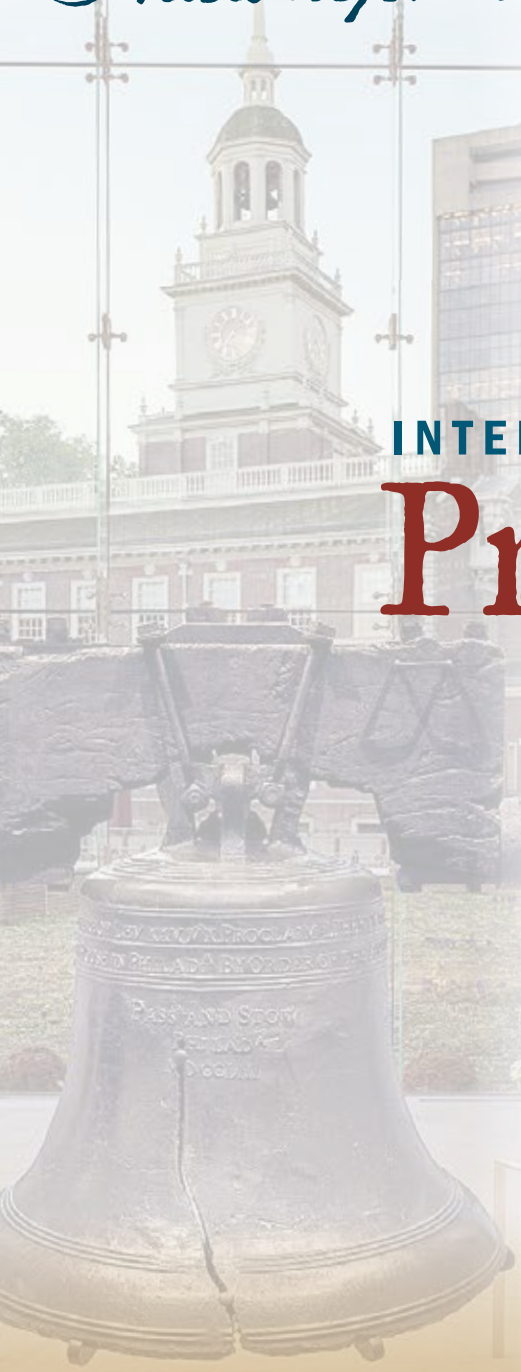
MICROWAVES | MEDICINE | MOBILITY

IMS2018

Philadelphia

ENERGY AND PERSISTENCE CONQUER ALL THINGS.

BENJAMIN FRANKLIN



2018

INTERNATIONAL MICROWAVE SYMPOSIUM

Program Book

AND EXHIBITION CATALOG

IEEE MTT-S RFIC ARFTG IMBioC®

IMS

Microwave Signal Sources from...

Your Time-Trusted Source.

Fast (1 µsec) INDIRECT SYNTHESIZER with Modulation

Models SM6218 and SM6220 The latest high performance Synthesizers.

The Series SM synthesizers are cost effective solutions for today's demanding Electronic Warfare, Simulator and Test Systems.

MAIN FEATURES

- High Speed: 1µsec
- Wide Frequency Range: 2 to 20 GHz
- Modulation Span: 1 GHz
- Analog & Digital Modulation Input
- High Reliability
- Pure Locked Mode (PLM)

Other Catalog & Custom Microwave Signal Sources from Kratos General Microwave include:

Digitally Tuned Oscillators (DTO)
Frequency Locked Oscillators (FLO)
Voltage Controlled Oscillators (VCO)

Visit us at BOOTH 1416

KRATOS | General Microwave
Microwave Electronics Division

227A Michael Drive, Syosset New York 11791
Tel: 516 - 802 - 0900, Fax: 516 - 802 - 0897
E-mail: kratosgeneralmicrowave@kratosdefense.com
www.kratosmed.com

IMS2018 Table of Contents

The Week At A Glance

	Early Morning	Mid Morning	Noon
Sunday, 10 June	**Full-Day Workshops / Short Courses 08:00–17:15 • Coffee Break 09:40–10:10 • Boxed Lunch Distribution 11:45–13:30 • Coffee Break 15:10–15:40 | PCC 100 Level** **WSC:** 5G mm-Wave Power Amplifers, Transmitters, Beamforming Techniques and Massive MIMO • **WSD:** eXtreme-Bandwidth: Architectures for RF and mmW Transceivers in Nanoscale CMOS **WSE:** Integrated mm-Wave & THz Sensing Technology for Automotive, Industrial and Healthcare • **WSF:** Advanced Integrated RF Filtering Circuits and Techniques **WSG:** Synthesizer Design and Frequency Generation/Synchronization Schemes for High-Performance Wireless Systems • **WSH:** High-performance WLAN Transceiver Design and Calibration Techniques **WSI:** High Effciency Power Amplifcation for Emerging Wireless Communications Solutions from Devices to Circuits and Systems • **WSJ:** Millimeter-wave Systems; Manufacturing, Packaging and Built-in Self Test **AM Workshops / Short Courses 08:00–11:50 • Coffee Break 09:40–10:10 | PCC 100 Level** **WSA:** RFIC Design in CMOS FinFET and FD-SOI **WSB:** ICs for Quantum Computing and Quantum Technologies		**Boxed Lunch Distribution** 11:45–13:30 PCC 100 Level
Monday, 11 June	**Full-Day Workshops** **WMA:** Wireless Technologies for Implantable and Wearable Systems • **WMB:** Microwave to THz Imaging Technologies for Biomedical Applications **WMC:** 3D-/4D-/Inkjet-Printed RF Components and Modules for IoT, 5G and Smart Skin Applications • **WMD:** Power Amplifer Technologies for 5G Communications Systems **WME:** Digital Pre-Distortion and Post-Correction from DC to mmWave for Wireline and Optical Communications • **WMF:** Microwaving Cells: From Biological Effects to Innovative Techniques for Cell Analysis **WMG:** Recent Advances in Effciency and Linearity Enhancement Techniques for RF Power Amplifcation • **WMJ:** Advanced Applications of Nonlinear Vector Network Measurements for Broadband RF Power Amplifiers Design & **WMK:** Affordable Phased-Arrays for SATCOM and Point-to-Point Systems Using Silicon Technologies **AM Workshops / Short Courses 08:00–12:00 • Coffee Break 09:40–10:10 | PCC 100 Level** ~~**SMA:** Practical Computer Modeling for Electromagnetic Medical Device Design~~ **CANCELLED** **WMH:** Microwave and Millimeter-wave Radiometers: Component Technologies, System Architectures, and Emerging Applications **Historical Exhibit** 08:00–17:00 | PCC 200 Level Bridge **RF Boot Camp** 08:00–16:30 | PCC 109B		**Boxed Lunch Distribution** 11:45–13:30 PCC 100 and 200 Levels
Tuesday, 12 June	**08:00–09:40 RTU1 and TU1 Oral Sessions** **RTU1A:** mm-Wave Power Amplifiers | PCC 201A **RTU1B:** Submillimeter Wave and Terahertz ICs | PCC 201B **RTU1C:** mm-Wave Radar and Beamforming Transceivers | PCC 204A **TU1C:** Advances in Combiners and Dividers | PCC 201C **TU1D:** Novel Microwave and Millimeter Materials, Devices and Radiating Structures | PCC 202AB **TU1G:** Resonator-based Sensors | PCC 204B **TU1H:** Advanced Structures using Additive Manufacturing Process | PCC 204C Coffee Break 09:40–10:10 | PCC 200 Level	**10:10–11:40 RTU2 and TU2 Oral Sessions** **RTU2A:** mm-Wave LNAs and RF Receiver Front-Ends | PCC 201A **RTU2B:** Wireless Transceivers and Transmitters for Connectivity and Cellular | PCC 201B **TU2C:** Recent Developments in Passive Circuits | PCC 201C **TU2D:** Advances in Modeling and Design Optimization| PCC 202AB **TU2E: Focus Session:** Radio to Terahertz Waves toward Nanoscale Sensing, Imaging, and Characterization of Biological Samples | PCC 203AB **TU2G:** Advances in Near-Range Radar Sensors | PCC 204B **TU2H:** 3D-Printed Waveguide Structures | PCC 204B **IMS Student Paper Competition** 10:10–11:50 |PCC Exhibit Hall	**IMS/RFIC Joint Panel Session:** Can a Residential Wireless Gbps Internet Connection Compete With Wired Alternatives? 12:00–13:00 | PCC 201A **Boxed Lunch Distribution** 11:45–13:30 PCC 200 Level
	5G Summit: 08:00–17:15 | PCC 103ABC | Coffee Breaks and Boxed Lunches (for 5G Summit) Distributed Outside PCC 103ABC **IMS Student Design Competitions** 09:00–17:00 | PCC Exhibit Hall **Historical Exhibit** 08:00–17:00 | PCC 200 Level Bridge • **Exhibition** 09:30–17:00 • **MicroApps** 09:45–17:00 | PCC Exhibit Hall • **Industry Workshops** 10:00–12:00 | PCC 105B, 106AB, 107B		
Wednesday, 13 June	**08:00–09:40 WE1 Oral Sessions** **WE1A:** 5G sub-systems: From Pre-distortion to Complete Link | PCC 201A **WE1B:** VHF/UHF Components and Analog Signal Processing | PCC 201B **WE1C:** Planar Multiplexers and Multi-Band Filters | PCC 201C **WE1D:** Advanced Behavorial Models of Devices and Systems | PCC 202AB **WE1E:** Advanced MEMS Filters, Resonators, and Waveguides | PCC 203AB **WE1F:** Si-based MMW/THz Circuits | PCC 204A **WE1G:** Enabling Array Components and Beam Forming Architectures | PCC 204B **WE1H:** High Performance Power Amplifiers | PCC 204C Coffee Break 09:40–10:10 | PCC 200 Level	**10:10–11:50 WE2 Oral Sessions** **WE2A:** Mulit GHz All Digital and Mixed Signal Circuits and Systems | PCC 201A **WE2B:** Advances in Mixers and Frequency Multipliers | PCC 201B **WE2C:** Filter Tuning, Synthesis, and Innovative Coupling Realizations | PCC 201C **WE2D:** Trapping Phenomena in GaN HEMTs | PCC 202AB **WE2E:** Ferrite, Ferroelectric, and Phase-Change Components | PCC 203AB **WE2F:** THz and mm-Wave Amplification Multiplication and Control Innovations | PCC 204A **WE2G:** Phased Array Systems and Applications | PCC 204B **WE2H:** High Power Doherty Power Amplifiers | PCC 204C **WEIF1: IMS Interactive Forum** 10:10–11:50 |PCC Exhibit Hall	**IMS Panel Session:** Body Wearable Technology: Is It Still Relevant And What Is Its Future? 12:00–13:00 | PCC 201A **Boxed Lunch Distribution** 11:45–13:30 PCC Level 200
	Historical Exhibit 08:00–17:00 | PCC 200 Level Bridge • **Exhibition** 09:30–18:00 • **MicroApps** 09:30–17:00 | PCC Exhibit Hall • **Industry Workshops** 10:00–12:00 | PCC 105B, 106AB, 107B		
Thursday, 14 June	**08:00–09:40 TH1 Oral Sessions** **TH1A:** Advanced Technologies for Non-Planar Filters and Diplexers | PCC 201A **TH1B:** Advanced Rectifiers and Energy Harvesters for Wireless Power Transfer | PCC 201B **TH1C:** Electromagnetic Biosensing | PCC 201C **TH1D: IMS/ARFTG Joint Session:** Advanced High Frequency Large Signal Measurement Techniques| PCC 202AB **TH1E:** Recent Advances in Terahertz and Photonics | PCC 203AB **TH1F:** RF Transceiver Architecture for MIMO and Beam Steering | PCC 204A **TH1H:** Doherty and Load-Modulated Power Amplifiers | PCC 204C Coffee Break 09:40–10:10 | PCC 200 Level	**10:10–11:50 TH2 Oral Sessions** **TH2A:** Synthesis and Design of Non-Planar Filters and Multiplexers | PCC 201A **TH2B:** Recent Developments in Wireless Power Transfer Techniques | PCC 201B **TH2C:** Hyperthemia Treatment and Implants Wireless Powering | PCC 201C **TH2D: IMS/ARFTG Joint Session:** Innovative mm-wave Calibration and Measurement | PCC 202AB **TH2E: Focus Session:** Integrated Microwave Photonics for Millimeter-wave and 5G Applications | PCC 203AB **TH2F: Focus Session:** 5G Millimeter-Wave Beamformers and Phased-Arrays| PCC 204A **Special Event Honoring George Haddad** | PCC 204B **TH2H:** Millimeter Wave Broadband Power Amplifiers | PCC 204C **THIF1: IMS Interactive Forum** 10:10–11:50 | PCC Exhibit Hall	**IMS Panel Session:** 5G PA/FEM: Si or III-V - Who Will Win The Race? 12:00–13:00 | PCC 201A **Boxed Lunch Distribution** 11:45–13:30 PCC Level 200 **IMS Physician's Panel Session:** U 12:00–14:00 | PCC 204B **Student Awards Luncheon** 12:00–14:00 | PCC 108AB
	Historical Exhibit 08:00–17:00 | PCC 200 Level Bridge • **Exhibition** 09:30–15:00 • **MicroApps** 09:45–14:00 | PCC Exhibit Hall • **Industry Workshops** 10:00–12:00 | PCC 105B, 106AB, 107B		
Friday, 15 June	**Full-Day Workshops / Short Courses 08:00–17:00 • Coffee Break 09:40–10:10 • Boxed Lunch Distribution 11:45–13:30 • Coffee Break** **WFA:** Ultra-Low-Power Nanowatt to Microwatt Receivers for the Internet of Things • **WFB:** RF Front-Ends for Enhanced Mobile Communications Towards 5G **WFF:** Tunable Passive Devices for Multi-band Systems • **WFG:** Advances in Linearization Techniques for 5G and Beyond **WFH:** Module Integration and Packaging/IC Co-Integration for Millimeter-wave Communications and 5G • **WFI:** Innovative Technologies for RF and millimeter-wave Tuning and Switching **WFJ:** Design of Matching Networks for Optimal Performance of Power Amplifiers and Transmitters • **WFK:** The New GaN: Advancements in novel-materials based GaN Microwave and mm-Wave Technologies **AM Workshops / Short Courses 08:00–12:00 • Coffee Break 09:40–10:10 | PCC Level 100** ~~**SFA:** Multi-Beam Antennas and Beam-Forming Networks~~ **CANCELLED** **WFD:** Advanced Synthesis techniques for reduced size filtering networks **WFE:** Recent Advances in Non-Linear and Non-Reciprocal RF Microwave		**Boxed Lunch Distribution** 11:45–13:30 PCC Level 200
	2018 IEEE MTT-S International Microwave Biomedical Conference (IMBioC) 08:00–17:10 | PCC Level 200 **91st ARFTG Microwave Measurement Conference (ARFTG)** 08:00–17:00 | Loews Hotel, Regency Ballroom		

IMS	RFIC /ARFTG/IMBioC	Workshops	Exhibition	Students / Competitions / Networking

Early Afternoon	Mid Afternoon	Late Afternoon / Evening
		RFIC Plenary Session 17:30–19:00 PCC, Grand Ballroom
PM Workshops 13:00–17:15 • Coffee Break 15:10–15:40 | PCC 100 Level		**RFIC Reception & Industry Showcase** 19:00–21:00 Loews Hotel, Millennium Hall
WSK: Towards Direct Digital RF Transceivers		
WSL: Ultra Low-Power Transceiver SoC Designs for IoT Applications		
		IMS Plenary Session 17:30–19:00 PCC, Grand Ballroom
Linearization		
PM Workshops / Short Courses 13:00–17:15 • Coffee Break 15:10–15:40 | PCC 100 Level		**IMS Welcome Reception** 19:30–20:30 Reading Terminal Market
~~**SMB:** Fundamentals of Magnetic Resonance Imaging~~ **CANCELLED**		
WMI: Automotive Radar and Vehicular Network Security		
3MT® Competition 14:00–16:00 |PCC 201C		
13:30–15:10 RMO3 Oral Sessions	**15:30–17:20 RMO4 Oral Sessions**	
RMO3A: RF Front-Ends for Emerging Wireless Paradigms | PCC 201A	**RMO4A:** Ultra-Low Power Radios for Security, Ranging and Connectivity | PCC 201A	
RMO3B: Mixed Signal Transmitters and Power Amplifiers | PCC 201B	**RMO4B:** Silicon Integrated mm-Wave Transmitters | PCC 201B	
RMO3C: cm/mm-Wave CMOS Integrated Phased-Array Building Blocks | PCC 204A	**RMO4C:** Highly Efficient mm-Wave Oscillators with Wide Tuning Range | PCC 204A	
13:30–15:10 TU3 Oral Sessions	**15:55–17:15 TU4 Oral Sessions**	
TU3B: Tom Brazil Memorial Session on Non-Linear Circuits | PCC 201B	**TU4B: Focus Session:** Non-Doherty Load Modulated Power Amplifiers | PCC 201B	
TU3C: Advances in Millimeter-Wave Integrated Waveguide Components and Transitions | PCC 201C	**TU4C:** Integrated Waveguide Structures and Techniques | PCC 201C	
TU3D: Advances in Numerical Modelling for Multi-Scale and Multi-Physics Applications| PCC 202AB	**TU4D:** Novel Theoretical Approaches in Microwave Structure Analysis and Design | PCC 202AB	
TU3E: Advances in Microwave and Terahertz Applications in Nanotechnology | PCC 203AB	**TU4E:** Nano-Scale Devices and Antennas | PCC 203AB	
TU3F: Biomedical Radar | PCC 204A	**TU4G:** Advances in Chipless and RFID Sensors | PCC 204B	
TU3G: Advances in Backscattering and RFID Circuits | PCC 204B	**TU4H:** Novel Interconnects for W- and D-band | PCC 204C	
TU3H: Novel Package/PCB Integration Concepts | PCC 204B		
	Special Event Honoring Peter Herczfeld | PCC 204A	
RTUIF: RFIC Interactive Forum 13:30–15:00 |PCC Exhibit Hall	**TUIF1: IMS Interactive Forum** 15:55–17:00 |PCC Exhibit Hall	
		Young Professionals Panel Session: "Skills that enable impact in microwaves, medicine, and mobility" 17:30–19:00 PCC 201A
		Young Professionals Networking Event 19:30–21:30 Lucky Strikes 1336 Chestnut Street, Philadelphia
		Amateur Radio Social 18:30–20:30 PCC 108AB
Industry Workshops 13:00–15:00 |PCC 105B, 106AB, 107B	**Industry Workshops** 15:15–17:15 |PCC 105B, 106AB, 107B	
	15:55–17:15 WE3 Oral Sessions	**Industry-Hosted Reception** 17:00–18:00 PCC Exhibit Hall
Exhibition Only Time 11:50–15:55 PCC Exhibit Hall	**WE3A:** Novel Microwave Circuits and Systems Applications | PCC 201A	
	WE3B: Focus Session: Emerging RF Switch Technologies for 5G and Defense Applications | PCC	
	WE3E: Microwave Acoustic Components for Wireless Applications | PCC 203AB	
	WE3F: Terahertz and mm-wave Technologies and Applications | PCC 204A	
	WE3G: Broadband Radar Systems and Technologies | PCC 204B	**MTT-S Awards Banquet** 18:30–21:30 Loews Hotel, Regency Ballroom
	WE3H: Special Session: Women in Microwaves: Research on Biomedical Applications | PCC 204C	
	WEIF2: IMS Interactive Forum 15:55–17:00 | PCC Exhibit Hall	
	Industry Workshops 15:15–17:15 | PCC 105B, 106AB, 107B	
13:30–15:10 TH3 Oral Sessions		
TH3A: New Tuning Concepts for 3-D, Planar and Integrated Filters and Duplexers | PCC 201A		
TH3B: Techniques and Components for High-Power Microwave Technology | PCC 201B		
TH3C: Biomedical Devices| PCC 201C	**IMS Closing Session/IMBioC Opening Session** 15:30–17:30 | PCC Grand Ballroom	**IMS Closing Session/ IMBioC Opening Session Reception** 17:30–18:30 PCC Grand Hall
TH3D: Advances in CMOS Microwave and Millimeter Wave Signal Sources | PCC 202AB		
TH3E: Advances in Semiconductor Monolithic Integrated Circuit Technology | PCC 203AB		
TH3F: THz and mm-Wave Sensing and Communication Systems | PCC 204A		
TH3H: Advances in Low Noise Technology | PCC 204C		
tilization of RF/Microwaves in Medicine		**Women in Microwaves Networking Event, Joint with IMBioC 2018** 19:00–21:00 Philadelphia Academy of Fine Arts
Industry Workshops 13:00–15:00 | PCC 105B, 106AB, 107B		
~~**SFB:** Using Active Fiber Optic for Distributed Antenna System (DAS) in 5G MIMO System and Automobile Radar System~~ **CANCELLED**		

Coffee Break 15:10–15:40 | PCC Level 200

Coffee Break 15:10–15:40 | PCC Exhibit Hall

Coffee Break 15:10–15:40 | PCC Exhibit Hall

All Workshops and Short Courses are located at the Pennsylvania Convention Center (PCC). Specific room assignments will be provided onsite.
Session and event locations may be changed with no notice. Please use the IMS Mobile App or IMS website, or the posted signage for the latest information.

Microwave Week Is All About Connections...

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

JOIN THE CONVERSATION:

Make sure you're engaging with IMS2018 on our social channels:

- Follow us on Twitter: ***http://twitter.com/MTT_IMS***
- 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: ***http://www.linkedin.com/groups?gid=2375668***
  (Group Name: 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: **#ims2018**

For the most up to date information visit: ***www.ims2018.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, IMBioC, 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 Philadelphia 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.

Download on the App Store

ANDROID APP ON Google play

For assistance, please email ***support@mtt.org***.

FRIENDS ARE THE TRUE SCEPTRES OF PRINCES.

BENJAMIN FRANKLIN

Life, Liberty and the Pursuit of Happiness[1]

Welcome to Philadelphia, the city of brotherly love!

It is my great pleasure to invite you to the 2018 International Microwave Symposium (IMS2018), the pre-eminent annual gathering of the RF, microwave, and millimeter-wave researchers, technologists, and practitioners. As most attendees know, the IMS is the flagship conference of the IEEE Microwave Theory & Techniques Society (MTT-S). The IMS is also the centerpiece of the IMS Microwave Week (IMS week), a week of co-located conferences including the RFIC Symposium and the ARFTG Conference. Unique to this year, the IMBioC'18 will be held as a co-located one-day conference on Friday. The IMS week also hosts a Tuesday 5G Summit and Panel that is co-sponsored by the IEEE Communications Society (ComSoc).

The IMS2018 themes "Microwaves, Medicine, and Mobility" highlight the contributions of the RF, microwave, and millimeter-wave industry and academic communities to the fields of medicine and tele-communications. IMS demonstrates how our community benefits the world at large, by achieving improved communications, connectivity, and health outcomes — across communities, countries, and continents — as befits an international society such as the MTT-S. This is especially true for the Plenary and Closing Ceremony speakers, who highlight the IMS themes by presenting a roadmap for improving healthcare within the next ten years and enabling new frontiers in communications and mobile connectivity.

The IMS2018 Steering Committee has worked diligently for more than two years to create a wonderful program that is attractive to all attendees of the IMS week. It is based on the principles of "listen, learn, earn, and enjoy."

The IMS attendees can listen and learn from leading experts in industry and academia, the latest technical innovations in microwave theory and practice, at the technical sessions, panels, workshops, and short courses. Please make time to attend the Thursday panel session of physicians describing their use of microwave technology-based tools for diagnosis and treatment. Learning opportunities also abound at our industry hosted workshops, Micro-Apps theater, and RF Bootcamp.

Other learning opportunities are available at the "Societies Pavilion" that is located, for the first time, in the exhibition area. Our attendees, especially Young Professionals (YoPros) and practicing engineers are highly encouraged to stop by and interface with the societies' volunteers, and learn about participation in the local chapter, regional, and society administrative committee activities.

Our attendees, especially our exhibitors, earn a great return-on-investment (ROI) for their time and efforts by interfacing with the users of their products and services and learning how their products and services help to serve the community. Unique to IMS2018, our exhibitors also have the opportunity, at the Thursday "Career Counseling Fair", to guide the future careers of our highly talented students, most of whom specialize on topics of great interest to the industry.

I highly encourage all our attendees to enjoy the IMS week activities, such as networking at the Welcome Reception held at the world-famous Reading Terminal Market; YoPros, Women in Microwaves (WiM), and Amateur Radio (Ham) receptions; Project Connect for Under-Represented Minorities; and the Ph.D. Student Initiative. The Amateur Radio Social is back on Tuesday evening, and includes a talk by Nobel Laureate, Dr. Joe Taylor.

As you enjoy the IMS week activities, please be sure to make time to enjoy the greater delights that Philadelphia — America's First Heritage City — has to offer. Many attendees know about the Liberty Bell, Independence Hall, Congress Hall, and the Franklin Court — all of which played a role in America's struggle for independence. During June's pleasant weather in Philadelphia, consider making a side trip to Valley Forge, Gettysburg, or to Longwood Gardens. You may also want to consider the museums and galleries that Philadelphia has to offer, e.g., Museum of Art with its largest collection of Duchamp, Rodin Museum with its largest public collection of Auguste Rodin's sculptures, and Barnes Foundation with the collections of Renoir, Cézanne, Matisse, Van Gogh, and Picasso.

If you cannot make time for any of the above, please do make time to try the world-famous "Philly Cheesesteak" at Pat's or Geno's. Better yet, try both places to see which one you like best and debate whose is better. But no matter where you try it, order it as a local — "wit" or "wit'out" is your choice!

As you read this Program Book with its collection of Ben Franklin's sayings (who would surely be an IEEE member if it had existed at that time) and historical footnotes, please celebrate the fact that we are a global community — bound together for a common purpose — to address the practical needs of society.

I look forward to seeing you in Philly in June! ■

Best regards,
Sridhar Kanamaluru
IMS2018 General Chair

[1] The United States Declaration of Independence voted by the Second Continental Congress on July 2, 1776 in Philadelphia includes the well-known phrase "Life, Liberty and the pursuit of Happiness" as examples of "unalienable rights" which all human beings have and which their governments must protect. While life and liberty are well defined, the exact meaning of "happiness" in 1776 is a matter of debate. Many believe that it meant "prosperity, thriving, wellbeing" – something that I wish for all attendees of the IMS Microwave Week.

Welcome to America's First World

Philadelphia is at the center of it all. It is easy and affordable to get here. Conveniently located in the Northeast United States, the second-most populous city in the East is just 90 minutes from New York City and two hours from Washington, D.C., by train. Philadelphia International Airport serves more than 120 cities worldwide with 1,000 daily flights, including 100 international flights. The regional public transportation system — ranked second in the nation among cities with more than 1 million residents — provides quick and easy access to the city from the surrounding metropolitan area.

You will be captivated by our 21st-century city where an inspired, young, creative culture is blooming and partnering with innovators and educators. With a spirit of independence, the city and region are giving birth to a new generation of energized people designing this Modern Renaissance City.

Feel like a Philadelphian as you walk day and night through the vibrant streetscape and immerse yourself in America's old and new worlds. Picturesque and friendly streets are lined with parks, rivers, shops, public art, restaurants and museums. Everything is within walking distance from downtown.

GENIUS WITHOUT EDUCATION IS LIKE SILVER IN THE MINE.

BENJAMIN FRANKLIN

Photo from the middle of the Ben Franklin Parkway, which begins at the City Hall, curves around Logan Circle, and ends at the Pennsylvania Museum of Art. Lined by the flags of many countries, the Ben Franklin Parkway runs through the cultural heart of Philadelphia and features several museums.

Tour Guides, in period attire, leading tourists through Philadelphia's historic district.

ARRIVING

Only 100 miles from New York City and 130 miles from Washington, D.C., we're not kidding when we say we're in the center of it all.

BY PLANE: There are more than 525 daily nonstop flights to Philadelphia (PHL). Once you're here, it's a 20-minute train ride on the SEPTA Airport Line right at the airport or a 20-minute ride in a taxi to cover the 10 miles from ***Philadelphia International Airport*** to Center City. SEPTA's Airport Line leaves every 30 minutes, and a one-way fare is $6.75 when you purchase a Quick Trip from the Fare Kiosk on the platform. The taxi ride costs a flat rate of $28.50. Call the Airport Ground Transportation Hotline at 215-937-6958 for information on other ground transportation options.

BY TRAIN: Amtrak Acela and commuter trains arrive at historic ***30th Street Station*** throughout the day, placing passengers within a short walk of Center City. Philadelphia is only an hour and 20 minutes from New York City and an hour and 45 minutes from Washington, D.C., via Acela Express.

BY BUS: Megabus offers low-cost express bus routes throughout the Northeast Corridor.

BY CAR: Almost half of the U.S. population is within a day's drive of Philadelphia. Interstates 95 and 76, and the Pennsylvania and New Jersey Turnpikes, provide access from all points on the compass. Once you arrive, there are more than 40 parking lots and garages in Center City. Pay with cash or credit. For a printable map of downtown parking, visit ***philapark.org***.

GETTING AROUND

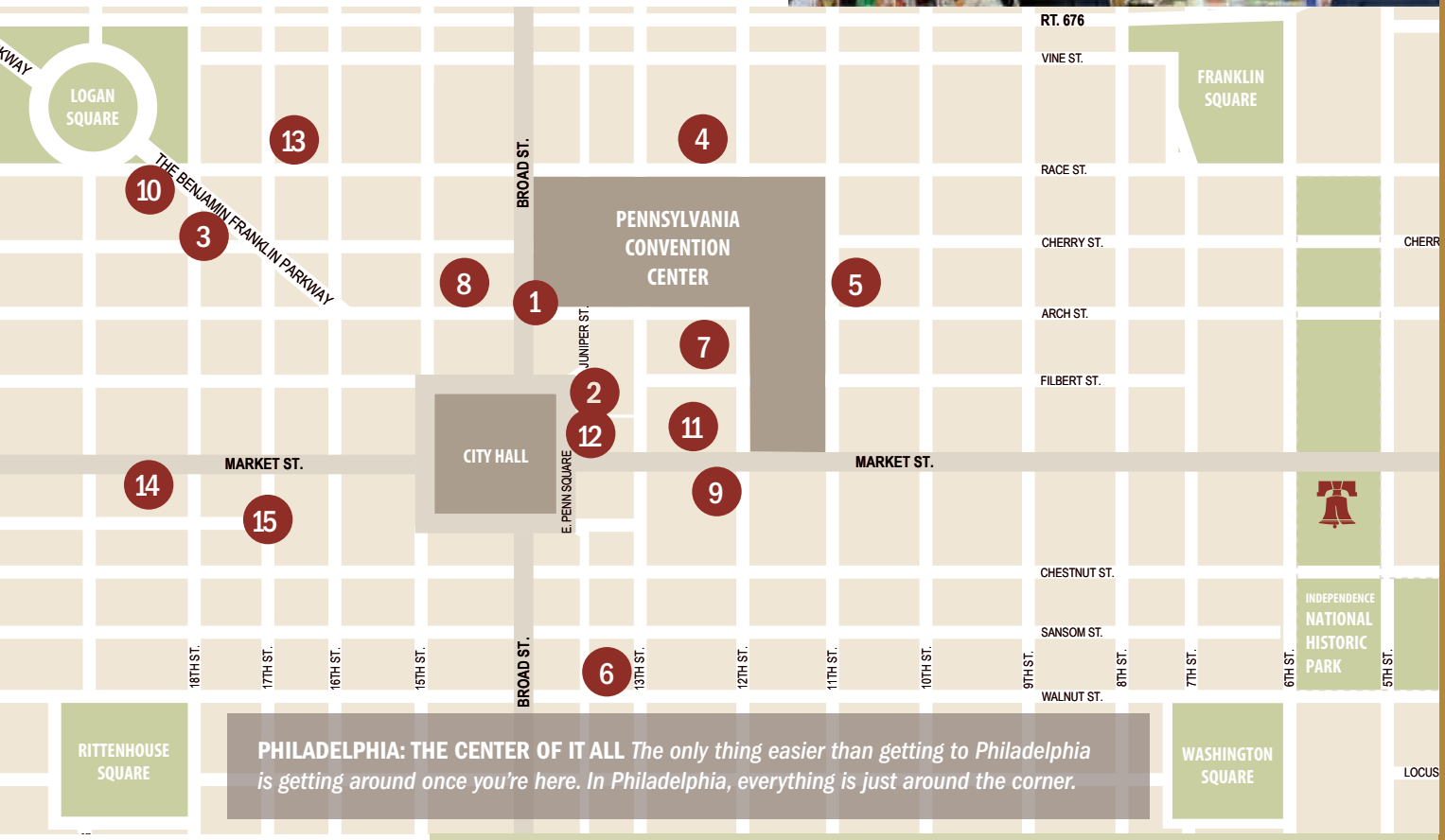
Philadelphia has been ranked as one of the most walkable cities in the nation, but it also has a top-notch mass transit system and more.

GET ORIENTED: Thanks to founder William Penn's smart and simple grid street design, the heart of the city is easy to navigate. The Schuylkill and Delaware rivers border Center City's 25 blocks on the west and east. Keep in mind that, south of Market Street, streets running east and west are named after trees while north and south streets are numbered. Check out the ***printable Center City map (pdf)*** or view our ***interactive city map*** for more information.

WALKING: First-rate dining, arts and entertainment, famous historic sites and tax-free clothing and shoes shopping are within steps of Center City hotels, so you'll save on transportation. As you walk, you'll notice color-coded

Heritage City!

Amish merchant at the Reading Terminal Market, where the IMS Welcome Reception will be held



directional signs that let you know what district you're in and point you toward area attractions. And look for ***Center City District's*** goodwill ambassadors, dressed in teal uniforms and equipped with maps, who are happy to give directions and answer questions.

PUBLIC TRANSPORTATION: Base cash fare for ***SEPTA*** buses, trolleys and subways is $2.50; transfers are $1. Get the SEPTA Key Card and put money in the Travel Wallet and enjoy the discounted $2 fare when you tap to ride. For families on the go, the best travel value is the One Day Family Independence Pass for $30 (good for up to 5 people traveling together). Sightseeing solo? Try the One Day Individual Independence Pass for $13. Both provide unlimited travel on all SEPTA modes of transportation for a full day.

IMS PHILADELPHIA HOTELS

1. Aloft Philadelphia
   Broad & Arch Streets
2. Courtyard by Marriott
   21 N. Juniper Street
3. Embassy Suites by Hilton
   1776 Benjamin Franklin Parkway
4. Four Points by Sheraton
   1201 Race Street
5. Hilton Garden Inn
   100 Arch Street
6. Holiday Inn Express
   1305 Walnut Street
7. Home2 Suites by Hilton
   1200 Arch Street
8. Le Meridien Philadelphia
   1421 Arch Street
9. Loews Philadelphia Hotel
   1200 Market Street
10. The Logan
    1 Logan Square
11. Philadelphia Marriot Downtown
    1201 Market Street
12. Residence Inn
    1 E. Penn Square
13. Sheraton Philadelphia Downtown
    201 N 17th Street
14. Sonesta Hotel
    1800 Market Street
15. Westin Philadelphia
    99 South 17th Street

CAB: There are more than 1,800 licensed and trained cabs in Philadelphia. Or download the Uber or Lyft app to order a town car to your location.

Philly PHLASH is the city's seasonal transportation loop that makes it easy and convenient to get around to Philadelphia's most popular attractions. The bus costs $5 for an all-day pass.

BY BIKE/SEGWAY: Check out ***Wheel Fun Rentals*** and ***Philadelphia Segway Tours*** for more information, or participate in Philly's bike share program, ***Indego***. With more than 100 stations located throughout the city, go for a ride and explore Philadelphia, then return your rented bike to any station location.

What's New For IMS2018

As many long-time MTT-S members and IMS attendees know, both the MTT-S and IMS have been highly successful for a very long time. For MTT-S, 2018 is the 66th year of its formation. For IMS, 2018 is the 61st year of technical sessions and 46th year of exhibits. Every IMS Steering Committee, responsible for defining the year's themes and innovations, carefully weighs this vast body of past successful events while contemplating changes and innovations to enhance the current attendee experience[1]. In most cases, the prudent practice is not to fix things that aren't broken; and focus on topics, technologies, and logistics that address the current needs of the rapidly changing attendee demographics. IMS2018 in Philadelphia, America's First Heritage City, takes this practice to heart by retaining and building on the successful past while introducing the following new activities, innovations, and logistics that focus on what matters most — ensuring that our attendees "listen, learn, earn, and enjoy" the IMS Week.

IMS2018 themes "Microwaves, Medicine, Mobility" are highlighted throughout the IMS week including the Plenary talk by Dr. Stephen Klasko on how to change the American healthcare landscape in ten years; several focus and special sessions; Thursday lunch panel of practicing physicians describing the microwave-based tools for diagnosis and treatment, and evening panel and reception jointly organized by the Women In Microwaves (WIM) and IMBioC'18; and at Friday's IMBioC'18 conference.

The mobility theme is highlighted at the Tuesday 5G Summit and Panel, co-sponsored by MTT-S and ComSoc; several workshops, panels, and technical sessions; and the Thursday Closing Ceremony speech by Prof. Nader Engheta. As a first, IMS2018 includes a reception at the end of the Closing Ceremony to mark the conclusion of the successful IMS and the kick-off to the Friday's IMBioC'18 conference. The theme is also reinforced by the technical demonstrations at the 5G Pavilion in the exhibition, where our industry partners demonstrate their products and services as well as present in the 5G Interactive Theater. Continuing from the practice from 2017, Wednesday noon through 15:55 is dedicated solely to the exhibition with a variety of competitions and demonstrations scheduled in the exhibition area.

IMS2018 features a "Societies Pavilion" in the exhibition where the IEEE societies and sister organizations such as the European Microwave Association showcase their technical areas, and present opportunities to all attendees to participate in their society's activities at the local chapter, regional, and administrative committees. Please meet the volunteers of the MTT-S, AP-S, EMC-S, ComSoc, ARFTG, EuMA, CMS, APMC2019, and the IEEE 5G Initiative to find out how you may contribute to our societies growth.

IMS2018 is hosting a "Student Career Counseling Fair" between 13:00 – 14:30 on Thursday in the exhibition. The fair, open to all registered students, offers the opportunity to meet exhibitors with interest in providing guidance on the future internships and career paths available at their companies.

The Tuesday evening Amateur Radio networking event, followed by a reception, is notable for the talk on Digital Weak Signal Communication by Nobel Laureate Dr. Joe Taylor, K1JT. Other focus group networking events include the Tuesday Young Professionals (YoPros) panel and networking reception, Project Connect program for under-represented minorities, and the PhD Student Sponsorship Initiative.

Following the launch in 2017, IMS2018 is continuing the highly successful Three Minute Thesis (3MT®) Competition on Monday. Please stop by for this exciting one-day event where the participants are trained in the months leading up to the competition to present their paper's highly technical content to a non-specialist audience using simple laypersons' language. The morning briefing session is followed in the afternoon by the actual competition and judging.

Please follow the IMS2018 activities and updates at our social media feeds on Facebook, YouTube, and Twitter, as well as at the large 16 ft X 10 ft screen in the exhibition. Also keep an eye out for flash announcements and updates on the electronic signage distributed throughout the convention area including the technical sessions. As always, the IMS Microwave Week Mobile App will be your "portal" to all things IMS as exemplified by its tagline "Connecting Minds, Exchanging Ideas". The mobile app is the primary interface for all attendees to get information, download content, and for the first time ever — directly network with other participating attendees with the Social Networking Feature. This opt-in feature provides the contact information and interests of other participating attendees so that networking and interacting with fellow attendees of similar interests is extremely easy. Also note that starting from 2018, the Mobile App will be active throughout the year so that the society can keep you updated on all the IMS activities.

Connecting Minds. Exchanging Ideas.

We invite you to experience and enjoy all of what's new at IMS2018! And provide feedback using the mobile App.

[1] The Steering Committee, much like the Second Continental Congress that met in Philadelphia between 1775 and 1781, formed the IMS2018 activities by adapting past practices for a modern reality. The Second Continental Congress created the Articles of Confederation, comprised of the preamble, thirteen articles, conclusion, and signatory section, for what it called the confederacy of "The United States of America". It is believed that the delegates adapted the practices of ancient Greece, Rome, England, and the Native American Iroquois confederacy in creating the Articles of Confederation.

Ben Franklin's IMS Microwave Week Itinerary!

As most electrical engineers know, Ben Franklin is long associated with his experiments on electricity including the famous one with kite and key during a lightning storm. Ben's electrical discoveries and terms are still in use, e.g., positive and negative charges, battery, and principle of conservation of charge.

In many ways, Philadelphia is Ben Franklin's town – shaped in almost every aspect by his contributions during the entire adult life that he spent here. Among others, the first volunteer fire company in America, anti-counterfeiting currencies, American Philosophical Society, homeowner's insurance, first hospital in the United States – yes, he did all that!

If Ben were alive today, and he is in every one of us, first and foremost he would be organizing the conference to be even better than what it is and second, he would plan on participating in every one of the following IMS Week activities.

FRIDAY, 8 JUNE 2018

- Arrive at Philly with loved ones
- Check into hotel
- Put on your Retro clothes (1770's or 1990's?) and catch the Phillies vs. Brewers Game at the Citizens Bank Park
- Try Geno's Philly Cheesesteak

SATURDAY, 9 JUNE 2018

- Pick up Registration Materials at Pennsylvania Convention Center (PCC) Grand Hall
- Check Mobile App features, and Opt-In & set up the Social Networking Feature
- Down-load eligible technical content on to mobile device using app, or web browser
- Sightsee Historic Mile (***www.discoverphl.com/visit/historic-mile/***)
- Dine at the City Tavern (***www.citytavern.com/***)

SUNDAY, 10 JUNE 2018

- Send loved ones on Gettysburg or Longwood Gardens Tour
- Workshops? So many to choose, e.g.,
  - WSB: ICs for Quantum Computing and Quantum Technologies
  - WSC: 5G mm-Wave Power Amplifiers, Transmitters, Beamforming Techniques and Massive MIMO
  - WSK: Towards Direct Digital RF Transceivers
- RFIC Plenary Session
- RFIC Industry Showcase & Reception
- Dinner, late-night drinks and/or desserts at Rittenhouse Square

MONDAY, 11 JUNE 2018

- Ship loved ones to the ***Franklin Institute***
- RF Boot Camp; Short Courses; Workshops
- Workshop WMB: Microwave to THz imaging technologies for biomedical applications
- RFIC Oral Session RMO2A: 28 GHz Phased Arrays, Beamformers and Sub-Components for 5G Applications
- RFIC Panel Session: How will the future self-driving cars see? LiDAR vs. Radar
- Three Minute Thesis (3MT®) Competition; Be ready to cheer your favorite speaker!
- IMS Plenary Session and Talk – Changing healthcare landscape in 10 years!
- Follow the Mummers to Reading Terminal Market for IMS Welcome Reception; Selfies and dancing with your guest on Filbert St.
- Dinner? Eclectic options on 13th St.

TUESDAY, 12 JUNE 2018

- Philly Zoo? Or Logan Square Museums? Tours?
- 5G Summit and Panel – Need registration for entry; Last minute registration accepted
- Exhibition Opening at 09:30
- Check for latest updates on electronic signage throughout PCC, and on Giant (16' x 10') Screen in exhibition area
- RFIC Oral Session RTU2B: Wireless Transceivers and Transmitters for Connectivity and Cellular
- IMS/RFIC Panel Session: "Can A Residential Wireless Gbs Internet Connection Compete With Wired Alternatives?"
- IMS Oral Session Tu3F: Bio-Medical Radar
- IMS Focus Session Tu2E: Radio to THz Waves toward Nanoscale Sensing, Imaging and Characterization of Biological Samples
- IMS Focus Session Tu4B: Non-Doherty Load Modulated Power Amplifiers
- IMS Project Connect Kickoff
- Industry Workshops/MicroApps
- IMS Interactive Forum in Exhibition Area
- IMS Student Paper Competition
- IMS Student Design Competition
- Special Event: Celebrating Dr. Herczfeld's Contributions to Microwave Photonics
- Dr. Joe Taylor, K1JT, presentation at the Amateur (Ham) Radio Social
- Young Professionals Panel Session; Networking Event at Lucky Strikes
- Late-night out? Try R2L Restaurant

WEDNESDAY, 13 JUNE 2018

- History (and Shopping) at Valley Forge, Maybe a Tour?
- IMS Focus Session We3B: Emerging RF switch technologies for 5G and defense
- IMS Special Session We3H: WIM, Research on Biomedical Applications
- IMS Panel: "Body Wearable Technology; Is It Still Relevant And What's Its Future?"
- IMS Interactive Forum in Exhibition Area
- Industry Workshops / MicroApps
- Exhibition-Only Time (11:50 – 15:55)
- 5G Interactive Theater Presentations
- Stop by Societies Pavilion in exhibition, and learn about volunteer opportunities with various IEEE and other Technical Societies
- Industry-Hosted Reception at Exhibition
- MTT-S Awards Banquet; Tickets required; Bring your dance shoes and groove to the Motown and Soul hits performed by Motor City Revue
- Late-night out again?[1] How about networking with new friends (put that Mobile App feature to use); or catching up on some emails? Show your boss that you are working hard on the companies' dime!

THURSDAY, 14 JUNE 2018

- Checking emails last night was a bad idea; remembered that today is the last day of exhibition, and you still need to meet with a ton of exhibitors. Better hurry! Exhibition closes at 15:00 today!
- Special Event: Celebrating Dr. Haddad's Contributions to MTT-S
- 5G Interactive Theater Presentations
- Industry Workshops / MicroApps
- Student Awards Luncheon
- IMS Focus Session Th2E: Integrated Microwave Photonics for Millimeter-wave and 5G Applications
- IMS Focus Session Th2F: 5G Millimeter-Wave Beamformers and Phased-Arrays
- IMS/ARFTG Joint Session Th1D: Advanced High Frequency Large Signal Measurement Techniques
- IMS/ARFTG Joint Session Th2D: Innovative mm-wave calibration and measurement techniques
- IMS Lunch Panel: "5G mmW PA/FEM: Si or III-V Who Will Win The Race?"
- IMS Physicians Lunch Panel (2-Hours): "Utilization Of RF/Microwave in Medicine."
- "Student Career Counseling Fair", 13:00 – 14:30 in Exhibition
- IMS Closing Ceremony and IMBioC Kickoff; Followed by Reception
- IMS Women in Microwaves Panel and Networking Reception, Philadelphia Academy of Fine Art (PAFA)
- Last night in town – Kimmel Center? Or a photo with Rocky at Museum of Art?

FRIDAY, 15 JUNE 2018

- IMBioC'18 Conference
- 91st ARFTG Microwave Measurement Conference
- Workshop WFB: RF Front-Ends for Enhanced Mobile Communications towards 5G
- Enroute to Airport, stop by Pat's for Cheesesteak and once done, start writing the blog on which one you like better
- Also start the trip report on all that you learned; and start planning for that paper or product that will bring you back to IMS next year (in Boston)!

1 Lost time is never found again, Ben Franklin

Call to Order

IMS Plenary Session

17:30 – 19:00 | **Monday, 11 June 2018** | Pennsylvania Convention Center, Grand Ballroom

ORGANIZERS: **A. Daryoush**, *Drexel University*; **A. Rosen**, *Rowan University*

"The Hitchhiker's Guide To the Healthcare Galaxy: The Actions That Changed the Healthcare Landscape in America From 2017-2027"

Stephen K. Klasko, MD, MBA, President and CEO,
Thomas Jefferson University and Jefferson Health

ABSTRACT:

What if someone came down from another planet and looked at the healthcare system in the place called *USA* on the planet earth. What they would find is a system that speaks of wellness but is financed by disease treatment, one that talks about moving from volume to value but has yet to figure out how to define or reward value, and one where every other aspect of its economy and lifestyle has been transformed by technology and consumerism except for healthcare. The author of the books, *We CAN Fix Healthcare* and *The Phantom Stethoscope*, President Klasko uses science fiction to challenge audiences to imagine an ideal future, and identify what it takes to design that future today. He reviews twelve "disruptors" for the demise of the old healthcare system, and shows how each is an opportunity to take the trends and incremental steps we see today and create the transformations and disruptions tomorrow. His optimism is an antidote to fear surrounding current change. Most importantly, President Klasko challenges us to erase traditional boundaries and silos, to see creativity as a strategy, and to reconsider a hospital system as a "consumer organization." He is passionate about designing a system without health disparities, a system that makes wellness the goal and a system where augmented intelligence use machine cognition to replace doctors' memorization skills so that doctors can be chosen based on self-awareness and empathy to create meaningful relationships with patients. The talk will demonstrate actionable strategies through an innovative "history of the future" thought experiment, a strategic planning process which has led to Dr. Klasko's organization rapidly becoming one of the fastest growing academic medical centers in the nation, one that is more optimistic about its future than its almost two-hundred year old past.

Formal meetings, much like the IMS, are started by the presiding officer by a "Call to Order" and often accompanied by a tap of the gavel. The IMS Plenary Session fulfills a similar role, to signify the beginning of the IMS technical sessions and showcases the Plenary Speaker who discusses the IMS themes.

As a historical footnote, the Vice President of the United States of America John Adams used a gavel to call the very first U.S. Senate to order in New York in the spring of 1789. The unique gavel of the United States Senate has an hourglass shape and no handle. The gavel in current use was presented to the Senate by the Republic of India and first used on November 17, 1954. This gavel replaced an ivory gavel that had been in use since at least 1789 and had deteriorated over the years.

In contrast to the Senate's, the gavel of the United States House of Representatives is plain wood with a handle. Used more often and more forcefully in the House, it has been broken and replaced many times.

IMS2018 Welcome Reception

19:30–20:30 | **Monday, 11 June 2018**

Reading Terminal Market

At the conclusion of the Plenary Session, the attendees will be led to the Welcome Reception as a parade by the "Mummers" – a local tradition. The Mummers parade is on New Year's Day in Philadelphia. The parade is believed to be the oldest folk festival in the United States. Organized as local clubs, the Mummers compete for prizes in the comics, fancies, string bands, and fancy brigade categories. The parade's origins trace back to mid-17th century roots of the first colonists, blending elements from Swedish, Finnish, Irish, English, German, and other European heritages, as well as African heritage. The IMS2018 Mummers parade is led by the costumed musicians of the Fralinger String Band.

The IMS Welcome Reception will be held at the historic Reading Terminal Market located right underneath the Philadelphia Convention Center (PCC). The market opened in 1893 under the elevated train shed of the Reading Railroad Company. The train shed is now the "Grand Hall" of the PCC, where the IMS attendees register and pick up their badges.

The Reading Terminal Market, considered by many as one of the finest public markets in the U.S., is not only a popular hometown attraction but also the most popular Philadelphia tourist destination after the Liberty Bell and Independence Hall. The Reading Terminal Market, as it was over a hundred years ago, is still reminiscent of personal and neighbourhood shopping.

The Mummers will perform at the Filbert Street, specially closed for the IMS Welcome Reception. Incidentally, "Philbert", a bronze statue of a pig serves as the Reading Terminal Market's mascot and a unique "piggy" bank; coins donated here go to programs that support healthy eating habits.

TECHNICAL SESSIONS

08:00 – 09:40 | Tuesday, 12 June 2018 | Pennsylvania Convention Center

201C

Tu1C: Advances in Combiners and Dividers

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

Tu1C-1: Filtering Power Divider with Wide Stopband Using Open-Stub Loaded Coupled-Line and Hybrid Microstrip T-Stub/DGS Cell

Liguo Fan, *UESTC, China*; Huizhen Jenny Qian, *UESTC, China*; Bingzheng Yang, *UESTC, China*; Guoan Wang, *University of South Carolina, USA;* Xun Luo, *UESTC, China*

Tu1C-2: An Ultra-Compact Folded Inductor Based Wideband Gysel Power Divider for Multi-Band 5G Applications

Moez Karim Aziz, *Georgia Tech, USA;* Min-Yu Huang, *Georgia Tech, USA;* Sensen Li, *Georgia Tech, USA;* Edgar Garay, *Georgia Tech, USA;* Hua Wang, *Georgia Tech, USA*

Tu1C-3: Compact Ridge Waveguide Gysel Combiner

Mohamed M. Fahmi, *University of Waterloo, Canada*; Raafat R. Mansour, *University of Waterloo, Canada*

Tu1C-4: Wide-Band Single-Ended-to-Balanced Power Divider with Broad-Band Common-Mode Suppression

Wenjie Feng, Wenquan Che, Quan Xue, *SCUT, China*; Chenxu Wang, *NJUST, China*; Roberto Gómez-García, *Universidad de Alcalá, Spain*

Tu1C-5: A 3D Compact Wideband 16_16 Butler Matrix for 4G/3G Applications

Rafael D. Cerna, *PUCP, Peru*; Manuel A. Yarlequé, *PUCP, Peru*

202AB

Tu1D: Novel Microwave and Millimeter Materials, Devices, and Radiating Structures

Chair: Jan Machac, *Czech Technical Unversity in Prague*
Co-Chair: *David Jackson, University of Houston*

Tu1D-1: Integrated Polarization Converter for Planar Cross-Polarized Millimeter Wave Components

Walid Dyab, *École Polytechnique de Montréal, Canada*; Ahmed A. Sakr, *École Polytechnique de Montréal, Canada*; Ke Wu, *École Polytechnique de Montréal, Canada*

Tu1D-2: Design of Full-Metal Polarizing Screen Based on Circuit Modeling

Carlos Molero, *IETR (UMR 6164), France;* T. Debogovic, *EPFL, Switzerland*; María García-Vigueras, *IETR (UMR 6164), France*

Tu1D-3: Planar Orthomode Transducer Based on Effective Polarization-Independent Coupling

Ahmed A. Sakr, *École Polytechnique de Montréal, Canada*; Walid Dyab, *École Polytechnique de Montréal, Canada*; Ke Wu, *École Polytechnique de Montréal, Canada*

Tu1D-4: Volumetric Double Negative Metamaterial Composed of Planar Resonators

Jan Machac, *Czech Technical University in Prague, Czech Republic*

Tu1D-5: Magneto-Electric-Dipole-Based Leaky-Wave Radiating Structure with Reduced Frequency-Dependent Beam Squint

Yue-Long Lyu, *Harbin Institute of Technology, China*; Fan-Yi Meng, *Harbin Institute of Technology, China*; Ke Wu, *École Polytechnique de Montréal, Canada*; Qun Wu, *Harbin Institute of Technology, China*; Guo-Hui Yang, *Harbin Institute of Technology, China*; Cong Wang, *Harbin Institute of Technology, China*

204B

Tu1G: Resonator-Based Sensors

Chair: Kamran Entesari, *Texas A&M University*
Co-Chair: Nils Pohl, *Ruhr-Universität Bochum*

Tu1G-1: Sensitivity and Selectivity Enhancement in Coupling Ring Resonator Sensors Using Splitting Resonant Frequencies

Mohammad H. Zarifi, *University of British Columbia, Canada*

Tu1G-2: Substrate-Integrated Liquid-Permittivity Microwave Sensor with Simultaneous Fixed-Reference Resonance

Humberto Lobato-Morales, *CICESE, Mexico*; Ricardo A. Chávez-Pérez, *CICESE, Mexico*; José L. Medina Monroy, *CICESE, Mexico*

Tu1G-3: Electromagnetic Rotary Encoders Based on Split Ring Resonators (SRR) Loaded Microstrip Lines

Javier Mata-Contreras, *Universitat Autònoma de Barcelona, Spain*; Cristian Herrojo, *Universitat Autònoma de Barcelona, Spain*; Ferran Martín, *Universitat Autònoma de Barcelona, Spain*

Tu1G-4: Wireless Remote Monitoring of Packaged Passive Sensor for in-situ Pressure Measurement in Highly Reflective Environments

J. Philippe, *LAAS, France;* D. Henry, *LAAS, France;* M.V. De Paolis, *LAAS, France;* A. Rumeau, *LAAS, France;* A. Coustou, *LAAS, France;* S. Charlot, *LAAS, France;* P. Pons, *LAAS, France;* H. Aubert, *LAAS, France*

204C

Tu1H: Advanced Structures Using Additive Manufacturing Process

Chair: Dominique Baillargeat, *XLIM (UMR 7252)*
Co-Chair: Carlos Saavedra, *Queen's University*

Tu1H-1: n-RiM: A Paradigm Shift in the Realization of Fully Inkjet-Printed Broadband Tunable FSS Using Origami Structures

Syed Abdullah Nauroze, *Georgia Tech, USA;* Aline Eid, *Georgia Tech, USA;* Manos M. Tentzeris, *Georgia Tech, USA*

Tu1H-2: Smart Floating Balls: 3D Printed Spherical Antennas and Sensors for Water Quality Monitoring

Wenjing Su, *Georgia Tech, USA;* Shicong Wang, *Georgia Tech, USA;* Ryan Bahr, *Georgia Tech, USA;* Manos M. Tentzeris, *Georgia Tech, USA*

Tu1H-3: 3D Printed Coaxial Transmission Line Using Low Loss Dielectric and Liquid Metal Conductor

Junyu Shen, *North Carolina State University, USA;* Dishit P. Parekh, *North Carolina State University, USA;* Michael D. Dickey, *North Carolina State University, USA;* David S. Ricketts, *North Carolina State University, USA*

Tu1H-4: Pushing Inkjet Printing to W-Band: An All-Printed 90-GHz Beamforming Array

John Kimionis, *Nokia Bell Labs, USA;* Shahriar Shahramian, *Nokia Bell Labs, USA;* Yves Baeyens, *Nokia Bell Labs, USA;* Amit Singh, *Nokia Bell Labs, USA;* Manos M. Tentzeris, *Georgia Tech, USA*

Tu1H-5: 2.4GHz Band Pass Filter Architecture for Direct Print Additive Manufacturing

Derar Hawatmeh, *University of South Florida, USA;* Thomas M. Weller, *University of South Florida, USA*

08:00 - 08:10
08:10 - 08:20
08:20 - 08:30
08:30 - 08:40
08:40 - 08:50
08:50 - 09:00
09:00 - 09:10
09:10 - 09:20
09:20 - 09:30
09:30 - 09:40

TUESDAY

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

TECHNICAL SESSIONS

10:10 – 11:50 | **Tuesday, 12 June 2018** | Pennsylvania Convention Center

TUESDAY

201C

Tu2C: Recent Developments in Passive Circuits

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

10:10 - 10:20

Tu2C-1: High-Power Wideband Low-Cost Limiters Using Cold Plasma

Zach Vander Missen, *Purdue University, USA;* Abbas Semnani, *Purdue University, USA;* Dimitrios Peroulis, *Purdue University, USA*

10:30 - 10:40

Tu2C-2: A Compact Quasi-Circulator with High Isolation Using Reconfigurable 180° Hybrid

Zhixian Deng, *UESTC, China*; Huizhen Jenny Qian, *UESTC, China*; Xun Luo, *UESTC, China*

10:50 - 11:00

Tu2C-3: A Cascaded Self-Similar Rat-Race Hybrid Coupler Architecture and its Compact Fully Integrated Ka-Band Implementation

Edgar Garay, *Georgia Tech, USA;* Min-Yu Huang, *Georgia Tech, USA;* Hua Wang, *Georgia Tech, USA*

11:10 - 11:20

Tu2C-4: A Wideband Filtering Balun Using CPW-to-Slotline Transitions

Jiyuan Ren, *UESTC, China*; Huizhen Jenny Qian, *UESTC, China*; Jie Zhou, *UESTC, China*; Xun Luo, *UESTC, China*

202AB

Tu2D: Advances in Modeling and Design Optimizatio

Chair: Jose Rayas-Sanchez, *ITESO*
Co-Chair: Q.J. Zhang, *Carleton University*

10:10 - 10:20

Tu2D-1: Efficient Simulation of Nonlinear Transmission Lines Using Empirical Interpolation and Projection-Based Model Order Reduction

Behzad Nouri, *Carleton University, Canada*; Michel Nakhla, *Carleton University, Canada*

10:30 - 10:40

Tu2D-2: Passivity Enforcement of Loewner Matrix Macromodels Using Singular Value Perturbation

Yi Qing Xiao, *McGill University, Canada*; Roni Khazaka, *McGill University, Canada*

10:50 - 11:00

Tu2D-3: Sensitivity Analysis of X-Parameters Using the Harmonic Balance Derivative First Moment

Marco T. Kassis, *McGill University, Canada*; Raffi Toukhtarian, *McGill University, Canada*; Dani Tannir, *Lebanese American University, Lebanon*; Roni Khazaka, *McGill University, Canada*

11:10 - 11:20

Tu2D-4: Estimating Unstable Poles in Simulations of Microwave Circuits

Adam Cooman, *Inria, France;* Fabien Seyfert, *Inria, France;* Smain Amari, *RMCC, Canada*

11:30 - 11:40

Tu2D-5: Rapid Design Tuning of Miniaturized Rat-Race Couplers Using Regression-Based Equivalent Network Surrogates

Piotr Kurgan, *Reykjavik University, Iceland*; Slawomir Koziel, *Reykjavik University, Iceland*; John W. Bandler, *McMaster University, Canada*

203AB

Tu2E: Radio to Terahertz Waves Toward Nanoscale Sensing, Imaging and Characterization of Biological Samples

Chair: Marco Farina, *Università Politecnica delle Marche*
Co-Chair: Arnaud Pothier, *XLIM (UMR 7252)*

10:10 - 10:20

Tu2E-1: Tracking Cancer Cells with Microfluidic High Frequency DEP Cytometer Implemented on BiCMOS Lab-on-Chip Platform

R. Manczak, F. Hjeij, T. Provent, S. Saada, C. Dalmay, P. Blondy, A. Pothier, *XLIM (UMR 7252), France;* B. Bessette, G. Begaud, S. Battu, M.O. Jauberteau, F. Lalloue, *HCP (EA 3842), France;* M. Inac, C. Baristiran Kaynak, Mehmet Kaynak, *IHP, Germany*; Cristiano Palego, *Bangor University, UK*

10:30 - 10:40

Tu2E-2: A Miniaturized 3–10GHz Time-Domain Contact-Based Dielectric Spectroscopy System

Reza Ebrahimi Ghiri, *Texas A&M University, USA;* Elif Kaya, *Texas A&M University, USA;* Kamran Entesari, *Texas A&M University, USA*

10:50 - 11:00

Tu2E-3: Imaging of Sub-Cellular Structures and Organelles by an STM-Assisted Scanning Microwave Microscope at mm-Waves

Marco Farina, Andrea Di Donato, Eleonora Pavoni, Gianluca Fabi, Antonio Morini, *Università Politecnica delle Marche, Italy*; James C.M. Hwang, *Lehigh University, USA;* Francesco Piacenza, *INRCA, Italy*; Ester Di Filippo, Tiziana Pietrangelo, *Università G. d'Annunzio, Italy*

11:10 - 11:20

Tu2E-4: Scanning Microwave Microscopy of Vital Mitochondria in Respiration Buffer

Jinfeng Li, *University of California, Irvine, USA;* Zahra Nemati, *University of California, Irvine, USA;* Kamel Haddadi, *IEMN (UMR 8520), France;* Douglas C. Wallace, *Children's Hospital of Philadelphia, USA;* Peter J. Burke, *University of California, Irvine, USA*

204B

Tu2G: Advances in Near-Range Radar Sensors

Chair: Christian Waldschmidt, *Universität Ulm*
Co-Chair: Lora Schulwitz, *Maxar Technologies*

10:10 - 10:20

Tu2G-1: A Single-Chip Remotely Powered Transceiver with an Embedded Temperature Sensor

Hengying Shan, *Purdue University, USA;* John Peterson III, *Purdue University, USA;* Alice Yi-Szu Jou, *Purdue University, USA;* Saeed Mohammadi, *Purdue University, USA*

10:30 - 10:40

Tu2G-2: Improved Throat Vibration Sensing with a Flexible 160-GHz Radar Through Harmonic Generation

Martin Geiger, *Universität Ulm, Germany*; Denis Schlotthauer, *Universität Ulm, Germany*; Christian Waldschmidt, *Universität Ulm, Germany*

10:50 - 11:00

Tu2G-3: Remote Measurement of Particle Streams with a Multistatic Dual Frequency Millimeter Wave Radar Sensor

Alwin Reinhardt, *Christian-Albrechts-Universität zu Kiel, Germany*; Alexander Teplyuk, *Christian-Albrechts-Universität zu Kiel, Germany*; Reinhard Knöchel, *Christian-Albrechts-Universität zu Kiel, Germany*; Michael Höft, *Christian-Albrechts-Universität zu Kiel, Germany*

11:10 - 11:20

Tu2G-4: Water Surface Velocity Estimation Using Cooperative Radar Sensors

Marc A. Mutschler, *Hochschule Ulm, Germany*; Christian Erhart, *Hochschule Ulm, Germany*; Thomas Walter, *Hochschule Ulm, Germany*; Christian Waldschmidt, *Universität Ulm, Germany*

11:30 - 11:40

Tu2G-5: Full-Coverage Indoor SAR Imaging with a Vehicle-Based FMCW Radar System

Jiaming Yan, Jiaming Hu, Li Sun, Hong Hong, Chen Gu, Xiaohua Zhu, *NJUST, China*; Changzhi Li, *Texas Tech University, USA; NJUST, China*

11:40 - 11:50

Tu2G-6: Hand Gesture Recognition Using a Three-Dimensional 24GHz Radar Array

Shengchang Lan, *Harbin Institute of Technology, China*; Zonglong He, *KAIST, Korea;* Kai Yao, *Harbin Institute of Technology, China*; Weichu Chen, *Harbin Institute of Technology, China*

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

204C

Tu2H: 3D-Printed Waveguide Structures

Chair: Valentina Palazzi, *Università di Perugia*
Co-Chair: Manos Tentzeris, *Georgia Tech*

Tu2H-1: A 400GHz Transmitter Integrated with Flip-Chiped 3D Printed Horn Antenna with an EIRP of 1.26dBm

Alexander Standaert, *Katholieke Universiteit Leuven, Belgium*; Patrick Reynaert, *Katholieke Universiteit Leuven, Belgium*

Tu2H-2: Direct Metal Printed 4th Order Stepped Impedance Filter in the C/X Band

Sebastian W. Sattler, *Technische Universität Graz, Austria*; Fabrizio Gentili, *Technische Universität Graz, Austria*; Reinhard Teschl, *Technische Universität Graz, Austria*; Wolfgang Bösch, *Technische Universität Graz, Austria*

Tu2H-3: X-Band Integrated Printed Antenna Measurement

Michael Hollenbeck, *Optisys, USA;* Robert Smith, *Optisys, USA;* Clinton Cathey, *Optisys, USA;* Janos Opra, *Optisys, USA*

Tu2H-4: Compact Orthomode Transducer with Broadband Beamforming Capability

E. Menargues, *SWISSto12, Switzerland;* S. Capdevila, *SWISSto12, Switzerland;* T. Debogovic, *SWISSto12, Switzerland;* A. Dimitriadis, *SWISSto12, Switzerland;* J.R. Mosig, *SWISSto12, Switzerland;* A. Skrivervik, *EPFL, Switzerland;* E. de Rijk, *SWISSto12, Switzerland*

PANEL SESSION

12:00 – 13:00 | **Tuesday, 12 June 2018** | Room 201A

TUP1

Can A Residential Wireless Gbps Internet Connection Compete With Wired Alternatives?

Organizers: Amin Arbabian, *Stanford University*; Oren Eliezer, *PHAZR, USA;* Rod Waterhouse, *Pharad, LLC;* Dalma Novak, *Pharad, LLC, USA*

Abstract: The demand for Internet bandwidth continues to grow rapidly; Nielsen's Law of Internet Bandwidth states that a user's connection speed increases by 50% per year. While we all may want a faster Internet connection, most people are unwilling to pay more to get higher data rates. Gigabit-per-second (Gbps) residential internet connections have typically been supported by well-established high-speed wired networks. However, there are a number of emerging technologies that offer the potential to compete with these approaches. Our expert panelists will discuss some of the technology advancements that are enabling Gbps internet connections and will debate the merits of both the wired and wireless technology alternatives, including 5G and satellite-based solutions.

