalter, University of California, Santa Barbara

14:50 – 15:00
Tu3D-5: 22-Gb/s 60-GHz OOK Demodulator in 0.13-µm SiGe BiCMOS for Ultra-High-Speed Wireless Communication
A. Ferchichi, S.U. Rehman, C. Carta, F. Ellinger, Technische Universität Dresden

15:00 – 15:10
Tu3D-6: High-Modulus Injection-Locked Frequency Divider Using Multi-Resonance Tank
W.-C. Lai, National Penghu University of Science & Technology; S.-L. Jang, Taiwan Tech; G.-Z. Li, Taiwan Tech

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

252AB

Tu3E: Microwaves in Quantum Computing

Chair: Costas Sarris, University of Toronto
Co-Chair: Steven Anlage, University of Maryland

Tu3E-1: Microwave Quantum Acoustic Processor

P. Arrangoiz-Arriola, E.A. Wollack, M. Pechal, W. Jiang, Z. Wang, T.P. McKenna, J. Witmer, R. Van Laer, A. Cleland, N. Lee, C.J. Sarabalis, P.J. Stas, A.H. Safavi-Naeini, Stanford University

Tu3E-2: High Saturation Power Josephson Parametric Amplifier with GHz Bandwidth

O. Naaman, Google; D.G. Ferguson, Northrop Grumman; A. Marakov, Northrop Grumman; M. Khalil, Northrop Grumman; W.F. Koehl, Northrop Grumman; R.J. Epstein, Northrop Grumman

Tu3E-3: Microwave Engineer's Guide to the Design of Superconducting Qubit Circuits

F. Solgun, IBM T.J. Watson Research Center

Tu3E-4: On the Possibility of Quantum Simulation of Electromagnetic Structures

J.A. Russer, M. Haider, C. Jirauschek, P. Russer, Technische Universität München

Tu3E-5: Integrating High-Density Microwave Signalling and Packaging with Superconducting Qubits

S. Deshpande, J.P. Paquette, M. Vahidpour, M. Selvanayagam, R. Lion, M. Pelstring, S. Caldwell, M. Reagor, D. Russell, Rigetti Computing

Tu3E-6: Microwave Packaging for Superconducting Qubits

B. Lienhard, J. Braumüller, MIT; W. Woods, D. Rosenberg, G. Calusine, S. Weber, MIT Lincoln Laboratory; A. Vepsäläinen, K. O'Brien, T.P. Orlando, S. Gustavsson, W.D. Oliver, MIT

254AB

Tu3F: Advances in RFID Systems

Chair: Thomas Ussmueller, Universität Innsbruck
Co-Chair: Smail Tedjini, LCIS (EA 3747)

Tu3F-1: Chirp Based Backscatter Modulation

R. Correia, Universidade de Aveiro; Y. Ding, Heriot-Watt University; S.N. Daskalakis, Heriot-Watt University; P. Petridis, Heriot-Watt University; G. Goussetis, Heriot-Watt University; A. Georgiadis, Heriot-Watt University; N.B. Carvalho, Universidade de Aveiro

Tu3F-2: Flipping a Coin, Heads or Tails. Flipping an RFID Tag on Metal, ETSI or FCC Bands

K. Zannas, LCIS (EA 3747); H. El Matbouly, LCIS (EA 3747); Y. Duroc, Laboratoire Ampère (UMR 5005); S. Tedjini, LCIS (EA 3747)

Tu3F-3: Anchorless Indoor Localization and Tracking in Real-Time at 2.45GHz

G. Paolini, Università di Bologna; D. Masotti, Università di Bologna; F. Antoniazzi, Università di Bologna; T. Salmon Cinotti, Università di Bologna; A. Costanzo, Università di Bologna

Tu3F-4: Design of RFID Sensor Tag for Cheese Quality Monitoring

A. Abdelnour, LCIS (EA 3747); N. Fonseca, Universidade Federal de Campina Grande; A. Rennane, CDER; D. Kaddour, LCIS (EA 3747); S. Tedjini, LCIS (EA 3747)

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Tu3G: Advances in Radar Sensors

Chair: Lora Schulwitz, Maxar Technologies
Co-Chair: Changzhan Gu, Google

Tu3G-1: Finger Gesture Sensing and Recognition Using a Wi-Fi-Based Passive Radar

Y.-C. Lai, National Sun Yat-sen University; C.-C. Chou, National Sun Yat-sen University; M.-C. Tang, National Sun Yat-sen University; T.-S. Horng, National Sun Yat-sen University; F.-K. Wang, National Sun Yat-sen University

Tu3G-2: Improvement of Detection in Concrete Surface Cracks Covered with Paper by Using Standing Wave of 77-GHz-Band Millimeter-Wave

A. Hirata, Chiba Institute of Technology; M. Nakashizuka, Chiba Institute of Technology; K. Suizu, Chiba Institute of Technology; Y. Sudo, AIS Engineering

Tu3G-3: A Digital I/Q Correction Technique for a 125-GHz Interferometric Radar with Sub-Micrometer Sensitivity

D. Rodriguez, Texas Tech University; C. Li, Texas Tech University

Tu3G-4: Enhancing Angle Estimation Accuracy of Ultra Compact Two-Channel Radar MMICs at 160GHz Using a Biomimetic Antenna Array

P. Grüner, Universität Ulm; T. Chaloun, Universität Ulm; C. Waldschmidt, Universität Ulm

Tu3G-5: THz Micro-Doppler Measurements Based on a Silicon-Based Picosecond Pulse Radiator

S. Razavian, University of California, Los Angeles; M.M. Assefzadeh, University of California, Los Angeles; M. Hosseini, University of California, Los Angeles; A. Babakhani, University of California, Los Angeles

259AB

Tu3H: Advances in Silicon-Integrated Power Amplifiers

Chair: Wolfgang Heinrich, FBH
Co-Chair: Kenle Chen, University of South Florida

Tu3H-1: A 38-GHz-Band Power Amplifier with Analog Pre-Distortion for 1600-MHz Transmission Bandwidth 64-QAM OFDM Modulated Signal

Y.-C. Chen, National Taiwan University; T.-C. Tsai, National Taiwan University; J.H. Tsai, National Taiwan Normal University; T.-W. Huang, National Taiwan University

Tu3H-2: A Ka-Band Stacked Power Amplifier with 24.8-dBm Output Power and 24.3% PAE in 65-nm CMOS Technology

Y. Chang, National Taiwan University; B.Z. Lu, National Taiwan University; Y. Wang, National Taiwan University; H. Wang, National Taiwan University

Tu3H-3: A Ka-Band Highly Linear Power Amplifier with a Linearization Bias Circuit

D. Wang, Tsinghua University; W. Chen, Tsinghua University; L. Chen, Tsinghua University; X. Liu, Tsinghua University; Z. Feng, Tsinghua University

Tu3H-4: A Fully-Integrated 2.6GHz Stacked Switching Power Amplifier in 45nm SOI CMOS with >2W Output Power and 43.5% Efficiency

M. Khorshidian, Columbia University; H. Krishnaswamy, Columbia University

Tu3H-5: A 19.1% PAE, 22.4-dBm 53-GHz Parallel Power Combining Power Amplifier with Stacked-FET Techniques in 90-nm CMOS

W.-C. Sun, National Chiao Tung University; C.-N. Kuo, National Chiao Tung University

13:30
13:40
13:50
14:10
14:10
14:20
14:30
14:40
14:50
15:00
15:10

TUESDAY

Coffee / Snacks 15:10 – 15:55 | Exhibit Show Floor

ROOM 253ABC BCEC

RFIC INTERACTIVE FORUM

13:30 – 15:10 TUESDAY, 4 JUNE 2019

RTuIF1 **CHAIR:** FRED LEE, *VERILY LIFE SCIENCES* | **CO-CHAIR:** ANTOINE FRAPPÉ, *ISEN LILLE*

RTuIF1-1: A 9dB Noise Figure Fully Integrated 79GHz Automotive Radar Receiver in 40nm CMOS Technology

T. Murakami, DENSO; N. Hasegawa, DENSO; Y. Utagawa, DENSO; T. Arai, DENSO; S. Yamaura, DENSO

RTuIF1-2: A Compact 76–81GHz 3TX/4RX Transceiver for FMCW Radar Applications in 65-nm CMOS Technology

L. Chen, Tsinghua University; L. Zhang, Tsinghua University; W. Wu, Tsinghua University; L. Zhang, Tsinghua University; Y. Wang, Tsinghua University

RTuIF1-3: A Full-Band Multi-Standard Global Analog & Digital Car Radio SoC with a Single Fixed-Frequency PLL

L.J. Breems, J. van Sinderen, H. Brekelmans, U. Moehlmann, R. Rutten, M. Bolatkale, S. Bajoria, J. Niehof, NXP Semiconductors; T. Fric, H. Stoffels, F. Fritschij, H. van der Ploeg, B. Oude-Essink, G. Lassche, Catena

RTuIF1-4: Laser Spectral Linewidth Reduction Using an Integrated Pound-Drever-Hall Stabilization System in 180nm CMOS SOI

M.H. Idjadi, University of Pennsylvania; F. Aflatouni, University of Pennsylvania

RTuIF1-5: 22nm FD-SOI Technology with Back-Biasing Capability Offers Excellent Performance for Enabling Efficient, Ultra-Low Power Analog and RF/Millimeter-Wave Designs

S.N. Ong, L.H.K. Chan, K.W.J. Chew, C.K. Lim, W.L. Oo, A. Bellaouar, C. Zhang, W.H. Chow, T. Chen, R. Rassel, J.S. Wong, C.W.F. Wan, J. Kim, W.H. Seet, GLOBALFOUNDRIES; D.L. Harame, Research Foundation CUNY

RTuIF1-6: A Low Power Fully-Integrated 76–81GHz ADPLL for Automotive Radar Applications with 150MHz/µs FMCW Chirp Rate and -95dBc/Hz Phase Noise at 1MHz Offset in FDSOI

A.R. Fridi, GLOBALFOUNDRIES; C. Zhang, GLOBALFOUNDRIES; A. Bellaouar, GLOBALFOUNDRIES; M. Tran, Mantric Technology

RTuIF1-7: An 82.2-to-89.3GHz CMOS VCO with DC-to-RF Efficiency of 14.8%

A. Tarkeshdouz, University of British Columbia; M. Haghi Kashani, University of British Columbia; E. Hadizadeh Hafshejani, University of British Columbia; S. Mirabbasi, University of British Columbia; E. Afshari, University of Michigan

RTuIF1-8: A 62GHz Tx/Rx 2×128-Element Dual-Polarized Dual-Beam Wafer-Scale Phased-Array Transceiver with Minimal Reticle-to-Reticle Stitching

U. Kodak, University of California, San Diego; B. Rupakula, University of California, San Diego; S. Zihir, IDT; G.M. Rebeiz, University of California, San Diego

RTuIF1-9: A 1–4GHz 4×4 MIMO Receiver with 4 Reconfigurable Orthogonal Beams for Analog Interference Rejection

S. Golabighezelahmad, University of Twente; E. Klumperink, University of Twente; B. Nauta, University of Twente

ROOM 160ABC BCEC

5G SUMMIT & EVENING PANEL SESSION

13:30 – 17:00 TUESDAY, 4 JUNE 2019

17:45 – 18:45

The 5G Summit is a special event co-organized by the IEEE Communications Society (ComSoc) and the IEEE Microwave Theory and Techniques Society (MTT-S). This year's summit features a half day of invited talks from industry experts focusing on the discussion of current 5G challenges and the evolution and detail of cutting-edge 5G innovations to overcome these challenges. This includes discussion of array development spanning the sub-6-GHz to mm-wave, the integration of mm-wave and m-MIMO techniques to enhance user experience, along with insight from the international community and their focus on the development of 5G technology. The Summit will conclude with a special 5G panel session where you can interact with industry experts and panelists. Visit the event website to get up-to-date details on featured panelists. This event is open to all attendees at a nominal cost, so if you haven't already registered, be sure to sign up at the registration booth (before we sell out).

5G SUMMIT SPEAKERS:

Driving the 5G NR Enhanced Mobile Broadband Evolution
John Smee, VP Engineering, *Qualcomm*

Bits to Beams — RF Technology Evolution for 5G mmWave Radios
Karim Hamed, General Manager, Microwave Communications at *Analog Devices*

Sub 6GHz 5G mMIMO FEM Design Challenges
Walter Honcharenko, *MACOM*

Commercializing 5G mm-Wave Arrays: Technical and Economic Factors
Alastair Upton and **Nitin Jain**, *Anokiwave*

Hyperdense Deployments with 5G Millimeter Wave
Farooq Khan, President, *PHAZR at JMA Wireless*

IEEE 5G SUMMIT

IEEE ComSoc IEEE Communications Society

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KEYSIGHT TECHNOLOGIES

STARTUPS PANEL DISCUSSION

MICROAPPS THEATER, BOOTH #200 BCEC

15:45 – 17:00 TUESDAY, 4 JUNE 2019

How Collaborations Between Big Corporations, Government and Startups Take Them All to the Next Level

MODERATOR: **Christine Dunn**, President, *ArcPoint Strategy*

PANELISTS: **Joe Lipowski**, CTO, *Starry*; **Warren Katz**, Director, *Techstars*; **Nam Pham**, Assistant Secretary of Business Development, *MA Executive Office of Housing & Economic Development*; **Lisa Aucoin**, VP of Engineering, *BAE Systems*

Christine Dunn

Joe Lipowski

Warren Katz

Nam Pham

Lisa Aucoin

	151AB	153AB	156AB
	Tu4A: Advanced Transmission Transitions and Interfaces **Chair:** Jun (Brandon) Choi, SUNY Buffalo **Co-Chair:** Ke Wu, Polytechnique Montréal	**Tu4B: Complexity Reduction for Statistical Analysis and Design Optimization** **Chair:** Erin Kiley, Massachusetts College of Liberal Arts **Co-Chair:** Jose Rayas-Sanchez, ITESO	**Tu4C: Advancement in Biomedical Sensing Systems** **Chair:** Abbas Omar, Universität Magdeburg **Co-Chair:** Chung-Tse Michael Wu, Rutgers University
15:55	**Tu4A-1: Wide-Band Blazed Grating for All Polarizations** H. Tian, University of California, Los Angeles; T. Itoh, University of California, Los Angeles	**Tu4B-1: Efficient Error Estimator for Model Order Reduction of Linear Parametric Systems** L. Feng, MPI for Dynamics of Complex Technical Systems; P. Benner, MPI for Dynamics of Complex Technical Systems	**Tu4C-1: Systolic and Diastolic Blood Pressure Estimation from Pulse Transit Time Using Dual Split-Ring Resonators with Notch Structure** P.-K. Chan, National Cheng Kung University; C.-C. Chen, NCUT; C.-L. Yang, National Cheng Kung University
16:05			
16:15	**Tu4A-2: A Full W-Band Waveguide-to-Differential Microstrip Transition** B. Deutschmann, Technische Universität Hamburg-Harburg; A.F. Jacob, Technische Universität Hamburg-Harburg	**Tu4B-2: Low-Cost and Reliable Yield Estimation of Miniaturized Microwave Couplers Using Variable-Fidelity Simulations and Response Features** S. Koziel, Reykjavik University; A. Bekasiewicz, Gdansk University of Technology; J.W. Bandler, McMaster University	**Tu4C-2: Microwave Stethoscope for Heart Sound by Near-Field Coherent Sensing** X. Hui, Cornell University; P. Sharma, Cornell University; E.C. Kan, Cornell University
16:25			
16:35	**Tu4A-3: Compact W-Band Shielded Asymmetrical Coplanar Stripline to Microstrip Transition for Millimeter-Wave Applications** Q. Li, UESTC; T. Yang, UESTC	**Tu4B-3: Space Mapping for Tuning Microwave Waveguide Filters** J.C. Melgarejo, Universitat Politècnica de València; M. Guglielmi, Universitat Politècnica de València; S. Cogollos, Universitat Politècnica de València; V.E. Boria, Universitat Politècnica de València	**Tu4C-3: A Perturbation-Injection-Locked Sensor with Self-Oscillating Active CSRR for Vital-Sign Detection from Fingertip** C.-Z. Wu, Taiwan Tech; C.-H. Tseng, Taiwan Tech
16:45			
16:55	**Tu4A-4: 3D Printed Slotted Rectangular Hollow Waveguides** K. Lomakin, FAU Erlangen-Nürnberg; S. Herold, FAU Erlangen-Nürnberg; D. Simon, NXP Semiconductors; M. Sippel, FAU Erlangen-Nürnberg; A. Sion, NXP Semiconductors; M. Vossiek, FAU Erlangen-Nürnberg; K. Helmreich, FAU Erlangen-Nürnberg; G. Gold, FAU Erlangen-Nürnberg	**Tu4B-4: Space-Mapping Inspired Scattering Model Construction Based on Sparse Representation** T. Yan, Shanghai Jiao Tong University; D. Li, Shanghai Jiao Tong University; W. Yu, Shanghai Jiao Tong University	**Tu4C-4: Designing a Metasurface-Based Tag Antenna for Wearable Vital Sign Sensors** R.E. Arif, National Sun Yat-sen University; M.-C. Tang, National Sun Yat-sen University; W.-C. Su, National Sun Yat-sen University; T.-S. Horng, National Sun Yat-sen University; F.-K. Wang, National Sun Yat-sen University; C.-H. Tseng, Taiwan Tech
17:05			
17:15			

157BC

Tu4D: High Frequency Low Phase Noise Oscillator Techniques

Chair: Ruonan Han, MIT
Co-Chair: Emery Chen, National Taiwan University

Tu4D-1: A K-Band CMOS Low-Phase-Noise Sub-Harmonically Injection-Locked QVCO with Divider-Less Frequency-Tracking Loop

H.-S. Yang, National Central University; I.Y.-E. Shen, National Central University; H.-Y. Chang, National Central University

Tu4D-2: An 100-to-110GHz Low-DC-Power Sub-Harmonically Injection-Locked Quadrature Oscillator Using Stacked Boosting Technique in 90-nm CMOS Process

W.-C. Chen, National Central University; H.-N. Yeh, National Central University; H.-Y. Chang, National Central University

Tu4D-3: A Dual-Band CMOS Standing-Wave Digitally Controlled Oscillator for Automotive Radars

C.-M. Lin, National Taiwan University; Y.-T. Lin, National Taiwan University; K.-Y. Kao, National Taiwan University; K.-Y. Lin, National Taiwan University

Tu4D-4: A 0.1-V 5-GHz VCO Achieving FoM of 190-dBc/Hz

J.-D. Jin, TSMC; Y.-T. Lu, TSMC

254AB

Tu4F: Chipless RFID

Chair: Mojgan Daneshmand, University of Alberta
Co-Chair: Kazuya Yamamoto, Mitsubishi Electric

Tu4F-1: All-Dielectric Electromagnetic Encoders Based on Permittivity Contrast for Displacement/Velocity Sensors and Chipless-RFID Tags

C. Herrojo, Universitat Autònoma de Barcelona; P. Vélez, Universitat Autònoma de Barcelona; F. Paredes, Universitat Autònoma de Barcelona; J. Mata-Contreras, Universidad de Málaga; F. Martín, Universitat Autònoma de Barcelona

Tu4F-2: A Retrodirective Microwave Barcode

K. Xu, SUNY Buffalo; D. Koshen, Nazarbayev University; M. Abdirash, Nazarbayev University; J.H. Choi, SUNY Buffalo

Tu4F-3: Electronically Re-Writable Chipless RFID Tag Using Solid State Metal-Insulator-Metal Switches on Paper Substrate

Jayakrishnan M.P., LCIS (EA 3747); A. Vena, IES (UMR 5214); B. Sorli, IES (UMR 5214); E. Perret, LCIS (EA 3747)

Tu4F-4: A Robust Detection Algorithm Using AC Characteristics of Backscatter Signal for Chipless RFID System

G. Khadka, Monash University; Md.S. Arefin, Monash University; N.C. Karmakar, Monash University

257AB

Tu4G: Novel Radar Technologies

Chair: Nestor Lopez, MIT Lincoln Laboratory
Co-Chair: Mohamed Abouzahra, MIT Lincoln Laboratory

Tu4G-1: Compensation of the Pulse-to-Pulse Instability of GaN HEMT-Based Power Amplifiers

P.M. Tomé, Instituto de Telecomunicações; F.M. Barradas, Instituto de Telecomunicações; T.R. Cunha, Instituto de Telecomunicações; J.C. Pedro, Instituto de Telecomunicações

Tu4G-2: Limiting Amplifier with 25THz Gain-Bandwidth-Product and Internal Amplitude Control for Data Rates Beyond 50Gbit/s in 130nm SiGe

P. Stärke, Technische Universität Dresden; C. Carta, Technische Universität Dresden; F. Ellinger, Technische Universität Dresden

Tu4G-3: UWB Positioning System with Orientation-Independent Characteristic by Using Omnidirectional Circularly Polarized Antenna

W.-T. Tsai, Y.-Y. Chen, C.-Y. Liou, S.-G. Mao, National Taiwan University

Tu4G-4: Single Conversion Stepped-Frequency Continuous-Wave Radar Using Self-Injection-Locking Technology

W.-C. Su, M.-C. Tang, R.E. Arif, T.-S. Horng, F.-K. Wang, National Sun Yat-sen University

Tu4G-5: An Integrated 79GHz Sequential Sampling Pulse Radar

A. Leibetseder, DICE; C. Wagner, DICE; A. Stelzer, Johannes Kepler Universität Linz

15:55
16:05
16:15
16:25
16:35
16:45
16:55
17:05
17:15

Rump Session 17:00 – 18:30 – page 42 | HAM Radio 18:30 – 20:30 – page 43
YP Panel 17:30 – 19:00 & Reception 19:30 – 21:30 – pages 42-43

RUMP SESSION

ROOM162AB BCEC

17:00 – 18:30 TUESDAY, 4 JUNE 2019

FCC Opens Above 95-GHz Spectrum: Beyond 5G & Other Applications

MODERATOR: **Michael Marcus**, *FCC (Retired) & Virginia Tech*

ABSTRACT:

As 5G gets closer to implementation reality, it is time to start thinking about what is next. On March 15, 2019 the FCC took a major step on spectrum above 95 GHz to open it to both experimentation and limited immediate commercial use. This follows earlier more limited steps by spectrum regulators in Japan and Europe. Join a group of both technologists and spectrum policy experts to discuss how this spectrum could be used, technology options, and spectrum policy issues that need to be resolved. The discussion will include many ideas for R&D possibilities.

SPEAKERS: Michael Marcus, *FCC (Retired) & Virginia Tech;* **Gerhard Schoenthal**, *Virginia Diodes;* **Josep Jornet**, *SUNY Buffalo;* **Upkar Dhaliwal**, *Future Wireless Technologies*

TUESDAY

YOUNG PROFESSIONALS (YP)

YP LOUNGE

New to IMS2019 is a lounge area dedicated specifically to YPs. The spacious YP Lounge, situated with views of Boston's Seaport, will be open for the entire duration of the conference, and it will be the place to go to find attendees meeting each over a lawn game, discussing a technical paper at one of the high-top tables, or just finding a comfortable spot to relax or catch up on emails.

YP LOUNGE LEVEL 2 BCEC

YP INFORMAL PANEL SESSION

17:30 – 19:00 TUESDAY, 4 JUNE 2019

How To Be "Wicked Smaht" and Competitive With the Pace of Innovation

Tom Rondeau

Ming Yu

Nick Kalita

Famous for innovative startups, prominent university labs and most importantly as a pioneer of modern Microwave engineering, Boston is an exceptional place for Young Professionals (YP) to network with one another and enjoy the unique culture that we have to boast. This year, the Steering Committee is focusing on providing engaging places and events for Young Professionals to feel inspired and learn valuable lessons from a diverse group of highly accomplished individuals in the field of Microwaves. Aligned with the innovative culture of Boston, the overarching theme of our YP events is how to stay inventive and competitive in a world where technology is so rapidly evolving around us.

To spark this conversation, an informal panel session will be held at the start of the conference where attendees can speak directly with carefully selected individuals who have made significant impacts with their careers. The panelists have unique backgrounds and include a technical director at a disruptive millimeter wave startup, a prominent professor and a DARPA program manager who is also the lead developer of software defined radio framework widely used today. Our panelists encompass high achievers in hardware and software, leadership, academia, government, industry, and startups. The panel discussion will not be held in the typical 'classroom' setting, but rather in a more open forum space, encouraging real opportunities for connection.

PANEL SPEAKERS: **Tom Rondeau**, Program Manager, *DARPA*; **Ming Yu**, Professor, *Chinese University of Hong Kong*; **Nick Kalita**, RF Engineering Director, *Starry*

AMATEUR (HAM) RADIO SOCIAL EVENT

WESTIN BOSTON WATERFRONT **HARBOR BALLROOM**

18:30 – 20:30 TUESDAY, 4 JUNE 2019

Howard E. Michel

IMS2019 will be hosting a ham radio social event in Boston, Massachusetts on Tuesday June 4 at 18:30. All radio amateurs and other interested IMS attendees are cordially invited. The keynote speaker will be the new CEO of the ARRL American Radio Relay League, Howard E. Michel (call sign WB2ITX). The ARRL organization consists of approximately 157,000 people who support the hobby with their interest in meeting fellow hams on the airwaves and moving radio technology forward. Howard will speak about the role and vision of the ARRL in the 21st century, as well as the latest technologies being used in the hobby.

The Boston, Massachusetts location for IMS2019 has special significance for amateur radio. In 1903, the first transatlantic wireless communication (via Morse code) originating within the United States was successfully transmitted from Marconi Station on Cape Cod. The message went from US President Teddy Roosevelt to the King of England.

Three years later, on December 24,1906, Massachusetts became home to the first radio voice communication when Reginald A. Fessenden used a massive 420 -foot radio tower at Brant Rock (a small village south of Boston) to send voice and music to ships along the Atlantic coast.

Today hams are using the latest digital modes and SDR software defined radio technology in addition to traditional CW, AM phone, SSB, FM, satellite, moon-bounce, and other radio techniques.

We hope to see you in Boston for a memorable ham radio event, and renew or begin your interest in this great hobby!

YP RECEPTION

COPPERSMITH 40 W. 3RD, BOSTON, 02127

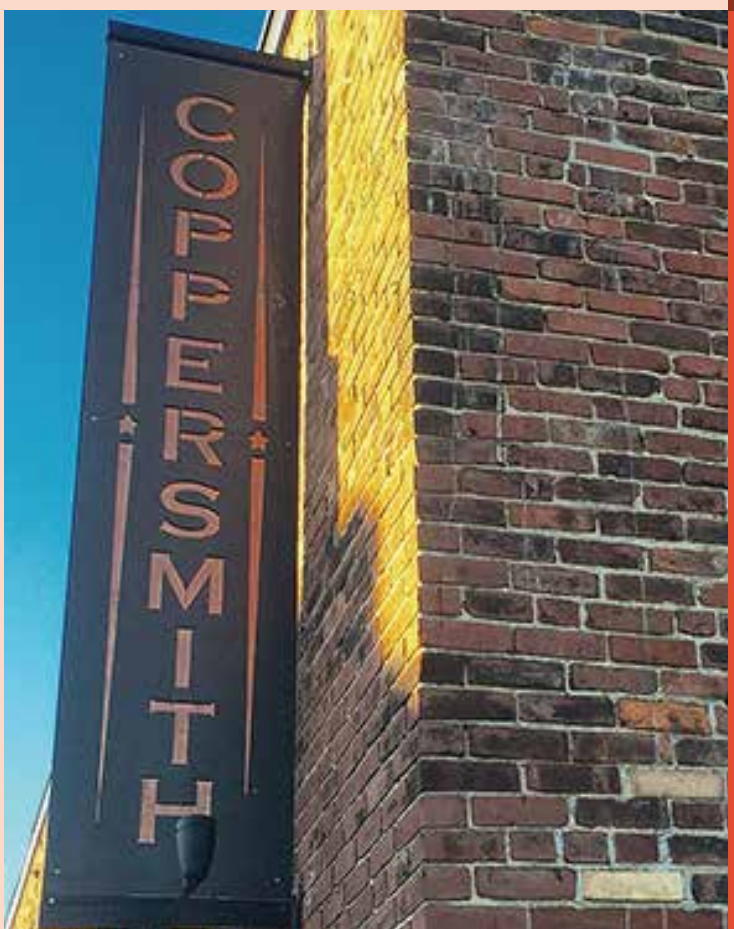
19:30 – 21:30 TUESDAY, 4 JUNE 2019

Immediately after the panel discussion, attendees will head off down the street to a reception at Coppersmith, which we have fully rented out. Coppersmith is a popular restaurant and bar where everyone can unwind and continue conversations with the panelists and network with other attendees. Because IMS is a one-of-a-kind opportunity where people of diverse backgrounds have access to each other, the Steering Committee is committed to making this event accessible to everyone, so it will be held later in the day and is open to all.

IEEE youngprofessionals

Young Professionals Reception Media Sponsor:

Microwaves&RF®



IMS Startup Pavilion: Booth 100

See who's new in the Industry!

ALTUM RF

iconicRF

jetcool

KUMU NETWORKS

Nalu Scientific
Data Acquisition Systems

RAYTECHX
Millimeter-wave, Innovative Technology

STARRY

IMS 5G Pavilion: Booth 2000

Visit the 5G Theater in Booth 2000. Presentation schedule available on the website and mobile app!

MEMtronics

Silicon illi ave Solutions

mixcomm

NanoSemi

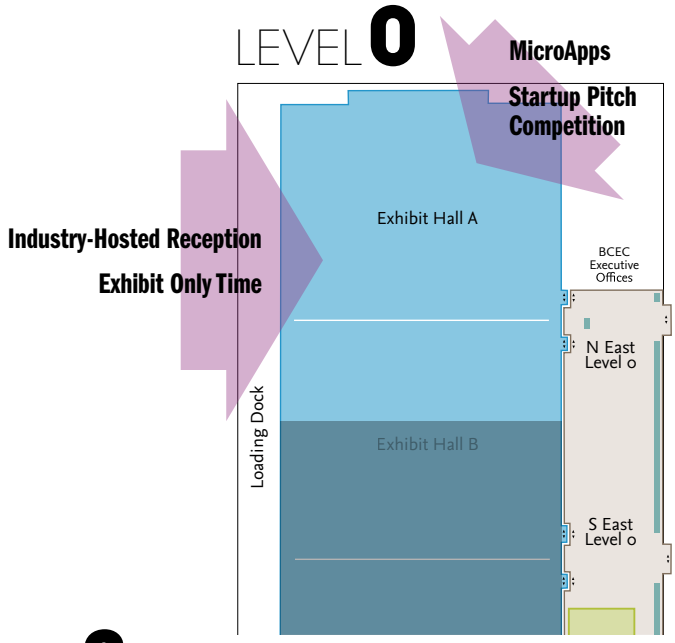
PENTEK

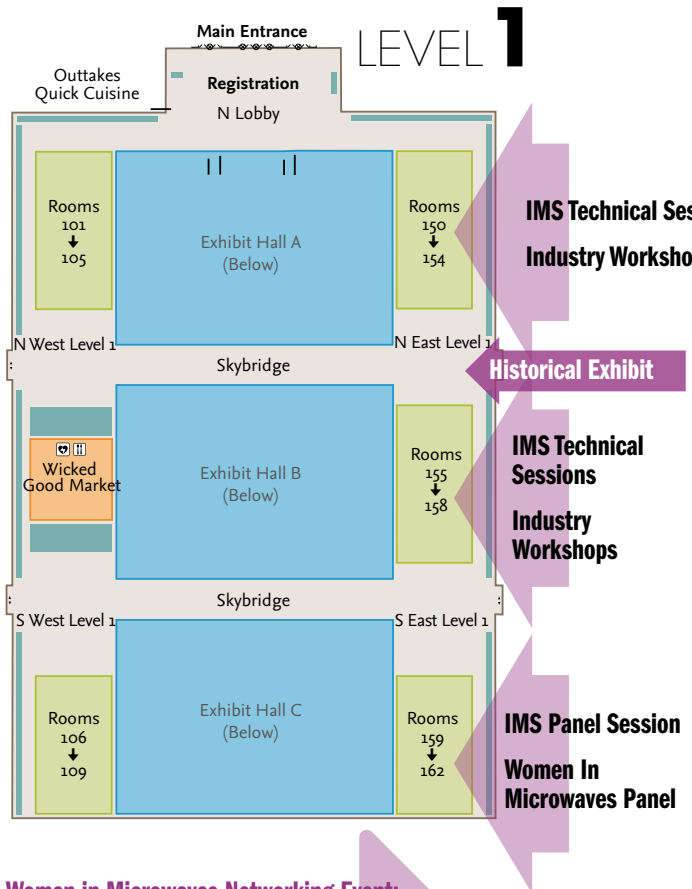
SynMatrix
Simplify Your Design

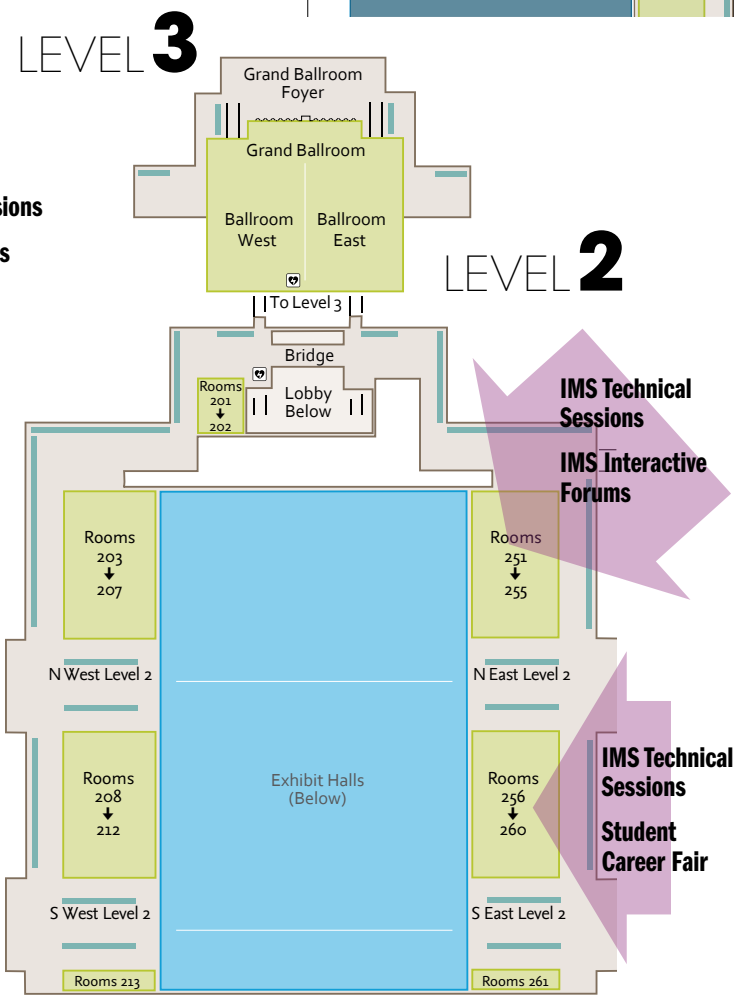
CONFERENCE HIGHLIGHTS

WEDNESDAY

EVENT	TIME
IMS Technical Sessions	08:00 – 17:15
MicroApps	09:45 – 16:00
Industry Workshops	10:00 – 17:15
Student Career Fair	10:00 – 17:00
IMS Interactive Forum	10:10 – 17:15
IMS Panel Session	12:00 – 13:15
Exhibit Only Time	13:30 – 15:30
Women in Microwaves Panel Session	16:00 – 17:00
Startup Pitch Competition	16:30 – 18:00
Industry-Hosted Reception	17:00 – 18:00
MTT-S Awards Banquet	18:30 – 21:30
Women in Microwaves Networking	19:00 – 21:00







Women in Microwaves Networking Event: Envoy Hotel Rooftop Bar

MTT-S Awards Banquet: Westin Boston Waterfront Grand Ballroom

151AB

We1A: Power Combiners and Transformers

Chair: Guoan Wang, University of South Carolina
Co-Chair: Bayaner Arigong, Washington State University

We1A-1: Reconfigurable Dual-Band Filtering Power Divider with Ultra-Wide Stopband Using Hybrid Microstrip/ Square Defected Ground Structure
Z. Tian, UESTC; Y. Rao, UESTC; Z. Deng, UESTC; X. Luo, UESTC

We1A-2: A 15–55GHz Low-Loss Ultra-Compact Folded Inductor-Based Multi-Section Wilkinson Power Divider for Multi-Band 5G Applications
S. Lee, Georgia Tech; M.-Y. Huang, Georgia Tech; Y. Youn, Georgia Tech; H. Wang, Georgia Tech

We1A-3: A Self-Packaged SISL Dual-Band Power Divider for WLAN Application with Low Loss and Compact Size
T. Feng, UESTC; K. Ma, UESTC; Y. Wang, UESTC

We1A-4: A Simple Low Loss Partially-Filled 16-Way Radial Power Combiner
H.J. du Toit, D.I.L. de Villiers, R.D. Beyers, Stellenbosch University

We1A-5: Cavity Balanced-to-Unbalanced Magic-T with Filtering Response
J.-Y. Lin, UTS; S.-W. Wong, Shenzhen University; Y. Yang, UTS; L. Zhu, University of Macau

We1A-6: Compact Wideband Marchand Balun with Amplitude and Phase Compensation Shield
X. Liu, UESTC; J. Zhou, UESTC; Z. Deng, UESTC; X. Luo, UESTC

153AB

We1B: Oscillator Analysis, Power Amplifier Design, and MIMO System Characterization

Chair: Anding Zhu, University College Dublin
Co-Chair: Christopher Silva, Aerospace

We1B-1: Cyclostationary Noise Analysis of Superregenerative Oscillators
S. Hernández, Universidad de Cantabria; S. Sancho, Universidad de Cantabria; A. Suárez, Universidad de Cantabria

We1B-2: Phase-Noise Reduction in Self-Injection Locked Oscillators Using Slow-Wave Structures
M. Pontón, Universidad de Cantabria; F. Ramírez, Universidad de Cantabria; A. Herrera, Universidad de Cantabria; A. Suárez, Universidad de Cantabria

We1B-3: On the Efficiency and AM/AM Flatness of Inverse Class-F Power Amplifiers
T. Sharma, Princeton University; J.S. Roberts, NXP Semiconductors; S.K. Dhar, University of Calgary; S. Shukla, NXP Semiconductors; R. Darraji, University of Calgary; D.G. Holmes, NXP Semiconductors; F.M. Ghannouchi, University of Calgary

We1B-4: Single-DC-Input Multi-Level Envelope Tracking of a High-Efficiency X-Band Power Amplifier
T. Cappello, University of Colorado Boulder; S. Verploegh, University of Colorado Boulder; C. Florian, Università di Bologna; Z. Popović, University of Colorado Boulder

We1B-5: Intra-Array Coupling Estimation for MIMO Transceivers Utilizing Blind Over-The-Air Measurements
S. Hesami, Maynooth University; S. Rezaei Aghdam, Chalmers University of Technology; C. Fager, Chalmers University of Technology; T. Eriksson, Chalmers University of Technology; R. Farrell, Maynooth University; J. Dooley, Maynooth University

156AB

We1C: Enabling Technologies for mm-Wave 5G Communication

Chair: Farshid Aryanfar, Peregrine Semiconductor
Co-Chair: Jon Comeau, Anokiwave

We1C-1: Single-Input Single-Output Digital Predistortion of Multi-User RF Beamforming Arrays
E. Ng, University of Waterloo; A. Ben Ayed, University of Waterloo; P. Mitran, University of Waterloo; S. Boumaiza, University of Waterloo

We1C-2: 5G mm-Wave Link Range Estimation Based on Over-The-Air Measured System EVM Performance
M.E. Leinonen, University of Oulu; N. Tervo, University of Oulu; M. Jokinen, University of Oulu; O. Kursu, University of Oulu; A. Pärssinen, University of Oulu

We1C-3: A 37–42GHz 8×8 Phased-Array for 5G Communication Systems with 48–50dBm EIRP
Y. Yin, University of California, San Diego; S. Zihir, IDT; T. Kanar, IDT; G.M. Rebeiz, University of California, San Diego

We1C-4: 2×64 Dual-Polarized Dual-Beam Single-Aperture 28GHz Phased Array with High Cross-Polarization Rejection for 5G Polarization MIMO
A. Nafe, University of California, San Diego; M. Sayginer, University of California, San Diego; K. Kibaroglu, University of California, San Diego; G.M. Rebeiz, University of California, San Diego

We1C-5: Multi-Gbps Tri-Band 28/38/60-GHz CMOS Transmitter for Millimeter-Wave Radio System-on-Chip
D. del Rio, Ceit-IK4; D. Yoon, National Chiao Tung University; F.-T. Chen, National Chiao Tung University; Y. Zhang, University of California, Los Angeles; C.-J. Liang, National Chiao Tung University; C.-W. Chiang, National Chiao Tung University; M.-C.F. Chang, National Chiao Tung University; Y.-C. Kuan, National Chiao Tung University

157BC

We1D: mm-Wave and THz Systems for Sensing and Communications

Chair: Adrian Tang, University of California, Los Angeles
Co-Chair: Joachim Oberhammer, KTH

We1D-1: A Low-Power FSK/Spatial Modulation Receiver for Short-Range mm-Wave Wireless Links
K. Zhan, Oregon State University; Y. Liu, Oregon State University; T. Kamgaing, Intel; R. Khanna, Intel; G. Dogiamis, Intel; H. Liu, Oregon State University; A. Natarajan, Oregon State University

We1D-2: 207–257GHz Integrated Sensing Readout System with Transducer in a 130-nm SiGe BiCMOS Technology
D. Wang, Fraunhofer IPMS; J. Yun, M.H. Eissa, M. Kucharski, K. Schmalz, A. Malignaggi, Y. Wang, J. Borngräber, Y. Liang, H.J. Ng, IHP; Q.H. Le, T. Kämpfe, K. Seidel, Fraunhofer IPMS; D. Kissinger, Universität Ulm

We1D-3: A Broadband Dual-Polarized Terahertz Direct Detector in a 0.13-µm SiGe HBT Technology
M. Andree, Bergische Universität Wuppertal; J. Grzyb, Bergische Universität Wuppertal; R. Jain, Bergische Universität Wuppertal; B. Heinemann, IHP; U.R. Pfeiffer, Bergische Universität Wuppertal

We1D-4: A 6-mW-DC-Power 300-GHz CMOS Receiver for Near-Field Wireless Communications
S. Lee, Hiroshima University; R. Dong, Hiroshima University; S. Hara, NICT; K. Takano, Hiroshima University; S. Amakawa, Hiroshima University; T. Yoshida, Hiroshima University; M. Fujishima, Hiroshima University

We1D-5: A 220GHz Dual Channel LNA Front-End for a Direct Detection Polarimetric Receiver
C.M. Cooke, Northrop Grumman; K. Leong, Northrop Grumman; A. Escorcia, Northrop Grumman; X.B. Mei, Northrop Grumman; T.W. Barton, University of Colorado Boulder; M.A. Vega, NASA Goddard Space Flight Center; D.L. Wu, NASA Goddard Space Flight Center; W.R. Deal, Northrop Grumman

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254AB

We1F: Microwave Acoustic Components and Applications

Chair: Amelie Hagelauer, FAU Erlangen-Nürnberg
Co-Chair: Steven Stitzer, Northrop Grumman

We1F-1: Laterally Excited Bulk Wave Resonators (XBARs) Based on Thin Lithium Niobate Platelet for 5GHz and 13GHz Filters

V. Plessky, GVR Trade; S. Yandrapalli, GVR Trade; P.J. Turner, Resonant; L.G. Villanueva, EPFL; J. Koskela, GVR Trade; M. Faizan, EPFL; A. De Pastina, EPFL; B. Garcia, Resonant; J. Costa, Resonant; R.B. Hammond, Resonant

We1F-2: A Super-High-Frequency Non-Released Silicon Fin Bulk Acoustic Resonator

M. Ramezani, University of Florida; M. Ghatge, University of Florida; V. Felmetsger, OEM Group; R. Tabrizian, University of Florida

We1F-3: Demonstration of a Sequentially Switched Delay Line (SSDL) Circulator with SAW Filter Delay Elements

C.F. Campbell, Qorvo

We1F-4: Ultra-High Isolation Nonreciprocal Acoustic Filters

C. Cassella, Northeastern University; M. Pirro, Northeastern University; G. Michetti, Northeastern University; M. Rinaldi, Northeastern University

We1F-5: Switched Mode Thin Film Bulk Acoustic Wave Resonators

M. Zolfagharloo Koohi, University of Michigan; A. Mortazawi, University of Michigan

257AB

We1G: Recent Advances in Radar Systems Applications

Chair: Martin Vossiek, FAU Erlangen-Nürnberg
Co-Chair: Arne Jacob, Handong University

We1G-1: Si-Based 94-GHz Phased Array Transmit and Receive Modules for Real-Time 3D Radar Imaging

J.-O. Plouchart, X. Gu, W. Lee, A. Tzadok, D. Liu, H. Liu, M. Yeck, C. Baks, A. Valdes-Garcia, IBM T.J. Watson Research Center

We1G-2: 2D mm-Wave Imaging Based on Singular Value Decomposition

B. Mamandipoor, Stanford University; U. Madhow, University of California, Santa Barbara; A. Arbabian, Stanford University

We1G-3: Millimeter-Wave Cost-Effective Phased-Array Radar with Orthogonally Located Linear Tx and Rx Arrays

M. Hiraki, Y. Motoda, T. Tanaka, Y. Ota, N. Morikoshi, R. Yokota, T. Kuramoto, S. Uchida, T. Yanagita, Renesas Electronics; T. Nakamura, Hitachi; G. Sun, T. Kirimoto, Univ. of Electro-Communications; S. Suzuki, Kansai Univ.

We1G-4: In-situ Time-Frequency Analysis of the 77GHz Bands Using a Commercial Chirp-Sequence Automotive FMCW Radar Sensor

M. Gardill, InnoSenT; J. Schwendner, InnoSenT; J. Fuchs, FAU Erlangen-Nürnberg

We1G-5: Vector Velocity and Position Measurement Using a 77-GHz Cooperative Radar System

S. Edstaller, FAU Erlangen-Nürnberg; D. Mueller, Siemens Mobility

We1G-6: An Unambiguous Phase-Based Algorithm for Single-Digit Micron Accuracy Distance Measurements Using FMCW Radar

L. Piotrowsky, Ruhr-Universität Bochum; T. Jaeschke, 2π-Labs; S. Küppers, 2π-Labs; N. Pohl, Ruhr-Universität Bochum

259AB

We1H: Advanced GaN Power Amplifiers

Chair: Jonmei Yan, MaXentric Technologies
Co-Chair: Wenhua Chen, Tsinghua University

We1H-1: 70% Efficient Dual-Input Doherty-Outphasing Power Amplifier for Large PAPR Signals

A. Yamaoka, Toshiba; T.M. Hone, Toshiba; K. Yamaguchi, Toshiba

We1H-2: A Fully Integrated C-Band GaN MMIC Doherty Power Amplifier with High Gain and High Efficiency for 5G Application

G. Lv, Tsinghua University; W. Chen, Tsinghua University; L. Chen, Tsinghua University; Z. Feng, Tsinghua University

We1H-3: Design, Analysis and Evaluation of a Broadband High-Power Amplifier for Ka-Band Frequencies

P. Neininger, Fraunhofer IAF; L. John, Fraunhofer IAF; P. Brückner, Fraunhofer IAF; C. Friesicke, Fraunhofer IAF; R. Quay, Fraunhofer IAF; T. Zwick, KIT

We1H-4: High-Efficiency, Ka-Band GaN Power Amplifiers

N. Estella, QuinStar Technology; E. Camargo, QuinStar Technology; J. Schellenberg, QuinStar Technology; L. Bui, QuinStar Technology

We1H-5: A Highly Efficient and Compact 6kW GaN Solid-State Microwave Generator for CW 2.45GHz Applications

H. Jeong, RFHIC; T. Yoon, RFHIC; H. Yoo, RFHIC; H. Jung, RFHIC; S. Cho, RFHIC

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Coffee / Snacks 09:30 – 10:30 | Exhibit Show Floor

MICROAPPS SCHEDULE

MICROAPPS THEATER, BOOTH #200 BCEC

09:45 – 16:00 WEDNESDAY, 5 JUNE 2019

MicroApps offers a wicked lot of information in 15 minutes! These presentations of application notes target the working engineer or technician and are color coded by general topic area below. On the exhibition floor, it's free, and it will make you "smahtter." Come see us at the MicroApps Theater.