1. John Cioffi, *Chief Executive Officer, ASSIA Inc.* and *Professor Emeritus at Stanford University*
2. Oleh Krutko, *Director of Engineering, Head of Millimeter Wave, Broadband*, and *Power Product Development, Qorvo*
3. Mike Geen, *Head of Engineering, Filtronic Broadband*
4. Pat Iannone, *Member of Technical Staff, Nokia/Bell Labs*
5. Wilhelmus Theunissen, *Facebook Connectivity Labs*

Tu2E: Focus Session

Radio to Terahertz Waves Toward Nanoscale Sensing, Imaging and Characterization of Biological Samples

Chair: Marco Farina, *Università Politecnica delle Marche*
Co-Chair: *Arnaud Pothier, XLIM (UMR 7252)*

10:10 – 11:50 | TUESDAY, 12 JUNE 2018 | 203AB

ABSTRACT:

Radio to terahertz waves are low-energy electromagnetic signals that, owing to their capability in interacting with biological samples in a penetrant yet non-destructive way, are suitable for sensing, imaging and characterization in a fast, compact and label-free manner. With near-field interaction, they can even have nanoscale lateral and depth resolution despite their long wavelengths. However, use of microwaves and millimeter-waves for this purpose presents new and interdisciplinary challenges, bridging fundamental science and technological development. This session introduces the most recent advances in CMOS sensors and microwave microscope enabled bio-sensing, imaging and characterization.

TECHNICAL SESSIONS

13:30 – 15:10 | **Tuesday, 12 June 2018** | Pennsylvania Convention Center

TUESDAY

201B

Tu3B: Tom Brazil Memorial Session on Non-Linear Circuits

Chair: Christian Fager, Chalmers *University of Technology*
Co-Chair: Anding Zhu, *University College Dublin*

13:30 - 13:40

Tu3B-1: High Frequency and Wideband Modulated Signal Generation Using Frequency Doublers

Arthur Chung, *University of Waterloo, Canada*; Marwen Ben Rejeb, *University of Waterloo, Canada*; Yehia Beltagy, *University of Waterloo, Canada*; Ali M. Darwish, *U.S. Army Research Laboratory, USA;* H. Alfred Hung, *U.S. Army Research Laboratory, USA;* Slim Boumaiza, *University of Waterloo, Canada*

13:40 - 13:50

13:50 - 14:00

Tu3B-2: Adaptive Principal Component Analysis for Online Reduced Order Parameter Extraction in PA Behavioral Modeling and DPD Linearization

Quynh Anh Pham, *Universitat Politècnica de Catalunya, Spain;* David López-Bueno, CTTC, Spain; Gabriel Montoro, *Universitat Politècnica de Catalunya, Spain*; Pere L. Gilabert, *Universitat Politècnica de Catalunya, Spain*

14:00 - 14:10

14:10 - 14:20

Tu3B-3: SISO Digital Predistortion for Concurrent Dual-Band Power Amplifier Using Baseband Stitching Technique

Jun Peng, *UESTC, China*; Songbai He, *UESTC, China*

14:20 - 14:30

14:30 - 14:40

Tu3B-4: Impact of Drain-Lag Induced Current Degradation for a Dynamically Operated GaN-HEMT Power Amplifier

N. Wolff, *FBH, Germany;* T. Hoffmann, *FBH, Germany;* Wolfgang Heinrich, *FBH, Germany;* Olof Bengtsson, *FBH, Germany*

14:40 - 14:50

14:50 - 15:00

Tu3B-5: Analysis of Chirped Oscillators Under Injection Signals

Franco Ramírez, *Universidad de Cantabria, Spain*; Sergio Sancho, *Universidad de Cantabria, Spain*; Mabel Pontón, *Universidad de Cantabria, Spain*; Almudena Suárez, *Universidad de Cantabria, Spain*

15:00 - 15:10

201C

Tu3C: Advances in Millimeter-Wave Integrated Waveguide Components and Transitions

Chair: Hjalti Sigmarsson, *University of Oklahoma*
Co-Chair: Kamal Samanta, *Sony*

Tu3C-1: Dually-Polarized Hybrid Junction Based on Polarization-Selective Periodic Wall

Ahmed A. Sakr, *École Polytechnique de Montréal, Canada*; Walid Dyab, *École Polytechnique de Montréal, Canada*; Ke Wu, *École Polytechnique de Montréal, Canada*

Tu3C-2: A Dielectric Waveguide Switch Based on Unable Multimode Interference at W-Band

Roland Reese, *Technische Universität Darmstadt, Germany*; Matthias Jost, *Technische Universität Darmstadt, Germany*; Ersin Polat, *Technische Universität Darmstadt, Germany*; Matthias Nickel, *Technische Universität Darmstadt, Germany*; Rolf Jakoby, *Technische Universität Darmstadt, Germany*; Holger Maune, *Technische Universität Darmstadt, Germany*

Tu3C-3: A Transition Between Dielectric Microstrip Line and Substrate Integrated Waveguide for V-Band

Haotian Zhu, *École Polytechnique de Montréal, Canada*; Shu Mao, *CityU, China*; Quan Xue, *SCUT, China*; Ke Wu, *École Polytechnique de Montréal, Canada*

Tu3C-4: A Novel V-Band Substrate Integrated Suspended Line to Rectangular Waveguide Transition

Yinzhou Chen, *UESTC, China*; Kaixue Ma, *UESTC, China*; Yongqiang Wang, *UESTC, China*

Tu3C-5: Micromachined Silicon-Core Substrate-Integrated Waveguides with Coplanar-Probe Transitions at 220–330GHz

Aleksandr Krivovitca, *KTH, Sweden*; Umer Shah, *KTH, Sweden*; Oleksandr Glubokov, *KTH, Sweden*; Joachim Oberhammer, *KTH, Sweden*

202AB

Tu3D: Advances in Numerical Modelling for Multi-Scale and Multi-Physics Applications

Chair: Werner Thiel, *ANSYS*
Co-Chair: Johannes Russer, *Technische Universität München*

Tu3D-1: Efficient Sensitivity Analysis of Microwave Structures with Multiple Design Parameters in FDTD

Kae-An Liu, *University of Toronto, Canada*; Costas D. Sarris, *University of Toronto, Canada*

Tu3D-2: Accuracy Controlled Direct Integral Equation Solver of Linear Complexity with Change of Basis for Large-Scale Interconnect Extraction

Miaomiao Ma, *Purdue University, USA;* Dan Jiao, *Purdue University, USA*

Tu3D-3: Matrix-Free Method for Maxwell-Thermal Co-Simulation in Unstructured Meshes

Kaiyuan Zeng, *Purdue University, USA;* Dan Jiao, *Purdue University, USA*

Tu3D-4: New Single Source Surface Integral Equation for Solution of Scattering Problems on 3D Dielectric Objects Situated in Multilayered Media

Shucheng Zheng, *University of Manitoba, Canada*; Vladimir Okhmatovski, *University of Manitoba, Canada*

Tu3D-5: Multiphysics Time-Domain Modeling of Nonlinear Permeability in Thin-Film Magnetic Material

Zhi Yao, *University of California, Los Angeles, USA;* Han Cui, *University of California, Los Angeles, USA;* Tatsuo Itoh, *University of California, Los Angeles, USA;* Yuanxun Ethan Wang, *University of California, Los Angeles, USA*

Tu3D-6: Rigorous Model of Nonlinear Optomechanical Coupling in Micro- and Nano-Structured Resonant Cavities

Davide Mencarelli, Matteo Stocchi, Luca Pierantoni, *Università Politecnica delle Marche, Italy*

Tu3D-7: An Embedded Domain Decomposition Method for Time-Harmonic Electromagnetic Problems

Jiaqing Lu, *The Ohio State University, USA;* Jin-Fa Lee, *The Ohio State University, USA*

203AB

Tu3E: Advances in Microwave and Terahertz Applications in Nanotechnology

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

Tu3E-1: Future Antenna Miniaturization Mechanism: Magnetoelectric Antennas

Hwaider Lin, *Northeastern University, USA;* Mohsen Zaeimbashi, *Northeastern University, USA;* Neville Sun, *Northeastern University, USA;* Xianfeng Liang, *Northeastern University, USA;* Huaihao Chen, *Northeastern University, USA;* Cunzheng Dong, *Northeastern University, USA;* Alexei Matyushov, *Northeastern University, USA;* Xinjun Wang, *Northeastern University, USA;* Yingxue Guo, *Northeastern University, USA;* Yuan Gao, *Northeastern University, USA;* Nian-Xiang Sun, *Northeastern University, USA*

Tu3E-2: Reconfigurable Spoof Surface Plasmon Polaritons Based Band Pass Filter

Nidhi Pandit, *IIT Roorkee, India*; Nagendra Prasad Pathak, *IIT Roorkee, India*

Tu3E-3: 2D-Graphene Epitaxy on SiC for RF Application: Fabrication, Electrical Characterization and Noise Performance

D. Fadil, *IEMN (UMR 8520), France;* W. Wei, *IEMN (UMR 8520), France;* M. Deng, *IMS (UMR 5218), France;* S. Fregonese, *IMS (UMR 5218), France;* W. Strupinski, *ITME, Poland*; E. Pallecchi, *IEMN (UMR 8520), France;* H. Happy, *IEMN (UMR 8520), France*

Tu3E-4: Modelling of Solution Processed Indium Arsenide Nanowire Microwave Switches

H. Votsi, *University of Surrey, UK*; B. Mirkhaydarov, *University of Surrey, UK*; S. Gillespie, *University of Surrey, UK*; P. Young, University of Kent, UK; M. Shkunov, *University of Surrey, UK*; Peter H. Aaen, *University of Surrey, UK*

Tu3E-5: Planar Semiconductor THz Antennas Using Spoof Plasmons for Surface Sensing

Maximilian Bettenhausen, *Universität Kassel, Germany*; Friedhard Römer, *Universität Kassel, Germany*; Bernd Witzigmann, *Universität Kassel, Germany*; Julia Flesch, *Universität Osnabrück, Germany*; Jacob Piehler, *Universität Osnabrück, Germany*; Changjiang You, *Universität Osnabrück, Germany*; Marcin Kazmierczak, *IHP, Germany*; Subhajit Guha, *IHP, Germany*; Giovanni Capellini, *IHP, Germany*; Thomas Schröder, *IHP, Germany*

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

TECHNICAL SESSIONS

13:30 – 15:10 | **Tuesday, 12 June 2018** | Pennsylvania Convention Center

204A

Tu3F: Biomedical Radar

Chair: Chung-Tse Michael Wu, *Rutgers University*
Co-Chair: Alfred Huang, *U.S. Army Research Laboratory*

13:30 - 13:40

Tu3F-1: Envelope Detection for a Double-Sideband Low IF CW Radar

Xujun Ma, *Southeast University, China*; Lianming Li, *Southeast University, China*; Xiaohu You, *Southeast University, China*; Jenshan Lin, *University of Florida, USA*

13:40 - 13:50

Tu3F-2: A Multi-Arc Method for Improving Doppler RadarMotion Measurement Accuracy

Songjie Bi, *University of California, Davis, USA;* Xiaomeng Gao, *University of California, Davis, USA;* Victor M. Lubecke, *University of Hawaii at Manoa, USA;* Olga Boric-Lubecke, *University of Hawaii at Manoa, USA;* Dennis Matthews, *Cardiac Motion, USA;* Xiaoguang Liu, *University of California, Davis, USA*

13:50 - 14:00

Tu3F-3: Wearable Vital Sign Sensor Using a Single-Input Multiple-Output Self-Injection-Locked Oscillator Tag

Chung-Yi Hsu, *National Sun Yat-sen University, Taiwan*; Lih-Tyng Hwang, *National Sun Yat-sen University, Taiwan*; Fu-Kang Wang, *National Sun Yat-sen University, Taiwan*; Tzyy-Sheng Horng, *National Sun Yat-sen University, Taiwan*

14:00 - 14:10

Tu3F-4: Self-Injection-Locked AIA Radar Sensor Using PLL Demodulator for Noncontact Vital Sign Detection

Chao-Hsiung Tseng, *Taiwan Tech, Taiwan*; Li-Te Yu, *Taiwan Tech, Taiwan*

14:10 - 14:20

Tu3F-5: Noncontact Vital Sign Detection Using 24GHz Two-Dimensional Frequency Scanning Metamaterial Leaky Wave Antenna Array

Qun Li, *UESTC, China*; Yonghong Zhang, *UESTC, China*; Chung-Tse Michael Wu, *Rutgers University, USA*

204B

Tu3G: Advances in Backscattering and RFID Circuits

Chair: Kazuya Yamamoto, *Mitsubishi Electric*
Co-Chair: Thomas Ussmueller, *Universität Innsbruck*

13:30 - 13:40

Tu3G-1: A 5.8GHz 1.77mW AFSK-OFDM CMOS Backscatter Transmitter for Low Power IoT Applications

A. Tang, *University of California, Los Angeles, USA;* Y. Kim, *University of California, Los Angeles, USA;* G. Virbila, *University of California, Los Angeles, USA;* Mau-Chung Frank Chang, *University of California, Los Angeles, USA*

13:50 - 14:00

Tu3G-2: Exploitation of Multi-Sine Intermodulation for Passive Backscattering UWB Localization

Massimo Del Prete, *Università di Bologna, Italy*; Nicolò Decarli, *Università di Bologna, Italy*; Diego Masotti, *Università di Bologna, Italy*; Davide Dardari, *Università di Bologna, Italy*; Alessandra Costanzo, *Università di Bologna, Italy*

14:00 - 14:10

Tu3G-3: Spectrally Efficient 4-PAM Ambient FM Backscattering for Wireless Sensing and RFID Applications

Spyridon N. Daskalakis, *Heriot-Watt University, UK;* Ricardo Correia, *Universidade de Aveiro, Portugal*; George Goussetis, *Heriot-Watt University, UK*; Manos M. Tentzeris, *Georgia Tech, USA;* Nuno Borges Carvalho, *Universidade de Aveiro, Portugal*; Apostolos Georgiadis, *Heriot-Watt University, UK*

14:20 - 14:30

Tu3G-4: Dual-Band High Order Modulation Ambient Backscatter

Ricardo Correia, *Universidade de Aveiro, Portugal*; Nuno Borges Carvalho, *Universidade de Aveiro, Portugal*

14:40 - 14:50

Tu3G-5: Intermodulation Uplink for Far-Field Passive RFID Applications

Nai-Chung Kuo, Bo Zhao, Ali M. Niknejad, *University of California, Berkeley, USA*

15:00 - 15:10

Tu3G-6: A Wirelessly-Powered 1.46GHz Transmitter with On-Chip Antennas in 180nm CMOS

Yuxiang Sun, *Rice University, USA;* Dai Li, *Rice University, USA;* Aydin Babakhani, *University of California, Los Angeles, USA*

204C

Tu3H: Novel Package/PCB Integration Concepts

Chair: Telesphor Kamgaing, *Intel*
Co-Chair: Rick Sturdivant, *AzUSA Pacific University*

13:30 - 13:40

Tu3H-1: A Low Loss Patch-Based Phase Shifter Based on SISL Platform

Yongqiang Wang, *UESTC, China*; Kaixue Ma, *UESTC, China*; Ningning Yan, *UESTC, China*

13:50 - 14:00

Tu3H-2: Substrate Integrated Gap Waveguide Bandpass Filters with High Selectivity and Wide Stopband

Ming Dong, *Yunnan University, China*; Dongya Shen, *Yunnan University, China*; Xiupu Zhang, *Yunnan University, China*; Wenping Ren, *Yunnan University, China*; Zu-hui Ma, *Yunnan University, China*; Rongrong Qian, *Yunnan University, China*; Hong Yuan, *Yunnan University, China*

14:10 - 14:20

Tu3H-3: Heterogeneously Integrated V-Band Amplifier

Vesna Radisic, *Northrop Grumman, USA;* Dennis W. Scott, *Northrop Grumman, USA;* Eric Kaneshiro, *Northrop Grumman, USA;* K.K. Loi, *Northrop Grumman, USA;* Sujane Wang, *Northrop Grumman, USA;* Cedric Monier, *Northrop Grumman, USA;* Augusto Gutierrez-Aitken, *Northrop Grumman, USA*

14:30 - 14:40

Tu3H-4: A Surface Mount 45 to 90GHz Low Noise Amplifier Using Novel Hot-Via Interconnection

John C. Mahon, *Analog Devices, USA;* Michael Clark, *Analog Devices, USA;* Peter Katzin, *Analog Devices, USA*

DOST THOU LOVE LIFE? THEN DO NOT SQUANDER TIME, FOR THAT'S THE STUFF LIFE IS MADE OF.

BENJAMIN FRANKLIN

TECHNICAL SESSIONS

15:55 – 17:15 | **Tuesday, 12 June 2018** | Pennsylvania Convention Center

TUESDAY

201B

Tu4B: Non-Doherty Load Modulated Power Amplifiers

Chair: Roberto Quaglia, *Cardiff University*
Co-Chair: Taylor Barton, *University of Colorado Boulder*

15:55 - 16:05

Tu4B-1: UHF Class-E Power Amplifier Design for Wide Range Variable Resistance Operation

David Vegas, *Universidad de Cantabria, Spain*; María Pampín, *Universidad de Cantabria, Spain*; Jose-Ramon Perez-Cisneros, *Universidad de Cantabria, Spain*; M. Nieves Ruiz, *Universidad de Cantabria, Spain*; Angel Mediavilla, *Universidad de Cantabria, Spain*; José A. García, *Universidad de Cantabria, Spain*

16:05 - 16:15

16:15 - 16:25

Tu4B-2: A Waveform-Engineered Outphasing RFPA Using a Broadband Balun Combiner

Aleksander Bogusz, *Cardiff University, UK*; Jonathan Lees, *Cardiff University, UK*; Roberto Quaglia, *Cardiff University, UK*; Gavin Watkins, *Toshiba Research Europe, UK*; Steve C. Cripps, *Cardiff University, UK*

16:25 - 16:35

16:35 - 16:45

Tu4B-3: Supply Modulation of a Broadband Load Modulated Balanced Amplifier

Tommaso Cappello, *University of Colorado Boulder, USA;* Prathamesh H. Pednekar, *University of Colorado Boulder, USA;* Corrado Florian, *Università di Bologna, Italy*; Zoya Popovi_, *University of Colorado Boulder, USA;* Taylor W. Barton, *University of Colorado Boulder, USA*

16:45 - 16:55

16:55 - 17:05

Tu4B-4: An X-Band RF-Input Outphasing Power Amplifier

Daniel N. Martin, *University of Colorado Boulder, USA;* Tommaso Cappello, *University of Colorado Boulder, USA;* Michael Litchfield, *BAE Systems, USA;* Taylor W. Barton, *University of Colorado Boulder, USA*

17:05 - 17:15

201C

Tu4C: Integrated Waveguide Structures and Techniques

Chair: Christian Damm, *Universität Ulm*
Co-Chair: Jun (Brandon) Choi, *SUNY Buffalo*

Tu4C-1: Slab Air-Filled Substrate Integrated Waveguide

Nhu-Huan Nguyen, *IMEP-LAHC (UMR 5130), France;* Anthony Ghiotto, *IMS (UMR 5218), France;* Tan-Phu Vuong, *IMEP-LAHC (UMR 5130), France;* Anne Vilcot, *IMEP-LAHC (UMR 5130), France;* Frédéric Parment, *CNES, France;* Ke Wu, *École Polytechnique de Montréal, Canada*

Tu4C-2: Single-Layer Slow-Wave Substrate Integrated Waveguide with Enhanced Capacitance

Xiaoqiang Li, *University of California, Los Angeles, USA;* Kirti Dhwaj, *University of California, Los Angeles, USA;* Tatsuo Itoh, *University of California, Los Angeles, USA*

Tu4C-3: Fabrication-Tolerant Reconfigurable AFSIW Filters Based on Through-Hole Mounted Metallic Posts for Versatile High Performance Systems

Tifenn Martin, IMS (UMR 5218), *France;* Anthony Ghiotto, IMS (UMR 5218), *France;* Frédéric Lotz, *Cobham Microwave, France;* Tan-Phu Vuong, IMEP-LAHC (UMR 5130), France

Tu4C-4: The Microfabrication of Monolithic Miniaturized Ridged Half-Mode Waveguides for 5G Millimeter-Wave Communication Systems

Thomas R. Jones, *University of Alberta, Canada*; Mojgan Daneshmand, *University of Alberta, Canada*

202AB

Tu4D: Novel Theoretical Approaches in Microwave Structure Analysis and Design

Chair: James Skala, *Georgia Tech*
Co-Chair: Tapan Sarkar, *Syracuse University*

Tu4D-1, Algorithm for Locating Complex Zeros and Poles with the Use of Border Tracking on Complex Plane, and its Application in Dispersion Characteristics Calculation

Jerzy Julian Michalski, *SpaceForest, Poland*

Tu4D-2: Interpolation and Extrapolation of S-Parameter Data of a Microwave Filter in the Frequency Domain Using the Cauchy Method

Nicolas F. Reginelli, *Syracuse University, USA;* Tapan K. Sarkar, *Syracuse University, USA;* Magdalena Salazar-Palma, *Universidad Carlos III de Madrid, Spain*

Tu4D-3: Wideband, Periodically Arranged Self-Dual Subwavelength Waveguides

Nasim Mohammadi Estakhri, *University of Pennsylvania, USA;* Nader Engheta, *University of Pennsylvania, USA;* Raphael Kastner, *University of Pennsylvania, USA*

Tu4D-4: Active Huygens' Cloaks for Arbitrary Metallic Polygonal Cylinders

Paris Ang, *University of Toronto, Canada*; George V. Eleftheriades, *University of Toronto, Canada*

Tu4D-5: Demonstration of Mode-Tunable Vortex Wave Radiation from Pseudo-Traveling Wave Ring Resonators Using Nonreciprocal Metamaterials

Junji Yamauchi, *Kyoto Institute of Technology, Japan*; Tetsuya Ueda, *Kyoto Institute of Technology, Japan*; Tatsuo Itoh, *University of California, Los Angeles, USA*

203AB

Tu4E: Nano-Scale Devices and Antennas

Chair: Dimitris Pavlidis, *Boston University*
Co-Chair: Trang Thai, *Intel*

Tu4E-1: MoS2 Phase-Junction-Based Schottky Diodes for RF Electronics

Xu Zhang, *MIT, USA;* Jesús Grajal, *Universidad Politécnica de Madrid, Spain;* Xiaoxue Wang, *MIT, USA;* Ujwal Radhakrishna, *MIT, USA;* Yuhao Zhang, *MIT, USA;* Jing Kong, *MIT, USA;* Mildred S. Dresselhaus, *MIT, USA;* Tomás Palacios, *MIT, USA*

Tu4E-2: Fatigue Test on Flexible Graphene Field Effect Transistors with Bottom Gate Electrode

W. Wei, *IEMN (UMR 8520), France;* D. Fadil, *IEMN (UMR 8520), France;* S. Mhedhbi, *IEMN (UMR 8520), France;* S. Bensalk, *IEMN (UMR 8520), France;* E. Pallecchi, *IEMN (UMR 8520), France;* H. Happy, *IEMN (UMR 8520), France*

Tu4E-3: Towards mm-Wave Nanoelectronics and RF Switches Using MoS2 2D Semiconductor

Myungsoo Kim, *University of Texas at Austin, USA;* Saungeun Park, *University of Texas at Austin, USA;* Atresh Sanne, *University of Texas at Austin, USA;* Sanjay Kumar Banerjee, *University of Texas at Austin, USA;* Deji Akinwande, *University of Texas at Austin, USA*

Tu4E-4: A Zero-Bias, Completely Passive 28THz Rectenna for Energy Harvesting from Infrared (Waste Heat)

G. Jayaswal, A. Belkadi, A. Meredov, B. Pelz, G. Moddel, Atif Shamim, *KAUST, Saudi Arabia*

Tu4E-5: Design of Dual-Band Transparent Antenna by Using Nano-Structured Thin Film Coating Technology

Yu-Ming Lin, *National Cheng Kung University, Taiwan;* Hung-Wei Wu, *Kun Shan University, Taiwan*; Tzu-Chun Tai, *National Cheng Kung University, Taiwan;* Cheng-Yuan Hung, *MIRDC, Taiwan;* Shoou-Jinn Chang, *National Cheng Kung University, Taiwan;* Yeong-Her Wang, *National Cheng Kung University, Taiwan*

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

15:55 – 17:15 | **Tuesday, 12 June 2018** | Pennsylvania Convention Center

204B

Tu4G: Advances in Chipless and RFID Sensors

Chair: Alessandra Costanzo, *Università di Bologna*
Co-Chair: Smail Tedjini, *LCIS (EA 3747)*

15:55 - 16:05
Tu4G-1: Chipless RFID Tag Discrimination and the Performance of Resemblance Metrics to be Used for it

Zeshan Ali, LCIS (EA 3747), *France;* Nicolas Barbot, *LCIS (EA 3747), France;* Romain Siragusa, *LCIS (EA 3747), France;* David Hely, *LCIS (EA 3747), France;* Maxime Bernier, *IMEP-LAHC (UMR 5130), France;* Frédéric Garet, *IMEP-LAHC (UMR 5130), France;* Etienne Perret, *LCIS (EA 3747), France*

16:05 - 16:15
Tu4G-2: Out-of-Sight Salt-Water Concentration Sensing Using Chipless-RFID for Pipeline Coating Integrity

Sameir Deif, *University of Alberta, Canada*; Lorna Harron, *Enbridge, Canada*; Mojgan Daneshmand, *University of Alberta, Canada*

16:15 - 16:25
Tu4G-3: A General-Purpose Small RFID Epidermal Datalogger for Continuous Human Skin Monitoring in Mobility

C. Miozzi, *Università di Roma "Tor Vergata", Italy*; S. Nappi, *Università di Roma "Tor Vergata", Italy*; S. Amendola, *Università di Roma "Tor Vergata", Italy*; G. Marrocco, *Università di Roma "Tor Vergata", Italy*

16:25 - 16:35
Tu4G-4: On the Cooperative Exploitation of Antenna Sensitivity and Auto-Tuning Capability of UHF RFID Chip: Application to Temperature Sensing

Konstantinos Zannas, *LCIS (EA 3747), France;* Hatem El Matbouly, *LCIS (EA 3747), France;* Yvan Duroc, *Laboratoire Ampère (UMR 5005), France;* Smail Tedjini, *LCIS (EA 3747), France*

204C

Tu4H: Novel Interconnects for W- and D-Band

Chair: Kamal Samanta, *Sony*
Co-Chair: Morgan Chen, *L3 Technologies*

15:55 - 16:05
Tu4H-1: Millimeter-Wave Multicast Chip-to-Chip Interconnect Network Using Dielectric Slab Waveguide

Utpal Dey, *Universität Stuttgart, Germany*; Jan Hesselbarth, *Universität Stuttgart, Germany*

16:05 - 16:15
Tu4H-2: A PCB-Embedding Scheme for LCP Ribbon Waveguide at D-Band

Joren Vaes, *Katholieke Universiteit Leuven, Belgium*; Ilja Ocket, *Katholieke Universiteit Leuven, Belgium*; Wan-Ling Tsai, *Katholieke Universiteit Leuven, Belgium*; Maarten Cauwe, *CMST, Belgium*; Patrick Reynaert, *Katholieke Universiteit Leuven, Belgium*; Bart Nauwelaers, *Katholieke Universiteit Leuven, Belgium*

16:25 - 16:35
Tu4H-3: Novel Broadband Transition for Rectangular Dielectric Waveguide to Planar Circuit Board at D Band

Wan-Ling Tsai, *Katholieke Universiteit Leuven, Belgium*; Ilja Ocket, *Katholieke Universiteit Leuven, Belgium*; Joren Vaes, *Katholieke Universiteit Leuven, Belgium*; Maarten Cauwe, *CMST, Belgium*; Patrick Reynaert, *Katholieke Universiteit Leuven, Belgium*; Bart Nauwelaers, *Katholieke Universiteit Leuven, Belgium*

16:45 - 16:55
Tu4H-4: A Low-Loss D-Band Chip-to-Waveguide Transition Using Unilateral Finline Structure

Ahmed Hassona, *Chalmers University of Technology, Sweden*; Zhongxia Simon He, *Chalmers University of Technology, Sweden*; Omid Habibpour, *Chalmers University of Technology, Sweden*; Vincent Desmaris, *Chalmers University of Technology, Sweden*; Vessen Vassilev, *Chalmers University of Technology, Sweden*; Songyuan Yang, *Chalmers University of Technology, Sweden*; Victor Belitsky, *Chalmers University of Technology, Sweden*; Herbert Zirath, *Chalmers University of Technology, Sweden*

17:05 - 17:15

Tu4B: Focus Session

Non-Doherty Load Modulated Power Amplifiers

Chairs: Roberto Quaglia, *Cardiff University;* Taylor Barton, *Univ. of Colorado*

15:55 – 17:10 | TUESDAY, 12 JUNE 2018 | 201B

ABSTRACT:

Load modulation in power amplifiers is a technique that allows for the change of the load termination of the active device in real-time in order to optimize a desired figure of merit (efficiency, linearity, output power). The Doherty amplifier is the most successful power amplifier adopting load modulation; however, other techniques exist that are able to overcome some of the Doherty's limitations and provide improved performance for specific applications. This focus session will highlight the emerging power amplifier solutions adopting load modulation techniques. These techniques are of high importance for the microwave community since they can be adopted in a wide range of applications (mobile telecom, 5G, WiFi, satellite telecommunications, radar, electronic warfare) and can enhance the performance of the power amplifier; the most critical component of a microwave radio.

NOTES

Special Event:

Honoring Peter Herczfeld's Technical Contributions To Microwave Photonics

15:55 – 17:10 | **Tuesday, 12 June 2018** | Room 204A

EVENT CHAIRS:

Prof. Yifei Li
Associate Professor, ECE
University of Massachusetts – Dartmouth

Prof. Arye Rosen
Associate Vice-President
Rowan University, Mullica Hill, NJ

This special event celebrates and honors Professor Peter Herczfeld's exceptional career in education and pioneering research in microwave photonics. Prof. Herczfeld received the Ph.D. Degree in Electrical Engineering from the University of Minnesota in 1967. He has served as a member of the faculty of Drexel University since 1967. Currently, he is the Lester Kraus Professor of Electrical and Computer Engineering at Drexel University. He is the founder of the Center for Microwave and Lightwave Engineering (CMLE) at Drexel University. He has supervised 31 doctoral students and over 70 master students.

Prof. Herczfeld has received numerous teaching honors including the Mary and Christian Lindback Distinguished Teacher Award at Drexel University in 1995 and the IEEE MTT-S Fred Rosenbaum Distinguished Educator Award in 1997. He is a Life Fellow of the IEEE, a recipient of the IEEE Millennium medal, and has served as the distinguished Lecturer of IEEE MTT-S. Dr. Herczfeld has received several research and publication awards, including the European Microwave Prize in 1986 and then again in 1994. He initiated the Microwave Photonics conferences, a Photonics Society-MTT joint venture, which has blossomed into a highly respected international meeting. In 2006 he received the IEEE MTT-S Pioneer award for research in microwave photonics.

THE LIST OF SPEAKERS INCLUDES:

Dr. Arye Rosen, *Rowan University*
Dr. Tibor Berceli, *Tech. University of Budapest*
Dr. Nils Jespersen, *Aerospace Corporation*
Dr. Afshin Daryoush, *Drexel University*
Dr. Mahmoud El-Sherif, *Photonics Inc.*
Dr. Arthur Paolella, *Harris Corporation*
Dr. William Jemison, *Clarkson University*
Dr. Edward Ackerman, *Photonic Systems, Inc*
Dr. Amarildo Vieria, *Arris Group, Inc*
Dr. Edward Niehenke, *Niehenke Consulting*
Dr. Linda Mullen, *Navair*
Dr. Yammy Yost, *W. L. Gore & Associates*
Dr. David Yoo, *Mitre Corporation*
Dr. Yifei Li, *UMass – Dartmouth*

15:55 – 17:15 | **Tuesday, 12 June 2018** | Pennsylvania Convention Center Exhibit Hall

TUIF1: Interactive Forum #1

Chair: Abbas Omar, *Universität Magdeburg* **Co-Chair:** Aly Fathy, *University of Tennessee*

TUIF1-1: Autonomously-Switchable Bandstop Filters with Integrated Sensor and Driver Circuitry

Eric J. Naglich, *U.S. Naval Research Laboratory, USA;* Sanghoon Shin, *U.S. Naval Research Laboratory, USA;* Spence Albright, *U.S. Naval Research Laboratory, USA*

TUIF1-2: Fully Reconfigurable Dual-Mode Bandpass Filter

Wentao Lin, *École Polytechnique de Montréal, Canada*; Tae-Hak Lee, *École Polytechnique de Montréal, Canada*; Ke Wu, *École Polytechnique de Montréal, Canada*

TUIF1-3: An Inductor-Based Real-Time Monitoring and Control System for Tunable Cavity MEMS Filters

Mohammad Abu Khater, *Purdue University, USA;* Mahmoud Abdelfattah, *Purdue University, USA;* Michael D. Sinanis, *Purdue University, USA;* Dimitrios Peroulis, *Purdue University, USA*

TUIF1-4: 2.4-GHz Tunable Miniature CMOS Active Bandpass Filter with Two Transmission Zeros Using Lumped Stepped-Impedance Ring Resonator

Yu-Chih Hsiao, *National Chiao Tung University, Taiwan*; Chinchun Meng, *National Chiao Tung University, Taiwan*; Hsieh-Hsiu Chang Chien, *National Chiao Tung University, Taiwan*; Guo-Wei Huang, NDL, Taiwan

TUIF1-5: Towards Improved Manufacturing Yield of Acoustic-Wave Ladder-Type Filters

Mohammad J. Almalkawi, *Skyworks Solutions, USA*

TUIF1-6: Outline Process from the Synthesis Towards the Nonlinear Modeling of Bulk Acoustic Wave Filters

Jordi Mateu, *Universitat Politècnica de Catalunya, Spain*; Carlos Collado, *Universitat Politècnica de Catalunya, Spain*; Alberto Hueltes, *Universitat Politècnica de Catalunya, Spain*; Rafael Perea-Robles, *Universitat Politècnica de Catalunya, Spain*; David Garcia-Pastor, *Universitat Politècnica de Catalunya, Spain*; Marta Gonzalez-Rodriguez, *Universitat Politècnica de Catalunya, Spain*; Jose M. Gonzalez-Arbesú, *Universitat Politècnica de Catalunya, Spain*

TUIF1-7: Multi-Octave GaN MMIC Circulator for Simultaneous Transmit Receive Applications

Ali M. Darwish, *U.S. Army Research Laboratory, USA;* Mathew M. Biedka, *University of California, Los Angeles, USA;* Khamsouk Kingkeo, *U.S. Army Research Laboratory, USA;* John Penn, *U.S. Army Research Laboratory, USA;* Edward A. Viveiros, *U.S. Army Research Laboratory, USA;* H. Alfred Hung, *U.S. Army Research Laboratory, USA;* Y. Ethan Wang, *University of California, Los Angeles, USA*

TUIF1-8: Nonlinearity and Power Handling Characterization of an Optically Reconfigurable Microwave Switch

A.W. Pang, *University of Bristol, UK*; S. Bensmida, *University of Bristol, UK*; M.J. Cryan, *University of Bristol, UK*

TUIF1-9, A 30.9dBm, 300MHz 45-nm SOI CMOS Power Modulator for Spread-Spectrum Signal Processing at the Antenna

Cameron Hill, *University of California, Santa Barbara, USA;* Cooper S. Levy, University of California, San Diego, *USA;* Hussam Al Shammary, *University of California, Santa Barbara, USA;* Ahmed Hamza, *University of California, Santa Barbara, USA;* James F. Buckwalter, *University of California, Santa Barbara, USA*

TUIF1-10: An X-Band Low Phase Noise Oscillator with High Harmonic Suppression Using SIW Quarter-Wavelength Resonator

Zongqi Cai, *UESTC, China*; Xiaohong Tang, *UESTC, China*; Ting Zhang, *UESTC, China*; Yang Yang, *University of Technology Sydney, Australia*

TUIF1-11: Chip-Scale RF Correlator with Monolithically Integrated Time-Varying Transmission Line (TVTL)

Qianteng Wu, *University of California, Los Angeles, USA;* Xiating Zou, *University of California, Los Angeles, USA;* Rui Zhu, *University of California, Los Angeles, USA;* Yuanxun Ethan Wang, *University of California, Los Angeles, USA*

TUIF1-12: Comparison of Highly Linear Resistive Mixers in Depletion and Enhancement Mode GaAs and GaN pHEMTs at Ka Band

Matthew S. Clements, *University of California, Davis, USA;* Anh-Vu Pham, *University of California, Davis, USA;* J. Scott Sacks, Cobham Advanced Electronics Solutions, *USA;* Bert C. Henderson, *Cobham Advanced Electronics Solutions, USA;* Steve E. Avery, *Cobham Advanced Electronics Solutions, USA*

TUIF1-13: Magnetless RF Isolator Design Using Grounded Transistors

Filipe M. Barradas, *Universidade de Aveiro, Portugal*; Telmo R. Cunha, *Universidade de Aveiro, Portugal*; Pedro M. Cabral, *Universidade de Aveiro, Portugal*; José C. Pedro, *Universidade de Aveiro, Portugal*

TUIF1-14: Design of a Low-Band Wideband Superconducting Filter Using Triple-Mode Resonator

Shuai Shang, *Tsinghua University, China;* Bin Wei, *Tsinghua University, China;* Bisong Cao, *Tsinghua University, China;* Xubo Guo, *Tsinghua University, China*

TUIF1-15: UHF Array Element Using a Reflection Coefficient Modulator

Madeleine Roche, *Portland State University, USA;* Richard Campbell, *Portland State University, USA;* Nasr Alkhafaji, *Portland State University, USA*

TUIF1-16: Broadband High Efficiency Post-Matching Doherty Power Amplifier Based on Mixed-Topology

Xin Yu Zhou, *CityU, China*; Wing Shing Chan, *CityU, China*; Shao Yong Zheng, Sun Yat-sen University, *China*; Wenjie Feng, *NJUST, China*; Derek Ho, *CityU, China*

TUIF1-17: A 1–17GHz Stacked Distributed Power Amplifier with 19–21dBm Saturated Output Power in 45nm CMOS SOI Technology

Li Gao, *University of California, San Diego, USA;* Qian Ma, *University of California, San Diego, USA;* Gabriel M. Rebeiz, *University of California, San Diego, USA*

TUIF1-18: A Group Delay Compensation Power Amplifier with Auto Power Level Control for 24GHz FMCW Automobile Radar Application

Dong Chen, *UESTC, China*; Yu Peng, *UESTC, China*; Tianjun Wu, *UESTC, China*; Ying Liu, *UESTC, China*; Huihua Liu, *UESTC, China*; Chenxi Zhao, *UESTC, China*; Yunqiu Wu, *UESTC, China*; Kai Kang, *UESTC, China*

TUIF1-19: Input Harmonic Sensitivity in High-Efficiency GaN Power Amplifiers

Tushar Sharma, *NXP Semiconductors, USA;* Shishir Shukla, *NXP Semiconductors, USA;* Damon G. Holmes, *NXP Semiconductors, USA;* Ramzi Darraji, *University of Calgary, Canada*; Jeffrey K. Jones, *NXP Semiconductors, USA;* Fadhel M. Ghannouchi, *University of Calgary, Canada*

TUIF1-20: A High Efficiency 3.6–4.0GHz Envelope-Tracking Power Amplifier Using GaN Soft-Switching Buck-Converter

Yuji Komatsuzaki, *University of California, San Diego, USA;* Sandro Lanfranco, *Nokia Bell Labs, USA;* Tapio Kolmonen, *Nokia Bell Labs, Finland;* Olli Piirainen, *Nokia Bell Labs, Finland;* Jarno K. Tanskanen, *Nokia Bell Labs, Finland;* Shuichi Sakata, *Mitsubishi Electric, Japan;* Rui Ma, *MERL, USA;* Shintaro Shinjo, *Mitsubishi Electric, Japan;* Koji Yamanaka, *Mitsubishi Electric, Japan;* Peter Asbeck, *University of California, San Diego, USA*

TUIF1-21: A Novel Approach to Selecting Doherty Amplifier Asymmetry

Tim Canning, *Infineon Technologies, Germany;* Bjoern Herrmann, *Infineon Technologies, USA* Haedong Jang, *Infineon Technologies, USA* Zulhazmi Mokhti, *Infineon Technologies, USA* Richard Wilson, *Infineon Technologies, USA*

TUIF1-22: An Efficient Linearized Octave-Bandwidth Power Amplifier for Carrier Aggregation

Maxwell R. Duffy, *University of Colorado Boulder, USA;* Eric Berry, *University of Colorado Boulder, USA;* Gregor Lasser, *University of Colorado Boulder, USA;* Zoya Popovi_, *University of Colorado Boulder, USA*

TUIF1-23: Ruggedness Characterization of Bonding Wire Arrays in LDMOSFET-Based Power Amplifiers

Liang Lin, *Ampleon, China;* Long Ren, *Ampleon, China*

Young Professionals Panel Session and Networking Event

Panel: Skills That Enable Impact In Microwaves, Medicine, and Mobility

17:30 – 19:00 | **Tuesday, 12 June 2018** | Pennsylvania Convention Center, Room 201A

ORGANIZERS:

Simone Bastioli, *RS Microwave (USA)*
Eric Naglich, *Naval Research Laboratory (USA)*
Tushar Sharma, *Univ. of Calgary (Canada)*

PANELISTS:

Mario Bokatius, *NXP Semiconductors*
Joel Johnson, *Harris Corporation*
Jennifer Kitchen, *Arizona State University*
Husnu Masaracioglu, *Qualcomm*
Brian Rautio, *Sonnet Software*

PHOTO BY LYLEPHOTOS.COM, ATLANTA, USED WITH PERMISSION

IMS2017 Young Professionals Panelists

The IMS2018 steering committee urges the engineering community to be a part of the future of healthcare and the benefits of a connected lifestyle through the theme "Microwaves, Medicine, and Mobility". Medicine and mobility are increasingly interesting applications of microwave engineering, especially among students and young professional's eager to make a positive impact on the world.

The IEEE Young Professionals is an international community of innovative members who are interested in elevating their professional image, expanding their global network, connecting with peers locally and giving back to the community. A great number of prestigious companies and institutions are making great strides in these socially important and technically challenging fields. Many of them are eagerly looking for the next generation of engineers and scientists who will use their valuable skills to develop, guide, and invent exciting advances that push the human condition forward. However, as a young professional, it isn't always obvious which skills are most valuable or missing from one's repertoire.

We have gathered a diverse and inspiring panel of speakers from the microwave community who will discuss what skills their organization looks for in a young engineering professional, skills they see young professionals lacking most, and how their own pursuit of skills benefited them throughout their career. Mark your calendar, tell your friends, and join the IMS2018 Young Professionals Panel to learn these exciting lessons from the folks on the inside. A reception with fun, food, and networking will follow.

PHOTO BY LYLEPHOTOS.COM, ATLANTA, USED WITH PERMISSION

Young Professionals at the IMS2017 Networking Event

Networking Event

19:30 – 21:30 | **Tuesday, 12 June 2018** | Lucky Strike, 1336 Chestnut St., Philadelphia, PA

Amateur (Ham) Radio Social

18:30 – 20:30 | **Tuesday, 12 June 2018** | Pennsylvania Convention Center, Room 108AB

IMS2018 is hosting a Ham Radio Social event in Philadelphia, celebrating a return to the location that held the very first one of the series 15 years ago. All radio amateurs and other interested attendees are cordially invited. Be prepared to swap stories and have an eye-ball chat with other fellow hams. The Mt. Airy VHF Club (a.k.a. "The Packrats") will have a display of equipment and their contesting activities, and Temple University students will be demonstrating projects on mesh networking.

PHOTO BY LXLEPHOTOS.COM, ATLANTA, USED WITH PERMISSION

The keynote speaker will be Dr. Joe Taylor, K1JT. Joe first obtained his amateur radio license as a teenager, which led him to the field of radio astronomy. His Amateur Radio feats have included mounting an "expedition" in April 2010 to use the Arecibo Radio Telescope to conduct moonbounce with other amateurs around the world using voice, Morse code, and digital communications. His talk will be about WSJT-X ("Weak Signal Communication, by K1JT"), a computer program suite he created that offers specific digital protocols optimized for EME (moonbounce), meteor scatter, and ionospheric scatter, at VHF/UHF, as well as for LF, MF, and HF propagation. The program can decode fraction-of-a-second signals reflected from ionized meteor trails and also steady signals more than 10 dB below the audible threshold. Professionally, Dr. Taylor was the James S. McDonnell Distinguished University Professor in Physics at Princeton University, having also served for six years as Dean of Faculty. He retired in 2006. He was awarded the 1993 Nobel Prize in Physics for the discovery of a new type of pulsar, opening new possibilities for the study of gravitation. In addition to the Nobel Prize, Dr. Taylor won the Wolf Prize in Physics (1992). He also was awarded a MacArthur fellowship in 1981.

Ham Radio Social at IMS 2013 in Seattle: from left to right, Al Katz, K2UYH, Marc Franco, N2UO, *SUSA*n Telewski, WB7BST, Fred Telewski, WA7TZY, and Wes Hayward, W7ZOI.

We hope to see you in Philly for a memorable Ham Radio event. For now, 73 and DX (that is, greetings and long-distance contacts, in ham jargon).

COURTESY OF THE NAIC - ARECIBO OBSERVATORY, A FACILITY OF THE NS

Arecibo Radio Space Telescope

TECHNICAL SESSIONS

08:00 – 09:40 | Wednesday, 13 June 2018 | Pennsylvania Convention Center

WEDNESDAY

201A

We1A: 5G Sub-Systems: From Predistortion to Complete Link

Chair: Jonathan Comeau, *Anokiwave*
Co-Chair: Kate Remley, *NIST*

08:00 – 08:10

We1A-1: Single-Input Single-Output Digital Predistortion of Power Amplifier Arrays in Millimeter Wave RF Beamforming Transmitters

Eric Ng, *University of Waterloo, Canada*; Yehia Beltagy, *University of Waterloo, Canada*; Patrick Mitran, *University of Waterloo, Canada*; Slim Boumaiza, *University of Waterloo, Canada*

08:10 – 08:20

We1A-2: Optimized DPD Feedback Loop for M-MIMO Sub-6GHz Systems

André Prata, Jordan Sveshtarov, Sérgio C. Pires, *Ampleon, The Netherlands;* Arnaldo S.R. Oliveira, Nuno Borges Carvalho, *Universidade de Aveiro, Portugal*

08:20 – 08:30

We1A-3: A 39GHz MIMO Transceiver Based on Dynamic Multi-Beam Architecture for 5G Communication with 150 Meter Coverage

Xianghua Li, Nan Zhang, Ke Lin, Shitao Sun, Jianping Zhao, *Huawei Technologies, China;* Zhilin Chen, Shoutian Sun, Chenxi Zhao, Huihua Liu, Yunqiu Wu, Kai Kang, *UESTC, China*

08:30 – 08:40

We1A-4: A 29–30GHz 64-Element Active Phased Array for 5G Application

Kuan Bao, Jun Zhou, Liangui Wang, Anfeng Sun, Qiang Zhang, Ya Shen, *NEDI, China*

08:40 – 08:50

We1A-5: A Scalable 64-Element 28GHz Phased-Array Transceiver with 50dBm EIRP and 8–12Gbps 5G Link at 300 Meters without any Calibration

Kerim Kibaroglu, Mustafa Sayginer, Gabriel M. Rebeiz, *University of California, San Diego, USA*

08:50 – 09:00

We1A-6: An FPGA-Based 1-Bit Digital Transmitter with 800-MHz Bandwidth for 5G Millimeter-Wave Active Antenna Systems

Masaaki Tanio, *NEC, Japan;* Shinichi Hori, *NEC, Japan;* Noriaki Tawa, *NEC, Japan;* Toshihide Kuwabara, *NEC, Japan;* Kazuaki Kunihiro, *NEC, Japan*

201B

We1B: VHF/UHF Components and Analog Signal Processing

Chair: Marc Franco, *Qorvo*
Co-Chair: Taylor Barton, *University of Colorado Boulder*

We1B-1: Space-Angle Signal Processing Using a Modulated Scatter Array

Nasr Alkhafaji, *Portland State University, USA;* Richard Campbell, *Portland State University, USA;* Madeleine Roche, Portland State University, *USA*

We1B-2: Low-Loss Broadband Magnetless Circulators for Full-Duplex Radios

Ahmed Kord, Dimitrios L. Sounas, Andrea Alù, *University of Texas at Austin, USA*

We1B-3: 400–560MHz Tunable 2-Pole RF MEMS Bandpass Filter with Improved Stopband Rejection

Tsu-Wei Lin, *University of California, San Diego, USA;* Li Gao, *University of California, San Diego, USA;* Roberto Gaddi, *Cavendish Kinetic, The Netherlands;* Gabriel M. Rebeiz, *University of California, San Diego, USA*

We1B-4: Continuously Tunable True-Time-Delay Phase Shifter Using Switchable Varactor-Tuned Transmission Lines

Huizhong Deng, Feng Lin, *Beijing Institute of Technology, China*

We1B-5: A Compact Lumped-Component Coupler with Tunable Coupling Ratios and Reconfigurable Responses

Bayaner Arigong, Han Ren, *Washington State University, USA;* Mi Zhou, *University of North Texas, USA;* Chang Chen, *USTC, China;* Hualiang Zhang, *UMass Lowell, USA*

We1B-6: High Power Directional Coupler with Equal Tunable Coupling Value at 352MHz and 704MHz

Przemyslaw Kant, *SpaceForest, Poland;* Karol Dobrzyniewicz, *SpaceForest, Poland;* Jerzy Julian Michalski, *SpaceForest, Poland*

201C

We1C: Planar Multiplexers and Multi-Band Filters

Chair: Sanghoon Shin, *U.S. Naval Research Laboratory*
Co-Chair: Laya Mohammadi, *Qualcomm Technologies*

We1C-1: A High Isolation and Low Loss Duplexer Based on SISL Platform

Yutong Chu, *UESTC, China*; Kaixue Ma, *UESTC, China*; Yongqiang Wang, *UESTC, China*

We1C-2: Design of a Planar, High Isolation Diplexer in Ku Band for Application to SmartLNB

Giuseppe Macchiarella, Gian Guido Gentili, Marco Politi, *Politecnico di Milano, Italy*; Marco Bonaventura, Massimo Martin, *DWave, Italy*

We1C-3: Broadband Contiguous Multiplexer Design Using Wideband Pseudo-Highpass Channel Filters

Sanghoon Shin, *U.S. Naval Research Laboratory, USA;* Eric J. Naglich, *U.S. Naval Research Laboratory, USA*

We1C-4: Dual-Band Bandpass Filter with Ultra-Wide Upper Stopband Using Slow-Wave Dual-Resonance Cells

Yunbo Rao, *UESTC, China*; Huizhen Jenny Qian, *UESTC, China*; Roberto Gómez-García, *UESTC, China*; Xun Luo, *UESTC, China*

We1C-5: Miniaturized Triple-Band Filter Design Utilizing Composite Planar Multilayered and Substrate Integrated Waveguide Structures

Qin Ji, *Chinese Academy of Sciences, China;* Yun-Sheng Xu, *Chinese Academy of Sciences, China;* Chang Chen, *Chinese Academy of Sciences, China;* Shan Jiang, *Chinese Academy of Sciences, China;* Lingyun Zhou, *Chinese Academy of Sciences, China*

202AB

We1D: Advanced Behavioral Models of Devices and Systems

Chair: Douglas Teeter, *Qorvo*
Co-Chair: Rob Jones, *Raytheon*

We1D-1: Automating the Accurate Extraction and Verification of the Cardiff Model via the Direct Measurement of Load-Pull Power Contours

Thoalfukar Husseini, *Al-Furat Al-Awsat Technical University, Iraq;* Azam Al-Rawachy, *Mosul University, Iraq;* Johannes Benedikt, *Cardiff University, UK;* James Bell, *Cardiff University, UK;* Paul Tasker, *Cardiff University, UK*

We1D-2: Non-Quasi-Static Large-Signal Model for RF LDMOS Power Transistors

Lei Zhang, *NXP Semiconductors, USA;* Hernan Rueda, *NXP Semiconductors, USA;* Kevin Kim, *NXP Semiconductors, USA;* Peter H. Aaen, *University of Surrey, UK*

We1D-3: A Nonlinear Behavioral Modeling Approach for Voltage-Controlled Oscillators Using Augmented Neural Networks

Huan Yu, *Georgia Tech, USA;* Madhavan Swaminathan, *Georgia Tech, USA;* Chuanyi Ji, *Georgia Tech, USA;* David White, *Cadence Design Systems, USA*

We1D-4: Broadband Hammerstein-Wiener Mixer Modeling extracted by Large-Signal Vector Measurements

Alessandro Cidronali, *Università di Firenze, Italy;* Giovanni Collodi, *Università di Firenze, Italy*

We1D-5: A Dual-Input Canonical Piecewise-Linear Function-Based Model for Digital Predistortion of Multi-Antenna Transmitters

Qing Luo, *Southeast University, China*; Chao Yu, *Southeast University, China*; Xiao-Wei Zhu, *Southeast University, China*

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

TECHNICAL SESSIONS

08:00 – 09:40 | **Wednesday, 13 June 2018** | Pennsylvania Convention Center

203AB

We1E: Advanced MEMS Filters, Resonators, and Waveguides

Chair: Venkata Chivukula, *Qualcomm Technologies*
Co-Chair: Joachim Oberhammer, *KTH*

We1E-1: 1.7GHz Y-Cut Lithium Niobate MEMS Resonators with FoM of 336 and f·Q of 9.15×1012

Yansong Yang, *University of Illinois at Urbana-Champaign, USA;* Ruochen Lu, *University of Illinois at Urbana-Champaign, USA;* Tomás Manzaneque, *University of Illinois at Urbana-Champaign, USA;* Songbin Gong, *University of Illinois at Urbana-Champaign, USA*

We1E-2: A 175MHz 72μW Voltage Controlled Oscillator with 1.4% Tuning Range Based on Lithium Niobate MEMS Resonator and 65nm CMOS

Ali Kourani, Ruochen Lu, Tomás Manzaneque, Yansong Yang, Anming Gao, Songbin Gong, *University of Illinois at Urbana-Champaign, USA*

We1E-3: A 12–20GHz Passively-Compensated Tunable Bandstop Filter with 40-dB Notch Level

Mahmoud Abdelfattah, *Purdue University, USA;* Mark Hickle, *BAE Systems, USA;* Michael D. Sinanis, *Purdue University, USA;* Yu-Chiao Wu, *Purdue University, USA;* Dimitrios Peroulis, *Purdue University, USA*

We1E-4: A Multi-Frequency MEMS-Based RF Oscillator Covering the Range from 11.7MHz to 1.9GHz

J. Stegner, M. Fischer, S. Gropp, U. Stehr, J. Müller, M. Hoffmann, M.A. Hein, *Technische Universität Ilmenau, Germany*

We1E-5: Micromachined Waveguides with Integrated Silicon Absorbers and Attenuators at 220–325GHz

Bernhard Beuerle, Umer Shah, Joachim Oberhammer, *KTH, Sweden*

We1E-6: An Ultra Low-Loss Silicon-Micromachined Waveguide Filter for D-Band Telecommunication Applications

James Campion, Oleksandr Glubokov, Adrían Gomez, Aleksandr Krivovitca, Umer Shah, Joachim Oberhammer, *KTH, Sweden*; Lars Bolander, Yinggang Li, *Ericsson, Sweden*

204A

We1F: Si-Based MMW/ THz Circuits

Chair: Joe Qiu, *U.S. Army Research Office*
Co-Chair: Vadim Issakov, *Infineon Technologies*

We1F-1: A 0.55THz Y-Vector Network Configured Beam Steering Phased Array in CMOS Technology

Yan Zhao, Richard Al Hadi, Yan Zhang, Weikang Qiao, Michael Kevin Lo, Mau-Chung Frank Chang, *University of California, Los Angeles, USA;* Hsin-Chia Lu, Tzu-Shiuan Tseng, *National Taiwan University, Taiwan;* Chewn-Pu Jou, Kevin Zhang, *TSMC, Taiwan;*

We1F-2: A Monostatic E-Band Radar Transceiver with a Tunable TX-to-RX Leakage Canceler for Automotive Applications

Maciej Kucharski, *IHP, Germany*; Dietmar Kissinger, *IHP, Germany*; Herman Jalli Ng, *IHP, Germany*

We1F-3: A 35–105GHz High Image-Rejection-Ratio IQ Receiver with Integrated LO Doubler and >40dB IRR

Qian Ma, *University of California, San Diego, USA;* Hyunchul Chung, *University of California, San Diego, USA;* Gabriel M. Rebeiz, *University of California, San Diego, USA*

We1F-4: A 110–125GHz 27.5dB Gain Low-Power I/Q Receiver Front-End in 65nm CMOS Technology

Chae Jun Lee, *KAIST, Korea;* Dong Min Kang, *KAIST, Korea;* Joon Hyung Kim, *KAIST, Korea;* Chul Woo Byeon, *KAIST, Korea;* Chul Soon Park, *KAIST, Korea*

We1F-5: A Multi-Mode Compact Size Multi-Coil Tuned Inductive Peaking ILFD for Low Injected Power Level

Nagarajan Mahalingam, Kiat Seng Yeo, *SUTD, Singapore;* Kaixue Ma, *UESTC, China*;

We1F-6: A 103-GHz Voltage Controlled Oscillator with 28% Tuning Range and 4.2dBm Peak Output Power Using SiGe BiCMOS Technology

Kefei Wu, Mona Hella, *Rensselaer Polytechnic Institute, USA*

204B

We1G: Enabling Array Components and Beam Forming Architectures

Chair: Glenn Hopkins, *Georgia Tech*
Co-Chair: Ahmed Kishk, *Concordia University*

We1G-1: A Ku-Band 8-Element Phased-Array Transmitter with Built-in-Self-Test Capability

Dong Chen, *UESTC, China*; Xiaoning Zhang, *UESTC, China*; Lin Zhang, *UESTC, China*; Zhilin Chen, *UESTC, China*; Shoutian Sun, *UESTC, China*; Ying Liu, *UESTC, China*; Chenxi Zhao, *UESTC, China*; Huihua Liu, *UESTC, China*; Yunqiu Wu, *UESTC, China*; Kai Kang, *UESTC, China*

We1G-2: A GaN Single-Chip Front-End for Active Electronically Scanned Arrays

W. Ciccognani, S. Colangeli, F. Costanzo, R. Giofrè, G. Polli, A. Salvucci, M. Vittori, E. Limiti, *Università di Roma "Tor Vergata", Italy;* M. Sotgia, M. Cirillo, *Rheinmetall Italia, Italy*

We1G-3: A Ku-Band Phased Array in Package Integrating Four 180nm CMOS Transceivers with On-Chip Antennas

Xiaoning Zhang, Yexi Song, Chao Yu, Dong Chen, Lin Zhang, Shoutian Sun, Zhilin Chen, Huihua Liu, Chenxi Zhao, Yunqiu Wu, Kai Kang, *UESTC, China*

We1G-4: Spatial Interference Mitigation Nulling the Embedded Element Pattern

Robin Irazoqui, *University of Oklahoma, USA;* Caleb Fulton, *University of Oklahoma, USA*

We1G-5: A Novel Agile Phase-Controlled Beamforming Network Intended for 360° Angular Scanning in MIMO Applications

Valentina Palazzi, *Università di Perugia, Italy;* Paolo Mezzanotte, *Università di Perugia, Italy;* Luca Roselli, *Università di Perugia, Italy*

We1G-6: Reconfigurable Dual-Mode Integrated Beam-Steering Array

Huy Nam Chu, *Taiwan Tech, Taiwan*; Ting Heish, *Taiwan Tech, Taiwan*; Tzyh-Ghuang Ma, *Taiwan Tech, Taiwan*

We1G-7: Two-Dimensional Butler Matrix Concept for Planar Array

Kejia Ding, *Concordia University, Canada;* Ahmed Kishk, *Concordia University, Canada*

204C

We1H: High Performance Power Amplifiers

Chair: Jonwei Yan, *MaXentric Technologies*
Co-Chair: Joseph Staudinger, *NXP Semiconductors*

We1H-1: Efficiency Degradation in Wideband Power Amplifiers

Luís C. Nunes, *Universidade de Aveiro, Portugal*; Diogo R. Barros, *Universidade de Aveiro, Portugal*; Pedro M. Cabral, *Universidade de Aveiro, Portugal*; José C. Pedro, *Universidade de Aveiro, Portugal*

We1H-2, A 1.4kW, Highly-Efficient, GaN, Partially-Matched FET for L-Band Applications

Brian Henricksen, *Qorvo, USA;* Gary Scott, *Qorvo, USA;* Matthew Irvine, *Qorvo, USA;* Raj Santhakumar, *Qorvo, USA*

We1H-3: An S-Band Internally Matched Packaged GaN HEMT with Over 720W Peak Power and 58% PAE

Kwanjin Oh, *Wavice, Korea;* Sangmin Lee, *Wavice, Korea;* Heejun Kim, *Wavice, Korea;* Heejae Yoon, *Wavice, Korea*

We1H-4: Design of a 5W Single Chip Front-End for C-Ku Band T/R Modules

Diego Palombini, *Elettronica, Italy;* Daniele Rampazzo, *Elettronica, Italy;* Andrea Bentini, *Elettronica, Italy;* Patrick Ettore Longhi, *Elettronica, Italy*

We1H-5: A 60-GHz Adaptively Biased Power Amplifier with Predistortion Linearizer in 90-nm CMOS

Shih-Min Weng, *National Tsing Hua University, Taiwan;* Yi-Chun Lee, *National Tsing Hua University, Taiwan;* Tse-Hung Chen, *National Tsing Hua University, Taiwan;* Jenny Yi-Chun Liu, *National Tsing Hua University, Taiwan*

08:00 - 08:10
08:10 - 08:20
08:20 - 08:30
08:30 - 08:40
08:40 - 08:50
08:50 - 09:00
09:00 - 09:10
09:10 - 09:20
09:20 - 09:30
09:30 - 09:40

WEDNESDAY

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

TECHNICAL SESSIONS

10:10 – 11:50 | Wednesday, 13 June 2018 | Pennsylvania Convention Center

WEDNESDAY

201A

We2A: Multi GHz all Digital and Mixed Signal Circuits and Systems

Chair: Isar Mostafanezhad, *Nalu Scientific*
Co-Chair: Greg Lyons, *MIT Lincoln Laboratory*

10:10 - 10:20
We2A-1: An Over-110-GHz-Bandwidth 2:1 Analog Multiplexer in 0.25-µm InP DHBT Technology
M. Nagatani, *NTT, Japan;* H. Wakita, *NTT, Japan;* H. Yamazaki, *NTT, Japan;* M. Mutoh, *NTT, Japan;* M. Ida, *NTT, Japan;* Y. Miyamoto, *NTT, Japan;* Hideyuki Nosaka, NTT, Japan

10:20 - 10:30
We2A-2: An FPGA-Based Multi-Level All-Digital Transmitter with 1.25GHz of Bandwidth
Daniel C. Dinis, MERL, *USA;* Rui Ma, MERL, *USA;* Koon H. Teo, MERL, *USA;* Philip Orlik, MERL, *USA;* Arnaldo S.R. Oliveira, *Universidade de Aveiro, Portugal*; José Vieira, *Universidade de Aveiro, Portugal*

10:30 - 10:40
We2A-3: An Echo-Canceller-Less NFIC-TSV Hybrid 3D Interconnect for Simultaneous Bidirectional Vertical Communication
Srinivasan Gopal, Sheikh Nijam Ali, Joe Baylon, Deukhyoun Heo, *Washington State University, USA;* Pawan Agarwal, *MaxLinear, USA*

10:40 - 10:50
We2A-4: A 16-Element 2.4-GHz Digital Array Receiver Using 2-D IIR Spatially-Bandpass Plane-Wave Filter
Sravan Pulipati, *University of Akron, USA;* Viduneth Ariyarathna, *University of Akron, USA;* Arjuna Madanayake, *University of Akron, USA*

10:50 - 11:00
We2A-5: A Wide-Range 130-nm CMOS Statistic-Based Frequency Ratio Calculator
Yun-Chih Lu, *National Taiwan University, Taiwan;* Yen-Yu Pan, *National Taiwan University, Taiwan;* Yi-Jan Emery Chen, *National Taiwan University, Taiwan*

201B

We2B: Advances in Mixers and Frequency Multipliers

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

10:10 - 10:20
We2B-1: 6–12GHz MMIC Double-Balanced Upconversion Mixer Based on Graphene Diode
Ahmed Hamed, *RWTH Aachen University, Germany;* Mohamed Saeed, *RWTH Aachen University, Germany;* Zhenxing Wang, *AMO, Germany;* Mehrdad Shaygan, *AMO, Germany;* Daniel Neumaier, *AMO, Germany;* Renato Negra, *RWTH Aachen University, Germany*

10:20 - 10:30
We2B-2: A 10GHz Up-Conversion Mixer with 13.6dBm OIP3 Using Regulator-Based Linearized Gm Stage and Harmonic Nulling
Jinbo Li, *University of California, Davis, USA;* Ajinkya More, *University of California, Davis, USA;* Shilei Hao, *University of California, Davis, USA;* Qun Jane Gu, *University of California, Davis, USA*

10:30 - 10:40
We2B-3: An Active High Conversion Gain W-Band Up-Converting Mixer for Space Applications
M. Hossain, *FBH, Germany;* M. Hrobak, *FBH, Germany;* D. Stoppel, *FBH, Germany;* Wolfgang Heinrich, *FBH, Germany;* V. Krozer, *FBH, Germany*

10:40 - 10:50
We2B-4: A High LO-to-RF Isolation 34–53GHz Cascode Mixer for ALMA Observatory Applications
Chun-Nien Chen, *National Taiwan University, Taiwan;* Yu-Hsuan Lin, *National Taiwan University, Taiwan;* Yen-Chih Chen, *National Taiwan University, Taiwan;* Chau-Ching Chiong, *Academia Sinica, Taiwan;* Huei Wang, *National Taiwan University, Taiwan*

10:50 - 11:00
We2B-5: A High-Efficiency E-Band SiGe HBT Frequency Tripler with Broadband Performance
Peigen Zhou, *Southeast University, China;* Jixin Chen, *Southeast University, China;* Huanbo Li, *Southeast University, China;* Debin Hou, *Southeast University, China;* Pinpin Yan, *Southeast University, China;* Chao Yu, *Southeast University, China;* Wei Hong, *Southeast University, China*

201C

We2C: Filter Tuning, Synthesis, and Innovative Coupling Realizations

Chair: Dimitra Psychogiou, *University of Colorado Boulder*
Co-Chair: Masud Hannan, *Intel*

10:10 - 10:20
We2C-1: An Efficient Technique for Tuning and Design of Wideband Filters
Huayong Jia, *University of Waterloo, Canada*; Raafat R. Mansour, *University of Waterloo, Canada*

10:20 - 10:30
We2C-2: Coupling Matrix Extraction Technique for Auto Tuning of Highly Lossy Filters
Ranjan Das, *IIT Bombay, India*; Qingfeng Zhang, *SUSTech, China*; Abhishek Kandwal, *SUSTech, China*; Haiwen Liu, Xi'an Jiaotong University, *China*

10:30 - 10:40
We2C-3: Half-Mode SIW Filters with Resonant Couplings Implementing Transmission Zeros
Enrico Massoni, Nicolò Delmonte, Luca Perregrini, Maurizio Bozzi, *Università di Pavia, Italy*; Giuseppe Macchiarella, *Politecnico di Milano, Italy*

10:40 - 10:50
We2C-4: High Selectivity Filters in Coaxial SIW Based on Singlets and Doublets
Stefano Sirci, *Universitat Politècnica de València, Spain*; Miguel A. Sánchez-Soriano, Universidad de Alicante, Spain; Jorge D. Martínez, *Universitat Politècnica de València, Spain*; Vicente E. Boria, *Universitat Politècnica de València, Spain*

10:50 - 11:00
We2C-5: A New Microstrip Bandstop Filter for Fully Canonical Cul-de-Sac Coupling Configuration
Masataka Ohira, *Saitama University, Japan*; Makoto Kanomata, *Saitama University, Japan*; Zhewang Ma, *Saitama University, Japan*; Xiaolong Wang, *Saitama University, Japan*

11:00 - 11:10
We2C-6: A Novel Microstrip Symmetric Diagonal Cross-Coupling Quadruplet Bandpass Filter Using Even/Odd-Mode Stepped Impedance Resonators
Ryo Mikase, *Saitama University, Japan*; Masataka Ohira, *Saitama University, Japan*; Zhewang Ma, *Saitama University, Japan*; Xiaolong Wang, *Saitama University, Japan*