START TIME	TITLE	SPEAKERS
09:45	Designing/Testing High Power Multipaction Free Filters	Lester Donaway, JasonHedges – API Technologies Corp
10:00	Developments In Imaging Techniques To Address The Thermal Challenges Presented By Today's Advanced Microwave Devices	Dustin Kendig – Microsanj
10:15	Differential Noise Figure Measurements Using a VNA	Steve Reyes – Anritsu Company
10:30	Digital to RF: System level improvements and new test requirements	Markus Loerner – Rohde & Schwarz USA, Inc.
10:45	Efficient Modeling and Simulation of Multi-Layer Printed Structures in WIPL-D Software Package	Jasmin Music – WIPL-D
11:00	European Telecommunications Standards Institute (ETSI) WLAN Power Measurement Compliance Testing using USB/LAN Power Sensor	Chin Aik Lee – Product Management
11:15	High-Frequency Extraction in the Virtuoso RF Module Design Flow	Sanam Vakili, Michael Brenneman – Cadence Design Systems
11:30	How To Bring a Test Scenario From the Field Into the Lab With 512 MHz Wide IQ Capturing, Recording And Replaying	Wolfgang Wendler – Rohde & Schwarz USA, Inc.
11:45	I/Q Balance Calibration for Quadrature Modulators in Direct Conversion RF Instrumentation Generators	Thomas Costello – Astronics Test Systems
12:00	Improving Probe-Tip S-parameters Measurements with Power Calibration up to 110 GHz	
12:15	Improving Pulsed Power Recovery of GaN LNAs	Chris Gregoire – Custom MMIC
12:30	Integrated Passive Devices (IPD) for RF Front End Integration	Feng Ling, Lijun Chen – Xpeedic Technology, Inc.
12:45	IQSTAR- Gain a Competitive Advantage Through Optimization of Your Circuit Test Flow and Data Analysis.	Arnaud Delias – AMCAD Engineering
13:00	Why Are Peak Power Meters Essential For Characterizing Pulsed Power Amplifiers?	Walt Strickler – Boonton
13:15	Measurement Accuracy of Vector Network Analysis	Anja Paula – Rohde & Schwarz USA, Inc.
13:30	Measurement of Allan Variance with Phase Noise Test Setup	Wolfgang Wendler – Rohde & Schwarz USA, Inc.
13:45	Measuring The Doherty Amplifier as a Dual-Input Device	Gareth Lloyd – Rohde & Schwarz USA, Inc.
14:00	Minimizing Acquisition Time on Phase Locked Loops to below 1 us.	Ian Collins – Analog Devices, Inc.
14:15	Modern techniques to characterize phase and group delay of frequency converters	Anja Paula – Rohde & Schwarz USA, Inc.
14:30	Multi-array antenna measurements up to 40 GHz	Anja Paula – Rohde & Schwarz USA, Inc.
14:45	Multi-Harmonic Load Pull With Wideband Impedance Control For 5G and WLAN Applications	Giampiero Esposito – Maury Microwave
15:00	New Generation YIG Oscillators Bridge Divide Created by High Frequency and Low Phase Noise Demands of Evolving Communications and Transport Markets	Ron Parrott, Tim Jenkins, Bill Linstrom – VIDA Products
15:15	New Power Measurement Techniques For Today's Demanding RF World	Lawrence Wilson – Rohde & Schwarz USA, Inc.
15:30	New Techniques for 5G Transmitter Measurements	Lawrence Wilson – Rohde & Schwarz USA, Inc.
15:45	Not All Sparkles are Fun	Ruan Lourens – Analog Devices

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WeIF1 | IN HONOR OF BARRY PERLMAN

CHAIR: KENNETH KOLODZIEJ, *MIT LINCOLN LABORATORY* | **CO-CHAIR:** NESTOR LOPEZ, *MIT LINCOLN LABORATORY*

WeIF1-1: Design and Characterization of Meshed Microstrip Transmission Lines

Z.J. Silva, Georgia Tech; C.R. Valenta, Georgia Tech; G.D. Durgin, Georgia Tech

WeIF1-2: Vertical RF Transition Using Spring Contact Probes with Passively Switched DGS Compensating for Impedance Matching

H. Aoyama, Mitsubishi Electric; H. Ishibashi, Mitsubishi Electric; H. Yukawa, Mitsubishi Electric; N. Yoneda, Mitsubishi Electric

WeIF1-3: A 360-Degree Rotatable RF Switch (360-RS) with Embedded Conductive Micro-Particles

N. Soufizadeh-Balaneji, North Dakota State University; A.R. Kallmeyer, North Dakota State University; S. May, North Dakota State University; B.D. Braaten, North Dakota State University

WeIF1-4: A Complex Load Matched Microstrip Balun

M.H. Maktoomi, Washington State University; M. Zhou, Qorvo; H. Ren, Washington State University; Y. Gu, University of Texas at Arlington; B. Arigong, Washington State University

WeIF1-5: A Microstrip Line Reflection-Type Phase Shifter for 60GHz Phased Array

H. Zhang, Washington State University; H. Ren, Washington State University; H. Tang, UMass Lowell; B. Zheng, UMass Lowell; B. Katz, SV Microwave; B. Arigong, Washington State University; H. Zhang, UMass Lowell

WeIF1-6: Millimeter-Wave SIW Filter Based on the Stepped-Impedance Face-to-Face E-Shaped DGSs

G. Wen, UESTC; J. Li, UESTC; F. Xie, UESTC; H. Wang, UESTC; Y. Huang, UESTC

WeIF1-7: A Wideband Bandpass Filter with Broad Stopband and Ultra-Wide Reflectionless Range for 5G Applications

C. Liu, UESTC; Z. Deng, UESTC; X. Liu, UESTC; X. Luo, UESTC

WeIF1-8: Phase Correction of Asymmetrical Chebyshev Polynomials for Extracted-Pole Fully Canonical Filters

Á. Triano, Universitat Autònoma de Barcelona; P. Silveira, Universitat Autònoma de Barcelona; J. Verdú, Universitat Autònoma de Barcelona; P. de Paco, Universitat Autònoma de Barcelona

WeIF1-9: Frequency-Tunable Substrate-Integrated Waveguide Filter Using Contactless Rotatable Flaps

S. Nam, Korea University; B. Lee, Korea University; J. Lee, Korea University

WeIF1-10: Synthesis of Microwave Filters with Dispersive Coupling Using Isospectral Flow Method

Y. Zhang, CUHK; H. Meng, CUHK; K.-L. Wu, CUHK

WeIF1-11: A Low-Loss Continuously Tunable Phase Shifter Based on a Bandpass Filter with Reconfigurable Transmission Zeros

R. Lovato, University of Central Florida; X. Gong, University of Central Florida

WeIF1-12: On-Chip Millimeter-Wave Bandpass Filter Design Using Multi-Layer Modified-Ground-Ring Structure

F. Sun, Jilin University; X. Zhu, UTS; H. Zhu, UTS; Y. Yang, UTS; R. Gómez-García, Universidad de Alcalá

WeIF1-13: Comprehensive Nonlinear Characterization and Modeling of a BAW Duplexer

D. Garcia-Pastor, Universitat Politècnica de Catalunya; J. Mateu, Universitat Politècnica de Catalunya; C. Collado, Universitat Politècnica de Catalunya; R. Perea-Robles, Universitat Politècnica de Catalunya; M. Gonzalez-Rodriguez, Universitat Politècnica de Catalunya; J.M. Gonzalez-Arbesú, Universitat Politècnica de Catalunya

WeIF1-14: Non-Reciprocal Mode Converting Substrate Integrated Waveguide with Unsymmetrical Perturbation

A. Afshani, Polytechnique Montréal; K. Wu, Polytechnique Montréal

WeIF1-15: A Novel Reconfigurable CMOS Compatible Ka Band Bandstop Structure Using Split-Ring Resonators and Vanadium Dioxide (VO_2) Phase Change Switches

A.A. Muller, EPFL; R. Abdul Khadar, EPFL; E.A. Casu, EPFL; A. Krammer, EPFL; M. Cavalleri, EPFL; A. Schuler, EPFL; J. Zhang, EPFL; A.M. Ionescu, EPFL

WeIF1-16: Low-Cost Planar RF MEMS-Based Attenuator

A. Raeesi, University of Waterloo; H. Al-Saedi, University of Waterloo; A. Palizban, University of Waterloo; A. Taeb, University of Waterloo; W.M. Abdel-Wahab, University of Waterloo; S. Gigoyan, University of Waterloo; S. Safavi-Naeini, University of Waterloo

WeIF1-17: An Ultra Low-Power Neuromorphic Bandpass Filter for Autonomous Cars

R. Borwankar, Worcester Polytechnic Institute; K. Vora, Worcester Polytechnic Institute; A. Desai, Worcester Polytechnic Institute; R. Ludwig, Worcester Polytechnic Institute; M. Haider, University of Alabama at Birmingham; Y. Massoud, Stevens Institute of Technology

WeIF1-18: A 2.35GHz Cross-Talk Canceller for 2×2 MIMO Full-Duplex Wireless System

A. Kumar, IIT Madras; S. Aniruddhan, IIT Madras

WeIF1-19: Advancing Lithium Niobate Based Thin Film Devices for 5G Front-Ends

Y. Yang, University of Illinois at Urbana-Champaign; R. Lu, University of Illinois at Urbana-Champaign; A. Kourani, University of Illinois at Urbana-Champaign; S. Gong, University of Illinois at Urbana-Champaign

WeIF1-20: A Quasi-Uniform Transversely Slotted SIW Leaky-Wave Structure with Enhanced Beam-Scanning Rate for Millimeter-Wave Applications

D. Zheng, Polytechnique Montréal; Y.-L. Lyu, Harbin Institute of Technology; K. Wu, Polytechnique Montréal

WeIF1-21: Experimental Verification of the Behavior of a Double Negative Metamaterial Composed of Planar Resonant Elements

J. Machac, Czech Technical University in Prague

WeIF1-22: A Stable Meshless Method for Electromagnetic Analysis

X. Zhang, East China Jiaotong University; L. Li, East China Jiaotong University; Z.D. Chen, Dalhousie University

WeIF1-23: Direct Optimization of Electrically Large Reflectors and Feed Chains

P. Meincke, TICRA; M. Palvig, TICRA; N. Vesterdal, TICRA; E. Jørgensen, TICRA

WeIF1-24: An Eye Diagram Parameters Measurement Method Based on K-Means Clustering Algorithm

B. Gao, UESTC; K. Wei, UESTC; L. Tong, UESTC

WeIF1-25: Linearization of a 500-W L-Band GaN Doherty Power Amplifier by Dual-Pulse Trap Characterization

T. Cappello, University of Colorado Boulder; C. Florian, Università di Bologna; A. Santarelli, Università di Bologna; Z. Popović, University of Colorado Boulder

WeIF1-26: Reduced-Cost Gradient-Based Optimization of Compact Microwave Components Through Adaptive Broyden Updates

S. Koziel, Reykjavik University; A. Pietrenko-Dabrowska, Gdansk University of Technology; J.W. Bandler, McMaster University

WeIF1-27: Accelerated EM-Driven Microwave Optimization by Means of Design Re-Utilization

S. Koziel, Reykjavik University; A. Bekasiewicz, Gdansk University of Technology; J.W. Bandler, McMaster University

WeIF1-28: Nonlinearity Modeling of Contact-Type RF MEMS Switch Based on Passive Intermodulation Analysis

Y. Zhang, Tsinghua University; Z. Gong, Tsinghua University; Z. Liu, Tsinghua University

WeIF1-29: Wideband Filtering Out-of-Phase Power Dividers Using Slotline Resonators and Microstrip-to-Slotline Transitions

H. Zhu, UTS; J.-Y. Lin, UTS; Y.J. Guo, UTS

WeIF1-30: Distributed Digital Predistortion Architecture for 5G Active Antenna System

H. Cao, Ericsson; H. Gao, Ericsson; Y. Zheng, Ericsson; J. Jie, Ericsson

WeIF1-31: A Continually-Stepped Variable-Gain LNA in 65-nm CMOS Enabled by a Tunable-Transformer for mm-Wave 5G Communications

S.N. Ali, Washington State University; Md. A. Hoque, Washington State University; S. Gopal, Washington State University; M. Chahardori, Washington State University; M.A. Mokri, Washington State University; D. Heo, Washington State University

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We2A: Advances in Passive Components

Chair: Holger Maune, Technische Universität Darmstadt
Co-Chair: Hualiang Zhang, UMass Lowell

10:10 – 10:30

We2A-1: New Embodiments of Static Field Micro-Particle Components for Reconfigurable RF Applications

N. Soufizadeh-Balaneji, North Dakota State University; D.A. Rogers, North Dakota State University; B.D. Braaten, North Dakota State University

10:30 – 10:50

We2A-2: A 90° Self-Compensating Slab Air-Filled Substrate Integrated Waveguide Phase Shifter

N.-H. Nguyen, IMEP-LAHC (UMR 5130); A. Ghiotto, IMS (UMR 5218); T. Martin, IMS (UMR 5218); A. Vilcot, IMEP-LAHC (UMR 5130); K. Wu, Polytechnique Montréal; T.-P. Vuong, IMEP-LAHC (UMR 5130)

10:50 – 11:10

We2A-3: Contra-Directional 3dB 90° Hybrid Coupler in Ridge Waveguides Using Even and Odd TE Modes

M.M. Fahmi, DRDC; J.A. Ruiz-Cruz, Universidad Autónoma de Madrid; R.R. Mansour, University of Waterloo

11:10 – 11:30

We2A-4: A Wideband Quasi-Circulator with Low NF and High P_{1dB} Using Noise-Canceling Technique

W. Chen, UESTC; Y. Shu, UESTC; Z. Deng, UESTC; H.J. Qian, UESTC; X. Luo, UESTC

153AB

We2B: Nonlinear Modeling Methods for Novel Microwave Components

Chair: Shahed Reza, Sandia National Laboratories
Co-Chair: Matthias Rudolph, Brandenburgische Technische Universität

10:10 – 10:30

We2B-1: Coupling Electromagnetic Waves to Spin Waves: A Compact Model for Frequency Selective Limiters

H. Cui, University of California, Los Angeles; Z. Yao, University of California, Los Angeles; Y.E. Wang, University of California, Los Angeles

10:30 – 10:50

We2B-2: A Phenomenological Model of Non-Linear Loss in Ferrimagnetic Frequency-Selective Limiters

A. Boryssenko, A&E Partnership; S. Gillette, Metamagnetics; M. Koledintseva, Metamagnetics

10:50 – 11:10

We2B-3: High-Q Anti-Series AlGaN/GaN High Electron-Mobility Varactor

R. Amirpour, Fraunhofer IAF; D. Schwantuschke, Fraunhofer IAF; P. Brückner, Fraunhofer IAF; R. Quay, Fraunhofer IAF; O. Ambacher, Fraunhofer IAF

11:10 – 11:30

We2B-4: Consistent Modelling of I-V and C-V Behaviour of GaN HEMTs in Presence of Trapping

J. Hodges, Macquarie University; D. Schwantuschke, F. van Raay, P. Brückner, R. Quay, Fraunhofer IAF; S. Khandelwal, Macquarie University

11:30 – 11:50

We2B-5: A Multi-Box Behavioural Mixer Model and its Validation Using Measurements

A. Ozgun, METU; T. Nesimoglu, METU; S. Demir, METU

156AB

We2C: 5G Technologies and Evaluation Techniques

Chair: Vittorio Camarchia, Politecnico di Torino
Co-Chair: Debabani Choudhury, Intel

10:10 – 10:30

We2C-1: A 28GHz MMIC Doherty Power Amplifier in GaN on Si Technology for 5G Applications

R. Giofrè, Università di Roma "Tor Vergata"; A. Del Gaudio, Università di Roma "Tor Vergata"; E. Limiti, Università di Roma "Tor Vergata"

10:30 – 10:50

We2C-2: A Spectral Shaper Based Two-Tap RF Self-Interference Canceller for Full-Duplex Radios

R. Palaniappan, IIT Madras; V. Gurumurthy, IIT Madras; S. Aniruddhan, IIT Madras

10:50 – 11:10

We2C-3: A Simultaneous Transmit-Receive Quadrature Balanced RF Front-End with Wideband Digital Self Interference Cancellation

N. Ginzberg, Technion; D. Regev, Toga Networks; G. Tsodik, Toga Networks; S. Shilo, Toga Networks; D. Ezri, Toga Networks; E. Cohen, Technion

11:10 – 11:30

We2C-4: Large-Signal Network Analysis for Over-The-Air Test of Up-Converting and Down-Converting Phased Arrays

A.J. Weiss, D.F. Williams, J. Quimby, R. Leonhardt, NIST; T. Choi, Z. Cheng, USC; K.A. Remley, NIST; A. Molisch, USC; B.F. Jamroz, J.D. Rezac, P. Vouras, NIST; C. Zhang, Samsung

11:30 – 11:50

We2C-5: 1.4-GHz Bandwidth Frequency-Dependent I/Q Imbalance Calibration for 5G mmWave Communications

Y. Aoki, M.T. Dao, K. Min, Y. Hwang, Y. Kim, S.-G. Yang, Samsung

We2C-6: A 28/60GHz Dual-Band Power Amplifier

A.A. Nawaz, Michigan State University; J.D. Albrecht, Michigan State University; A.C. Ulusoy, Michigan State University

157BC

We2D: mm-Wave Building Blocks and Transceivers

Chair: William Deal, Northrop Grumman
Co-Chair: Theodore Reck, Virginia Diodes

10:10 – 10:30

We2D-1: A W-Band Switching Rectifier with 27% Efficiency for Wireless Power Transfer in 65-nm CMOS

P. He, Southeast University; D. Zhao, Southeast University

10:30 – 10:50

We2D-2: A WR-3 Band Distributed Frequency Doubler with a Differential Quasi-Cascode Structure

I. Lee, Korea University; Y. Kim, Korea University; S. Jeon, Korea University

10:50 – 11:10

We2D-3: A 90–98GHz 2×2 Phased-Array Transmitter with High Resolution Phase Control and Digital Gain Compensation

B. Yang, UESTC; H.J. Qian, UESTC; J. Zhou, UESTC; Y. Shu, UESTC; X. Luo, UESTC

11:10 – 11:30

We2D-4: A Highly Linear FMCW Radar Chipset in H-Band with 50GHz Bandwidth

C.M. Grötsch, B. Schoch, Universität Stuttgart; S. Wagner, Fraunhofer IAF; I. Kallfass, Universität Stuttgart

11:30 – 11:50

We2D-5: Highly-Integrated Low-Power 60GHz Multichannel Transceiver for Radar Applications in 28nm CMOS

V. Issakov, R. Ciocoveanu, Infineon Technologies; R. Weigel, FAU Erlangen-Nürnberg; A. Geiselbrechtinger, J. Rimmelspacher, Infineon Technologies

We2D-6: A W-Band Transmitter Channel with 16dBm Output Power and a Receiver Channel with 58.6mW DC Power Consumption Using Heterogeneously Integrated InP HBT and Si CMOS Technologies

A.S.H. Ahmed, A. Simsek, A.A. Farid, UCSB; A.D. Carter, M. Urteaga, Teledyne; M.J.W. Rodwell, UCSB

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

254AB

We2F: Phase Change, Ferroelectric and Ferrite Control Devices

Chair: Thomas Lingel, Anaren
Co-Chair: Amir Mortazawi, University of Michigan

We2F-1: Monolithic PCM Based Miniaturized T-Type RF Switch for Millimeter Wave Redundancy Switch Matrix Applications

T. Singh, University of Waterloo; R.R. Mansour, University of Waterloo

We2F-2: Intrinsically Switchable Miniature Ferroelectric Stacked Crystal Filters

M. Zolfagharloo Koohi, University of Michigan; S. Nam, University of Michigan; A. Mortazawi, University of Michigan

We2F-3: Injection Locked Oscillator Theory for Frequency Selective Limiters

S.N. Stitzer, Northrop Grumman

We2F-4: Increased Power Handling of Vanadium Dioxide T/R Switches Using a Resonant Topology

N.J. Estes, University of Notre Dame; J.D. Chisum, University of Notre Dame

257AB

We2G: Advances in Broadband Transceiver Chips for Radar and Communication Systems

Chair: Rudy Emrick, Northrop Grumman
Co-Chair: Mohamed Abouzahra, MIT Lincoln Laboratory

We2G-1: 30Gb/s 60.2mW 151GHz CMOS Transmitter/Receiver with Digitally Pre-Distorted Current Mode PAM-4 Modulator for Plastic Waveguide and Contactless Communications

Y. Kim, U.S. Naval Research Laboratory; B. Hu, Y. Du, R. Huang, R. Al Hadi, A. Tang, UCLA; H.-N. Chen, C. Jou, TSMC; T. Itoh, M.-C.F. Chang, UCLA

We2G-2: A W-Band FMCW Radar System-on-Chip Employing Synchronized Switching Digitally Controlled Artificial Dielectric for Chirp

A. Tang, Y. Kim, JPL; Y. Zhang, R. Huang, M.-C.F. Chang, UCLA

We2G-3: An S-Band CMOS Mixer-First Single-RF-Port Duplexing FMCW Radar

H.-C. Chou, C.-C. Peng, National Tsing Hua University; Y.-J. Wang, Tron Future Tech; T.-S. Chu, National Tsing Hua University

We2G-4: A Master/Slave 55.5–64.8GHz 4×4 FMCW Radar Transceiver in 130nm SiGe BiCMOS for Massive MIMO Applications

E. Öztürk, Silicon Radar; U. Yodprasit, Silicon Radar; D. Kissinger, Universität Ulm; W. Winkler, Silicon Radar; W. Debski, Silicon Radar

We2G-5: A 205GHz Serial Direct-Sequence Spread Spectrum (DS/SS) Radar System-on-Chip in 28nm CMOS

A. Tang, Jet Propulsion Laboratory; Y. Kim, Jet Propulsion Laboratory; G. Virbila, University of California, Los Angeles; M.-C.F. Chang, University of California, Los Angeles

We2G-6: A 79-GHz Scalable FMCW MIMO Automotive Radar Transceiver Architecture with Injection-Locked Synchronization

A. Mushtaq, Silicon Radar; W. Winkler, Silicon Radar; D. Kissinger, Universität Ulm

259AB

We2H: Wideband GaN Power Amplifiers

Chair: Charles Campbell, Qorvo
Co-Chair: Rüdiger Quay, Fraunhofer IAF

We2H-1: A 2–20GHz Distributed GaN Power Amplifier Using a Novel Biasing Technique

M. Roberg, Qorvo; S. Schafer, Qorvo; O. Marrufo, Qorvo; T. Hon, Qorvo

We2H-2: High-Efficiency Broadband PA Design Based on Continuous Class-F Mode with Compression

S.M.H. Syed Anera, Cardiff University; T. Husseini, Cardiff University; S. Alsahali, Cardiff University; J.J. Bell, Cardiff University; R. Quaglia, Cardiff University; M. Kermalli, Futurewei Technologies; P.J. Tasker, Cardiff University; J. Benedikt, Cardiff University

We2H-3: A 10–3100MHz Nested-Mode Highly Efficient Power Amplifier for Multi-Octave Applications

X. Chen, Tsinghua University; W. Chen, Tsinghua University; Z. Feng, Tsinghua University; F.M. Ghannouchi, University of Calgary

We2H-4: A Novel 1.4–4.8GHz Ultra-Wideband, Over 45% High Efficiency Digitally Assisted Frequency-Periodic Load Modulated Amplifier

Y. Komatsuzaki, Mitsubishi Electric; R. Ma, MERL; M. Benosman, MERL; Y. Nagai, MERL; S. Sakata, Mitsubishi Electric; K. Nakatani, Mitsubishi Electric; S. Shinjo, Mitsubishi Electric

We2H-5: A 2 to 18GHz Compact High-Gain and High-Power GaN Amplifier

H. Wu, Chengdu Ganide Technology; Q. Lin, Qinghai University for Nationalities; L. Zhu, Qinghai University for Nationalities; S. Chen, Qinghai University for Nationalities; Y. Chen, Chengdu Ganide Technology; L. Hu, Chengdu Ganide Technology

10:10
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11:00
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11:50

IMS Panel Session at Lunchtime – See Page 52

INDUSTRY WORKSHOPS

BCEC

10:00 – 17:15 WEDNESDAY, 5 JUNE 2019

Industry workshops cover contemporary topics spanning the state of the art in RF, microwave, and mm-wave areas. These two-hour workshops include in-depth technical presentations from and discussions with experts in the industry. On-site registration is available. Don't miss this opportunity to expand your knowledge and interact with colleagues in these very relevant fields!

SESSION TIME	ROOM #	SESSION TITLE	EVENT COMPANY	SPEAKERS
10:00 – 12:00	152	RF GaN Device Model Survey and Extraction Techniques	Keysight Technologies	Raj Sodhi
	156C	Antenna, Array Design and Prototyping Using MATLAB®	MathWorks, Inc.	Vishwanath Iyer
	157A	Generating & Analyzing 5G NR Signals and it's application towards 3GPP gNB Conformance Testing	Keysight Technologies	Randy Becker
	158	Tackling Emerging Millimeter-Wave Applications Beyond 50 GHz (802.11ay, 5GNR, Aerospace-Defense)	Keysight Technologies	Greg Jue, O. J. Danzy
15:15 – 17:15	152	Leaping from circuits to systems – Chip, package and PCB co analysis methodology for 5G mm-wave front ends	Cadence Design Systems, Inc., Indian Institute of Technology Madras	Ritabrata Bhattacharya, Vikas Aggarwal, Ashish Gupta, Taranjit Kukal, Sankaran Aniruddhan, Jagdish Lohani
	156C	A Framework For Development and Deployment of RF Systems with SoCs	Analog Devices, Inc.	Travis Collins, Robin Getz
	157A	Millimeter-wave Measurement Challenges Workshop	Keysight Technologies	Suren Singh, Steve Crain
	158	Hybrid Beamforming for 5G Systems	MathWorks, Inc., Analog Devices, Inc.	Honglei Chen, Rick Gentile, Chung Wu

IMS PANEL SESSION

ROOM 162AB BCEC

12:00 – 13:15 WEDNESDAY, 5 JUNE 2019

100 Gb/s Wireless Link: How do We Get There and What are the Future Applications?

ORGANIZER: **Omeed Momeni**, *University of California, Davis* and **Ruonan Han**, *MIT*

ABSTRACT:

The ever-growing demand for higher data speed is already driving the wireless communication technology toward the mm-wave and THz spectrum. The move from Radio Frequency (RF) to mm-wave in the upcoming next generation of mobile cellular communication (5G), backhaul, and WiGig systems are the perfect examples. These systems can ideally achieve several Gb/s data rate across tens of meters. In recent years many research works have shown the feasibility of tens of Gb/s data rates over a relatively short range. A few works have gone further to show that 100 Gb/s or even higher is achievable in a wireless link. Would a 100 Gb/s Wireless link be ever used in a product and be able to compete with other alternatives? If so, how do we get there and what are the future applications? What are the necessary conditions to make this a reality? In this panel, we will have expert panelists from a variety of industry and academia backgrounds to share their views on this topic.

PANELISTS: **Ali Niknejad**, *University of California Berkeley*; **Kenichi Okada**, *Tokyo Institue of Technology*; **Tadao Nagatsuma**, *Osaka University*; **Ali Sadri**, *Intel Corp.*; **Herbert Zirath**, *Chalmers University*; **Shahriar Shahramian**, *Nokia Bell Labs*

EXHIBIT ONLY TIME

EXHIBIT HALL BCEC

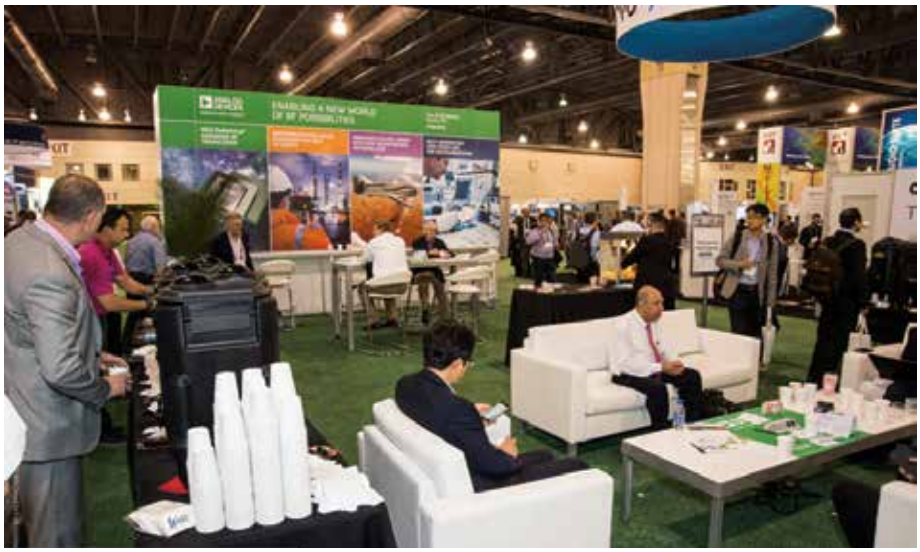
13:30 – 15:30 WEDNESDAY, 5 JUNE 2019

The IMS Microwave Week is a very busy time for all attendees. The events start at 08:00 and frequently conclude after 21:00. There are overlapping workshops, sessions, panels, competitions, and networking events. At the same time, the world's largest microwave exhibition drawing more than 600 exhibitors and displaying the latest innovations, products, and services is happening in the Exhibit Hall on Level 0.

Attendees face a difficult scheduling task, balancing the demands on their time between the exhibition, sessions, networking, and catching up with friends and collaborators. Don't forget the lure of a city like Boston, with historic sites within a couple of miles. What does an attendee do?

"Exhibition Only" time on Wednesday from 13:30 to 15:30 allows attendees to spend two complete hours in the exhibition with no competing technical session. Thus, attendees can use this time to interact with IMS Exhibitors, learn about the latest products and services, establish partnerships, and offer suggestions for product improvements and new products and services. Attendees can also visit Booth 200 to watch Microapps presentations. These 15 minute presentations of application notes target the working engineer or technician.

Please plan on visiting the exhibition during the "Exhibition Only" time and be ready for the Industry-Hosted Reception starting at 17:00. If you can't make it during the "Exhibition Only" time, the Exhibition is open from 09:30 – 17:00 on Tuesday, 09:30 – 18:00 on Wednesday, and 09:30 -15:00 on Thursday.



151AB

We3A: Substrate-Integrated Waveguide Bandpass Filters

Chair: Dimitra Psychogiou, University of Colorado
Co-Chair: Masud Hannan, Intel

15:55 **We3A-1: Dual-Band Bandpass Filter Design with Novel Double-Layer Mixed Coupled SIR/CPW-SIR Resonators**

S. Xu, UESTC; F. Meng, Tianjin University; K. Ma, Tianjin University; K.S. Yeo, SUTD

16:05

16:15 **We3A-2: Compact Quasi-Elliptic and Highly Selective AFSIW Filter with Multilayer Cross-Coupling**

T. Martin, IMS (UMR 5218); A. Ghiotto, IMS (UMR 5218); T.-P. Vuong, IMEP-LAHC (UMR 5130); K. Wu, Polytechnique Montréal; F. Lotz, Cobham Microwave

16:25

16:35 **We3A-3: Mixed-Mode Substrate Integrated Waveguide Bandpass Filter with Controllable Transmission Zeros**

W. Lin, Polytechnique Montréal; T.-H. Lee, Polytechnique Montréal; K. Wu, Polytechnique Montréal

16:45

16:55 **We3A-4: Highly Configurable Cylindrical-Resonator-Based Bandpass Filter Built of Silica-Based Post-Wall Waveguide and its Application to Compact E-Band Hybrid-Coupled Diplexer**

Y. Uemichi, Fujikura; O. Nukaga, Fujikura; X. Han, Fujikura; S. Amakawa, Hiroshima University; N. Guan, Fujikura

17:05

17:15

153AB

We3B: Multi-GHz CMOS Mixed-Signal Circuits and Systems

Chair: Christian Carlowitz, FAU Erlangen-Nürnberg
Co-Chair: Markus Gardill, InnoSenT

We3B-1: A 64-Gb/s 4.2-Vpp Modulator Driver Using Stacked-FET Distributed Amplifier Topology in 65-nm CMOS

T.-J. Chen, National Tsing Hua University; H.-M. Su, National Tsing Hua University; T.-H. Lee, ITRI; S.S.H. Hsu, National Tsing Hua University

We3B-2: A 1-Bit Digital Transmitter System Using a 20-Gbps Quadruple-Cascode Class-D Digital Power Amplifier with 45nm SOI CMOS

S. Hori, NEC; K. Motoi, NEC; T. Soma, NEC; H. Noguchi, NEC; S. Deb, NEC; M. Tanio, NEC; N. Tawa, NEC; T. Kaneko, NEC; K. Kunihiro, NEC

We3B-3: An Inductorless, 0.5mA/15fJ, Small Footprint, SiGe BiCMOS Quasi-Current-Mode Logic Family for Highly Parallelized, 40GHz Clock SAR ADCs

P. Hermansen, University of Toronto; E. Socher, University of Toronto; D. Case, Finisar; A. Cathelin, STMicroelectronics; P. Chevalier, STMicroelectronics; T. Nguyen, Finisar; S.P. Voinigescu, University of Toronto

We3B-4: Dual-Equalization-Path Energy-Area-Efficient Near Field Inductive Coupling for Contactless 3D IC

S. Gopal, Washington State University; M. Chahardori, Washington State University; Md.A. Hoque, Washington State University; S.N. Ali, Washington State University; M.A. Mokri, Washington State University; D. Heo, Washington State University

156AB

We3C: High-Capacity Wireless Communication Systems

Chair: Kenneth Kolodziej, MIT Lincoln Laboratory
Co-Chair: Zaher Bardi, Retired

We3C-1: Demonstration of a 40Gbps Bi-Directional Air-to-Ground Millimeter Wave Communication Link

Q. Tang, A. Tiwari, I. del Portillo, M. Reed, H. Zhou, D. Shmueli, Facebook; G. Ristroph, IJK Controls; S. Cashion, D. Zhang, J. Stewart, P. Bondalapati, Q. Qu, Y. Yan, B. Proctor, H. Hemmati, Facebook

We3C-2: 16,384-QAM Microwave Link with 53% Linearized-Transmitter Efficiency, 2.5 Watt Peak Power, and On-Air EVM Below 1%

E. McCune, Eridan Communications

We3C-3: Evaluation of Distributed MIMO Communication Using a Low-Complexity Sigma-Delta-over-Fiber Testbed

I.C. Sezgin, Chalmers University of Technology; T. Eriksson, Chalmers University of Technology; J. Gustavsson, Chalmers University of Technology; C. Fager, Chalmers University of Technology

We3C-4: A Low-Cost Electronic Scanning Antenna with Two-Wave Mixing

R. Zhu, Axend; Q. Xu, Axend; G. Liu, Axend; Q. Duan, Axend; Y. Li, Axend; Y.E. Wang, University of California, Los Angeles

157BC

We3D: Microwave-through-THz Photonics Devices and Systems

Chair: Jeffrey Nanzer, Michigan State University
Co-Chair: Mona Jarrahi, University of California, Los Angeles

We3D-1: 300-GHz-Band Wireless Communication Using Fermi-Level Managed Barrier Diode Receiver

T. Nagatsuma, Osaka University; M. Sonoda, Osaka University; T. Higashimoto, Osaka University; R. Kimura, Osaka University; L. Yi, Osaka University; H. Ito, Kitasato University

We3D-2: Broadband Photoconductive Terahertz Detection with a 100dB Dynamic Range without Using a Short-Carrier-Lifetime Substrate

N.T. Yardimci, University of California, Los Angeles; D. Turan, University of California, Los Angeles; S. Cakmakyapan, University of California, Los Angeles; M. Jarrahi, University of California, Los Angeles

We3D-3: High-Power Terahertz Generation from Bias-Free, Telecommunication-Compatible Photoconductive Nanoantennas

D. Turan, University of California, Los Angeles; N.T. Yardimci, University of California, Los Angeles; M. Jarrahi, University of California, Los Angeles

We3D-4: A 1 to 20GHz Silicon-Germanium Low-Noise Distributed Driver for RF Silicon Photonic Mach-Zehnder Modulators

N. Hosseinzadeh, A. Jain, K. Ning, R. Helkey, J.F. Buckwalter, University of California, Santa Barbara

We3D-5: Broadband Simultaneous Transmit and Receive from a Single Antenna Using Improved Photonic Architecture

E.I. Ackerman, C.H. Cox III, H.V. Roussell, Photonic Systems; P.S. Devgan, Air Force Research Laboratory

254AB

We3F: Advanced MEMS Component Technologies, Characterization Techniques and Packaging

Chair: Songbin Gong, University of Illinois at Urbana-Champaign
Co-Chair: Matthew Morton, Raytheon

We3F-1: Highly Integrated RF-MEMS Multi-Frequency Oscillator on a Silicon-Ceramic Composite Substrate

J. Stegner, Technische Universität Ilmenau; M. Fischer, Technische Universität Ilmenau; S. Gropp, Technische Universität Ilmenau; U. Stehr, Technische Universität Ilmenau; J. Müller, Technische Universität Ilmenau; M. Hoffmann, Technische Universität Ilmenau; M.A. Hein, Technische Universität Ilmenau

We3F-2: Single Crystalline ScAlN Surface Acoustic Wave Resonators with Large Figure of Merit ($Q \times k_t^2$)

Z. Hao, Georgia Tech; M. Park, Georgia Tech; D.G. Kim, Georgia Tech; A. Clark, IQE; R. Dargis, IQE; H. Zhu, SCUT; A. Ansari, Georgia Tech

We3F-3: Monolithically Integrated Reconfigurable RF MEMS Based Impedance Tuner on SOI Substrate

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

We3F-4: Linearity and RF Power Handling of Capacitive RF MEMS Switches

D. Molinero, Wispry; S. Aghaei, Wispry; A. Morris, Wispry; S. Cunningham, Wispry

257AB

We3G: Recent Advances in Non-Destructive Microwave Near-Field Sensing

Chair: Xun Gong, University of Central Florida
Co-Chair: Venkata Chivukula, Qualcomm

We3G-1: A Silicon Based 4.5-GHz Near-Field Capacitive Sensing Imaging Array

J. Zhou, University of California, Los Angeles; R. Al Hadi, University of California, Los Angeles; W. Qiao, University of California, Los Angeles; Y. Zhao, University of California, Los Angeles; C. Chen, University of California, Los Angeles; M. Kaynak, IHP; X. Cheng, Lehigh University; J.C.M. Hwang, Lehigh University; M.-C.F. Chang, University of California, Los Angeles

We3G-2: A CMOS Time Domain Microwave Broadband Dielectric Spectroscopy System with a Contact-Less Sensor for Liquid Chemical Detection

E. Kaya, Texas A&M University; A. Pourghorban Saghati, Texas A&M University; K. Entesari, Texas A&M University

We3G-3: Open Complementary Split-Ring Resonator for Eye Tracking

C.-S. Lee, Dalian University of Technology; B. Bai, Dalian University of Technology; Q. Song, Dalian University of Technology

We3G-4: Smart Clamp-Type Microwave Sensor for Accidental Leak Detection from Pipe Joints

M.A. Karimi, KAUST; A. Shamim, KAUST

15:55
16:05
16:15
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16:45
16:55
17:05
17:15

WIM Networking Event 19:00 – 21:00 – page 57
MTT-S Awards Banquet 18:30 – 21:30 – page 58

ROOM 253ABC BCEC

IMS INTERACTIVE FORUM

15:55 – 17:15 WEDNESDAY, 5 JUNE 2019

WeIF2 | IN HONOR OF LARRY WHICKER

CHAIR: NESTOR LOPEZ, *MIT LINCOLN LABORATORY* | **CO-CHAIR:** EKATERINA KONONOV, *MIT LINCOLN LABORATORY*

WeIF2-1: X-Band MMIC Balanced Frequency Doubler Based on Graphene Diodes

A. Hamed, M. Saeed, RWTH Aachen University; Z. Wang, M. Shaygan, D. Neumaier, AMO; R. Negra, RWTH Aachen University

WeIF2-2: Borrowing from Microwave Holography a Technique for Broad-Band Nano Imaging at Infrared Wavelengths

A. Di Donato, D. Mencarelli, L. Pierantoni, A. Morini, M. Farina, Università Politecnica delle Marche

WeIF2-3: Nano-Scale Electronics: Rigorous Quantum Study of a Single Molecule Device

D. Mencarelli, L. Pierantoni, Università Politecnica delle Marche

WeIF2-4: Estimation of Parameter Variability for High Dimensional Microwave Problems via Partial Least Squares

M. Larbi, Georgia Tech; H.M. Torun, Georgia Tech; M. Swaminathan, Georgia Tech

WeIF2-5: Design of 24GHz High-Linear High-Gain Low-Noise Amplifiers Using Neutralization Techniques

Y. Ding, S. Vehring, G. Boeck, Technische Universität Berlin

WeIF2-6: Coupling-Induced Hysteresis in Free-Running Oscillators

A. Suárez, Universidad de Cantabria; R. Melville, Emecon; F. Ramírez, Universidad de Cantabria

WeIF2-7: Nonlinear Distortion Suppression of Cooperative Jamming System for Secure Wireless Communication

C. Li, UESTC; W. Guo, UESTC; X. Quan, UESTC; Q. Xu, UESTC; Y. Liu, UESTC; Y. Shen, UESTC; H. Zhao, UESTC; Y. Tang, UESTC

WeIF2-8: A Josephson Traveling Wave Parametric Amplifier for Quantum Coherent Signal Processing

M. Haider, J.A. Russer, J. Abundis Patino, C. Jirauschek, P. Russer, Technische Universität München

WeIF2-9: A 40-GHz High Linearity Transmitter in 65-nm CMOS Technology with 32-dBm OIP3

T.-Y. Kuo, Y.-T. Lin, C.-N. Chen, H. Wang, National Taiwan University

WeIF2-10: The Impact of Layout Dependent Intrinsic Parasitic RLC on High Frequency Performance in 3T and 4T Multi-Finger nMOSFETs

J.-C. Guo, J.-R. Ou, J.-M. Lin, National Chiao Tung University

WeIF2-11: A Low Phase Noise Differential Oscillator Employing Stub-Loaded Nested Split-Ring Resonator Inspired Balanced Bandpass Filter

Z. Cai, UESTC; X. Tang, UESTC; Z. Li, UESTC; T. Zhang, UESTC; Y. Liu, UESTC; Y. Yang, UTS

WeIF2-12: Monolithically Integrated Parametric Mixers with Time-Varying Transmission Lines (TVTL)

X. Zou, Q. Wu, Y.E. Wang, University of California, Los Angeles

WeIF2-13: A Novel VHF Heating System to Aid Selective Laser Melting

N. Parker, S. Hefford, J. Lees, S. Cripps, A. Porch, Cardiff University

WeIF2-14: Dual Gate and Drain Supply Modulation of an X-Band PA

M.R. Duffy, G. Lasser, T. Cappello, Z. Popović, University of Colorado Boulder

WeIF2-15: Impedance Sensing Integrated Directly into a Power Amplifier Output Matching Network

D. Donahue, P. de Falco, T.W. Barton, University of Colorado Boulder

WeIF2-16: Beam-Oriented Digital Predistortion for Hybrid Beamforming Array Utilizing Over-The-Air Diversity Feedbacks

X. Liu, W. Chen, L. Chen, Z. Feng, Tsinghua University

WeIF2-17: Spatial Power Combiner Using Cavity Modes in W-Band

J. Velazco, L. Samoska, M. Taylor, A. Pereira, A. Fung, R. Lin, A. Peralta, Jet Propulsion Laboratory

WeIF2-18: Linearization of a Multi-Band Multi-Target Directional Modulation Transmitter Using Low-Complexity Crosstalk-Cancelled Digital Predistortion

L. Chen, W. Chen, Tsinghua University; Y. Liu, CAEP; X. Liu, Z. Feng, Tsinghua University

WeIF2-19: High Gain Fully-Integrated Broadband Differential LNAs in 0.15-µm GaAs pHEMT Process Using R-L-C Feedback Gain Compensation for Radio Astronomical Receiver

Z.-Y. Jiang, Y. Chang, Y. Wang, National Taiwan University; C.-C. Chiong, Academia Sinica; H. Wang, National Taiwan University

WeIF2-20: Low-Noise and Small-Sized Receiver Frontend with Unified Circuit-Antenna Integration

S.N. Nallandhigal, Polytechnique Montréal; K. Wu, Polytechnique Montréal

WeIF2-21: Highly Robust 130nm SiGe BiCMOS Power Limiter, LNA and Mixer IC for a Wideband 1.5–18GHz MIMO Radar Receiver

M. Sakalas, N. Joram, F. Ellinger, Technische Universität Dresden

WeIF2-22: Highly Linear 90–170GHz SPDT Switch with High Isolation for Fully Integrated InP Transceivers

T. Shivan, FBH; M. Hossain, FBH; R. Doerner, FBH; S. Schulz, FBH; T.K. Johansen, Technical University of Denmark; S. Boppel, FBH; W. Heinrich, FBH; V. Krozer, FBH

WeIF2-23: A 10-GHz Code-Modulated Interferometric Imager Using Commercial-Off-The-Shelf Phased Arrays

V. Chauhan, S. Schönherr, Z. Hong, B. Floyd, North Carolina State University

WeIF2-24: Novel Synthesis Technique of Mixed-Topology Extracted-Pole Resonators with Parallel-Connected Structures for Ladder-Type Acoustic Filters

Á. Triano, J. Verdú, P. de Paco, Universitat Autònoma de Barcelona

MICROAPPS THEATER BOOTH #200 BCEC

THE NEXT TOP STARTUP PITCH EVENT COMPETITION

16:30 – 18:00 WEDNESDAY, 5 JUNE 2019

"The Next Top Startup" will be held in the MicroApps Theater on the IMS Exhibition Floor. This pitch event is where small companies, students, and creative individuals can pitch their ideas to a panel of judges for prizes and fame in front of the audience. The judges are from all areas of the startup ecosystem, including investment firms, tech startup incubators, and experts in RF technologies. The judges will provide valuable feedback from their wealth of experience, and the participants will get the opportunity to show off their products and ideas to IMS Exhibition attendees. The startups will compete for various prizes and the title of "Best Startup of IMS2019."

"THE NEXT TOP STARTUP" PITCHING EVENT JUDGES:

Jacques Benkoski, Partner, *U.S. Venture Partners*;
Craig Mullet, President, *Branison Group*;
Cliff Hirsch, Founder, *Pinestream Communications*

Jacques Benkoski

Craig Mullet

Cliff Hirsch

WOMEN IN MICROWAVES
PANEL SESSION

ROOM 162AB BCEC

16:00 – 17:00 WEDNESDAY, 5 JUNE 2019

Challenges Still Facing Women in Microwaves and How You Can Help.

MODERATOR: **Karen Field**, Executive Director, Content for the Infrastructure Intelligence Group at *Informa*, overseeing the brands Electronic Design and Microwaves and RF

ABSTRACT:

Because we can all make a difference in building a better future for ourselves and each other, this year's WiM panel will focus on the topic of "Challenges Still Facing Women in Microwaves and How You Can Help". The panel consists of exceptional women who work in different aspects of STEM who have made their mark in the field, and continue to inspire and mentor those around them.

The discussion will fearlessly and honestly address the reasons we still need a special event like this despite the progress that has been made for equality. Breaking down barriers that systemically limit and disproportionately affect women can only improve the future of the field of Microwaves.

We hope all IMS attendees, including men, women, and students attend this panel session and participate in a spirited and informative discussion that will inspire everyone to take the messages and lessons into their lives and make an even brighter future for all those who work in STEM.