202AB

We2D: Trapping Phenomena in GaN HEMTs

Chair: Matthias Rudolph, *Brandenburgische Technische Universität*
Co-Chair: Q.J. Zhang, *Carleton University*

10:10 - 10:20
We2D-1: A Simple Method to Extract Trapping Time Constants of GaN HEMTs
Luís C. Nunes, *Universidade de Aveiro, Portugal*; João L. Gomes, *Universidade de Aveiro, Portugal*; Pedro M. Cabral, *Universidade de Aveiro, Portugal*; José C. Pedro, *Universidade de Aveiro, Portugal*

10:20 - 10:30
We2D-2: Investigation of Fast and Slow Charge Trapping Mechanisms of GaN/AlGaN HEMTs Through Pulsed I-V Measurements and the Associated New Trap Model
Julien Couvidat, Nandha Kumar Subramani, Vincent Gillet, Sylvain Laurent, Jean Christophe Nallatamby, Michel Prigent, Nathalie Deltimple, Raymond Quéré, *XLIM (UMR 7252), France;* Christophe Charbonniaud, *AMCAD Engineering, France*

10:30 - 10:40
We2D-3: Modeling Buffer-Related Charge Trapping Effect by Using Threshold Voltage Shifts in AlGaN/GaN HEMTs
Yonghao Jia, *UESTC, China*; Yuehang Xu, *UESTC, China*; Yongxin Guo, *National University of Singapore, Singapore*

10:40 - 10:50
We2D-4: Modeling the Virtual Gate Voltage in Dispersive GaN HEMTs
Peng Luo, *Brandenburgische Technische Universität, Germany*; Frank Schnieder, *FBH, Germany;* Olof Bengtsson, *FBH, Germany;* Wolfgang Heinrich, *FBH, Germany;* Matthias Rudolph, *Brandenburgische Technische Universität, Germany*

10:50 - 11:00
We2D-5: Assessment of the Trap-Induced Insertion Loss Degradation of RF GaN Switches Under Operating Regimes
Corrado Florian, *Università di Bologna, Italy*; Gian Piero Gibiino, *Università di Bologna, Italy*; Alberto Santarelli, *Università di Bologna, Italy*

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

TECHNICAL SESSIONS

10:10 – 11:50 | **Wednesday, 13 June 2018** | Pennsylvania Convention Center

203AB

We2E: Ferrite, Ferroelectric, and Phase-Change Components

Chair: Shamsur Mazumder, *Worcester Polytechnic Institute*
Co-Chair: Steven Stitzer, *Northrop Grumman Mission Systems*

We2E-1: Design, Fabrication and Characterization of a PCM-Based Compact 4-Bit Capacitor Bank

Junwen Jiang, *University of Waterloo, Canada*; Raafat R. Mansour, *University of Waterloo, Canada*

We2E-2: Voltage-Tunable Parallel-Plate Capacitors Fabricated on Low-Loss MBE-Grown BST

Cedric J.G. Meyers, Cristopher R. Freeze, Anne Stemmer, Robert A. York, *University of California, Santa Barbara, USA*

We2E-3: Intrinsically Switchable and Bandwidth Reconfigurable FBAR Filter Employing Electrostriction in Ferroelectric BST

Milad Zolfagharloo *Koohi, University of Michigan, USA;* Suhyun Nam, *University of Michigan, USA;* Amir Mortazawi, *University of Michigan, USA*

We2E-4: Complete Methodology of Low-Loss Ultra-Wideband Junction Circulator

Hamza Turki, *XLIM (UMR 7252), France;* Laure Huitema, *XLIM (UMR 7252), France;* Thierry Monediere, *XLIM (UMR 7252), France;* Bertrand Lenoir, *INOVEOS, France;* Christophe Breuil, *INOVEOS, France*

We2E-5: Ferrimagnetic Garnets for Low Temperature Co-Fired Ceramics Microwave Circulators

L. Qassym, *Thales Research & Technology, France;* V. Laur, *Lab-STICC (UMR 6285), France;* R. Lebourgeois, *Thales Research & Technology, France;* P. Queffelec, *Lab-STICC (UMR 6285), France*

204A

We2F: THz and mm-Wave Amplification Multiplication and Control Innovations

Chair: Edward Niehenke, *Niehenke Consulting*
Co-Chair: Omeed Momeni, *University of California, Davis*

We2F-1: F-Band, GaN Power Amplifiers

Edmar Camargo, *QuinStar Technology, USA;* James Schellenberg, *QuinStar Technology, USA;* Lani Bui, *QuinStar Technology, USA;* Nicholas Estella, *QuinStar Technology, USA*

We2F-2: First Full W-Band GaN Power Amplifier MMICs with Novel Broadband Radial Stubs and 50GHz of Bandwidth

Maciej _wikli_ski, *Fraunhofer IAF, Germany*; Christian Friesicke, *Fraunhofer IAF, Germany*; Peter Brückner, *Fraunhofer IAF, Germany*; Dirk Schwantuschke, *Fraunhofer IAF, Germany*; Roger Lozar, *Fraunhofer IAF, Germany*; Hermann Massler, *Fraunhofer IAF, Germany*; Sandrine Wagner, *Fraunhofer IAF, Germany*; Rüdiger Quay, *Fraunhofer IAF, Germany*

We2F-3: in situ Load-Pull MMIC for Large-Signal Characterization of mHEMT Devices at Submillimeter-Wave Frequencies

Laurenz John, Matthias Ohlrogge, Sandrine Wagner, Christian Friesicke, Axel Tessmann, Arnulf Leuther, *Fraunhofer IAF, Germany*; Thomas Zwick, *KIT, Germany*

We2F-4: 220–265GHz Active ×6 Frequency Multiplier MMIC with InP HEMT Technology

Kangseop Lee, *POSTECH, Korea;* Hiroshi Hamada, *NTT, Japan;* Hideaki Matsuzaki, *NTT, Japan;* Hideyuki Nosaka, *NTT, Japan;* Ho-Jin Song, POSTECH, Korea

We2F-5: A 160GHz Frequency Quadrupler Based on Heterogeneous Integration of GaAs Schottky Diodes onto Silicon Using SU-8 for Epitaxy Transfer

Souheil Nadri, Linli Xie, Masoud Jafari, Naser Alijabbari, Michael E. Cyberey, N. Scott Barker, Arthur W. Lichtenberger, Robert M. Weikle II, *University of Virginia, USA*

We2F-6: A 460GHz MEMS-Based Single-Pole Double-Throw Waveguide Switch

Theodore Reck, Cecile Jung-Kubiak, Goutam Chattopadhyay, *Jet Propulsion Laboratory, USA*

204B

We2G: Phased Array Systems and Applications

Chair: Roberto Vincenti Gatti, *Università di Perugia*
Co-Chair: Julio Navarro, *Boeing*

We2G-1: Heterogeneously-Integrated Phased-Array Antennas for Line-of-Sight (LOS) Communications and Sensor Applications

Julio Navarro, Boeing, *USA*

We2G-2: Development of a Receive Phased Array Antenna for High Altitude Platform Stations Using Integrated Beamformer Modules

Will Theunissen, Facebook, *USA;* Vipul Jain, *Anokiwave, USA;* Gaurav Menon, *Anokiwave, USA*

We2G-3: A Planar All-Silicon 256-Element Ka-Band Phased Array for High-Altitude Platforms (HAPs) Application

Matthew Stoneback, Facebook, *USA;* Kristian Madsen, *Anokiwave, USA*

We2G-4: Intermodulation Effects and System Sensitivity Degradation in 5G Phased-Arrays Due to Multiple Interferers

Bhaskara Rupakula, *University of California, San Diego, USA;* Gabriel M. Rebeiz, *University of California, San Diego, USA*

We2G-5: Linearity and Efficiency Improvements in Phased-Array Transmitters with Large Number of Elements and Complex Modulation

Bhaskara Rupakula, *University of California, San Diego, USA;* Abdurrahman H. Aljuhani, *University of California, San Diego, USA;* Gabriel M. Rebeiz, *University of California, San Diego, USA*

204C

We2H: High Power Doherty Power Amplifiers

Chair: Slim Boumaiza, *University of Waterloo*
Co-Chair: Manouchehr Ghanevati, *Northrop Grumman Aerospace Systems*

We2H-1: A 150W High Efficiency Integrated Doherty Amplifier for LTE-Advanced Applications

Alan Xu, *NXP Semiconductors, China;* Marvin Lu, *NXP Semiconductors, China;* Eric Wang, NXP Semiconductors, *China*

We2H-2, A 225 Watt, 1.8–2.7GHz Broadband Doherty Power Amplifier with Zero-Phase Shift Peaking Amplifier

Haedong Jang, *Infineon Technologies, USA* Richard Wilson, *Infineon Technologies, USA*

We2H-3: Digitally-Assisted Doherty Power Amplifier: Efficiency Enhancement and Linearity Improvement

Mir Masood, *NXP Semiconductors, USA;* Peter Rashev, *NXP Semiconductors, USA;* J. Stevenson Kenney, *Georgia Tech, USA*

We2H-4: A Sub-6GHz Compact GaN MMIC Doherty PA with a 49.5% 6dB Back-Off PAE for 5G Communications

Sih-Han Li, *National Tsing Hua University, Taiwan;* Shawn S.H. Hsu, *National Tsing Hua University, Taiwan;* Jie Zhang, *ITRI, Taiwan;* Keh-Ching Huang, *ITRI, Taiwan*

We2H-5: A Compact and Broadband Ka-Band Asymmetrical GaAs Doherty Power Amplifier MMIC for 5G Communications

Guansheng Lv, *Tsinghua University, China;* Wenhua Chen, *Tsinghua University, China;* Zhenghe Feng, *Tsinghua University, China*

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

WEDNESDAY

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

WEIF1: Interactive Forum #2

Chair: Aly Fathy, *University of Tennessee* **Co-Chair:** Kiki Ikossi, *IEEE*

WEIF1-1: Real-Time Frequency-Agile Circuit Reconfiguration for S-Band Radar Using a High-Power Tunable Resonant Cavity Matching Network

Sarvin Rezayat, *Baylor University, USA;* Chris Kappelmann, *Baylor University, USA;* Zachary Hays, *Baylor University, USA;* Lucilia Hays, *Baylor University, USA;* Charles Baylis, *Baylor University, USA;* Edward A. Viveiros, *U.S. Army Research Laboratory, USA;* Abbas Semnani, *Purdue University, USA;* Dimitrios Peroulis, *Purdue University*, *USA*

WEIF1-2: Compact Transmitter for Pulsed-Radar Detection of On-Body Concealed Weapons

Aaron D. Pitcher, *McMaster University, Canada;* Justin J. McCombe, *McMaster University, Canada;* Eric A. Eveleigh, *McMaster University, Canada;* Natalia K. Nikolova, *McMaster University, Canada*

WEIF1-3: Active HEMT Based Envelope Detector for Ultra-Wideband Wireless Communication Systems

Bruno Cimoli, *Technical University of Denmark, Denmark;* Juan Sebastián Rodríguez Páez, *Technical University of Denmark, Denmark;* Arsen Turhaner, *Technical University of Denmark, Denmark;* Tom Keinicke Johansen, *Technical University of Denmark, Denmark;* Juan José Vegas Olmos, *Mellanox Technologies, Denmark*

WEIF1-4: Curtailed Digital Predistortion Model for Crosstalk in MIMO Transmitters

Praveen Jaraut, *IIT Roorkee, India*; Meenakshi Rawat, *IIT Roorkee, India*; Fadhel M. Ghannouchi, *University of Calgary, Canada*

WEIF1-5: A RF-DAC Based 40Gbps PAM Modulator with 1.2pJ/Bit Energy Efficiency at Millimeterwave Band

Frida Strömbeck, *Chalmers University of Technology, Sweden*; Zhongxia Simon He, *Chalmers University of Technology, Sweden*; Herbert Zirath, *Chalmers University of Technology, Sweden*

WEIF1-6: Multiband Microwave Sensing for Surface Roughness Classification

Philipp A. Scharf, *Hochschule Ulm, Germany*; Johannes Iberle, *Hochschule Ulm, Germany*; Hubert Mantz, *Hochschule Ulm, Germany*; Thomas Walter, *Hochschule Ulm, Germany*; Christian Waldschmidt, *Universität Ulm, Germany*

WEIF1-7: The Influence of Metallization on Resonance Frequency and Temperature Sensitivity of GHz Operating III-Nitride SAW Based Sensor Structures

A. Müller, IMT Bucharest, Romania; A. Nicoloiu, IMT Bucharest, Romania; A. Dinescu, IMT Bucharest, Romania; A. Stavrinidis, FORTH, Greece; I. Zdru, IMT Bucharest, Romania; G. Konstantinidis, *FORTH, Greece*

WEIF1-8: 55nm Ultra-Low-Power Local Oscillator for EPCglobal Gen2v2 Standardized Passive UHF RFID Tags

Georg Saxl, *Universität Innsbruck, Austria;* Manuel Hechenblaickner, *Universität Innsbruck, Austria;* Manuel Ferdik, *Universität Innsbruck, Austria;* Thomas Ussmueller, Universität Innsbruck, Austria

WEIF1-9: On-Wafer Measurements of Responsivity of FET-Based subTHz Detectors

P. Kopyt, *Warsaw University of Technology, Poland;* B. Salski, *Warsaw University of Technology, Poland;* P. Zagrajek, *Warsaw Military University, Poland;* M. Bauwens, *Dominion Microprobes, USA;* D. Obr_bski, *Institute of Electron Technology, Poland;* J. Marczewski, *Institute of Electron Technology, Poland;* N. Scott Barker, University of Virginia, *USA*

WEIF1-10: Study on Wide Power Dynamic Range Coherent Power Combining Based on S-Band 20-kW Frequency Pushing Magnetrons

Xiaojie Chen, *Sichuan University, China;* Zhenlong Liu, *Sichuan University, China;* Changjun Liu, Sichuan University, China

WEIF1-11: Towards Study on Thermoacoustic Imaging Guided Focused Microwave Therapy for Breast Cancer Treatment

Srishti Saraswat, *University of Arizona, USA;* Jinpil Tak, *University of Arizona, USA;* Min Liang, *University of Arizona, USA;* Cheng Lyu, *University of Arizona, USA;* Russell S. Witte, *University of Arizona, USA;* Hao Xin, *University of Arizona, USA*

WEIF1-12: Honey-Bee Localization Using an Energy Harvesting Device and Power Based Angle of Arrival Estimation

Jake Shearwood, *Bangor University, UK*; Daisy Man Yuen Hung, *Bangor University, UK*; Paul Cross, *Bangor University, UK*; Shaun C. Preston, *Bangor University, UK*; Cristiano Palego, *Bangor University, UK*

WEIF1-13: Through The Wall Respiration Rate Detection Using Hilbert Vibrational Decomposition

Harikesh, *IIT Delhi, India;* Ananjan Basu, *IIT Delhi, India;* Mahesh P. Abegaonkar, *IIT Delhi, India;* Shiban Kishen Koul, *IIT Delhi, India*

WEIF1-14: A Large Planar Holographic Reflectarray for Fresnel-Zone Microwave Wireless Power Transfer at 5.8GHz

Guy S. Lipworth, *Metamaterials Commercialization Center, USA;* Joseph A. Hagerty, *Metamaterials Commercialization Center, USA;* Daniel Arnitz, *Metamaterials Commercialization Center, USA;* Yaroslav A. Urzhumov, *Metamaterials Commercialization Center, USA;* David R. Nash, *Metamaterials Commercialization Center, USA;* Russell J. Hannigan, *Metamaterials Commercialization Center, USA;* Casey T. Tegreene, *Metamaterials Commercialization Center, USA;* Matthew S. Reynolds, University of Washington, *USA*

WEIF1-15: Mid-Range Wireless Power Transfer Based on Goubau Lines

Brian J. Vaughn, *Purdue University, USA;* Dimitrios Peroulis, *Purdue University, USA;* Alden Fisher, *Purdue University*, *USA*

WEIF1-16: Compact and Wide-Band Efficiency Improved RF Differential Rectifier for Wireless Energy Harvesting

Mohamed M. Mansour, *Kyushu University, Japan;* Xavier Le Polozec, *Ericsson, France;* Haruichi Kanaya, *Kyushu University, Japan*

WEIF1-17: Nonlinear Resonant Circuits for Coupling-Insensitive Wireless Power Transfer Circuits

Omar Abdelatty, *University of Michigan, USA;* Xiaoyu Wang, *University of Michigan, USA;* Amir Mortazawi, *University of Michigan, USA*

WEIF1-18: Performance Comparison of Two Stage of Dickson Voltage Rectifier Realized in FD-SOI 28nm and BiCMOS 55nm for RF Energy Harvesting

M. Awad, *IMEP-LAHC (UMR 5130), France;* P. Benech, *IMEP-LAHC (UMR 5130), France;* J.-M. Duchamp, *IMEP-LAHC (UMR 5130), France;* N. Corrao, *IMEP-LAHC (UMR 5130), France*

WEIF1-19: A 4-Bit Programmable Metamaterial Based on VO2 Mediums

Yong Zhang, *Tsinghua University, China;* Jinyu Zhang, *Tsinghua University, China;* Yan Wang, *Tsinghua University, China;* Zhiping Yu, *Tsinghua University, China;* Binzhen Zhang, *NUC, China*

WEIF1-20: Ultra-Wide Band On-Chip Circulators for Full-Duplex Communications

Mathew M. Biedka, *University of California, Los Angeles, USA;* Rui Zhu, *University of California, Los Angeles, USA;* Qiang Mark Xu, *University of California, Los Angeles, USA;* Yuanxun Ethan Wang, *University of California, Los Angeles*, *USA*

WEIF1-21: Photonic-Enabled RF Canceller for In-Band Full-Duplex 5G Networks

Kenneth E. Kolodziej, *MIT Lincoln Laboratory, USA;* Siva Yegnanarayanan, *MIT Lincoln Laboratory, USA;* Bradley T. Perry, *MIT Lincoln Laboratory, USA*

WEIF1-23: A Dual-Band RF Front-End Architecture for Accurate and Reliable GPS Receivers

Ramón López La Valle, *UNLP, Argentina;* Javier G. García, *UNLP, Argentina;* Pedro A. Roncagliolo, *UNLP, Argentina*

WEIF1-24: A Polarization Independent Frequency Selective Surface Based on the Matryoshka Geometry

A. Gomes Neto, *IFPB, Brazil;* T.R. de Sousa, *IFPB, Brazil;* J.C. e Silva, *IFPB, Brazil;* D.F. Mamedes, *IFPB, Brazil*

WEIF1-25: Josephson Junction Microwave Modulators

Ofer Naaman, *Northrop Grumman, USA;* Joshua Strong, *Northrop Grumman, USA;* David Ferguson, *Northrop Grumman, USA;* Jonathan Egan, *Northrop Grumman, USA;* Nancyjane Bailey, *Northrop Grumman, USA;* Robert Hinkey, *Northrop Grumman, USA*

PANEL SESSION

12:00 – 13:00 **| Wednesday, 13 June 2018 |**
Room 201A

WEP1

Body Wearable Technology: Is It Still Relevant And What Is Its Future?

Organizers: Dalma Novak, *Pharad, LLC.*; Rod Waterhouse, *Pharad, LLC.*

Abstract: Body wearable technology has been incorporated into a vast range of industries/applications; whether to improve the mobility and situational awareness of a modern-day soldier, monitor the physical exertion of an elite athlete, or simply to change the color of a piece of clothing to suit the mood of the person wearing it. While there have been many successful applications of wearable technology and significant adoption within our society, there have also been some notable failures (Google glass?). In some cases it could be argued that the technology is more of a solution looking for a problem. In this session we will have expert panelists from a variety of backgrounds (industry, academia and military) share their view on this topic, as well as debate the usefulness and future direction of body wearable technologies.

Panelists:

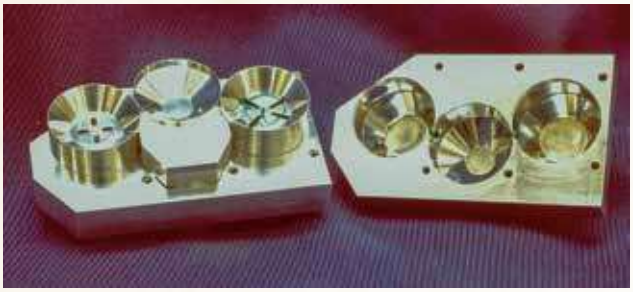
1. Gerard Hayes, *Wireless Research Center of North Carolina*
2. Karu Esselle, *Macquarie University*
3. Manos Tentzeris, *Georgia Institute of Technology*
4. Mitchell Mayer, *Army Cerdec*
5. Preet Sibia, *Infineon Technologies*
6. Roger Antunez, *First Vision*

History

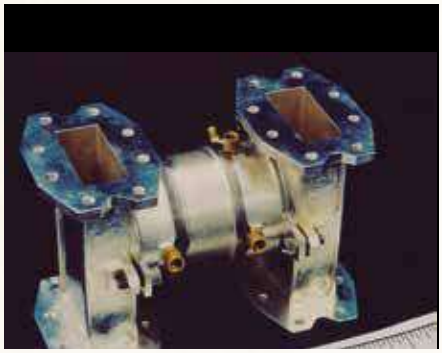
Philadelphia, PA and the neighbouring states of New Jersey, New York, and Maryland provided some of the key enabling microwave and antenna technologies that made satellite communications possible. RCA Astro (East Windsor, NJ) and GE Aerospace (Valley Forge, PA), both now part of Lockheed Martin, were instrumental in building some of the early satellites including DSCS, MILSTAR, GPS, ACTS, and LANDSAT.

The photos below show examples of the advanced filter technology, circa late 1970s at GE Aerospace. Photos provided by Mr. Herb Thal.

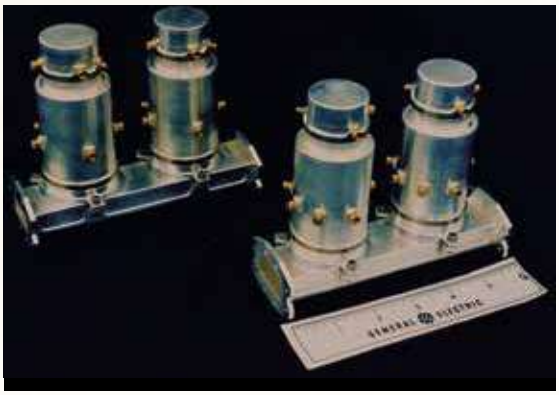
COMPONENTS



6 Pole, elliptic function TE011 mode filter with shaped cavities for mode control and increased unloaded Q, having a 40 MHz passband at 11725 MHz with two S21 nulls on each side and Qu=20000. (Circa 1978)



Directional Filter for Diplexing at 12 GHz for BSE TV Broadcast Satellite.



Hybrid TE113/TE111 mode, 4 Pole, directionally coupled, band reject filters for low-loss, narrow band rejection at 8 GHz for DSCS III. (Circa 1977)

Exhibition Only Time

11:50 – 15:55 | **Wednesday, 13 June 2018** | Pennsylvania Convention Center, Exhibit Hall

The IMS Microwave Week is a very busy time for all the 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 600+ exhibitors and displaying the latest innovations, products, and services is happening a hundred feet away.

The attendees face a difficult scheduling task, balancing the demands on their time between the exhibition, sessions, networking, and catching up with their friends and collaborators. Don't forget the lure of a city like Philadelphia, with historic sites no farther away than a couple of miles from the convention center. What does an attendee do?

The IMS2018 Steering Committee, following the lead from IMS2017, has implemented an "Exhibition Only" time from 11:50 to 15:55 on Wednesday, 13 June 2018. No technical sessions are scheduled at this time, so that the attendee can spend four complete hours in the exhibition with no competing activities. Thus, the attendees can use this time to interact with the IMS Exhibitors, learn about the latest products and services, establish partnerships, and offer suggestions for product improvements and new products and services.

Please plan on visiting the exhibition during the "Exhibition Only" time, participating at the Interactive Forum, and be ready for the Industry Hosted Reception starting at 17:00. If you have a good set of pipes (or is it waveguides?), be ready to join the Barbershop Quartets as they perform at the two networking areas in the exhibition.

The following activities are scheduled in the exhibition during the "Exhibition Only" time, to further maximize the efficient use of attendee time and help their IMS Microwave Week schedule.

- 5G Demos and 5G Interactive Theater Presentations at the 5G Pavilion (1433)
- MicroApps Seminar located in the MicroApps Theater (Booth 1457)
- Meet the Technical Society Members (Booth 1512)

You don't have to panic 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.

Be There, Be Sharp, or Be Flat!

History

Ben Franklin invented a musical instrument called the armonica, also called as the glass armonica or harmonica. The instrument was very popular, and thousands were built and sold. Many of the instrument's performers were women, which was somewhat unusual for the period. Composers were also struck by the haunting sounds produced by Franklin's instrument. Mozart wrote two pieces for the armonica, including "Adagio and Rondo 617," and in 1815, Beethoven wrote a short melodrama where a narrator told a story while accompanied by armonica. *[Source: **http://www.pbs.org/benfranklin/l3_inquiring_glass.html**]*

Glass Armonica, invented by Ben Franklin in 1762, being used during a performance.

OF ALL MY INVENTIONS, THE GLASS ARMONICA HAS GIVEN ME THE GREATEST PERSONAL SATISFACTION.

BENJAMIN FRANKLIN

Society Time

17:00 – 18:00 | **Wednesday, 13 June 2018** | Pennsylvania Convention Center, Exhibit Hall

First-time and recent IMS attendees may be unaware that 2018 is the 61st year of technical sessions and 46th year of exhibits at the IMS. As importantly, many are not aware that the IMS is sponsored by the IEEE Microwave Theory & Techniques Society (MTT-S). MTT-S members, most of whom are engineers, technologists, or academics volunteer to serve on the IMS Steering Committee, and spend more than three years planning, organizing, and executing the world's largest and most prestigious microwave symposium and exhibition. The IMS Microwave Week that attendees experience — is the direct result and culmination of the three-year effort of the MTT-S member volunteers.

MTT-S
MHz to THz Community

The MTT-S (***www.mtt.org***), a transnational society with more than 10,500 members and 190 chapters worldwide, does far more than just organize the IMS. The society promotes the advancement of microwave theory and its applications, including RF, microwave, millimeter-wave, and terahertz technologies. The MTT-S, for more than 60 years, has also worked to advance the professional standing of its members and enhance the quality of life for all people through the development and application of microwave technology. As we enter an exciting future, the MTT-S mission is to continue to understand and influence microwave technology, and to provide a forum for all microwave engineers.

The MTT-S will continue to serve as the global focus for the promotion of the RF and microwave engineering professions, by advancing and distributing knowledge and supporting professional development. The all-volunteer society, driven to excellence by its leadership and with the active participation of all its world-wide members, provides ample opportunities for the development of critical, non-technical skills that enable you to be more effective professionally. Our professional venues, such as the IMS, provide a great opportunity for networking with experienced innovators, experts, and practitioners.

IEEE
EuMA European Microwave Association

The MTT-S members share a common passion and mission, to provide growth opportunities to everyone and especially to young professionals and other demographics that are traditionally not represented within our industry. To further this mission, IMS2018 features a "Societies Pavilion" in the exhibition where the IEEE societies and sister organizations such as the European Microwave Association showcase their technical areas, and present opportunities to all attendees to participate in their society's activities at the local chapter, regional, and administrative committees.

Please stop by the Societies' Pavilion (Booth 1512) during the Industry Hosted Reception (or at any other convenient time during the exhibition) and meet the volunteers of the MTT-S, AP-S, EMC-S, ComSoc, ARFTG, EuMA, CMS, APMC2019, and the IEEE 5G Initiative to find out how you may contribute to our societies' and your own professional growth.

History

PHILADELPHIA'S SOCIETY HILL, adapted from an article by George W. Dowdall, *Professor Emeritus of Sociology at Saint Joseph's University* and *Adjunct Fellow, Center for Public Health Initiatives, University of Pennsylvania*

Society Hill is one of Philadelphia's oldest neighborhoods, with more buildings surviving from the eighteenth and nineteenth centuries than any other in the country. Society Hill's history begins in 1682, when William Penn (yes, of "Penn-sylvania") first set foot in his new colony at the point where Dock Creek poured into the Delaware. To spur development, he gave a charter to "The Society of Free Traders" and a strip of land in the same area, which became part of the new city of Philadelphia when Penn's surveyor sketched the grid centered on High Street (now Market), a few blocks north. The Society flew its flag on the top of a small hill that soon become known as "The Society's Hill" and is now defined by the boundaries of Walnut, Lombard, Front and Eighth Streets.

The Society Hill is south of Independence National Historic Park, and has evolved over the centuries as a diverse, complex residential and commercial neighborhood. It was reborn during the 1950s as a city historic district and attracted international attention for its innovative combination of urban renewal and preservation.

Rear of Merchants' Exchange Building (Philadelphia) — the building was declared a National Historic Landmark in 2001. It is the oldest existing stock exchange building in the United States but is now used as the headquarters of the Independence National Historical Park. [Source: Wikipedia; Photo by Justine Adams Lee - Own work, CC BY-SA 3.0, ***https://commons.wikimedia.org/w/index.php?curid=21780645***].

Special Event:

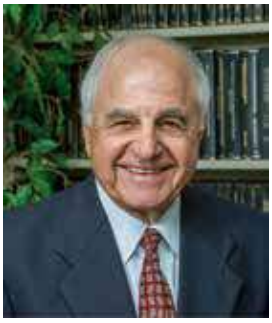
Honoring George Haddad's Service To the Microwave Community For More Than Half a Century

10:10 – 11:50 | **Thursday,14 June** | Room 204B

EVENT CHAIRS:

Samir El-Ghazaly
Department of Electrical Engineering
University of Arkansas, Fayetteville, AR

Khalil Najafi
Electrical & Computer Engineering
University of Michigan, Ann Arbor, MI



This special event celebrates and honors Professor George Haddad's long and dedicated service to microwave engineers and the IEEE Microwave Theory and Techniques Society (MTT-S) for more than 50 years.

George I. Haddad received the B.S.E., M.S.E., and Ph.D. degrees in Electrical Engineering from The University of Michigan. He is currently the Robert J. Hiller Professor Emeritus of Electrical Engineering and Computer Science at the University of Michigan. He served as the Department Chair from 1975–1986 and 1991–1997. He also served as Director of the Electron Physics Laboratory from 1969–1975, Director of the Solid-State Electronics Laboratory from 1986–1991, and Director of the Center for High Frequency Microelectronics from 1986–2000. His expertise is in the areas of microwave and millimeter-wave devices and integrated circuits, microwave-optical interactions, and optoelectronic devices and integrated circuits.

Dr. Haddad received the 1970 Curtis W. McGraw Research Award of the American Society for Engineering Education for outstanding achievements by an engineering teacher, The College of Engineering Excellence in Research Award (1985), the Distinguished Faculty Achievement Award (1986) of The University of Michigan, and the S. S. Attwood Award of the College of Engineering for Outstanding Contributions to Engineering Education, Research and Administration. He is a member of Eta Kappa Nu, Sigma Xi, Phi Kappa Phi, Tau Beta Pi, the American Society for Engineering Education, and the American Physical Society. He is a Fellow of the IEEE and a Member of the National Academy of Engineering.

Dr. Haddad served as Editor of the IEEE MTT-S Transactions from 1968–1971 and on the MTT-S-Administrative Committee from 1970–1976. He received the MTT-S Distinguished Service Award, the 1996 MTT-S Distinguished Educator Award, and the IEEE Third Millennium Medal. He has also served and participated on numerous other IEEE committees and activities.

THE LIST OF SPEAKERS INCLUDES:

Jack East, *University of Michigan*
Samir El-Ghazaly, *University of Arkansas*
Madhu Gupta, *San Diego State University*
Magdy Iskander, *University of Hawaii*
Imran Mehdi, *Jet Propulsion Lab*
Amir Mortazawi, *University of Michigan*
Khalil Najafi, *University of Michigan*
Dimitris Pavlidis, *NSF*
Kamal Sarabandi, *University of Michigan*
Peter Staecker, *MTT-S Awards Committee*
Robert Trew, *North Carolina State University*
Fawwaz Ulaby, *University of Michigan*

Philadelphia's best known landmark is "LOVE" itself. Robert Indiana debuted the design for his famous sculpture as a painting in 1964. After constructing the aluminum piece, Indiana lent it to Philadelphia as part of the U.S. Bicentennial in 1976. LOVE remained in John F. Kennedy Plaza, which has since become known as LOVE Park, for two years. The sculpture moved briefly to New York until a local businessman bought it and donated it to the City of Brotherly Love. An iconic image synonymous with Philadelphia, the piece's likeness has been recreated on items ranging from postage stamps to jewelry.

15:55 – 17:00 | **Wednesday, 13 June 20187** | Pennsylvania Convention Center Exhibit Hall

WEIF2: Interactive Forum #3

Chair: Kiki Ikossi, *IEEE* **Co-Chair:** Abbas Omar, *Universität Magdeburg*

WEIF2-1: Millimeter-Wave Resonant Cavity for Complex Permittivity Measurements of Materials

Duane C. Karns, *Battelle, USA;* James C. Weatherall, *Battelle, USA;* Joseph Greca, *Battelle, USA;* Peter R. Smith, *AASKI Technology, USA;* Kevin Yam, *Battelle, USA;* Jeffrey Barber, *DHS, USA;* Barry T. Smith, *DHS, USA*

WEIF2-2: Towards the Source Reconstruction with a Time-Reversal Method for Practical Applications

Jing-cheng Liang, *UESTC, China*; Zhizhang Chen, *Dalhousie University, Canada;* Jinyan Li, *UESTC, China*; Yiqiang Yu, *Dalhousie University, Canada;* Junfeng Wang, *UESTC, China*

WEIF2-3: Time-Domain Modeling of Noisy Electromagnetic Field Propagation

Johannes A. Russer, *Technische Universität München, Germany;* Michael Haider, *Technische Universität München, Germany*

WEIF2-4: Towards a Unifying Computational Platform with the Node-Based Meshless Method

Junfeng Wang, *UESTC, China*; Zhizhang Chen, *Dalhousie University, Canada;* Jinyan Li, *UESTC, China*; Yiqiang Yu, *Dalhousie University, Canada;* Jing-cheng Liang, *UESTC, China*

WEIF2-5: Three Port Non-Linear Characterization of Power Amplifiers Under Modulated Excitations Using a Vector Network Analyzer Platform

Alberto Maria Angelotti, *Università di Bologna, Italy*; Gian Piero Gibiino, *Università di Bologna, Italy*; Troels Nielsen, *Keysight Technologies, Denmark;* Felice Francesco Tafuri, *Keysight Technologies, Denmark;* Alberto Santarelli, *Università di Bologna, Italy*

WEIF2-6: Rapid Dimension Scaling of Miniaturized Microstrip Couplers with Respect to Operating Conditions and Substrate Parameters

Slawomir Koziel, *Reykjavik University, Iceland*; Adrian Bekasiewicz, *Gda_sk University of Technology, Poland;* John W. Bandler, *McMaster University, Canada*

WEIF2-7: A Neural Network Modeling Approach to Power Amplifiers Taking into Account Temperature Effects

Shao-Hua Zhou, *Tianjin University, China;* Hai-Peng Fu, *Tianjin University, China;* Jian-Guo Ma, *Tianjin University, China;* Qi-Jun Zhang, Tianjin University, China

WEIF2-8: A Novel CAD Probe for Bidirectional Impedance and Stability Analysis

Thomas A. Winslow, *MACOM, USA*

WEIF2-9: An Analytical Gradient Model for the Characterization of Conductor Surface Roughness Effects

Liang Chen, *Shanghai Jiao Tong University, China;* Min Tang, *Shanghai Jiao Tong University, China;* Junfa Mao, *Shanghai Jiao Tong University, China*

WEIF2-10: Measurement & Extraction of the Low-Frequency Dynamics of an Envelope Tracking Amplifier Using Multisine Excitations

Piet Bronders, *Vrije Universiteit Brussel, Belgium;* Jan Goos, *Vrije Universiteit Brussel, Belgium;* John Lataire, *Vrije Universiteit Brussel, Belgium;* Yves Rolain, *Vrije Universiteit Brussel, Belgium;* Gerd Vandersteen, *Vrije Universiteit Brussel, Belgium;* Sebastian Gustafsson, *Chalmers University of Technology, Sweden*; Guillaume Paillonc*y, National Instruments, USA*

WEIF2-11, Electrical Characterization of Highly Efficient, Optically Transparent Nanometers-Thick Unit Cells for Antenna-on-Display Applications

Seung Yoon Lee, *POSTECH, Korea;* Dooseok Choi, Samsung Electronics, Korea; Youngno Youn, *POSTECH, Korea;* Wonbin Hong, *POSTECH, Korea*

WEIF2-12: RoF SpatialMux MIMO-LTE Fronthaul System Transmission Parameter Selection with Nelder-Mead Optimization Algorithm

Carlos Mateo, *Universidad de Zaragoza, Spain;* Pedro L. Carro, *Universidad de Zaragoza, Spain;* Paloma Garcia-Ducar, *Universidad de Zaragoza, Spain;* Jesus de Mingo, *Universidad de Zaragoza, Spain;* Iñigo Salinas, *Universidad de Zaragoza, Spain*

WEIF2-13: Effective Extracting Method for Electromagnetic Parameters of Periodically Loaded Substrate Integrated Waveguide Units

Yuliang Zhou, *UESTC, China*; Yong Mao Huang, *UESTC, China*; Haiyan Jin, *UESTC, China*; Du Xu, *UESTC, China*; Shuai Ding, *UESTC, China*; Lorenzo Silvestri, *Università di Pavia, Italy*; Maurizio Bozzi, *Università di Pavia, Italy*; Luca Perregrini, *Università di Pavia, Italy*

WEIF2-14: Microstrip Crossover for Millimeter-Wave Applications

Karrar Al Khanjar, *INRS-EMT, Canada;* Tarek Djerafi, *INRS-EMT, Canada*

WEIF2-15: Propagation Characteristics of Mode-Selective Transmission Line

Desong Wang, *École Polytechnique de Montréal, Canada*; Ke Wu, *École Polytechnique de Montréal, Canada*

WEIF2-16: A Mix-Mode Hybrid Using Broadside-Coupled Asymmetric Coplanar Striplines

Lap K. Yeung, *University of California, Los Angeles, USA;* Yuanxun Ethan Wang, *University of California, Los Angeles*, *USA*

WEIF2-17: High Selective Bandpass Filter with Controllable Transmission Zeros

Yiqiang Gao, *Chinese Academy of Sciences, China;* Wei Shen, *Chinese Academy of Sciences, China;* Liang Wu, *Chinese Academy of Sciences, China;* Xiaowei Sun, Chinese Academy of Sciences, China

WEIF2-18: Independently Controllable External Coupling for Resonant Junctions in Diplexers

Yun Wu, *University of Greenwich, UK;* Yi Wang, *University of Greenwich, UK;* Liang Sun, *Chinese Academy of Sciences, China*

WEIF2-19: Compact Substrate-Integrated Waveguide Triplexer Based on a Common Triple-Mode Cavity

Haowei Xie, *NJUST, China*; Kang Zhou, *NJUST, China*; Chunxia Zhou, *NJUST, China*; Wen Wu, *NJUST, China*

WEIF2-20: High Isolation Superconducting Diplexer Designed with Double-Side Structure

Xiang Wang, *Tsinghua University, China;* Bei Wei, *Tsinghua University, China;* Bisong Cao, *Tsinghua University, China;* Xubo Guo, *Tsinghua University, China*

WEIF2-21: Relationship Between Band-Edge Steepness and Power-Handling Capability in Filters

Pengyu Ma, *Tsinghua University, China;* Bin Wei, *Tsinghua University, China;* Zhan Xu, Beijing Institute of Technology, China; Chenjie Luo, *Tsinghua University, China;* Xubo Guo, *Tsinghua University, China;* Bisong Cao, *Tsinghua University, China*

WEIF2-22: Multiband Filters with Positive or Negative Dispersive Cross-Couplings

Ahmad Haidar, *XLIM (UMR 7252), France;* Hussein Ezzeddine, *Jwaya University College, Lebanon;* Johann Sence, *XLIM (UMR 7252), France;* Olivier Tantot, *XLIM (UMR 7252), France;* Stéphane Bila, *XLIM (UMR 7252), France*

WEIF2-23: Design Technique for Integration of Manifold Multiplexers Considering Constraints on Inter-Channel Spacings

A. Cordon, *Universidad Pública de Navarra, Spain;* I. Arregui, *Universidad Pública de Navarra, Spain;* I. Arnedo, *Universidad Pública de Navarra, Spain;* F. Teberio, *Universidad Pública de Navarra, Spain;* C. Arnold, Tesat Spacecom, Germany; M.A.G. Laso, *Universidad Pública de Navarra, Spain;* J. Lorente, *Tesat Spacecom, Germany*

WEIF2-24: A Novel Independently-Tunable Dual-Mode SIW Resonator with a Reconfigurable Bandpass Filter Application

Mahmoud Abdelfattah, *Purdue University, USA;* Dimitrios Peroulis, *Purdue University*, *USA*

TECHNICAL SESSIONS

15:55 – 17:15 | **Wednesday, 13 June 2018** | Pennsylvania Convention Center

WEDNESDAY

201A

We3A: Novel Microwave Circuits and Systems Applications

Chair: Kavita Goverdhanam, *U.S. Army CERDEC*
Co-Chair: Ajay Poddar, *Synergy Microwave*

15:55 - 16:05

We3A-1: Expand Horizons of Microfluidic Systems: An Inkjet Printed Flexible Energy Autonomous Micropump System for Wearable and IoT Microfluidic Applications

Tong-Hong Lin, *Georgia Tech, USA;* Wenjing Su, *Georgia Tech, USA;* Manos M. Tentzeris, *Georgia Tech, USA*

16:05 - 16:15

16:15 - 16:25

We3A-2: An Active Microwave Imaging Technique Using Spatial Frequency Sampling

Stavros Vakalis, *Michigan State University, USA;* Jeffrey A. Nanzer, *Michigan State University, USA*

16:25 - 16:35

16:35 - 16:45

We3A-3: Linearity Enhancement of GaN Doherty Amplifier by Forward Gate Current Blocking Method

Ibrahim Khalil, Srinidhi Embar R., Geoffery Tucker, *NXP Semiconductors, USA*

16:45 - 16:55

We3A-4, An Ultra-Low-Power, High Gain Mixer for Smart Cities Applications

Raunak Borwankar, Reinhold Ludwig, Yehia Massoud, *Worcester Polytechnic Institute, USA;* Mohammad R. Haider, *University of Alabama at Birmingham, USA;*

16:55 - 17:05

We3A-5: Fully Printed Microwave Sensor for Simultaneous and Independent Level Measurements of 8 Liquids

Muhammad Akram Karimi, *KAUST, Saudi Arabia;* Muhammad Arsalan, *EXPEC ARC, Saudi Arabia;* Atif Shamim, *KAUST, Saudi Arabia*

17:05 - 17:15

201B

We3B: Emerging RF Switch Technologies for 5G and Defense Applications

Chair: Jeong-sun Moon, *HRL Laboratories*
Co-Chair: Aly Fathy, *University of Tennessee*

We3B-1: Can Phase Change Materials Put the Radio into Software Defined Radio?

William J. Chappell, *DARPA, USA;* Timothy M. Hancock, *DARPA, USA;* Roy H. Olsson III, *DARPA, USA*

We3B-2: Improvements in GeTe-Based Phase Change RF Switches

Robert M. Young, *Northrop Grumman, USA;* Pavel Borodulin, *Northrop Grumman, USA;* Nabil El-Hinnawy, TowerJazz, *USA;* Andy Ezis, *Northrop Grumman, USA;* Matthew R. King, Wolfspeed, *USA;* Vivien Luu, *Northrop Grumman, USA;* Doyle T. Nichols, *Northrop Grumman, USA*

We3B-3: 5THz Figure-of-Merit Reliable Phase-Change RF Switches for Millimeter-Wave Applications

Jeong-sun Moon, *HRL Laboratories, USA;* Hwa-change Seo, *HRL Laboratories, USA;* Kyung-ah Son, *HRL Laboratories, USA;* Kangmu Lee, *HRL Laboratories, USA;* Daniel Zehnder, *HRL Laboratories, USA;* Haw Tai, *HRL Laboratories, USA*

We3B-4, Reversible, Fast Optical Switching of Phase Change Materials for Active Control of High-Frequency Functions

Areski Ghalem, Cyril Guines, Damien Passerieux, Jean-Christophe Orlianges, Laure Huitema, Aurelian Crunteanu, *XLIM (UMR 7252), France*

We3B-5: GeTe Phase Change Research at the US Army Research Laboratory

Leonard De La Cruz, *U.S. Army Research Laboratory, USA;* A. Glen Birdwell, *U.S. Army Research Laboratory, USA;* Mona Zaghloul, George Washington University, *USA;* Tony G. Ivanov, *U.S. Army Research Laboratory, USA*

203AB

We3E: Microwave Acoustic Components for Wireless Applications

Chair: Amelie Hagelauer, *FAU Erlangen-Nürnberg*
Co-Chair: Robert Weigel, *FAU Erlangen-Nürnberg*

We3E-1: Applicability Investigation of SAW Devices in the 3 to 5GHz Range

Tetsuya Kimura, *Murata Manufacturing, Japan;* Masashi Omura, *Murata Manufacturing, Japan;* Yutaka Kishimoto, *Murata Manufacturing, Japan;* Ken-ya Hashimoto, *Chiba University, Japan*

We3E-2: A Compact Intrinsically Switchable Filter Bank Employing Multifunctional Ferroelectric BST

Milad Zolfagharloo *Koohi, University of Michigan, USA;* Amir Mortazawi, *University of Michigan, USA*

We3E-3: Input-Reflectionless Acoustic-Wave-Lumped-Element Resonator-Based Bandpass Filters

Dimitra Psychogiou, *University of Colorado Boulder, USA;* Dakotah J. Simpson, *University of Colorado Boulder, USA;* Roberto Gómez-García, *Universidad de Alcalá, Spain*

We3E-4: Compact Size and Wideband Triplexer Using SAW Resonators and LC Components

Jung-Do Ha, Seok-Jae Lee, *Wisol, Korea;* Youna Jang, Jongsik Lim, Sang-Min Han, Dal Ahn, *Soonchunhyang University, Korea*

We3E-5: Multi-Band Acoustic-Wave-Lumped-Element Resonator-Based Bandstop Filters with Continuously Tunable Stopband Bandwidths

Dimitra Psychogiou, *University of Colorado Boulder, USA;* Dakotah J. Simpson, *University of Colorado Boulder, USA*

204A

We3F: Terahertz and mm-Wave Technologies and Applications

Chair: John Kuno, *QuinStar Technology*
Co-Chair: Jae-Sung Rieh, *Korea University*

We3F-1: A Terahertz Microscopy Technique for Sweat Duct Detection

Panagiotis C. Theofanopoulos, *Arizona State University, USA;* Georgios C. Trichopoulos, *Arizona State University, USA*

We3F-2: D-Band 360° Phase Shifter with Uniform Insertion Loss

Roee Ben Yishay, *ON Semiconductor, Israel;* Danny Elad, *ON Semiconductor, Israel*

We3F-3: Silica-Based Packaging Structure for D-Band RF Module

Masaharu Ito, *NEC, Japan;* Tsunehisa Marumoto, *NEC, Japan*

We3F-4: Substrate Integrated Waveguides for mm-Wave Functionalized Silicon Interposer

Matthieu Bertrand, *L2E (UR2), France;* Emmanuel Pistono, Giuseppe Acri, Florence Podevin, *IMEP-LAHC (UMR 5130), France;* Darine Kaddour, *LCIS (EA 3747), France;* Vincent Puyal, *CEA-LETI, France;* Selin Tolunay Wipf, Christian Wipf, Matthias Wietstruck, Mehmet Kaynak, *IHP, Germany*; Philippe Ferrari, *TIMA, France*

We3F-5: Multiline TRL Calibration Standards for S-Parameter Measurement of Planar Goubau Lines from 0.75THz to 1.1THz

Juan Cabello-Sánchez, *Chalmers University of Technology, Sweden*; Helena Rodilla, *Chalmers University of Technology, Sweden*; Vladimir Drakinskiy, *Chalmers University of Technology, Sweden*; Jan Stake, *Chalmers University of Technology, Sweden*

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

15:55 – 17:15 | **Wednesday, 13 June 2018** | Pennsylvania Convention Center

204B

We3G: Broadband Radar Systems and Technologies

Chair: Rudy Emrick, *Orbital ATK*
Co-Chair: Nestor Lopez, *MIT Lincoln Laboratory*

15:55 - 16:05

We3G-1: A 4-Channel 10–40GHz Wide-band Receiver with Integrated Frequency Quadrupler for High Resolution Millime-ter-Wave Imaging Systems

Qian Ma, *University of California, San Diego, USA;* Hyunchul Chung, *University of California, San Diego, USA;* Gabriel M. Rebeiz, *University of California, San Diego, USA*

16:05 - 16:15

We3G-2: A Ka Band FMCW Transceiver Front-End with 2GHz Bandwidth

Bowen Ding, *Chinese Academy of Sciences, China;* Shengyue Yuan, *Chinese Academy of Sciences, China;* Chen Zhao, *Chinese Academy of Sciences, China;* Li Tao, *Chinese Academy of Sciences, China;* Tong Tian, *Chinese Academy of Sciences, China*

16:15 - 16:25

We3G-3: On Hardware Implementations of Stepped-Carrier OFDM Radars

Benedikt Schweizer, *Universität Ulm, Germany*; Daniel Schindler, *Robert Bosch, Germany;* Christina Knill, *Universität Ulm, Germany*; Jürgen Hasch, *Robert Bosch, Germany;* Christian Waldschmidt, *Universität Ulm, Germany*

16:25 - 16:35

We3G-4: 28GHz 5G-Based Phased-Arrays for UAV Detection and Automotive Traffic-Monitoring Radars

Yaochen Wang, *University of California, San Diego, USA;* Thomas Phelps, *University of California, San Diego, USA;* Kerim Kibaroglu, *University of California, San Diego, USA;* Mustafa Sayginer, *University of California, San Diego, USA;* Qian Ma, *University of California, San Diego, USA;* Gabriel M. Rebeiz, *University of California, San Diego, USA*

16:35 - 16:45

204C

We3H: Women in Microwaves: Research on Biomedical Applications

Chair: Katia Grenier, *LAAS-CNRS*
Co-Chair: Dominique Schreurs, *Katholieke Universiteit Leuven*

15:55 - 16:05

We3H-1: Cells and Electropulsation Microchambers Modeling for Linear and Non-Linear Optical Microspectroscopy

C. Merla, *ENEA, Italy*; M. Liberti, *Università di Roma "La Sapienza", Italy*; F. Apollonio, *Università di Roma "La Sapienza", Italy*; L.M. Mir, *VAT (UMR 8203), France*

16:05 - 16:15

We3H-2: Yeast Cell Growth Monitoring Using Microwave Measurements Cor-related to Optical Absorbance

Xiue Bao, Ilja Ocket, Ju Zheng, Juncheng Bao, Meng Zhang, Dries Kil, Vanessa Franssens, Bob Puers, Dominique M.M.-P. Schreurs, Bart Nauwelaers, *Katholieke Universiteit Leuven, Belgium*

16:15 - 16:25

We3H-3: Label-Free Discrimination of Human Lymphoma Cell Sub-Populations with Microwave Dielectric Spectroscopy

Katia Grenier, *LAAS, France;* François Artis, *LAAS, France;* Mary Poupot, CRCT, *France;* J.-J. Fournié, CRCT, *France;* David Dubuc, *LAAS, France*

16:25 - 16:35

We3H-4: Characterization and Analysis of Wideband Temperature-Dependent Dielectric Properties of Liver Tissue for Next-Generation Minimally Invasive Microwave Tumor Ablation Technology

Luz Maria Neira, *University of Wisconsin-Madison, USA;* James Sawicki, *University of Wisconsin-Madison, USA;* Barry D. Van Veen, *University of Wisconsin-Madison, USA;* Susan C. Hagness, *University of Wisconsin-Madison, USA*

16:35 - 16:45

16:45 - 16:55

16:55 - 17:05

17:05 - 17:15

We3B: Focus Session

Emerging RF Switch Technologies for 5G and Defense Applications

Chairs: Jeong-sun Moon, *HRL Laboratories, LLC;* Aly Fathy, *Univ. of Tennessee*

15:55 - 17:10 | WEDNESDAY, 13 JUNE 2018 | 201B

ABSTRACT:

While RF switches are key elements in modern wireless communications and defense applications, switch performance has been stagnant over a decade or so. With 5G on the horizon, defense RF systems moving to the millimeter-wave, and software defined configurability; low loss RF and millimeter-wave switches are highly desirable. Recent phase-change material RF switches are very promising with a 10 times better RF switch figure-of-merit (Ron*Coff) demonstrated over SOI switches. This focused session will cover emerging PCM RF switches for 5G wireless and defense applications.

We3H: Special Session

Women in Microwaves: Research on Biomedical Applications

Chairs: Katia Grenier, *LAAS-CNRS;* **Dominique Schreurs,** *KU Leuven*

15:55 - 17:10 | WEDNESDAY, 13 JUNE 2018 | 204C

ABSTRACT:

This session is focusing on microwave based biomedical investigations performed by women researchers. A wide range of applications is covered, starting from electromagnetic fields effects for new disease treatment solutions or tumor ablation, including also non-invasive cellular characterization and finally involving wireless body tracking systems with applications in early diseases diagnostic.

MTT-S Awards Banquet

18:30 – 21:30 | **Wednesday, 13 June 2018** | Loews Philadelphia Hotel, Regency Ballroom

The MTT-S Awards Banquet program includes dinner, entertainment, and technical and service awards presented by the MTT-S Awards Committee. Please join us in congratulating this year's award winners! After-dinner entertainment features MoTown and Philly sounds, courtesy of the Motor City Revue! Wear your dancing shoes!

AWARD TITILE	DESCRIPTION
IEEE Electronmagenetics Award	**Tatsuo Itoh** For contributions to electromagnetic modeling, artificial materials, microwave electronics, and antennas
Microwave Career Award	**Eliot D. Cohen** To recognize a career of meritorious achievement and outstanding technical contribution by an individual in the field of microwave theory and techniques.
Distinguished Service Award	**Manfred Schindler** To recognize significant contributions and outstanding service to the IEEE Microwave Theory and Techniques Society and the microwave profession over a sustained period of time.
Distinguished Educator Award	**Ching-Kuang Clive Tzuang and Alwyn John Seeds** To recognize a distinguished educator in the field of Microwave Engineering and Science who exemplifies the special human qualities of the late Fred J. Rosenbaum, who considered teaching a high calling and demonstrated his dedication to MTT-S through tireless service.
Microwave Pioneer Award	**Robert J. Mattauch** To recognize a major, lasting contribution in the field of interest to IEEE Microwave Theory and Techniques Society at least 20 years prior to the year of the award.
Microwave Application Award	**Peter Siegel** To recognize the most outstanding application of microwave theory and techniques by an individual or a team of individuals.
N. Walter Cox Award	**Bela Szendrenyi** To recognize an individual who has given exemplary service to the Society in a spirit of selfless dedication and cooperation. The award is given in memory of N. Walter Cox, longstanding MTT-S volunteer, who had demonstrated technical, administrative, and interpersonal leadership skills before passing away early in his career.
IEEE MTT-S Outstanding Young Engineer Award	**Simone Bastioli, Changzhi Li, Nils Pohl, and Maciej Wojnowski** Recognizes an outstanding young MTT-S Member, who has distinguished him/herself through achievement(s), which may be technical (within the MTT-S Field of Interest), may be exemplary service to the MTT-S, or may be a combination of both. What distinguishes this award from other MTT-S achievement-based awards (such as Prize, Application, and Pioneer) is that by its title, this award's focus is a person, not an achievement, and that we are implicitly recognizing the person who was responsible for the success of the cited achievement(s) during his/her early career. A separate award may be made to an MTT-S Member working nominally in industry and an MTT-S Member working nominally in academia.
IEEE Microwave and Wireless Components Letters Tatsuo Itoh Prize	**Daniel J. Shepphard, Jeffrey Powell, and Steve C. Cripps** This award will recognize the best letter published in the IEEE Microwave and Wireless Components Letters in the year preceding the award.
Microwave Prize	**Eric J. Naglich and Andrew C. Guyette** To recognize the most significant contribution by a published paper to the field of interest of IEEE Microwave Theory and Techniques Society.

AWARD TITILE	DESCRIPTION
IEEE Microwave Magazine Best Paper Award	**Alessandro Cidronali, Stefano Maddio, Marco Passafiume, and Gianfranco Manes** This award will recognize the best feature article published in the IEEE Microwave Magazine in the year preceding the award.
IEEE Transactions on Terahertz Science & Technology Best Paper Award	**R. Risacher, R. Gusten, J. Stutzki, H. Hubers, D. Buchel, U. Graf, S. Heyminck, C. Honingh, K. Jacobs, B. Klein, T. Klein, C. Leinz, P. Putz, N. Reyes, L. Ricken, H. Wunsch, P. Fusco, and S. Rosner** This award will recognize the best paper published in the IEEE Transactions on Terahertz Science & Technology in the year preceding the award.

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.

Eleven MTT-S members who were evaluated by our Society were elected to the grade of Fellow, effective 1 January 2018:

Bertan Bakkaloglu	for contributions to radio frequency circuits
N Scott Barker	for contributions to millimeter-wave and terahertz micromachining
Vicente Boria	for contributions to high-power microwave filters and multiplexers
Maurizio Bozzi	for contributions to substrate integrated waveguides and integrated periodic structures
Yi-Jan Emery Chen	for contributions to monolithic RF CMOS power amplifiers and transceiver frontends
Zhenqiang Ma	for contributions to flexible and biodegradable microwave electronics
Earl McCune	for leadership in polar modulation circuits and signals
Luca Roselli	for contributions to sustainable radio-frequency modules for wireless sensor networks
Robert Weikle	for contributions to millimeter-wave and submillimeter-wave electronics and instrumentation for terahertz frequencies
Thomas Weller	for contributions to modeling and design of passive microwave circuits and components
Thomas Zwick	for contributions to millimeter wave transceivers

IN ADDITION, TEN OTHER MTT-S MEMBERS indicated below were elected to the grade of Fellow effective 1 January 2018 after their qualifications were evaluated by other IEEE societies or councils:

Yongxin Guo (AP)	for contributions to wideband printed antennas
Konstantina Nikita (AP)	for contributions to bioelectromagnetics and implantable antennas for medical applications
C Reddy (AP)	for leadership in simulation methods for antenna placement and co-site analysis
Ronan Sauleau (AP)	for contributions to lens and millimeter wave antennas
Daniel Weile (AP)	for contributions to computational electromagnetics
Hao Xin (AP)	for contributions to electromagnetic metamaterials and 3D printing of metamaterial structures
Thomas Kazior (ED)	for leadership in microwave and millimeter wave compound semiconductor technology and heterogeneous integration with silicon
Paul Meaney (EMB)	for contributions to microwave tomography and its translation to clinical use
Charles Bunting (EMC)	for educational contributions to electromagnetic compatibility and reverberation chambers
Stefano Grivet-talocia (EMC)	for contributions to passive macromodeling for signal and power integrity

TECHNICAL SESSIONS

08:00 – 09:40 | **Thursday, 14 June 2018** | Pennsylvania Convention Center

THURSDAY

201A

Th1A: Advanced Technologies for Non-Planar Filters and Diplexers

Chair: Giuseppe Macchiarella, *Politecnico di Milano*
Co-Chair: Richard Snyder, *RS Microwave*

08:00 – 08:10
Th1A-1: Integrated Third-Order Millimeter-Wave On-Chip Bandpass Filter Using 0.13-µm SiGe Bi-CMOS Technology
Yang Yang, *University of Technology Sydney, Australia*; He Zhu, *University of Technology Sydney, Australia*; Xi Zhu, *University of Technology Sydney, Australia*; Quan Xue, *SCUT, China*

08:10 – 08:20
Th1A-2: Pseudoelliptic Combline Filter in a Circularly Shaped Tube
Roman Tkadlec, *CommScope, Italy*; Giuseppe Macchiarella, *Politecnico di Milano, Italy*

08:20 – 08:30
Th1A-3: A Very Compact 3D-Printed Doublet Structure Based on a Double Iris and a Pair of Slanting Rods
Cristiano Tomassoni, *Università di Perugia, Italy;* Giuseppe Venanzoni, *Università di Perugia, Italy;* Marco Dionigi, *Università di Perugia, Italy;* Roberto Sorrentino, *RF Microtech, Italy*

08:30 – 08:40
Th1A-4: A Wideband Diplexer for Ka-Band Passive Intermodulation Measurement
D. Smacchia, *ESA-VSC High Power RF Laboratory, Spain;* C. Carceller, Marco Guglielmi, P. Soto, Vicente E. Boria, J. Ruiz, P. González, *Universitat Politècnica de València, Spain*

08:40 – 08:50
Th1A-5: A Compact 28GHz Bandpass Filter Using Quartz Folded Waveguide
Hiroshi Kojima, Manabu Nakahori, Kei Matsutani, Katsuhito Kuroda, Kengo Onaka, Masayoshi Koshino, Takaki Murata, Norio Nakajima, *Murata Manufacturing, Japan*

08:50 – 09:00
Th1A-6: High Modes Suppressions with Transmission Zeros Design for a Novel Quarter-Mode SIW Filter
Xiao-Long Huang, Liang Zhou, Cheng-Rui Zhang, Junfa Mao, *Shanghai Jiao Tong University, China*

09:00 – 09:10
Th1A-7: A Compact Tunable Filtering Rat-Race Coupler
Mohamed F. Hagag, Dimitrios Peroulis, *Purdue University, USA*

201B

Th1B: Advanced Rectifiers and Energy Harvesters for Wireless Power Transfer

Chair: David Ricketts, *North Carolina State University*
Co-Chair: Kenjiro Nishihkawa, *Kagoshima University*

08:00 – 08:10
Th1B-1: Accurate Analytical Model for Hybrid Ambient Thermal and RF Energy Harvester
Xiaoqiang Gu, *École Polytechnique de Montréal, Canada*; Lei Guo, *École Polytechnique de Montréal, Canada*; Moussa Harouna, *École Polytechnique de Montréal, Canada*; Simon Hemour, IMS (UMR 5218), *France;* Ke Wu, *École Polytechnique de Montréal, Canada*

08:10 – 08:20
Th1B-2: A 16.8dB Input Power Range Microwave Rectifier with a Small Capacitor in Parallel with the Diode
Pengde Wu, *Sichuan University, China;* Changjun Liu, *Sichuan University, China*

08:20 – 08:30
Th1B-3: A 434MHz Dual-Mode Power Harvesting System with an On-Chip Coil in 180nm CMOS SOI for mm-Sized Implants
Hamed Rahmani, Aydin Babakhani, *University of California, Los Angeles, USA*

08:30 – 08:40
Th1B-4: GHz-Band High-Efficiency Rectifier Design Based on MHz-Band Multi-Harmonic Active Source-Pull Technique
Minato Machida, *University of Electro-Communications, Japan;* Ryo Ishikawa, *University of Electro-Communications, Japan;* Yoichiro Takayama, *University of Electro-Communications, Japan;* Kazuhiko Honjo, *University of Electro-Communications, Japan*

08:40 – 08:50
Th1B-5: An Inverter-Based Bidirectional and Reconfigurable RF Energy Harvesting Circuit with Rectifier and Oscillator Modes
Soroush Dehghani, *University of British Columbia, Canada*; Aaron Clements, *University of British Columbia, Canada*; Thomas Johnson, *University of British Columbia, Canada*

08:50 – 09:00
Th1B-6: Dynamic-Range Extension Technique Based on Balanced Rectifiers
Muh-Dey Wei, *RWTH Aachen University, Germany;* Renato Negra, *RWTH Aachen University, Germany*

201C

Th1C: Electromagnetic Biosensing

Chair: Arnaud Pothier, *XLIM (UMR 7252)*
Co-Chair: Wenquan Che, *NJUST*

08:00 – 08:10
Th1C-1: Real-Time kHz to GHz Monitoring of Incubated Yeast Cell Growth Using Interdigitated Capacitors
Mojtaba Chehelcheraghi, *Katholieke Universiteit Leuven, Belgium*; Vanessa Franssens, *Katholieke Universiteit Leuven, Belgium*; Ilja Ocket, *Katholieke Universiteit Leuven, Belgium*; Bart Nauwelaers, *Katholieke Universiteit Leuven, Belgium*

08:10 – 08:20
Th1C-2, Ultra-Wideband Characterization, Electroporation, and Dielectrophoresis of a Live Biological Cell Using the Same Vector Network Analyzer
Xiaotian Du, *Lehigh University, USA;* Xiao Ma, *Lehigh University, USA;* Lei Li, *Lehigh University, USA;* Hang Li, *Lehigh University, USA;* Xuanhong Cheng, *Lehigh University, USA;* James C.M. Hwang, *Lehigh University, USA*

08:20 – 08:30
Th1C-3: DEP Measurement of the Dielectric Properties of Single CHO Cells Under Thermal Stress
Samaneh Afshar, *University of Manitoba, Canada*; Elham Salimi, *University of Manitoba, Canada*; Michael Butler, *NIBRT, Ireland;* Douglas Thomson, *University of Manitoba, Canada*; Greg Bridges, *University of Manitoba, Canada*

08:30 – 08:40
Th1C-4: Contactless pH Measurement Based on High Resolution Enhanced Q Microwave Resonator
Zahra Abbasi, *University of Alberta, Canada*; Mojgan Daneshmand, *University of Alberta, Canada*

08:40 – 08:50
Th1C-5: A 5_5 Microwave Permittivity Sensor Matrix in 0.14-µm CMOS
Zhebin Hu, *Technische Universiteit Delft, The Netherlands;* Gerasimos Vlachogiannakis, *Technische Universiteit Delft, The Netherlands;* Michiel A.P. Pertijs, *Technische Universiteit Delft, The Netherlands;* Leo de Vreede, *Technische Universiteit Delft, The Netherlands;* Marco Spirito, *Technische Universiteit Delft, The Netherlands*

202AB

Th1D: Advanced High Frequency Large Signal Measurement Techniques*

Chair: Matt King, *Georgia Tech*
Co-Chair: Nuno Carvalho, *Universidade de Aveiro*

08:00 – 08:10
Th1D-1: On-Chip High Impedance RMS Voltage Measurements at 265–300GHz
Sandeep Kshattry, *University of Texas at Dallas, USA;* Kenneth K. O, *University of Texas at Dallas, USA*

08:10 – 08:20
Th1D-2: Estimation of Load-Pull Reflection Coefficients for Modulated Signals
Dhecha Nopchinda, *Chalmers University of Technology, Sweden*; Thomas Eriksson, *Chalmers University of Technology, Sweden*; Koen Buisman, *Chalmers University of Technology, Sweden*

08:20 – 08:30
Th1D-3: Removing the Random Contributions of LO Phases from Multi-Tone RF Phase Measurements Based on Down-Conversion
Yichi Zhang, *University of Texas at Dallas, USA;* Wei Zhao, *University of Texas at Dallas, USA;* Zilong Zhang, *University of Texas at Dallas, USA;* Zheng Liu, *University of Texas at Dallas, USA*

08:30 – 08:40
Th1D-4: Traceable Characterization of Broadband Pulse Waveforms Suitable for Cryogenic Josephson Voltage Applications
Alirio S. Boaventura, *NIST, USA;* Dylan F. Williams, *NIST, USA;* Gustavo Avolio, *Katholieke Universiteit Leuven, Belgium*; Paul D. Hale, *NIST, USA*

***Joint IMS/ARFTG Sessions**

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

TECHNICAL SESSIONS

08:00 – 09:40 | **Thursday, 14 June 2018** | Pennsylvania Convention Center

203A

Th1E: Recent Advances in Terahertz and Photonics

Chair: Goutam Chattopadhyay, *Jet Propulsion Laboratory*
Co-Chair: Jianping Yao, *University of Ottawa*

Th1E-1: 600-GHz-Band Waveguide-Output Uni-Traveling-Carrier Photodiodes and Their Applications to Wireless Communication

Tadao Nagatsuma, *Osaka University, Japan;* Tsubasa Kurokawa, *Osaka University, Japan;* Masato Sonoda, *Osaka University, Japan;* Tadao Ishibashi, *NTT, Japan;* Makoto Shimizu, *NTT, Japan;* Kazutoshi Kato, *Kyushu University, Japan*

Th1E-2: Terahertz Spectroscopy with Asynchronous Optical Sampling Using a Compact Bidirectional Mode-Locked Fiber Laser

Robert D. Baker, *University of Arizona, USA;* Nezih T. Yardimci, *University of California, Los Angeles, USA;* Yi-Hsin Ou, *University of Arizona, USA;* Mona Jarrahi, *University of California, Los Angeles, USA;* Khanh Q. Kieu, *University of Arizona, USA*

Th1E-3: A High Sensitivity Photonic Frequency Discriminator for Low Phase Noise Tunable Micro/mm Wave Synthesis

Naoya Kuse, IMRA America, *USA;* Martin E. Fermann, IMRA America, *USA*

Th1E-4: Automatic Monitor-Based Tuning of RF Silicon Photonic True-Time-Delay Beamforming Networks

Gihoon Choo, *Texas A&M University, USA;* Christi K. Madsen, *Texas A&M University, USA;* Samuel Palermo, *Texas A&M University, USA;* Kamran Entesari, *Texas A&M University, USA*

Th1E-5: A Flexible Multi-Gbps Transmitter Using Ultra-High Speed Sigma-Delta-over-Fiber

Ibrahim Can Sezgin, *Chalmers University of Technology, Sweden*; Thomas Eriksson, *Chalmers University of Technology, Sweden*; Johan Gustavsson, *Chalmers University of Technology, Sweden*; Christian Fager, *Chalmers University of Technology, Sweden*

204A

Th1F: RF Transceiver Architecture for MIMO and Beam Steering

Chair: *Steven Rosenau, SSL*
Co-Chair: Zaher Bardai, *IMN Epiphany*

Th1F-1: A 4 Element Phased Array Transmitter with Efficiency Enhancement Using Beamforming for High-Bandwidth WLAN Applications

Avraham Sayag, *Technion, Israel;* Emanuel Cohen, *Technion, Israel*

Th1F-2: A Scalable Dual-Polarized 256-Element Ku-Band Phased-Array SATCOM Receiver with ±70° Beam Scanning

Abdurrahman H. Aljuhani, *University of California, San Diego, USA;* Tumay Kanar, *University of California, San Diego, USA;* Samet Zihir, *University of California, San Diego, USA;* Gabriel M. Rebeiz, *University of California, San Diego, USA*

Th1F-3: A 700–950MHz Tunable Frequency Division Duplex Transceiver Combining Passive and Active Self-Interference Cancellation

Leo Laughlin, *University of Bristol, UK*; Chunqing Zhang, *University of Bristol, UK*; Mark A. Beach, *University of Bristol, UK*; Kevin A. Morris, *University of Bristol, UK*; John L. Haine, *University of Bristol, UK*; Muhammad Kalimuddin Khan, *u-blox, Ireland*

Th1F-4: Towards Ultra-Low-Voltage and Ultra-Low-Power Discrete-Time Receivers for Internet-of-Things

Feng-Wei Kuo, *TSMC, Taiwan;* Sandro Binsfeld Ferreira, *Unisinos University, Brazil;* Ron Chen, *TSMC, Taiwan;* Lan-chou Cho, *TSMC, Taiwan;* Chewn-Pu Jou, *TSMC, Taiwan;* Mark Chen, *TSMC, Taiwan;* Masoud Babaie, *Technische Universiteit Delft, The Netherlands;* Robert Bogdan Staszewski, *University College Dublin, Ireland*

204C

Th1H: Doherty and Load-Modulated Power Amplifiers

Chair: Paul Draxler, *Qualcomm Technologies*
Co-Chair: Kenle Chen, *University of Rhode Island*

Th1H-2: Broadband and Linearity Enhanced Doherty Power Amplifier Using Complex-Valued Load Modulation

Xiaohu Fang, *University of Waterloo, Canada*; Hamed Golestaneh, *University of Waterloo, Canada*; Slim Boumaiza, *University of Waterloo, Canada*

Th1H-3: A Highly Linear Doherty Power Amplifier with Multigated Transistors Supporting 80MSymbol/s 256-QAM

Doohwan Jung, *Georgia Tech, USA;* Huan Zhao, *Georgia Tech, USA;* Hua Wang, *Georgia Tech, USA*

Th1H-4: Digital Sequential PA for Flexible Efficiency Tuning Over Wide Power Back-Off Range

Andreas Wentzel, *FBH, Germany;* Wolfgang Heinrich, *FBH, Germany*

Th1H-5: Load Tuning Assisted Discrete-Level Supply Modulation Using BST and GaN Devices for Highly Efficient Power Amplifiers

Sebastian Preis, *FBH, Germany;* N. Wolff, *FBH, Germany;* Felix Lenze, *Technische Universität Darmstadt, Germany*; Alex Wiens, *Technische Universität Darmstadt, Germany*; Rolf Jakoby, *Technische Universität Darmstadt, Germany*; Wolfgang Heinrich, *FBH, Germany;* Olof Bengtsson, *FBH, Germany*

08:00 – 08:10
08:10 – 08:20
08:20 – 08:30
08:30 – 08:40
08:40 – 08:50
08:50 – 09:00
09:00 – 09:10
09:10 – 09:20
09:20 – 09:30
09:30 – 09:40

READING MAKES A FULL MAN, MEDITATION A PROFOUND MAN, DISCOURSE A CLEAR MAN.