PANELISTS: **Amy Duwel**, Ph.D., Director of Materials and Devices, *Draper*; **Dr. Ellen Ferraro**, Chief Engineer for Integrated Communication Systems (ICS), *Raytheon;* **Rashaunda Henderson**, Ph.D., Associate Professor of Electrical Engineering, *University of Texas at Dallas;* **Yasmine King**, Global Account Manager, *Analog Devices*; **Suja Ramnath**, President and CEO, *Integra Technologies*

Amy Duwel, Ph.D.

Dr. Ellen Ferraro

Rahaunda Henderson, Ph.D.

Yasmine King

Suja Ramnath

Karen Field

WOMEN IN MICROWAVES
NETWORKING EVENT

ENVOY HOTEL 70 SLEEPER ST., BOSTON 02127

19:00 – 21:00 WEDNESDAY, 5 JUNE 2019

After the Panel Session, join us at the beautiful Envoy Rooftop Bar to unwind over food and beverages. Men are welcome and encouraged to attend! Just be sure to wear a button showing your support for Women in Microwaves. The free buttons can be found at the Welcome Booth, Help Desk Booth, and will be given out at the Panel Session.

This is a great opportunity for attendees to connect with our WiM speakers and network with people supportive of women in the RF and microwave industry. Join the discussion and see how women in the field have made a difference despite unique obstacles and get ideas about how you can help.

We look forward to seeing you there!

Women in Microwaves
Reception Media Sponsor:

Microwaves&RF®

WESTIN BOSTON WATERFRONT **GRAND BALLROOM**

MTT-S AWARDS BANQUET **18:30 – 21:30** WEDNESDAY, 5 JUNE 2019

Join us for an entertaining evening celebrating our technology and our people. Boston has a long history of being at the hub of innovation, and we are excited to have Dr. Ryan Chin, CEO and co-founder of the fast growing driverless vehicle start-up, Optimus Ride, as our banquet speaker. Our banquet special musical performer will be the talented, popular-music violist, Jeremy Green. The evening will culminate with the presentation of the prestigious 2019 MTT society awards.

KEYNOTE

Optimus Ride: The Fastest Path to Fully Driverless Mobility Systems

Ryan Chin, Ph.D., Co-founder and CEO, *Optimus Ride Inc.*

ABSTRACT: Self-driving vehicles are the key 21st century disruptive technology that can transform every aspect of mobility in our cities and communities. This talk will present the capabilities and limitations of the self-driving vehicles to date and discuss Optimus Ride's unique approach to deploying commercially viable fully driverless autonomous systems.

Dr. Ryan C.C. Chin is the CEO and Co-founder of Optimus Ride Inc. — an MIT spinoff company based in Boston, MA that develops self-driving technologies that enable safe, sustainable, and equitable mobility access.

Dr. Chin is a leading expert in the area of Smart Cities and urban mobility systems. He was the Managing Director of the City Science Initiative at the MIT Media Lab (2012-2015) where innovative research was conducted on urban housing, transport, energy, and big data analytics. He researched Autonomous Mobility-on-Demand (MoD) Systems – a network of selfdriving, shared-use, electric vehicles (EVs). He developed EVs including the GreenWheel, RoboScooter, Persuasive Electric Vehicle, and the CityCar – a foldable, electric, two-person vehicle. Time Magazine named the CityCar the "Automotive Invention of the Year" in 2007. His research led to the MIT Press publication of Reinventing the Automobile: Personal Urban Mobility for the 21st Century by Mitchell, Borroni-Bird, and Burns in 2010.

Dr. Chin advises industry and government agencies on Smart Cities innovations. He was a member of the White House PCAST's (President's Council of Advisors on Science and Technology) working group in 2015 on "Technology and the Future of Cities." His MIT Professional Education course "Beyond Smart Cities" attracted global participants from corporate, public, and educational sectors. He frequently travels as a speaker at conferences like TEDx, MIT EmTech, and Smart City Expo. His op-ed articles have been featured in publications like the Guardian and BBC. His work has been exhibited at the Cooper Hewitt, Venice Biennale, and London Science Museum. Dr. Chin won the $100K Buckminster Fuller Challenge (2009) and Esquire Magazine named him as one of the "Best and Brightest Innovators" under the age of 35 (2006). He received at MIT his PhD (2012) and MS (2004) in Media Arts and Sciences and a MArch (2000) in Architecture. He earned both his BCE and BSArch from the Catholic University of America (1997).

AWARDS

The MTT-S Awards Banquet program includes dinner, entertainment, and technical and service awards presented by the MTT-S Awards Committee.

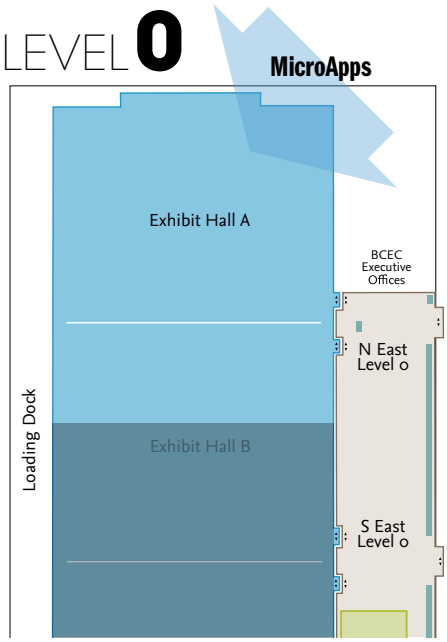
MTT-S AWARD	2018 AWARD RECIPIENT AND DESCRIPTION
Microwave Career Award	**James C. Rautio** for a career of leadership, meritorious achievement, creativity and outstanding contributions in the field of microwave theory and techniques.
Distinguished Service Award	**Wayne A. Shiroma** in recognition of a distinguished record of service to the IEEE MTT society and the microwave profession over a sustained period of time.
Distinguished Educator Award	**Amir Mortazawi** for outstanding achievements as an educator, mentor, and role model of microwave engineers and engineering students
Microwave Pioneer Award	**Frederick H. Raab** in recognition of pioneering contributions to the theory, development, and practical use of high efficiency power amplifiers
Microwave Application Award	**Martin Vossiek** for original and innovative research in wireless local positioning systems and for fostering the translating of these innovations into successful business in industrial automation and logistics
Outstanding Young Engineer Award	**Vadim Issakov** for outstanding early career contributions in the field of microwave and millimeter-wave integrated circuits and measurement. **Harish Krishnaswamy** for outstanding early career leadership and contributions in the field of millimeter-wave packaging and passive device characterization. **Jeffrey Nanzer** for outstanding early career contributions in distributed phased arrays and mm-wave photonic wireless systems. **Etienne Perret** for outstanding early career contributions to chipless RF identification of objects in an unknown environment.
N.W. Cox Award Recognizes	**Rhonda Franklin** for exemplary service to the Society in a spirit of selfless dedication and cooperation.

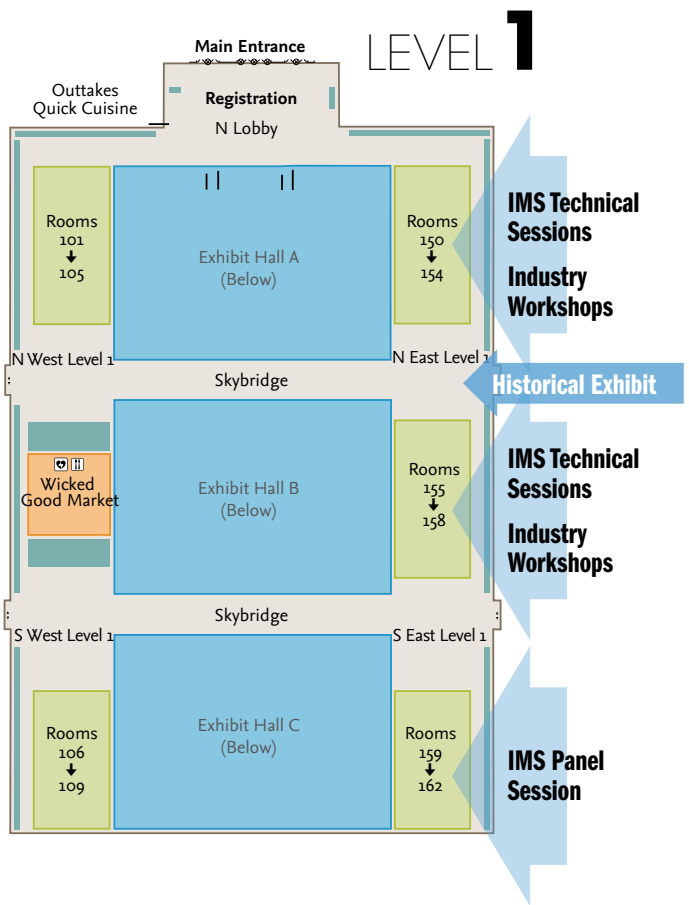
MTT-SOCIETY BEST PAPER AWARDS	
Microwave Prize	**Jaber Moghaddasi**, **Tarek Djerafi**, and **Ke Wu** | This award recognizes, on an annual basis, the most significant contribution by a published paper to the field of interest of the MTT-S. The Microwave Prize is the Society's oldest Award.
IEEE Microwave and Wireless Components Letters "Tatsuo Itoh" Award	**Abbas Semnani, Mohammad Abu Khater, Yu-Chen Wu, and Dimitrios Peroulis** | This award recognizes, on an annual basis, the most significant contribution in a paper published in the *IEEE Microwave and Wireless Component. Letters*.
IEEE Transactions on Terahertz Science & Technology Best Paper Award	**M. I. B. Shams; Z. Jiang; S. M. Rahman; L. Cheng; J. L. Hesler; P. Fay; L. Liu** | This award recognizes, on an annual basis, the most significant contribution in a paper published in the *IEEE Transactions on Terahertz Science and Technology.*
IEEE Microwave Magazine Best Paper Award	**Thomas Zwick, Florian Boes, Benjamin Göttel, Akanksha Bhutani, and Mario Pauli** | This award recognizes, on an annual basis, the most significant contribution in a paper published in the IEEE Microwave Magazine.

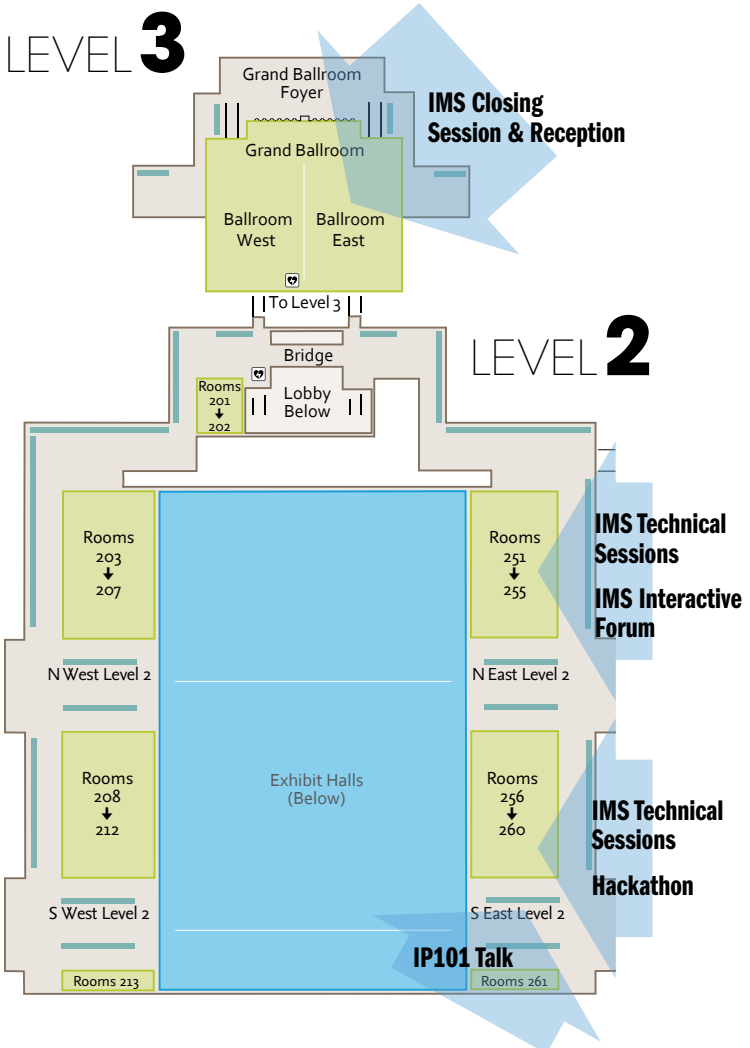
CONFERENCE HIGHLIGHTS

THURSDAY

EVENT	TIME
IMS Technical Sessions	08:00 – 14:50
MicroApps	09:45 – 15:00
Industry Workshops	10:00 – 15:00
Hackathon	10:30 – 12:00
IMS Panel Session	12:00 – 13:15
IP101 Talk	13:00 – 14:00
IMS Interactive Forum	13:30 – 15:10
IMS Closing Session & Reception	15:30 – 18:00







151AB

Th1A: Planar Multi-Band Filter Synthesis and Design

Chair: Sanghoon Shin, U.S. Naval Research Laboratory
Co-Chair: Laya Mohammadi, Qualcomm

Th1A-1: High Selectivity In-Line Topology Dual-Band Filters Based on Direct Synthesis Approach

Y. He, Yokohama National University; Z. Ma, Saitama University; N. Yoshikawa, Yokohama National University

Th1A-2: Multi-Band Differential Bandpass Filters with Quasi-Elliptic-Type Passbands and Multi-Transmission Zero Common-Mode Suppression

D. Simpson, University of Colorado Boulder; D. Psychogiou, University of Colorado Boulder

Th1A-3: Input-Reflectionless Negative-Group-Delay Bandstop-Filter Networks Based on Lossy Complementary Duplexers

R. Gómez-García, Universidad de Alcalá; J.-M. Muñoz-Ferreras, Universidad de Alcalá; W. Feng, NJUST; D. Psychogiou, University of Colorado Boulder

Th1A-4: EM-Based Design Approach for Multiband Filters by Reflected Group Delay Method and Cascade Space Mapping

X. Fan, S. Li, P.D. Laforge, University of Regina; Q.S. Cheng, SUSTC

Th1A-5: Miniaturized Substrate Integrated Waveguide Filters with Stepped-Impedance Slot Resonators for Millimeter-Wave Application

Z. Wang, UESTC; Y. Dong, UESTC

153AB

Th1B: Recent Advances in Packaging, Interconnects and Multi-Chip Modules

Chair: Kamal Samanta, Sony
Co-Chair: Telesphor Kamgaing, Intel

Th1B-1: An Improved High-Power X-Band 4×4 Tile-Type LTCC T/R Module Based on Liquid Cooling Micro-Channels

Z. Wang, UESTC; J. Xiao, UESTC; J. Huang, UESTC; H. Yin, UESTC; Y. Yang, UESTC; B. Yan, UESTC; B. Zhao, CETC 54

Th1B-2: Microcoaxial Interconnects for Signals, Bias, and Supply of MMICs

D. Torres, Draper; A. Kopa, Draper; M. Meinhold, Draper; P. Lewis, Draper; J. Delisio, Draper; C. Gray, Draper

Th1B-3: A D-Band Rectangular Waveguide-to-Coplanar Waveguide Transition Using Metal Ridge

Y. Dong, T V. Zhurbenko, P.J. Hanberg, T.K. Johansen, Technical University of Denmark

Th1B-4: Free Space Vertical Interconnects Using Near Field Coupling Antennas in a Fabry-Perot Cavity Environment

A. Dave, University of Minnesota; R. Franklin, University of Minnesota

Th1B-5: A Novel e-Textile Integrated Wideband Monopole Antenna for Body-Worn Energy Harvesting Systems

Y. Jiang, T. Leng, Y. Fang, L. Xu, K. Pan, Z. Hu, University of Manchester

156AB

Th1C: Active Phased Arrays Systems

Chair: Julio Navarro, Boeing
Co-Chair: Glenn Hopkins, Georgia Tech

Th1C-1: Monolithically Fabricated 4096-Element, PolyStrata Broadband D-Band Array Demonstrator

J.W. Jordan, S. Lynch, M. Clark, B.L. Cannon, L.A. Adames, D. Wrenn, K. Jackson, N. Erickson, J. Clough, D. Brown, J.-M. Rollin, Nuvotronics; P. Lopez, P. Boutet, M. Moretto, Nokia

Th1C-2: A Scalable Circularly-Polarized 256-Element Ka-Band Phased-Array SATCOM Transmitter with ±60° Beam Scanning and 34.5dBW EIRP

K.K.W. Low, A. Nafe, University of California, San Diego; S. Zihir, IDT; T. Kanar, IDT; G.M. Rebeiz, University of California, San Diego

Th1C-3: A Scalable 60GHz Tx/Rx 2×64-Element Dual-Polarized Dual-Beam Wafer-Scale Phased-Array with Integrated Dual-Transceivers

U. Kodak, B. Rupakula, UCSD; S. Zihir, IDT; G.M. Rebeiz, UCSD

Th1C-4: A 128-Element 54–63GHz 2-Dimensional Tx/Rx Phased-Array with 64-QAM/30Gbps Communication Links

B. Rupakula, University of California, San Diego; S. Zihir, IDT; G.M. Rebeiz, University of California, San Diego

Th1C-5: A Modular Architecture for Wide Scan Angle Phased Array Antenna for K/Ka Mobile SATCOM

W.M. Abdel-Wahab, H. Al-Saedi, E. Haj Mirza Alian, M. Raeis-Zadeh, A. Ehsandar, A. Palizban, N. Ghafarian, G. Chen, University of Waterloo; H. Gharaee, ICT Research Institute; M.R. Nezhad-Ahmadi, S. Safavi-Naeini, University of Waterloo

157BC

Th1D: Innovative Systems and Applications

Chair: Kavita Goverdhanam, US Army CERDEC
Co-Chair: Rui Ma, Mitsubishi Electric

Th1D-1: Sensitive Spectroscopy Using DSRR Array and Linvill Negative Impedance

M. Abdolrazzaghi, University of Alberta; N. Kazemi, University of Alberta; M. Daneshmand, University of Alberta

Th1D-2: A Bidirectional 36Gbps Connectorless Connector at 2–4cm Using a 28GHz 2×2 Phased-Array with Position-Offset Compensation

Y. Yin, B. Ustundag, K. Kibaroglu, M. Sayginer, G.M. Rebeiz, University of California, San Diego

Th1D-5: Multi-Functional Composite RF Four-Way Switch

G. Beziuk, Rmit University; T.C. Baum, DST Group; K. Ghorbani, Rmit University; K.J. Nicholson, DST Group

Th1D-6: Leakage Phase Noise Mitigation for Monostatic FMCW Radar Sensors Using Carrier Transmission

A. Dürr, B. Schweizer, C. Waldschmidt, Universität Ulm

Th1D-7: A Novel Physical Layer Security Technique Using Master-Slave Full Duplex Communication

N. Ebrahimi, B. Yektakhah, K. Sarabandi, H.S. Kim, D. Wentzloff, D. Blaauw, University of Michigan

08:00
08:10
08:20
08:30
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09:40

THURSDAY

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

252AB

Th1E: Nanoscale Devices for RF to THz Applications

Chair: Luca Pierantoni, Universita Politecnica delle Marche
Co-Chair: Dimitris Pavlidis, Florida International University

Th1E-1: Magnetic Nanowires for RF Applications: Ferromagnetic Resonance and Permeability Characterization

Y. Zhang, University of Minnesota; J. Um, University of Minnesota; W. Zhou, University of Minnesota; B. Stadler, University of Minnesota; R. Franklin, University of Minnesota

Th1E-2: Black Phosphorus MOSFET for Future-Generation Thin-Film Electronics Capable of Microwave Operation

K. Xiong, Lehigh Univ.; C. Li, Yale Univ.; L. Li, Lehigh Univ.; Q. Guo, Yale Univ.; K. Watanabe, T. Taniguchi, NIMS; A. Madjar, Lehigh Univ.; F. Xia, Yale Univ.; J.C.M. Hwang, Lehigh Univ.

Th1E-3: On-Wafer Graphene Devices for THz Applications Using a High-Yield Fabrication Process

P.C. Theofanopoulos, G.C. Trichopoulos, Arizona State University

Th1E-4: Exploiting Graphene Quantum Capacitance in Subharmonic Parametric Downconversion

M. Saeed, E. Heidebrecht, A. Hamed, R. Negra, RWTH Aachen University

Th1E-5: Inverted Scanning Microwave Microscopy for Nanometer-Scale Imaging and Characterization of Platinum Diselenide

G. Fabi, UNIVPM; X. Jin, J.C.M. Hwang, Lehigh Univ.; C.H. Joseph, E. Pavoni, UNIVPM; L. Li, K. Xiong, Y. Ning, Lehigh Univ.; D. Mencarelli, A. Di Donato, A. Morini, Y. Zhao, R. Al Hadi, Alcatera; M. Farina, UNIVPM

Th1E-6: Compact BandStop Filter Utilizing Low Cost Solution Cast Nanomagnetic Thin Films

Y. He, MSU; E. Drew, Z.J. Zhang, Georgia Tech; T. Hogan, MSU; J. Papapolymerou, MSU

254AB

Th1F: Emerging mm-Wave Transistor Technologies for 5G and DoD Applications

Chair: Jeong-sun Moon, HRL Laboratories
Co-Chair: Joe Qiu, U.S. Army Research Office

Th1F-1: Broadband, Linear, and High-Efficiency mm-Wave PAs in Silicon — Overcoming Device Limitations by Architecture/Circuit Innovations

H. Wang, Georgia Tech; F. Wang, Georgia Tech; T.-W. Li, Georgia Tech; H.T. Nguyen, Georgia Tech; S. Li, Georgia Tech; T.-Y. Huang, Georgia Tech

Th1F-2: Recent Developments on SiGe BiCMOS Technologies for mm-Wave and THz Applications

M. Wietstruck, IHP; S. Marschmeyer, IHP; S. Schulze, IHP; S. Tolunay Wipf, IHP; C. Wipf, IHP; M. Kaynak, IHP

Th1F-3: Novel High-Speed Linear GaN Technology with High Efficiency

J.-S. Moon, J. Wong, B. Grabar, M. Antcliffe, P. Chen, HRL Laboratories; E. Arkun, I. Khalaf, A. Corrion, T. Post, HRL Laboratories

Th1F-4: GaN-Based Multi-Channel Transistors with Lateral Gate for Linear and Efficient Millimeter-Wave Power Amplifiers

K. Shinohara, C. King, E.J. Regan, J. Bergman, A.D. Carter, A. Arias, M. Urteaga, B. Brar, Teledyne Scientific & Imaging; R. Page, Cornell University; R. Chaudhuri, M. Islam, H. Xing, D. Jena, Cornell University

Th1F-5: High Power Density ScAlN-Based Heterostructure FETs for mm-Wave Applications

T.E. Kazior, Raytheon; E.M. Chumbes, Raytheon; B. Schultz, Raytheon; J. Logan, Raytheon; D.J. Meyer, U.S. Naval Research Laboratory; M.T. Hardy, U.S. Naval Research Laboratory

257AB

Th1G: Design and Characterization of Wireless Power Transfer Systems

Chair: Paolo Mezzanotte, Università di Perugia
Co-Chair: Shigeo Kawasaki, JAXA

Th1G-1: Experimenting Waveforms and Efficiency in RF Power Transfer

N. Ayir, Tampere University; M.F. Trujillo Fierro, Tampere University; T. Riihonen, Tampere University; M. Allén, Tampere University

Th1G-2: Smart Wireless Sensor System by Microwave Powering for Space-by-Wireless

D. Kobuchi, University of Tokyo; K. Matsuura, University of Tokyo; Y. Narusue, University of Tokyo; S. Yoshida, Kagoshima University; K. Nishikawa, Kagoshima University; S. Kawasaki, JAXA

Th1G-3: Low-Power Receiver Architecture for 5G and IoT-Oriented Wireless Information and Power Transfer Applications

I. Hussain, Polytechnique Montréal; K. Wu, Polytechnique Montréal

Th1G-4: Estimation of Required Transmit Power to Realize Zero Maintenance Sensor System with Space Time Beam Forming Algorithm

G. Pabbisetty, Toshiba; K. Murata, Toshiba; K. Taniguchi, Toshiba; H. Mori, Toshiba

Th1G-5: Log-Spiral Antenna Integrated with GaAsSb-Base Backward Diodes for Microwave Energy Harvesting

M. Sato, Fujitsu; K. Kawaguchi, Fujitsu; T. Takahashi, Fujitsu; N. Okamoto, Fujitsu; T. Kurosawa, Tokyo Metropolitan University; X. Liu, Tokyo Metropolitan University; S. Yamashita, Tokyo Metropolitan University; M. Suhara, Tokyo Metropolitan University

259AB

Th1H: PA Design Techniques and Baseband Terminations

Chair: Gayle Collins, Obsidian Microwave
Co-Chair: John Wood, Wolfspeed

Th1H-1: Current Mode Outphasing Power Amplifier

L.C. Nunes, Universidade de Aveiro; F.M. Barradas, Universidade de Aveiro; D.R. Barros, Universidade de Aveiro; P.M. Cabral, Universidade de Aveiro; J.C. Pedro, Universidade de Aveiro

Th1H-2: Comprehensive Analysis of Input Waveform Shaping for Efficiency Enhancement in Class B Power Amplifiers

S.K. Dhar, University of Calgary; T. Sharma, Princeton University; N. Zhu, NXP Semiconductors; D.G. Holmes, NXP Semiconductors; R. Darraji, University of Calgary; F.M. Ghannouchi, University of Calgary

Th1H-3: Analysis of the Baseband Termination of High Power RF Transistors

H. Ladhani, NXP Semiconductors; J.K. Jones, NXP Semiconductors; J.S. Kenney, Georgia Tech

Th1H-4: Impact of the Input Baseband Impedance on the Instantaneous Bandwidth of Wideband Power Amplifiers

D.R. Barros, Universidade de Aveiro; L.C. Nunes, Universidade de Aveiro; P.M. Cabral, Universidade de Aveiro; J.C. Pedro, Universidade de Aveiro

Th1H-5: Compact High-Efficiency High-Power Wideband GaN Amplifier Supporting 395MHz Instantaneous Bandwidth

N. Zhu, NXP Semiconductors; R. McLaren, NXP Semiconductors; J.S. Roberts, NXP Semiconductors; D.G. Holmes, NXP Semiconductors; M. Masood, NXP Semiconductors; J.K. Jones, NXP Semiconductors

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Coffee / Snacks 09:30 – 10:30 | Exhibit Show Floor

MICROAPPS SCHEDULE

MICROAPPS THEATER, BOOTH #200 BCEC

09:45 – 15:00 THURSDAY, 6 JUNE 2019

MicroApps offers a wicked lot of information in 15 minutes! These presentations of application notes target the working engineer or technician and are color coded by general topic area below. On the exhibition floor, it's free, and it will make you "smahtter." Come see us at the MicroApps Theater.

START TIME	TITLE	SPEAKERS
09:45	Optimizing Performance and Accuracy in the New Spectre RF 18.1 Release	TawnaWilsey – Cadence Design Systems
10:00	PCB/Package Layout Considerations for RF-frontend in 5G mmwave handset containing GaAs PA-module, CMOS-RFIC. PMIC and BaseBand CMOS-IC	Vikas Aggarwal, Ritabrata Bhattacharya, Ashish Gupta, Taranjit Kukal, Jagdish Lohani – Cadence Design Systems; Surender Singh – Design Systems
10:15	Phased Array System Design that Incorporates Component Level Performance	Eamon Nash – ADI; Wilfredo Rivas-Torres – Keysight Technologies
10:30	Point Ports: A New EM Port for Board Simulations	John Dunn –AWR Group, National Instruments
10:45	Power Distribution Network Testing through Impedance Analysis	Anja Paula – Rohde & Schwarz USA, Inc.
11:15	Rapid 5G Filter Design using advanced EDA Tools	Ralf Ihmels – Mician Inc
11:30	Recent Phase Hit Analysis in Modern GaAs Voltage Controlled Oscillators and Synthesizers	Marty Richardson – Analog Devices, Inc.
11:45	The Benefits of using a COTS based SDR for your 5G Development Platform	Bob Muro – Pentek Inc
12:00	Removing the Guesswork from IC Die Design in RF Modules	Kerry Judd – Cadence Design Systems
12:15	RF switch design in integrated silicon technologies for 5G and IoT front-ends	Paul Hurwitz – TowerJazz
12:30	Signal Integrity measurements with vector network analyzers up to 40 GHz	Anja Paula – Rohde & Schwarz USA, Inc.
12:45	Broadband millimeter-wave power – making the most of III-V technology	Tony Fattorini – Altum RF
13:00	SMD Component Test System	Subbaiah Pemmaiah – Copper Mountain Technologies
13:15	System Margin Testing – System Level Performance with Ideal vs. Defined Re-al-World Clocks and Los	Martin Stumpf – Rohde & Schwarz USA, Inc.
13:30	Testing Vulnerabilities of GNSS Receivers in Autonomous Vehicles	Lawrence Wilson – Rohde & Schwarz USA, Inc.
13:45	TFLE-Thin Film Lumped Elements Filters and Transition Time Converters (TTC) Solutions	Rafi Hershtig – K&L Microwave
14:00	The impact of glass-weave effects on millimeter-wave PCB's	John Coonrod – Rogers Corp.
14:15	Tools and Techniques for Validation of VNA Calibrations with Wafer Microprobes	Craig Kirkpatrick – Form Factor, Inc.
14:30	Tunable and Fixed Filtering Solutions Enhances Dynamic Range and Flexibility of 4G/5G-LTE Measurements	Rafi Hershtig – K&L Microwave
14:45	Materials and techniques for void reduction under bottom termination components	Seth Homer – Indium Corporation

Circuit & System design | Test & Measurement | CAD and Modeling | Devices | Manufacturing, Materials

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Microwave Journal

INDUSTRY WORKSHOPS

BCEC

10:00 – 15:00 THURSDAY, 6 JUNE 2019

Industry workshops cover contemporary topics spanning the state of the art in RF, microwave, and mm-wave areas. These two-hour workshops include in-depth technical presentations from and discussions with experts in the industry. On-site registration is available. Don't miss this opportunity to expand your knowledge and interact with colleagues in these very relevant fields!

SESSION TIME	ROOM #	SESSION TITLE	EVENT COMPANY	SPEAKERS
10:00 – 12:00	152	Accelerating Benchmarking of Quantum Systems	Keysight Technologies	Nizar Messaoudi
	156C	Understanding the 5G NR Physical Layer	MathWorks, Inc.	Houman Zarrinkoub
	157A	Application of Advanced Non-Linear Models to High Efficiency GaN Power Amplifier Design	Modelithics, Inc., QORVO, Inc., Keysight Technologies	Larry Dunleavy, Rached Hajji, Jack Sifri
	158	Fixtures: A Necessary Evil. Now How Do I Get Rid of It	Keysight Technologies	O.J. Danzy, Bob Schaefer, Heidi Barnes
13:00 – 15:00	152	Design and Physical Realization of Phased-Array Antennas for MIMO and Beam-Steering Applications	AWR Group, National Instruments	John Dunn, Derek Linden, Joel Kirshman
	156C	Energy Efficiency, Linearization and MISO Transmitters	Rohde & Schwarz	Gareth Lloyd
	157A	Electronic Warfare Test and Evaluation Workshop	Keysight Technologies	Erik Diez, Joanne Mistler
	158	Design, Fab and Test Your Own Microwave Component	North Carolina State University	David Ricketts

151AB

Th2A: Non-Planar Filters 1

Chair: Ming Yu, CUHK
Co-Chair: Vicente Boria, Universitat Politècnica de València

10:10 Th2A-1: A Compact Waveguide Quasi-Elliptic Dual-Band Filter

L. Zhu, Telesat; R.R. Mansour, University of Waterloo; M. Yu, CUHK

10:20 Th2A-2: Evaluation of High Performance Aluminum for Microwave Filters

P. Martín-Iglesias, T. Raadik, ESA-ESTEC; F. Teberio, J.M. Percaz, UPNA; S. Martín-Iglesias, INTA; L. Pambaguian, ESA-ESTEC; I. Arregui, I. Arnedo, T. Lopetegi, M.A.G. Laso, UPNA

10:30 Th2A-3: The Stubbed Waveguide Cavity

S. Bastioli, RS Microwave; R.V. Snyder, RS Microwave

10:50 Th2A-4: A Tunable Diplexer Using Filters with Redundant Couplings

Y. Yang, CUHK; M. Yu, CUHK; Q. Wu, Xidian University

11:10 Th2A-5: Star-Junction Multiplexer Design Under Minimum Susceptance Networks Approach

P. Silveira, Universitat Autònoma de Barcelona; J. Verdú, Universitat Autònoma de Barcelona; P. de Paco, Universitat Autònoma de Barcelona

11:30 Th2A-6: Stepped-Impedance Band-Pass Filters with Improved Selectivity

L. Miranda, F. Teberio, UPNA; P. Martín-Iglesias, ESA-ESTEC; I. Calero, I. Arregui, I. Arnedo, J.M. Percaz, D. Santiago, T. Lopetegi, M.A.G. Laso, UPNA

11:40 Th2A-7: Miniaturized Quartz Waveguide Filter Using Double-Folded Structure

K. Matsutani, H. Kojima, M. Nakahori, K. Kuroda, K. Onaka, M. Koshino, T. Toi, Murata Manufacturing

153AB

Th2B: 3D-Printed RF Components and Interconnects

Chair: Valentina Palazzi, Università di Perugia
Co-Chair: Weijing SU, Google

10:10 Th2B-1: Shaping and Slotting High-Q Spherical Resonators for Suppression of Higher Order Modes

C. Guo, Xi'an Jiaotong University; J. Li, Shenzhen University; Y. Yu, University of Birmingham; F. Zhang, University of Birmingham; S. Li, University of Birmingham; M.M. Attallah, University of Birmingham; X. Shang, NPL; A. Zhang, Xi'an Jiaotong University; Y. Wang, University of Birmingham; M.J. Lancaster, University of Birmingham

10:30 Th2B-2: A Full X-Band Fully 3-D Printed E-Plane Rectangular-Coax-to-Waveguide Transition

J. Li, Shenzhen University; C. Guo, Xi'an Jiaotong University; Y. Yu, University of Birmingham; G.-L. Huang, Shenzhen University; T. Yuan, Shenzhen University; Y. Wang, University of Birmingham; J. Xu, UESTC; A. Zhang, Xi'an Jiaotong University

10:50 Th2B-3: W-Band Finite Ground Coplanar Waveguide (FG-CPW) Using Laser Enhanced Direct-Print Additive Manufacturing (LE-DPAM)

M.M. Abdin, University of South Florida; W.J.D. Johnson, Harris; J. Wang, University of South Florida; T.M. Weller, Oregon State University

11:10 Th2B-4: Ultra Wideband Transition from Coaxial Line to Two Parallel Lines Manufactured Using Additive Manufacturing Technology

J. Haumant, Elliptika; R. Allanic, Lab-STICC (UMR 6285); C. Quendo, Lab-STICC (UMR 6285); D. Diedhiou, Elliptika; A. Manchec, Elliptika; C. Person, Lab-STICC (UMR 6285); R.-M. Sauvage, DGA

11:30 Th2B-5: Study of 3D-Printed Helical-Microstrip Transmission Lines

J.M. Lopez-Villegas, Universitat de Barcelona; A. Salas, Universitat de Barcelona; N. Vidal, Universitat de Barcelona; J. Sieiro, Universitat de Barcelona

156AB

Th2C: Beamforming Architectures, Components and Calibration Techniques

Chair: Ahmed Kishk, Concordia University
Co-Chair: Roberto Vincenti Gatti, Università di Perugia

10:10 Th2C-1: Free-Space Phased-Array Characterization and Calibration Using Code-Modulated Embedded Test

Z. Hong, North Carolina State University; S. Schönherr, North Carolina State University; V. Chauhan, North Carolina State University; B. Floyd, North Carolina State University

10:30 Th2C-2: An in-situ Self-Test and Self-Calibration Technique Utilizing Antenna Mutual Coupling for 5G Multi-Beam TRX Phased Arrays

A. Nafe, University of California, San Diego; K. Kibaroglu, University of California, San Diego; M. Sayginer, University of California, San Diego; G.M. Rebeiz, University of California, San Diego

10:50 Th2C-3: Mitigation of Interferers and Nonlinear Spurious Products for Digital Array and MIMO Systems

N. Peccarelli, University of Oklahoma; R. Irazoqui, University of Oklahoma; C. Fulton, University of Oklahoma

11:10 Th2C-4: A Fully Integrated S-Band 1-Watt Phased Array T/R IC in 0.13µm SOI-CMOS Technology

Z. Wang, N. Li, W. Liu, J. Zhan, Q. Zhang, D. Ren, L. Huang, Y. Xu, S. Yao, J. Ma, S. Zhou, L. Li, J. Ma, Archiwave Microelectronics; N. Yan, Fudan University; J. Lu, Archiwave Microelectronics

11:30 Th2C-5: Very Concise Eight-Port Coupler for Two-Dimensional Beamforming Application

K. Ding, Concordia University; A.A. Kishk, Concordia University

157BC

Th2D: mm-Wave and THz Power Amplifiers

Chair: James Buckwalter, University of California, Santa Barbara
Co-Chair: Ed Niehenke, Niehenke Consulting

10:10 Th2D-1: A 140-GHz 0.25-W PA and a 55–135GHz 115–135mW PA, High-Gain, Broadband Power Amplifier MMICs in 250-nm InP HBT

Z. Griffith, Teledyne Scientific & Imaging; M. Urteaga, Teledyne Scientific & Imaging; P. Rowell, Teledyne Scientific & Imaging

10:30 Th2D-2: 300GHz Broadband Power Amplifier with 508GHz Gain-Bandwidth Product and 8dBm Output Power

B. Schoch, Universität Stuttgart; A. Tessmann, Fraunhofer IAF; A. Leuther, Fraunhofer IAF; S. Wagner, Fraunhofer IAF; I. Kallfass, Universität Stuttgart

10:50 Th2D-3: A 175GHz Bandwidth High Linearity Distributed Amplifier in 500nm InP DHBT Technology

T. Shivan, FBH; M. Hossain, FBH; R. Doerner, FBH; S. Schulz, FBH; T.K. Johansen, Technical University of Denmark; S. Boppel, FBH; W. Heinrich, FBH; V. Krozer, FBH

11:10 Th2D-4: 190-GHz G-Band GaN Amplifier MMICs with 40GHz of Bandwidth

M. Ćwikliński, Fraunhofer IAF; P. Brückner, Fraunhofer IAF; S. Leone, Fraunhofer IAF; C. Friesicke, Fraunhofer IAF; R. Lozar, Fraunhofer IAF; H. Maßler, Fraunhofer IAF; R. Quay, Fraunhofer IAF; O. Ambacher, Fraunhofer IAF

11:30 Th2D-5: Investigation of Compact Power Amplifier Cells at THz Frequencies Using InGaAs mHEMT Technology

L. John, Fraunhofer IAF; A. Tessmann, Fraunhofer IAF; A. Leuther, Fraunhofer IAF; P. Neininger, Fraunhofer IAF; T. Zwick, KIT

252AB

Th2E: Measurement at the Limits*

Chair: Leonard Hayden, Qorvo
Co-Chair: Matt King, HRL Laboratories

Th2E-1: Silicon-Micromachined Waveguide Calibration Shims for Terahertz Frequencies
J. Campion, KTH; U. Shah, KTH; J. Oberhammer, KTH

Th2E-2: A Differential Probe with Integrated Balun for On-Wafer Measurements in the WR-3.4 (220–330 GHz) Waveguide Band
C. Zhang, University of Virginia; M. Bauwens, Dominion MicroProbes; M.E. Cyberey, University of Virginia; L. Xie, University of Virginia; A.W. Lichtenberger, University of Virginia; N.S. Barker, University of Virginia; R.M. Weikle II, University of Virginia

Th2E-3: A Novel Contactless Dielectric Probe for On-Wafer Testing and Characterization in the V-Band
M.A. Basha, University of Waterloo; A. Zekrallah, Ain Shams University; M.S. Abdelkhalek, KIT; S. Safavi-Naeini, University of Waterloo

Th2E-4: Multiport Vector Network Analyzer Configured in RF Interferometric Mode for Reference Impedance Renormalization
K. Haddadi, IEMN (UMR 8520); E. Okada, IEMN (UMR 8520); K. Daffé, IEMN (UMR 8520); F. Mubarak, VSL; D. Théron, IEMN (UMR 8520); G. Dambrine, IEMN (UMR 8520)

Th2E-5: Accurate Monte Carlo Uncertainty Analysis for Multiple Measurements of Microwave Systems
B.F. Jamroz, NIST; D.F. Williams, NIST; J.D. Rezac, NIST; M. Frey, NIST; A.A. Koepke, NIST

** Joint IMS/ARFTG Sessions*

254AB

Th2F: Advances in CMOS, and HBT Technologies for Monolithic ICs

Chair: Tony Ivanov, U.S. Army
Co-Chair: Cynthia Hang, Raytheon

Th2F-1: A 27-GHz Transformer Based Power Amplifier with 513.8-mW/mm² Output Power Density and 40.7% Peak PAE in 1-V 28-nm CMOS
K.-C. Chiang, National Taiwan University; T.-C. Tsai, National Taiwan University; I. Huang, National Taiwan University; J.-H. Tsai, National Taiwan Normal University; T.-W. Huang, National Taiwan University

Th2F-2: A 0.1-to-10GHz Digital Frequency Discriminator IC with Time to Digital Converter and Adaptive Control of Frequency Division Ratio for Instantaneous Frequency Measurement
A. Hirai, Mitsubishi Electric; K. Tsutsumi, Mitsubishi Electric; M. Tsuru, Mitsubishi Electric; K. Mori, Mitsubishi Electric; M. Shimozawa, Mitsubishi Electric

Th2F-3: Post-Process Local Porous Silicon Integration Method for RF Application
G. Scheen, Université catholique de Louvain; R. Tuyaerts, Université catholique de Louvain; M. Rack, Université catholique de Louvain; L. Nyssens, Université catholique de Louvain; J. Rasson, Université catholique de Louvain; J.-P. Raskin, Université catholique de Louvain

Th2F-4: Silicon-Substrate Enhancement Technique Enabling High Quality Integrated RF Passives
M. Rack, L. Nyssens, J.-P. Raskin, Université catholique de Louvain

Th2F-5: InGaP/GaAs HBT Broadband Power Amplifier IC with 54.3% Fractional Bandwidth Based on Cascode Structure
W. Lee, H. Kang, Sungkyunkwan University; H. Lee, University of Calgary; W. Lim, J. Bae, H. Koo, Sungkyunkwan University; J. Yoon, Samsung; Y. Yang, Sungkyunkwan University

Th2F-6: 185mW InP HBT Power Amplifier with 1 Octave Bandwidth (25–50GHz), 38% Peak PAE at 44GHz and Chip Area of 276×672µm²
A. Arias, Teledyne Scientific & Imaging and UCSB; P. Rowell, M. Urteaga, Z. Griffith, K. Shinohara, J. Bergman, A.D. Carter, R. Pierson, B. Brar, Teledyne; J.F. Buckwalter, M.J.W. Rodwell, UCSB

257AB

Th2G: Microwave and mm-Wave Wireless Energy Harvesting

Chair: Alessandra Costanzo, Università di Bologna
Co-Chair: Quenton Bonds, NASA

Th2G-1: A 58–64GHz Transformer-Based Differential Rectifier in 40nm CMOS with -12dBm Sensitivity for 1V at 64GHz
H. Gao, Technische Universiteit Eindhoven; D.M.W. Leenaerts, Technische Universiteit Eindhoven; P. Baltus, Technische Universiteit Eindhoven

Th2G-2: A Scalable High-Gain and Large-Beamwidth mm-Wave Harvesting Approach for 5G-Powered IoT
A. Eid, Georgia Tech; J. Hester, Georgia Tech; M.M. Tentzeris, Georgia Tech

Th2G-3: A 2.45GHz RF Power Harvesting System Using Textile-Based Single-Diode Rectennas
D. Vital, Florida International University; S. Bhardwaj, Florida International University; J.L. Volakis, Florida International University

Th2G-4: High-Efficiency Rectifier with Wide Input Power Rage Based on a Small Capacitor in Parallel with the Diode
P. Wu, Sichuan University; X. Chen, Sichuan University; H. Lin, Sichuan University; C. Liu, Sichuan University

Th2G-5: A Highly Efficient Dual-Band Harmonic-Tuned GaN RF Synchronous Rectifier with Integrated Coupler and Phase Shifter
Md.A. Hoque, Washington State University; S.N. Ali, Skyworks Solutions; Md.A. Mokri, Washington State University; S. Gopal, Intel; Md. Chahardori, Washington State University; D. Heo, Washington State University

259AB

Th2H: Load-Modulated Power Amplifiers

Chair: Paul Draxler, Qualcomm
Co-Chair: Zoya Popović, University of Colorado Boulder

Th2H-1: A 750-W High Efficiency LDMOS New Four-Way Doherty Amplifier for Base-Station Applications
X. Jiang, Ampleon; T. Zhang, Ampleon; J. He, Ampleon; S. Loysel, Ampleon; B. Zhang, Ampleon; J. Gajadharsing, Ampleon

Th2H-2: An 80W Power Amplifier with 50% Efficiency at 8dB Power Back-Off Over 2.6–3.8GHz
P. Saad, Ericsson; R. Hou, Ericsson; R. Hellberg, Ericsson; B. Berglund, Ericsson

Th2H-3: Fully Integrated Wideband Doherty PA with Additive-Voltage Supported Load-Modulation in CMOS 130nm
E. Heidebrecht, RWTH Aachen University; M.-D. Wei, RWTH Aachen University; R. Negra, RWTH Aachen University

Th2H-4: Load Modulated Balanced Amplifier with Reconfigurable Phase Control for Extended Dynamic Range
Y. Cao, University of Central Florida; H. Lyu, University of Central Florida; K. Chen, University of Central Florida

Th2H-5: Doherty-to-Balanced Switchable Power Amplifier
H. Lyu, University of Central Florida; Y. Cao, University of Central Florida; K. Chen, University of Central Florida

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Panel Session at Lunchtime – See Page 66

HACKATHON

ROOM 258 BCEC

10:30 – 12:00 THURSDAY, 6 JUNE 2019

The Hackathon is back at the 2019 International Microwave Symposium (IMS2019) in Boston, Massachusetts!

This is a fun event where participating teams (two people per team) are given a microwave design problem, and are required to prototype their solutions within a certain amount of time. This year's hackathon will continue the fast-paced style of recent years' hackathons, but be extended to one hour so that the scale and complexity of the problem are increased. The competition is open to all IMS attendees, and awards will be given to the winning hackers!

The theme of this hackathon is "Everyday Microwave". We highlight the idea that applications of knowledge in microwave and prototyping of microwave designs do not necessarily rely on sophisticated materials and tools; rather, they can be realized through simple things in our everyday life: materials for your home decor, cutting knifes, calculators, pencils and paper. Also, the hackers will not be allowed to use professional simulation software; because we believe the countless free tools on the Internet and a Smith Chart would suffice! All computers and parts needed for the competition will be provided.

IMS PANEL SESSION

ROOM 162AB BCEC

12:00 – 13:15 THURSDAY, 6 JUNE 2019

In-Band Full-Duplex: Is It Really Going To Happen?

ABSTRACT:

In-Band Full-Duplex (IBFD), or Simultaneous Transmit and Receive (STAR), technology has recently been proclaimed as a critical enabler of fifth-generation (5G) wireless networks as well as other applications that were previously considered impracticable. IBFD systems promise enhanced spectral and network efficiencies, but must mitigate their inherent self-interference through a variety of techniques that need to be robust across a diverse set of operating environments. While many groups around the world have demonstrated systems utilizing these different techniques, only a handful of mature prototypes have been presented for potential large-scale deployment. In this session, expert panelists from a variety of backgrounds will discuss if IBFD technology will ever leave the laboratory, expand upon its potential deployment hurdles, and debate when it may start to appear in tomorrow's wireless devices.