BENJAMIN FRANKLIN

TECHNICAL SESSIONS

10:10 – 11:50 | **Thursday, 14 June 2018** | Pennsylvania Convention Center

THURSDAY

201A

Th2A: Synthesis and Design of Non-Planar Filters and Multiplexers

Chair: Ming Yu, *Chinese University of Hong Kong*
Co-Chair: Vicente Boria, *Universitat Politècnica de València*

10:10 - 10:20
Th2A-1: Singly Terminated Network and Contiguous Multiplexer Design

Y. Yang, *China Academy of Space Technology, China;* Q. Wu, Xidian University, *China*; X. Yin, *China Academy of Space Technology, China;* M. Yu, Chinese University of Hong Kong, China

10:20 - 10:30

10:30 - 10:40
Th2A-2: Accurate Design Procedure for Waffle-Iron Low-Pass Filter

F. Teberio, *Universidad Pública de Navarra, Spain;* I. Arnedo, *Universidad Pública de Navarra, Spain;* J.M. Percaz, *Universidad Pública de Navarra, Spain;* I. Arregui, *Universidad Pública de Navarra, Spain;* P. Martin-Iglesias, *ESA-ESTEC, The Netherlands;* T. Lopetegi, *Universidad Pública de Navarra, Spain;* M.A.G. Laso, *Universidad Pública de Navarra, Spain*

10:40 - 10:50

10:50 - 11:00
Th2A-3: The Strongly-Coupled Resonator Triplet

Simone Bastioli, *RS Microwave, USA;* Richard V. Snyder, *RS Microwave, USA;* Giuseppe Macchiarella, *Politecnico di Milano, Italy*

11:00 - 11:10

11:10 - 11:20
Th2A-4: Improved Fully Canonical W-Band Waveguide Filter

Daniel Miek, *Christian-Albrechts-Universität zu Kiel, Germany*; Alwin Reinhardt, *Christian-Albrechts-Universität zu Kiel, Germany*; Frank Daschner, *Christian-Albrechts-Universität zu Kiel, Germany*; Michael Höft, *Christian-Albrechts-Universität zu Kiel, Germany*

11:20 - 11:30

11:30 - 11:40
Th2A-5: Miniature Triple-Mode Dielectric Resonator Filters

Mustafa S. Bakr, *Technische Universität Graz, Austria*; Ian C. Hunter, *University of Leeds, UK;* Wolfgang Bösch, *Technische Universität Graz, Austria*

11:40 - 11:50
Th2A-6: Dielectric Tuning Screws for Microwave Filters Applications

Javier Ossorio, *Universitat Politècnica de València, Spain*; Vicente E. Boria, *Universitat Politècnica de València, Spain*; Marco Guglielmi, *Universitat Politècnica de València, Spain*

201B

Th2B: Recent Developments in Wireless Power Transfer Techniques

Chair: Paolo Mezzanotte, *Università di Perugia*
Co-Chair: Kamran Ghorbani, *RMIT University*

Th2B-1: Design of Capacitive Coupler for Wireless Power Transfer Under Fresh Water Focusing on kQ Product

Masaya Tamura, *Toyohashi University of Technology, Japan;* Yasumasa Naka, *Toyohashi University of Technology, Japan;* Kousuke Murai, *Toyohashi University of Technology, Japan*

Th2B-2: Dual Transmitter Free-Positioning Wireless Power Transfer System with Optimum Switching Phase Detection Technique

Ukyo Takeda, Keio University, Japan; Yusuke Inada, Keio University, Japan; Yusuke Kimoto, Keio University, Japan; Toru Kawajiri, Keio University, Japan; Hiroki Ishikuro, Keio University, Japan

Th2B-3, The C-Band HySIC RF Energy Harvester Based on the Space Information, Communication and Energy Harvesting Technology

Shigeo Kawasaki, *JAXA, Japan;* Satoshi Yoshida, Kenjiro Nishikawa, *Kagoshima University, Japan;* Toshihiro Nakaoka, *Sophia University, Japan;*

Th2B-4: A Low Complexity and Accurate Battery-Less Trackable Device

Daniel Belo, *Universidade de Aveiro, Portugal*; Diogo C. Ribeiro, *Universidade de Aveiro, Portugal*; Pedro Pinho, *Universidade de Aveiro, Portugal*; Nuno Borges Carvalho, *Universidade de Aveiro, Portugal*

Th2B-5: Dynamic Impedance Matching of Multiple Loads in Wireless Power Transfer Using a Genetic Optimization Approach

Jordan Besnoff, *Potomac Technologies, USA;* Yohay Buchbut, *Potomac Technologies, USA;* Kobi Scheim, *Potomac Technologies, USA;* David S. Ricketts, *North Carolina State University, USA*

Th2B-6: 65/30GHz Dual-Frequency Wirelessly Powered Monolithic 1.83 mm2 Wireless Temperature Sensor Using a 3-Stage Inductor-Peaked Rectifier with On-Chip Antenna in 65-nm CMOS

Hao Gao, Marion K. Matters-Kammerer, Peter Baltus, *Technische Universiteit Eindhoven, The Netherlands*

201C

Th2C: Hyperthermia Treatment and Implants Wireless Powering

Chair: Robert Caverly, *Technische Universität Wien*
Co-Chair: Abbas Omar, *Universität Magdeburg*

Th2C-1: Microwave Ablation Applicator with Sensing Capabilities for Thermal Treatment of Malignant Tissue

Carolin Reimann, *Technische Universität Darmstadt, Germany*; Martin Schüßler, *Technische Universität Darmstadt, Germany*; Sönke Schmidt, *Technische Universität Darmstadt, Germany*; Frank Hübner, Goethe-Universität Frankfurt, Germany; Babak Bazrafshan, Goethe-Universität Frankfurt, Germany; Thomas Vogl, Goethe-Universität Frankfurt, Germany; Rolf Jakoby, *Technische Universität Darmstadt, Germany*

Th2C-2: Experimental Validation of Computational Models of Microwave Tissue Heating with Magnetic Resonance Thermometry

Pegah Faridi, Kansas State University, *USA;* Punit Prakash, Kansas State University, *USA*

Th2C-3: Dual Modality Implant for Simultaneous Magnetic Nanoparticle Heating and Brachytherapy Treatment of Tumor Resection Cavities in Brain

Paul R. Stauffer, Dario B. Rodrigues, Thinh Nguyen, Laura Doyle, Voichita Bar-Ad, Wenyin Shi, Kevin D. Judy, Mark D. Hurwitz, *Thomas Jefferson University, USA;* Robert Goldstein, *AMF Life Systems*

Th2C-5: Design of a RF-to-DC Link for In-Body IR-WPT with a Capsule-Shaped Rotation-Insensitive Receiver

Alex Pacini, *Università di Bologna, Italy*; Francesca Benassi, *Università di Bologna, Italy*; Diego Masotti, *Università di Bologna, Italy*; Alessandra Costanzo, *Università di Bologna, Italy*

IF PASSION DRIVES, LET REASON HOLD THE REINS.
BENJAMIN FRANKLIN

202AB

Th2D: Innovative mm-Wave Calibration and Measurement Techniques*

Chair: Jon Martens, *Anritsu*
Co-Chair: Andrea Ferrero, *Keysight Technologies*

Th2D-1: Miniature Antenna Probe System for 140–220GHz On-Wafer Radiation Pattern Measurements

Yu-Shao Jerry Shiao, *NDL, Taiwan;* Kuan-Yu Chen, *NDL, Taiwan;* Guo-Wei Huang, *NDL, Taiwan*

Th2D-2: Effects Degrading Accuracy of CPW mTRL Calibration at W Band

G.N. Phung, *FBH, Germany;* F.J. Schmückle, *FBH, Germany;* R. Doerner, *FBH, Germany;* Wolfgang Heinrich, *FBH, Germany;* T. Probst, *PTB, Germany;* U. Arz, *PTB, Germany*

Th2D-3: A Novel TRM Calibration Method for Improvement of Modelling Accuracy at mm-Wave Frequency

Jiangtao Su, *Hangzhou Dianzi University, China;* Baoguo Yang, CETC 41, China; Haijun Gao, *Hangzhou Dianzi University, China;* Xiwei Huang, *Hangzhou Dianzi University, China;* Jialin Cai, *Hangzhou Dianzi University, China;* Xiang Wang, *Hangzhou Dianzi University, China;* Fushun Nian, *CETC 41, China*

Th2D-4: A Single-Element VNA Electronic Calibration in CMOS

Jun-Chau Chien, *Stanford University, USA;* Amin Arbabian, *Stanford University, USA;* Ali M. Niknejad, *University of California, Berkeley, USA*

Joint IMS/ARFTG Sessions

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

10:10 – 11:50 | **Thursday, 14 June 2018** | Pennsylvania Convention Center

203AB

Th2E: Integrated Microwave Photonics for Millimeter-Wave and 5G Applications

Chair: James Buckwalter, *University of California, Santa Barbara*
Co-Chair: Ed Ackerman, *Photronics*

10:10 - 10:20

Th2E-1: Plasmonics for Next-Generation Wireless Systems

Maurizio Burla, Romain Bonjour, Yannick Salamin, Felix Abrecht, Claudia Hoessbacher, Christian Haffner, Wolfgang Heni, Yuriy Fedoryshyn, Benedikt Baeuerle, Arne Josten, Juerg Leuthold, *ETH Zürich, Switzerland;* Delwin Elder, *University of Washington, USA;* Larry Dalton, *University of Washington, USA*

10:20 - 10:30

Th2E-2: Monolithically Integrated Si Photonics Transmitters in 0.25µm BiCMOS Platform for High-Speed Optical Communications

Iria García López, *IHP, Germany*; Pedro Rito, *IHP, Germany*; Despoina Petousi, *IHP, Germany*; Stefan Lischke, *IHP, Germany*; Dieter Knoll, *IHP, Germany*; Marcel Kroh, *IHP, Germany*; Lars Zimmermann, *IHP, Germany*; Minsu Ko, *IHP, Germany*; A. Cagri Ulusoy, *Michigan State University, USA;* Dietmar Kissinger, *IHP, Germany*

10:30 - 10:40

Th2E-3: Towards Integrated Wideband High Resolution Optical Synthesizers

Farshid Ashtiani, *University of Pennsylvania, USA;* Pouria Sanjari, *University of Pennsylvania, USA;* Mohamad Hossein Idjadi, *University of Pennsylvania, USA;* Firooz Aflatouni, *University of Pennsylvania, USA*

10:40 - 10:50

Th2E-4: Integrated Microwave Photonics for High Performance RF Receiver Frontends

Yifei Li, *UMass Dartmouth, USA;* Longtao Xu, *UMass Dartmouth, USA;* Peter Herczfeld, *Drexel University, USA;* Jeffrey Rodriguez, *UMass Dartmouth, USA*

204A

Th2F: 5G Millimeter-Wave Beamformers and Phased-Arrays

Chair: Gabriel Rebeiz, *University of California, San Diego*
Co-Chair: Aly Fathy, *University of Tennessee*

10:10 - 10:20

Th2F-1: A Software-Defined Phased Array Radio with mmWave to Software Vertical Stack Integration for 5G Experimentation

Bodhisatwa Sadhu, *IBM T.J. Watson Research Center, USA;* Arun Paidimarri, *IBM T.J. Watson Research Center, USA;* Mark Ferriss, *IBM T.J. Watson Research Center, USA;* Mark Yeck, *IBM T.J. Watson Research Center, USA;* Xiaoxiong Gu, *IBM T.J. Watson Research Center, USA;* Alberto Valdes-Garcia, *IBM T.J. Watson Research Center, USA*

10:20 - 10:30

Th2F-2: Ultra-Compact and Modular 5G Phased-Array 4-Channel Beamformer Front-Ends with <2° RMS Phase Error

Tumay Kanar, *IDT, USA;* Samet Zihir, *IDT, USA;* Naveen Yanduru, *IDT, USA*

10:30 - 10:40

Th2F-3: 28GHz Phased Array Transceiver in 28nm Bulk CMOS for 5G Prototype User Equipment and Base Stations

Jeremy Dunworth, Bon-Hyun Ku, Yu-Chin Ou, David Lu, Paul Monat, Kaushik Chakraborty, Andrew Arnett, Gang Liu, Tony Segoria, Jongrit Lerdworatawee, Joung Won Park, Hajir Hedayati, Atlazo, *USA;* Ali Tassoudji, Keith Douglas, Vladimir Aparin, *Qualcomm Technologies, USA;* Aliakbar Homayoun, *Cypress Semiconductor, USA;* Hyun-Chul Park, *Samsung Electronics, Korea*

10:40 - 10:50

Th2F-4: Compact 28-GHz Phased Array Antenna for 5G Access

Risto Valkonen, *Nokia Bell Labs, Finland*

10:50 - 11:00

Th2F-5: Test and Characterization for 5G Phased Array Antenna Systems

Michael Millhaem, *Keysight Technologies, USA*

204C

Th2H: Millimeter Wave Broadband Power Amplifiers

Chair: Charles Cambell, *Qorvo*
Co-Chair: Robert Leoni, *Raytheon*

10:10 - 10:20

Th2H-1: An 8-Way Combined E-Band Power Amplifier with 24dBm Psat and 12% PAE in 0.12µm SiGe

Eric C. Wagner, *University of California, San Diego, USA;* Gabriel M. Rebeiz, *University of California, San Diego, USA*

10:30 - 10:40

Th2H-2: A +27dBm Psat 27dB Gain W-Band Power Amplifier in 0.1µm GaAs

Aviv Barabi, Eran Socher, *Tel Aviv University, Israel;* Noam Ross, Amity Wolfman, Ofer Shaham, *Rafael Advanced Defense Systems, Israel*

10:40 - 10:50

Th2H-3: A 6–18GHz 40W Reactively Matched GaN MMIC Power Amplifier

Michael Litchfield, *BAE Systems, USA;* James J. Komiak, *BAE Systems, USA*

10:50 - 11:00

Th2H-4: 6–18GHz Watt-Level Switchless Dual-Band PA MMIC Using Coupled-Line-Based Diplexer

Kwangseok Choi, *Seoul National University, Korea;* Hongjong Park, *Seoul National University, Korea;* Junghyun Kim, *Hanyang University, Korea;* Youngwoo Kwon, *Seoul National University, Korea*

11:00 - 11:10

11:10 - 11:20

Th2H-5: A Highly Linear InP Distributed Amplifier Using Ultra-Wideband Intermodulation Feedforward Linearization

Duy P. Nguyen, *University of California, Davis, USA;* Nguyen L.K. Nguyen, *University of California, Davis, USA;* Alexander N. Stameroff, *Keysight Technologies, USA;* Anh-Vu Pham, *University of California, Davis, USA*

11:20 - 11:30

Th2E: Focus Session:

Integrated Microwave Photonics for Millimeter-wave and 5G Applications

Chair: James Buckwalter, *Univ. of California, Santa Barbara;* Ed Ackerman, *Photronics, Inc.*

LOCATION: 203AB

ABSTRACT:

This focus session will present advancements in integrated photonic and optoelectronic circuits and systems that will advance microwave and millimeter-wave systems. Advancements of photonic integrated circuit technology related to silicon photonics, indium phosphide, and other processes will support higher circuit complexity and offer unique signal processing capability. This session highlights recent research on process technology, circuits, and systems with a specific focus on next generation (5G and data center) communication systems that will be significantly enhanced with integrated photonic and optoelectronic components.

Th2F: Focus Session:

5G Millimeter-Wave Beamformers and Phased-Arrays

Chairs: Gabriel Rebeiz, *Univ. of California, San Diego;* Aly Fathy, *Univ. of Tennessee*

LOCATION: 204A

ABSTRACT:

With the explosion of 5G mm-wave systems, there is a large interest in low-cost beamformers and phased-array solutions capable nof Gbps links at hundreds of meters. This session will present the latest developments in this area, and cover both SiGe and CMOS beamformers, and 8x8 and 16x16-element phased arrays. The session will also cover system demonstrations with Gbps data links at long distances. Finally, measurement techniques for high-speed and low-cost phased-array characterization including complex constellation at wide scan angles will be presented.

10:10 – 11:50 | **Thursday, 14 June 2018** | Pennsylvania Convention Center Exhibit Hall

THIF1: Interactive Forum #4

Chair: Aly Fathy, *University of Tennessee* **Co-Chair:** Abbas Omar, *Universität Magdeburg*

THIF1-1: Cryogenic Millimeter-Wave CMOS Low-Noise Amplifier

Mikko Varonen, *VTT Technical Research Centre of Finland, Finland;* Kieran Cleary, *Caltech, USA;* Denizhan Karaca, *Aalto University, Finland;* Kari A.I. Halonen, *Aalto University, Finland*

THIF1-2: A Compact 0.8dB Low Noise and Self-Packaged LNA Using SISL Technology for 5GHz WLAN Application

Zhengmin Ke, *UESTC, China*; Shouxian Mou, *UESTC, China*; Kaixue Ma, *UESTC, China*; Fanyi Meng, *UESTC, China*

THIF1-3: Wideband 220–330GHz Turnstile OMT Enabled by Silicon Micromachining

Adrian Gomez-Torrent, *KTH, Sweden*; Umer Shah, *KTH, Sweden*; Joachim Oberhammer, *KTH, Sweden*

THIF1-4: 140–220-GHz Distributed Antenna and Amplifier Co-Integrated in SiGe BiCMOS Process for UWB Receivers

Paolo Valerio Testa, *Technische Universität Dresden, Germany;* Bernhard Klein, *Technische Universität Dresden, Germany;* Ronny Hahnel, *Technische Universität Dresden, Germany;* Corrado Carta, *Technische Universität Dresden, Germany;* Dirk Plettemeier, *Technische Universität Dresden, Germany;* Frank Ellinger, *Technische Universität Dresden, Germany*

THIF1-5: 0.15mm2, DC-70GHz, Graphene-Based Power Detector with Improved Sensitivity and Dynamic Range

Mohamed Saeed, *RWTH Aachen University, Germany;* Ahmed Hamed, *RWTH Aachen University, Germany;* Saad Qayyum, *RWTH Aachen University, Germany;* Zhenxing Wang, *AMO, Germany;* Mehrdad Shaygan, *AMO, Germany;* Daniel Neumaier, *AMO, Germany;* Renato Negra, RWTH Aachen University, Germany

THIF1-6: Spectrum Efficient D-Band Communication Link for Real-Time Multi-Gigabit Wireless Transmission

Vessen Vassilev, Zhongxia Simon He, Sona Carpenter, Herbert Zirath, Yu Yan, Ahmed Hassona, Jingjing Chen, *Chalmers University of Technology, Sweden*; Mikael Hörberg, *Ericsson, Sweden;* Yinggang Li, *Ericsson, Sweden;* Jonas Hansryd, *Ericsson, Sweden;* Mingquan Bao, *Ericsson, Sweden;* Thomas Emanuelsson, *Ericsson, Sweden*

THIF1-7: Non-Line of Sight Terahertz Imaging from a Single Viewpoint

Sai kiran Doddalla, *Arizona State University, USA;* Georgios C. Trichopoulos, *Arizona State University, USA*

THIF1-8: 2.2-pJ/Bit 30-Gbit/s Mach-Zehnder Modulator Driver in 22-nm-FDSOI

Laszlo Szilagyi, *Technische Universität Dresden, Germany;* Ronny Henker, *Technische Universität Dresden, Germany;* David Harame, *GLOBALFOUNDRIES, Germany;* Frank Ellinger, *Technische Universität Dresden, Germany*

THIF1-9: Photonic-Assisted Wideband Microwave Measurement

Yihan Li, *IMRA America, USA;* Naoya Kuse, *IMRA America, USA;* Martin E. Fermann, *IMRA America, USA*

THIF1-10: An 8-Beam 2.4GHz Digital Array Receiver Based on a Fast Multiplierless Spatial DFT Approximation

V.A. Coutinho, *Universidade Federal de Pernambuco, Brazil;* Viduneth Ariyarathna, *University of Akron, USA;* D.F.G. Coelho, *University of Calgary, Canada*; R.J. Cintra, *Universidade Federal de Pernambuco, Brazil;* Arjuna Madanayake, *University of Akron, USA*

THIF1-11: A Miniature Electromagnetic Bandgap Structure Using Integrated Fan-Out Wafer-Level Package (InFO-WLP) for Gigahertz Noise Suppression

Ming-Hsien Tsai, *TSMC, Taiwan;* Sen-Kuei Hsu, *TSMC, Taiwan;* Chi-Kai Shen, *National Taiwan University, Taiwan;* Pei-Shen Wei, *National Taiwan University, Taiwan;* Chan-Hong Chern, *TSMC, Taiwan;* Tzong-Lin Wu, *National Taiwan University, Taiwan*

THIF1-12: A Low-Profile Substrate Integrated Magneto-Electric Dipole Antenna Based on Folded Magnetic Wall for UWB Application

Xiuping Li, *BUPT, China;* Quanping Li, *BUPT, China;* Hua Zhu, BUPT, China; Jia Song, *BUPT, China;* Zihang Qi, *BUPT, China*

THIF1-13: Millimeter-Wave Chip-to-Chip Interconnect Using Plastic Wire Operating in Single and Dual Mode

Utpal Dey, *Universität Stuttgart, Germany*; Jan Hesselbarth, *Universität Stuttgart, Germany*

THIF1-14: Laser Assisted Additive Manufacturing of CPW mm-Wave Interdigital Capacitors

Ramiro A. Ramirez, *University of South Florida, USA;* Di Lan, *University of South Florida, USA;* Eduardo A. Rojas-Nastrucci, *Embry-Riddle Aeronautical University, USA;* Thomas M. Weller, *University of South Florida, USA*

THIF1-15: Aerosol Jet Printing of Millimeter Wave Transmission Lines on 3D Ceramic Substrates Made by Additive Manufacturing

Anthony Delage, *XLIM (UMR 7252), France;* Nicolas Delhote, *XLIM (UMR 7252), France;* Serge Verdeyme, *XLIM (UMR 7252), France;* Barbara Bonnet, Thales Alenia Space, *France;* Ludovic Carpentier, *CNES, France;* Cindy Schick, *3DCeram, France;* Thierry Chartier, *IRCER (UMR 7315), France;* Christophe Chaput, *3DCeram, France*

THIF1-16: A Fully 3D Printed Multi-Chip Module with an On-Package Enhanced Dielectric Lens for mm-Wave Applications Using Multimaterial Stereolithography

Ryan Bahr, *Georgia Tech, USA;* Xuanke He, *Georgia Tech, USA;* Bijan Tehrani, *Georgia Tech, USA;* Manos M. Tentzeris, *Georgia Tech, USA*

THIF1-17: Broadband Millimeter Wave Characterization of 3-D Printed Materials

Arthur C. Paolella, *Harris, USA;* Chris Corey, *Harris, USA;* Diana Foster, *Harris, USA;* Joseph Desjardins, *Harris, USA;* Caitlin Smith, *Harris, USA;* Lauren Walters, *Harris, USA*

THIF1-18: Preclinical Efficacy of a Microwave and Adrenaline Based Haemostat Utilising a Novel Co-Axial Cable Structure

Shaun C. Preston, *Bangor University, UK*; Paul Sibbons, *NPIMR, UK;* Malcolm White, *Creo Medical, UK;* Christopher P. Hancock, *Bangor University, UK*

THIF1-19: Complex Permittivity Extraction of Layered Biological Samples

Harshitha Thippur Shivamurthy, *Technische Universiteit Delft, The Netherlands;* Vincenzo Mascolo, *Technische Universiteit Delft, The Netherlands;* Raffaele Romano, *Technische Universiteit Delft, The Netherlands;* Andrea Neto, *Technische Universiteit Delft, The Netherlands;* Marco Spirito, *Technische Universiteit Delft, The Netherlands*

THIF1-20: All-Digital Beam Forming for SKA1-LOW: CTPM Design and Verification

Rui Cao, *KLAASA, China;* Manqing Wu, *KLAASA, China;* Xiaohui Tao, *KLAASA, China;* Zhuang Li, *KLAASA, China;* Jinzhong Zhang, *KLAASA, China;* Xiaozheng Liu, *KLAASA, China;* Shuai Li, *KLAASA, China;* Xiaoguang Zhang, *KLAASA, China;* Quan Wang, *KLAASA, China;* Huanpeng Tang, *KLAASA, China;* Andrew Faulkner, *University of Cambridge, UK;* Eloy DeMarco, *University of Cambridge, UK;* Nima Razavi-Ghods, *University of Cambridge, UK*

THIF1-21: Tunable Leaky Wave Antenna Based on Bidirectional Amplifier Enhanced Composite Right/Left Handed Transmission Line

Dongyin Ren, *SUNY Buffalo, USA;* Kevin Xu, *SUNY Buffalo, USA;* Jun H. Choi, *SUNY Buffalo, USA*

THIF1-22: Design of a Ku-Band Compact Dual Polarized Horn Arrays with OMT

Chang Ding, *Harbin Institute of Technology, China*; Fan-Yi Meng, *Harbin Institute of Technology, China*; Lizhong Song, *Harbin Institute of Technology, China*

THIF1-23: A Novel 24-GHz Air-Filled Cavity-Backed Slot Antenna Array with Out-of-Phase Power Divider for Automotive Radar System

Ningning Yan, *UESTC, China*; Kaixue Ma, *UESTC, China*; Yun He, *UESTC, China*; Ze Jian, *UESTC, China*

THIF1-24: Performance of V-Band On-Chip Antennas in GlobalFoundries 45nm CMOS SOI Process for mm-Wave 5G Applications

Sensen Li, *Georgia Tech, USA;* Huy Thong Nguyen, *Georgia Tech, USA;* Taiyun Chi, *Georgia Tech, USA;* Chaojiang Li, *GLOBALFOUNDRIES, USA;* Ned Cahoon, *GLOBALFOUNDRIES, USA;* Arvind Kumar, *GLOBALFOUNDRIES, USA;* Greg Freeman, *GLOBALFOUNDRIES, USA;* David Harame, *GLOBALFOUNDRIES, USA;* Hua Wang, *Georgia Tech, USA*

Thursday, 14 June 2018

THP1 12:00 – 13:00 | Room 201A

5G mm-W PA/FEM: Si or III-V - Who Will Win The Race?

Organizers: Kamal Samanta, *Sony Europe*

Abstract: 5G is proposed as the next major revolution of wireless communications, where mm-W FEMs (front-end modules) will be delivering wide-band power, yet within highly reduced size and cost. This requires innovative solutions in semiconductor/device technology and circuit topologies. Traditionally, state-of-the-art FEMs are implemented on III-V (GaAs/GaN) due to their demanding performance requirements (power/bandwidth/efficiency). However, Si devices are very attractive due to their maturity and ability to integrate complex digital and RF/analog circuitry cost-effectively. Recently, Si has been overcoming the high-frequency barrier, while GaN/SOI is maintaining performance at a low cost and operating voltages. Both Si and III-V technologies will be represented with panelists from leading foundries/industries. The panel will review state-of-the-art industrial developments in Si (SiGe/BiCMOS and SOI/CMOS) and III-V (GaN/SOI/SiC and GaAs) devices; compare their performance; and discuss the future trends and challenges for 5G deployment. The panel will also debate critical issues such as the use of the right technology/process (Si or III-V) and beamforming topology (all-digital mass-MIMO, RF or hybrid) for 5G FEMs.

Panelists:

1. Bror Peterson, *Qorvo*
2. Christophe Auvinet, *UMS*
3. Joy Laskar, *MAJA Systems*
4. Kamal Samanta, *Sony Europe*
5. Marc Rocchi, *OMMIC*
6. Sushil Kumar, *Global Foundries*

THP2 12:00 – 14:00 | Room 204B

Utilization of RF/Microwaves in Medicine

Organizers: Usmah Kawoos, *(Henry M Jackson Foundation), Naval Medical Research Center, Silver Spring, MD;* Anilchandra Attaluri, *School of Science, Engineering, and Technology, The Pennsylvania State University – Middletown, PA*; Arye Rosen, *Rowan University, Glassboro, NJ*

Abstract: Over the past three decades, collaboration between physicians and engineers has increased dramatically, to the benefit of our society. Biomedical engineering departments, the majority of which found in engineering schools and some within medical schools, offer seemingly unlimited opportunities and continue to attract a large number of students. To benefit from the merits of interdisciplinary cooperation and facilitate the transfer of technology to the market, existing large corporations, start-up medical companies, and research funding agencies now demand strong collaboration between engineers and physicians. With this in mind, IMS2018 has made the subject of RF/microwaves in Medicine a major theme of the conference. The physicians on this panel will discuss the use of RF/microwaves in their respective fields. Topics ranging from microwave hyperthermia therapy for reoccurrences of breast cancer, advances in RF renal denervation, to back pain management using RF, will be highlighted.

Panelists:

1. Review and Advances In RF Renal Denervation
   Nicholas Ruggiero, M.D, *Cardiology, Thomas Jefferson University Hospital, Philadelphia, PA*
2. Microwave Hyperthermia Therapy For Reoccurrences Of Breast Cancer
   Mark Hurwitz, M.D, *Radiation Oncology (Thermal oncology), Thomas Jefferson University Hospital, Philadelphia, PA*
3. Advances In Mri: Overview Of MRI Physics And Technology, Focused On Clinical Use And Directed Towards Engineers
   Donald Mitchell, M.D., *Magnetic Resonance Imaging, Thomas Jefferson University Hospital, Philadelphia, PA*
4. Back Pain Management Using RF
   Eugene Viscusi, M.D., *Anesthesiology, Thomas Jefferson University Hospital, Philadelphia, PA*
5. Rf Ablation In The Treatment Of Metastatic Spinal Tumors
   Francis Kralick, D.O., *Neurological Surgery, Shore Medical Center, Brigantine, NJ*
6. Rf Treatment Of Bone Tumors
   Hamid RS Hosseinzadeh, M.D., *Orthopedic Surgery, School of Osteopathic Medicine, Stratford, NJ*
7. Prolieve®Transurethral Microwave Thermodilatation Therapy for BPH
   William Jow, M.D., *Medifocus Inc., Columbia, MD*
8. Advances In RF/Microwave In Cardiac Ablation
   Daniel Frisch, M.D., *Cardiology, Thomas Jefferson University Hospital, Philadelphia, PA*
9. Utilization Of RF In Pain Management
   Andrew Ng, M.D., *Anesthesiology, Thomas Jefferson University Hospital, Philadelphia, PA*
10. Advances In Microwave Ablation Of Liver Cancer
    Ernest Rosato, M.D., *Oncology Surgery, Thomas Jefferson University Hospital, Philadelphia, PA*

DSCS III Satellite, launched in 1982, in the thermal test facility at GE Aerospace, Valley Forge, PA. Photo provided by Mr. Herb Thal.

TECHNICAL SESSIONS

13:30 – 15:10 | **Thursday, 14 June 2018** | Pennsylvania Convention Center

THURSDAY

201A

Th3A: New Tuning Concepts for 3-D, Planar, and Integrated Filters and Duplexers

Chair: Eric Naglich, *U.S. Naval Research Laboratory*
Co-Chair: Xiaoguang Leo Liu, *University of California, Davis*

13:30 - 13:40
Th3A-1: A Tunable Waveguide Filter Designed with a Constant Absolute Bandwidth Using a Single Tuning Element
Gowrish B., *University of Waterloo, Canada*; Raafat R. Mansour, *University of Waterloo, Canada*

13:40 - 13:50
Th3A-2: Tunable Multiband Bandpass-to-Bandstop RF Filters
Dakotah J. Simpson, *University of Colorado Boulder, USA;* Roberto Gómez-García, *Universidad de Alcalá, Spain;* Dimitra Psychogiou, *University of Colorado Boulder, USA*

13:50 - 14:00
Th3A-3: A Combline Tunable Filter with Loss Compensation Circuit
Arash Fouladi Azarnaminy, *University of Waterloo, Canada*; Raafat R. Mansour, *University of Waterloo, Canada*

14:00 - 14:10
Th3A-4: A _/4-Inverted N-Path Filter in 45-nm CMOS SOI for Transmit Rejection with Code Selective Filters
Hussam AlShammary, *University of California, Santa Barbara, USA;* Cameron Hill, *University of California, Santa Barbara, USA;* Ahmed Hamza, *University of California, Santa Barbara, USA;* James F. Buckwalter, *University of California, Santa Barbara, USA*

14:10 - 14:20
Th3A-5: A Compact Tunable Bandpass Filter Using Switchable Varactor-Tuned Dual-Mode Resonator
Minjae Jung, *Yonsei University, Korea;* Byung-Wook Min, *Yonsei University, Korea*

14:20 - 14:30
Th3A-6: Tunable Three-Pole Diplexer with High Selectivity and Isolation
Li Gao, *University of California, San Diego, USA;* Tsu-Wei Lin, *University of California, San Diego, USA;* Gabriel M. Rebeiz, *University of California, San Diego, USA*

201B

Th3B: Techniques and Components for High-Power Microwave Technology

Chair: Malgorzata Celuch, *QWED*
Co-Chair: Vadim Yakovlev, *Worcester Polytechnic Institute*

13:30 - 13:40
Th3B-1: Determination of the Complex Permittivity of High Loss Liquids with a Novel Reentrant Cavity
David Marqués-Villarroya, *Universitat Politècnica de València, Spain*; Felipe Peñaranda-Foix, *Universitat Politècnica de València, Spain*; Antoni J. Canós, *Universitat Politècnica de València, Spain*; Beatriz García-Baños, *Universitat Politècnica de València, Spain*; José M. Catalá-Civera, *Universitat Politècnica de València, Spain*

13:40 - 13:50
Th3B-2: Effects of Average Power-Handling Capability on DC-Sputtering Aluminum Nitride Thin Film on Ceramic Substrate
Tzu-Chun Tai, *National Cheng Kung University, Taiwan;* Hung-Wei Wu, *Kun Shan University, Taiwan*; Yu-Ming Lin, *National Cheng Kung University, Taiwan;* Sin-Pei Wang, *Kun Shan University, Taiwan*; Yeong-Her Wang, *National Cheng Kung University, Taiwan;* Shoou-Jinn Chang, *National Cheng Kung University, Taiwan*

13:50 - 14:00
Th3B-3, A 2D Coupled Electromagnetic, Thermal and Fluid Flow Model: Application to Layered Microwave Heat Exchangers
Ajit A. Mohekar, *Worcester Polytechnic Institute, USA;* Joseph M. Gaone, *Worcester Polytechnic Institute, USA;* Burt S. Tilley, *Worcester Polytechnic Institute, USA;* Vadim V. Yakovlev, *Worcester Polytechnic Institute, USA*

14:00 - 14:10
Th3B-4, Acoustical Behavior of Fully-Printed, BST MIM Varactor Modules in High Power Matching Circuits
Daniel Kienemund, *Technische Universität Darmstadt, Germany*; Nicole Bohn, *KIT, Germany;* Thomas Fink, *COMET, Switzerland;* Mike Abrecht, *COMET, Switzerland;* Walter Bigler, *COMET, Switzerland;* Joachim R. Binder, *KIT, Germany;* Rolf Jakoby, *Technische Universität Darmstadt, Germany*; Holger Maune, *Technische Universität Darmstadt, Germany*

14:10 - 14:20
Th3B-5: A Novel Approach to the Modeling of a Fabry-Perot Open Resonator
T. Karpisz, *Warsaw University of Technology, Poland;* B. Salski, *Warsaw University of Technology, Poland;* P. Kopyt, *Warsaw University of Technology, Poland;* J. Krupka, *Warsaw University of Technology, Poland*

201C

Th3C: Biomedical Devices

Chair: Changzhi Li, *Texas Tech University*
Co-Chair: Yanzhu Zhao, *Medtronic*

13:30 - 13:40
Th3C-1: An Energy-Efficient Wirelessly Powered Millimeter-Scale Neurostimulator with Optimized Inductive Loop Antenna and Custom Rectifier
Hongming Lyu, *University of California, Los Angeles, USA;* Jigong Wang, University of Texas Medical Branch, *USA;* Jun-Ho La, University of Texas Medical Branch, *USA;* Jin Mo Chung, University of Texas Medical Branch, *USA;* Aydin Babakhani, *University of California, Los Angeles, USA*

13:40 - 13:50
Th3C-2: A Programmable RF Transmitter for Wideband Thermoacoustic Spectroscopic Imaging
Hao Nan, *Stanford University, USA;* Amin Arbabian, *Stanford University, USA*

13:50 - 14:00
Th3C-3: Noncontact Pulse Transit Time Measurement Using a Single-Frequency Continuous-Wave Radar
Mu-Cyun Tang, *National Sun Yat-sen University, Taiwan*; Chien-Min Liao, *National Sun Yat-sen University, Taiwan*; Fu-Kang Wang, *National Sun Yat-sen University, Taiwan*; Tzyy-Sheng Horng, *National Sun Yat-sen University, Taiwan*

14:00 - 14:10
Th3C-4: Non-Contact Beat-to-Beat Blood Pressure Measurement Using Continuous Wave Doppler Radar
Heng Zhao, *NJUST, China*; Xu Gu, *NJUST, China*; Hong Hong, *NJUST, China*; Yusheng Li, *NJUST, China*; Xiaohua Zhu, *NJUST, China*; Changzhi Li, *Texas Tech University*, *USA*

14:10 - 14:20
Th3C-5: Fingertip Pulse Signals Enhanced by Using Intermodulation Multiplication of Active High-Sensitivity Split-Ring Resonator
Ta-Chung Chang, Po-Kai Chan, Chia-Hui Chen, *National Cheng Kung University, Taiwan;* Kuan-Wei Chen, Chin-Lung Yang, *National Cheng Kung University, Taiwan*

14:20 - 14:30
Th3C-6: Sleep Scoring with a UHF RFID Tag by Near Field Coherent Sensing
Pragya Sharma, *Cornell University, USA;* Edwin C. Kan, *Cornell University, USA*

202AB

Th3D: Advances in CMOS Microwave and Millimeter Wave Signal Sources

Chair: Deukhyoun Heo, *Washington State University*
Co-Chair: Yi-Jan Emery Chen, *National Taiwan University*

13:30 - 13:40
Th3D-1: A 169.6GHz Hybrid Mode-Switching Push-Push Oscillator with 21.7% Tuning Range and 180.6dBc/Hz FoMT in 28nm CMOS Technology
Yiyang Shu, *UESTC, China*; Huizhen Jenny Qian, *UESTC, China*; Xun Luo, *UESTC, China*

13:40 - 13:50
Th3D-2: A Low Power Active-Passive Dual Gm-Boosted W-Band Oscillator for Wireless Network-on-Chip Applications
Joe Baylon, *Washington State University, USA;* Srinivasan Gopal, *Washington State University, USA;* Luke Renaud, *Washington State University, USA;* Sheikh Nijam Ali, *Washington State University, USA;* Deukhyoun Heo, *Washington State University*, *USA*

13:50 - 14:00
Th3D-3: A Low-Phase-Noise 20GHz Phase-Locked Loop with Parasitic Capacitance Reduction Technique for V-Band Applications
Hee Sung Lee, *KAIST, Korea;* Kwang Kyu Hwang, *KAIST, Korea;* Dong Min Kang, *KAIST, Korea;* Seong Jun Cho, *KAIST, Korea;* Chul Woo Byeon, *Wonkwang University, Korea;* Chul Soon Park, *KAIST, Korea*

14:00 - 14:10
Th3D-4: A 17.5-dBm Output Power 11.2% DC-to-RF Efficiency Low Phase Noise CMOS Quadrature Voltage-Controlled Oscillator
Kuan-Hsueh Lu, *National Central University, Taiwan;* Guan-Lin Huang, *National Central University, Taiwan;* Hong-Yeh Chang, *National Central University, Taiwan*

14:10 - 14:20
Th3D-5: A 60GHz Push-Push Voltage-Controlled Oscillator with Adaptive Gate Biasing in 28nm Bulk CMOS Technology
Johannes Rimmelspacher, *FAU Erlangen-Nürnberg, Germany;* Robert Weigel, *FAU Erlangen-Nürnberg, Germany;* Amelie Hagelauer, *FAU Erlangen-Nürnberg, Germany;* Vadim Issakov, *Infineon Technologies, Germany*

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

TECHNICAL SESSIONS

13:30 – 15:10 | **Thursday, 14 June 2018** | Pennsylvania Convention Center

203AB

Th3E: Advances in Semiconductor Monolithic Integrated Circuit Technology

Chair: Amin Ezzeddine, *Amcom Communications*
Co-Chair: Cynthia Hang, *Raytheon*

13:30 - 13:40

Th3E-1: A New Integrated K-Band Analog Vector Sum Phase Shifter

Fatemeh Akbar, *University of Michigan, USA;* Amir Mortazawi, *University of Michigan, USA*

13:40 - 13:50

Th3E-2: Tunable Delay Line Using Distributed Inductive/Capacitive Miller Effect

Wooram Lee, *IBM T.J. Watson Research Center, USA;* Alberto Valdes-Garcia, *IBM T.J. Watson Research Center, USA*

13:50 - 14:00

Th3E-3: A 50–110GHz Four-Channel Dual Injection Locked Power Amplifier with 36% PAE at 19dBm Psat Using Self-Start Technique in 65nm CMOS Process

Shunli Ma, *Fudan University, China;* Fan Ye, *Fudan University, China;* Junyan Ren, *Fudan University, China*

14:00 - 14:10

14:10 - 14:20

Th3E-4, An 18-dBm, 57 to 85-GHz, 4-Stack FET Power Amplifier in 45-nm SOI CMOS

Kang Ning, *University of California, Santa Barbara, USA;* James F. Buckwalter, *University of California, Santa Barbara, USA*

14:20 - 14:30

14:30 - 14:40

Th3E-5, 12W, 30% PAE, 40GHz Power Amplifier MMIC Using a Commercially Available GaN/Si Process

Joël Moron, *OMMIC, France;* Rémy Leblanc, *OMMIC, France;* François Lecourt, *OMMIC, France;* Peter Frijlink, *OMMIC, France*

14:40 - 14:50

14:50 - 15:00

15:00 - 15:10

204A

Th3F: THz and mm-Wave Sensing and Communication Systems

Chair: Steven Bowers, *University of Virginia*
Co-Chair: Lei Liu, *University of Notre Dame*

Th3F-1: A Programmable Active THz Electromagnetic Surface On-Chip for Multi-Functional Imaging

Xue Wu, *Princeton University, USA;* Huaixi Lu, Peking University, China; Xuyang Lu, *Princeton University, USA;* Kaushik Sengupta, *Princeton University, USA*

Th3F-2: Wide-Band THz Spectroscope in Silicon THz Combining Sub-Wavelength Near-Field Sensing and Robust Regression Analysis

Xue Wu, *Princeton University, USA;* Huaixi Lu, *Peking University, China;* Kaushik Sengupta, *Princeton University, USA*

Th3F-3: Scalable mm-Wave 4-Channel Radar SoC with Vector Modulators and Demodulators for MIMO and Phased Array Applications

Herman Jalli Ng, *IHP, Germany*; Reinhard Feger, Johannes Kepler Universität Linz, Austria; Dietmar Kissinger, *IHP, Germany*

Th3F-4: A 256-QAM 39GHz Dual-Channel Transceiver Chipset with LTCC Package for 5G Communication in 65nm CMOS

Zhilin Chen, Zhengdong Jiang, Zhiqing Liu, Yixuan Cheng, Lin Zhang, Dong Chen, Jingzhi Zhang, Shoutian Sun, Jiayu Dong, Pengxue Liu, You Zhou, Huihua Liu, Chenxi Zhao, Yunqiu Wu, Kai Kang, *UESTC, China*; Xianghua Li, Jianping Zhao, *Huawei Technologies, China*

Th3F-5, 300-GHz, 100-Gb/s InP-HEMT Wireless Transceiver Using a 300-GHz Fundamental Mixer

Hiroshi Hamada, *NTT, Japan;* Takuya Fujimura, *Tokyo Institute of Technology, Japan;* Ibrahim Abdo, *Tokyo Institute of Technology, Japan;* Kenichi Okada, *Tokyo Institute of Technology, Japan;* Ho-Jin Song, *POSTECH, Korea;* Hiroki Sugiyama, *NTT, Japan;* Hideaki Matsuzaki, *NTT, Japan;* Hideyuki Nosaka, NTT, Japan

204C

Th3H: Advances in Low Noise Technology

Chair: James Sowers, *SSL*
Co-Chair: James Whelehan, *Innovative Technology*

Th3H-1: LNA Design with CMOS SOI Process — 1.4dB NF K/Ka Band LNA

Chaojiang Li, *GLOBALFOUNDRIES, USA;* Omar El-Aassar, *University of California, San Diego, USA;* Arvind Kumar, *GLOBALFOUNDRIES, USA;* Myra Boenke, *GLOBALFOUNDRIES, USA;* Gabriel M. Rebeiz, *University of California, San Diego, USA*

Th3H-2: A 2–4GHz Silicon Germanium Cryogenic Low Noise Amplifier MMIC

Shirin Montazeri, *UMass Amherst, USA;* Joseph C. Bardin, *UMass Amherst, USA*

Th3H-3, A 0.38-V, Sub-mW 5-GHz Low Noise Amplifier with 43.6% Bandwidth for Next Generation Radio Astronomical Receivers in 90-nm CMOS

Ying Chen, *National Taiwan University, Taiwan;* Yu-Hsuan Lin, *National Taiwan University, Taiwan;* Chau-Ching Chiong, *Academia Sinica, Taiwan;* Huei Wang, *National Taiwan University, Taiwan*

Th3H-4: 70–116-GHz LNAs in 35-nm and 50-nm Gate-Length Metamorphic HEMT Technologies for Cryogenic and Room-Temperature Operation

Fabian Thome, *Fraunhofer IAF, Germany*; Arnulf Leuther, *Fraunhofer IAF, Germany*; Juan Daniel Gallego, *Centro Astronómico de Yebes, Spain;* Frank Schäfer, *MPI for Radio Astronomy, Germany;* Michael Schlechtweg, *Fraunhofer IAF, Germany*; Oliver Ambacher, *Fraunhofer IAF, Germany*

Th3H-5: A Beyond 110GHz GaN Cascode Low-Noise Amplifier with 20.3dBm Output Power

Rainer Weber, Maciej _wikli_ski, Sandrine Wagner, Roger Lozar, Hermann Massler, Peter Brückner, *Fraunhofer IAF, Germany*; Rüdiger Quay, *Fraunhofer IAF, Germany*

THURSDAY

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

Adjournment sine die[1]

IMS Closing and IMBioC Opening Session

15:30 – 17:30 | **Thursday, 14 June 2018** | Pennsylvania Convention Center, Grand Ballroom

ORGANIZERS: **A. Daryoush**, *Drexel University*; **A. Rosen**, *Rowan University*

"Extreme Platforms for Extreme Functionality"

Nader Engheta, PhD, H. Nedwill Ramsey Professor at the *University of Pennsylvania*

ABSTRACT:

Nanoscience, nanotechnology, and materials science and engineering have witnessed significant development in recent years. Platforms with unprecedented "extreme" electromagnetic features can now be constructed, providing ample opportunities for manipulating, tailoring and sculpting waves and fields at various length scales. In electronics, controlling and tailoring flow of charged carriers has led to design of many functional devices. In microwaves and photonics, by analogy, we control electromagnetic and optical waves using materials. However, the challenges and opportunities are different in these two fields. Materials are means to shape waves, and as such they can endow electromagnetic waves and photons with desired functionalities. One can now tailor structures much smaller than the wavelengths of visible light, thus enabling game-changing possibilities and paradigm-shifting opportunities for functionalizing fields and waves at the nanoscale, opening doors to innovation and discovery. For example, we have been exploring a series of phenomena related to the wave-matter interaction in platforms with extreme scenarios, such as near-zero-index materials, low-index photonics, optical lumped circuit paradigm ("optical metatronics") for optical information processing at the nanoscale, specially engineered materials that solve equations as waves go through them, one-atom-thick optical devices, photonic doping, geometry-independent resonant cavities, etc. These "extreme platforms" offer new opportunities for functional devices of future.

In this talk, I will discuss some of these exciting possibilities for "extreme platforms", and forecast some future directions and opportunities.

"Renal Denervation for Uncontrolled Hypertension: Complexity After Symplicity"

Dr. Nicholas J. Ruggiero II, MD, Thomas Jefferson University

ABSTRACT:

Renal denervation for uncontrolled hypertension demonstrated in many early trials to be extremely successful. These trials accounted for widespread implementation of the procedure in Europe and a change in the ESC management guidelines. The large, randomized, pivotal US trial, Symplicity HTN 3, unfortunately showed no benefit in comparison to optimal medical therapy. These results bridaled enthusiasm for this technology and accounted for many companies to desert the premise altogether. Fortunately, those who believe in the procedure are pressing forward and multiple new trials which are currently enrolling will ultimately determine the future of renal denervation. In the lecture, he will discuss the mechanism of action of renal denervation and early trial data for the Symplicity HTN 3. He will also give insight for new studies and data as well as alternative options besides RF ablation.

IMS Closing and IMBioC Opening Reception

17:30–18:30 | Pennsylvania Convention Center, Grand Hall

A one-hour reception will be held in the Grand Hall of the Pennsylvania Convention Center, at the end of the Closing Ceremony. Attendees will have an opportunity to discuss and network with the Closing Ceremony Speakers, as well as celebrate the fond memories of the IMS Microwave Week.

[1] Adjournment sine die is a Latin phrase which means "without assigning a day for a further meeting or hearing." For example, to adjourn an assembly sine die means to adjourn the assembly for an indefinite period. In the U.S., adjournment sine die is an adjournment till the next session of the congress. This is particularly apt for the Closing Ceremony, as it is the last official technical session organized by the IMS2018 (Philadelphia) Steering Committee. However, the IMS will reconvene at a different location (Boston in 2019) with a new body of organizers, much like the US Congress. ***https://www.conginst.org/2015/01/05/what-is-a-sine-die-adjournment/***

Women in Microwaves Networking Event

Women in Engineering: Academia, Defense, Industry and BioTech

19:00 – 21:00 | **Thursday, 14 June 2018** | Philadelphia Academy of the Fine Arts

ORGANIZERS AND EVENT HOSTS: **Charlotte Blair**, *ANSYS (USA)*, **Sherry Hess**, *National Instruments (USA)*, **Katia Grenier**, *LAAS-CNRS (France)*

The main emphasis of this event is building a network of women who work in microwaves and RF, as well as creation of an informal mentoring network that enables women to connect with other women of all ages and across industry, academia and biotechnology. Don't miss this chance to unwind over some food and beverages while soaking in the art that the PAFA exhibits. Men, if you would like to attend, please don't forget to bring a female friend to this event.

GUEST SPEAKER ABSTRACT:

Our guest speaker will share her experiences on "working at the frontier of engineering and biology: focus on linear and non-linear optical micro spectroscopy to understand electropulsation mechanisms on cells." This talk will be followed by further conversation and networking amongst attendees.

ABOUT DR. CATERINA MERLA:

Guest Speaker:
Prof. Caterina Merla
ENEA

Dr. Caterina Merla received the Laurea and the Ph.D. degrees in electronic engineering from the University of Rome "La Sapienza," Italy, in 2004 and 2008, respectively. From 2008 to 2010, she was a Postdoctoral Fellow with the XLIM Research Institute, CNRS- University of Limoges, Limoges, France. From 2010 to 2012, she has been a Postdoctoral Fellow with the Italian Inter-University Center of Electromagnetic Fields and Biosystems (ICEmB). She is currently with the Italian National Agency for New Technologies, Energy and Sustainable Economic Development (ENEA), Research Centre in Rome and a Visiting Research Scientist at Lehigh University, Bethlehem, PA. Her research interests are mainly focused on the microdosimetric evaluation of the electromagnetic (EM) field at single cell level, biological sample dielectric measurements, and design and dosimetry of exposure systems oriented to EM protection studies and medical applications. Dr. Merla was the recipient of the 2008 International Union of Radio Science (URSI) Young Scientist Awards presented at the XXIX URSI General Assembly, Chicago, IL.

The Pennsylvania Academy of the Fine Arts

118 – 128 N. Broad Street,
Philadelphia, PA 19102

The Pennsylvania Academy of the Fine Arts (PAFA), founded in 1805 in Philadelphia, is the first and oldest art museum and art school in the United States. The academy's museum is internationally known for its collections of 19th- and 20th-century American paintings, sculptures, and works on paper. Its archives house important materials for the study of American art history, museums, and art training.

Prior to the founding of the Academy, there were limited opportunities for women to receive professional art training in the United States. This period between the mid-19th and early 20th centuries shows a remarkable growth of formally trained women artists.

By 1868, women assumed more active leadership roles and achieved influential positions. For example, in 1878 Catherine Drinker, at the age of 27, became the first woman to teach at the academy. One of her pupils, her younger cousin Cecilia Beaux, would leave a lasting legacy at the academy as the first female faculty member to instruct painting and drawing, beginning in 1895. By the 1880s women artists competed with men for top accolades and recognition.

Even as women artists were making progress in the United States, they had difficulty studying in Europe. Women who chose to travel overseas typically studied the works of master artists in the galleries, not in classes. In this regard, the U.S. was more progressive than Europe at the time.

In 2010, The Academy acquired the Linda Lee Alter Collection of Art by Women, nearly 500 works by female artists, from collector Linda Lee Alter. Artists in the collection include those of international renown, such as Louise Bourgeois, Judy Chicago, Louise Nevelson, Kiki Smith and Kara Walker, as well renowned Philadelphia artists including Elizabeth Osborne.

Three Minute Thesis (3MT®) Competition

14:00 – 16:00 | **Monday, 11 June 2018** | Pennsylvania Convention Center, Room 201C

In its second year, the IMS2018 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 2018, the 3MT® competition received 129 submissions, of which 84 were accepted to the technical program at IMS, and 21 were designated as 3MT® finalists. We encourage all IMS2018 attendees to come to our briefing session at 09:00 – 10:30.

The winners of the 3MT® competition will receive their prizes at the IMS2018 Closing Ceremony on Thursday, 14 June 2018.

JUDGES: **William Cowen**, *Villanova University*; **Sarah Hartman-Caverly**, *Penn State University-Berks*; **Heidi Rose**, *Villanova University*; **Eugene Sonn**, *WHYY Public Radio*; **Tom Wright**, *Temple University*

MASTER OF CEREMONIES: **Rashaunda Henderson**, *University of Texas at Dallas*

ORGANIZERS: **John Bandler**, *McMaster University and Bandler Corporation*; **Erin Kiley**, *Massachusetts College of Liberal Arts*

Seeing through the Skin for Advanced Fingerprint Biometrics
(We3F) Panagiotis Theofanopoulos, Arizona State University

Radar Microphone: Alexa's Backup in Noisy Environments
(Tu2G) Martin Geiger, University of Ulm

I Need a New Antenna! Can You Print Me One Real Quick?
(Tu1H) John Kimionis, Nokia - Bell Labs (Murray Hill, NJ)

Manufacturing the Future: 3D Printing of Microwave Systems
(ThIF1) Ryan Bahr, Georgia Institute of Technology

Sniffing out Weapons with Microwaves
(WeIF1) Aaron Pitcher, McMaster University

Indoor Radar Imaging: I Can See You
(Tu2G) Jiaming Yan, Nanjing University of Science and Technology

Energy Harvesting: A Revolutionary Solution to Power the Future
(We3A) Tong-Hong Lin, Georgia Institute of Technology

Future Antenna Miniaturization Mechanism
(Tu3E) Hwaider Lin, Northeastern University

Origami: Unfolding the Future of Engineering
(Tu1H) Syed Abdullah Nauroze, Georgia Institute of Technology

A Touchless Touchpad
(Tu2G) Shengchang Lan, Harbin Institute of Technology

Reflecting Wireless Signals to Save Power
(Tu3G) Adrian Tang, NASA Jet Proplusion Laboratory, University of California, Los Angeles

RFID Technology: More than Just Identification
(Tu4G) Konstantinos Zannas, University of Grenoble Alpes, Grenoble INP, LCIS

Future Implantable Neurostimulators
(Th3C) Hongming Lyu, University of California, Los Angeles

Hear a Whisper in the Middle of a Concert: Be Selective!
(We2C) Enrico Massoni, University of Pavia

Navigating the Uncertainties of Electromagnetic Field Computations
(Tu3D) Kae-An Liu, University of Toronto

Low-Power Electronic Circuits for Future Quantum Computers
(Th3H) Shirin Montazeri, University of Massachusetts, Amherst

A Powerful Multi-functional Tool for Security, Industrial and Biomedical Applications
(Th3F) Xue Wu, Princeton University

Microwave Sensing: From Corrosion Prevention Management to Non-invasive Infection Monitoring
(Th1C) Zahra Abbasi, University of Alberta

A Deeper Sense of Tiny Biological Processes
(Th1C) Mojtaba Chehelcheraghi, KU Leuven, ESAT- TELEMIC, Telecommunications and Microwaves

RF Blood Pressure Measurement: Noncontact and Continuous
(Th3C) Hong Hong, Nanjing University of Science and Technology

Electromagnetic Heat Exchangers in Energy Beaming Application
(Th3B) Ajit A. Mohekar, Worcester Polytechnic Institute

3MT® THREE MINUTE THESIS
FOUNDED BY THE UNIVERSITY OF QUEENSLAND

Student Design Competitions

09:30 – 17:00 | **Tuesday, 12 June 2018** | Pennsylvania Convention Center, Exhibit Hall

ORGANIZERS: A. Katz, A. Poddar, U. Rohde, G. Wang

ABSTRACT:

The Student Design Competition (SDC) is one of the liveliest parts of the 2018 International Microwave Symposium's (IMS2018's) Technical Program. The SDC goal is to encourage student innovation and hands-on activities. Student teams compete for the honor of the "Best Design" in one of the multiple design contests devised and sponsored by the IEEE Microwave Theory & Techniques Society's (MTT-S') 27 Technical Committees (TCs). Since its inception thirteen years ago, the SDC has grown in popularity, support, and size from a single contest to more than ten parallel contests. Past competitions have covered challenging and emerging topics in the RF and microwave field. Several outstanding designs that originated from the SDC have been documented in the Microwave Magazine. IMS2018, in Philadelphia, will continue this tradition with a very strong SDC program.

SPONSORING TECHNICAL COMMITTEE/S	TITLE	CONTACT
TC-2 (Microwave Acoustics)	Carrier Aggregation BAW Quadplexer Module	Holger Maune
TC-5 (Microwave High-Power Techniques)	14th High Efficiency Power Amplifier Student Design Competition	James Komiak, Kamal Samanta
TC-6 (Microwave and Millimeter-wave Integrated Circuits), TC-14 (Microwave Low Noise Techniques), TC-16 (Microwave Systems) and TC-20 (Wireless Communications)	Wide bandwidth Mobile Com Receiver Module	Rüdiger Quay, Nils Pohl, and Roger Kaul
TC-7 (Microwave and Millimeter-wave Solid State Devices) with endorsement/support of TC-6 (Microwave and Millimeter-wave Integrated Circuits)	16 QAM Radio Design	David S. Ricketts
TC-8 (Filters and Passive Components)	Reconfigurable Bandpass Filter Design	Eric Naglich, Sanghoon Shin
TC-10 (Biological Effects and Medical Applications) is the main sponsor, TC-20 (Wireless Communications) is co-sponsor.	High-Sensitivity Fast-Response Motion Sensing Radar	José María Muñoz Ferreras, Fu-Kang Wang, Chung-Tse Michael Wu and Olga Boric-Lubecke
TC-15 (Microwave Field Theory)	Elucidating the Physics of Microwaves through Experimental and Software-Based Demonstrations	Costas Sarris
TC-17 (HF/VHF/UHF Technology)	High-Efficiency Power Amplifier for 475 kHz	Frederick H. Raab
TC-22 (Signal Generation and Frequency Conversion)	High Dynamic Range Mixer	Edmar Camargo, Bert Henderson
TC-22 (Signal Generation and Frequency Conversion) with TC-14 (Microwave Low Noise Techniques), TC-17 (HF/VHF/UHF Technology) and TC-20 (Wireless Communications)	Tunable Low Phase Noise X-Band (8-12 GHz) Voltage Controlled Oscillator	Ajay Poddar, Bert Henderson
TC-24 (RFID Technologies)	Backscatter Radio	Valentina Palazzi, Thomas Ußmüller and John Kimionis
TC-26 (Wireless Energy Transfer and Conversion) is the organizer with MTT-10 (Biological Effects and Medical Applications) and TC-20 (Wireless Communications) co-sponsors.	Wearable Microwave Energy Harvesting	Simon Humour, Luciano Tarricone

IMS Student Paper Competition

10:10 – 11:50 | **Tuesday, 12 June 2018** | Pennsylvania Convention Center, Exhibit Hall

ORGANIZERS: Abbas Omar and Changzhi Li

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 IMS2018 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 (listed after the paper title below in parentheses).