PANELISTS: **Leo Laughlin**, *Univ. of Bristol*; **Harish Krishnaswamy**, *Columbia University*; **Dani Korpi**, *Nokia Bell Labs*; **Joel Goodman**, *US Naval Research Laboratory*; **Jonathan Doane**, *MIT Lincoln Laboratory.*

IP101 TALK

YP LOUNGE LEVEL 2 BCEC

13:00 – 14:00 THURSDAY, 6 JUNE 2019

Introduction to Intellectual Property for Early-Stage Companies

In an economy strongly characterized by fast technological change and easy access to information, intellectual property is more important than ever before. Businesses are increasingly relying on IP to raise capital, erect barriers to entry, generate steady revenue streams, defend against lawsuit threats and improve market position. IP has become particularly important for early-stage companies that aim to create a market foothold using technological innovation.

This talk provides an introduction to intellectual property, common misconceptions and best practices. Topics discussed in this talk include trademarks, patents and trade secrets, and how early-stage companies can leverage these to further their goals. Common questions addressed in this talk include: what rights does a patent provide? when should I file a patent application? can a patent be obtained worldwide?

ABOUT THE SPEAKER:

Michele Moresco, PhD is a patent agent in the Electrical and Computer Technologies group at Wolf, Greenfield & Sacks, a Boston-based law firm that specializes in intellectual property law. Michele has extensive knowledge in the areas of optics and photonics, communications, semiconductors, electromagnetism and signal processing.

Michele counsels clients, including Startups, Fortune 500 companies and academic institutions, on IP best practices. His practice focuses on U.S. and international patent prosecution, patent litigation, due diligence and freedom-to-operate.

Prior to joining Wolf, Greenfield & Sacks, Michele was a Postdoctoral Associate at the Research Laboratory of Electronics at MIT. While at MIT, Michele was involved in a variety of research topics, including fiber-optics networks, infrared and visible pixel arrays, and Lidar sensors for autonomous vehicles. Michele holds a PhD in electrical engineering from Boston University, where he presented a thesis on Monte Carlo models for semiconductor materials and devices.

Th1F1 | IN HONOR OF TERRY OXLEY

CHAIR: NESTOR LOPEZ, *MIT LINCOLN LABORATORY* | **CO-CHAIR:** PATRICK BELL, *MIT LINCOLN LABORATORY*

ThIF1-1: Integrated 2-b Riemann Pump RF-DAC in GaN Technology for 5G Base Stations

M. Weiß, Fraunhofer IAF; C. Friesicke, Fraunhofer IAF; R. Quay, Fraunhofer IAF; O. Ambacher, Fraunhofer IAF

ThIF1-2: A 241-GHz-Bandwidth Distributed Amplifier with 10-dBm P1dB in 0.25-µm InP DHBT Technology

T. Jyo, NTT; M. Nagatani, NTT; M. Ida, NTT; M. Mutoh, NTT; H. Wakita, NTT; N. Terao, NTT; H. Nosaka, NTT

ThIF1-3: A 10W Fully-Integrated LDMOS MMIC Doherty in LGA Package for 2.7GHz Small Cell Application

L. Lin, Ampleon; L. Yang, Ampleon; S. Zheng, Ampleon; J. Peng, Ampleon

ThIF1-4: Microwave Materials: Dielectric Compositions for Use in High-Frequency LTCC, Filter, Resonator, and Antenna Applications

P.M. Marley, Ferro; W. Symes, Ferro; M. Megherhi, Ferro; C. Gleason, Ferro

ThIF1-5: A Fully Printed Backscatter Radio Transceiver

A. Walla, University of Melbourne; B. Hassan, University of Melbourne; J. Yong, University of Melbourne; Y. Liang, University of Melbourne; Y. Yu, University of Melbourne; B. Nasr, University of Melbourne; A. Nirmalathas, University of Melbourne; E. Skafidas, University of Melbourne

ThIF1-6: A Microfluidic Spherical Helix Module Using Liquid Metal and Additive Manufacturing for Drug Delivery Applications

Y. Guan, BUPT; S. Wang, Tongji University; M.M. Tentzeris, Georgia Tech; Y. Liu, BUPT

ThIF1-7: Microwave Breast Imaging Incorporating Material Property Dependencies

M. Hughson, University of Manitoba; J. LoVetri, University of Manitoba; I. Jeffrey, University of Manitoba

ThIF1-8: Rhodamine B Temperature Dosimetry of Biological Samples Interacting with Electromagnetic Fields in Macrosystems

A. Nefzi, XLIM (UMR 7252); L. Carr, XLIM (UMR 7252); C. Dalmay, XLIM (UMR 7252); A. Pothier, XLIM (UMR 7252); P. Leveque, XLIM (UMR 7252); D. Arnaud-Cormos, XLIM (UMR 7252)

ThIF1-9: Flexible, Conformal Phased Arrays with Dynamic Array Shape Self-Calibration

A.C. Fikes, Caltech; A. Safaripour, Caltech; F. Bohn, Caltech; B. Abiri, Caltech; A. Hajimiri, Caltech

ThIF1-10: Full-Sphere Frequency Scanning Array Antenna Based on Passive Dual-Band CRLH Series Integrated Feeding Network

D. Ren, SUNY Buffalo; J.H. Choi, SUNY Buffalo

ThIF1-11: Fast Frequency-Agile Real-Time Optimization of High-Power Tuning Network for Cognitive Radar Applications

J. Alcala-Medel, Baylor University; A. Egbert, Baylor University; C. Calabrese, Baylor University; A. Dockendorf, Baylor University; C. Baylis, Baylor University; G. Shaffer, Purdue University; A. Semnani, Purdue University; D. Peroulis, Purdue University; E. Viveiros, U.S. Army Research Laboratory; K. Gallagher, U.S. Army Research Laboratory; A. Martone, U.S. Army Research Laboratory

ThIF1-12: Human Motion Analysis Based on Multi-Channel Doppler Radar System

H.-S. Chang, National Chung Cheng University; H.-C. Chu, National Chung Cheng University; H.-C. Chu, National Chung Cheng University; P.-T. Chen, National Chung Cheng University; C.-C. Chang, National Chung Cheng University; S.-F. Chang, National Chung Cheng University

ThIF1-13: AMCW Radar of Micrometer Accuracy Distance Measurement and Monitoring

F. Strömbeck, Chalmers University of Technology; Z.S. He, Chalmers University of Technology; H. Zirath, Chalmers University of Technology

ThIF1-14: Enabling Safe Autonomous Vehicles by Advanced mm-Wave Radar Simulations

J.D. Castro, ANSYS; S. Singh, ANSYS; A. Arora, ANSYS; S. Louie, ANSYS; D. Senic, ANSYS

ThIF1-15: A Reconfigurable Modulator for Digital Outphasing Transmitters

F. Hühn, FBH; A. Wentzel, FBH; W. Heinrich, FBH

ThIF1-16: Reconfigurable GaN Digital Tx Applying BST Bandpass Filter

A. Wentzel, FBH; C. Schuster, Technische Universität Darmstadt; R. Jakoby, Technische Universität Darmstadt; H. Maune, Technische Universität Darmstadt; W. Heinrich, FBH

ThIF1-17: 100MHz to 1GHz On-Chip Circulator with Integrated Driver Amplifiers

M. Biedka, University of California, Los Angeles; P. Rodgers, Northrop Grumman; N. Gutierrez, University of California, Los Angeles; T. LaRocca, Northrop Grumman; Y.E. Wang, University of California, Los Angeles

ThIF1-18: A Miniaturized 3–10GHz Dual-Comb Spectroscopy System for Chemical Detection

R. Ebrahimi Ghiri, Texas A&M University; K. Entesari, Texas A&M University

ThIF1-19: Sensitivity Optimization in SRRs Using Interferometry Phase Cancellation

M. Abdolrazzaghi, University of Alberta; M. Daneshmand, University of Alberta

ThIF1-20: Triode-Mode Envelope Detectors for Near Zero Power Wake-Up Receivers

J. Moody, University of Virginia; S.M. Bowers, University of Virginia

ThIF1-21: W-Band Measurements of Low-Loss Dielectrics with a Fabry-Perot Open Resonator

T. Karpisz, Warsaw University of Technology; B. Salski, Warsaw University of Technology; P. Kopyt, Warsaw University of Technology; J. Krupka, Warsaw University of Technology

ThIF1-22: Robust and High-Efficiency Wireless Body Area Networks with Spoof Surface Plasmons on Clothing

X. Tian, NUS; M. Zhang, NUS; J.S. Ho, NUS

ThIF1-23: Concurrent Multi-Directional Beam-Forming Receiving Network for Full-FoV High-Efficiency Wireless Power Transfer

M.-Y. Huang, Georgia Tech; T.-Y. Huang, Georgia Tech; M. Swaminathan, Georgia Tech; H. Wang, Georgia Tech

ThIF1-24: Compact Harmonic-Tuned Rectifier Using Inductive Matching Network

M.-D. Wei, RWTH Aachen University; C.-Y. Fan, RWTH Aachen University; F. Dietrich, RWTH Aachen University; R. Negra, RWTH Aachen University

ThIF1-25: Time-Reversal Microwave Tomography Using Frequency Domain Sampling

J. Doroshewitz, Michigan State University; S. Mukherjee, LLNL; E.J. Rothwell, Michigan State University; L. Udpa, Michigan State University; J.A. Nanzer, Michigan State University

151AB

Th3A: Non-Planar Filters 2

Chair: Giuseppe Macchiarella, Politecnico di Milano
Co-Chair: Miguel Laso, Universidad Pública de Navarra

13:30

Th3A-1: W-Band Quintuple-Mode Filter Using Quarter-Mode Substrate-Integrated Waveguide Resonators

X.-L. Huang, SJTU; L. Zhou, SJTU; C.-R. Zhang, SJTU; J.-F. Mao, SJTU

13:40

Th3A-2: Miniaturized Microwave Filter Using Circular Spiral Resonators in a Single Metal Cavity

R.-S. Chen, S.-W. Wong, Shenzhen University; J.-Y. Lin, UTS; Y. He, Shenzhen University

13:50

Th3A-3: Iterative Synthesis of Equi-Ripple Dual-Band Filtering Functions with One Additional Transmission Zero

P. Zhao, Polytechnique Montréal; K. Wu, Polytechnique Montréal

14:10

14:10

Th3A-4: Spurious Bypass Method for Increasing Passband Width

R.V. Snyder, RS Microwave

14:20

14:30

Th3A-5: Rectangular Waveguide Quadruplet Filter for Satellite Applications

J. Ossorio, Universitat Politècnica de València; S. Cogollos, Universitat Politècnica de València; V.E. Boria, Universitat Politècnica de València; M. Guglielmi, Universitat Politècnica de València

14:40

14:50

153AB

Th3B: 3D Printed Wireless Modules and Systems

Chair: Matt Tyhach, Raytheon
Co-Chair: Dominique Baillargeat, XLIM (UMR 7252)

Th3B-1: Fully Inkjet-Printed Multi-Layer Tunable Origami FSS Structures with Integrated Thermal Actuation Mechanism

S.A. Nauroze, Georgia Tech; M.M. Tentzeris, Georgia Tech

Th3B-2: Novel 3D-Printed Reconfigurable Origami Frequency Selective Surfaces with Flexible Inkjet-Printed Conductor Traces

Y. Cui, Georgia Tech; S.A. Nauroze, Georgia Tech; M.M. Tentzeris, Georgia Tech

Th3B-3: Microfluidics-Based 3D-Printed 4×4 Butler Matrix in Coaxial Technology for Applications up to K Band

V. Palazzi, Università di Perugia; P. Mezzanotte, Università di Perugia; F. Alimenti, Università di Perugia; M.M. Tentzeris, Georgia Tech; L. Roselli, Università di Perugia

Th3B-4: Achieving Fully Autonomous System-on-Package Designs: An Embedded-on-Package 5G Energy Harvester Within 3D Printed Multilayer Flexible Packaging Structures

T.-H. Lin, Georgia Tech; S.N. Daskalakis, Georgia Tech; A. Georgiadis, Heriot-Watt University; M.M. Tentzeris, Georgia Tech

252AB

Th3E: The Art of Large Signal Measurement and Calibration

Chair: Tibault Reveyrand, XLIM (UMR 7252)
Co-Chair: Alfred Riddle, Quanergy Systems

Th3E-1: Characterization of Electromagnetic Coupling Effects in MIMO Antenna Array Beamforming

M. Jordão, Universidade de Aveiro; D. Belo, Universidade de Aveiro; R. Caldeirinha, Politécnico de Leiria; A.S.R. Oliveira, Universidade de Aveiro; N.B. Carvalho, Universidade de Aveiro

Th3E-2: Ultra-Fast (13ns) Low Frequency/Microwave Transient Measurements, Application to GaN Transistors Characterization of Pulse to Pulse Stability

M. Ben-Sassi, XLIM (UMR 7252); G. Neveux, XLIM (UMR 7252); D. Barataud, XLIM (UMR 7252)

Th3E-3: An Approach for Characterizing the Frequency Response of Sampling-Oscilloscopes Using a Large-Signal Network Analyzer

A.S. Boaventura, NIST; D.F. Williams, NIST; P.D. Hale, NIST; G. Avolio, Anteverta-mw

Th3E-4: Large-Signal-Network-Analyzer Phase Calibration on an Arbitrary Grid

A. Sanders, University of Colorado Boulder; D.F. Williams, NIST; J.M. Kast, Colorado School of Mines; K.A. Remley, University of Colorado Boulder; R.D. Horansky, University of Colorado Boulder

**** Joint IMS/ARFTG Sessions***

254AB

Th3F: GaN Semiconductor Devices and Monolithic ICs

Chair: Ali Darwish, U.S. Army
Co-Chair: Nicholas Kolias, Raytheon

Th3F-1: A GaN/Diamond HEMTs with 23W/mm for Next Generation High Power RF Application

W.S. Lee, RFHIC; K.W. Lee, RFHIC; S.H. Lee, RFHIC; K. Cho, RFHIC; S. Cho, RFHIC

Th3F-2: GaN MMIC Differential Multi-Function Chip for Ka-Band Applications

B. Berthelot, LAAS; J.-G. Tartarin, LAAS; C. Viallon, LAAS; R. Leblanc, OMMIC; H. Maher, LN2; F. Boone, LN2

Th3F-3: Millimeter-Wave Single-Pole Double-Throw Switches Based on a 100-nm Gate-Length AlGaN/GaN-HEMT Technology

F. Thome, Fraunhofer IAF; P. Brückner, Fraunhofer IAF; R. Quay, Fraunhofer IAF; O. Ambacher, Fraunhofer IAF

Th3F-4: High-Power (>2 W) E-Band PA MMIC Based on High Efficiency GaN-HEMTs with Optimized Buffer

E. Ture, Fraunhofer IAF; S. Leone, Fraunhofer IAF; P. Brückner, Fraunhofer IAF; R. Quay, Fraunhofer IAF; O. Ambacher, Fraunhofer IAF

Closing Session and Reception 15:30 – 18:00 | BCEC Grand Ballroom

THURSDAY

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

257AB

Th3G: Novel Techniques and Applications for Near Field Wireless Power Transfer

Chair: Kenjiro Nishikawa, Kagoshima University

Co-Chair: Costas Sarris, University of Toronto

13:30

Th3G-1: Triple-Band Near-Field Wireless Power Transfer System Using Coupled Defected Ground Structure Band Stop Filters

A. Barakat, Kyushu University; S. Alshhawy, Kyushu University; K. Yoshitomi, Kyushu University; R.K. Pokharel, Kyushu University

13:40

13:50

Th3G-2: Capacitive Coupler Utilizing Electric Double Layer for Wireless Power Transfer Under Seawater

M. Tamura, Toyohashi University of Technology; K. Murai, Toyohashi University of Technology; Y. Naka, Toyohashi University of Technology

14:10

14:10

Th3G-3: 45% RF-to-DC Conversion Efficiency Wireless Power Transfer System Through Biological Tissues Using Complex Conjugate Impedance Matching Taking Account of Tissue's Properties

S. Chalise, Kyushu University; M. Nakao, Kyushu University; F. Tahar, Kyushu University; A. Barakat, Kyushu University; K. Yoshitomi, Kyushu University; R.K. Pokharel, Kyushu University

14:20

14:30

Th3G-4: Range-Adaptive Impedance Matching of Wireless Power Transfer System Using a Machine Learning Strategy Based on Neural Networks

S. Jeong, Georgia Tech; T.-H. Lin, Georgia Tech; M.M. Tentzeris, Georgia Tech

14:40

14:50

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.

The winners of the Advanced Practice and Industry Paper Competitions will receive their prizes at the IMS2019 Closing Ceremony on Thursday, 6 June 2019.

THE APPC FINALISTS:

A 1-Bit Digital Transmitter System Using a 20-Gbps Quadruple-Cascode Class-D Digital Power Amplifier with 45nm SOI CMOS | We3B-2
Authors: Shinichi Hori, Keiichi Motoi, Tatsuya Soma, Hidemi Noguchi, Soubhik Deb, Masaaki Tanio, Noriaki Tawa, Tomoya Kaneko, Kazuaki Kunihiro, NECC

A Tunable Coaxial Filter with Minimum Variations in Absolute Bandwidth and Q Using a Single Tuning Element | Tu2A-2
Authors: Gowrish B., Raafat R. Mansour, Univ. of Waterloo

A CMOS Time Domain Microwave Broadband Dielectric Spectroscopy System with a Contact-Less Sensor for Liquid Chemical Detection | We3G-2
Authors: Elif Kaya, Ali Pourghorban Saghati, Kamran Entesari, Texas A&M Univ.

THE IPC FINALISTS:

70% Efficient Dual-Input Doherty-Outphasing Power Amplifier for Large PAPR Signals | We1H-1
Authors: Atsushi Yamaoka, Thomas M. Hone, Keiichi Yamaguchi, Toshiba, Japan

Monolithically Fabricated 4096-Element, PolyStrata Broadband D-Band Array Demonstrator | Th1C-1
Authors: Jared Williams Jordan, Seth Lynch, Michael Clark, Benjamin L. Cannon, Luis A. Adames, Darel Wrenn, Kimberly Jackson, Neal Erickson, Justin Clough, Darryl Brown, Jean-Marc Rollin, Nuvotronics; Pierre Lopez, Pascal Boutet, Maurizio Moretto, Nokia

Si-Based 94-GHz Phased Array Transmit and Receive Modules for Real-Time 3D Radar Imaging | We1G-1
Authors: Jean-Olivier Plouchart, Xiaoxiong Gu, Wooram Lee, Asaf Tzadok, Duixian Liu, Huijian Liu, Mark Yeck, Christian Baks, Alberto Valdes–Garcia, IBM T.J. Watson Research Center

IMS CLOSING SESSION AND RECEPTION

GRAND BALLROOM BCEC

15:30 – 18:00 THURSDAY, 6 JUNE 2019

Join us as we wrap-up the IMS with Prof. Dina Katabi's keynote presentation describing cutting edge work being done using wireless sensors for health monitoring. The presentation will be followed by the highly anticipated 2019 IMS Best Paper Awards (Best Student Paper, Best 3MT, Best Advance Practice Paper, and Best Industry Paper). Immediately following the awards join us for an IMS celebration/reception just outside the ballroom.

Health Monitoring with Machine Learning and Wireless Sensors

Prof. Dina Katabi, *MIT*

ABSTRACT:

Driven by advances in medicine and increased lifespans, societies are now aging at an alarming rate. This fact presents a host of new challenges – many seniors live alone and are subject to falls, accidental injuries, chronic disease exacerbations, and depression. The situation places an alarming burden on our health care system and society more generally, a burden that is only expected to grow over time.

This talk will introduce Emerald, a new technology that uses machine learning for health monitoring in the home. Emerald automates health monitoring through innovations in wireless sensing and machine learning. The Emerald device is a Wi-Fi like box that transmits low power radio signals, and analyzes their reflections using neural networks. It infers the movements, breathing, heart rate, falls, sleep apnea, and sleep stages, of people in the home – all without requiring them to wear any sensors or wearables. By monitoring a variety of physiological signals continuously and without imposing a burden on users, Emerald can automatically detect degradation in health, enabling early intervention and care. The talk will describe the underlying technology, and present results demonstrating Emerald's promise in a geriatric population.

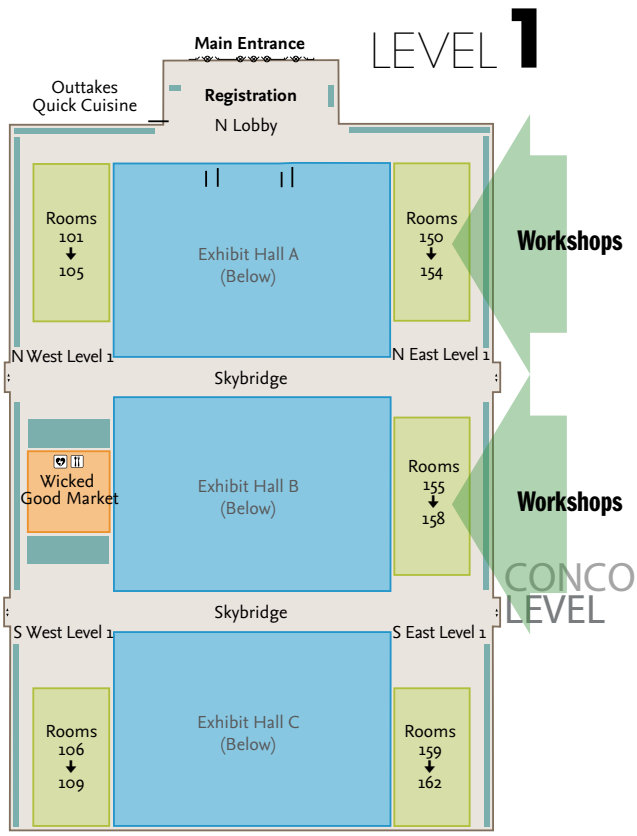
ABOUT THE SPEAKER:

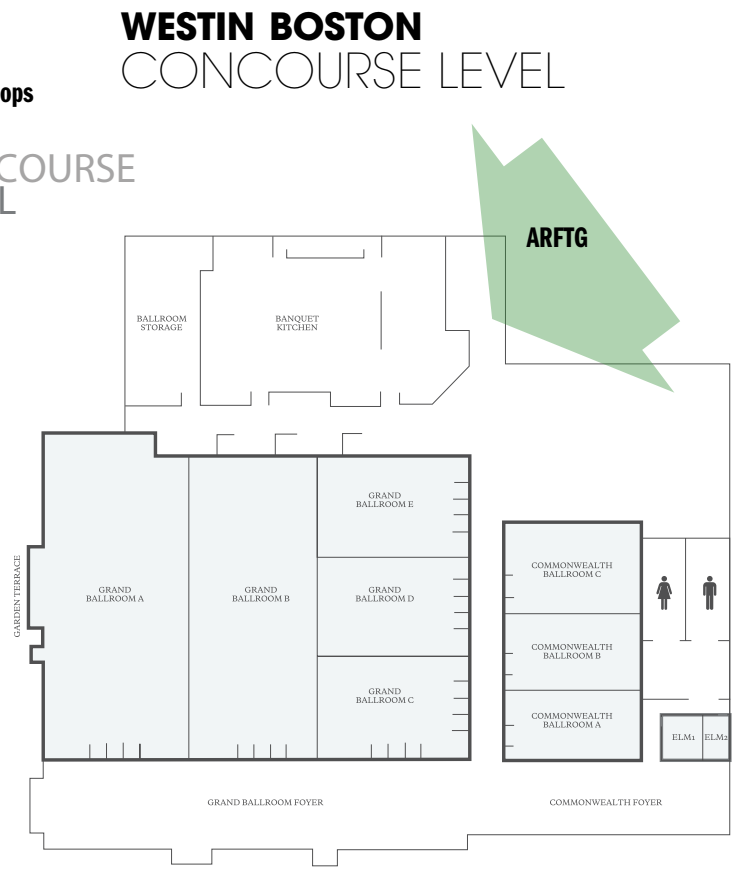
Dina Katabi is the Andrew & Erna Viterbi Professor of Electrical Engineering and Computer Science at MIT. She is also the director of the MIT's Center for Wireless Networks and Mobile Computing, a member of the National Academy of Engineering, and a recipient of the MacArthur Genius Award. Professor Katabi received her PhD and MS from MIT in 2003 and 1999, and her Bachelor of Science from Damascus University in 1995. Katabi's research focuses on innovative mobile and wireless technologies with particular application to digital health. Her research has been recognized by the ACM Grace Murray Hopper Award, the SIGCOMM test of Time Award, the Faculty Research Innovation Fellowship, a Sloan Fellowship, the NBX Career Development chair, and the NSF CAREER award. Her students received the ACM Best Doctoral Dissertation Award in Computer Science and Engineering twice. Further, her work was recognized by the IEEE William R. Bennett prize, three ACM SIGCOMM Best Paper awards, an NSDI Best Paper award, and a TR10 award. Several Startups have been spun out of Katabi's lab such as PiCharging and Emerald.