This year's SPC finalists are:

Planar Orthomode Transducer Based on Effective Polarization-Independent Coupling (Tu1D)
Student Finalist: Ahmed Sakr
Advisor: Ke Wu, Polytechnique Montreal

A Wideband Filtering Balun Using CPW-to-slotline Transitions (Tu2C)
Student Finalist: Jiyuan Ren
Advisor: Xun Luo, University of Electronic Science and Technology of China

Improved Throat Vibration Sensing with a Flexible 160-GHz Radar through Harmonic Generation (Tu2G)
Student Finalist: Martin Geiger
Advisor: Christian Waldschmidt, University of Ulm

Remote Measurement of Particle Streams with a Multistatic Dual Frequency Millimeter Wave Radar Sensor (Tu2G)
Student Finalist: Alwin Reinhardt
Advisor: Michael Höft, University of Kiel

Adaptive Principal Component Analysis for Online Reduced Order Parameter Extraction in PA Behavioral Modeling and DPD Linearization (Tu3B)
Student Finalist: Quynh Anh Pham
Advisor: Pere L. Gilabert, Universitat Politècnica de Catalunya

Efficient Sensitivity Analysis of Microwave Structures with Multiple Design Parameters in FDTD (Tu3D)
Student Finalist: Kae-An Liu
Advisor: Costas Sarris, University of Toronto

New Single Source Surface Integral Equation for Solution of Scattering Problems on 3D Dielectric Objects Situated in Multilayered Media (Tu3D)
Student Finalist: Shucheng Zheng
Advisor: Vladimir Okhmatovski, University of Manitoba

Modelling of Solution Processed Indium Arsenide Nanowire Microwave Switches (Tu3E)
Student Finalist: Haris Votsi
Advisor: Peter Aaen, University of Surrey

Spectrally Efficient 4-PAM Ambient FM Backscattering for Wireless Sensing and RFID Applications (Tu3G)
Student Finalist: Spyridon Daskalakis
Advisor: Apostolos Georgiadis, Heriot-Watt University

A Waveform-Engineered Outphasing RFPA Using a Broadband Balun Combiner (Tu4B)
Student Finalist: Aleksander Bogusz
Advisor: Jonathan Lees, Cardiff University,

Contactless pH Measurement Based on High Resolution Enhanced Q Microwave Resonator (Th1C)
Student Finalist: Zahra Abbasi
Advisor: Mojgan Daneshmand, University of Alberta

A Flexible Multi-Gbps Transmitter Using Ultra-High Speed Sigma-Delta-over-Fiber (Th1E)
Student Finalist: Ibrahim Can Sezgin
Advisor: Christian Fager, Chalmers University of Technology

Miniature Triple-Mode Dielectric Resonator Filters (Th2A)
Student Finalist: Mustafa Bakr
Advisor: Ian Hunter, University of Leeds

A Tunable Waveguide Filter Designed with a Constant Absolute Bandwidth Using a Single Tuning Element (Th3A)
Student Finalist: Gowrish Basavarajappa
Advisor: Raafat R Mansour, University of Waterloo

Tunable Multiband Bandpass-to-Bandstop RF Filters (Th3A)
Student Finalist: Dakotah Simpson
Advisor: Dimitra Psychogiou, University of Colorado

A Novel Approach to the Modeling of a Fabry-Perot Open Resonator (Th3B)
Student Finalist: Tomasz Karpisz
Advisor: Bartlomiej Salski, Warsaw University of Technology

A Programmable Active THz Electromagnetic Surface on-Chip for Multi-functional Imaging (Th3F)
Student Finalist: Xue Wu
Advisor: Kaushik Sengupta, Princeton University

GHz Lithium Niobate MEMS Resonators with FoM of 336 and f·Q of 9.15×10^12 (We1E)
Student Finalist: Yansong Yang
Advisor: Songbin Gong, University of Illinois at Urbana-Champaign

A Ku-Band 8-Element Phased-Array Transmitter with Built-in-Self-Test Capability (We1G)
Student Finalist: Dong Chen
Advisor: Kang Kai, University of Electronic Science and Technology of China

An Echo Canceller-less NFIC-TSV Hybrid 3D Interconnect for Simultaneous Bidirectional Vertical Communication (We2A)
Student Finalist: Srinivasan Gopal
Advisor: Deukhyoun Heo, Washington State University

A 10 GHz Up-conversion Mixer with 14.5 dBm OIP3 Using Regulator-based Constant Gm Stage and Harmonic Nulling (We2B)
Student Finalist: Jinbo Li
Advisor: Qun Jane Gu, University of California, Davis

A Novel Microstrip Symmetric Diagonal Cross-Coupling Quadruplet Bandpass Filter Using Even/Odd-Mode Stepped Impedance Resonators (We2C)
Student Finalist: Ryo Mikase
Advisor: Masataka Ohira, Saitama University

Intermodulation Effects and System Sensitivity Degradation in 5G Phased-Arrays due to Multiple Interferers (We2G)
Student Finalist: Bhaskara Rupakula
Advisor: Gabriel Rebeiz, University of California, San Diego

A Compact Intrinsically Switchable Filter Bank Employing Multifunctional Ferroelectric BST (We3E)
Student Finalist: Milad Zolfagharloo Koohi
Advisor: Amir Mortazawi, University of Michigan

On Hardware Implementations of Stepped-Carrier OFDM radars (We3G)
Student Finalist: Benedikt Schweizer
Advisor: Christian Waldschmidt, University of Ulm

28 GHz 5G-Based Phased-Arrays for UAV Detection and Automotive Traffic-Monitoring Radars (We3G)
Student Finalist: Yaochen Wang
Advisor: Gabriel Rebeiz, University of California San Diego

IMS2018 Industry Paper Competition (IPC)

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 Industry Paper Competition will receive their prizes at the IMS2018 Closing Ceremony on Thursday, 14 June 2018.

ORGANIZER: Steven Rosenau, SSL

This year's IPC finalists are:

X-band Integrated Printed Antenna Measurement
Michael Hollenbeck, Optisys LLC

A Surface Mount 45 to 90GHz Low Noise Amplifier Using Novel Hot-Via Interconnection
John Mahon, Analog Devices, Inc.

A Software-Defined Phased Array Radio with mmWave to Software Vertical Stack Integration for 5G Experimentation
Alberto Valdes-Garcia, IBM T.J. Watson Research Center

History

Assembly of GPS II Satellites, showing L-band and UHF antenna arrays.

IMS2018 Advanced Practice Paper Competition (APPC)

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 winners of the Advanced Practice Paper Competition will receive their prizes at the IMS2018 Closing Ceremony on Thursday, 14 June 2018.

ORGANIZER: Steven Rosenau, SSL

This year's APPC finalists are:

Pseudoelliptic Combline Filter in a Circularly Shaped Tube
Roman Tkadlec, CommScope Italy Slr.

An Over-110-GHz-Bandwidth 2:1 Analog Multiplexer in 0.25-um InP DHBT Technology
Munehiko Nagatani, Nippon Telegraph and Telephone Corp.

Digitally-assisted Doherty Power Amplifier: Efficiency Enhancement and Linearity Improvement
Mir Masood, NXP Semiconductors

The Strongly-Coupled Resonator Triplet
Simone Bastioli, RS Microwave Company

A 5x5 Microwave Permittivity Sensor Matrix in 0.14-µm CMOS
Zhebin Hu, Delft University of Technology

A 29-30GHz 64-element Active Phased array for 5G Application
Kuan Bao, Nanjing electronic device research institute

Analysis of chirped oscillators under injection signals
Mabel Ponton, University de Cantabria

Direct Metal Printed 4th order Stepped Impedance Filter at 8GHz
Sebastian Sattler, Graz University of Technology

Linearity enhancement of GaN Doherty amplifier by forward gate current blocking method
Ibrahim Khalil, NXP Semiconductors

A 256-QAM 39 GHz Dual-channel Transceiver Chipset with LTCC Package for 5G Communication in 65 nm CMOS
Zhilin Chen, University of Electronic Science and Technology of

F-Band, GaN Power Amplifiers
James Schellenberg, Quinstar Technology, Inc.

Ultra-Compact and Modular 5G Phased-Array 4-Channel Beamformer Front-Ends with <2° RMS Phase Error
Tumay Kanar, Integrated Device Technology, Inc.

Non-Quasi-Static Large-Signal Model for RF LDMOS Power Transistors
Lei Zhang, NXP Semiconductors

A PCB-Embedding Scheme for LCP Ribbon Waveguide at D-band
Ilja Ocket, IMEC

Dynamic-Range Extension Technique based on Balanced Rectifiers
Muh-Dey Wei, RWTH Aachen University

70–116-GHz LNAs in 35-nm and 50-nm Gate-Length Metamorphic HEMT Technologies for Cryogenic and Room-Temperature Operation
Fabian Thome, Fraunhofer IAF

Wearable Vital Sign Sensor Using a Single-Input Multiple-Output Self-Injection-Locked Oscillator Tag
Fu-Kang Wang, National Sun Yat-sen University

Terahertz Spectroscopy with Asynchronous Optical Sampling Using a Compact Bidirectionally Mode-locked Fiber Laser
Robert Baker, University of Arizona

A Multi-Frequency MEMS-Based RF Oscillator Covering the Range from 11.7 MHz to 1.9 GHz
Johannes Stegner, Technische Universität Ilmenau

Broadband Contiguous Multiplexer Design Using Wideband Pseudo-Highpass Channel Filters
Sanghoon Shin, Naval Research Laboratory

A Ku-band Phased Array in Package Integrating Four 180 nm CMOS Transceivers with On-chip Antennas
Xiaoning Zhang, University of Electronic Science and Technology of

A 17.5-dBm Output Power 11.2% DC-to-RF Efficiency Low Phase Noise CMOS Quadrature Voltage-Controlled Oscillator
Hong-Yeh Chang, National Central University

Electromagnetic Rotary Encoders based on Split Ring Resonators (SRR) Loaded Microstrip Lines
Cristian Herrojo, Universitat Autònoma de Barcelona

Micromachined Silicon-core Substrate-integrated Waveguides with Coplanar-probe Transitions at 220-330 GHz
Aleksandr Krivovitca, KTH Royal Institute of Technology

A 5.8 GHz 1.77mW AFSK-OFDM CMOS Backscatter Transmitter for Low Power IoT Applications
Adrian Tang, Jet Propulsion Laboratory

A Highly Linear InP Distributed Amplifier Using Ultra-wideband Intermodulation Feedforward Linearization
Duy Nguyen, University of California, Davis

Integrated Polarization Converter for Planar Cross-Polarized Millimeter Wave Components
Ahmed Sakr, École Polytechnique de Montréal

A Scalable Dual-Polarized 256-Element Ku-Band Phased-Array SATCOM Receiver with ±70° Beam Scanning
Abdurrahman Aljuhani, University of California, San Diego

A Programmable RF Transmitter for Wideband Thermoacoustic Spectroscopic Imaging
Hao Nan, Stanford University

Tunable Multiband Bandpass-to-Bandstop RF Filters
Dakotah Simpson, University of Colorado at Boulder

Student Career Counseling Fair

13:00 – 14:30 | **Thursday, 14 June 2018** | Pennsylvania Convention Center, Exhibit Hall

Participating IMS exhibitors will be on hand to offer students guidance on careers including internships in our industry, for RF, microwave, and millimeter-wave devices, components, and systems design and development. In addition, the presenting companies will discuss future career opportunities within their companies and offer advice for students to successfully navigate from University to industry. There is no charge for students to attend the Career Counseling Fair; however participants must be registered IMS attendees.

Participating Companies:

Analog Devices
Anaren Microwave, Inc.
Cadence Design Systems, Inc.
Cobham
Copper Mountain Technologies
ERZIA Technologies
Marki Microwave, Inc.
MCV Microwave
Mercury Systems
MPI Corporation
SAGE Millimeter, Inc.
SV Microwave
Viking Technology/Sanmina
XMA Corporation

HIDE NOT YOUR TALENTS, THEY FOR USE WERE MADE; WHAT'S A SUNDIAL IN THE SHADE?

BENJAMIN FRANKLIN

Philadelphia's Independence Hall is the birthplace of America. The Declaration of Independence and U.S. Constitution were both debated and signed inside this building. The legacy of the nation's founding documents — universal principles of freedom and democracy — has influenced lawmakers around the world and distinguished Independence Hall as a UNESCO World Heritage Site. Source: *https://www.nps.gov/inde/learn/historyculture/places-independencehall.htm*

The Signers[1]

IMS2018 Steering Committee

Executive Committee (Ex-Com)

General Chair Sridhar Kanamaluru
Co-Chair Afshin Daryoush
Vice-Chair Arye Rosen
Advisors Richard Snyder, Ke Wu
Protocol Ke Wu
LAC Chairs Robert Caverly, James C.M. Hwang
TPC Chairs Mohammad Tofighi, Allen Katz
Finance Chair Asher Madjar
Treasurer Robert Alongi
Event Management Elsie Vega, Dillian Waldron
Exhibition Management Lee Wood, Susie Horn
Publicity Amanda Scacchitti
RFIC Chair Walid Ali-Ahmad
IMBioC Chair Jung-chih (JC) Chiao
ARFTG Chair Dominque Schreurs

Technical Program Committee (TPC)

TPC Chairs Mohammad Tofighi, Allen Katz

TPC Advisors Olga Boric-Lubecke, Ramesh Gupta

TPC Liaisons Stefano Pellerano, Greg Lyons, Tim Hancock, Arnaud Potheir, Jean-Pierre Teyssier

Plenary & Closing Sessions Afshin Daryoush, Arye Rosen

5G Committee Debabani Choudhury, Amarpal Khanna, Dylan Williams, Joy Laskar, Tim LaRocca, Stefano Pellerano, Doug Zuckerman, Ashutosh Dutta, Elsie Vega, Adam Greenberg, Lee Wood, Susie Horn, Amanda Scacchitti, Janet O'Neil

CFP Topics Mohammad Tofighi, Allen Katz

ePaper Management Sandy Owens, Phil Hinton, Paul Comtois

Workshops/Short Courses J.-C. Chiao, Amir Mortazawi, Tony Ivanov, Ahmad Hoorfar

Special/Focus Sessions Dominique Schreurs, Aly Fathy

Panel Sessions Dalma Novak, Rod Waterhouse, Kamal K. Samanta

Interactive Forum Aly Fathy, Kiki Ikossi

Student Design Competition Allen Katz, Ajay Poddar, Ulrich Rohde, Guoan Wang

Student Paper Competition Abbas Omar, Changzhi Li, Haobo Lai

Advanced Practices Paper Competition Steven Rosenau

Industry Paper Competition Steven Roseneau, Changzhan Gu

3MT® Competition John Bandler, Erin Kiley

Micro-Apps and Industry Workshops James Weiler, Murat Eron, Kirit Dixit, Susie Horn, Candi Wooldridge

RF Bootcamp Larry Dunleavy, Karen Hall, Angie Rogers

Marketing, Publicity, Promotions, and Publications (MP3) Committee

IMS2018 Logo, CFP - Design, Printing Afsin Daryoush, Colleen Kiefer, Amanda Scacchitti

Microwave Magazine Nader Engheta, Robert Caverly, Ed Ackerman, Dietmar Kissinger, Iwao Hosako

Digest Amanda Scacchitti, George Vokalek, Sandy Owens, Mark Slater

Program Book Amanda Scacchitti, Colleen Kiefer

Workshop Notes Amanda Scacchitti, J.-C. Chiao

MTT-S Transactions - Special Issue Afshin Daryoush, Abbas Omar, Ajay Poddar, Stavros Iezekial

Website, Mobile App, Social Media Feed Amanda Scacchitti, Mark Slater, Li Zhang, Tushar Sharma, Amaad Soomro

Exhibition Publicity Lee Wood, Amanda Scacchitti, Susie Horn

Exhibition Promotions Lee Wood, Susie Horn, Candi Wooldridge

FOR EVERY MINUTE SPENT IN ORGANIZING, AN HOUR IS EARNED.

BENJAMIN FRANKLIN

Local Arrangements Committee (LAC)

LAC Chairs Robert Caverly, James C.M. Hwang

Event Management Elsie Vega, Dillian Waldron, Deidre Artis, Cassandra Carollo

Exhibition Management Lee Wood, Susie Horn

Sales/Sponsorship Stacy DiLallo

Registrations Klaus Breuer, Nannette Jordan, Kevin Lepine, James Booth

Historical Exhibits Steven Stitzer, Jonathon Allen, Jonathan Becker

Societies Pavilion James Weiler, Susie Horn, Amanda Scacchitti

Amateur (Ham) Radio Marc Franco, Dennis Silage

Project Connect Ronda Franklin, Rashaunda Henderson, Tom Weller, Duane Harvey

Student Volunteers James C.M. Hwang, Xiaoguang (Leo) Liu, Jeff Karper, Akash Anand

Signage Elsie Vega, Amanda Scacchitti, Susie Horn

Young Professionals Simone Bastioli, Eric Naglich, Tushar Sharma

SIGHT Sridhar Kanamaluru

STEM Dru Reynolds, Robert Caverly, Maggie Caverly

Women in Microwaves Charlotte Blair, Sherry Hess, Katia Grenier

University Liaison James C.M. Hwang

Visa Letters Zaher Bardai

Guest Programs Maggie Caverly, Karleen Mays, Sally Katz

Banquets, Entertainment Dillian Waldron, Maggie Caverly, Elsie Vega, Teresa Ulrich, Tom Fagan, Marvin Weilerstein, Chuck Swift (Emeritus)

Industry Liaison Murat Eron

[1] The Signers Hall at the National Constitution Center, in Philadelphia, houses 42 life-size statues of the US Founding Fathers who signed the US Constitution on 17 September 1787.

Seventy-four individuals were selected to attend the Constitutional Convention, but a number of them could not attend or chose not to attend. The names of thirty-nine delegates are inscribed upon the proposed constitution. All but seven were native to the thirteen colonies: Pierce Butler, Thomas Fitzsimons, James McHenry, and William Paterson were born in Ireland, Robert Morris in England, James Wilson in Scotland, and Alexander Hamilton in the West Indies. Jonathan Dayton, aged 26, was the youngest to sign the Constitution, while Benjamin Franklin, aged 81, was the oldest.

The IMS2018 Steering Committee, like the Signers, includes members located throughout the world and the United States. Some of these members could not participate in the face-to-face meetings, but carried out all their work remotely. Their dedication to the cause, is instrumental to IMS2018 success. The IMS2018 "Signers" list is provided on facing page.

IMS2018 Technical Program Review Committee

Peter Aaen
Mohamed Abouzahra
Bayaner Arigong
Farshid Aryanfar
Peter Asbeck
Irfan Ashiq
Dominique Baillargeat
Constantine Balanis
John Bandler
Zaher Bardai
Joseph Bardin
Taylor Barton
Simone Bastioli
Tibor Berceli
Pierre Blondy
Luciano Boglione
Fabrizio Bonani
Quenton Bonds
Vicente Boria-Esbert
Hermann Boss
Slim Boumaiza
Steven Bowers
James Buckwalter
Vittorio Camarchia
Edmar Camargo
Richard Campbell
Charles Campbell
Nuno Carvalho
Robert Caverly
Malgorzata Celuch
Goutam Chattopadhyay
Wenquan Che
Zhizhang David Chen
Emery Chen
Kenle Chen
Morgan Chen
Norman Chiang
J-C Chiao
Venkata Chivukula
Jun Choi
Debabani Choudhury
Terry Cisco
Gayle Collins
Jonathan Comeau
Benjamin Cook
Alessandra Costanzo
Guglielmo d Inzeo
Christian Damm
Francois Danneville
Ali Darwish
Debasis Dawn
Leo de Vreede
William Deal
Gerald DeJean
Erick Djoumessi
Paul Draxler
John Ebel
Danny Elad
Rudy Emrick
Kamran Entesari
Amin Ezzeddine
Christian Fager
Aly Fathy
Andrea Ferrero
Marc Franco
Christopher Galbraith
Jose A. Garcia
Markus Gardill
Edward Gebara
Manouchehr Ghanevati
Kamran Ghorbani
Roberto Gomez-Garcia
Xun Gong
Anand Gopinath
Kavita Goverdhanam
Katia Grenier
changzhan Gu
Ramesh Gupta
Amelie Hagelauer
Cynthia Hang
Masud Hannan
David Harame
Leonard Hayden
John Heaton
Wolfgang Heinrich
Bert Henderson
Rashaunda Henderson
Deukhyoun Heo
Damon Holmes
Glenn Hopkins
Alfred Hung
James Hwang
Kiki Ikossi
Vadim Issakov
Tatsuo Itoh
Kenji Itoh
Tony Ivanov
David Jackson
Robert Jackson
Arne Jacob
Mona Jarrahi
Dan Jiao
Branka Jokanovic
Rob Jones
Reynold Kagiwada
Telesphor Kamgaing
Shigeo Kawasaki
Arvind Keerti
Amarpal Khanna
Roni Khazaka
Erin Kiley
Matt King
Ahmed Kishk
Dietmar Kissinger
Reinhard Knoechel
Alexander Koelpin
Kwang-Jin Koh
Nicholas Kolias
Pawel Kopyt
Slawomir Koziel
Sushil Kumar
Hiromu Kuno
Paolo Lampariello
Joy Laskar
Wei-Chiang Lee
Timothy Lee
Robert Leoni
Changzhi Li
Jenshan Lin
Sarah Linz
Xiaoguang Leo Liu
Lei Liu
Nestor Lopez
Victor Lubecke
Xun Luo
Fabian Lurz
Gregory Lyons
Rui Ma
Stephen Maas
Giuseppe Macchiarella
Jan Machac
Raafat Mansour
Jon Martens
Holger Maune
Kenneth Mays
Shamsur Mazumder
Imran Mehdi
Davide Mencarelli
Chinchun Meng
Francisco Mesa
Paolo Mezzanotte
Laya Mohammadi
Omeed Momeni
Amir Mortazawi
Matthew Morton
Isar Mostafanezhad
Jose-Maria Munoz-Ferreras
Koichi Murata
Tadao Nagatsuma
Eric Naglich
Michel Nakhla
Jeffrey Nanzer
Julio Navarro
Brad Nelson
Edward Niehenke
Natalia Nikolova
Kenjiro Nishikawa
Joachim Oberhammer
Hiroshi Okazaki
Vladimir Okhmatovski
Abbas Omar
Valentina Palazzi
Bo Pan
John Papapolymerou
Dimitris Pavlidis
Jose Pedro
Dimitrios Peroulis
Felix Pflaum
Anh-Vu Pham
Luca Pierantoni
Ajay Poddar
Nils Pohl
Zoya Popovic
Marian Pospieszalski
Arnaud Pothier
Dimitra Psychogiou
Shishir Punjala
Joe Qiu
Rüdiger Quay
Frederick Raab
Jose Rayas-Sanchez
Gabriel Rebeiz
Kate Remley
Tibault Reveyrand
Shahed Reza
David Ricketts
Alfred Riddle
Jae Sung Rieh
Chris Rodenbeck
Habil Ulrich Rohde
David Root
Luca Roselli
Steven Rosenau
Matthias Rudolph
Johannes Russer
Carlos Saavedra
Prabir Saha
Magdalena Salazar Palma
Kamal Samanta
Tapan Sarkar
Costas Sarris
James Schellenberg
Manfred Schindler
Dominique Schreurs
Lora Schulwitz
Brian Sequeira
Arvind Sharma
Tushar Sharma
Vikas Shilimkar
Sanghoon Shin
Hjalti Sigmarsson
Christopher Silva
James Skala
Phillip Smith
Richard Snyder
James Sowers
Joseph Staudinger
Steven Stitzer
Rick Sturdivant
Almudena Suarez
Frank Sullivan
Hai Ta
Adrian Tang
Paul Tasker
Jesse Taub
Smail Tedjini
Douglas Teeter
Manos Tentzeris
Trang Thai
Werner Thiel
Thomas Ussmueller
Freek van Straten
Roberto Vincenti Gatti
Martin Vossiek
Christian Waldschmidt
Guoan Wang
Huei Wang
Yuanxun Ethan Wang
Robert Weigel
Andreas Weisshaar
Tom Weller
Cheng P. Wen
James Whelehan
John Wood
Ke Wu
Chung-Tse (Michael) Wu
Vadim Yakovlev
Kazuya Yamamoto
Jonmei Yan
Huiwen Yao
Jianping Yao
Ehsan Yavari
Adam Young
Ming Yu
Qijun Zhang
Hualiang Zhang
Yanzhu Zhao
Anding Zhu

RFIC Plenary Session

17:30 – 19:00 | **Sunday, 10 June 2018** | Pennsylvania Convention Center, Grand Ballroomm

PLENARY SPEAKER 1

"Compact Silicon Integrated mmWave Circuits: From Skepticism to 5G and Beyond"

Honorable Zachary J. Lemnios, Vice President, Physical Sciences & Government Programs *IBM Research*

ABSTRACT:

Silicon integration of millimeter wave (mmWave) circuits began with early investments from DARPA almost 20 years ago, with the DARPA TEAM (Technology for Efficient Agile Microelectronics) program. By convincing skeptics that mmWave circuits, traditionally implemented using discrete III-V blocks, could function reliably when fully integrated into silicon-based SiGe and CMOS processes, this technology has broadly evolved across today's highly integrated systems. The development of comprehensive CMOS and SiGe PDK (Process Development Kit) and the supporting modeling and design infrastructure provided a viable path for circuit designers to adopt this technology.

The tremendous volume reduction of ~1000X coupled with a ~1000X increase in integration complexity brought about by silicon-integration has already enabled the first generation of mmWave commercial automotive radar and data communication products, and placed mmWave as a key component of the next global mobile communications standard — 5G. This level of multi-antenna mmWave system sophistication was unimaginable a decade ago.

This talk will review the journey of mmWave technology over the last two decades, and outline the possibilities of a future where multi-functional mmWave circuits are a key differentiator in vertically integrated "Antennas to AI" cognitive systems.

PLENARY SPEAKER 2

"The Road Ahead for Autonomous Cars — What's in for RFIC"

Lars Reger, Automotive Chief Technology Officer Business Unit Automotive *NXP Semiconductors*

ABSRACT:

Our cars are morphing into connected, self-driving "robots" that can sense the environment, think and act autonomously. Today's cars are loaded with technologies that enable new in-vehicle experiences or safety and automation applications like advanced driver assistance systems (ADAS). Connectivity is ultimately redefining the way cars are conceptualized and built. In cars of the future, all of the interfaces — radio, cellular, WiFi, Bluetooth, GPS, vehicle-to-everything (V2X) communications, and more — can be integrated into a single, secure smart antenna that serves as both a transmitter and receiver of communications with a variety of channels, standards, and bandwidths. However, various wireless technologies can also introduce cyber security risks. As the car becomes a hub of connectivity, it opens potential attack opportunities for hackers. How secure can a fully connected car be? What should future car architectures look like to enhance security? How will RFIC technology and connectivity transform the driving experience of tomorrow and what are the next big innovations to expect?

RFIC Welcoming Reception

Featuring Industry Showcase and Student Paper Awards Finalists

19:00 – 21:00 | **Sunday, 10 June 2018** | Loews Hotel, Millennium Hall

The RFIC "Interactive" Reception starts immediately after the Plenary Session and will highlight the Industry Showcase and Student Paper Awards Finalists in an engaging social and technical evening event with food and drinks. This event is supported by the RFIC Symposium corporate sponsors. You will not want to miss the RFIC Reception this year! Authors of these industry showcase and student finalists papers will present their innovative work, summarized in poster format, and some authors will also have hardware demonstrations.

Industry Showcase

CHAIR: Oren Eliezer, *PHAZR*

A 22nm FDSOI Technology Optimized for RF/mmWave Applications

S.N. Ong, *et al.*
GLOBALFOUNDRIES, Singapore; Germany; USA; India; CEA-LETI, France

RM02B-1 | 10:10

A Robust Reconfigurable Front-End for Non-Contiguous Multi-Channel Carrier Aggregation Receivers

Dror Regev, *et al.*
Toga Networks, Israel; Huawei Technologies, China

RM01A-2 | 8:20

A Dual-Core 60GHz Push-Push VCO with Second Harmonic Extraction by Mode Separation

Vadim Issakov, *et al.*
Infineon Technologies, Germany; Austria

RM04C-3 | 16:20

A 264-µW 802.15.4a-Compliant IR-UWB Transmitter in 22nm FinFET for Wireless Sensor Network Application

Renzhi Liu, *et al.*
Intel, USA; University of Texas at Dallas, USA

RM04A-2 | 16:00

A Compact 75GHz LNA with 20dB Gain and 4dB Noise Figure in 22nm FinFET CMOS Technology

Woorim Shin, *et al.*
Intel, USA

RTU2A-2 | 10:30

A Compact 75GHz PA with 26.3% PAE and 24GHz Bandwidth in 22nm FinFET CMOS

Steven Callender, *et al.*
Intel, USA

RTU1A-2 | 8:20

Monitoring Architecture for a 76–81GHz Radar Front End

Karthik Subburaj, *et al.*
Texas Instruments, India; USA

RTU1C-2 | 8:20

Industry showcase and Student Paper Finalists list continued on page 64

Student Paper Finalists

CHAIR: Brian Floyd, *NC State University*

A Secure TOF-Based Transceiver with Low Latency and Sub-cm Ranging for Mobile Authentication Applications

Haixin Song, *et al.*
Tsinghua University, China

RM04A-1 | 15:40

A 29–37GHz BiCMOS Low-Noise Amplifier with 28.5dB Peak Gain and 3.1–4.1dB NF

Zhe Chen, *et al.*
Technische Universiteit Eindhoven, The Netherlands

RTU2A-3 | 10:50

An 8.8-GS/s 8b Time-Interleaved SAR ADC with 50-dB SFDR Using Complementary Dual- Loop-Assisted Buffers in 28nm CMOS

X. Shawn Wang, *et al.*
University of California, Los Angeles, USA; University of Macau, China; National Chiao Tung University, Taiwan

RM02C-1 | 10:10

A 28GHz Packaged Chireix Transmitter with Direct On-Antenna Outphasing Load Modulation Achieving 56%/38% PA Efficiency at Peak/6dB Back-Off Output Power

Sensen Li, *et al.*
Georgia Tech, USA

RM02A-4 | 11:10

A -195dBc/Hz FoM$_T$ 20.8-to-28-GHz LC VCO with Transformer-Enhanced 30% Tuning Range in 65-nm CMOS

S. Lightbody, *et al.*
University of British Columbia, Canada; Microsemi, Canada

RM04C-1 | 15:40

A 10GHz Digital Phase Noise Filter with 14dB Noise Suppression and -127dBc/Hz Noise Sensitivity at 1MHz Offset

Tongning Hu, *et al.*
University of California, Davis, USA

RM01C-4 | 9:00

A 28GHz CMOS Phased-Array Transceiver Featuring Gain Invariance Based on LO Phase Shifting Architecture with 0.1-Degree Beam-Steering Resolution for 5G New Radio

Jian Pang , *et al.*
Tokyo Institute of Technology, Japan; NEC, Japan

RM02A-1 | 10:10

A Low Power PWM Optical Phased Array Transmitter with 16° Field-of-View and 0.8° Beamwidth

Reza Fatemi, *et al.*
Caltech, USA

RM01B-3 | 8:40

RFIC Technical Sessions

08:00 – 09:40 | **Monday, 11 June 2018** | Pennsylvania Convention Center

201A

RM01A: Building Blocks for 5G Transceivers

Chair: Steven Turner, *BAE Systems*
Co-Chair: Waleed Khalil, *The Ohio State University*

08:00 – 08:20

RM01A-1: A 25.1–27.6GHz Tunable-Narrowband Digitally-Calibrated Merged LNA-Vector Modulator for 5G Phased Arrays

Rahul Singh, *Carnegie Mellon University, USA;* Susnata Mondal, *Carnegie Mellon University, USA;* Jeyanandh Paramesh, *Carnegie Mellon University, USA*

08:20 – 08:40

RM01A-2: A Robust Reconfigurable Front-End for Non-Contiguous Multi-Channel Carrier Aggregation Receivers

Dror Regev, *Toga Networks, Israel*; Shimi Shilo, *Toga Networks, Israel*; Doron Ezri, *Toga Networks, Israel*; Junping Zhang, Huawei Technologies, China

08:40 – 09:00

RM01A-3: A True Time Delay 16-Element 4-Beam Digital Beamformer

Sunmin Jang, *University of Michigan, USA;* Rundao Lu, *University of Michigan, USA;* Jaehun Jeong, *Broadcom, USA;* Michael P. Flynn, *University of Michigan, USA*

09:00 – 09:20

RM01A-4: A 9.4–11.7GHz VCO in 0.12µm SiGe BiCMOS with -123dBc/Hz Phase Noise at 1MHz Offset for 5G Systems

Eric C. Wagner, *University of California, San Diego, USA;* Gabriel M. Rebeiz, *University of California, San Diego, USA*

201B

RM01B: Advances in Packaging, Modeling and Optical Phased Arrays

Chair: Richard Chan, *Qorvo*
Co-Chair: Tzung-Yin Lee, *Skyworks Solutions*

08:00 – 08:20

RM01B-1: Chip-Package-PCB Co-Design of Power Combiners in SESUB and WLCSP Technology with Re-Distribution Layers

Thanh Vinh Dinh, *LaMIPS, France;* Sidina Wane, *Energy-Vision, France;* Dominique Lesénéchal, *LaMIPS, France;* Philippe Descamps, *LaMIPS, France;* Laurent Leyssenne, *Thales, France;* Damienne Bajon, *ISAE, France*

08:20 – 08:40

RM01B-2: An Efficient mm-Wave Integrated Circuit Synthesis Method with Accurate Scalable Passive Component Modeling

Zhijian Pan, *Tsinghua University, China;* Wei Zhu, *Tsinghua University, China;* Qiang Yao, *Tsinghua University, China;* Di Li, *Tsinghua University, China;* Zuochang Ye, *Tsinghua University, China;* Yan Wang, *Tsinghua University, China*

08:40 – 09:00

RM01B-3: A Low Power PWM Optical Phased Array Transmitter with 16° Field-of-View and 0.8° Beamwidth

Reza Fatemi, *Caltech, USA;* Aroutin Khachaturian, *Caltech, USA;* Ali Hajimiri, *Caltech, USA*

09:00 – 09:20

RM01B-4: A CMOS-SOI Power Amplifier Technology Using EDNMOS for Sub 6GHz Wireless Applications

Rui Tze Toh, *GLOBALFOUNDRIES, Singapore*; Shyam Parthasarathy, *GLOBALFOUNDRIES, India*; Shaoqiang Zhang, *GLOBALFOUNDRIES, Singapore*; Madabusi Govindarajan, *GLOBALFOUNDRIES, India*; Jen Shuang Wong, *GLOBALFOUNDRIES, Singapore*; Kok Wai Johnny Chew, *GLOBALFOUNDRIES, Singapore*; Luis Andia, *GLOBALFOUNDRIES, Singapore*; Diing Shenp Ang, *Nanyang Technological University*, Singapore

204A

RM01C: Techniques for High-Performance Frequency Synthesis

Chair: Salvatore Levantino, *Politecnico di Milano*
Co-Chair: Joseph Cali, *BAE Systems*

08:00 – 08:20

RM01C-1: A 15.6–18.2GHz Digital Bang-Bang PLL with -63dBc In-Band Fractional Spur

Dmytro Cherniak; *Politecnico di Milano, Italy*, Luigi Grimaldi; *Politecnico di Milano, Italy*, Fabio Padovan; *Infineon Technologies, Austria*, Matteo Bassi; *Infineon Technologies, Austria*; Roberto Nonis, *Infineon Technologies, Austria*; Carlo Samori, *Politecnico di Milano, Italy*; Salvatore Levantino, *Politecnico di Milano, Italy*

08:20 – 08:40

RM01C-2: A 14nm FinFET Sub-Picosecond Jitter Fractional-N Ring PLL for 5G Wireless Communication

Seungjin Kim, *Samsung, Korea*; Byungki Han, *Samsung, Korea*; Mingyu Cho, *Samsung, Korea*; Seunghyun Oh, *Samsung, Korea*; Jongwoo Lee, *Samsung, Korea*; Thomas Byunghak Cho, *Samsung, Korea*

08:40 – 09:00

RM01C-3: A 1.33mW, 1.6ps$_{rms}$-Integrated-Jitter, 1.8–2.7GHz Ring-Oscillator-Based Fractional-N Injection-Locked DPLL for Internet-of-Things Applications

Jiang Gong, Yuming He, Ao Ba, Yao-Hong Liu, Johan Dijkhuis, Stefano Traferro, Christian Bachmann, Kathleen Philips, *Holst Centre, The Netherlands*; Masoud Babaie, *Technische Universiteit Delft, The Netherlands*

09:00 – 09:20

RM01C-4: A 10GHz Digital Phase Noise Filter with 14dB Noise Suppression and -127dBc/Hz Noise Sensitivity at 1MHz Offset

Tongning Hu, *University of California, Davis, USA;* Shilei Hao, *University of California, Davis, USA;* Qun Jane Gu, *University of California, Davis, USA*

09:20 – 09:40

RM01C-5: A 5.5–7.3GHz Analog Fractional-N Sampling PLL in 28-nm CMOS with 75fs$_{rms}$ Jitter and -249.7dB FoM

Wanghua Wu, *Samsung, USA;* Chih-Wei Yao, *Samsung, USA;* Kunal Godbole, *Samsung, USA;* Ronghua Ni, *Samsung, USA;* Pei-Yuan Chiang, *Samsung, USA;* Yongping Han, *Samsung, USA;* Yongrong Zuo, *Samsung, USA;* Ashutosh Verma, *Samsung, USA;* Ivan Siu-chuang Lu, *Samsung, USA;* Sang Won Son, *Samsung, USA;* Thomas Byunghak Cho, *Samsung, Korea*

RFIC Technical Sessions

10:10 – 11:50 | Monday, 11 June 2018 | Pennsylvania Convention Center

201A

RM02A: 28 GHz Phased Arrays, Beamformers and Sub-Components for 5G Applications

Chair: Bodhisatwa Sadhu, *IBM T.J. Watson Research Center*
Co-Chair: Stefano Pellerano, *Intel*

10:10 – 10:30

RM02A-1: A 28GHz CMOS Phased-Array Transceiver Featuring Gain Invariance Based on LO Phase Shifting Architecture with 0.1-Degree Beam-Steering Resolution for 5G New Radio

Jian Pang, Rui Wu, Yun Wang, Masato Dome, Hisashi Kato, Hongye Huang, Aravind Tharayil Narayanan, Hanli Liu, Bangan Liu, Takeshi Nakamura, Takuya Fujimura, Masaru Kawabuchi, Ryo Kubozoe, Tsuyoshi Miura, Daiki Matsumoto, Kenichi Okada, *Tokyo Institute of Technology, Japan;* Naoki Oshima, Keiichi Motoi, Shinichi Hori, Kazuaki Kunihiro, Tomoya Kaneko, *NEC, Japan;*

10:30 – 10:50

RM02A-2: A Wideband High-Power Multi-Standard 23–31GHz 2×2 Quad Beamformer Chip in SiGe with >15dBm OP1dB Per Channel

Berktug Ustundag, *University of California, San Diego, USA;* Kerim Kibaroglu, *University of California, San Diego, USA;* Mustafa Sayginer, *University of California, San Diego, USA;* Gabriel M. Rebeiz, *University of California, San Diego, USA*

10:50 – 11:10

RM02A-3: A Dual-Polarized Dual-Beam 28GHz Beamformer Chip Demonstrating a 24Gbps 64-QAM 2×2 MIMO Link

Kerim Kibaroglu, *University of California, San Diego, USA;* Mustafa Sayginer, *University of California, San Diego, USA;* Ahmed Nafe, *University of California, San Diego, USA;* Gabriel M. Rebeiz, *University of California, San Diego, USA*

11:10 – 11:30

RM02A-4: A 28GHz Packaged Chireix Transmitter with Direct On-Antenna Outphasing Load Modulation Achieving 56%/38% PA Efficiency at Peak/6dB Back-Off Output Power

Sensen Li, *Georgia Tech, USA;* Taiyun Chi, *Georgia Tech, USA;* Huy Thong Nguyen, *Georgia Tech, USA;* Tzu-Yuan Huang, *Georgia Tech, USA;* Hua Wang, *Georgia Tech, USA*

11:30 – 11:50

201B

RM02B: Technology Optimization for RF Applications

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

RM02B-1: A 22nm FDSOI Technology Optimized for RF/mmWave Applications

S.N. Ong, W.H. Chow, L.H.K. Chan, K.K.S. Tan, C.K. Lim, Jen Shuang Wong, Jen Shuang Wong, W.L. Oo, Kok Wai Johnny Chew, K. Sundaram, M.T. Lau, *GLOBALFOUNDRIES, Singapore*; S. Lehmann, C. Schippel, Y. Andee, Z. Zhao, C. Schwan, J. Mazurier, A. Huschka, C. Grass, A. Pakfar, S. Morvan, B. Rice, D. Harame, *GLOBALFOUNDRIES, Germany*; C. Zhang, M. Hauschildt, J. Watts, A. Bellaouar, R. Taylor, S. Embabi, G. Workman, *GLOBALFOUNDRIES, USA;* Madabusi Govindarajan, *GLOBALFOUNDRIES, India*; A. Divay, *CEA-LETI, France*

RM02B-2: f_T Enhancement of CMOS Transistor Using Isolated Polysilicon Gates

Xi Sung Loo, *MIT, USA;* Moe Z. Win, *MIT, USA;* Kiat Seng Yeo, *SUTD, Singapore*

RM02B-3: A Small Signal AC Model Using Scalable Drain Current Equations of AlGaN/GaN MIS Enhancement HEMT

H. Aoki, *Teikyo Heisei University, Japan*; H. Sakairi, *ROHM, Japan*; N. Kuroda, *ROHM, Japan*; Y. Nakamura, *ROHM, Japan*; K. Chikamatsu, *ROHM, Japan*; K. Nakahara, *ROHM, Japan*

RM02B-4: AlScN/Diamond Surface Acoustic Wave Resonators on Si Substrates with Frequency up to 33.7GHz

Lei Wang, *NUDT, China*; Shuming Chen, *NUDT, China*; Jinying Zhang, *UCAS, China*; Jian Zhou, *NUDT, China*; Jingting Luo, *Shenzhen University, China*

204A

RM02C: ADC-Based RF/Mixed-Signal Systems and Wireline Transceiver Techniques

Chair: Yuxiang Zheng, *FutureWei Technologies*
Co-Chair: Fred Lee, *Verily Life Sciences*

RM02C-1: An 8.8-GS/s 8b Time-Interleaved SAR ADC with 50-dB SFDR Using Complementary Dual-Loop-Assisted Buffers in 28nm CMOS

X. Shawn Wang, Jieqiong Du, Boyu Hu, Mau-Chung Frank Chang, *University of California, Los Angeles, USA;* Chien-Heng Wong, Yilei Li, Yuan Du, *University of California, Los Angeles, USA;* Yen-Cheng Kuan, *National Chiao Tung University, Taiwan*; Chi-Hang Chan, *University of Macau, China*

RM02C-2: A Direct $\Delta\Sigma$ Receiver with Current-Mode Digitally-Synthesized Frequency-Translated RF Filtering

Sushil Subramanian, *University of Southern California, USA;* Hossein Hashemi, *University of Southern California, USA*

RM02C-3: A Methodology for Accurate DFE Characterization

Alireza Sharif-Bakhtiar, *University of Toronto, Canada*; Anthony Chan Carusone, *University of Toronto, Canada*

RM02C-4: A Flexible Low-Latency DC-to-4 Gbit/s Link Operating from -40 to +200°C in 28nm CMOS for Galvanically Isolated Applications

Simon Ooms, *Katholieke Universiteit Leuven, Belgium*; Patrick Reynaert, *Katholieke Universiteit Leuven, Belgium*

RFIC Lunchtime Panel Session

11:45 – 13:15 | **Monday, 11 June 2018** | Room 201A

How Will the Future Self-Driving Cars See? LiDAR vs. Radar

ORGANIZERS AND MODERATORS: **Hossein Hashemi,** *University of Southern California, USA;* **Amin Arbabian,** *Stanford University, USA*

PANELISTS: **Juergen Hasch,** Senior Expert, Corporate Sector Research and Advance Engineering, *Robert Bosch GmbH, Germany*; **Manju Hegde,** CEO & Co-Founder, *Uhnder Inc.;* **Ron Kapusta,** System Architect, Autonomous Transportation and Safety, *Analog Devices, USA;* **Lute Maleki,** Senior Distinguished Engineer, *GM Cruise, USA;* **Karam Noujeim,** Head of Radar and Sensor Fusion, *Intelligent Driving Group, Baidu USA*

ABSTRACT:

In 2004, the Defense Advanced Research Projects Agency (DARPA) held its first Grand Challenge with $1 million for grabs for any self-driving car that could travel a 150-mile route from California to Nevada. No self-driving car managed to finish the course. Fortunately, several teams succeeded in the subsequent 2005 second Grand Challenge, and a 2007 Urban Challenge. Since that event, almost all the traditional car companies as well as several startups in the field (nuTonomy, UBER, Zoox, and Waymo) have been working on deploying self-driving cars, with different levels of autonomy, in the market. Recent analysis, estimates that the self driving car market will be several trillion dollars by 2050, with the potential to revolutionize transportation.

A self-driving car needs advanced sensors (eyes) as well as a powerful computing unit (brain). Various sensor technologies have been suggested to provide "sight" for self-driving cars. The top candidates (in no particular order) are cameras, LiDAR, and radar, and their combinations. The performance, cost, and reliability ofvision systems have improved considerably thanks to the ubiquitous *USA*ge of sensors in consumer products, as well as the advanced vision algorithms being deployed. On the other hand, radar and LiDAR have not enjoyed as much reduction in cost, area, and power consumption due to their limited commercial *USA*ge. As such, the past few years has witnessed a plethora of startup companies, as well as some established companies, working on development of low-cost, high-performance, and reliable radars, LiDARs, and associated signal processing algorithms (brain) for the emerging self-driving car market.

This expert panel covers the state of the art in radar and LiDAR technologies, and attempts to draw contrasts between the two approaches in the context of self-driving cars. Among other things, the panelists will argue whether radar can deliver the necessary performance to eliminate the need for LiDAR, and whether LiDAR can become cheap and compact enough to remove the need for radar in self-driving cars. Radar and LiDAR enabling self-driving cars may very well be the next multi-billion dollar business opportunity for the RF and microwave communities.

Benjamin Franklin's first audience before King Louis XVI at Versailles to arrange the Treaty of Amity. Photo credit: "Franklin's First Audience before King Louis XVI, at Versailles. March 20, 1778." Color chromolitho-graph. Copyright 1903. Prints and Photographs Division, Library of Congress.

History

The French aid in military armaments, personnel, and loans during the United States revolutionary war proved to be critical to its success. France had been secretly aiding the American Colonies since 1776. During the Revolution, France sent an estimated 12,000 soldiers and 32,000 sailors to the American war effort, the most famous of whom was the Marquis of Lafayette.

The Continental Congress sent diplomat Benjamin Franklin to France to secure a formal alliance. When Franklin came to the signing ceremony, he wore, as a symbol, the same brown velvet suit he had worn when he appeared before Britain's Privy Council in 1774. At the time, he was accused of theft for having brought to light British documents that showed the British were purposefully repressing the Colonies.

The Radio Frequency Integrated Circuits (RFIC) conference, much like the French help to the United States, provides critical support to the IMS to address all segments of the RF, Microwave, and Millimeter-Wave devices, circuits, and systems.

RFIC Technical Sessions

13:30 – 15:10 | Monday, 11 June 2018 | Pennsylvania Convention Center

201A

RM03A: RF Front-Ends for Emerging Wireless Paradigms

Chair: Ramesh Harjani, *University of Minnesota*
Co-Chair: Leon van den Oever, *Qualcomm*

13:30 – 13:50

RM03A-1: Fully-Integrated Non-Magnetic 180nm SOI Circulator with >1W P1dB, >+50dBm IIP3 and High Isolation Across 1.85 VSWR

Aravind Nagulu, *Columbia University, USA;* Andrea Alù, *CUNY Advanced Science Research Center, USA;* Harish Krishnaswamy, *Columbia University, USA*

13:50 – 14:10

RM03A-2: Full Duplex Circulator-Receiver Phased Array Employing Self-Interference Cancellation via Beamforming

Mahmood Baraani Dastjerdi, *Columbia University, USA;* Negar Reiskarimian, *Columbia University, USA;* Tingjun Chen, *Columbia University, USA;* Gil Zussman, *Columbia University, USA;* Harish Krishnaswamy, *Columbia University, USA*

14:10 – 14:30

RM03A-3: Mixer-First MIMO Receiver with Multi-Port Impedance Tuning for Decoupling of Compact Antenna Systems

Charley Wilson III, *North Carolina State University, USA;* Jacob Dean, *North Carolina State University, USA;* Brian A. Floyd, *North Carolina State University, USA*

14:30 – 14:50

RM03A-4: An 8-Element, 1–3GHz Direct Space-to-Information Converter for Rapid, Compressive-Sampling Direction-of-Arrival Finding Utilizing Pseudo-Random Antenna-Weight Modulation

Matthew Bajor, *Columbia University, USA;* Tanbir Haque, *Columbia University, USA;* Guoxiang Han, *Columbia University, USA;* Ciyuan Zhang, *Columbia University, USA;* John Wright, *Columbia University, USA;* Peter R. Kinget, *Columbia University, USA*

14:50 – 15:10

RM03A-5: An FDD/FD Capable, Single Antenna RF Front End from 800MHz to 1.2GHz with Baseband Harmonic Predistortion

Hazal Yüksel, *Cornell University, USA;* Thomas Tapen, *Cornell University, USA;* Zachariah Boynton, *Cornell University, USA;* Emory Enroth, *Cornell University, USA;* Alyssa Apsel, *Cornell University, USA;* Alyosha C. Molnar, *Cornell University, USA*

201B

RM03B: Mixed Signal Transmitters and Power Amplifiers

Chair: Jeffrey Walling, *University of Utah*
Co-Chair: Debo Chowdhury, *Broadcom*

13:30 – 13:50

RM03B-1: A 1W Quadrature Class-G Switched-Capacitor Power Amplifier with Merged Cell Switching and Linearization Techniques

Si-Wook Yoo; *Michigan State University, USA*, Shih-Chang Hung; *Michigan State University, USA*, Sang-Min Yoo; *Michigan State University, USA*

13:50 – 14:10

RM03B-2: A 0.19mm² 128mW 0.8–1.2GHz 2-Beam 8-Element Digital Direct to RF Beamforming Transmitter in 40nm CMOS

Boyi Zheng, *University of Michigan, USA;* John Bell, *University of Michigan, USA;* Yan He, *University of Michigan, USA;* Lu Jie, *University of Michigan, USA;* Michael P. Flynn, *University of Michigan, USA*

14:10 – 14:30

RM03B-3: A Wide-Band Transmitter and Low-Noise PLL for a Highly Integrated 4T-4R-2F ZIF Transceiver in 28nm

P. Litmanen, *Qorvo, USA;* S. Akhtar, *Texas Instruments, USA;* S. Finocchiaro, *Texas Instruments, USA;* F. Dantoni, *Texas Instruments, USA*

14:30 – 14:50

RM03B-4: A 30-dBm Class-D Power Amplifier with On/Off Logic for an Integrated Tri-Phasing Transmitter in 28-nm CMOS

Mikko Martelius, *Aalto University, Finland*; Kari Stadius, *Aalto University, Finland*; Jerry Lemberg, *Aalto University, Finland*; Enrico Roverato, *Aalto University, Finland*; Tero Nieminen, *CoreHW, Finland*; Yury Antonov, *Aalto University, Finland*; Lauri Anttila, *Tampere University of Technology, Finland*; Mikko Valkama, *Tampere University of Technology, Finland*; Marko Kosunen, *Aalto University, Finland*; Jussi Ryynänen, *Aalto University, Finland*

204A

RM03C: cm/mm-Wave CMOS Integrated Phased-Array Building Blocks

Chair: Domine Leenaerts, *NXP Semiconductors*
Co-Chair: Osama Shana'a, *MediaTek*

13:30 – 13:50

RM03C-1: Ka-Band CMOS 360° Reflective-Type Phase Shifter with ±0.2dB Insertion Loss Variation Using Triple-Resonating Load and Dual-Voltage Control Techniques

Peng Gu, *Southeast University, China*; Dixian Zhao, *Southeast University, China*

13:50 – 14:10

RM03C-2: A 60GHz 360° Phase Shifter with 2.7° Phase Resolution and 1.4° RMS Phase Error in a 40-nm CMOS Technology

Bindi Wang, *Technische Universiteit Eindhoven, The Netherlands*, Hao Gao, *Technische Universiteit Eindhoven, The Netherlands*; M.K. Matters-Kammerer, *Technische Universiteit Eindhoven, The Netherlands*; Peter G.M. Baltus, *Technische Universiteit Eindhoven, The Netherlands*

14:10 – 14:30

RM03C-3: Low-Loss and Small-Size 28GHz CMOS SPDT Switches Using Switched Inductor

Wonho Lee, *KAIST, Korea;* Songcheol Hong, *KAIST, Korea*

14:30 – 14:50

RM03C-4: A Ka-Band CMOS Digital-Controlled Phase-Invariant Variable Gain Amplifier with 4-Bit Tuning Range and 0.5-dB Resolution

Yongran Yi, *Southeast University, China*; Dixian Zhao, *Southeast University, China*; Xiaohu You, *Southeast University, China*

14:50 – 15:10

RM03C-5: A 5-Bit, 0.25dB Step Variable Attenuator at E-Band

Tyler N. Ross, *Huawei Technologies, Canada*; Kimia T. Ansari, *Huawei Technologies, Canada*; Sam Tiller, *Huawei Technologies, Canada*; Morris Repeta, *Huawei Technologies, Canada*

RFIC Technical Sessions

15:40 – 17:20 | **Monday, 11 June 2018** | Pennsylvania Convention Center

201A

RM04A: Ultra-Low Power Radios for Security, Ranging and Connectivity

Chair: Gernot Hueber, *NXP Semiconductors*
Co-Chair: David Wentzloff, *University of Michigan*

15:40 - 16:00

RM04A-1: A Secure TOF-Based Transceiver with Low Latency and Sub-cm Ranging for Mobile Authentication Applications

Haixin Song, *Tsinghua University, China;* Zhendong Ding, *Tsinghua University, China;* Woogeun Rhee, *Tsinghua University, China;* Zhihua Wang, *Tsinghua University, China*

16:00 - 16:20

RM04A-2: A 264-µW 802.15.4a-Compliant IR-UWB Transmitter in 22nm FinFET for Wireless Sensor Network Application

Renzhi Liu, *Intel, USA;* Brent R. Carlton, *Intel, USA;* Stefano Pellerano, *Intel, USA;* Farhana Sheikh, *Intel, USA;* Divya Shree Vemparala, *Intel, USA;* Ahmed Ali, *University of Texas at Dallas, USA;* V. Srinivasa Somayazulu, *Intel, USA*

16:20 - 16:40

RM04A-3: A 486µW All-Digital Bluetooth Low Energy Transmitter with Ring Oscillator Based ADPLL for IoT Applications

Xing Chen, *University of Michigan, USA;* Jacob Breiholz, *University of Virginia, USA;* Farah Yahya, *University of Virginia, USA;* Christopher Lukas, *University of Virginia, USA;* Hun-Seok Kim, *University of Michigan, USA;* Benton Calhoun, *University of Virginia, USA;* David D. Wentzloff, *University of Michigan, USA*

16:40 - 17:00

RM04A-4: A 217µW -82dBm IEEE 802.11 Wi-Fi LP-WUR Using a 3rd-Harmonic Passive Mixer

Jaeho Im, *University of Michigan, USA;* Hun-Seok Kim, *University of Michigan, USA;* David D. Wentzloff, *University of Michigan, USA*

17:00 - 17:20

RM04A-5: Ultra-Fast Bit-Level Frequency-Hopping Transmitter for Securing Low-Power Wireless Devices

Rabia Tugce Yazicigil, *MIT, USA;* Phillip Nadeau, *Analog Devices, USA;* Daniel Richman, *D. E. Shaw Research, USA;* Chiraag Juvekar, *MIT, USA;* Kapil Vaidya, *IIT Bombay, India;* Anantha P. Chandrakasan, *MIT, USA*

201B

RM04B: Silicon Integrated mm-Wave Transmitters

Chair: Q. Jane Gu, *University of California, Davis*
Co-Chair: Mona Hella, *Rensselaer Polytechnic Institute*

RM04B-1: Q-Band CMOS Transmitter System-on-Chip for Protected Satellite Communication

T. LaRocca, *Northrop Grumman, USA*, K. Thai; *Northrop Grumman, USA;* R. Snyder, *Northrop Grumman, USA;* R. Jai, *Northrop Grumman, USA;* O. Fordham, *Northrop Grumman, USA;* N. Daftari, *Northrop Grumman, USA;* B. Wu, *Northrop Grumman, USA;* Y. Yang, *Northrop Grumman, USA;* M. Watanabe, *Northrop Grumman, USA*

RM04B-2: An E-Band QPSK Transmitter Element in 28-nm CMOS with Multistate Power Amplifier for Digitally-Modulated Phased Arrays

Nai-Chung Kuo, *University of California, Berkeley, USA;* Ali M. Niknejad, *University of California, Berkeley, USA;* Howard C. Luong, *HKUST, China*

RM04B-3: A Low EVM SiGe BiCMOS 40–100GHz Direct Conversion IQ Modulator for Multi-Gbps Communications Systems

Qian Ma, *University of California, San Diego, USA;* Hyunchul Chung, *University of California, San Diego, USA;* Gabriel M. Rebeiz, *University of California, San Diego, USA*

RM04B-4: A 120GHz I/Q Transmitter Front-End in a 40nm CMOS for Wireless Chip to Chip Communication

Chae Jun Lee, *KAIST, Korea;* Seung Hun Kim, *KAIST, Korea;* Hyuk Su Son, *KAIST, Korea;* Dong Min Kang, *KAIST, Korea;* Joon Hyung Kim, *KAIST, Korea;* Chul Woo Byeon, *KAIST, Korea;* Chul Soon Park, *KAIST, Korea*

RM04B-5: A 0.3-V 2.5-mW 154-to-195GHz CMOS Injection-Locked LO Generation with -186.5dB FoM

Xiaolong Liu, Howard C. Luong; *HKUST, China*

204A

RM04C: Highly Efficient mm-Wave Oscillators with Wide Tuning Range

Chair: Foster Dai, Auburn University
Co-Chair: Ruonan Han, MIT

RM04C-1: A -195dBc/Hz FoM$_T$ 20.8-to-28-GHz LC VCO with Transformer-Enhanced 30% Tuning Range in 65-nm CMOS

S. Lightbody, *University of British Columbia, Canada*; A.H.M. Shirazi, *University of British Columbia, Canada*; H. Djahanshahi, Microsemi, Canada; R. Zavari, Microsemi, Canada; S. Mirabbasi, *University of British Columbia, Canada*; S. Shekhar, *University of British Columbia, Canada*

RM04C-2: A 31.8–40.8GHz Continuously Wide-Tuning VCO Based on Class-B Oscillator Using Single Varactor and Inductor

Jayol Lee; *ETRI, Korea*, Dong-Woo Kang; *ETRI, Korea*, Youngseok Baek; *ETRI, Korea*, Bontae Koo; *ETRI, Korea*

RM04C-3: A Dual-Core 60GHz Push-Push VCO with Second Harmonic Extraction by Mode Separation

Vadim Issakov, *Infineon Technologies, Germany*; Fabio Padovan, *Infineon Technologies, Austria*

RM04C-4: A 200-GHz Sub-Harmonic Injection-Locked Oscillator with 0-dBm Output Power and 3.5% DC-to-RF-Efficiency

Songhui Li, *Technische Universität Dresden, Germany;* David Fritsche, *Technische Universität Dresden, Germany;* Corrado Carta, *Technische Universität Dresden, Germany;* Frank Ellinger, *Technische Universität Dresden, Germany*

RM04C-5: A 20.7–31.8GHz Dual-Mode Voltage Waveform-Shaping Oscillator with 195.8dBc/Hz FoM$_T$ in 28nm CMOS

Yiyang Shu, *UESTC, China*; Huizhen Jenny Qian, *UESTC, China*; Xun Luo, *UESTC, China*

RFIC Technical Sessions

08:00 – 09:40 | Tuesday, 12 June 2018 | Pennsylvania Convention Center

201A

RTU1A: mm-Wave Power Amplifiers

Chair: Margaret Szymanowski, *NXP Semiconductors*
Co-Chair: Gary Hau, *Qualcomm*

08:00 – 08:20

RTU1A-1: A Continuous-Mode 23.5–41GHz Hybrid Class-F/F-1 Power Amplifier with 46% Peak PAE for 5G Massive MIMO Applications

Tso-Wei Li, *Georgia Tech, USA;* Hua Wang, *Georgia Tech, USA*

08:20 – 08:40

RTU1A-2: A Compact 75GHz PA with 26.3% PAE and 24GHz Bandwidth in 22nm FinFET CMOS

Steven Callender, *Intel, USA;* Stefano Pellerano, *Intel, USA;* Christopher Hull, *Intel, USA*

08:40 – 09:00

RTU1A-3: A K-Band Power Amplifier with 26-dBm Output Power and 34% PAE with Novel Inductance-Based Neutralization in 90-nm CMOS

Wei-Cheng Huang, *National Taiwan University, Taiwan;* Jung-Lin Lin, *National Taiwan University, Taiwan;* Yu-Hsuan Lin, *National Taiwan University, Taiwan;* Huei Wang, *National Taiwan University, Taiwan*

09:00 – 09:20

RTU1A-4: A 14.8dBm 20.3dB Power Amplifier for D-Band Applications in 40nm CMOS

Dragan Simic, *Katholieke Universiteit Leuven, Belgium;* Patrick Reynaert, *Katholieke Universiteit Leuven, Belgium*

09:20 – 09:40

RTU1A-5: A 31GHz 2-Stage Reconfigurable Balanced Power Amplifier with 32.6dB Power Gain, 25.5% PAE_{max} and 17.9dBm P_{sat} in 28nm FD-SOI CMOS

Florent Torres, *STMicroelectronics, France;* Magali De Matos, *IMS (UMR 5218), France;* Andreia Cathelin, *STMicroelectronics, France;* Eric Kerhervé, *IMS (UMR 5218), France*

201B

RTU1B: Submillimeter Wave and Terahertz ICs

Chair: Hossein Hashemi, *University of Southern California*
Co-Chair: Vipul Jain, *Anokiwave*

08:00 – 08:20

RTU1B-1: A 410GHz OOK Transmitter in 28nm CMOS for Short Distance Chip-to-Chip Communications

Alexander Standaert, *Katholieke Universiteit Leuven, Belgium;* Patrick Reynaert, *Katholieke Universiteit Leuven, Belgium*

08:20 – 08:40

RTU1B-2: A 308–317GHz Source with 4.6mW Peak Radiated Power and On-Chip Frequency-Stabilization Feedback in 0.13µm BiCMOS

Chen Jiang, *University of Michigan, USA;* Mohammed Aseeri, *KACST, Saudi Arabia;* Andreia Cathelin, *STMicroelectronics, France;* Ehsan Afshari, *University of Michigan, USA*

08:40 – 09:00

RTU1B-3: A 280GHz +9dBm TRP Dense 2D Multi Port Radiator in 65nm CMOS

Nadav Buadana, *Tel Aviv University, Israel;* Samuel Jameson, *Tel Aviv University, Israel;* Eran Socher, *Tel Aviv University, Israel*

09:00 – 09:20

RTU1B-4: Heterodyne Sensing CMOS Array with High Density and Large Scale: A 240-GHz, 32-Unit Receiver Using a De-Centralized Architecture

Zhi Hu, *MIT, USA;* Cheng Wang, *MIT, USA;* Ruonan Han, *MIT, USA*

09:20 – 09:40

RTU1B-5: Proximal-Field Radiation Sensors for Millimeter-Wave Integrated Radiators

Amirreza Safaripour, *Caltech, USA;* Bahar Asghari, *Caltech, USA;* Ali Hajimiri, *Caltech, USA*

204A

RTU1C: mm-Wave Radar and Beamforming Transceivers

Chair: Vito Giannini, *Uhnder*
Co-Chair: Pierre Busson, *STMicroelectronics*

08:00 – 08:20

RTU1C-1: A 35GHz mm-Wave Pulse Radar with Pulse Width Modulated by SDM Realizing Sub-mm Resolution for 3D Imaging System

Shunli Ma, *Fudan University, China*; Jincheng Zhang, *Fudan University, China*; Tianxiang Wu, *Fudan University, China*; Junyan Ren, *Fudan University, China*

08:20 – 08:40

RTU1C-2: Monitoring Architecture for a 76–81GHz Radar Front End

Karthik Subburaj, Pankaj Gupta, Karthik Ramasubramanian, Dheeraj Shetty, Rohit Chatterjee, Shankar Ram Narayanamoorthy, Anjan Prasad Easwaran, Sriram Murali, Indu Prathapan, Sachin Bharadwaj, Sumeer Bhatara, Sai Gunaranjan, Sundarrajan Rangachari, *Texas Instruments, India;* Brian Ginsburg, Krishnanshu Dandu, Sreekiran Samala, Dan Breen, Tim Davis, Zahir Parkar, Zeshan Ahmad, Neeraj Nayak, Meysam Moallem, Eunyoung Seok, Karan Bhatia, Tom Altus, Vito Giannini, Venkatesh Srinivasan, *Texas Instruments, USA*

08:40 – 09:00

RTU1C-3: A 151-to-173GHz FMCW Transmitter Achieving 14dBm P_{sat} with Synchronized Injection-Locked Power Amplifiers and Five In-Phase Power Combining Doublers in 65nm CMOS

Shunli Ma, *Fudan University, China*; Tianxiang Wu, *Fudan University, China*; Jincheng Zhang, *Fudan University, China*; Junyan Ren, *Fudan University, China*

09:00 – 09:20

RTU1C-4: A True Time Delay-Based SiGe Bi-Directional T/R Chipset for Large-Scale Wideband Timed Array Antennas

Moon-Kyu Cho, *Georgia Tech, USA;* Ickhyun Song, *Georgia Tech, USA;* John D. Cressler, *Georgia Tech, USA*

09:20 – 09:40

RTU1C-5: A 57–71GHz Beamforming SiGe Transceiver for 802.11ad-Based Fixed Wireless Access

Erik Öjefors, *Sivers IMA, Sweden*; Mikael Andreasson, *Sivers IMA, Sweden*; Torgil Kjellberg, *Sivers IMA, Sweden*; Håkan Berg, *Sivers IMA, Sweden*; Lars Aspemyr, *Sivers IMA, Sweden*; Richard Nilsson, *Sivers IMA, Sweden*; Klas Brink, *Sivers IMA, Sweden*; Robin Dahlbäck, *Sivers IMA, Sweden*; Dapeng Wu, *Sivers IMA, Sweden*; Kristoffer Sjögren, *Sivers IMA, Sweden*; Mats Carlsson, *Sivers IMA, Sweden*

RFIC Technical Sessions

10:10 – 11:50 | **Tuesday, 12 June 2018** | Pennsylvania Convention Center

201A

RTU2A: mm-Wave LNAs and RF Receiver Front-Ends

Chair: Kamran Entesari, *Texas A&M University*
Co-Chair: Danilo Manstretta, *University of Pavia*

10:10 – 10:30

RTU2A-1: A 4.7mW W-Band LNA with 4.2dB NF and 12dB Gain Using Drain to Gate Feedback in 45nm CMOS RFSOI Technology

Li Gao, *University of California, San Diego, USA;* Qian Ma, *University of California, San Diego, USA;* Gabriel M. Rebeiz, *University of California, San Diego, USA*

10:30 – 10:50

RTU2A-2: A Compact 75GHz LNA with 20dB Gain and 4dB Noise Figure in 22nm FinFET CMOS Technology

Woorim Shin, *Intel, USA;* Steven Callender, *Intel, USA;* Stefano Pellerano, *Intel, USA;* Christopher Hull, *Intel, USA*

10:50 – 11:10

RTU2A-3: A 29–37GHz BiCMOS Low-Noise Amplifier with 28.5dB Peak Gain and 3.1–4.1dB NF

Zhe Chen, *Technische Universiteit Eindhoven, The Netherlands*; Hao Gao, *Technische Universiteit Eindhoven, The Netherlands*; Domine Leenaerts, *Technische Universiteit Eindhoven, The Netherlands*; DUSAn Milosevic, *Technische Universiteit Eindhoven, The Netherlands*; Peter G.M. Baltus, *Technische Universiteit Eindhoven, The Netherlands*

11:10 – 11:30

RTU2A-4: Circuit Techniques for Enhanced Channel Selectivity in Passive Mixer-First Receivers

Edward C. Szoka, *Cornell University, USA;* Alyosha C. Molnar, *Cornell University, USA*

11:30 – 11:50

RTU2A-5: A 750μW -88dBm-Sensitivity CMOS Sub-Harmonic Phase-Tracking Receiver

Bingwei Jiang, *HKUST, China*; Howard C. Luong, *HKUST, China*

201B

RTU2B: Wireless Transceivers and Transmitters for Connectivity and Cellular

Chair: Magnus Wiklund, *Qualcomm*
Co-Chair: Yuan-Hung Chung, *MediaTek*

10:10 – 10:30

RTU2B-1: A 28nm CMOS Wireless Connectivity Combo IC with a Reconfigurable 2×2 MIMO WiFi Supporting 80+80MHz 256-QAM, and BT 5.0

Chia-Hsin Wu, Chris Hunter, Jongdae Bae, Huijung Kim, Jisoo Chang, Inhyo Ryu, Seongwon Joo, Byeongwan Ha, Won Ko, Jounghyun Yim, Sangwook Han, Taewan Kim, Daeyoung Yoon, Inyoung Choi, Sangyun Lee, Qing Liu, Myounggyun Kim, Jiyoung Lee, Shinwoong Kim, Byunghak Cho, *Samsung, Korea;* Alexander Thoukydides, Michael Cowell, Jacob Sharpe, *Samsung Cambridge Solution Centre, UK;*

10:30 – 10:50

RTU2B-2: An Asymmetrical Parallel-Combined Cascode CMOS WiFi 5GHz 802.11ac RF Power Amplifier

Sergey Anderson, *DSP Group, Israel*; Nadav Snir, *DSP Group, Israel*

10:50 – 11:10

RTUB-3: A 0.62nJ/b Multi-Standard WiFi/BLE Wideband Digital Polar TX with Dynamic FM Correction and AM Alias Suppression for IoT Applications

Ao Ba, Johan van den Heuvel, Paul Mateman, Cui Zhou, Benjamin Busze, Minyoung Song, Yuming He, Ming Ding, Johan Dijkhuis, Evgenii Tiurin, Suryasarman Madampu, Pepijn Boer, Stefano Traferro, Yan Zhang, Yao-Hong Liu, Christian Bachmann, Kathleen Philips; *Holst Centre, The Netherlands*

11:10 – 11:30

RTU2B-4: A Wideband Transmitter for LTE-A HPUE Using CIM3 Cancellation

Yangjian Chen; *MediaTek, UK*; Arnaud Werquin; *MediaTek, UK*; Mohammed Hassan; *MediaTek, UK*; Christophe Beghein; *MediaTek, UK*; Bernard Tenbroek; *MediaTek, UK*; Jon Strange; *MediaTek, UK*; Chi-Tsan Chen; *MediaTek, Taiwan*; Tzung-Han Wu; *MediaTek, Taiwan*; Yen-Horng Chen; *MediaTek, Taiwan*; Chinq-Shiun Chiu; *MediaTek, Taiwan*

11:30 – 11:50

RTU2B-5: A 40nm 4-Downlink and 2-Uplink RF Transceiver Supporting LTE-Advanced Carrier Aggregation

Tzung-Han Wu, *MediaTek, Taiwan*; Yuan-Yu Fu, *MediaTek, Taiwan*; Sheng-Che Tseng, *MediaTek, Taiwan*; Ying-Tsang Lu, *MediaTek, Taiwan*; Yangjian Chen, *MediaTek, UK*; Chien-Shan Chiang, *MediaTek, Taiwan*; Zong-You Li, *MediaTek, Taiwan*; Bo-Yu Lin, *MediaTek, Taiwan*; Min-Hua Wu, *MediaTek, Taiwan*; Jui-Chih Kao, *MediaTek, Taiwan*; Tzu-Yu Yeh, *MediaTek, Taiwan*; Li-Shin Lai, *MediaTek, Taiwan*; Chao-Wei Wang, *MediaTek, Taiwan*; Chih-Hao Eric Sun, *MediaTek, Taiwan*; Yen-Horng Chen, *MediaTek, Taiwan*; Chinq-Shiun Chiu, *MediaTek, Taiwan*; Shih-Chieh Yen, *MediaTek, Taiwan*; Guang-Kaai Dehng, *MediaTek, Taiwan*; George Chien, MediaTek, Singapore; Bernard Tenbroek, *MediaTek, UK*

NOTES

RFIC Technical Sessions

13:30 – 15:10 | **Tuesday, 12 June 2018** | Pennsylvania Convention Center Exhibit Hall

RTUIF: Interactive Forum

Chair: Ranjit Gharpurey, University of Texas at Austin Co-Chair: Mohyee Mikhemar, Broadcom

RTUIF-1: Power Amplifier with Temperature Adaptive Biasing for Improved DEVM

Hamza Najjari, *IMS (UMR 5218), France;* Christophe Cordier, *NXP Semiconductors, France;* Stéphane David, *NXP Semiconductors, France;* Serge Bardy, *NXP Semiconductors, France;* Jean-Baptiste Begueret, *IMS (UMR 5218), France*

RTUIF-2: A 150µW -57.5dBm-Sensitivity Bluetooth Low-Energy Back-Channel Receiver with LO Frequency Hopping

Abdullah Alghaihab, *University of Michigan, USA;* Hun-Seok Kim, *University of Michigan, USA;* David D. Wentzloff, *University of Michigan, USA*

RTUIF-3: A 12.46µW Baseband Timing Circuitry for Synchronization and Duty-Cycling of Scalable Wireless Mesh Networks in IoT

Enkhbayasgalan Gantsog, *Cornell University, USA;* Ivan Bukreyev, *Cornell University, USA;* Frank Lane, MixComm, *USA;* Alyssa Apsel, *Cornell University, USA*

RTUIF-4: An Analog Wide-Bandwidth Baseband Chain for 12Gbps 256QAM Direct-Conversion Receiver

B. Jalali, *Acacia Communications, USA;* M. Moretto, *Nokia, Italy*; A. Singh, *Nokia Bell Labs, USA;* S. Shahramian, *Nokia Bell Labs, USA;* Y. Baeyens, *Nokia Bell Labs, USA*

RTUIF-5: A Blocker-Tolerant Double Noise-Cancelling Wideband Receiver Front-End Using Linearized Transconductor

Duksoo Kim, *Seoul National University*, Korea; Sangwook Nam, *Seoul National University*, Korea

RTUIF-6: A 10.56-GHz Broadband Transceiver with Integrated T/R Switching via Matching Network Re-Use in 28-nm CMOS Technology

Wei Zhu, *Tsinghua University, China;* Lei Zhang, *Tsinghua University, China;* Yan Wang, *Tsinghua University, China*

RTUIF-7: A Gradient Descent Bias Optimizer for Oscillator Phase Noise Reduction Demonstrated in 45nm and 32nm SOI CMOS

Mark Ferriss, *IBM T.J. Watson Research Center, USA;* Bodhisatwa Sadhu, *IBM T.J. Watson Research Center, USA;* Daniel Friedman, *IBM T.J. Watson Research Center, USA*

RTUIF-8: Truly Balanced K-Band Push-Push Frequency Doubler

Soenke Vehring, *Technische Universität Berlin, Germany*; Georg Boeck, *Technische Universität Berlin, Germany*

RTUIF-9: A Crosstalk-Immune Sub-THz All-Surface-Wave I/O Transceiver in 65-nm CMOS

Yuan Liang, *Nanyang Technological University*, Singapore; Chirn Chye Boon, *Nanyang Technological University*, Singapore; Hao Yu, *SUSTC, China*

RTUIF-10: 300GHz OOK Transmitter Integrated in Advanced Silicon Photonics Technology and Achieving 20Gb/s

E. Lacombe, *STMicroelectronics, France;* C. Belem-Goncalves, *STMicroelectronics, France;* C. Luxey, Polytech'Lab (EA 7498), *France;* F. Gianesello, *STMicroelectronics, France;* C. Durand, *STMicroelectronics, France;* D. Gloria, *STMicroelectronics, France;* G. Ducournau, *IEMN (UMR 8520), France*

RTUIF-11: A 2.56Gbps Asynchronous Serial Transceiver with Embedded 80Mbps Secondary Data Transmission Capability in 65nm CMOS

Xiaoran Wang, *Southern Methodist University, USA;* Tianwei Liu, *Southern Methodist University, USA;* Shita Guo, *Southern Methodist University, USA;* Mitchell A. Thornton, *Southern Methodist University, USA;* Ping Gui, *Southern Methodist University, USA*

Industry Showcase *(cont'd from page 56)*

CHAIR: Oren Eliezer, *PHAZR*

Q-Band CMOS Transmitter System-on-Chip for Protected Satellite Communication

T. LaRocca, *et al.*
Northrop Grumman, USA

RM04B-1 | 15:40

A 28nm CMOS Wireless Connectivity Combo IC with a Reconfigurable 2×2 MIMO WiFi Supporting 80+80MHz 256-QAM, and BT 5.0

Chia-Hsin Wu, *et al.*
Samsung, Korea, Samsung Cambridge Solution Centre, UK

RTU2B-1 | 10:10

A 57–71GHz Beamforming SiGe Transceiver for 802.11ad-Based Fixed Wireless Access

Erik Öjefors, *et al.*
Sivers IMA, Sweden

RTU1C-5 | 9:20

Student Paper Finalists *(cont'd from page 56)*

CHAIR: Brian Floyd, *NC State University*

A Flexible Low-Latency DC-to-4 Gbit/s Link Operating from -40 to +200°C in 28nm CMOS for Galvanically Isolated Applications

Simon Ooms, *et al.*
Katholieke Universiteit Leuven, Belgium

RM02C-4 | 11:10

An 8-Element, 1–3GHz Direct Space-to-Information Converter for Rapid, Compressive-Sampling Direction-of-Arrival Finding Utilizing Pseudo-Random Antenna-Weight Modulation

Matthew Bajor, *et al.*
Columbia University, USA

RM03A-4 | 14:30

Fully-Integrated Non-Magnetic 180nm SOI Circulator with >1W P1dB, >+50dBm IIP3 and High Isolation Across 1.85 VSWR

Aravind Nagulu, *et al.*
Columbia University, USA; CUNY Advanced Science Research Center, USA

RM03A-1 | 13:30

Automatic RF Techniques Group (ARFTG)

91st ARFTG Microwave Measurement Conference

08:00 – 17:00 | **Friday, 15 June 2018** | Loews Hotel, Philadelphia, PA

Welcome to 91st ARFTG Conference

08:00 – 08:10 **Dominique Schreurs,** *ARFTG President and General Chair*; **Andrej Rumiantsev,** *TPC Chair*

Session A – Characterization Challenges of Modulated Signal Metrics

Session Chair: **Andrej Rumiantsev**

KEYNOTE: The Toughest RF Measurements in 5G

08:10 – 08:50 Roger Nichols, *Keysight*

A-1 **Impact of Phase Calibration on EVM Measurement Quality**

08:50 – 09:10 Diogo Ribeiro, *Instituto de Telecomunicacoes;* Dylan Williams, *NIST;* Richard Chamberlin, *NIST;* Nuno Borges Carvalho, *Universidade de Aveiro*

In this paper, the calibrated measurement of wideband modulated signals by mixer-based large-signal network analyzers (LSNAs) will be evaluated, with a focus on the impact of the phase calibration in the measured error vector magnitude (EVM). The uncertainties of the EVMrms results will also be analyzed.

A-2 **Importance of Preserving Correlations in Error-Vector-Magnitude Uncertainty**

09:10 – 9:30 Benjamin F. Jamroz, *NIST;* Dylan F. Williams, *NIST;* Kate A. Remley, *NIST;* Robert D. Horansky, *NIST*

Correlations are an important consideration in the uncertainty analysis of high-frequency electronic systems. We introduce a method to scramble the correlations of a correlated uncertainty analysis and develop a software tool to do this as part of the NIST Microwave Uncertainty Framework. We then compare the results of a correlated uncertainty analysis and the scrambled analysis in estimating the uncertainty in Error-Vector-Magnitude of a modulated signal. This comparison shows that preserving correlations in uncertainties is critical to accurately assessing system performance and uncertainty.

A-3 **Optimizing the Signal-to-Noise and Distortion Ratio of a GaN LNA using Dynamic Bias**

09:30 – 09:50 Lowisa Hanning, *Chalmers University of Technology;* Johan Bremer, *Chalmers University of Technology;* Marie Ström, *Saab AB;* Niklas Billström, *Saab AB;* Thomas Eriksson, *Chalmers University of Technology;* Mattias Thorsell, *Chalmers University of Technology*

This paper shows how the signal-to-noise and distortion ratio (SNDR) for low noise amplifiers (LNA) can be derived from the commonly specified parameters noise figure, gain, third order output intercept point and 1 dB compression point. The parameters dependency of the biasing of the amplifier are also incorporated which enables the possibility to study how SNDR can be optimized for different operating conditions by dynamically change the gate- and drain voltage. An experimental verification shows that improvements in SNDR can be achieved by selecting gate and drain voltage of the LNA according to the level of the input signal power.

09:50 – 10:40 **Break – Exhibits and Interactive Forum**

Session B - Large-Signal Measurement of Wireless Infrastructure Building Blocks

Session Chair: **Peter Aaen**

B-1

Extracting Improved Figures of Merit for Characterizing Nonlinear Devices Using Multisine Excitation Signals

10:40 – 11:00

Evi Van Nechel, *Vrije Universiteit Brussel;* Yves Rolain, *Vrije Universiteit Brussel;* John Lataire, *Vrije Universiteit Brussel*

This paper proposes a technique for extracting multiple measurement-based figures of merit with a single measurement taken from 1 measurement setup. Separate estimates of the linear term, the noise term and the in-band and out-of-band nonlinear distortion allow to calculate the signal-to-noise and distortion ratio, noise power ratio, adjacent channel leakage power ratio, etc. Those are extracted in least squares sense for a class of modulated excitation signals resembling real communication signals like LTE. The proposed method allows to split the linear dynamics from the nonlinear distortion, resulting in improved measures that are closer to the actual definitions of these figures of merit. Experimental results validate the proposed technique.

B-2

A Fully Calibrated NVNA Set-up for Linearity Characterization of RF Power Devices using Unequally Spaced Multi-Tone Signal Through IM3 & IM5 Measurements

11:00 – 11:20

Vincent Gillet, *XLIM;* Jean-Pierre Teyssier, *Keysight Technologies;* Michel Prigent, *XLIM;* Raymond Quéré, *XLIM*

This paper presents an innovative experimental method and its associated test bench for assessing the in-band linearity degradation of radiofrequency and microwave power devices, suitable both for on-wafer and connectorized characterization. The Unequally Spaced Multi-Tone (USMT) signal is a tailored signal which presents flexible characteristics depending on the number of pilot tones (e.g. Peak to average radio, IQ enveloppe, and Radiofrequency bandwidth). It behaves like a complex modulation signal with particularity to have a complete separation of pilot tones, IM3 and IM5 and it was used for linearity measurements. The method has been used up to 28 MHz RF Bandwidth on a VNA with the spectrum option (PNA-L from Keysight Technologies). In only one acquisition, simultaneous criteria are evaluated, like output power, gain, Power Added Efficiency (PAE), in-band degradation such as Carrier to Intermodulation ratio (C/I) induced by the device, by measuring the USMT signal.

B-3

A Robust and Reliable Behavioral Model of High Power GaN HEMTS for RF Doherty Amplifier Application

11:20 – 11:40

Lotfi Ayari, *AMCAD ENGINEERING;* Alain Xiong, *AMCAD ENGINEERING;* Christophe Maziere, *AMCAD ENGINEERING;* Zacharia Ouardirhi, *AMCAD ENGINEERING;* Tony Gasseling, *AMCAD ENGINEERING*

The aim of this work is to improve the black-box transistor's model behavior when used for Doherty Power Amplifier (DPA) designs. A methodology is proposed to reinforce the model's robustness when the transistor sees a dynamic load impedance modulation. In comparison with previous works, this modeling approach uses a specific load impedance pattern needed for the model extraction. In addition, the choice of the nonlinear descrip-tion order is optimized to reinforce the model convergence capa-bilities. A 10 W GaN Packaged Transistor operating in AB and C classes has been measured with a Nonlinear Vector Network Analyzer (NVNA) based Load Pull setup. These measurements have been used to extract seamlessly the models. Finally, different DPA architectures have been simulated in order to prove the model validity, reliability and robustness.

B-4

Wideband Test Bench Dedicated to Behavioral Modeling of Non Linear RF Blocks with Frequency Transposition and Memory

11:400 – 12:00

Christophe Maziere, *AMCAD ENGINEERING;* Wissam Waabe, *AMCAD ENGINEERING;* Zacharia Ouardirhi, *AMCAD ENGINEERING;* Tony Gasseling, *AMCAD ENGINEERING*

This paper presents a measurement scenario for the behavioral modeling of RF blocks exhibit memory effects, mismatch and frequency transposition. The measurement principle is based on the use of a regular VNA setup and is applied here for the characterization and modeling of a Down-converter chain. The validation process of such a methodology is carried out with an experimental set-up based on transceiver architecture. It has been experimentally demonstrated that this measurement principle allows accurate model identification by performing a simple set of measurements. Extracted model proves the ability to provide a good prediction for complex communication signals.

12:00 – 01:30

Awards Luncheon

Session C - It's All About Calibration and Measurements for 5G

Session Chair: **Jon Martens**

C-1

Electro-Optic Near Field Imaging of High-Power RF/Microwave Transistors in Plastic Packages

13:30 – 13:50 PM

Jonas Urbonas, *University of Surrey;* Frederik Vanaverbeke, *NXP Semiconductors;* Kevin Kim, *NXP Semiconductors;* Peter H. Aaen1, *University of Surrey*

In this paper, through-plastic vector E-field measurements of an LDMOS transistor in an over-molded plastic package are presented. The measurement system uses a commercially-available electro-optic system connected to an NVNA with a comb generator to non-invasively measure the phase-coherent multi-harmonic E-fields. The device is measured in a load-pull measurement system, which is used to present optimal source and load impedances to the transistor during the multi-harmonic E-field measurements. All three E-field components are measured at the fundamental (2.2 GHz) and two harmonics at P1dB = 53.2 dBm.

C-2

Wideband Dynamic Drain Current Measurements with a Galvanically Isolated Probe Targeting Supply-Modulated RF Power Amplifiers for 5G Infrastructure

13:50 – 14:10

Nikolai Wolff, *Ferdinand-Braun-Institut, Leibniz-Institut für Höchstfrequenztechnik;* Thomas Hoffmann, *Ferdinand-Braun-Institut, Leibniz-Institut für Höchstfrequenztechnik;* Wolfgang Heinrich, *Ferdinand-Braun-Institut; Olof Bengtsson, Ferdinand-Braun-Institut, Leibniz-Institut für Höchstfrequenztechnik*

Supply modulation of RF power amplifiers (PA) is a powerful efficiency enhancement technique. For optimization of the RF PA and the supply modulator the dynamic low frequency drain current is of high interest but measurements are difficult due to the large voltage variations at the PA drain bias supply ter-invasive technique is preferred to the use of bulky directional couplers. A Sensor based on a shunt resistor is a favorable choice, but complicated by the extremely large common-mode voltage. In this paper a measurement technique based on reflection measurements of an active reflector element using an interferometer based on a Doppler radar is investigated. The system allows for very wideband current measurements with high common-mode rejection and low parasitic loading of the shunt resistor. Thereby, the method has the potential to meet the requirements for the extreme wide bandwidth signals used in the future telecommunication infrastructure for 5G.

C-3

Efficient Linearization of a RF Transmitter under 5G Waveforms Through Iterated Ridge Regression

14:10 – 14:30

Juan Becerra, *University of Seville;* Abraham Pérez-Hernández, *University of Seville;* María J. Madero-Ayora, *University of Seville;* Carlos Crespo-Cadenas, *University of Seville*

This work presents a novel method for the digital predistortion of power amplifiers (PAs) based on sparse behavioral models. The iterated Ridge regression is adapted to work in the Volterra series framework. Experiments driven on a test bench based on a GaN PA driven by a 15-MHz filter bank multicarrier (FBMC) signal were conducted in order to validate the algorithm. Experimental results in a digital predistortion scenario and the comparison with the orthogonal matching pursuit highlight the enhancement of this pruning method.

C-4

A New Calibration Method for Achieving High Insertion-Loss Measurements with a Vector Network Analyzer

14:30 – 14:50

Jeff Jargon, *NIST;* Dylan Williams, *NIST*

We present a new calibration method for achieving high insertion-loss measurements with a vector network analyzer (VNA). The method requires a characterized attenuator and other additional hardware, including an amplifier, an isolator, two directional couplers, and two attenuators. With this setup, we measure wave-parameters rather than scattering-parameters. This technique enables us to shift the dynamic range of our measurements while decreasing uncertainties due to the noise floor of the VNA. With hardware available in our laboratory, we can measure values of insertion-loss up to 150 dB.

14:50 – 15:40

Break – Exhibits and Interactive Forum

Session D – But don't miss mm-Waves and Beyond

Session Chair: **Leonard Hayden**

D-1

Experimental Study on Crosstalk Reduction between Integrated Inductors Up To Millimeter-Wave Regime

15:40 – 16:00 PM

Vadim Issakov, *Infineon Technologies AG;* Andreas Werthof, *Infineon Technologies AG;* Johanens Rimmelspacher, *University of Erlangen-Nuremberg;* Robert Weigel, *University of Erlangen-Nuremberg;* Angelika Geiselbrechtinger, *Infineon Technologies AG*

Amount of inductors in SoCs is increasing with the growing complexity of the chips. Driven on one hand by integration of 5G transceivers, yet on the other hand by chip area reduction, inductors need to be placed densely. This causes interferences coupled via inductors. This paper presents an experimental study on coupling between on-chip inductors and investigation of various crosstalk reduction techniques for highly integrated SoCs up to mm-wave frequencies. We compare different orientations of 8-shaped inductors and discuss a rotated version of the 8-shape coil, which provides an additional improvement of 10 dB over the entire frequency range. Two-port measurements of coupled inductors connected single-endedly are performed up to 145 GHz. Additionally, 4-port measurements are done up to 70 GHz. We propose analyzing the crosstalk mechanisms by converting the measured S-parameters into the mixed-mode representation. Test structures were realized in 28 nm bulk CMOS technology node.

D-2

MM-wave Partial Information De-embedding: Errors and Sensitivities

16:00 – 16:20 PM

Jon Martens, *Anritsu*

De-embedding methods making significant structural assumptions have become popular in recent years, particularly in PC board and cable assembly spaces, because of the relative immunity to repeatability and standards availability problems at the DUT plane. Some of the same issues occur in mm-wave fixtures where repeatability can be even more of a challenge. The intrinsic errors, repeatability behavior and configuration sensitivities of one such method, based on phase localization of structures in the fixture using reflection data alone, are studied in this work with examples in the WR-10 and WR-2.2 bands. For some classes of fixtures, the repeatability immunity and standards sensitivity can be orders of magnitude better than with classical methods while showing similar sensitivities to first tier calibration issues. The absolute errors can, however, be substantial for certain distributions of mismatch within the fixture.

D-3

On the Impact of Radiation Losses in TRL Calibrations

16:20 – 16:40 PM

Marco Spirito, *Delft University of Technology;* Carmine De Martino, *Delft University of Technology;* Luca Galatro, *Delft University of Technology*

In this contribution we analyze the impact of radiation losses due to multimode propagations in (single medium) calibration substrates. The impact of the complex modelling of the loss mechanism due to radiation mode is applied to the specific case of TRL on-wafer calibrations for mm-wave operation. A quantitative analysis based on 3D EM simulation is performed to provide guidelines on the material to be used as the calibration substrate, the backside conditions, and the accuracy that can then be expected.

D-4

Direct mm-Wave On-Wafer Power Calibration Employing CMOS as a Transfer Device

16:40 – 17:00

Carmine De Martino, *Delft University of Technology;* Eduard Malotaux, *Delft University of Technology;* Luca Galatro, *Delft University of Technology;* Marco Spirito, *Delft University of Technology*

In this paper we present a measurement procedure and required hardware to realize absolute power calibration in on-wafer VNA-based mm-wave setups, without requiring disconnection. The approach uses a 28nm CMOS n-channel MOSFET as the power calibration transfer device, providing sufficient responsivity up to 325GHz. The square law conversion from mm-wave to DC output of the CMOS device is employed to achieve a direct on-wafer calibration. The use of the calibration transfer device allows for a zero-movement calibration procedure of a mm-wave measurement setup thereby reducing errors originating from cable movements, while also reducing the required time in comparison to the standard, calorimeter based, approaches. The proposed calibration method is benchmarked against the procedure using instrumentation power meters in WR3 showing that using the calibration transfer device become possible to have decent calibration performance but with significantly less effort and time.

Session P - Interactive Forum | 09:50 – 15:40

P-1 **Accuracy Improvement of On-wafer Measurement at Millimeter-wave Frequency by a Full-automatic RF Probe-Tip Alignment Technique**

Ryo Sakamaki, *National institute of Advanced Industrial Science and Technology*; Masahiro Horibe, *AIST*

P-2 **Determination of the Line Characteristic Impedance Using Calibration Comparison**

Manuel Pulido-Gaytán, *CICESE;* J. Apolinar Reynoso-Hernandez, *CICESE;* Andres Zárate-de Landa, *CICESE;* José Raul Loo-Yau, *Centro de Investigación y de Estudios Avanzados del I.P.N (CINVESTAV);* María del Carmen Maya-Sanchez, *Centro de Investigación Científica y de Educación Superior de Ensenada (CICESE)*

P-3 **On the Importance of Calibration Standards Definitions for On-Wafer Measurements up to 110 GHz**

Thorsten Probst, *Physikalisch-Technische Bundesanstalt (PTB);* Sherko Zinal, *PTB;* Ralf Doerner, *Ferdinand-Braun-Institut (FBH);* Uwe Arz, *Physikalisch-Technische Bundesanstalt (PTB)*

P-4 **Improving Wafer-Level Calibration Consistency with TMRR Calibration Method**

Andrej Rumiantsev, *MPI Corporation;* Tony Fu, *MPI Corporation;* Ralf Doerner, *Ferdinand-Braun-Institut (FBH)*

P-5 **15-Term Self-Calibration without an Ideal THRU- or LINE-Standard**

Sebastian Wagner, *Hochschule Augsburg - University of Applied Sciences*; Reinhard Stolle, *Hochschule Augsburg - University of Applied Sciences*

P-6 **Moisture Effect on the Characteristics of Cellulosic Material Made RF Lines.**

Cyril Guers, *Université de Savoie & Université Grenoble Alpes;* F. Garet, *Université de Savoie,* P. Xavier, *Université Grenoble Alpes;* P. Huber, *Centre Technique du Papier;* G. Depres, *Arjowiggins Rives;* P. Artillan, *Université de Savoie;* T.P. Vuong, *Université Grenoble Alpes*

P-7 **Permeability Measurements of Thin Sheet Materials and Uncertainty Analysis**

JeongHwan Kim, *KRISS*

P-8 **Frequency Dependence Measurement Technique of the Interface Conductivity using a Dielectric Rod Resonator Sandwiched Between Copper-Clad Dielectric Substrates**

Takashi Shimizu, Utsunomiya University; *YUSA*ku Hirano, Utsunomiya University; Yoshinori Kogami, Utsunomiya University

P-9 **Material Parameters Extraction of Printed Circuits and Semiconductor Substrates Using Wideband Reflection Measurements**

Aleksandr A. Savin, *Tomsk State University of Control Systems and Radio Electronics;* Vladimir G. Guba, *Copper Mountain Technologies;* Aleksandr A. Ladur, *NPK TAIR;* Olesia N. Bykova, *NPK TAIR;* Eugeny A. Shutov, *Tomsk State University of Control Systems and Radio Electronics;* Feodor I. Sheyerman, *Tomsk State University of Control Systems and Radio Electronics;* Brian Walker, *Copper Mountain Technologies*

P-10 **Active Antenna Array Characterization for Massive MIMO 5G Scenarios**

Marina Jordao, Instituto de Telecomunicacoes; Daniel Belo, Instituto de Telecomunicacoes; Nuno Borges Carvalho, Instituto de Telecomunicacoes

P-11 **Digitally Assisted Wideband Compensation of Parallel RF Signal Paths in a Transmitter**

Prasidh Ramabadran, *National University of Ireland, Maynooth; Sidath Madhuwantha, National University of Ireland, Maynooth;* Pavel Afanasyev, *National University of Ireland, Maynooth; Ronan Farrell, National University of Ireland, Maynooth;* Lazaro Marco, *Ampleon;* John Dooley, *National University of Ireland, Maynooth*

P-12 **Swept-Frequency Square-Wave Generation for Phase-Reference in Mixer-Based Instruments**

Diogo Ribeiro, *Instituto de Telecomunicacoes;* Nuno Borges Carvalho, *Instituto de Telecomunicacoes*

P-13 **Quantitative Measurement in Scanning Microwave Microscopy**

Masahiro Horibe, *AIST*; Seitaro Kon, *AIST;* Iku Hirano, *AIST*

P-14 **Low-Cost, Wideband Multiport Reflectometer in Single-Layer Structure for Accurate High VSWR Measurement**

Florian Dietrich, RWTH Aachen University; Muh-Dey Wei, RWTH Aachen University; Renato Negra, RWTH Aachen University

P-15 **On the Effective Modeling of the Test-Set Non-linearity**

Thoalfukar Husseini, *Cardiff University;* Syed M. H. Syed Anera, *Cardiff University;* Azam Al-rawachy, *Cardiff University;* James Bell, *Cardiff University;* Paul J Tasker, *Cardiff University;* Johannes Benedikt, *Cardiff University*

P-16 **UV Thermal Imaging of RF GaN Devices with GaN Resistor Validation**

Dustin Kendig, *Microsanj;* Georges Pavlidis, *Georgia Institute of Technology;* Samuel Graham, *Georgia Institute of Technology;* Justin Reiter, *Analog Devices;* Michael Gurr, *Raytheon Corporation;* David Altman, *Raytheon Corporation;* Stephen Huerster, *Raytheon Corporation;* Ali Shakouri, *Purdue University*

Closing Notes. End of ARFTG-91st Conference

IEEE

www.arftg.org

MTT-S

IMBioC Opening Session

15:30 – 17:30 | **Thursday, 14 June 2018** | Pennsylvania Convention Center, Grand Ballroom

"Renal Denervation for Uncontrolled Hypertension: Complexity After Symplicity"

Dr. Nicholas J. Ruggiero II, MD, Thomas Jefferson University

ABSTRACT:

Renal denervation for uncontrolled hypertension demonstrated in many early trials to be extremely successful. These trials accounted for widespread implementation of the procedure in Europe and a change in the ESC management guidelines. The large, randomized, pivotal US trial, Symplicity HTN 3, unfortunately showed no benefit in comparison to optimal medical therapy. These results bridaled enthusiasm for this technology and accounted for many companies to desert the premise altogether. Fortunately, those who believe in the procedure are pressing forward and multiple new trials which are currently enrolling will ultimately determine the future of renal denervation. In the lecture, he will discuss the mechanism of action of renal denervation and early trial data for the Symplicity HTN 3. He will also give insight for new studies and data as well as alternative options besides RF ablation.

IMBioC Opening Reception

17:30–18:30 | Pennsylvania Convention Center, Grand Hall

A one-hour opening reception will be held in the Grand Hall of the Pennsylvania Convention Center, in parallel to the IMS Closing Reception. Attendees will have an opportunity to network.

IMBioC Plenary Session

10:00 – 10:40 | **Friday, 15 June 2018** | 201A

"Is There a Fundamental Law of Health and Disease?"

Dr. Chung-Kang Peng, *Beth Israel Deaconess Medical Center/ Harvard Medical School (BIDMC/HMS)*

ABSTRACT:

In recent years, technologies enable us to collect overwhelming amount of signals about our patients. As a result, it becomes possible to quantify health and disease of human body from an integrative system viewpoint. However, conventional biomedical research tools that have been developed with reductionist theory may not be appropriate, mainly because these tools typically focus on individual components of the whole system, while ignoring important nonlinear interactions among different components of the system. In this talk, I will discuss a general framework to study physiologic dynamics. With this framework, we can derive useful measures that best reflect the emergent properties of the integrative systems, and to identify system-level properties that are critical to our understanding of a healthy system and its pathological perturbations. This new approach has a wide range of biomedical applications that will also be discussed in this talk.

IMBioC Technical Sessions

08:00 – 09:30 | Friday, 15 June 2018 | Pennsylvania Convention Center

201A

FR1A: Transistor-Level Biosensor Techniques

Chair: Christian Damm, *Universität Ulm and Simon Hemour, IMS (UMR 5218)*

FR1A-1: (Invited) Integrated Millimeter-Wave and THz Analyzer Platforms for Miniature Biosensors

Dietmar Kissinger, *IHP, Germany*

FR1A-2: A Compact Energy Efficient CMOS Permittivity Sensor Based on Multiharmonic Downconversion and Tunable Impedance Bridge

G. Vlachogiannakis, Z. Hu, H. Thippur Shivamurthy, A. Neto, M.A.P. Pertijs, L.C.N. de Vreede, M. Spirito, *Technische Universiteit Delft, The Netherlands*

FR1A-3: Homodyne and Heterodyne Terahertz Dielectric Sensors: Prototyping and Comparison in BiCMOS Technology for Lab-on-Chip Applications

Defu Wang, *IHP, Germany*; Klaus Schmalz, *IHP, Germany*; Mohamed Hussein Eissa, *IHP, Germany*; Johannes Borngräber, *IHP, Germany*; Maciej Kucharski, *IHP, Germany*; Mohamed Elkhouly, *Robert Bosch, Germany;* Minsu Ko, *IHP, Germany*; Yong Wang, *IHP, Germany*; H.J. Ng, *IHP, Germany*; Jongwon Yun, *IHP, Germany*; Bernd Tillack, *IHP, Germany*; Dietmar Kissinger, *IHP, Germany*

FR1A-4: Towards High-Transconductance Graphene High-Speed Biosensors

W. Wei, *IEMN (UMR 8520), France;* S. Mhedbhi, *IEMN (UMR 8520), France;* P. Tilmant, *IEMN (UMR 8520), France;* H. Happy, *IEMN (UMR 8520), France;* E. Pallecchi, *IEMN (UMR 8520), France*

201B

FR1B: Neuroimplants and Miniaturized Devices

Chair: Ifana Mahbub, *University of North Texas and Yong Xin Guo, National University of Singapore*

FR1B-1: (Invited) Multiscale Modeling and Electroneural Interfaces for Neuroimplants: from a Retinal Prosthesis to Restore Vision to the Blind to a Hippocampus Implant for Memory Restoration

Gianluca Lazzi, *University of Southern California, USA*

FR1B-2: A Ka-Band Beamformer for Wireless Power Transfer to Body Area Networks

Nicholas D. Saiz, *Stanford University, USA;* Gabriel Buckmaster, *Stanford University, USA;* Thomas H. Lee, Stanford University, *USA*

FR1B-3: NEMS Magnetoelectric Antennas for Biomedical Application

Hwaider Lin, *Northeastern University, USA;* Mohsen Zaeimbashi, *Northeastern University, USA;* Neville Sun, *Northeastern University, USA;* Xianfeng Liang, *Northeastern University, USA;* Huaihao Chen, *Northeastern University, USA;* Cunzheng Dong, *Northeastern University, USA;* Alexei Matyushov, *Northeastern University, USA;* Xinjun Wang, *Northeastern University, USA;* Yingxue Guo, *Northeastern University, USA;* Yuan Gao, *Northeastern University, USA;* Nian X. Sun, *Northeastern University, USA*

FR1B-4: UHF RFID Sensor Tag Antenna Concept for Stable and Distance Independent Remote Monitoring

Lukas Görtschacher, *Technische Universität Graz, Austria*; Wolfgang Bösch, *Technische Universität Graz, Austria*; Jasmin Grosinger, *Technische Universität Graz, Austria*

201C

FR1C: Bio-Tissue and Cell Modelling

Chair: James Hwang, *Lehigh University and Pai-Yen Chen, Wayne State University*

FR1C-1: (Invited) Shared Knowledge, Gaps and Challenges of Microdosimetry: Realistic Models of Cells and Endoplasmic Reticulum

A. Denzi, *Università di Roma La Sapienza, Italy;* C. Merla, *ENEA, Italy*; F.M. Andre, *VAT (UMR 8203), France;* T. Garcia-Sanchez, *VAT (UMR 8203), France;* L.M. Mir, *VAT (UMR 8203), France;* F. Apollonio, *Università di Roma La Sapienza, Italy;* M. Liberti, *Università di Roma La Sapienza, Italy*

FR1C-2: Development of a Tissue Dielectric Properties Model Based on Maxwell-Fricke Mixture Theory

Sevde Etoz, *University of Wisconsin-Madison, USA;* William Greisch, *University of Wisconsin-Madison, USA;* Christopher L. Brace, *University of Wisconsin-Madison, USA*

FR1C-3: Reproducibility Evaluation of Composite Dielectric Materials Based on an Error Propagation Model

Birk Hattenhorst, *Ruhr-Universität Bochum, Germany*; Christoph Baer, *Ruhr-Universität Bochum, Germany*; Thomas Musch, *Ruhr-Universität Bochum, Germany*

FR1C-4: Molecular Dynamics Simulations in Service of Microwave Dielectric Analysis of Biomolecules

M. Cifra, *Czech Academy of Sciences, Czech Republic*; J. Pr__a, *Czech Academy of Sciences, Czech Republic*; D. Havelka, *Czech Academy of Sciences, Czech Republic*; O. Krivosudsk_, *Czech Academy of Sciences, Czech Republic*

08:00 – 08:30

08:30 – 08:50

08:50 – 09:10

09:10 – 09:30

IMBioC Interactive Forum

09:30 – 10:00 & 15:10 – 15:40 | **Friday, 15 June 2018** | Pennsylvania Convention Center, Room 204B

FRIF1: Interactive Forum

Chair: Hung Cao, University of Washington

FRIF1-1: Accuracy Enhancement of Doppler Radar-Based Heartbeat Rate Detection Using Chest-Wall Acceleration

Mehrdad Nosrati, *Stevens Institute of Technology, USA;* Negar Tavassolian, *Stevens Institute of Technology, USA*

FRIF1-2: A Novel Millimeter Wave Radar Sensor for Medical Signal Detection

Salam Benchikh, *INRS-EMT, Canada*; Homa Arab, *INRS-EMT, Canada*; Serioja Ovidiu Tatu, *INRS-EMT, Canada*

FRIF1-3: Robust Radar-Based Human Motion Recognition with L1-Norm Linear Discriminant Analysis

Panos P. Markopoulos, *Rochester Institute of Technology, USA;* Fauzia Ahmad, *Temple University, USA*

FRIF1-4: A Novel Miniature Tissue Resection Device with Moveable Jaws that Combines 400KHz and 5.8GHz Energy for Cutting and Coagulation

Louis A. Turner, *Bangor University, UK*; Patrick Burn, *Bangor University, UK*; James E. Coad, *West Virginia University School of Medicine, USA;* Chris Hancock, *Bangor University, UK*

FRIF1-5: Feasibility Study of Applying Ferromagnetic Contrast Agents in Thermoacoustic Imaging

Dajun Zhang, *ShanghaiTech University, China*; Xiong Wang, *ShanghaiTech University, China*

FRIF1-6: Total Variation Constrained Sparse Image Reconstruction of Multiple Stationary Human Targets Behind Walls

Qiang An, *Fourth Military Medical University, China*; Jianqi Wang, *Fourth Military Medical University, China*; *Ahmad Hoorfar, Villanova University, USA*

FRIF1-7: Acoustic Transmission of Biomedical Data via the Intercommunication System of an MRI

Viktoria Kalpen, *Universität Innsbruck, Austria;* Fabian Eichin, *Universität Innsbruck, Austria;* Thomas Ussmueller, *Universität Innsbruck, Austria*

FRIF1-8: Real-Time Evaluation of Heart Rate and Heart Rate Variability Using Microwave Reflectometry

Atsushi Mase, *Kyushu University, Japan;* Yuichiro Kogi, *Fukuoka Institute of Technology, Japan*; Toru Maruyama, *Kyushu University, Japan*

FRIF1-9: Miniaturized Wireless Power Transfer Module Design for Brain Optoelectronic Implant

D.K. Biswas, *University of North Texas, USA;* N.T. Tasneem, *University of North Texas, USA;* J. Hyde, *University of North Texas, USA;* M. Sinclair, *University of North Texas, USA;* I. Mahbub, *University of North Texas, USA*

FRIF1-10: Improving the Efficiency of Magnetic Induction-Based Wireless Body Area Network (WBAN)

Negar Golestani, *University of Southern California, USA;* Mahta Moghaddam, *University of Southern California, USA*

FRIF1-11: Numerical Evaluation of Sensitivity of Microwave Metamaterial and Microstrip TL Sensors to Blood Glucose Concentration

Jan Vrba, *ELEDIA@CTU, Czech Republic*; David Vrba, *ELEDIA@CTU, Czech Republic*; Luis Díaz, *ELEDIA@CTU, Czech Republic*; Ondrej Fiser, ELEDIA@CTU, Czech Republic

RIF1-12: Inductive Ear-to-Ear Communication Systems: Coupling Enhancement by Means of Constructional Coil Features

Jan-Christoph Edelmann, *Universität Innsbruck, Austria;* S. Bergmueller, *Universität Innsbruck, Austria;* D. Mair, *Universität Innsbruck, Austria;* Gilbert Prokop, *Universität Innsbruck, Austria;* Thomas Ussmueller, *Universität Innsbruck, Austria*

FFRIF1-13: X-Band Microwave Radiation Induced Biological Effects in Rats Skin: Plausible Role of Heat Shock Proteins

Saurabh Verma, *DRDO, India*; Gaurav K. Keshri, *DRDO, India*; Manish Sharma, *DRDO, India*; Kumar V. Mani, *DRDO, India*; Santanu Karmakar, *DRDO, India*; Satish Chauhan, *DRDO, India*; Asheesh Gupta, *DRDO, India*

FRIF1-14: Characterization of Microwave Dicke Radiometer for Non-Invasive Tissue Thermometry

Sathya Priya Sugumar, *IIT Madras, India*; C.V. Krishnamurthy, *IIT Madras, India*; Kavitha Arunachalam, *IIT Madras, India*

FRIF1-15: A Highly Sensitive RF Biosensor Based on Splitter/Combiner Configuration for Single-Cell Characterization

Abdulrahman Alghamdi, *Purdue University, USA;* Saeed Mohammadi, *Purdue University, USA*

FRIF1-16: Predicting Nonthermal Electroporation of Intervertebral Disc Tissue

Steven Schwartz, *Rowan University, USA;* Gary L. Thompson, *Rowan University, USA*

FRIF1-17: Simulation of Electroporation in Cell Using Bipolar AC Pulse

Hao Qiu, *Fort Valley State University, USA;* Xianping Wang, *Southeast Missouri State University, USA;* Wenbing Zhao, *Cleveland State University, USA*

FRIF1-18: Correlation Between Dielectric Properties and Women Age for Breast Cancer Detection at 30GHz

S. Di Meo, G. Matrone, P.F. Espin-Lopez, A. Martellosio, M. Pasian, M. Bozzi, L. Perregrini, A. Mazzanti, *Italy*; F. Svelto, *Università di Pavia, Italy*; P.E. Summers, *Istituto Europeo di Oncologia, Italy*; G. Renne, *Istituto Europeo di Oncologia, Italy*; L. Preda, *Università di Pavia, Italy* M. Bellomi, *Istituto Europeo di Oncologia, Italy*

FRIF1-19: Preliminary Measurements of Magnetic Nanoparticles as Potential Biomarkers for Impedance Flow Cytometry

Pawe_ Barmuta, *Katholieke Universiteit Leuven, Belgium*; Izabela Kami_ska, *Polish Academy of Sciences, Poland*; Juncheng Bao, *Katholieke Universiteit Leuven, Belgium*; Tomislav Markovi_, *Katholieke Universiteit Leuven, Belgium*; Bo_ena Sikora, *Polish Academy of Sciences, Poland*; Krzysztof Fronc, *Polish Academy of Sciences, Poland*; Dominique Schreurs, *Katholieke Universiteit Leuven, Belgium*; Ilja Ocket, *Katholieke Universiteit Leuven, Belgium*

FRIF1-20: Spurious Material Detection on Functionalized Thin-Film Sensors Using Multiresonant Split-Rings

Mario Mueh, *Technische Universität Darmstadt, Germany*; Christian Damm, *Universität Ulm, Germany*

FRIF1-21: Real-Time Microscopic Observation of Biological Interactions with Microwave Fields

C.F. Williams, *Cardiff University, UK*; J. Lees, *Cardiff University, UK*; D. Lloyd, *Cardiff University, UK*; G.M. Geroni, *Cardiff University, UK*; S. Jones, *Cardiff University, UK*; S. Ambala, *Cardiff University, UK*; W. Baradat, *Cardiff University, UK*; G. Comat, *Cardiff University, UK*; A. Aboubakary, *Cardiff University, UK*; S. Voisin, *Cardiff University, UK*; Adrian Porch, *Cardiff University, UK*

FRIF1-22: Numerical Study of Pore Density Distribution and Pore Formation Energy

Hao Qiu, *Fort Valley State University, USA;* Xianping Wang, *Southeast Missouri State University, USA;* Ravindra Joshi, *Texas Tech University, USA;* Wenbing Zhao, *Cleveland State University, USA*

FRIF1-23: NanoNeuroRFID: A Low Loss Brain Implantable Device Based on Magnetoelectric Antenna

Mohsen Zaeimbashi, *Northeastern University, USA;* Hwaider Lin, *Northeastern University, USA;* Zhiguang Wang, *Northeastern University, USA;* Huaihao Chen, *Northeastern University, USA;* Shadi Emam, *Northeastern University, USA;* Yuan Gao, *Northeastern University, USA;* Nian X. Sun, *Northeastern University, USA*

FRIF1-24: Power Budget and Reconstruction Algorithms for Through the Wall Radar Imaging System

S. Pisa, *Università di Roma La Sapienza, Italy;* E. Piuzzi, *Università di Roma La Sapienza*, Italy; E. Pittella, *Università di Roma La Sapienza, Italy;* P. D'Atanasio, *Università di Roma La Sapienza, Italy;* A. Zambotti, *Università di Roma La Sapienza, Italy;* G. Sacco, *Università di Roma La Sapienza, Italy*

IMBioC Technical Sessions

10:50 – 12:20 | Friday, 15 June 2018 | Pennsylvania Convention Center

201A

FR2A: Microwave Imaging and MRI

Chair: Abbas Omar, *Universität Magdeburg and Xudong Chen, National University of Singapore*

FR2A-1: (Invited) Recent Advances in RF Aspects of Magnetic Resonance Imaging

Robert Caverly, *Villanova University, USA*

FR2A-2: Real-Time Microwave Imaging of Breast Phantoms with Constrained Deconvolution of Planar Data

D. Tajik, *McMaster University, Canada;* F. Foroutan, *McMaster University, Canada;* D.S. Shumakov, *Health Canada, Canada*; A.D. Pitcher, *McMaster University, Canada;* E.A. Eveleigh, *McMaster University, Canada;* N.K. Nikolova, *McMaster University, Canada*

FR2A-3: A Fast Algorithm for Microwave Biomedical Imaging with Inhomogeneous Background

Kuiwen Xu, *Hangzhou Dianzi University, China;* Yu Zhong, *A*STAR, Singapore*; Xudong Chen, *National University of Singapore, Singapore*

FR2A-4: Realization of Breast Tissue-Mimicking Phantom Materials: Dielectric Characterization in the 0.5–50GHz Frequency Range

S. Di Meo, *Università di Pavia, Italy*; L. Pasotti, *Università di Pavia, Italy*; M. Pasian, *Università di Pavia, Italy*; G. Matrone, *Università di Pavia, Italy*

201B

FR2B: Microwave and Antennas for Wireless Power and Wearables

Chair: Aydin Farajidavar, *New York Institute of Technology and Simon Hemour, IMS (UMR 5218)*

FR2B-1: (Invited) RF in Medicine: Current Status and Future Directions of Antennas and Wireless Power

Yongxin Guo, *National University of Singapore, Singapore*

FR2B-2: Evaluating the Microwave Performance of Epidermal Electronics with Equivalent Transmission Line Modeling

Tammy Chang, *Stanford University, USA;* Jonathan A. Fan, *Stanford University, USA;* Thomas H. Lee, *Stanford University, USA*

FR2B-3: High Efficiency Wireless Power Transfer System Using Spiral DGS Resonators Through Biological Tissues

Sumin Chalise, *Kyushu University, Japan;* F. Tahar, *Kyushu University, Japan;* M.R. Saad, *Kyushu University, Japan;* A. Baraket, *Kyushu University, Japan;* Kuniaki Yoshitomi, *Kyushu University, Japan;* R.K. Pokharel, *Kyushu University, Japan*

FR2B-4: High-Q Implantable Resonator for Wireless Power Delivery

L. Di Trocchio, *IMS (UMR 5218), France;* J.-L. Lachaud, *IMS (UMR 5218), France;* C. Dejous, *IMS (UMR 5218), France;* A. Kuhn, *ISM (UMR 5255), France;* S. Hemour, *IMS (UMR 5218), France*

201C

FR2C: Biosensors

Chair: Arnaud Pothier, *XLIM (UMR 7252) and Pingshan Wang, Clemson University*

FR2C-1: (Invited) Biosensors for Measuring the Dielectric Response of Single Cells to Applied Stress

Gregory Bridges, *University of Manitoba, Canada*

FR2C-2: A Four-Layer Phantom for Testing in-vitro Microwave-Based Sensing Approach in Intra-Cranial Pressure Monitoring

Jacob Velander, *Uppsala University, Sweden*; Syaiful Redzwan, *Uppsala University, Sweden*; Mauricio D. Perez, *Uppsala University, Sweden*; Noor Badariah Asan, *Uppsala University, Sweden*; Daniel Nowinski, *Uppsala University Hospital, Sweden*; Anders Lewén, *Uppsala University Hospital, Sweden*; Per Enblad, *Uppsala University Hospital, Sweden*; Robin Augustine, *Uppsala University, Sweden*

FR2C-3: Microwave Noninvasive Blood Glucose Monitoring Sensor: Penetration Depth and Sensitivity Analysis

Heungjae Choi, *Cardiff University, UK*; Steve Luzio, *Swansea University, UK*; Jan Beutler, *Université du Luxembourg, Luxembourg*; Adrian Porch, *Cardiff University, UK*

FR2C-4: Microwave Sensing Based on Peelable Microfluidic Thin Film Resonator

Rong Wang, *University of Hong Kong, China*; Li Jun Jiang, *University of Hong Kong, China*

10:50 – 11:20

11:20 – 11:40

11:40 – 12:00

12:00 – 12:20

IMBioC Technical Sessions

13:20 – 15:10 | Friday, 15 June 2018 | Pennsylvania Convention Center

201A

FR3A: Biomedical Radar

Chair: José-María Muñoz-Ferreras, *Universidad de Alcalá and* Negar Tavassolian, *Stevens Institute of Technology*

13:20 – 13:50

FR3A-1: (Invited) Biomedical Radars Using Self-Injection-Locking Technology

T.-S. Jason Horng, *National Sun Yat-Sen University, Taiwan*

13:50 – 14:10

FR3A-2: Multi-Target Vital-Signs Monitoring Using a Dual-Beam Hybrid Doppler Radar

Mehrdad Nosrati, *Stevens Institute of Technology, USA;* Shahram Shahsavari, *New York University, USA;* Negar Tavassolian, *Stevens Institute of Technology, USA*

14:10 – 14:30

FR3A-3: Noise Tolerable Vital Sign Detection Using Phase Accumulated Demodulation for FMCW Radar System

Wei-Fang Chang, *National Cheng Kung University, Taiwan;* Kuan-Wei Chen, *National Cheng Kung University, Taiwan;* Chin-Lung Yang, *National Cheng Kung University, Taiwan*

14:30 – 14:50

FR3A-4: Monitoring of Healing Progression of Cranial Vault Using One-Dimensional Pulsed Radar Technique

Doojin Lee, *University of Waterloo, Canada*; George Shaker, *University of Waterloo, Canada*; Daniel Nowinski, *Uppsala University Hospital, Sweden*; Robin Augustine, *Uppsala University, Sweden*

14:50 – 15:10

FR3A-5: A Supervised Learning Approach for Real Time Vital Sign Radar Harmonics Cancellation

Justin J. Saluja, *University of Florida, USA;* Jenshan Lin, *University of Florida, USA;* Joaquin Casanova, *University of Florida, USA*

201B

FR3B: Wireless Implantable Monitoring Systems

Chair: Roberto Gómez-García, *Universidad de Alcalá and* Hong Hong, *Nanjing University of Science and Technology*

FR3B-1: (Invited) Multi-Channel Wireless and Battery-Less Brain Signal Monitoring System

John Volakis, *Florida International University, USA*

FR3B-2: Ultrasonic Energy Harvesting Scheme for Implantable Active Stent

Sayemul Islam, *Temple University, USA;* Albert Kim, *Temple University, USA*

FR3B-3: Initial in-vitro Trial for Intra-Cranial Pressure Monitoring Using Subdermal Proximity-Coupled Split-Ring Resonator

Syaiful Redzwan, Jacob Velander, Mauricio D. Perez, Noor Badariah Asan, Robin Augustine, *Uppsala University, Sweden*; Mina Rajabi, Frank Niklaus, *KTH, Sweden*; Daniel Nowinski, Anders Lewén, Per Enblad, *Uppsala University Hospital, Sweden*

FR3B-4: Low-Impedance Probes for Wireless Monitoring of Neural Activation

Carolina Moncion, *Florida International University, USA;* Satheesh Bojja-Venkatakrishnan, *Florida International University, USA;* Jorge Riera Diaz, *Florida International University, USA;* John Volakis, Florida International University, *USA*

FR3B-5: Towards a Distributed Multi-Channel System for Studying Gastrointestinal Tract

Rui Bao, *New York Institute of Technology, USA;* Amir Javan-Khoshkholgh, *New York Institute of Technology, USA;* Wahib Alrofati, *New York Institute of Technology, USA;* Aydin Farajidavar, New York Institute of Technology, *USA*

201C

FR3C: Bio-Tissue Characterization

Chair: Katia Grenier, LAAS and Natalia Nikolova, *McMaster University*

FR3C-1: (Invited) Low Volume and Label-Free Molecules Characterization and Cell Monitoring with Microwave Dielectric Spectroscopy

K. Grenier, *LAAS, France;* A. Tamra, *LAAS, France;* A. Zedek, *LAAS, France;* G. Poiroux, *LAAS, France;* F. Artis, *LAAS, France;* T. Chen, *LAAS, France;* W. Chen, *LAAS, France;* M. Poupot, *CRCT (UMR 1037), France;* J.-J. Fournié, *CRCT (UMR 1037), France;* D. Dubuc, *LAAS, France*

FR3C-2: A Noninvasive Blood Glucose Measurement by Microwave Dielectric Spectroscopy: Drift Correction Technique

Masahito Nakamura, *NTT, Japan;* Takuro Tajima, *NTT, Japan;* Michiko Seyama, *NTT, Japan;* Kayo Waki, *University of Tokyo, Japan*

FR3C-3: A 60GHz Mixer-Based Reflectometer in 130nm SiGe BiCMOS Technology Toward Dielectric Spectroscopy in Medical Applications

Rahul Kumar Yadav, *IHP, Germany*; Mohamed Hussein Eissa, *IHP, Germany*; Jan Wessel, *IHP, Germany*; Dietmar Kissinger, *IHP, Germany*

FR3C-4: Measurement of Broadband Temperature-Dependent Dielectric Properties of Liver Tissue

Hojjatollah Fallahi, *Kansas State University, USA;* Punit Prakash, *Kansas State University, USA*

FR3C-5: Validation of Clausius-Mossotti Function in Single-Cell Dielectrophoresis

Xiaotian Du, *Lehigh University, USA;* Xiao Ma, *Lehigh University, USA;* Hang Li, *Lehigh University, USA;* Yaqing Ning, *Lehigh University, USA;* Xuanhong Cheng, *Lehigh University, USA;* James C.M. Hwang, *Lehigh University, USA*

IMBioC Technical Sessions

15:40 – 17:30 | **Friday, 15 June 2018** | Pennsylvania Convention Center

201A

FR4A: Pulsed Fields for Biomedical Applications

Chair: Roberto Gómez-García, *Universidad de Alcalá* and *Xiaoguang Liu, University of California, Davis*

15:40 - 16:00

FR4A-1: Miniature Flexible Planar Microwave and RF Energy Delivery Structure for New Endoscopic Procedures — Design and Initial Pre-Clinical Data

Chris Hancock, *Bangor University, UK*; Steve Morris, *Creo Medical, UK*; Zacharias Tsiamoulos, *St. Mark's Hospital, UK;* Brian Saunders, *St. Mark's Hospital, UK*

16:00 | 16:10 - 16:20 | 16:30

FR4A-2: Non-Contact Picosecond Pulsed Electric Fields Up Regulate SOX2 Gene Expression in Mesenchymal Stem Cells

Ross A. Petrella, *Old Dominion University, USA;* Peter A. Mollica, *Old Dominion University, USA;* Martina Zamponi, *Old Dominion University, USA;* Shu Xiao, *Old Dominion University, USA;* Robert D. Bruno, *Old Dominion University, USA;* Patrick C. Sachs, *Old Dominion University, USA*

16:20 - 16:40

FR4A-3: A Microwave Ablation System for the Visualisation and Treatment of Pulmonary Nodules and Tumours

Shaun C. Preston, *Bangor University, UK*; William Taplin, *Bangor University, UK*; Aeron W. Jones, *Bangor University, UK*; Chris Hancock, *Bangor University, UK*

16:40 | 16:50 - 17:00 | 17:10

FR4A-4: Electropermeabilization of Isolated Cancer Stem Cells with a Novel and Versatile Nanosecond Pulse Generator

I.W. Davies, *Bangor University, UK*; C. Merla, *ENEA, Italy*; A. Casciati, *ENEA, Italy*; A. Zambotti, *ENEA, Italy*; J. Bishop, *Creo Medical, UK*; G. Hodgkins, *Creo Medical, UK*; C. Palego, *Bangor University, UK*; Chris Hancock, *Bangor University, UK*

17:00 | 17:10 - 17:20 | 17:30

FR4A-5: Flexible Ablation Device with Single Applicator Structure that Supports both Radiofrequency and Microwave Energy Delivery

Patrick Burn, *Bangor University, UK*; Pallav Shah, *Imperial College London, UK*; Chris Hancock, *Bangor University, UK*

201B

FR4B: Biomedical Signal Monitoring and Communication

Chair: Chung-Tse (Michael) Wu, *Rutgers University* and *Hung Cao, University of Washington*

FR4B-1: Soft Wearable Sensors for Precise Physiological Signals Measurements Based on the Fabric-Substrate Complementary Split-Ring Resonator

Po-Kai Chan, *National Cheng Kung University, Taiwan;* Ta-Chung Chang, *National Cheng Kung University, Taiwan;* Kuan-Wei Chen, *National Cheng Kung University, Taiwan;* Chin-Lung Yang, *National Cheng Kung University, Taiwan*

FR4B-2: Characterization of Passive Wireless Electrocardiogram Acquisition in Adult Zebrafish

Silviu Gruber, *University of Washington, USA;* Tai Le, *University of Washington, USA;* Miguel Huerta, *University of Washington, USA;* Konnor Wilson, *University of Washington, USA;* Jingchun Yang, *Mayo Clinic, USA;* Xiaolei Xu, *Mayo Clinic, USA;* Hung Cao, *University of Washington, USA*

FR4B-3: A Miniature Wireless 64-Channel System for Monitoring Gastrointestinal Activity

Amir Javan-Khoshkholgh, *New York Institute of Technology, USA;* Wahib Alrofati, *New York Institute of Technology, USA;* Zaid Abukhalaf, *New York Institute of Technology, USA;* Ahmed Ibrahim, *Pennsylvania State University, USA;* Mehdi Kiani, *Pennsylvania State University, USA;* Aydin Farajidavar, *New York Institute of Technology, USA*

FR4B-4: Wireless Passive Monitoring of Electrocardiogram in Firefighters

Tai Le, *University of Washington, USA;* Miguel Huerta, *University of Washington, USA;* Alexander Moravec, *University of Washington, USA;* Hung Cao, *University of Washington, USA*

FR4B-5: Bone Conduction: A Feasible Concept for Ear-to-Ear Communication?

Jan-Christoph Edelmann, *Universität Innsbruck, Austria;* Gilbert Prokop, *Universität Innsbruck, Austria;* Thomas Ussmueller, *Universität Innsbruck, Austria*

201C

FR4C: Bio-Tissue Characterization II

Chair: Abbas Omar, *Universität Magdeburg* and Perry Li, *Abbott Laboratories*

FR4C-1: (Invited) Material Characterization for the Detection of African Trypanosomes Using RNA-Derivatized Surface Layers with mm-Wave and THz Sensors

Mario Mueh, *Technische Universität Darmstadt, Germany*; Robert Knieß, *Technische Universität Darmstadt, Germany*; H. Ulrich Göringer, *Technische Universität Darmstadt, Germany*; Christian Damm, *Universität Ulm, Germany*

FR4C-2: Measuring Ion-Pairing in Buffer Solutions with Microwave Microfluidics

Angela C. Stelson, *NIST, USA;* Charles E. Little, *NIST, USA;* Nathan D. Orloff, *NIST, USA;* Christian J. Long, *NIST, USA;* James C. Booth, *NIST, USA*

FR4C-3: Discrimination of Glioblastoma Cancer Stem Cells by Measuring Their UHF-Dielectrophoresis Crossover Frequency

R. Manczak, C. Dalmay, P. Blondy, A. Pothier, *XLIM (UMR 7252), France;* S. Saada, B. Bessette, G. Begaud, S. Battu, M.O. Jauberteau, F. Lalloue, *HCP (EA 3842), France;* M. Inac, C. Baristiran Kaynak, M. Kaynak, *IHP, Germany*; C. Palego, *Bangor University, UK*;

FR4C-4: Ferromagnetic Resonance Characterization of Magnetic Nanowires for Biolabel Applications

Wen Zhou, *University of Minnesota, USA;* Joseph Um, *University of Minnesota, USA;* Yali Zhang, *University of Minnesota, USA;* Alexander Nelson, *University of Minnesota, USA;* Bethanie Stadler, *University of Minnesota, USA;* Rhonda Franklin, University of Minnesota, *USA*

FR4C-5: Effect of Thickness Inhomogeneity in Fat Tissue on In-Body Microwave Propagation

Noor Badariah Asan, Jacob Velander, Syaiful Redzwan, Mauricio D. Perez, Thiemo Voigt, Robin Augustine, *Uppsala University, Sweden*; Emadeldeen Hassan, *Umeå University, Sweden*; Taco J. Blokhuis, *Maastricht UMC+, The Netherlands*;

IMBioC Sponsors and Exhibition:

09:00 – 17:00 | **Friday, 15 June 2018** | Pennsylvania Convention Center, Room 204B

Dedicated exhibit time 09:30 –10:00 & 15:10 – 15:40

Company Name

- AP-S
- Cicor Group
- Creo Medical Ltd.
- CST of America
- Huber+Suhner, Inc.
- Keysight Technologies
- Kyocera America, Inc.
- LitePoint
- MTT-S
- National Instruments
- Sonnet Software Inc.
- Springer SBM B.V.
- Statek Corp.
- Vishay Intertechnology, Inc.
- ZMT Zurich MedTech AG

Financial Sponsor:

Technical Sponsors:

Coffee/Tea Break Sponsor:

IMBioC Student Paper Competition Finaists:

A Ka-band Beamformer for Wireless Power Transfer to Body Area Networks
Student: Nicholas Saiz, *Stanford University*

Development of a Tissue Dielectric Properties Model Based on Maxwell- Fricke Mixture Theory
Student: Sevde Etoz, *University of Wisconsin–Madison*

Multi-Target Vital-Signs Monitoring Using a Dual-Beam Hybrid Doppler Radar
Student: Mehrdad Nosrati, *Stevens Institute of Technology*

A 60 GHz Mixer-based Reflectometer in 130nm SiGe BiCMOS Technology toward Dielectric Spectroscopy in Medical Applications
Student: Rahul Kumar Yadav, *IHP Gmbh*

Ferromagnetic Resonance Characterization of Magnetic Nanowires for Biolabel applications
Student: Wen Zhou, *University of Minnesota, Twin Cities*

NEMS Magnetoelectric Antennas for Biomedical Application
Student: Hwaider Lin, *Northeastern University*

Reproducibility Evaluation of Composite Dielectric Materials Based on an Error Propagation Model
Student: Birk Hattenhorst, *Ruhr University Bochum*

Evaluating the Microwave Performance of Epidermal Electronics with Equivalent Transmission Line Modeling
Student: Tammy Chang, *Stanford University*

Homodyne and Heterodyne Terahertz Dielectric Sensors: Prototyping and Comparison in BiCMOS Technology for Lab-on-Chip Applications
Student: Defu Wang, *IHP Microelectronics*

Feasibility Study of Applying Ferromagnetic Contrast Agents in Thermoacoustic Imaging
Student: Dajun Zhang, *ShanghaiTech University*

A Compact Energy Efficient CMOS Permittivity Sensor Based on Multi-Harmonic Downconversion and Tunable Impedance Bridge
Student: Gerasimos Vlachogiannakis, *Delft University of Technology*

Measurement of Broadband Temperature-Dependent Dielectric Properties of Liver Tissue
Student: Hojjatollah Fallahi, *Kansas State University*

Notes

RF BOOTCAMP

08:00 – 16:30 | **Monday, 11 June 2018** | Room: 109B

ORGANIZERS: L. Dunleavy, *Modelithics, Inc.*; K. Hall, *Keysight Technologies*

INSTRUCTORS:

- Joanne Mistler, *Keysight Technologies*
- Nilesh Kamdar, *Keysight Technologies*
- Brooks Hanley, *Keysight Technologies*
- Daniel G. Swanson, Jr., *SW Filter Design*
- Dr. Tom Weller, *University of South Florida*
- Dr. Larry Dunleavy, *Modelithics, Inc.*

ABSTRACT:

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 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 IEEE continuing education credits (CEUs).**

AGENDA:

Time	Session
08:00–08:30	Registration
08:30–08:40	Introductions – Speakers and Participants
08:40–09:40	The RF/Microwave Signal Chain Network Characteristics, Analysis and Measurement
09:40–09:55	Break
09:55–10:30	Fundamentals of RF Simulation
10:30–11:05	Impedance Matching and Device Modeling Basics
11:05–12:00	Introduction to RF and Microwave Filters
12:00–12:45	Lunch
12:45–13:45	Spectral Analysis and Receiver Technology
13:45–14:30	Signal Generation Modulation and Vector Signal Analysis
14:30–15:10	Microwave Antenna Basics
15:10–15:25	Break
15:25–16:05	Introduction to Radar and Radar Measurements
16:05–16:30	Recap and Q&A session

Valley Forge functioned as the third of eight military encampments for the Continental Army's main body, commanded by General George Washington. In September 1777, British forces had captured the American capital of Philadelphia. After failing to retake the city, Washington led his 12,000-person army into winter quarters at Valley Forge, located approximately 18 miles (29 km) northwest of Philadelphia. They remained there for six months, from December 19, 1777 to June 19, 1778. At Valley Forge, the Continentals struggled to manage a disastrous supply crisis while retraining and reorganizing their units. About 1,700 to 2,000 soldiers died due to disease, possibly exacerbated by malnutrition. Today, Valley Forge National Historical Park preserves and protects over 3,500 acres of the original encampment site.

Valley Forge long occupied a prominent place in American storytelling and memory. The image of Valley Forge as a site of terrible suffering and unshakeable perseverance emerged years after the encampment ended. Valley Forge has long been portrayed in stories and pictures as blanketed in snow or coated in ice. The Continental Army did not experience a particularly harsh winter at Valley Forge, but many soldiers remained unfit for duty, owing to the lack of proper clothing and uniforms ("naked" referred to a ragged or improperly attired individual). Years later, General Marquis de Lafayette recalled that "the unfortunate soldiers were in want of everything; they had neither coats, hats, shirts, nor shoes; their feet and legs froze till they had become almost black, and it was often necessary to amputate them."

IEEE 5G SUMMIT

MTT-S

IEEE ComSoc
IEEE Communications Society

08:00 – 17:10 | Tuesday, 12 June 2018 | Room 103ABC

The 5G Summit at the Pennsylvania Convention Center in Philadelphia is an IEEE event that is organized by two of IEEE's largest societies – MTT-S and ComSoc. This special collaboration, for the second year running, complements MTT-S' "hardware and systems" focus with ComSoc's "networking and services" focus. The one-day Summit features talks from experts from industry, academia, and government on various aspects of 5G services and applications. It's further complemented by the 5G Pavilion at the IMS2018 exhibition where table top demonstrations and "fire-side" chats are presented at the 5G theater.

AN INVESTMENT IN KNOWLEDGE PAYS THE BEST INTEREST.