CONFERENCE HIGHLIGHTS

FRIDAY

EVENT	TIME
ARFTG	08:00 – 17:00
Workshops	08:00 – 17:15





AUTOMATIC RF TECHNIQUES GROUP

93RD ARFTG MICROWAVE MEASUREMENT SYMPOSIUM

Measurement challenges for the upcoming RF and mm-wave communications and sensing systems

Session A: Non-linear measurement techniques **Session Chair:** Marco Spirito and Patrick Roblin			
KEYNOTE	08:10 to 08:50	Design of an On-Chip mmWave LSNA with Load Pull and Advanced Signal Sources	Dylan Williams, Jerome Cheron, Richard Chamberlin, Tasshi Denis; *NIST*
A-1	08:50 to 09:10	Characterizing Amplifier Modulation Distortion Using a Vector Network Analyzer	Jan Verspecht, Augustine Stav, Sam Kusano, Jean-Pierre Teyssier; *Keysight Technologies*
A-2	09:10 to 09:30	Harmonic Cancellation Technique for Ultra-Wideband Filter-Less 5G Transmitter	Girish Chandra Tripathi[1], Meenakshi Rawat[1], Patrick Roblin[2] *[1]Insitute of Technology Roorkee, [2]The Ohio State University*
A-3	09:30 to 09:50	A Novel Modulated Rapid Load Pull System with Digital Pre-Distortion Capabilities	Sattam Alsahali[1], Jonathan Lees[1], Aamir Sheik[2], Dragan Gecan[2], Alexander Alt[1], Guofeng Wang[1], Simon Woodington[2], Peng Chen[1], Paul Tasker[1] *[1]Cardiff University, [2]MESURO*
Break	09:50 to 10:40	**Exhibits and Interactive Forum**	

Session B: Mixed-Signal and MIMO systems calibration and measurements **Session Chair:** Peter Aaen and Joe Gering			
B-1	10:40 to 11:00	Frequency Response Of Real Time Digital Oscilloscope With Time-Interleaving Architecture	Chihyun Cho, Dong-Joon Lee, Hyun-Jee Goo, Joo-Gwang Lee, *KRISS*
B-2	11:00 to 11:20	Automatic Vector Signal Generator Calibration Method Suitable For Multiport Large-Signal Measurements	Tibault Reveyrand, Alexis Courty, Morgane Portelance, Pierre Medrel, Philippe Bouysse, J. M. Nebus, *XLIM*
B-3	11:20 to 11:40	Calibrated Digital Predistortion Using A Vector Network Analyzer As The Receiver	Thaimí Niubó Alemán[1,2], Yunsik Hahn[2], Patrick Roblin[2], Jean-Pierre Teyssier[3], J. Apolinar Reynoso-Hernández[1], Vanessa Chen[2], Siddharth Rajan[2] *[1]Cicese, [2]The Ohio State University, [3]Keysight Technologies*
B-4	11:40 to 12:00	Over-The-Air Phase Measurement And Calibration Method For 5G mmW Phased Array Radio Transceiver	Markku Jokinen, Olli Kursu, Nuutti Tervo, Jani Saloranta, Marko E. Leinonen, Aarno Pärssinen, *University of Oulu*
Awards Luncheon: 12:00 to 13:30			

Session C: Calibration and measurements from coaxial to on-wafer and from RF to (sub)mm-wave **Session Chair:** Leonard Hayden and Andrej Rumiantsev			
C-1	13:30 to 13:50	Confidence and Prediction Intervals for Microwave Calibrations and Measurements	Dylan Williams, Benjamin Jamroz, Jacob Rezac, *NIST*
C-2	13:50 to 14:10	S-Parameter Definition for Adapters with a Dielectrically Loaded Connector	Johannes Hoffmann, P. Huerlimann, M. Wollensack, J. Ruefenacht, M. Zeier, *METAS*
C-3	14:10 to 14:30	TRL Error-box Split to Compensate for the Bias Dependency of ESD and Antenna Protection Diodes in mm-Wave	Carmine De Martino, Eduard Malotaux, Marco Spirito, *TU Delft*
C-4	14:30 to 14:50	Electronic Calibration of One-Port Networks at Submillimeter Wavelengths using Schottky Diodes as On-Wafer Standards	Linli Xie[1], Matthew Bauwens[2], Souheil Nadri[1], Michael Cyberey[1], Alexander Arsenovic[3], Arthur Lichtenberger[1], N. Scott Barker[1], Robert M Weikle[1] *[1]University of Virginia, [2]Dominion MicroProbes, [3]810 Labs*
Break	**14:50 to 15:40**	**Exhibits and Interactive Forum**	

Session D: Other areas of RF and microwave measurement techniques **Session Chair:** Jim Booth and Jeffrey Jargon			
D-1	15:40 to 16:00	Differential Noise Measurements: Sensitivities and Uncertainties with Direct Correlation- and Balun-Based Methods	Jon Martens, *Anritsu*
D-2	16:00 to 16:20	Experimental Verification and Imaging of Radiation Due to Coaxial-to-Microstrip Transitions	Haris Votsi, Jonas Urbonas, Peter Aaen, *University of Surrey*
D-3	16:20 to 16:40	The HΓ-VNA, an Interferometric Approach For the Accurate Measurement Of Extreme Impedances	Raffaele Romano[1], Faisal Mubarak[2], Marco Spirito[3], Luca Galatro[1,3] *[1]Vertigo, [2]VSL, [3]TU Delft*
D-4	16:40 to 17:00	Non-Contact Characterization of Antenna Parameters via One-Port Open-Fixture Network Calibration	Seckin Sahin, Niru Nahar, Kubilay Sertel, *The Ohio State University*
Closing Notes. End of ARFTG-93rd Conference			

Interactive Forum Session Chair: Rusty Myers

P-1	09:50 to 15:40	Investigating the Effects of IF Bandwidth and Averaging on Calibrated Scattering-Parameter Measurements	Jeff Jargon, Amanda Koepke, Paul Hale, *NIST*
P-2	09:50 to 15:40	Noise Power Ratio Prediction and Measurement of a Ku band GaN Power Amplifier	Matthew Cullen, Mark Cavin, Lowell Hoover, Alan Cherrette, *Lockheed Martin*
P-3	09:50 to 15:40	Two-Tone Intermodulation Measurement of W-band Amplifiers based on High-Linearity Frequency Down-Conversion	Yuh-Jing Hwang, *Academia Sinica*
P-4	09:50 to 15:40	Low-Cost & Light-Weight 6 GHz Band Resin Based Cavity for Dielectric Plate Characterizations using Additive Manufacturing Techniques	Takashi Shimizu, Yoshinori Kogami, *Utsunomiya University*
P-5	09:50 to 15:40	Investigation of Waveguide Sensors for Ultra-Short-Distance Measurements	Aleksandra Baskakova, Karel Hoffmann, *Czech Technical University in Prague*
P-6	09:50 to 15:40	Impact of RFIC Spurious Noise on Receiver of Cellular Handset in Communication State	Masafumi Iwaki[1,3], Kazuhiro Matsumoto[1], Kazuhiko Kobayashi[1,2] *[1]Taiyo Yuden, [2]Taiyo Yuden Mobile Technology Co., [3]Chiba University*
P-7	09:50 to 15:40	Identity Authentication System using a Support Vector Machine (SVM) on Radar Respiration Measurements	Shekh Md Mahmudul Islam[1], Ashikur Rahman[2], Narayana Santhanam[1], Olga Boric-Lubecke[1], Victor Lubecke[1] *[1]University of Hawaii, [2]Aptiv*
P-8	09:50 to 15:40	Machine Learning in a Quality Managed RF Measurement Workflow	Aric Sanders[1], John M. Bass[2], Arpita Bhutani[3], MaryAnn S. Ho[4], James C. Booth[1] *[1]NIST, [2]Rose-Hulman Institute of Technology, [3]Peak to Peak Charter School, Lafayette, Co, [4]Fairview High School, Boulder Co.*
P-9	09:50 to 15:40	Waveguide Method for Surface Impedance Measurements on Composite Material Substrates	Dimitrios Fakis[1], Chris Worral[2], Mihalis Kazilas[3] *[1]Brunel University, [2]National Structural Integrity Research Center, [3]TWI*
P-10	09:50 to 15:40	Methodology of Nanoscale Electrical Characterization for Wide-Range Dielectric Permittivity Materials by Scanning Microwave Microscopy	Masahiro Horibe, Iku Hirano, *AIST*
P-11	09:50 to 15:40	Spectral Purity Measurement of Millimeter-Wave Signal Sources	Jae-Yong Kwon[1,2] Aditia Nur Bakti[2], No-Weon Kang[1] *[1]KRISS, [2]University of Science and Technology, Daejeon*
P-12	09:50 to 15:40	Challenges in Terahertz Fiber Based Inter-device Communications	Kathirvel Nallappan, Hichem Guerboukha, Yang Cao, Chahe Nerguizian, Maksim Skorobogatiy, *Ecole Polytechnique de Montreal*

ARFTG IEEE MTT-S MHz to THz Community www.arftg.org

Check the website (ims-ieee.org) or the mobile app for the most up-to-date room assignments as well as a detailed listing of workshop speakers and presentations. On-site registration is available for those who didn't pre-register. Workshop hopping within the day is allowed after the first 30 minutes.

	Workshop Title	Workshop Abstract
WFA	**Electroceuticals: Technologies and Modeling for Electromagnetically-Mediated Medical Treatments** **Sponsor:** IMS **Organizer:** L. Tarricone, Università del Salento; C. Merla, Enea **08:00 – 17:15** **Room 150**	The workshop addresses the "electroceutical" topic: a multidisciplinary initiative for medical treatments using electric/magnetic/electromagnetic power to modulate different body functions controlled by neurological circuits. These functions span from control of neuro-disorders, to heart pathologies, endocrine or metabolic dysfunctions. The workshop will cover the technological aspects, and will provide updated knowledge on modelling interactions between the stimulating signals (in a wide band of frequencies) and the targeted organs, down to the network of neurons. In the workshop, new technological applications related to flexible electronics (at radiofrequency-RF and microwaves-MW) and implantable devices will be proposed, including the use of nanosecond pulsed electric fields to target deep body regions with the new paradigm of the electric pulse bipolar cancellation effect. Advanced modelling of tissues and organs will be proposed under these stimulations to provide the so-called "dose-effects" curve as a meter for controlled and personalized treatments.
WFB	**The Analog vs. Digital Battle – A Fight of Paradigms to Optimize Systems & PA Solutions for Wireless Infrastructure in 5G and Beyond** **Sponsor:** IMS **Organizer:** A. Wentzel, FBH; G. Lasser, University of Colorado Boulder **08:00 – 17:15** **Room 151AB**	Next-generation wireless networks require a denser spatial distribution of base stations and a simultaneous usage of several antennas (MIMO). Moreover, frequency and service agility of the hardware components as well as integration of the RFPAs into the antenna and high frequency operation are pursued trends to fulfill the future requirements. As a result, the RFPAs need to satisfy the following essential requirements: high energy efficiency over a wide dynamic range of output power, supporting large bandwidths, while maintaining a small form factor and flexibility. In this workshop, international industry and academic experts will discuss demands and various perspectives with regard to efficient, extremely broadband and highly linear system and circuit design techniques suitable for future wireless communications in 5G and beyond. Various Si- and GaN-based solutions from cutting edge Doherty designs, load- as well as supply-modulated amplifiers, up to all-digital transmitters and PA approaches will be examined up to mm-waves.
WFC	**Towards A One-Chip Solution for GaN Front-Ends** **Sponsor:** IMS **Organizer:** C. Andrei, Brandenburgische Technische Universität; C.F. Campbell, Qorvo **08:00 – 17:15** **Room 153AB**	The goal of this full-day workshop is to address the current state-of-the-art of GaN-based RF front-ends for communication systems, with focus on the next generation of integrated one-chip solutions. In particular, the challenges related to the design requirements for system components and the hardware implementation of innovative array antennas and RF front-ends for communications up to Ka-band will be addressed. Speakers from leading companies, research institutes and academia will present several aspects related to the design of antenna arrays, switches and switch-based modules, rugged low-noise amplifiers, high power amplifiers, and novel system architectures. The talks will tackle different approaches to implement front-ends in communication systems in the microwave bands. A brief discussion will conclude the workshop summarizing the key issues addressed during the day. The attendees will be encouraged to pose questions and to discuss design issues that they may have.
WFD	**In-Band Full-Duplex Technologies and Applications** **Sponsor:** IMS **Organizer:** K. Kolodziej; B. Perry, MIT Lincoln Laboratory **08:00 – 17:15** **Room 156AB**	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). This technology could lead to enhanced spectral efficiency for future wireless networks, such as fifth-generation New Radio (5G NR) and beyond, and/or could enable capabilities and applications that were previously considered impossible, such as IBFD with phased array systems. In this workshop, experts from academic and federal research institutions will discuss the various approaches that can be taken to suppress the inherent self-interference that is generated in IBFD systems, and will present both static and adaptive techniques that span across the propagation, analog and digital domains. Presentations will contain details and measured results that encompass high-isolation antenna designs, RF and photonic cancellation as well as signal processing approaches, which include beamforming and linear/non-linear equalization. Throughout this workshop, state-of-the-art IBFD systems that utilize these technologies will be provided as practical examples for various applications.
WFE	**System Concepts and Digital Signal Processing for Advanced Microwave Sensors and Imagers** **Sponsor:** IMS **Organizer:** M. Gardill, InnoSenT; C. Carlowitz, FAU Erlangen-Nürnberg; N. Pohl, Ruhr-Universität Bochum **08:00 – 17:15** **Room 152**	Recent developments in system concepts and digital signal processing techniques are the key enablers for advanced microwave sensors and imagers offering unprecedented accuracy and resolution. A profound understanding of the underlying working principles of those systems is a key competence to advance the design of microwave sensors and imagers at component, system, as well as signal-processing levels. In this workshop, those concepts and processing techniques are introduced from both methodology-driven as well as application-driven viewpoints. Imaging radars, holographic techniques, polarimetric decomposition techniques, advanced processing for automotive radar, cognitive radar, and the application of compressed sensing to radar systems are introduced in tutorial-style presentations from leading experts working in the respective fields, from both academia and industry. The workshop provides a unique platform for an active exchange, to learn from cross-platform implementations, and to get ready to actively contribute to the next-level generation of microwave sensors and imagers.

Check the website (ims-ieee.org) or the mobile app for the most up-to-date room assignments as well as a detailed listing of workshop speakers and presentations. On-site registration is available for those who didn't pre-register. Workshop hopping within the day is allowed after the first 30 minutes.

Workshop Abstract	Workshop Title	
Radar sensors are used extensively almost everywhere to make daily life more comfortable and safe. Recent advances in silicon-based semiconductor technologies and packaging solutions enable the realization of cost-efficient low-power highly-integrated mm-wave radar sensor systems. In this full-day workshop we will discuss emerging (non-automotive) radar applications focusing on industrial, medical and consumer electronics, operating at mm-wave frequencies. Distinguished speakers from leading companies and academia will present a wide range of topics spanning from chip design of highly-integrated radar transceivers in silicon-based technologies, advanced system architectures (e.g. interferometry or MIMO radar), state-of-the-art and future trends on radar modulation techniques (e.g. FMCW using Micro-Doppler effect, PMCW, OFDM, Pulse-Doppler-Radar) up to the emerging applications (e.g. gesture recognition, object classification, glucose detection, vital sign monitoring). A brief concluding discussion will round-off the workshop to summarize the key learnings on the wide range of aspects presented during the day.	**Advanced Radar Systems for Industrial, Medical and Consumer Applications** **Sponsor:** IMS; RFIC **Organizer:** V. Issakov, Infineon Technologies; J. Reinstädt, Infineon Technologies; R. Weigel, FAU Erlangen-Nürnberg **08:00 – 17:15** **Room 156C**	WFF
Remarkable advances in the available computational power over the past few years, and those anticipated to come, have propelled machine learning algorithms (some developed decades ago) to the forefront of R&D in a wide and diverse range of fields: from medicine to autonomous vehicles and robotics. As the interest in these algorithms deepens, new algorithmic and theoretical developments are reported and applications are explored. These are assisted by the availability of open-source software tools and libraries, such as Google's TensorFlow and PyTorch. This workshop is a first step towards exploring the relevance and importance of machine learning for microwave engineers, and their CAD tools as used in industry and academia. We are combining a review of the field, its rich past in the microwave community (where artificial neural networks (ANNs) have been used as tools for microwave device modeling for many years) and its prospects, as developments in "deep learning" push the envelope of traditional ANNs even further, creating new opportunities to be harnessed.	**Microwave Engineering Applications of Machine Learning: Past, Present and Future** **Sponsor:** IMS **Organizer:** C. D. Sarris, University of Toronto **13:30 – 17:15** **Room 157A**	WFG
In this half-day workshop we discuss several aspects of the Remote Radio Unit (RRU). This is a remote radio transceiver that is located on the radio mast and is connected to the baseband unit (BBU) typically via a fiber interface. The RRU should support data rates of tens or hundreds of Gbps and MIMO operation. This poses challenging requirements for RF front-ends and antenna beamforming. Therefore, RRU has become one of the most important sub-systems in the distributed fronthaul architecture. Distinguished speakers from leading companies from industry and academia discuss several aspects of 5G infrastructure with a focus on challenges related to the hardware implementation of RF Front-End Modules (FEMs) and beamforming techniques for RRU. Additionally, a vision of 5G wireless networks will be provided. A brief concluding discussion will round-off the workshop to summarize the key learnings and discuss the future trends in radio access networks.	**Challenges for mm-Wave Remote Radio Units in 5G Infrastructure** **Sponsor:** IMS **Organizer:** V. Issakov, Infineon Technologies; U. Rüddenklau, Infineon Technologies; A. Hagelauer, FAU Erlangen-Nürnberg **08:00 – 11:50** **Room 157A**	WFH

First-time exhibitors are highlighted. Exhibitors as of 9 April 2019

First-time exhibitors are highlighted. Exhibitors as of 9 April 2019

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Huber+Suhner, Inc.	655
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IEEE Electromagnetic Compatibility Society	1256
IEEE Future Networks Initiative	1256
IEEE Xplore Digital Library	1256
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IMS Startup Pavilion	100
IMS University Booth	1400
IMST GmbH	1172
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EXHIBITOR ACTIVITIES

TUESDAY, 4 JUNE:

EXHIBIT HOURS	**09:30 – 17:00**
ATTENDEE COFFEE BREAKS	09:30 – 10:30 & 15:10 – 15:55 (coffee available by the meeting rooms from 9:40 – 10:10 only)
5G PAVILION THEATER PRESENTATIONS	BOOTH 2000
MICROAPPS THEATER PRESENTATIONS	BOOTH 200
INDUSTRY WORKSHOPS	ROOMS 152, 156C, 157A, & 158
SOCIETIES PAVILION/IEEE MOVE TRUCK	BOOTH 1256
SWEET TREAT TUESDAY	12:30 – 13:30
UNIVERSITY DEMOS	BOOTH 1400
STARTUP PANEL DISCUSSION	15:45 – 17:00, BOOTH 200

WEDNESDAY, 5 JUNE:

EXHIBIT HOURS	**09:30 – 18:00**
ATTENDEE COFFEE BREAKS	09:30 – 10:30 & 14:30 – 15:30 (coffee available by the meeting rooms from 9:40 – 10:10 only)
5G PAVILION THEATER PRESENTATIONS	BOOTH 2000
EXHIBIT ONLY TIME	13:30 – 15:30
INDUSTRY HOSTED RECEPTION	17:00 – 18:00
INDUSTRY WORKSHOPS	ROOMS 152, 156C, 157A, & 158
OPTIMUS RIDE VEHICLE	MICROWAVE BOULEVARD
MICROAPPS THEATER PRESENTATIONS	BOOTH 200
SOCIETIES PAVILION/IEEE MOVE TRUCK	BOOTH 1256
UNIVERSITY DEMOS	BOOTH 1400
NEXT TOP STARTUP COMPETITION	16:30 – 17:00, BOOTH 200

THURSDAY, 6 JUNE:

EXHIBIT HOURS	**09:30-15:00**
ATTENDEE COFFEE BREAK	09:30-10:30 (coffee available by the meeting rooms from 9:40 – 10:10 & 15:10 – 15:55)
5G PAVILION THEATER PRESENTATIONS	BOOTH 2000
INDUSTRY WORKSHOPS	ROOMS 152, 156C, 157A, & 158
MICROAPPS THEATER PRESENTATIONS	BOOTH 200
SOCIETIES PAVILION/IEEE MOVE TRUCK	BOOTH 1256
UNIVERSITY DEMOS	BOOTH 1400

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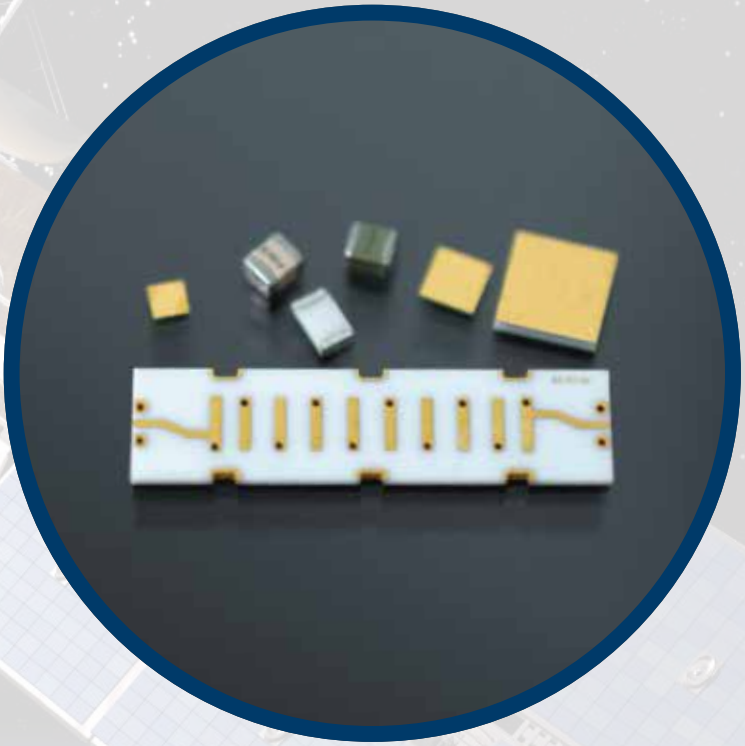

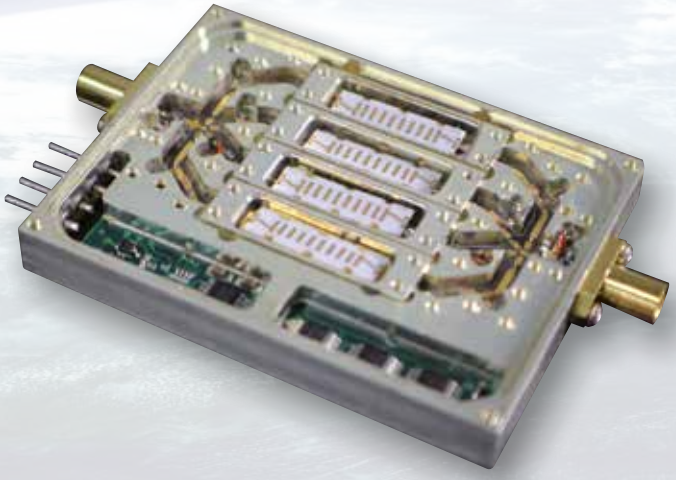

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