BENJAMIN FRANKLIN

AGENDA:

Time	Session
08:00–08:05	Welcome and 5G Summit Overview: **Debabani Choudhury**, Intel Labs
08:05–08:15	'Overview on 5G Initiative', **Ashutosh Dutta**, IEEE 5G Initiative
08:15–08:55	'Bringing the World Closer Together', **Jin Bains**, Facebook
08:55–09:35	'AT&T's Perspectives on 5G Services', **David Lu**, AT&T
09:35–09:50	**Coffee Break**
09:50–10:30	'5G Spectrum Policy Issues', **Michael Marcus**, Marcus Spectrum Solutions
10:30–11:10	'Millimeter–wave technology and research trends for 5G Access and Wireless Transmission applications – An industry view', **Renato Lombardi**, Huawei
11:10–11:50	'5G Automotive Challenges and Opportunities', **Timothy Talty**, General Motors
11:50–12:00	**Boxed Lunch Pickup | 103ABC Foyer**
12:00–12:55	5G Summit Panel: mmWave Radios in Smartphones: What they will look like in 2, 5 and 10 years Moderators: **Dylan Williams**, NIST and **Paul Khanna**, NI Panelists: **Walid Ali-Ahmad**, UCSD; **Farshid Aryanfar**, Straightpath Communications; **Devereux Palmer**, Lockheed Martin; **Harish Krishnaswamy**, Columbia University; **Tim LaRocca**, Northrop Grumman; **Joy Laskar**, Maja Systems; **Ke Lu**, Anokiwave
13:00–13:40	'GaN-on-Silicon Transcendent – Enabling The Cost, Integration, and Affordability Challenges to Make 5G a Reality', **Anthony Fischetti**, MACOM
13:40–14:20	'RFSOI Technology solutions that enable Connected Intelligence through a Complete 5G Platform Solution', **Shankaran Janardhanam**, Global Foundries
14:20–15:00	'Mm-Wave Power Amplification, Full-Duplex, and Autonomous Beam-Forming – The Unreasonable Quest for "Perfect" 5G Mm-Wave Front-Ends and Some Reasonable Solutions', **Hua Wang**, Georgia Tech
15:00–15:15	**Coffee Break**
15:15–15:50	'Using Software-Defined Approach to Address 5G Research, Prototype and Test', **Charles Schroeder,** National Instruments
15:50–16:30	'mmWave in 5G Commercial Wireless: What Do You Need to Measure?', **Roger Nichols**, Keysight
16:35–17:15	'5G testbed as Service', **Ivan Seskar**, Rutgers University

Industry Co-Sponsors:

KEYSIGHT TECHNOLOGIES

NATIONAL INSTRUMENTS

Media Sponsor:

Microwave Journal

WORKSHOPS

Sunday, 10 June 2018

*All Workshops and Short Courses are located at the Pennsylvania Convention Center. Room assignments will be updated at the IMS2018 website (**www.ims2018.org**) and in the IMS Microwave Week Mobile App, at least one week prior to the IMS2018 start. On-site signs will also guide you to the Workshops and Short Courses rooms.*

WSA

08:00 – 11:50

RFIC Design in CMOS FinFET and FD-SOI

Sponsor: RFIC

Organizer: Magnus Wiklund, *Qualcomm*; Tzung-Yin Lee, *Skyworks*

Abstract: Both CMOS FinFET and FD-SOI are the enabling technologies to achieve nanoscale CMOS beyond 20nm. This technological revolution allows highest integration density for high volume products at low cost. Due to the fundamental changes in how a transistor is built, there are tremendous impacts on its characteristics (e.g., ft, Vth, VDD). Considering this change, traditional and well-known circuits and architectures need to be refined or even be re-invented. This workshop gives an overview of novel architectures and designs in the context of RF and millimeter wave that benefit from FinFET and FD-SOI technologies. In several presentations, trends, design challenges, and how to overcome these challenges are shown by application/circuit examples. Furthermore, commoditization of 4G and emerging 5G cellular systems have continued to push applications of advanced Si/SiGe and SOI technology for integration, performance, and cost. This workshop will discuss the challenges and trade-offs of various Si-based technologies for 5G cellular applications, their respective modeling, automated design and layout perspectives for successful productization.

1. The Paradigm Shift of RF and millimeter Wave Circuit Design with FinFET Technology: How to Keep Up with The Next Generation of CMOS Process Technology for Circuit Optimization and Planning
   Hyung-Jin Lee; *Intel Corporation*
2. Integration of a Wideband Direct-RF Radio in 16nm FinFET
   Brendan Farley; *Xilinx Ireland*
3. Compiling Analog-to-Digital Converters in FDSOI
   Trond Ytterdal, *Norwegian Institute of Technology*
4. Millimeter-Wave Circuit Design and Techniques in FDSOI CMOS Technology
   Abdellatif Bellaouar; *GLOBALFOUNDRIES*

WSB

08:00 – 11:50

ICs for Quantum Computing and Quantum Technologies

Sponsors: IMS; RFIC

Organizers: Edoardo Charbon, *EPFL, Kavli Institute of Nanoscience Delft, Intel*; Ranjit Gharpurey, *The University of Texas at Austin*

Abstract: Quantum computers (QCs) hold the promise to change computing as we know it today. What is generally not discussed is the importance of classical electronics to support a QC's computational core: the qubit. In this workshop, we look at the requirements of electronic circuits and systems supporting qubits, with a special interest in scalability issues and silicon (CMOS, SiGe, ...) compatibility of quantum-classical computing systems. World experts in the field will present their work and their visions for a possibly integrated QC of the future, often reflecting on architectural and design issues, with a keen interest in the design of high-speed and RF circuits and systems sought by QC architects. Finally, we will look at other applications that could benefit from qubits and, in general, quantum technologies, from the perspective of classical readout and control CMOS circuits and systems operating at cryogenic temperatures (Cryo-CMOS). We will conclude with a general vision of the field and its trends as well as perspectives for the future.

1. Should RFIC Designers Care About Quantum Computing?
   Stefano Pellerano; *Intel*
2. Fabrication and Integration of Superconducting Qubits and Circuits
   William D. Oliver; *MIT Lincoln Laboratory, MIT Research Laboratory of Electronics, MIT Department of Physics*
3. Superconducting Classical Circuits for Quantum Computing Readout and Control
   Oleg Mukhanov; *HYPRES, Inc.*
4. Silicon Germanium Cryogenic Low Noise Amplifiers for Quantum Computing
   Joseph C. Bardin; *University of Massachusetts Amherst*
5. Cryo-CMOS Circuits and Systems for Scalable Quantum Computing
   Masoud Babaie; *Delft University of Technology*; Fabio Sebastiano; *Delft University of Technology*; Andrei Vladimirescu; *TU Delft, ISEP, UC Berkeley*; Edoardo Charbon; *EPFL, Kavli Institute of Nanonscience Delft, Intel*

WORKSHOPS

Sunday, 10 June 2018

*All Workshops and Short Courses are located at the Pennsylvania Convention Center. Room assignments will be updated at the IMS2018 website (**www.ims2018.org**) and in the IMS Microwave Week Mobile App, at least one week prior to the IMS2018 start. On-site signs will also guide you to the Workshops and Short Courses rooms.*

WSC 08:00 – 17:15

5G Mm-Wave Power Amplifiers, Transmitters, Beamforming Techniques and Massive MIMO

Sponsor: RFIC

Organizers: Patrick Reynaert, *KU Leuven*; Leon van den Oever, *Qualcomm*; Ping Gui, *SMU University*

Abstract: The fifth Generation (5G) communication systems are expected to represent a major revolution in mobile wireless technologies. The focus of this workshop is on 5G systems that will operate at mm-wave frequencies (28-80GHz) and may employ massive MIMO, in order to achieve enhanced data rates, higher spectral efficiency, extended battery life, and low system latency. Aspects that will be addressed are: system architecture, power-amplifier (PA) design, circuit techniques, technology choices, front-end and antenna interfaces, and user equipment/basestation. Moreover, this workshop brings together the advocates and experts of both bulk CMOS, SOI CMOS and SiGe, as well as GaN and other technologies, to explain in which cases certain technology may be the right choice.

1. Millimeter Wave Beamforming: System Level Challenges and Implications for RF Design;
   Vasanthan Raghavan; *Qualcomm*
2. Design Considerations for 5G Mm-Wave Transceivers;
   Stefan Andersson; *Ericsson Research, Lund, Sweden*
3. Power Amplifier Requirements for Mm-Wave 5G Systems;
   Bror Peterson; *Qorvo*
4. Broadband, Linear, and High-Efficiency Mm-Wave Power Amplifiers and Co-Designs with Antennas;
   Hua Wang; *Georgia Tech*
5. Reconfigurable Wideband Architectures and Antenna Co-Design and Co-Integration For Future MIMO Arrays;
   Kaushik Sengupta; *Princeton University*
6. Hybrid Beamforming Receivers for Millimeter-wave MIMO Communication;
   Jeyanandh Paramesh; *Carnegie Mellon University*
7. 5G Infrastructure Radio Design, Measurement and Standards Aspects;
   Raja Mir; *Nokia*
8. Enabling Cost-Effective 5G Phased Array mmWave Products by Optimizing the flow from Design-for-Test to Production;
   Mustapha Slamani; *GLOBALFOUNDRIES*

WSD 08:00 – 17:15

eXtreme-Bandwidth: Architectures for RF and mmW Transceivers in Nanoscale CMOS

Sponsor: RFIC

Organizers: Francois Rivet, *Univ. Bordeaux, France;* Gernot Hueber, *NXP Semiconductors, Austria*

Abstract: With the advent of nano-scale CMOS technology, exciting new developments have recently taken place in the field of RF and mm-wave transmitters, receivers and frequency synthesizers. The low-voltage, fast speed, fine feature-size and low cost of the new technology have forever changed the way we design circuits, architectures and systems. Not only have RF/mm-wave circuits taken different topologies from what has been taught in textbooks but also their integrations with digital processors have enabled new possibilities for digital assistance. The motivation of this workshop is to capture what is the state at the edge of technology, what is the demand of the industry in the context of high volume products, and, what are circuit and architectural concepts that are demanded or enforced by the technology. We focus especially on circuit enabling extreme bandwidth using various techniques including MIMO, analog/digital signal processing, novel high-rate ADCs, techniques for channel bonding, carrier aggregation to reach data rates far beyond what is achievable nowadays.

1. Millimeter-wave CMOS Transceiver Toward 1 Tbps Wireless Communication;
   Kenichi Okada; *Tokyo Institute of Technology*
2. Wideband Transceiver Design for 5G mm-Wave Phased-Arrays in FinFET Technology;
   Steven Callender; *Intel Labs*
3. 300-GHz CMOS Wireless Transceiver and Its Future;
   Minoru Fujishima; *Hiroshima University*
4. Multi-GHz Frequency Synthesis for Radar Applications;
   Bodhisatwa Sadhu; *IBM T.J. Watson Research Center*
5. Linear Mm-Wave Power Amplifiers and Transceivers for 5G NR Mmwave;
   Jeremy Dunworth; *Qualcomm*
6. Hybrid Architectures Leveraging Best of Both Worlds for eXtreme-Bandwidth Communications;
   Payam Heydari; *University of California Irvine*
7. Wideband Mm-wave Communication Systems: A Systematic Design Approach;
   Hasan Al-Rubaye; *University of California San Diego*;
   Gabriel M. Rebeiz; *University of California San Diego*

WORKSHOPS

Sunday, 10 June 2018

*All Workshops and Short Courses are located at the Pennsylvania Convention Center. Room assignments will be updated at the IMS2018 website (**www.ims2018.org**) and in the IMS Microwave Week Mobile App, at least one week prior to the IMS2018 start. On-site signs will also guide you to the Workshops and Short Courses rooms.*

WSE

08:00 – 17:15

Integrated Mm-Wave & THz Sensing Technology for Automative, Industrial and Healthecare

Sponsors: IMS; RFIC

Organizers: Hongtao Xu, *Fudan University*; Vito Giannini, *Uhnder Inc*

Abstract: Recent advances in millimeter-wave and THz silicon technology have drawn strong interest in the RF community. Mm-wave sensors and THz imagers are becoming essential building blocks in several application domains. For example, in the automotive industry, mm-wave radars are considered as a key component for safety critical applications and autonomous driving cars. In the industrial world, drones and robotics will rely on such sensors to avoid obstacles or complete complex tasks. In the medical and pharmaceutical industry, THz prototypes find application in home patient monitoring, high-resolution imaging and spectroscopy. This workshop aims at covering the state of the art and the future development trends including FMCW and MIMO radars, as well as THz imagers. This includes silicon and systems operating at carriers beyond 30 GHz. Distinguished speakers from industry and academia will highlight system requirements, technology advances, challenges and solutions for implementations on system and silicon level.

1. Autonomous Vehicles Systems and the Future of Riding;
   Sergio Pacheco; *NXP*
2. MIMO Radars and Beamforming with Multichip Cascading;
   Sreekiran Samara; *Texas Instruments*
3. MIMO Radar System Integration;
   Chris Pan; *Uhnder Inc.*
4. New SiGe Technologies with Cut Off Frequencies Towards 600 GHz and Their Potential Impact on Future Mm-Wave Sensing in Automotive and Industrial Applications;
   Wolfgang Liebl; *Infineon*
5. Mm-Wave for Cm Accurate Ranging: Signals, Building Blocks and A Little Bit of Algorithms;
   Wim Dehaene; *KU Leuven*
6. Millimeter Waves for Cars, People, Cells, and Molecules;
   Ilja Ocket; *imec and KU Leuven*
7. Hyperimager: A Compact Multi-Spectral Imaging Platform;
   Alberto Valdes-Garcia; *IBM Research*
8. Large-Scale THz Active Arrays in Silicon for Bio-Chemical Sensing;
   Ruonan Han; *MIT*
9. Silicon based Multispectral Terahertz Imaging;
   Richard Al Hadi; *UCLA*
10. An Integrated-Circuit Approach to Terahertz Nearfield Imaging;
    Ullrich Pfeiffer; *University of Wuppertal*

WSF

08:00 – 17:15

Advanced Integrated RF Filtering Circuits and Techniques

Sponsor: RFIC

Organizers: WSF Harish Krishnaswamy, *Columbia University*; Mohyee Mikhemar, *Broadcom Limited*

Abstract: The complexity of the conventional RF front-end SAW/BAW filtering and switching is the biggest hurdle in the pursuit of a true wideband software-defined radio for high performance wireless applications. It is also a challenge for many IoT systems with application-specific size or cost restrictions. Therefore, there have been serious efforts from the RFIC community to come up with RF filtering techniques that are suitable for CMOS integration. After more than a decade of promising research results, some of these techniques are starting to be used in mass market products. In this workshop, experts from academic, industry, and federal research institutions will present the state-of-the-art in the area of CMOS-integrated RF filtering such as N-path filters, electrical balance duplexers, and various linear periodic time varying (LPTV) systems that have been used, for example, to implement a fully-integrated non-magnetic CMOS circulator. Moreover, the commercial state-of-the art performance of SAW/BAW technology and tunable RF components will be presented as a point of reference. Finally, the workshop will conclude with an interactive panel discussion about the potential and limitations of CMOS integrated RF filtering.

1. Workshop Introduction: Integrated Antenna-Interface Components: A Blessing in Disguise for Wireless Transceivers;
   Harish Krishnaswamy; *Columbia University*
2. Pushing the Interference Robustness of CMOS N-Path Filters;
   Eric Klumperink; *Twente University in Enschede, The Netherlands*
3. Demystifying the Analysis of LPTV Circuits Using Adjoint Networks;
   Shanthi Pavan; *Indian Institute of Technology, Madras*
4. Solutions for Reconfigurable Mobile Device RF Front-Ends;
   Arthur Morris; *WiSpry, Inc*
5. Electrical-Balance Techniques for Tunable, Fully Integrated RF Front-Ends;
   Barend van Liempd; *IMEC*
6. Integrated Self-Interference Cancellation for Next-Generation Wireless Communication Systems;
   Jin Zhou; *University of Illinois at Urbana-Champaign*
7. Rethinking the RF Front-End: Integrated Magnetic-Free Non-Reciprocity and Its Application in Emerging Wireless Communication Paradigms;
   Negar Reiskarimian; *Columbia University*
8. Using Sampling Aliases For Sharp Programmable Filtering: Some Radio Applications;
   Sudhakar Pamarti; *UCLA*

WORKSHOPS

Sunday, 10 June 2018

*All Workshops and Short Courses are located at the Pennsylvania Convention Center. Room assignments will be updated at the IMS2018 website (**www.ims2018.org**) and in the IMS Microwave Week Mobile App, at least one week prior to the IMS2018 start. On-site signs will also guide you to the Workshops and Short Courses rooms.*

WSG 08:00 – 17:15

Synthesizer Design and Frequency Generation/Synchronization Schemes for High-Performance Wireless Systems

Sponsors: IMS; RFIC

Organizers: Jaber Khoja, *Rockwell Collins;* Ed Balboni, *Analog Devices*

Abstract: This workshop will focus on wireless systems demanding high performance local oscillators and clock generators. This includes cellular infrastructure, wireless backhauling, mm-wave radar and imaging, and data converters for communication systems. In all these applications, it would be desirable to implement the whole system in the same silicon technology process, while achieving low integrated phase noise (<1deg) and noise floor at mm-wave, low reference and integer boundary spurs (<90dBc). State-of-the-art RF to THz synthesizer architectures and building block details will be covered, including phase-locked loops, frequency doubler/tripler, injection locked divider, and clock distribution, etc. Advanced PLL architectures such as inductor-less PLLs, SSPLL, ILPLL will also be discussed. In addition, this workshop will discuss the fundamentals of digital PLLs as well as the latest advancements in the field. Digital PLLs have great scalability and easy portability to new CMOS process nodes, and have today a wide range of applications from wireless to wireline systems, not limited to the GHz frequency range but spanning up to the millimeter-wave range. The workshop will introduce the main concepts to analyze and design digital PLLs, taking into account system design constraints, quantization noise and design of the mixed-blocks such as the DCO and the TDC. State-of-the-art techniques will be discussed, such as new architectures, TDCs and DCOs with high figure-of-merit, and digital-to-time converters.

1. Methods of Distributed Synchronization in Future Wireless Networks; Jaber Khoja; *Rockwell Collins;* Roger Dana; *Rockwell Collins*
2. Survey of Recent Advances in Microwave Frequency Synthesizers for Next generation Radar, Cellular and Satellite Systems; Ed Balboni; *Analog Devices*
3. Improved Frequency Stability in Low Power Consuming Oscillators and Clocks: CSAC, MEMS and Dual-Mode Crystal Oscillators; Vladimir Stofanik; *Slovak University of Technology in Bratislava, Slovakia*
4. Low Noise Sapphire Resonator and Oscillators; Michael Tobar; School of Physics, *The University of Western Australia*
5. VIDA Products Developed Miniaturized YIG Oscillators Enabled by Differential YIG Resonators; Ronald Parrott; *VIDA Products*; Allen Sweet; *VIDA Products;* Charles Fields; *VIDA Products*
6. Millimeter-Wave Injection-Locked CMOS Frequency Synthesizers; Howard Luong; Hong Kong University of Science and Technology
7. Prediction and Mitigation of Spurs and Phase Noise in Fractional Synthesizers; Gord Allan; *Analog Devices*
8. CMOS/SiGe Millimeter-Wave Frequency Generation; Mona Mostafa Hella ; *Rensselaer Polytechnic Institute*
9. Injection Locking Techniques for Low-power Millimeter-wave Phased Array Circuitry; James Buckwalter; *Electrical and Computer Engineering, University of California - Santa Barbara (UCSB)*

WSH 08:00 – 17:15

High-performance WLAN Transceiver Design and Calibration Techniques

Sponsors: RFIC

Organizers: Jean-Baptiste, *Begueret University of Bordeaux*; Yuan-Hung Chung, *MediaTek Inc*.

Abstract: Ubiquitous wireless connectivity keeps driving the development of high-performance/low-power wireless systems and building blocks for next generation transceivers. Today, the best and fastest performances are provided by the 802.11ac standard, delivering speeds up to several Gbps. To achieve these data rate levels, the 11ac works exclusively in the 5 GHz band in which wide bandwidths (80/160 MHz) are available. Nevertheless, to improve the speed, the next generation 802.11 ax answers this issue precisely: this technology will allow to quadruple the average data rate per user in a dense environment. The 11ax standard uses both 2.4 and 5GHz bands, wide channels (40 MHz, 80 MHz, and 160 MHz) and high order modulations (1024 QAM). The key technologies will be presented on how to achieve wider bandwidth, higher linearity, lower power consumption, better EVM, and highly integration, such as fulfilling the requirements of 802.11ax standard. Moreover, the workshop will present/discuss digital and mixed-signal techniques for correcting RF and analog imperfections of a WLAN transceiver circuits.

1. Discrete-Time Approach to Push High-Performance in WLAN Receivers; R. Bogdan *Staszewski; University College Dublin (UCD)*; Iman Madadi; *University College Dublin (UCD)*; Massoud Tohidian; *University College Dublin (UCD)*
2. A 2.4-GHz High-Efficiency Multilevel Outphasing WLAN Transmitter and An Integration RF Subsampling Receiver for Adaptive PA Linearization; SungWon Chung; *University of Southern California, Los Angeles, CA*; Philip A. Godoy; *Marvell*; Taylor W. Barton; *University of Colorado, Boulder*; Joel L. Dawson; *Eta Devices*
3. WLAN Digital Power Amplifiers, Circuit & Calibration Techniques; Renaldi Winoto; *Tectus Corp.*
4. Challenges in WLAN Front End Modules Designs Supporting the Proposed 802.11ax Standard; Darcy Poulin; *Skyworks Solutions*; Bill Vaillancourt; *Skyworks Solutions*
5. WiFi Access Point Front End Module Trends and Challenges; Brad Nelson; *Qorvo*; Bob Baeten; *Qorvo*
6. High-Performance CMOS Frequency Synthesizer for WLAN Applications; Kenichi Okada; *Tokyo Institute of Technology*
7. High Performance Frequency Synthesis with Digital Calibration Techniques; Fa Foster Dai; *Auburn University, USA*
8. Analog-to-Digital Converter Architecture for Low-power and High-speed Operation in Emerging Wireless Systems; Mike Shuo-Wei Chen; *University of Southern California*; Jae-Won Nam; *University of Southern California*

WORKSHOPS

Sunday, 10 June 2018

*All Workshops and Short Courses are located at the Pennsylvania Convention Center. Room assignments will be updated at the IMS2018 website (**www.ims2018.org**) and in the IMS Microwave Week Mobile App, at least one week prior to the IMS2018 start. On-site signs will also guide you to the Workshops and Short Courses rooms.*

WSI

08:00 – 17:15

High Efficiency Power Amplification for Emerging Wireless Communications Solutions from Devices to Circuits and Systems

Sponsors: IMS; RFIC

Organizers: Jeffrey Walling, *University of Utah;* Ayman Fayed, *Ohio State University*; Debopriyo Chowdhury, *Broadcom Limited*

Abstract: The "wireless revolution" is forcing the wireless industry to bring down consumer cost for wireless devices, while simultaneously increasing speed and performance. Consequently, RF transceivers are being implemented in CMOS digital integrated circuit (IC) processes. But, this poses design challenges for achieving watt-level RF power transmission that meets the spectral purity requirements of future wideband wireless communications. This workshop discusses the state-of-the-art architectures and trends for achieving RF power across the fields of devices, circuits and systems. We will explore options for power amplifiers (PAs) from the device level with presentations on GaN devices, to the power amplifier level, with presentations on CMOS and GaN PAs for emerging wireless communications solutions frequencies, and to the system level, with presentations on employing envelope tracking and on approaches for system level linearization.

1. An Introduction to High-Frequency GaN-based High Electron Mobility Transistors;
   Siddharth Rajan; *Ohio State University*
2. Efficiency-Enhancement of GaN PAs for 5G transmitters;
   Zoya Popovic; *University of Colorado*
3. CMOS PA design at mm-wave Frequencies;
   Patrick Reynaert; *KU Leuven*
4. Envelope Tracking for 5G transmitters;
   Donald Kimball; *Maxentric*
5. A Wideband Envelope Tracking Solution for WLAN Systems;
   Debopriyo Chowdhury; *Broadcom Limited*
6. Linearity, Bandwidth, and Back-Off Efficiency Enhancement Design Techniques for GHz Digitally Intensive CMOS Power Amplifiers;
   Jongseok Park; *Georgia Tech University*

WSJ

08:00 – 17:15

Millimeter-Wave Systems; Manufacturing, Packaging and Built-in Self Test

Sponsor: RFIC; ARFTG

Organizers: Didier Belot, *CEA-LETI Grenoble*; Mona Hella, *Rensselaer Polytechnic Institute*; Pierre Busson, *ST Microelectronics*

Abstract: This workshop discusses advanced manufacturing, packaging, and testing techniques for mm-Wave systems. Topics include plastic waveguides, on-chip antenna arrays, wafer scale integration, as well as calibration and testing issues. New approaches for in-situ measurement of individual element's response in large phased array systems are also presented. The workshop aims at bringing together experts from academia, industry and research labs to discuss the implementation and testing challenges and solutions for next generation wireless applications.

1. Packaging Approaches for mm-wave Applications;
   Tanja Braun; *Fraunhofer Institute for Reliability and Microintegration*
2. Antenna Arrays in the Mm-Wave Band;
   Kubilay Sertel; *ElectroScience Laboratory, The Ohio State University*
3. Code-Modulated Embedded Test for MM-Wave Phased Array;
   Brian Floyd; *ECE Dept., NC State University*
4. Built-in-Self-Test Methods for Phased-Array Beamforming ICs;
   Gabriel Rebeiz; *UC San Diego*
5. Millimeter Wave Testing: the Struggle between Feasibility and Mass Production Support;
   Mustapha Slamani; *GLOBALFOUNDRIES*
6. Plastic is Fantastic: How a Cheap Material Could Become the Next High Data Rate Communication Channel;
   Baudouin Martineau; *CEA-LETI Grenoble*
7. Packaging Solution for Low Cost Si based 100 Gb/s Wireless Links;
   Frederic *Gianesello; ST-Micro Crolles*
8. Polymer Microwave Fibers: A High-Speed, Robust and Low-Cost Alternative to Copper and Optical Wireline Communication;
   Patrick Reynaert; *University of Leuven (KU Leuven)*

WORKSHOPS

Sunday, 10 June 2018

*All Workshops and Short Courses are located at the Pennsylvania Convention Center. Room assignments will be updated at the IMS2018 website (**www.ims2018.org**) and in the IMS Microwave Week Mobile App, at least one week prior to the IMS2018 start. On-site signs will also guide you to the Workshops and Short Courses rooms.*

WSK 13:30 – 17:15

Towards Direct Digital RF Transceivers

Sponsors: IMS; RFIC

Organizers: Eric Klumperink, *University of Twente*; Waleed Khalil, *The Ohio State University*

Abstract: With significant advances in digital CMOS devices and their ft values reaching 300GHz, the direct digital-to-RF interface as well as early digitization becomes an increasingly more viable solution. RF systems hence widely use data-converters closer to the RF-port, as Moore's law makes digital signal processing in CMOS ever more powerful and cost effective. Direct digitization/analogization is still feasible only for certain applications, as dynamic range and speed requirements of the ADC and DAC often lead to a feasibility or power bottleneck. This workshop will review the state-of-the-art and trends in highly digital RF systems, highlighting key design challenges in different application domains as well as architectural solutions to address them. Techniques like channelization and time/frequency interleaving that can relax ADC and DAC requirements will be discussed as well as application examples. Finally, the workshop will review photonics-based data converters as they offer a compelling solution to the performance bounds set by sampling clock jitter.

1. Theoretical Comparison of Direct-Sampling vs. Heterodyne RF Receivers; Ramon Gomez, *Univ. of California, Irvine*
2. Architectures for Frequency-Domain Channelization of Broadband Signals; Ranjit Gharpurey, *Univ. of Texas at Austin*
3. RF-Sampling DACs and ADCs Integrated in 16nm FinFet SoCs; Bruno Vaz, *Xilinx*, Christophe Erdmann, *Xilinx*
4. Photonic Analog to Digital Converters for Direct Digital Receivers; Ronald Esman, Oliver King, Thomas Cullen, Daniel Esman, Altin Pelteku, *Rockwell Collins*

WSL 13:30 – 17:15

Ultra Low-Power Transceiver SoC Designs for IoT Applications

Sponsors: IMS; RFIC

Organizers: Yanjie Wang, *Intel Labs*; Yao-Hong Liu, *IMEC*

Abstract: Internet-of-Things (IoT) is regarded as one important part of the future 5G mobile communication, and draws much attention from both academia and industry in recent years. Due to the expansion of IoT and especially wearable sensors, remote personal monitoring based on the huge amount of real-time data streams has become a clear trend in the healthcare and wellbeing domains. IoT edge nodes continue to integrate increasingly complex sensing, compute, and connectivity capabilities into smaller form factors, while pursuing energy autonomy through multi-modal energy harvesting. This workshop explores the IoT designers' perspective on RFIC front-end, system designs/innovations, antenna/antenna-array designs, integrated sensors, packaging designs, as well as leading edge solutions for their energy harvesting, power management, etc.

1. Ultra Low Power Crystal Free Radios; Ali Niknejad; *UC Berkeley*; Osama Khan; *UC Berkeley*
2. Ultra-Narrow Band Communications; David Lachartre; *CEA-LETI*
3. An Ultra-Low Power Dual-Core ARM®-Based Wireless MCU in 40 nm RF-NV CMOS for Battery Supplied IoT Applications; Jean-Robert Tourret ; *NXP*
4. A Bidirectional Terahertz Pico-Radio in CMOS for Wireless Sensor Networks and Internet-of-Things; Taiyun Chi; *Speed Link*
5. Energy-Efficient Proprietary Transceivers for IoT and Smartphone-Based WPAN; Woogeun Rhee; *Tsinghua University*

WORKSHOPS

Monday, 11 June 2018

*All Workshops and Short Courses are located at the Pennsylvania Convention Center. Room assignments will be updated at the IMS2018 website (**www.ims2018.org**) and in the IMS Microwave Week Mobile App, at least one week prior to the IMS2018 start. On-site signs will also guide you to the Workshops and Short Courses rooms.*

WMA 08:00 – 17:15

Wireless Technologies for Implantable and Wearable Systems

Sponsor: IMS

Organizers: Giuseppina Monti, *Department of Innovation Engineering, University of Salento, Lecce, Italy*; Jan-Christoph Edelmann, *Department of Mechatronics, Microelectronics & Implantable Systems, University of Innsbruck, Austria*; Luciano Tarricone, *Department of Engineering for Innovation, University of Salento, Lecce, Italy*; Thomas Ussmueller, *Department of Mechatronics, Microelectronics & Implantable Systems, University of Innsbruck, Austria*

Abstract: This workshop addresses general issues related to the development of implantable and wearable systems, with a specific focus on healthcare and medical applications. To start with, the use of wireless implantable devices for both power and data transmission is addressed. This includes a scientific review dealing with the problem of communicating between implants and externals whereby crossing human tissue layers (biological matter is a hostile environment for radiofrequency-based communication). As per wearable systems, topics covered include ultra-low-power microwave components and systems, epidermal radioelectronics, eco-compatible substrates for minimally-invasive wearable devices, harvesting issues in the case of miniaturized wearable devices, as well as technological key-factors like the use of 3D/4D inkjet printing for manufacturing. In a nutshell, the workshop provides an extensive overview covering the main theoretical background and technological key-points for cutting-edge research and applications in the addressed area. A panel discussion will conclude the event stimulating interactions among attendees, speakers and chairmen.

1. Hello from the Other Side: Communication Between Implants and Externals; John Stockton; *Abbott Laboratories*
2. Resonant Inductive Wireless Power Transfer Link for Rechargeable Pacemakers; Luciano Tarricone, Giuseppina Monti, Maria Valeria De Paolis, Laura Corchia, *Department of Engineering for Innovation, University of Salento, Lecce, Italy*
3. Wireless Power and Antennas for Bio-Implants; Yong-Xin Guo; *National University of Singapore*
4. A Novel Measurement Approach for Inductive Through-the-Head Coupling; Jan-Christoph Edelmann, Dominik Mair, Thomas Ussmueller; *Department of Mechatronics, Microelectronics & Implantable Systems, University of Innsbruck, Austria*
5. Efficient Antenna Design Process for Wireless Wearable and Implantable Devices; C. J. Reddy; *Altair Engineering, Inc.*
6. Epidermal Radioelectronics: The Next Frontier of Wearable Systems; Gaetano Marrocco; *University of Roma Tor Vergata - Pervasive Electromagnetics Lab*
7. 3D/4D/Inkjet-Printed RF Wearable and Implantable Modules for Smart Skin and Health Monitoring Applications; Manos M. Tentzeris; *Ken Byers Professor in Flexible Electronics, Georgia Tech*
8. Compact Transparent Thin Film Antenna for Wearable Device; Hung-Wei Wu; *Kun Shan University, Taiwan*
9. Smart Powering of Wearable and Eco-Compatible Tags; Diego Masotti, Alessandra Costanzo; *University of Bologna, Italy*
10. Ultra-Low Power Microwave Components and Systems for Remote Health Monitoring Applications; Jasmin Grosinger, Wolfgang Bösch; *Institute of Microwave and Photonic Engineering, Graz University of Technology, Austria*
11. Development of a Wearable Energy Harvesting Powered Device for Monitoring Honey Bee Movement; Jake Shearwood, Daisy Man Yuen Hung, Paul Cross, Cristiano Palego; Bangor University

WMB 08:00 – 17:15

Microwave to THz Imaging Technologies for Biomedical Applications

Sponsor: IMS

Organizers: Andreas Stelzer, *Johannes Kepler University Linz, Austria*; Christian Damm, *University of Ulm, Germany*

Abstract: Medical imaging techniques are fundamental for modern health care. The various established imaging techniques work very well in most cases, but all do have certain limitations. Sometimes they simply cannot deliver good images because there is no physical contrast effect due to low interaction between the object and the used signal, e.g. soft matter not visible in x-rays. And many times these very expensive devices are not available in sufficient number, are not portable or it is simply too expensive to take continuously images in short intervals. Especially for future point-of-care applications it is desirable to have cheaper systems, capable of taking images at the bedside or monitor changing medical conditions over prolonged times. New microwave to THz imaging approaches offer these and even more possibilities which will not replace existing techniques but rather complement them. This workshop features imaging applications using microwave, mm-wave and THz systems for medical applications. Both sides, the theory and system design as well as the real clinical application including measurements and case studies are presented. Both areas are not treated separately but closely linked in the workshop having contributions from academia and industry with strong cooperation in between. Practitioners as well as researchers will present their results for a broad audience aiming to address the needs of electrical engineers as well as medical staff interested in the possibilities of this emerging area, the technology behind and inherent limitations. Medical applications include functional neuroimaging, diagnostic of stroke, traumatic brain injuries, burn wound assessment, surgical flap viability monitoring, breast cancer detection and ablation monitoring. Joint this workshop, have your questions answered and get in touch with renowned experts in this field during presentations and discussions.

1. On The Road Towards Pre-Hospital Stroke Diagnostics With A Microwave System; Andreas Fhager; *Chalmers University, Sweden*
2. Electromagnetic Tomography For Human Brain Imaging: Application For Detection Of Stroke, Traumatic Brain Injuries And Brain Tumor; Sergui Semenov, Ali Fard; *EMTensor GmbH*
3. Multiport VNA System for Microwave Imaging; Sebastian Poltschak, Andreas Haderer, Reinhard Feger, Andreas Stelzer; *Johannes Kepler University Linz, Austria*
4. Burn Wound Assessment Through Microwave Imaging; Daniel Oppelt, Martin Vossiek; *Friedrich-Alexander Universität Erlangen-Nürnberg, Germany*
5. Microwave Monitoring Of Breast Tumor Ablation; Susan Hagness; *University of Wisconsin-Madison, USA*
6. Implementation And Testing Of Prototype Systems For Medical Microwave Imaging And Sensing; Elise Fear, Jeremie Bourqui; *University of Calgary, Canada*
7. In Situ Monitoring Of Surgical Flap Viability Using Thz Imaging; Zachary Taylor; *UCLA, USA*

WORKSHOPS

Monday, 11 June 2018

*All Workshops and Short Courses are located at the Pennsylvania Convention Center. Room assignments will be updated at the IMS2018 website (**www.ims2018.org**) and in the IMS Microwave Week Mobile App, at least one week prior to the IMS2018 start. On-site signs will also guide you to the Workshops and Short Courses rooms.*

WMC

08:00 – 17:15

3D-/4D-/Inkjet-Printed RF Components and Modules for IoT, 5G and Smart Skin Applications

Sponsor: IMS

Organizers: Dominique Baillargeat, *XLIM Université de Limoges/CNRS, France;* Manos Tentzeris, *Georgia Tech*

Abstract: In this workshop, the particular importance and associated opportunities of additively manufactured radio- frequency (RF) components and modules for Internet of Things (IoT), 5G, Smart Skin and millimeter-wave ubiquitous sensing applications is thoroughly discussed. First, the current advances and capabilities of additive manufacturing (AM) tools are presented. Then, completely printed chipless radio-frequency identification (RFID), RF sensing and RF communication systems, and their current capabilities and limitations are reported. The focus is then shifted toward more complex backscattering energy autonomous RF structures. For each of the essential components of these structures, that encompass energy harvesting and storage, backscattering front ends, passive components, interconnects, packaging, shape-chaging (4-D printed) topologies and sensing elements, current trends are described and representative state- of-the-art examples reported. Finally, the results of this analysis are used to argue for the unique appeal of AM RF components and systems toward empowering a technological revolution of cost- efficient dense and ubiquitous IoT implementations.

1. Additively Manufactured RF/Wireless Modules for IoT, mmW and WSN Applications;
   Manos Tentzeris; *Georgia Tech*
2. Additive Manufacturing Applied To Microwave Filters And Antennas Up To 60 GHz;
   Nicolas Delhote; *XLIM Université de Limoges/CNRS*; Dominique Baillargeat; *XLIM Université de Limoges/CNRS*
3. FHE Process Maturation for RF Applications;
   John D. Williams; *Boeing Research & Technology*
4. Energy Harvesting-enabled Self-sustainable Inkjet-printed Wireless Sensor Platform and via-enabled multi-layer printed structure for IoT Applications;
   Sangkil Kim; *PUSAn National University*
5. Additive Manufacturing Enabling "More Than Moore" Innovation In The Semiconductor Industry;
   Benjamin Cook; *Texas Instruments Kilby Labs*
6. Additively Manufactured Active FMCW Radar Imaging for Long-Range Wireless Passive Sensors;
   Herve Aubert; *ENSEEIHT/LAAS CNRS, France*
7. Ink-Jet Printing Technology: A Suitable Approach For Sustainable Flexible Electronics;
   Henri Happy; *IEMN, France*
8. Inkjet And 3D Printed Circuits For The Internet Of Things And 5G Communication Systems;
   Apostolos Georgiadis; *Heriot-Watt University*; Spyros Daskalakis; *Heriot-Watt University, UK*
9. Additively Manufactured Wearable Electronics;
   Wenjing Su; *Google;* Jiang Zhu; *Google*; Huan Liao; *Google*; Manos Tentzeris; *Georgia Tech*
10. 3D-Printed Millimeter-Wave Quasi-Optical Lens Systems;
    Arthur Paolella; *Harris Corporation*

WMD

08:00 – 17:15

Power Amplifier Technologies for 5G Communications Systems

Sponsor: IMS

Organizers: Harris Moyer, *HRL Laboratories*, LLC.; Zoya Popovic, *University of Colorado, Boulder*

Abstract: Proposed standards for 5G communications utilize mmW frequency bands (>28 GHz) whereas current 4G technology still operates below 6 GHz. Power amplifier performance capability will be a critical component for developing specifications for 5G base stations and handsets. In addition to cost considerations, efforts to increase linearity and improve efficiency for systems with higher order amplitude modulation will be emphasized. Over the past decade, significant improvements in GaN technologies and further maturation of GaAs, CMOS and SiGe processes have enabled the potential for low cost production of mmW power amplifiers. Also, efficiency enhancement techniques such as Dougherty, Chireix outphasing and supply modulation are enabling amplification of signals with high peak-to-average power ratios (PAPR) such as 64QAM and 256QAM. With the frequency of operation increasing by an order of magnitude, amplifier architectures and device technologies will need to be re-evaluated to determine the proper balance between cost and overall system performance. Because the number of proposed bands widely varies and ranges from 28 to 71 GHz, there will be possibilities for multiple types of power amplifiers operating at different powers levels and frequencies. The goal of this workshop is to present a comparison of different material systems, such as GaAs, SiGe, CMOS, InP GaN on SiC and GaN on Si, especially in terms of process maturity and cost, as well as performance at higher frequencies.

1. Qorvo 5G PA and Front End Module MMIC Technology;
   Michael Roberg; *Qorvo, Richardson, TX*
2. GaN MMIC Technology for mmW 5G;
   Miroslav Micovic; *HRL Laboratories, LLC*.
3. Millimeter-wave CMOS Power Amplifiers for 5G Applications;
   Kamran Entesari; *Texas A&M University*
4. Exploiting Digital Friendly CMOS Power Amplifiers and Systems for 5G Communications;
   Jeffrey S. Walling; *University of Utah*
5. RF and Millimeter-wave SiGe and SOI CMOS for High Peak and Average Efficiency;
   James Buckwalter; *University of California, Santa Barbara*
6. 5G and InP HBT MMIC technology – the Prospects and Opportunities at mm-Wave;
   Zach Griffith; *Teledyne Scientific & Imaging*
7. 100nm and 60nm GaN/Si MMICs: The optimum complement to Si MMICs for 5G Mobile Telecommunications;
   Marc Rocchi; *OMMIC SAS*
8. GaN on Si with CMOS for Low Cost Advanced Phased Arrays;
   Christopher Galbraith; *MIT Lincoln Labs*
9. Advanced GaAs Integration for 5G Power Amplifiers;
   David Danzilio; *WIN Semiconductors Corp.*

WORKSHOPS

Monday, 11 June 2018

*All Workshops and Short Courses are located at the Pennsylvania Convention Center. Room assignments will be updated at the IMS2018 website (**www.ims2018.org**) and in the IMS Microwave Week Mobile App, at least one week prior to the IMS2018 start. On-site signs will also guide you to the Workshops and Short Courses rooms.*

WME

08:00 – 17:15

Digital Pre-Distortion and Post-Correction from DC to mmWave for Wireline and Optical Communications

Sponsor: IMS; RFIC

Organizers: Hermann Boss, *Rohde & Schwarz, Munich, Germany*; Noriaki Kaneda, *Nokia Bell Labs, Murray Hill, NJ, USA;* SungWon Chung, *University of Southern California, Los Angeles, CA, USA*

Abstract: This workshop overviews the recent advancements in digital pre-distortion (DPD) and digital post-correction (DPC) techniques over a broad range of spectrum from DC to mmWave. Beyond the classical DPD applications on wireless and satellite power amplifier linearization, this workshop will culminate the applications of the DPD and DPC techniques for wireline and optical communications. With wireline communication, to advance the data rate limit, designers are leveraging a high-order modulation, which requires a digital-to-analog converter (DAC) based transmitter along with an analog-to-digital converter (ADC) based receiver. Since the poor linearity of high-speed data converters often becomes a performance bottleneck with such high performance wireline transceivers and also with wireline MIMO transceivers, DPC and DPD techniques become essential not only to the equalization of nonideal lossy channels but also to the linearization of nonlinearities in high-speed circuit elements. As the recent trend of using a high-order wideband modulation continues with Tb/s coherent optical communication, fiber nonlinearity has become a critical design challenge. A robust and low-power implementation of DPC and DPD, which includes the realization of nonlinearity tolerant modulation and coding schemes as well as adaptive pre-emphasis and equalization, is becoming increasingly important. This workshop for the first time brings together researchers from industry and academic working on diverse DPD and DPC techniques in wireless, wireline, and optical communications in one place, revisiting the fundamental principles in common as well as providing a unique opportunity to learn from cross-platform implementations.

1. Linearization of Power Amplifiers Used in Radio Frequency Transmitters; Neil Braithwaite; *Consultant, Orange, CA, USA*
2. Model Order Reduction Techniques for Digital Predistortion in Highly Efficient Power Amplification Architectures; Pere Gilabert, Gabriel Montoro Lopez, Thi Pham; *Universitat Politècnica de Catalunya, Barcelona, Spain*
3. A Digital PLL Architecture with Digital-Signal-Processing Techniques for Spur Mitigation; Cheng-Ru Ho, Mike Chen; *University of Southern California, Los Angeles, CA*
4. ADC-Based Receiver Calibration and Equalization Techniques; Samuel Palermo; *Texas A&M University, TX, USA*
5. ADC Nonlinearity in Wireline Receivers; Anthony Carusone; *University of Toronto, Canada*
6. Digital Post-Correction of Nonlinearity with Memory Effects in GaN HEMT Track-and-Hold Circuits for High Performance ADCs; SungWon Chung; *University of Southern California, Los Angeles, CA, USA;* Puneet Srivastava; *Analog Devices, Willmington, MA, USA;* Xi Yang, Tomás Palacios, Hae-Seung Lee; *Massachusetts Institute of Technology, Cambridge, MA, USA*
7. A Feed Forward Equalization Transmitter Architecture which Is Robust to Coefficient Errors for High-Speed Wireline Communication; Byungsub Kim, Seungho Han, Sooeun Lee, Minsoo Choi, Jae-Yoon Sim, Hong-June Park; *Pohang University of Science and Technology, Korea*
8. Digital Predistortion and Post Equalization Techniques in Optical Communications; Noriaki Kaneda; *Nokia Bell Labs, Murray Hill, NJ*
9. Digital-Preprocessed Analog-Multiplexed DAC for Ultra-high-speed Optical Transmission; Hirosh Yamazaki, Munehiko Nagatani, Fukutaro Hamaoka, Masanori Nakamura, Hideyuki Nosaka, Toshikazu Hashimoto, Yutaka Miyamoto; *NTT Network Innovation Laboratories, Kanagawa, Japan*; Shigeru Kanazawa; *NTT Device Innovation Center, Kanagawa, Japa*
10. Digital Equalization in Ultra-High Capacity Coherent Optical Transmission; David Millar; *Mitsubishi Electric Research Laboratories, MA, USA*

WMF

08:00 – 17:15

Microwave Cells: from Biological Effects to Innovative Techniques for Cell Analysis

Sponsor: IMS

Organizers: Katia Grenier, *LAAS-CNRS, France;* Martin Schuessler, *TU Darmstadt, Germany*, Rolf Jakoby, *TU Darmstadt, Germany*

Abstract: In the microwave regime the interaction between electromagnetic fields and biological cells is characterised by strong dielectric dispersion and field penetration of the matter. The resulting biological effects are classified into thermal and non-thermal effects and their understanding is the basis for the engineering of tailored analysis tools and applicators for cell biology. Due to the nature of the electromagnetic fields, the interaction between fields and cells is per se contactless. By proper power control, it is non-destructive, and thus by applying dielectric spectroscopy, a label free cell analysis method can be implemented. This analysis technique is highly flexible since it can be applied to a large number of cells in suspension as well as for the investigation of single cells, whereby it is possible to resolve sub-cellular structures. Besides this sensing functionality, electrokinetic forces can be used to imprint mechanical forces on cells. There are several well established applications for forced cell movement e.g. for analysis or sorting. Forces can also be applied only to parts of cells e.g. the membrane by using CW or pulsed high frequency signals, in order to form temporary pores for the uptake of exogenous molecules. With the evolution in these applications, more detailed modeling of the interactions between microwave EM fields and cells is needed, which requires the simultaneous consideration of thermal effects, effects of flow, cell morphology and deformation, etc. For the realization of devices in commercially attractive lab-on-a-chip setups the integration of CMOS circuits and microfluidics offers a powerful platform. This technology even allows for multi-sensor integration e.g. for dielectric and mechanical sensors and real time characterization of cells. The workshops intends to exemplarily highlight the state of the art in this fascinating field of research to motivate a scientific discussion on existing and future developments.

1. Mastering Electric Fields at the Atomic Level to Transport Drugs and Biomarkers Across the Plasma Membrane Into Living Cells; Henry David Herce; *Harvard Medical School, Dana-Farber Cancer Institute, Boston, Massachusetts, USA*
2. Microwave Assisted Electroporation; Soenke Schmidt; *TU Darmstadt, Germany*
3. Intense and Intensified Electric Fields in the Low-Permittivity Interior of the Biological Membrane — Nanoscale Reactor for Hydroxyl Radical Formation; Tom Vernier; *Frank Reidy Research Center for Bioelectrics, Old Dominion University (ODU), Norfolk, Virginia, USA*
4. Dielectric Response of Single Cells to Applied Stress; Greg E. Bridges; *University of Manitoba, Winnipeg, Canada*
5. Multi-Physics Modeling and Measurements for Microwave Microfluidic Devices and Cellular Interactions; Ilja Ocket; *ESAT- TELEMIC, Telecommunications and Microwaves, Kasteelpark Arenberg 10*
6. Dosimetry for RF and nsPEF Biomedical Investigation; Philippe Leveque; *Xlim, CNRS-University of Limoges, France;* Delia Arnaud-Cormos; *Xlim, CNRS-University of Limoges, France*
7. Microwave Dielectric Spectroscopy of Cells and Molecules; Katia Grenier; *LAAS-CNRS, Toulouse, France;* David Dubuc; *University of Toulouse, France*
8. Measuring the Microwave Permittivity of Giant Unilamellar Vesicle Membranes; Pingshan Wang; *Clemson University, SC, USA;* Yan Cui; *Clemson University, SC, USA*
9. Broadband Electromagnetic Characterization of Individual Biological Cells and Subcelluar Structures; James C. M. Hwang; Lehigh University, PA, *USA*
10. A Microwave CMOS/Microfluidics Dielectric Spectrometer for Biosensing and Flow Cytometry; Jun-Chau Chien; Stanford University, CA, *USA*

Workshops

WORKSHOPS

Monday, 11 June 2018

*All Workshops and Short Courses are located at the Pennsylvania Convention Center. Room assignments will be updated at the IMS2018 website (**www.ims2018.org**) and in the IMS Microwave Week Mobile App, at least one week prior to the IMS2018 start. On-site signs will also guide you to the Workshops and Short Courses rooms.*

WMG

08:00 – 17:15

Recent Advances in Efficiency and Linearity Enhancement Techniques for RF Power Amplification

Sponsor: IMS

Organizers: WMG Andrei Grebennikov, *Sumitomo Electric Europe, UK*; Marc Franco, *Qorvo, NC*

Abstract: This workshop will discuss the recent advances in efficiency and linearity enhancement techniques for RF power amplification to use in modern and future generation wireless communication systems. These include both high-efficiency load-network techniques in power amplifiers such as Class F and Class E and their combinations and approximations using embedding and de-embedding nonlinear device models and advanced high-efficiency transmitter architectures based on envelope tracking, broadband Doherty, multi-level outphasing, and other load-modulated techniques using different technologies and at different frequencies including millimeter waves. Modern trends in system-level approaches including power amplifier behavioral modeling and analog/digital linearization schemes including multi-band/multi-channel power amplifier linearization will also be discussed.

1. The Role of Active Device in Power Amplifier Design; Gayle Collins; *Nuvotronics, NC*
2. Class F, Class E and Their Derivatives; Mury Thian; *Queen's University Belfast*
3. Accelerated Design of High-Efficiency RF Power Amplifiers Using Nonlinear Embedding; Patrick Roblin; *Ohio State University, Columbus*
4. High-Power High-Efficiency Broadband Doherty Amplifiers; James Wong; *Sumitomo Electric Europe, UK*
5. Envelope Tracking for Handset Transmitters; Florinel Balteanu; *Skyworks Solutions, CA*
6. Supply-Modulated GaN PAs for Broadband High-PAR Signals; Zoya Popovic; *University of Colorado Boulder*
7. Load Modulation Techniques for Efficient Power Amplifiers; Taylor Barton; *University of Colorado Boulder*
8. Linear and Efficient Transmitters for Active Antenna Arrays; Christian Fager; *Chalmers University of Technology, Sweden*
9. Digital Linearization of RF Power Amplifiers; Neil Braithwaite; *Tarana Wireless, CA*
10. Multiband/Multichannel Power Amplifier Linearization; Meenakshi Rawat; *Indian Institute of Technology Roorkee*
11. Wideband Linearization for the Millimeter-Waves; Allen Katz; *College of New Jersey/Linearizer Technology*

WMH

08:00 – 11:50

Microwave and Millimeter-Wave Radiometers: Component Technologies, System Architectures, and Emerging Applications

Sponsors: IMS; RFIC

Organizers: Hasan Sharifi, *HRL Labs*; Robert Schmid, *Johns Hopkins Applied Physics Lab*

Abstract: Radiometers precisely measure the electromagnetic radiation that is passively emitted by physical media. At microwave and millimeter-wave frequencies, radiometers can provide useful remote sensing observations under adverse conditions (rain, fog, etc.) and without external illumination where infrared and optical sensors fail. Over the past decade, both the underlying semiconductor technologies and the application spaces of radiometers have evolved significantly. The continued performance increases of advanced node CMOS and scaled SiGe HBTs have enabled the development of radiometers for applications requiring low cost, high volume, and miniaturization. In addition, the recent development of terahertz InP/InGaAs HEMTs have enabled high-resolution radiometry at previously inaccessible frequencies. These advances necessitate a re-evaluation of architecture and technology tradeoffs to fully leverage the unique capabilities enabled by these technologies. Furthermore, while radiometers have traditionally been limited to use in niche scientific and military applications, the application spaces of these systems have grown substantially. Passive imaging systems are now widely implemented for public security, and noninvasive subcutaneous sensing radiometers are increasingly utilized for medical applications. In addition, the proliferation of CubeSats has created a demand for highly integrated radiometers which can enable continuous observations of the Earth's atmosphere and yield improved weather forecasting and climate modeling. This workshop will discuss radiometer theory and system architectures, and will highlight current state-of-the-art microwave and millimeter-wave radiometers in security imaging and scientific applications. A comparison of these systems will show the how the varying application spaces impose requirements which flow down through the system architecture and component designs to the semiconductor technologies. Calibration procedures and techniques for validating, operating, and ensuring accurate data retrieval from these systems will also be discussed.

1. CMOS Systems-on-Chip for NASA Radiometry and Spectroscopy from microwave to THz; Adrian Tang; *Jet Propulsion Lab*
2. Millimeter-Wave Radiometers at 94 GHz and 140 GHz Using Advanced SiGe; Gabriel Rebeiz; *University of California San Diego*
3. Low Noise Radiometers for Passive Millimeter Wave Imaging; Harris Moyer; *HRL Labs*
4. An Overview Of Millimeter Wave Radiometry: Imaging Phenomenology And Applications; David Wikner; *US Army Research Laboratory*
5. Microwave Radiometers for Earth Observation from Space; Jeff Piepmeier; *NASA's Goddard Space Flight Center*

WORKSHOPS

Monday, 11 June 2018

*All Workshops and Short Courses are located at the Pennsylvania Convention Center. Room assignments will be updated at the IMS2018 website (**www.ims2018.org**) and in the IMS Microwave Week Mobile App, at least one week prior to the IMS2018 start. On-site signs will also guide you to the Workshops and Short Courses rooms.*

WMI 13:30 – 17:15

Automotive Radar and Vehicular Network Security

Sponsor: IMS

Organizers: John Pierro, *Telephonics*

Abstract: The march toward autonomous, self-driving cars and trucks is moving faster than anyone could have imagined. The future is a sensor-laden vehicle loaded with LIDAR, optical cameras, and nearly a half-dozen radars. Sensors will be relied on to safely navigate the vehicle on roads both urban and rural, including high speed interstates, congested city streets, and rural back roads. Car manufacturers are investing heavily in the technology as are the ride-hailing services such as Uber and Lyft. In June, 2016 a Tesla Model S self-driving car was involved in a crash with a tractor-trailer and the driver was killed. It is believed that the cause of the crash was a malfunctioning optical sensor. This example demonstrates how critical sensors are to the safe operation of the car. Now, instead of a hardware failure, imagine what could have happened if a third party were to launch an attack and intentionally disrupt the sensor's operation? A variety of methods are available: (1) jamming, the transmission of RF signals (in the case of radar) to interfere with the radar, (2) spoofing, the replication and retransmission of radar transmit signals designed to provide false information and to corrupt data, and (3) interference, the intentional or unintentional modification or disruption of a radar signal due to unwanted signals such as signals from different automotive radars. IMS has been very successful in drawing the best speakers and organizing very strong workshops on the latest advancements in MMW radar technology. That said, virtually nothing has been said about security issues in automotive systems such as radar and dedicated short range communications systems. This workshop is focused on starting the conversation about this important topic. Four very knowledgeable speakers with expertise in the security aspects of these complex systems will address these critical issues.

1. Millimeter-Wave Automotive Radar:Background Theory, State-of-the Art, and Vulnerabilities; Domenic John Belgiovane; *The Ohio State University/Orbital ATK*
2. Resilient Millimeter-Wave Radar Sensor Concepts for Secure Autonomous Transportation; Herman, Jalli Ng; *IHP*
3. Automated Vehicle Sensor Insecurity?; Jonathan Petit; *OnBoard Security*

WMJ 08:00 – 17:15

Advanced Applications of Nonlinear Vector Network Measurements for broadband RF Power Amplifiers Design and Linearization

Sponsors: IMS; ARFTG

Organizers: Karun Rawat, *Indian Institute of Technology Roorkee, India*; Patrick Roblin, *Ohio State University, USA*

Abstract: With the advent of 5G communication era, there is huge upcoming requirement of high data rate for supporting heterogeneous network. The key requirement such as spectrum efficient modulation schemes, multiple access techniques and carrier aggregation etc. are under investigation to handle spectral as well as energy efficient radio transmission. In particular, the radio frequency (RF) and microwave power amplifiers (PAs) and transmitters should meet these challenges of high bandwidth and efficiency. This essentially requires innovations in the area of nonlinear design and characterization to develop new generation of PAs and transmitters. This workshop will focus on the new areas explored in non-linear vector analysis and its application in developing new strategies for enhancing the PA and transmitter design. This will particularly focus on non-linear device characterization and measurement challenges for catering to the needs of 5G communication standards. The workshop will focus on following key areas targeting the demands of 5G applications: (1) Broadband nonlinear measurements with NVNA and high efficiency PA design for handling wideband modulated signals with high crest factor. (2) Non-linear device characterization, modeling and PA design based on non-linear embedding and other novel techniques. (3) New digital schemes and architectures for developing non-linear behavioral model and linearization of broadband PA and wireless transmitters for 5G applications. In addition to the above key areas, this workshop will also address the challenges in developing new digital radio front ends and massive MIMO platforms for high speed data link and throughput. This workshop will bring together some of the leading world experts to present the novel measurement techniques and associated PA as well as linearized transmitter design schemes to cater to the upcoming needs of 5G communication.

1. Power Amplifier Design Using Nonlinear Embedding: Waveform Engineering At The Current Generator Plane; Antonio Raffo; *University of Ferrara, Italy; Dominique Schreurs*; K.U. Leuven, *Belgium*
2. Bandwidth And Efficiency Enhancement Schemes In Radio Frequency Power Amplifiers; Karun Rawat; *Indian Institute of Technology Roorkee, India*
3. Systematic Design of High Efficiency Doherty and Outphasing PA from Load-Pull Data; Christian Fager; *Chalmers Univ. of Technology, Sweden*
4. PA design using Simulation-Based Nonlinear-Embedding: Trust but Verify with NVNA Measurements; Patrick Roblin; *Ohio State University, USA*
5. Linearization of Broadband PA and Wireless Transmitters for 5G Applications; Meenakshi Rawat; *Indian Institute of Technology Roorkee, India*
6. New Approach For Active Devices Characterization Under Wideband Modulated Signals Within a Coherent Stimulus- Response Network Environment; Jean Pierre Teyssier; *Keysight Technologies, USA*
7. Load Modulation Measurements of X-Band Outphasing Power Amplifiers; Zoya Popovic; *University of Colorado, Boulder, USA*
8. Non-Linear Device Characterization And Modeling For Technology Development And Pa Design; Sonja Nedeljkovic; *Broadcom, Fort Collins, USA*

WORKSHOPS

Monday, 11 June 2018

*All Workshops and Short Courses are located at the Pennsylvania Convention Center. Room assignments will be updated at the IMS2018 website (**www.ims2018.org**) and in the IMS Microwave Week Mobile App, at least one week prior to the IMS2018 start. On-site signs will also guide you to the Workshops and Short Courses rooms*

WMK

08:00 – 17:15

Affordable Phased-Arrays for SATCOM and Point-to-Point Systems Using Silicon Technologies

Sponsor: IMS

Organizers: Domine Leenaerts, *NXP – Netherlands*; Frank vanVliet, *TNO – Netherlands*; Gabriel Rebeiz, *UCSD*

Abstract: SiGe and CMOS has allowed for a ten-fold reduction in the cost of phased-array systems, and systems employing silicon beamformer chips are currently being developed for SATCOM and terrestrial point-to-point systems. This workshop presents the latest work in this area, and covers chip development, antenna development, phased-array systems, built-in-test, and several system-level demonstrators. It is shown that state-of-the-art systems can be built using silicon technologies, and that affordable phased-arrays with tho*USA*nds of elements are becoming a reality.

1. Ka-Band Phased Array For Airborne Terminals;
   Maria Carolina *Viganò; ViaSat-Switzerland*
2. Modern AESA Panel Array for SatCom Applications;
   Patrick Schuh; *Hensolt - Germany*
3. Techniques And Technologies Enabling Affordable Satcom Antenna Systems;
   F.E. van Vliet ; *TNO - Netherlands*
4. Single Panel Phased-Arrays for SATCOM and Low Power Radars;
   Lee Paulsen; *Rockwell Collins - US*
5. Modular Phased Array Antennas For Satcom At Millimeter Wavelengths;
   Tobias Chaloun; *Univ. Ulm*
6. Afforrdable Ku and Ka-band SATCOM Phased-Arrays;
   Gabriel Rebeiz; *UCSD*
7. Phased Array Development for High Altitude Platforms and Satcom at Facebook Connectivity Labs;
   Will Theunissen; *Facebook*
8. Advanced Silicon Beamformer Chips for Ku-band and Ka-band SATCOM Systems;
   Tumay Kanar; *IDT*
9. SiGe BiCMOS Transmitter for Ka-band Satellite Phased Array System;
   Domine Leenaerts; *NXP Semiconductors*

NOTES

SHORT COURSES

Monday, 11 June 2018

*All Workshops and Short Courses are located at the Pennsylvania Convention Center. Room assignments will be updated at the IMS2018 website (**www.ims2018.org**) and in the IMS Microwave Week Mobile App, at least one week prior to the IMS2018 start. On-site signs will also guide you to the Workshops and Short Courses rooms.*

SMA 08:00 – 11:50

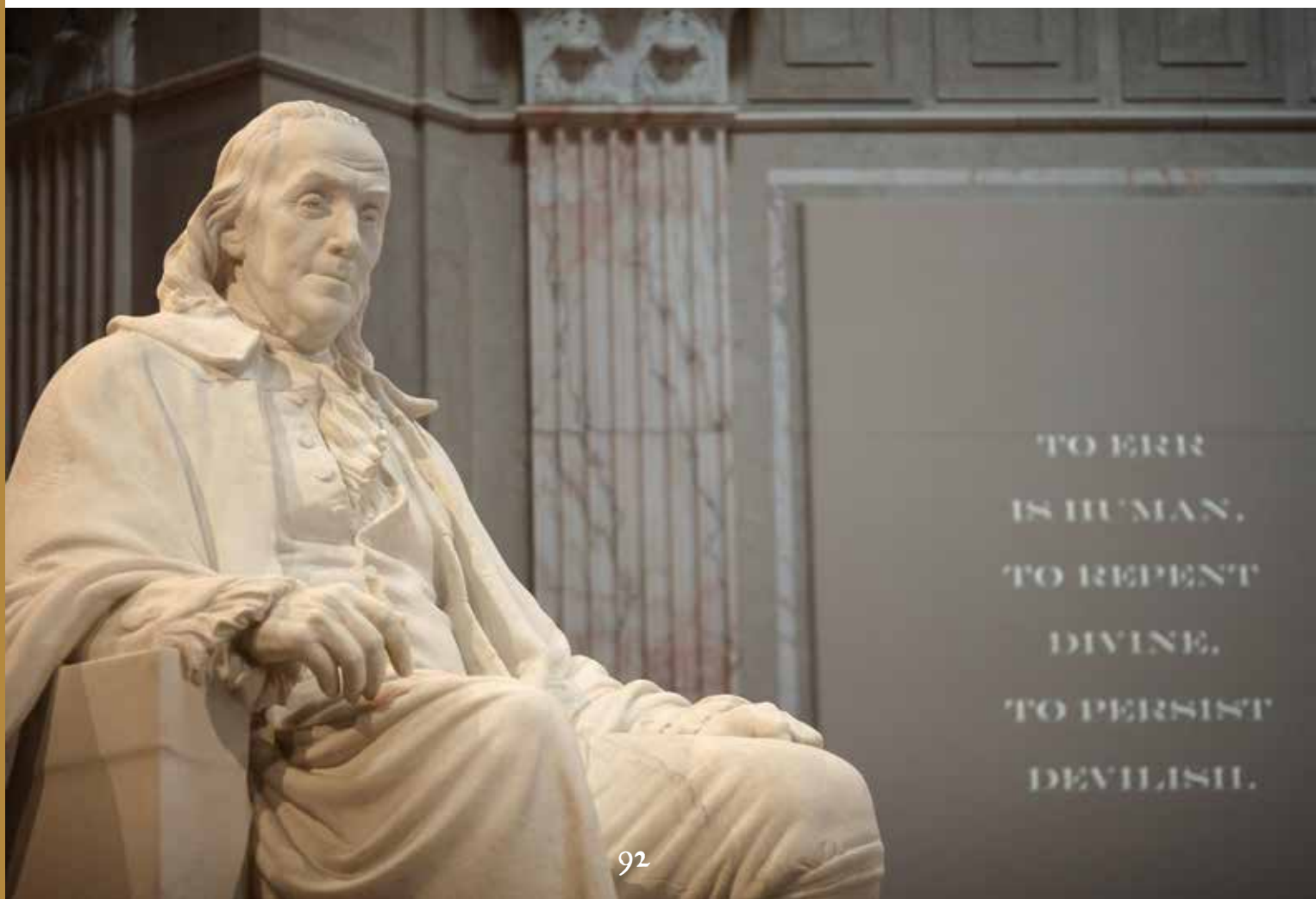
Practical Computer Modeling for Electromagnetic Medical Device Designs

CANCELLED

SMB 13:30 – 17:15

Fundamentals of Magnetic-Resonance Imaging

CANCELLED



WORKSHOPS

Friday, 15 June 2018

*All Workshops and Short Courses are located at the Pennsylvania Convention Center. Room assignments will be updated at the IMS2018 website (**www.ims2018.org**) and in the IMS Microwave Week Mobile App, at least one week prior to the IMS2018 start. On-site signs will also guide you to the Workshops and Short Courses rooms.*

WFA

08:00 – 17:15

Ultra-Low-Power Nanowatt to Microwatt Receivers for the Internet of Things

Sponosrs: IMS; RFIC

Organizers: N. Scott Barker, *University of Virginia*; Songbin Gong, *University of Illinois, Urbana-Champaign*; Steven Bowers, *University of Virginia*

Abstract: Continued expansion of the internet of things (IoT) into more and ever smaller devices requires development of low power and ultra low power communications radios. The receivers for these devices can be particularly challenging as they seek to increase sensitivity in a noisy and interference filled environment while maintaining low dc power levels needed to maximize time between battery charges or to enable the complete elimination of the battery all together in favor of energy harvesting. Many of these devices are parts of sensor nodes, which spend the majority of their time in an asleep-yet-alert state where a wakeup receiver is the only powered on block. In such scenarios, the power consumption of the receiver can become the dominant power consumer of the entire node. While much of the work up to this point has been in CMOS integrated circuits, new research in other technologies such as MEMs based receivers also show promise for the future. This workshop will address the design challenges associated with developing low power receivers for IoT applications including tradeoffs between RF frequency, data rate, sensitivity, power, and technology. Prominent researchers from both academia and industry will give insight into their individual design philosophy and vision for where the field is headed, followed by a moderated panel discussion to try to reconcile differences in their visions and take additional questions from attendee.

1. Recent Trends in Ultra-Low Power Radios;
   David Wentzloff; *University of Michigan*
2. Nanowatt Wake-Up Receivers: Exploring Power And Sensitivity Trade-Offs;
   Patrick Mercier; *University of California, San Diego*
3. Radio Frequency Micro-Systems For Iot Inspired Front-End Signal Processing;
   Songbin Gong; *University of Illinois at Urbana-Champaign*
4. Resonant Micromechanical Receivers;
   Gianluca Piazza; *Carnegie Mellon University*
5. Design Considerations Of Ultra Low Power Radios For The IoT;
   Nathan Roberts; *PsiKick Inc.*
6. Wirelessly-powered Centimeter-Scale Nanowatt Radios in CMOS;
   Arun Natarajan; *Oregon State University*
7. Ultra-low Power Receivers In Highly Scaled CMOS;
   Brent Carlton; *Intel*
8. Muting the Chatter: Maintaining Sensitivity Of Nanowatt Receivers In High Interference Environments;
   Steven Bowers; *University of Virginia*

WFB

08:00 – 17:15

RF Front-Ends for Enhanced Mobile Communications Towards 5G

Sponsors: IMS; RFIC

Organizers: Vadim Issakov, *Infineon Technologies;* Uwe Rueddenklau, *Infineon Technologies*; Amelie Hagelauer; *FAU Erlangen-Nürnberg*

Abstract: The 5th generation (5G) wireless systems are the proposed telecommunication standards, which offer the next major disruptive technological step in mobile communications. The future 5G systems aim at much higher data rates, higher density of mobiles users, lower network latency, spectral efficiency and enhanced signaling compared to the existing 4G systems. To achieve these goals, the operation will be extended to new frequency bands at mm-wave frequencies. Additionally, massive MIMO systems and novel system architectures like digital, hybrid or analog beamforming are expected to be extensively employed. Therefore, major research efforts towards 5G are focusing nowadays on RF front-ends beamforming transceivers and antenna arrays at mm-wave frequencies. Numerous new technological challenges need to be resolved not only on the level of portable user equipment (UE), but also on the level of wireless radio access networks (RAN) and backhaul, including macro-, micro and pico-cells. Particularly, the RAN infrastructure needs to support much higher data rates and enormous amount of data for 5G, as required by enhanced Mobile Broadband (eMBB) applications. The goal of this full-day workshop is to address the transition from the current state-of-the-art 4G systems towards 5G with a particular focus on challenges related to hardware implementation of RF Front-End Modules (FEMs), beamforming transceivers and antenna arrays. Speakers from leading companies and academia will present several aspects related to semiconductor technology choice, circuit design techniques, novel system architectures, packaging, antenna arrays and network considerations. The talks will distinguish between challenges related to mobile radio user-equipment on the one hand, but also on the base-stations and backhaul networks on the other hand. A brief concluding discussion will round-off the workshop to summarize the key learnings on the wide range of aspects presented during the day.

1. Millimeter-Wave RF Front-Ends for Enhanced Mobile Communications Towards 5G: An Industry View;
   Renato Lombardi; *Huawei Technologies, Research Center, Italy*
2. mm-Wave Front-End Challenges for 5G Base Stations;
   Kristoffer Andersson; *Ericsson, Sweden*
3. Power Amplifier Implementation Challenges in Front-Ends for 5G mobile Broadband; Sergio Pires; *Ampleon Netherlands B.V., Netherlands*
4. Modular Phased-Array Solution with Beam-Steering Antennas for 5G Millimeter-Wave RAN;
   Nebojsa Maletic[1], Andrea Malignaggi[1], Dietmar Kissinger[1,2];
   Presenter: Nebojsa Maletic, [1]*IHP;* [2]*Technische Universität Berlin*
5. Front-End Module Architecture & Silicon Technology Front-End for 5G Radio Interface; Anirban Bandyopadhyay; *GLOBALFOUNDRIES, NY, USA*
6. Antenna in Package Integration for 5G and Beyond;
   Authors: Thomas Zwick, Mario Pauli, Presenter: Mario Pauli,
   Karlsruhe Institute of Technology
7. System Considerations for 5G mm-Wave Transceiver RAN vs. UE;
   S. Schindler, M. Wilhelm, U. Rüddenklau, V. Issakov, L. Verweyen
8. Challenges and Opportunities of mm-Wave for 5G Mobile Radio;
   Jonathan Jensen; *Intel Corporation, Hilsboro, USA*
9. 28GHz CMOS Phased-Array Transceiver for 5G New Radio;
   Kenichi Okada; *Tokyo Institute of Technology, Japan*
10. mmWave RF Front-Ends for 5G; Barend van Liempd; *imec vzw, Belgium*;
    Mark Ingels; *imec vzw, Belgium*

WORKSHOPS

Friday, 15 June 2018

*All Workshops and Short Courses are located at the Pennsylvania Convention Center. Room assignments will be updated at the IMS2018 website (**www.ims2018.org**) and in the IMS Microwave Week Mobile App, at least one week prior to the IMS2018 start. On-site signs will also guide you to the Workshops and Short Courses rooms.*

WFD 08:00 - 11:50

Advanced Synthesis Techniques for Reduced Size Filtering Networks

Sponsor: IMS

Organizers: Fabien Seyfert, *INRIA*; Stéphane Bila, *Xlim*

Abstract: Today's microwave communication hardware manufacturers face more than ever the often contradictory challenges to provide filtering equipments with a reduced footprint, exhibiting high selectivity at the edges of the pass-bands, possibly with the lowest losses, and all this of course at minimal cost. Once the choice of a particular technology has been met, often dictated by the implementation of the end application, the remaining optimization margin resides essentially in the selected synthesis technique used to design and tune the hardware. In this workshop we will focus on advanced design procedures dedicated, in particular, to the reduction of the hardware's footprint. For example design procedures allowing the manufacturing of inline filters implementing transmission zeros for highly selective responses will be presented, as well as the use of multi-mode cavities for the realisation of mult-iband filters and multiplexers will be presented. Advanced synthesis and tuning techniques for the design of waveguide filters and multiplexers, used for example in space applications where the size issue is particularly acute and a co-design technique for antenna filters that allows to implement the matching network within the filtering device itself will also be detailed.

1. Novel Synthesis Techniques For Compact Inline Filters With Transmission Zeros;
   Giuseppe Macchiarella; *Politecnico di Milano*; Simone Bastioli; *RS Microwave*; Richard Snyder; *RS Microwave*
2. Novel Solutions For The Synthesis And Practical Design Of Waveguide Filters And Multiplexers For Space Applications;
   Santiago Cogollos; Universitat Politecnica de Valencia; Vicente Boria; Universitat Politecnica de Valencia
3. Analytical Circuit Model Extraction for Computer Aided Tuning of Microwave Filters and Diplexers;
   Ke-Li Wu; Chinese University of Hong Kong
4. Synthesis and Design of Multi-band Filters Employing Multi-mode Resonators;
   Li Zhu; Honeywell; Raafat Mansour; University of Waterloo; Ming Yu; Honeywell
5. An Convex Optimization Approach To The Matching Problem: Application To The Co-Conception Of Antenna Filters;
   Fabien Seyfert; INRIA; David Martinez; INRIA; Gibin Bose; INRIA; Stephane Bila; Xlim

WFE 08:00-11:50

Recent Advances in Non-Linear and Non-Reciprocal RF Microwave Devices

Sponsors: IMS; RFIC

Organizers: Dimitra Psychogiou, *University of Colorado at Boulder*; Michael Geiler, *Metamagnetics*

Abstract: Wireless communication, radar and electronic warfare systems are entering a new era in which the need for advanced functionality, low SWaP and low cost set contradicting requirements for their RF front-ends. In particular, the RF front-ends' SWaP is limited by their non-reciprocal counter parts (e.g RF circulators, isolators) which either need large volume and external biasing in ferrite-based schemes or exhibit poor noise figure, power handling and dynamic range in active-based non-magnetic architectures. In order to overcome the aforementioned limitations, innovations are required in the areas of materials, process integration and modeling. Among them, the realization of devices that do not require magnetic biasing and are suitable for monolithic integration are of critical importance. It is the aim of this workshop to present recent progress in these areas by both academic and industry experts. In addition, recent developments in non-linear RF devices that exploit the presence of spin-waves in magnetic materials (i.e, frequency selective limiters and signal-to-noise enhancers) will also be presented. The first part of this workshop will focus on architectures and concepts that facilitate non-reciprocity by means of novel RF-design techniques using spatiotemporal modulation. New classes of non-reciprocal and non-linear RF devices including circulators, isolators, gyrators and antennas will be presented. The second part will focus on the design and monolithic integration of magnetic devices using self-biased materials as well as spin-wave-based RF components. Lastly, recent progress on magnetic miniaturized and monolithically integrated components (M3IC), a research effort that has been initiated and supported by DARPA will also be presented.

1. Magnet-free Non-Reciprocity Using Spatio-Temporal Modulation;
   Andrea Alu; *Advanced Science Research Center, City University of New York*
2. Integrated Non-reciprocal RF/mmWave Components and Beyond through Temporal Modulation;
   Harish Krishnaswamy; *Department of Electrical Engineering, Columbia University*
3. Time-Varying Electromagnetic Devices: Breaking the Fundamental Limits of Passives;
   Yuanxun Ethan Wang; *Department of Electrical and Computer Engineering, UCLA*
4. Non-Linear Ferrite Signal Processing Devices;
   John Adam; *Retired Northrop Grumman*
5. Advances In Non-Reciprocal Devices And Materials;
   Vincent Harris; *Northeastern University; Michael Geiler; Metamagnetics*
6. Magnetic Miniaturized and Monolithically Integrated Components;
   Young-Kai Chen; *DARPA*

WORKSHOPS

Friday, 15 June 2018

*All Workshops and Short Courses are located at the Pennsylvania Convention Center. Room assignments will be updated at the IMS2018 website (**www.ims2018.org**) and in the IMS Microwave Week Mobile App, at least one week prior to the IMS2018 start. On-site signs will also guide you to the Workshops and Short Courses rooms.*

WFF 08:00 – 17:15

Techniques Passive Devices for Multi-band Systems

Sponsor: IMS

Organizers: Dimitra Psychogiou, *University of Colorado*; Guoan WANG, *University of South Carolina*; Roberto Gómez-García, *University of Alcalá*; Xun Luo, *University of Electronic Science and Technology of China*

Abstract: With the rapid development of the current and next generation communications (i.e., 5G wireless, internet-of-everything, and so on), multi-band and multifunction transceivers to meet the requirements of such system remain as great challenges. Thus, frequency and bandwidth tunable passive circuits with high performance as key elements in multi-band systems are dramatically demanded and highly developed based on novel materials, miniaturized structures and specific technologies, which can be utilized for the implementation of multi-band RF, microwave, millimeter-wave, and THz communication systems. This unique workshop focuses, for the first time, on the area of various tunable multi-band passive circuits by reporting recent research findings with the coverage of new materials, design techniques, and various technologies in this exciting field. This includes tunable passives with the application of ferromagnetic and ferroelectric thin films, phase change materials, liquid metal loaded technology, micro-electromechanical-system (MEMS), as well as other state-of-art design techniques for multiband operation. Meanwhile, novel on-chip tunable passive circuits (e.g., phase shifter) for 5G wireless communication system using advanced CMOS and SiGe are reported, which are widely used in the practical application of RF, microwave, mm-wave, and THz integrated circuits. The metamaterial and plasmonic devices are also introduced for compact CMOS passive integration. Furthermore, multi-function filtering components and integrated antenna sub-system, along with SAW-based-resonator technologies for the realization of advanced compact microwave filtering devices, are described. Recent advances on reconfigurable and multi-band filters in 3-D and substrate-integrated technologies are also presented.

1. Reconfigurable Front-End Components For Smart Radio Applications; Mina Rais-Zadeh; *University of Michigan/JPL*
2. Switchable and Tunable Ferroelectric Devices for Adaptive and Reconfigurable RF Circuits; Amir Mortazawi; *University of Michigan*
3. Perovskite Ferroelectric And Multiferroic Rf Tunable Capacitors; Yong-Kyu Yoon; *University of Florida*
4. Tunable Transmission Lines For On-Chip Tuning And Rf Phase Shifting Front Ends; Alberto Valdes-Garcia; *IBM T. J. Watson Research Center*
5. Single-Chip Multi-Frequency Radio Frequency Passive Components Based on Aluminum Nitride Cross-Sectional Lamé Mode MEMS Resonators; Matteo Rinaldi; *Northeastern University*
6. Microfluidically Loaded Wideband Frequency Tunable Antennas and RF Filters; Gokhan Mumcu; *University of South Florida*
7. Tunable Passive Circuits for Wireless Multi-Band Application; Xun Luo; *University of Electronic Science and Technology of China/Huawei Technologies Co.*
8. New Concepts For Absorptive Rf Filtering And Coupling-Less Rf Tuning; Roberto Gómez-García; *University of Alcala*
9. Reconfigurable Circuits for Multi-band Application Based on Different Two-port Impedance Matching Networks; Wenquan Che; *Nanjing University of Science and Technology*
10. Reconfigurable and Multi-Band Filters in 3-D and Substrate-Integrated-Cavity Technologies; Vicente Boria-Esbert ; *Technical University of Valencia*
11. High Resolution Tunable Delay lines; Raffat Mansour; *University of Waterloo*
12. High-power Reconfigurable Microwave and Millimeter-wave Devices; Dimitrios Peroulis; *Purdue University*

WFG 08:00 – 17:15

Advances in Linearization Techniques for 5G and Beyond

Sponsor: IMS

Organizers: John Wood, *Obsidian Microwave, LLC, Raleigh, NC*

Abstract: Linearity is now a required specification in many power amplifier designs. Linearization techniques are being applied to achieve these specifications; for example, digital pre-distortion (DPD) is now ubiquitous in cellular wireless downlink base-station transmitters. As the demand for data continues to rise, features such as increased bandwidths, increased frequencies, and use of spectrally-efficient communications signals are being deployed to meet this demand. These features place significant challenges on the linearization techniques employed, and new techniques have been and continue to be developed to meet these challenges. In this workshop we shall review some recent advances in algorithmic techniques and approaches, system design, and practical software and hardware implementations of linearization systems for next-generation wireless communications. We shall address multi-carrier and multi-band communications, wide bandwidths, high peak-to-average power ratio signals, from RF through millimeter-wave, with applications in cellular wireless, satellite communications, uplink and downlink, small-cell and macro base stations, backhaul, point-to-point radio. The workshop will host speakers with world-class reputations from academia and industry, and also showcase some recent research developments. We are planning to have demonstrations of practical state-of-the-art commercial systems. This will be an advanced workshop, for academics and industry professionals active in linearization and DPD development for RF, microwave, and millimeter-wave applications.

1. Advances in Analog Linearization for Satellite Communications; Allen Katz; *The College of New Jersey/Linearizer Technology, Inc.*
2. Digital Predistortion for Wireless Transmitters in 5G: System Requirements and Design Challenges; Anding Zhu; *University College Dublin, Ireland*
3. Digital Predistortion Linearization for Power Efficient Wideband Communication Systems.; Pere Gilabert; *Universitat Politècnica de Catalunya (UPC-Barcelona Tech.), Spain.*
4. Intermodulation Mitigation in Concurrent Multi-band PAs using Multi-band Predistortion Techniques; Fadhel Ghannouchi; *iRadio Lab, University of Calgary, Alberta, Canada*; Mayada Younis; *iRadio Lab, University of Calgary, Alberta, Canada*; Abubaker Abdelhafiz; *iRadio Lab, University of Calgary, Alberta, Canada*
5. Undersampling Based Wideband and Low-complexity Digital Pre-distortion System for 5G; Ziming Wang; *National University of Ireland Maynooth, Ireland*
6. Causes, Identification and Compensation of Short-, Medium- and Long-Term Memory Effects in Power Amplifiers; Filipe Barradas, Telmo Cunha, Pedro Lavrador, Pedro Cabral, Luis Nunes, Jose Carlos Pedro; *Instituto de Telecomunicações, DETI, Universidade de Aveiro, Aveiro, Portugal*
7. System-level Design Considerations for Digital Predistortion of Wireless Base Station Transmitters; John Wood; *Obsidian Microwave, LLC, Raleigh, NC*
8. Elevating Radio Performance to New Thresholds; Kevin Chuang; *NanoSemi, Inc., Boston, MA*

WORKSHOPS

Friday, 15 June 2018

*All Workshops and Short Courses are located at the Pennsylvania Convention Center. Room assignments will be updated at the IMS2018 website (**www.ims2018.org**) and in the IMS Microwave Week Mobile App, at least one week prior to the IMS2018 start. On-site signs will also guide you to the Workshops and Short Courses rooms.*

WFH 08:00 – 17:15

Module Integration and Packaging/IC Co-Integration for Millimeter-wave Communications and 5G

Sponsor: IMS; RFIC

Organizers: Alberto Valdes-Garcia, *IBM T. J. Watson Research Center*; Kamal Samanta, *Sony Europe, UK*; Telesphor Kamgaing, *Intel Corporation*

Abstract: Rapidly growing demand for broadband cellular data traffic is driving fifth generation (5G) standardization towards deployment by 2020. One anticipated key to enabling gigabit-per-second 5G speeds is Millimeter-wave (mm-wave) operation. mm-wave bands offer 50 times the bandwidth available in existing RF bands but pose numerous technical challenges to the low-cost deployment of radio solutions. U.S. regulators recently issued a notice of inquiry for provision of mobile services in several frequency bands above 24 GHz. Additionally, reliable coverage over the typical 200 meter cell radius in non-line-of-sight dense urban conditions, and practical antenna array solutions for base station and user equipment (UE) have been demonstrated at 28 GHz and other mm-wave frequencies. High-volume implementation of the UE radio is also envisioned as multiple-element phased-array transceiver in silicon and/or III-V technologies. However, packaging constitutes a great technical challenge as co-design and co-integration of the transceiver and package will be critical in meeting both electrical and thermo-mechanical requirements in various applications ranging from handsets and backhaul radios to base stations. This workshop will focus on gathering a combination of academic and industry experts in mm-wave system integration and packaging to discuss novel integrated circuits, modules, and antenna solutions for potential mm-wave 5G radios. The speakers will present state-of-the-art research results in this area and ultimately help participants identify the enabling radio and packaging technologies for 5G cellular communications. Emphasis will be put on novel 3D integration approaches and advanced mm-wave system-on-package architectures based on IC/Package/antenna co-optimization. Novel materials and thermo-mechanical challenges associated with compact and large phased array systems in silicon and III-V technologies will also be discussed for 5G radios in different mm-wave frequency bands including 28 GHz, 39 GHz, 69 GHz, 67 GHz, 73 GHz and forward-looking frequencies above 90 GHz.

1. Integration And Packaging Of 5G And Millimeter Wave Compact Radio Modules;
   Tauno Vähä-Heikkilä; *VTT Technical Research Centre of Finland*
2. PCB Interconnection Concepts For Highly Integrated Ka-Band Antenna For 5G And Satcom Front-Ends; Marta Martinez; *IMST GmbH, Germany*; Jens Leiß ; *IMST GmbH*; Rens Baggen ; *IMST GmbH;* Constantine Kakoyiannis; *IMST GmbH*
3. Advances in Polyjet- and Aerosoljet-printed Millimeter-wave Packages;
   Premjeet Chahal; *Michigan State University*; John Papapolymerou; *Michigan State University*
4. mm-Wave Packaging And Integration For 5G Base Station And Portable Devices; Xiaoxiong Gu; *IBM Research*
5. Silicon Based System on Package Phased Array Design for 5G; Danny Elad; *On Semiconductor, Israel*;
   Ofer Markish; ON Semiconductor; Oded Katz; ON Semiconductor; Benny Sheinman; *On Semiconductor, Israel*
6. Wafer-Scale Compatible mm-Wave Dual-Polarization Antenna Co-integration in Silicon; Arun Natarajan; *Oregon State University*
7. Millimeter Wave Integrated Antenna Solutions; Loïc Marnat; *CEA-LETI*
8. Millimeter Wave Phased Array Antenna And Front End Co-Design For Smartphones And Small Cells; Yu-Chin Ou; *Qualcomm*

WFI 08:00 – 17:15

Innovative Technologies for RF and millimeter-wave Tuning and Switching

Sponsor: IMS

Organizers: Pierre Blondy, *XLIM CNRS Universite de Limoges*; Raafat Mansour, *University of Waterloo*

Abstract: Front-end reconfigurability is becoming one of the most critical functions of wireless communication systems. While semiconductor technology has advanced considerably over the past years, the technology still suffers from series limitations, which limits its use in reconfigurable circuits at millimetre-wave frequencies and in high power applications. Research groups from industry and academia are developing innovative approaches for switchable/reconfigurable front-ends using new technologies and materials such as plasmas technologies, and active electromagnetic surfaces. This workshop will present the latest technology developments in the areas of tuning and switching, with a good balance between presentations from industry and academia, covering both high power and millimetre-wave applications.

1. Analog Devices MEMS Switch Technology, A New Switching Solution For RF Instrumentation From 0Hz/DC to 67GHz Applications.;
   Eric Carty; *Analog Devices*
2. The Material Importance For Reliable RF MEMS;
   Chris Keimel; *Menlo Micro*
3. Application of RF MEMS Variable Capacitors And Switches In Aperture Tuned Antenna Design;
   Paul Tornatta; *Cavendish Kinetics*
4. High Power Latching-Type MEMS Switches for RF Tuning;
   Raafat Mansour; *University of Waterloo*
5. MEMS & PCM Switches for Reconfigurable Millimeter-wave Circuits;
   Pierre Blondy; *XLIM CNRS Universite de Limoges*; Aurelian Crunteanu; *XLIM CNRS Universite de Limoges*
6. Chalcogenide Phase-Change Material Switches for RF Switching and Tuning Applications;
   Nabil El Hinnawy; *TowerJazz*
7. Plasma Technology For High-Power Limiters, Switches And Tuners;
   Dimitrios Peroulis; *Purdue University*
8. Transistor based Active Tunable and Switchable Metasurface;
   Li Aobo; *University of California at San Diego*; Daniel Sievenpiper; *University of California at San Diego*

WORKSHOPS

Friday, 15 June 2018

*All Workshops and Short Courses are located at the Pennsylvania Convention Center. Room assignments will be updated at the IMS2018 website (**www.ims2018.org**) and in the IMS Microwave Week Mobile App, at least one week prior to the IMS2018 start. On-site signs will also guide you to the Workshops and Short Courses rooms.*

WFJ 08:00 – 17:15

Design of Matching Networks for Optimal Performance of Power Amplifiers and Transmitters

Sponsor: IMS

Organizers: Frederick Raab, *Green Mountain Radio Research*; Gayle Collins, *Obsidian Microwave*

Abstract: New materials and technologies are providing designers with the opportunity to produce solutions that could not be accomplished in the past, opening up new avenues for innovative power amplifier (PA) design. Multistandard requirements for wireless infrastructure are driving the need for broadband PAs capable of achieving performance across several bands. The requirement for power at ever-increasing frequencies is driving the development of n-dimensional power combiners and multi-input multi-output systems (MIMO). The complexity of the communication systems is driving a need to go beyond traditional approaches to impedance matching circuits and use such techniques as network synthesis. Network synthesis requires an understanding of the components of a dynamically interacting system and designing a network that ensures the desired performance. It is used widely in control, robotics and mechanical design and in the field of PA design the output matching network is often considered to be solely a passive circuit rather than part of a dynamic non-linear system. Network synthesis provides a method of designing an interactive system given a desired frequency- or time-domain response, with metrics such as power, efficiency and linearity. Such a system may include a passive or non-passive network that interacts with an active, often non-linear device: the power transistor. In this workshop we will present the motivation for the application of network synthesis to power amplifier design. The successful application of network synthesis to Doherty design and switch mode PAs will be presented as well as approaches such as the Real Frequency Technique to increase the bandwidth of traditionally narrowband PA designs. Procedures for achieving the best trade-offs for performance will be address including how to design for high peak to average ratio modulated signals, efficiency, linearity and power. Design of continuous mode PAs with be demonstrated along with best practices for mixed signal (Analog/Digital) power modules.

1. Introduction to Network Synthesis for Power Amplifiers; Gayle Collins; *Obsidian Microwave*
2. Impedances Needed by High-Efficiency Power Amplifiers; Frederick Raab; *Green Mountain Radio Research*
3. Real Frequency Technique for Broadband Power Amplifier Design; Binboga Siddik Yarman; *Istanbul University*
4. Designing Matching Networks with the Real Frequency Technique; Pieter Abrie; *Ampsa (Pty) Ltd.*
5. Network Synthesis, Transforms and Practical Issues for Broadband High Efficiency Power Amplifiers; Ramon Beltran; *Qualcomm Technologies*
6. Continuous Modes for High Efficiency Design; Tim Canning; *Infineon Technologies*
7. Broadband Highly Efficient and Linear Power Amplifiers for Next-Generation RF Front-Ends; Dimitrios Peroulis; *Purdue University*; Kenle Chen; *University of Rhode Island*
8. Synthesis of Advanced Doherty Amplifier Combiners; John Gajadharsing; *Ampleon Netherlands B.V.*
9. Quasi-load insensitive class-E for Doherty and Outphasing Transmitters; Leo de Vreede; *Delft University of Technology*; Morteza Alavi; *Delft University of Technology*

WFK 08:00 – 17:15

The New GaN: Advancements in Novel-materials based GaN Microwave and mm-Wave Technologies

Sponsor: IMS

Organizers: Frank Sullivan, *Raytheon Corp.*; Rüdiger Quay, *Fraunhofer IAF*

Abstract: In-Al-Ga-N/GaN wide band gap heterojunction technology as an advancement in active devices has been in development for several years. AlGaN/GaN devices are currently improving systems for radars and jammers particularly and are improving the operation cost fo 4G base stations in mobile communications. This workshop aims to summarize the recent technical advancements and compare the potential performance to the widely used AlGaN/GaN device structures. InAlN/GaN, AlN/GaN and other heterojunction structures offer several potential advantages over AlGaN/GaN. These include 1) a lattice matched structure with much reduced lattice stress, 2) higher reliability and robustness due to the improved lattice match, 3) much higher output current and current density and thus higher output power where the high breakdown condition is preserved, 4) potentially higher chemical and thermal stability due to the higher temperature the structures can withstand, 5) potentially improved control of surface instabilities, and 6) thinner barrier and gate shorter gate structures which will lead to higher power performance at higher frequencies into the millimeter range. Both device and resulting microwave and millimeter circuit advancements will be addressed. This workshop will bring together experts from around the world to discuss the state of the art of this technology.

1. Dynamic Range-enhanced Electronics and Materials (DREaM); Young-Kai Chen; *DARPA*
2. Development Of Epitaxial Processes For Gan-On-Si For Rf Applications; Joff Derluyn; *EpiGaN, Belgium*
3. Epitaxial Growth Of Inaln And Inalgan Barriers For Advanced Rf Devices; Hugues Marchand; *IQE, England*
4. AlN/GaN Heterostructures And Ics For High Power Density Mm-Wave Operation; Rüdiger Quay; *Fraunhofer IAF*
5. InAl(Ga)N/GaN HEMTs on SiC Technology for Ka and Q band Applications; Stephane Piotrowicz; *III-V Lab 1 Avenue Augustin Fresnel - Palaiseau, France*
6. Advances In Novel Iii-N Transistor Structutres: FinFETs and Vertical Devices; Tomas Palacios; *MIT*
7. Next Generation GaN-based Materials and Devices for RF Applications; Tom Kazior; *Raytheon*
8. Nitrides in Transition: Exploring Unconventional Epitaxial Semiconductors and Superconductors; Dave Meyer; *Electronics Science and Technology Division Naval Research Lab*
9. Panel with all speakers

SHORT COURSES

Friday, 15 June 2018

*All Workshops and Short Courses are located at the Pennsylvania Convention Center. Room assignments will be updated at the IMS2018 website (**www.ims2018.org**) and in the IMS Microwave Week Mobile App, at least one week prior to the IMS2018 start. On-site signs will also guide you to the Workshops and Short Courses rooms.*

SFA

08:00 – 11:50

Multi-Beam Antennas and Beam-Forming Networks

CANCELLED

SFB

13:30 – 17:15

Using active Fiber Optic for Distributed Antenna System (DAS) System in 5G MIMO System and Automobile Radar System

CANCELLED

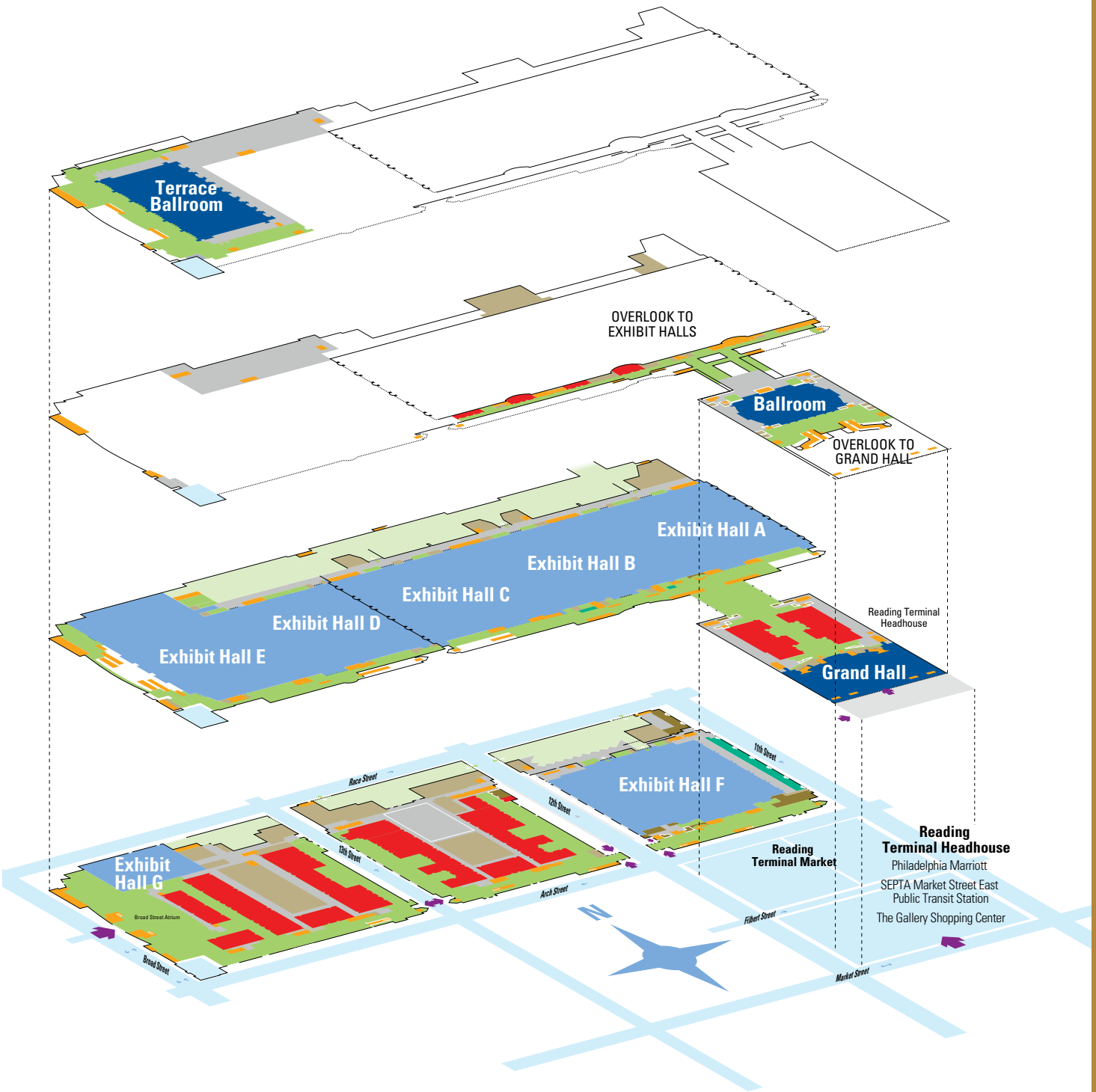
WORLD PREMIERE 2011

THE PENNSYLVANIA CONVENTION CENTER

ORIGINAL & EXPANSION FLOORPLANS

KEY

- Entrances
- Exhibit Halls
- Meeting Rooms
- Ballrooms
- Shops
- Public Areas
- Stair, Elevator, Escalator
- Loading Dock
- House Storage
- Offices
- Back of House
- **C** Concession Stand
- **D** Dressing Rooms
- **E** Elevator
- **FE** Freight Elevator
- **F** Fire Hose Conne
- **R** Restrooms
- **T** Ticket Offices
- Columns
- Telephone
- Water Fountain



IMS

Connecting Minds. Exchanging Ideas.

JOIN US IN BOSTON FOR IMS2019 2-7 JUNE 2019

BOSTON 2019

THE HUB OF MICROWAVES

Notes

Notes

Notes

Notes

2018 Exhibition Catalog

INTERNATIONAL MICROWAVE SYMPOSIUM

10–15 June 2018

Pennsylvania Convention Center

Philadelphia, Pennsylvania

IEEE

MTT-S

Gold & Silver Sponsors

Gold

ANALOG DEVICES

AHEAD OF WHAT'S POSSIBLE™

KEYSIGHT TECHNOLOGIES

NATIONAL INSTRUMENTS™

Silver

MACOM™

Partners from RF to Light

qorvo®

Wolfspeed™

A CREE COMPANY

Table of Contents

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

Download on the App Store

ANDROID APP ON Google play

For assistance, please contact IMS2018 Tech Support at support@mtt.org

IMS2018 Special Thanks

Analog Devices, Inc
Booth 1725
Sponsor of: **Charging Station/Exhibit Floor Seating**

Anokiwave
Booth 538
Sponsor of: **Aisle Signs**

Anritsu Co.
Booth 925
Sponsor of: **Press Lounge**

API Technologies Corp.
Booth 503
Sponsor of: **Map Guide**

Copper Mountain Technologies
Booth 1849
Sponsor of: **Registration**

Custom MMIC
Booth 851
Sponsor of: **Wednesday Specialty Coffee & Tea**

Everything RF / Microwaves 101
Booth 536
Sponsor of: **Attendee Coffee Break - Tuesday PM, Exhibitor Lounge**

High Frequency Electronics
Booth 803
Sponsor of: **Attendee Coffee Break - Wednesday PM, Welcome Reception**

IMS2018 Special Thanks

Keysight Technologies
Booth 1325
Sponsor of: **5G Summit Industry Co-Sponsor**
Welcome Reception - Hosted Bar Sponsor

MACOM
Booth 1125
Sponsor of: **Hotel Key Card, Exhibition Catalog Belly Band,**
Wednesday Popcorn Machine

Microwave Journal
Booth 1834
Sponsor of: **5G Summit Media Sponsor**

Microwaves & RF
Booth 1941
Sponsor of: **Young Professional Reception,**
Women in Microwaves Reception

National Instruments
Booth 1825
Sponsor of: **5G Summit Industry Co-Sponsor, Wireless Internet**

Qorvo
Booth 725
Sponsor of: **Delegate Bags**

RF Globalnet
Booth 1402
Sponsor of: **Speaker Breakfast**

Sonnet Software Inc.
Booth 541
Sponsor of: **IMS T-shirt**

Wolfspeed, A Cree Company
Booth 931
Sponsor of: **Badge Lanyards**

Exhibition

IMS2018 First-Time Exhibitors

Exhibitors as of 20 April 2018

Advanced Circuits	2625
Advanced Microwave Technology Co., Ltd.	2437
AIM Specialty Materials	1057
A-INFO, Inc.	353
ALPHA-RLH (Lasers and Microwaves French Cluster)	2051
Amosense Co., Ltd.	2059
Amwav Technology Limited	1956
Aspocomp Group Plc	2427
Avalon Test Equipment	1360
CDM Electronics	1259
Chengdu Heguang Industry Co., Ltd.	2248
ClioSoft, Inc.	1656
CML Microcircuits (USA) Inc.	551
Compunetics, Inc.	248
ConductRF	1650
Dalian Dongshin Microwave Absorbers Co., Ltd.	1063
Danyang Teruilai Electronics Co., Ltd.	2431
Donggan Yuhoo Electronic Technology Co., Ltd.	1062
EB Industries	315
Element Six (UK) Limited	1908
Evans Capacitor Company	1758
Focusimple Electronics Co., Ltd.	2061
Greenleaf Corp.	2426
GVD Corporation	861
Haojin Communication Technologies	2435
Hebei Sinopack Electronics Technology Co., Ltd.	2524
Hirose Electric USA	2034
Innovative Power Products, Inc.	212
Intelliconnect USA, LLC	2151
ITEQ Corp.	2413
Joymax Electronics Co., Ltd.	1156
Kunshan KunDer Technology Co., Ltd.	2504
Leonardo	251
Mack Technologies	960
Max Echo Technology Corp.	314
Micro Harmonics Corp.	555
Microwave Measurement Systems LLC	1760
Miczen Technologies Co., Ltd.	2439
Milliwave Silicon Solutions, Inc.	1433
Nanjing MJK Electronic Engineering Co., Ltd.	2327
Netcom, Inc.	556
Northeast Electronics Corp.	312
Optiforms, Inc.	204
Pentek	1433
Phase Sensitive Innovations	962
Quarterwave	2508
RAF Electronic Hardware	2052
Reldan Metals Co. Div. of ARM, LLC.	2105
Reliable Corporation	2007
RS Simmons Co., LLC	554
SAF North America	350
Shaanxi Shinhom Enterprise Co., Ltd.	214
Shanghai AT Microwave Limited	2329
Shanghai Hexu Microwave Technology Co., Ltd.	2416
Shanghai Juncoax RF Technologies Co., Ltd.	2107
Shanghai Ucwave Electroninc Engineering Co., Ltd.	2429
Shenzhen Megmeet Electronics Co., Ltd.	2409
Silicon Cert Laboratories	351
SiTime	1433
SpaceForest	1235
Speedlink	1433
Sunsight	857
SuperApex Corporation	1953
Susumu International (USA) Inc.	2428
Suzhou Hexagon Communication Technologies Co., Ltd.	2441
Tagore Technology Inc.	206
The Goodsystem Corp.	1762
Tianjin HiGaAs Microwave Technology Co., Ltd.	2314
TMY Technology Inc.	2208
Tooling Dynamics	208
TPT Wire Bonder	1855
TTM Technologies	2624
UIY Technology Co., Ltd.	2335
Viking Technology/Sanmina	352
WAVEPIA Co., Ltd.	316
Wavesline Electronics, Inc.	557
Withwave Co., Ltd.	2325
Wuhan Gewei Electronics Technologies Co., Ltd.	215, 1433
Zhejiang Huazheng New Material Co., Ltd.	2055
Zhejiang Jiakang Electronics Co., Ltd.	2404

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

For assistance, please contact IMS2018 Tech Support at support@mtt.org

IMS2018 Welcome Reception

The IMS2018 Welcome Reception is taking place at the World Famous Reading Terminal Market. Join other attendees and exhibitors for an evening of fun and networking before the start of the technical sessions and exhibition!

Monday, 11 June 2018 | 19:30 – 20:30

Reading Terminal Market
51 N 12th St, Philadelphia, PA 19107

Thank you to the Sponsor of the Hosted Bars: KEYSIGHT TECHNOLOGIES

Thank you to our Media Sponsor: HIGH FREQUENCY ELECTRONICS

IEEE

MTT-S

Exhibiting Companies

First-time exhibitors are highlighted. Exhibitors as of 20 April 2018.

3D Glass Solutions **1352**
Albuquerque, NM
www.3dglasssolutions.com

3G Shielding Specialties **1640**
Tampa, FL
www.3gshielding.com

3RWAVE **2110**
Suwon, Gyeonggi, Korea (South)
www.3rwave.com

A.J. Tuck Co. **1803**
Brookfield, CT
www.ajtuckco.com

A.L.M.T. Corp. **2153**
Tokyo, Japan
www.allied-material.co.jp/english

A.T. Wall Company **909**
Warwick, RI
www.atwall.com

A-Alpha Waveguide Co. **1309**
El Sequndo, CA
www.a-alphawaveguide.com

ABF Elettronica Srl **2319**
Arcore, Monza E Brianza, Italy
www.abfelettronica.it

Accurate Circuit Engineering **1237**
Santa Ana, CA
www.ace-pcb.com

ACEWAVETECH **2119**
Incheon, Korea (South)
www.acewavetech.com

AdTech Ceramics **1937**
Chattanooga, TN
www.adtechceramics.com

Advance Reproductions Corp. **959**
North Andover, MA
www.advancerepro.com

Advanced Circuitry International **2102**
Duluth, GA
www.aciatlanta.com

Advanced Circuits **2625**
Aurora, CO
www.4pcb.com

Advanced Microwave Technology Co. Ltd. **2437**
Shanghai, Shanghai, China
www.advancedmicrowave.net

Advanced Switch Technology **209**
Kingston, ON, Canada
www.astswitch.com

Advanced Test Equipment Rentals **916**
San Diego, CA
www.atecorp.com

Aelius Semiconductors PTE. Ltd. **2333**
Singapore
www.aeliussemi.com

Aethercomm Inc. **1012**
Carlsbad, CA
www.aethercomm.com

Agile Microwave Technology, Inc. **1263**
Cary, NC
www.agilemwt.com

AI Technology, Inc. **1813**
Princeton Junction, NJ
www.aitechnology.com

AIM Specialty Materials **1057**
Cranston, RI
www.aimspecialty.com

A-INFO, Inc. **353**
Irvine, CA
www.ainfoinc.com

Aldetec, Inc. **1009**
Sacramento, CA
www.aldetec.com

Alfred Tronser GmbH **1358**
Engelsbrand, Baden-Wuettember, Germany
www.tronser.com

Aliner Industries, Inc. **2049**
New Taipei City, Taiwan
www.aliner.com.tw

ALPHA-RLH (Lasers and Microwaves French Cluster) **2051**
Talence, France
www.alpha-rlh.com

Altair Engineering **1609**
Hampton,VA
www.altair.com

AMCAD Engineering **1231**
Limoges, France
www.amcad-engineering.com

Amcom Communications, Inc. **1356**
Gaithersburg, MD
www.amcomusa.com

American Beryllia, Inc. **2724**
Haskell, NJ
www.americanberyllia.com

American Microwave Corp. **2317**
Frederick, MD
www.americanmic.com

American Standard Circuits, Inc. **1055**
West Chicago, IL
www.asc-i.com

AMETEK Engineered Interconnect and Packaging **2516**
New Bedford, MA
www.ametek-ecp.com

Amosense Co., Ltd. **2059**
Seoul, Korea (South)
www.amosense.com

Ampleon **1449**
Nijmegen, AV, The Netherlands
www.ampleon.com

Amplical Corp. **553**
Whippany, NJ
www.amplocal.com

AmpliTech, Inc. **1102**
Bohemia, NY
www.amplitechinc.com

Amwav Technology Limited **1956**
Chengdu, Sichuan, China
www.amwav.com

Analog Devices, Inc. **1725**
Norwood, MA
www.analog.com

Anapico Ltd. **1709**
Glattbrugg, Switzerland
www.anapico.com

RF Globalnet Connects The RF and Microwave World

- TIMELY, INDUSTRY SPECIFIC NEWS
- ORIGINAL EDITORIAL CONTENT
- RELEVANT PRODUCT LISTINGS
- TECHNICAL INSIGHT FROM INDUSTRY EXPERTS

Visit us at www.rfglobalnet.com to sign up for our free email newsletter.

RF Globalnet

www.rfglobalnet.com | (724) 940-7555 | info@rfglobalnet.com

Exhibiting Companies

Anaren, a TTM Technologies Company **2304**
Salem, NH
www.anaren.com

Anatech Electronics, Inc. **2054**
Garfield, NJ
www.anatechelectronics.com

Ancortek, Inc. **2316**
Fairfax, VA
www.ancortek.com

Anokiwave **538**
San Diego, CA
www.anokiwave.com

Anritsu Co. **925**
Richardson, TX
www.anritsu.com

ANSYS, Inc. **1025**
Canonsburg, PA
www.ansys.com

AO Technologies **1102**
Etang la Ville, France
www.aotechnologies.fr

APA Wireless Technologies **2725**
Ft. Lauderdale, FL
www.apawireless.com

API Technologies **503**
Orlando, FL
http://apitech.com/

APMC 2018 **1512**
Tokyo, Japan
apmc2018.org

Apple, Inc. **219**
Cupertino, CA
www.apple.com

Applied Thin-Film Products (ATP) **2124**
Fremont, CA
www.thinfilm.com

AR RF/Microwave Instrumentation **425**
Souderton, PA
www.arworld.us

ARC Technologies, Inc. **1058**
Amesbury, MA
www.arc-tech.com

Ardent Concepts, Inc. **213**
Hampton, NH
www.ardentconcepts.com

ARFTG **1512**
Kansas City, MO
www.arftg.com

Artech House **1840**
Norwood, MA
www.artechhouse.com

ASB, Inc. **1210**
Daejeon, Korea (South)
www.asb.co.kr

Aselsan **2305**
Ankara, Turkey
www.aselsan.com.tr

Aspocomp Group Plc **2427**
Espoo, Finland
www.aspocomp.com

Association of Old Crows **2502**
Alexandria, VA
www.crows.org

Astra Microwave Products Ltd. **2333**
Hyderabad, Telengana, India
www.astramwp.com

Astronics Test Systems **1440**
Irvine, CA
www.astronicstestsystems.com

ATC **707,713**
Huntington Station, NY
www.atceramics.com

Atlanta Micro, Inc. **2128**
Norcross, GA
www.atlantamicro.com

Avalon Test Equipment **1360**
Vista, CA
www.avalontest.com

AVX Corp. **707, 713**
Faintain Inn, SC
www.avx.com

AWR Corporation (Now NI) **1825**
El Segundo, CA
www.awrcorp.com

B&Z Technologies **1202**
East Setauket, NY
www.bnztech.com

Barry Industries, Inc. **949**
Attleboro, MA
www.barryind.com

Beijing Xibao Electronic Technology Co., Ltd. **2012**
Beijing, China
www.xibao-electronictech.com

Benchmark **2341**
Anaheim, CA
www.larkengineering.com

Besser Associates, Inc. **1833**
Mountain View, CA
www.besserassociates.com

BJG Electronics **1652**
Ronkonkoma, NY
www.bjgelectronics.com

Bliley Technologies, Inc. **2218**
Erie, PA
www.bliley.com

Boonton **932**
Parsippany, NJ
www.boonton.com

BSC Filters Ltd. **515**
York, United Kingdom
www.bscfilter.com

Butler Winding (GCG) **1735**
Arcade, NY
www.butlerwinding.com

C W Swift **802**
Van Nuys, CA
www.cwswift.com

Cadence Design Systems, Inc. **1861**
San Jose, CA
www.cadence.com

Caiqin Technology Co., Ltd. **441**
Jiangsu, China
www.hkcandq.com

Cambridge University Press **1608**
New York, NY
www.cambridge.org/us

AR's Hybrid Power Modules, Now To 100 Watts

700 MHz to 6 GHz In One Band

CW Hybrid Power Modules (HPM's) For EW, Wireless & Communications

The HPM's are 50 ohm high gain amplifier blocks that provide up to 100 watts of output power in a connectorized housing for applications where performance, size and weight are critical. These products are available in highly linear Class A or more efficient Class AB designs to give you the ultimate flexibility for your particular application. They are price competitive for wireless and communication applications and meet the stringent requirements for counter IEDs and electronic warfare military systems. For wireless applications, these amplifiers can test systems, higher power amplifiers or semiconductors, and be used for accelerated life testing and stress screening (HALT & HASS).

If you require complete benchtop amplifier systems including power supplies and remote control capabilities we can provide output powers in excess of 500 watts.

To obtain more detailed information on these and other products call AR RF/Microwave Instrumentation at 215 723 8181 or visit us at www.arworld.us/covered.

ISO 9001:2015 Certified

We don't just build great products.
We build great products that last.

BUILT TO LAST

rf/microwave instrumentation

Other ar divisions: modular rf • sunar rf motion • receiver systems • ar europe

USA 215-723-8181. For an applications engineer, call 800-933-8181.
In Europe, call ar United Kingdom +44 1908 282766 • ar France +33147917530 • ar Deutschland +49 6101 802700 • ar Benelux +31 172 423000

www.arworld.us
Download the AR RF/Microwave Mobile App: www.arworld.us/arApp

Exhibiting Companies

Carlisle Interconnect Technologies **956**
St. Augustine, FL
www.carlisleit.com

CDM Electronics **1259**
Turnersville, NJ
www.cdmelectronics.com

CEL **317**
Santa Clara, CA
www.cel.com

Centerline Technologies **305**
Hudson, MA
www.centerlinetech-usa.com

Century Seals, Inc. **2337**
Seaford, DE
www.centuryseals.com

Cernex, Inc. **1406**
San Jose, CA
www.cernex.com

Charter Engineering, Inc. **2207**
Pinellas Park, FL
www.ceiswitches.com

Chen Precision Co., Ltd. **2424**
Tainan, Taiwan
www.chenprecision.com

Chengdu Filter Technology Co., Ltd. **2406**
Chengdu, Sichuan, China
www.filter-mw.com

Chengdu Heguang Industry Co., Ltd. **2248**
Chengdu, Sichuan, China
www.cdheguang.com

Chengdu Keylink Microwave Technology Co., Ltd. **308**
Chengdu, Sichuan, China
www.keylinkmw.com

Chengdu Ninecharm Technology Co., Ltd. **662**
Chengdu, Sichuan, China
www.ninecharm.com

Chin Nan Precision Electronics Co., Ltd. **1060**
Tainan, Taiwan
www.chinnan.com.tw

Chi-Shuai Enterprise Co., Ltd. **1905**
Tainan City, Taiwan
www.chi-shuai.com

Chongqing Acoustic-Optic-Electric Co., Ltd. **1109**
Chongqing, China
www.sipatsaw.com

Ciao Wireless, Inc. **902**
Camarillo, CA
www.ciaowireless.com

Cicor Group **2006**
Bronschhofen, Switzerland
www.cicor.com

CIE-MS (Microwave Society of Chinese Institute of Electronics) **1512**
Nanjing, China
www.mtt.org

Cinch Connectivity Solutions **1031**
Lombard, IL
www.belfuse.com/cinch

Cirexx International, Inc. **1338**
Santa Clara, CA
www.cirexx.com

ClioSoft, Inc. **1656**
Fremont, CA
www.cliosoft.com

CML Microcircuits (USA) Inc. **551**
Winston-Salem, NC
www.cmlmicro.com

Cobham **1039**
Colorado Springs, CO
www.cobham.com/caes

Coilcraft, Inc. **1215**
Cary, IL
www.coilcraft.com

Colorado Engineering, Inc. **2232**
Colorado Springs, CO
www.coloradoengineering.com

Colorado Microcircuits, Inc. **2053**
Loveland, CO
www.coloradomicrocircuits.com

CommAgility **932**
Parsippany, NJ
www.commagility.com

Communications & Power Industries **1149**
Beverly, MA
www.cpii.com

Component Distributors, Inc. **1161**
Denver, CO
www.cdiweb.com

Compunetics, Inc. **248**
Monroeville, PA
www.compunetics.com

ConductRF **1650**
Methuen, MA
www.conductrf.com

Connectronics, Inc. **1241**
Edinburgh, IN
www.connectronicsinc.com

Copper Mountain Technologies **1849**
Indianapolis, IN
www.coppermountaintech.com

Corning, Inc. **1616**
Corning, NY
www.corning.com/gilbert

Corry Micronics Inc. **807**
Corry, PA
www.cormic.com

Crane Aerospace & Electronics **2215**
Chandler, AZ
www.craneae.com

Crystek Corp. **1933**
Fort Myers, FL
www.crystek.com

CST of America, Inc. **825**
Framingham, MA
www.cst.com

CTS Corporation **2114**
Lisle, IL
www.ctscorp.com

Exhibiting Companies

CTT, Inc. 1213
San Jose, CA
www.cttinc.com

Custom Cable Assemblies, Inc. 806
Warner Robins, GA
www.customcableinc.com

Custom Microwave Components, Inc. 915
Fremont, CA
www.customwave.com

Custom MMIC 851
Chelmsford, MA
www.custommmic.com

Custom-Cal Global Tech Solutions 1661
Hamilton, NJ
www.cc-globaltech.com

Daa-Sheen Technology Co., Ltd. 1936
Tainan, Taiwan
www.daasheen.com

Dalian Dongshin Microwave Absorbers Co., Ltd. 1063
Dalian, Liaoning, China
www.isorb.cn

Danyang Teruilai Electronics Co., Ltd. 2431
Danyang, Jiangsu, China

DAPU Telecom Tech. Co.,Ltd 1902
Dongguan, Guangdong, China
www.dptel.com

dB Control 456
Fremont, CA
www.*dBControl.com*

dBm 1739
Oakland, NJ
www.dbmcorp.com

Delta Electronics Mfg. Corp. 1403
Beverly, MA
www.deltarf.com

Delta-Sigma, Inc. 2408
Riverside, CA
www.111rfpower.com

Design Workshop Technologies Inc. 2029
Pointe-Claire, QC, Canada
www.designw.com

DeWeyl Tool Company, Inc. 917
Petaluma, CA
www.deweyl.com

Diamond Antenna & Microwave Corp. 1302
Littleton, MA
www.diamondantenna.com

Dino-Lite Scopes 1708
Torrance, CA
www.dinolite.us

DITF Interconnect Technology 1903
Minden, NV
www.ditf.com

DiTom Microwave, Inc. 1726
Fresno, CA
www.ditom.com

Donggan Yuhoo Electronic Technology Co., Ltd. 1062
Dongguan, Guangdong, China
www.dgyuhoo.com

Dow-Key Microwave Corp. 515
Ventura, CA
www.dowkey.com

Drexel University 260
Philadelphia, PA
www.drexel.com

Ducommun Incorporated 1312
Carson, CA
www.ducommun.com

Duet Investment LLC 2434
Shanghai, China
www.duetinvest.com

DYCO Electronics (GCG) 1735
Hornell, NY
www.dycoelectronics.com

Dynawave, Inc. 1817
Haverhill, MA
www.dynawave.com

Eastern Optx Inc. 1553
Moorestown, NJ
www.eastern-optx.com

EB Industries 315
Farmingdale, NY
www.ebindustries.com

ECHO Microwave Co., Ltd. 858
Sungnam-si, Gyeonggi, Korea (South)
www.echomicrowave.com

Eclipse Microwave, Inc. 1806
San Jose, CA
www.eclipsemicrowave.com

EGIDE 2108
Cambridge, MD
www.egide-group.com

Elbit Systems 1113
Holon, Israel
http://elbitsystems.com

Element Six (UK) Limited 1908
Harwell, Didcot, Oxfordshire, United Kingdom
www.e6.com

Elite RF LLC 307
Hoffman Estates, IL
http://eliterfllc.com

Eljay Microwave, LLC 1432
Londonderry, NH
www.eljaymicrowave.com

EM Research, Inc. 2230
Reno, NV
www.emresearch.com

EMCO Elektronik GmbH 2012
Planegg, Germany
www.emco-elektronik.com

Empower RF Systems, Inc. 1048
Inglewood, CA
www.empowerrf.com

EMSCAN 1442
Calgary, AB, Canada
www.emscan.com

EMWorks 1002
Lasalle, QC, Canada
www.electromagneticworks.com

ENGIN-IC, Inc. 437
Plano, TX
www.engin-ic.com

Epoxy Technology, Inc. 2132
Billerica, MA
www.epotek.com

Exhibitors as of 20 April 2018

Exhibiting Companies

Erzia Technologies, S.L. 2318
Santander, Cantabria, Spain
www.erzia.com

ETL Systems 1809
Madley, Hereford, United Kingdom
www.etlsystems.com

European Microwave Association 1512
Louvain-la-Neuve, Belgium
www.eumweek.com

European Microwave Week 1842
London, United Kingdom
www.eumweek.com

Evaluation Engineering 2117
Sarasota,FL
www.evaluationengineering.com

Evans Capacitor Company 1758
East Providence, RI
www.evanscap.com

Everbeing Int'l Corp. 2425
Hsinchu, Taiwan, China
www.probestation.tw

Everything RF / Microwaves 101 536
New Delhi, India
www.everythingrf.com

evissaP, Inc 1730
San Jose,CA
www.evissaP.com

Exodus Advanced Communications Corp. 1704
Las Vegas, NV
www.exoduscomm.com

EXXELIA 2050
Paris, France
www.exxelia.com

EZ Form Cable Corp. 1255
Hamden, CT
www.ezform.com

F&K Delvotec, Inc. 1612
Foothill Ranch, CA
www.fkdelvotec.com

Farran Technology Ltd. 2306
Cork, Ireland
www.farran.com

FECOA ELASI 2103
North Hills, CA
www.elasiphil.com

FEI-Elcom Tech Inc. 2106
Rockleigh, NJ
www.fei-elcomtech.com

Ferrite Microwave Technologies 1918
Nashua,NH
www.ferriteinc.com

Filtronic 2302
Sedgefield, County Durham, United Kingdom
www.filtronic.com

Flann Microwave Ltd. 2149
Bodmin, Cornwall, United Kingdom
www.flann.com

Flexco Microwave, Inc. 318
Port Murray, NJ
www.flexcomw.com

Focus Microwaves, Inc. 2025
Dollard-Des-Ormeaux, QC, Canada
www.focus-microwaves.com

Focusimple Electronics Co., Ltd. 2061
Jiaxing, ZheJiang, China
www.focusimple.com

FormFactor 1531
Livermore, CA
www.formfactor.com

Frontlynk Technologies, Inc. 938
Tainan, Taiwan
www.frontlynk.com

FTG Corp. 952
Chatsworth, CA
www.ftgcorp.com

Fuzhou Micable Electronic Tech Co. 1802
Fuzhou, Fujian, China
www.micable.cn

Gap Wireless 1335
Mississauga, ON, Canada
www.gapwireless.com

Geib Refining Corp. 1907
Warwick, RI
www.GeibRefining.com

Gel-Pak 2063
Hayward, CA
www.gelpak.com

General Microwave Corporation 1416
Syosset, NY
www.kratosmed.com

Genmix Technology Co., Ltd. 1239
SeongNam-Si, GyeongGi-Do, Korea (South)
www.genmixtech.com

GEROTRON Communication GmbH 2012
Martinsried, Germany
www.gerotron.com

GGB Industries, Inc. 1317
Naples, FL
www.ggb.com

GigaLane Co., Ltd. 2141
Gyeonggi-do, Korea (South)
www.gigalane.com

Global Communication Semiconductors, LLC 1506
Torrance, CA
www.gcsincorp.com

Global Test Equipment 2403
Downers Grove, IL
www.4gte.com

GLOBALFOUNDRIES 1225
Santa Clara, CA
www.globalfoundries.com

Golden Loch Ind. Co., Ltd. 1157
Tainan, Taiwan
www.goldenloch.com.tw

Gova Advanced Material Technology Co., Ltd. 906
Zhaoqing City, Guangdong Province, China
www.gova-tech.com/?l2

Gowanda Electronics (GCG) 1735
Gowanda, NY
www.gowanda.com

Greenleaf Corp. 2426
Saegertown, PA
www.greenleafcorporation.com

SIX DAYS ■ THREE CONFERENCES ■ ONE EXHIBITION

EUROPE'S PREMIER MICROWAVE, RF, WIRELESS AND RADAR EVENT

EuMW2018 PASSION FOR MICROWAVES

EUROPEAN MICROWAVE WEEK
IFEMA FERIA DE MADRID, SPAIN
23-28 SEPTEMBER 2018
www.eumweek.com

EUROPE'S PREMIER MICROWAVE, RF, WIRELESS AND RADAR EVENT

The European Microwave Exhibition (25th - 27th September 2018)

- 10,000 sqm of gross exhibition space
- 4,500 attendees from around the globe
- 1,500 - 1,700 Conference delegates
- In excess of 300 international exhibitors (including Asia and US as well as Europe)

IMS BOOTH 1842

INTERESTED IN EXHIBITING?

For International Sales:
Richard Vaughan,
International Sales Manager
E: rvaughan@horizonhouse.co.uk
Tel: +44 20 7596 8742

For US Sales:
Alyssa Connell,
Event Coordinator
E: aconnell@mwjournal.com
Tel: +1 781 619 1930

or visit www.eumweek.com

Exhibiting Companies

Greenray Industries, Inc. **2104**
Mechanicsburg, PA
www.greenrayindustries.com

GVD Corporation **861**
Canbridge, MA
www.gvdcorp.com

Haojin Communication Technologies **2435**
Shanghai, China
www.haojintech.com

Harbour Industries LLC **1850**
Shelburne, VT
www.harbourind.com

Hebei Sinopack Electronics Technology Co., Ltd. **2524**
Shijiazhuang, Zhejiang, China
www.sinopack.com.cn

Herley Industries **1515**
Woburn, MA
www.herley.com

Hermetic Solutions Group **433**
Wenatchee, WA
www.pacaero.com

Herotek, Inc. **812**
San Jose, CA
www.herotek.com

Hesse Mechatronics **919**
Tempe, AZ
www.hesse-mechatronics.com

High Frequency Electronics **803**
Bedford, NH
www.highfrequencyelectronics.com

Hirose Electric USA **2034**
Downers Grove, IL
www.hirose.com

Holzworth Instrumentation, Inc. **1949**
Boulder, CO
www.holzworth.com

HRL Laboratories, LLC **1206**
Malibu, CA
www.hrl.com

Huang Liang Technologies Co., Ltd. **202**
Kaohsiung City, Taiwan
www.thlp.com.tw

Huber+Suhner, Inc. **1116**
Charlotte, NC
www.hubersuhner.com

Hughes Circuits **859**
San Marcos, CA
www.hughescircuits.com

HYPERLABS **654**
Beaverton, OR
www.hyperlabsinc.com

IEEE 5G Initiative **1512**
Piscataway, NJ
www.5gsummit.org

IEEE Antennas and Propagation Society **1512**
Austin, TX
www.ieeeaps.org

IEEE Communications Society **1512**
New York, NY
www.comsoc.org

IEEE EMCS **1512**
Piscataway, NJ
www.emcs.org

IEEE Xplore Digital Library **2148**
Piscataway, NJ
www.ieee.org/digitalsubscriptions

IHP GmbH **1340**
Frankfurt(Oder), Germany
www.ihp-microelectronics.com

IMS 5G Pavilion **1433**
Louisville, CO
www.ims2018.org

IMS University Booth **260**
Louisville, CO
www.ims2018.org

IMST GmbH **1407**
Kamp-Lintfort, NRW, Germany
www.imst.com

Indium Corp. **348**
Clinton, NY
www.indium.com

Infineon Technologies **717**
El Segundo, CA
www.infineon.com

INGUN USA, Inc. **2012**
Lake Wylie, SC
www.ingun.us

Innertron, Inc. **1611**
Incheon, Korea (South)
www.innertron.com

Innovative Power Products, Inc. **212**
Holbrook, NY
www.innovativepp.com

In-Phase Technologies, Inc. **1337**
Bordentown, NJ
www.in-phasetech.com

Inspower Co., Ltd. **1354**
Siheng-si, Gyeonggi-do, Korea (South)
www.inspower.co.kr

Integra Technologies, Inc. **815**
El Segundo, CA
www.integratech.com

Integrand Software **1636**
Berkeley Heights, NJ
www.integrandsoftware.com

Integrated Device Technology **661**
San Jose, CA
www.idt.com

Intelliconnect USA, LLC **2151**
Crossville, TN
www.intelliconnectusa.com

International Manufacturing Services, Inc. **1513**
Portsmouth, RI
www.ims-resistors.com

inTEST Thermal Solutions **908**
Mansfield, MA
www.inTESTthermal.com

Ion Beam Milling, Inc. **1752**
Manchester, NH
www.ionbeammilling.com

Ironwood Electronics **1750**
Eagan, MN
www.ironwoodelectronics.com

Isola **2125**
Chandler, AZ
www.isola-group.com

IMS2018 5G SUMMIT

IEEE 5G SUMMIT

MTT-S MHz to THz Community

IEEE ComSoc IEEE Communications Society

INDUSTRY CO-SPONSORS:

KEYSIGHT TECHNOLOGIES

NATIONAL INSTRUMENTS™

MEDIA SPONSOR:

Microwave Journal

5G KIOSK PARTICIPANTS:

Visit Booth: 1433

FINGU

FINGU

FINGU

FINGU

KEYSIGHT TECHNOLOGIES

Silicon illi ave Solutions

SiTime

Speedlink

PENTEK

Exhibiting Companies

ITEQ Corp. **2413**
Xinpu Township, Hsinchu County, Taiwan
www.iteq.com.tw

ITF Co., Ltd. **1749**
Bucheon-si, Gyeonggi-do, Korea (South)
www.itf.co.kr

IW Insulated Wire, Inc. **2016**
Bethel, CT
www.iw-microwave.com

JFW Industries, Inc. **1003**
Indianapolis, IN
www.jfwindustries.com

Johanson Technology, Inc. **1313**
Camarillo, CA
www.johansontechnology.com

Joymax Electronics Co., Ltd. **1156**
Taoyuan, Taiwan
www.joymax.com.tw

JQL Electronics, Inc. **1954**
Rolling Meadows, IL
www.jqlelectronics.com

Junkosha, Inc. **2240**
Kasama, Ibaragki, Japan
www.junkosha.co.jp/english/index.html

K&L Microwave, Inc. **515**
Salisbury, MD
www.klmicrowave.com

KCB Solutions **1261**
Shirley, MA
www.kcbsolutions.com

KEYCOM Corp. **1438**
Tokyo, Japan
www.keycom.co.jp/index-e.htm

Keysight Technologies **1325, 1433**
Santa Clara, CA
www.keysight.com

Knowles Capacitors **1304**
Cazenovia, NY
www.dilabs.com

Krytar, Inc. **1203**
Sunnyvale, CA
www.krytar.com

Kuhne Electronic GmbH **1955**
Berg, Bavaria, Germany
www.kuhne-electronic.de

Kunshan KunDer Technology Co., Ltd. **2504**
Kunshan, Jiangsu, China
www.kskunder.com.cn

KVG Quartz Crystal Technology GmbH **408**
Neckarbischofsheim, Germany
www.kvg-gmbh.de

Kyocera America, Inc. **1117**
San Diego, CA
www.kyocera.com

L3 Technologies **535**
Hauppauge, NY
www.l3t.com

LadyBug Technologies LLC **402**
Santa Rosa, CA
www.ladybug-tech.com

Lake Shore Cryotronics, Inc. **1434**
Westerville, OH
www.lakeshore.com

Lanjian Electronics **1114**
Zhenjiang, Jiangsu, China
www.lanjianelectronics.com

Laser Processing Technology, Inc. **1111**
Portland, OR
www.lpt-inc.com

Laser Services, Inc. **1719**
Westford, MA
www.laserservicesusa.com

Leader Tech, Inc. **759**
Tampa, FL
www.leadertechinc.com

Leonardo **251**
Rome, Italy
www.leonardocompany.com

Liberty Test Equipment, Inc. **1631**
Roseville, CA
www.libertytest.com

Light Speed Cable Technology Co., Ltd. **2139**
Shenzhen, Guangdong, China
www.lightspeedtm.cc

Lilliput Electronics (USA) Inc. **2013**
City of Industry, CA
www.lilliputweb.net

Lincos Tech Co., Ltd. **2204**
SHENZHEN, Guangdong, China

Linearizer Technology, Inc. **808**
Hamilton, NJ
www.lintech.com

Lintek Pty Ltd. **912**
Queanbeyan, NSW, Australia
www.lintek.com.au

Linwave Technology Ltd. **1912**
Lincoln, Lincolnshire, United Kingdom
www.linwave.co.uk

LitePoint **1004**
Sunnyvale, CA
www.litepoint.com

Logus Microwave **249**
West Palm Beach, FL
www.logus.com

Lorentz Solution, Inc. **914**
Santa Clara, CA
www.lorentzsolution.com

LPKF Laser & Electronics **1216**
Tualatin, OR
www.lpkfusa.com

Lucas-Milhaupt, Inc. **1557**
Cudahy, WI
www.LucasMilhaupt.com

M2 Global Technology Ltd. **1648**
San Antonio, TX
www.m2global.com

Mack Technologies **960**
Melbourne, FL
www.macktech.com

MACOM **1125**
Lowell, MA
www.macom.com

Microwave Journal

Celebrating 60 Years

Exhibiting Companies

Magvention 303
Suzhou (SIP), Jiangsu, China
www.magvention.com

Marki Microwave, Inc. 2031
Morgan Hill, CA
www.markimicrowave.com

Materion Advanced Materials 2315
Buffalo, NY
www.materion.com/advancedmaterials

Materion Ceramics, Inc. 2004
Tucson, AZ
www.materion.com

MathWorks 2056
Natick, MA
www.mathworks.com

Maury Microwave Corp. 1525
Ontario, CA
www.maurymw.com

Max Echo Technology Corp 314
Taichung City, Taiwan, Taiwan
www.maxecho.com.tw

MaXentric Technologies LLC 1932
Fort Lee, NJ
www.maxentric.com

MCV Microwave 2213
San Diego, CA
www.mcv-microwave.com

MECA Electronics, Inc. 1059
Denville, NJ
www.e-meca.com

Mega Circuit, Inc. 817
Addison, IL
www.megacircuit.com

MegaPhase 2309
Stroudsburg, PA
www.megaphase.com

Mercury Systems 1543
Andover, MA
www.mrcy.com

Metallife, Inc. 1906
Ansan, Gyeonggi-dp, Korea (South)
www.metal-life.co.kr

Metallix Refining, Inc. 2303
Shrewsbury, NJ
www.metallix.com

Metamagnetics, Inc. 2433
Westborough, MA
www.mtmgx.com

METDA Corp. 1712
Shijuazhuang, Hebei, China
www.Metdac.com

Metropole Products, Inc. 1724
Stafford, VA
www.metropoleproducts.com

Mician GmbH 1549
Bremen, Germany
www.mician.com

Micro Harmonics Corp. 555
Fincastle, VA
www.microharmonics.com

Micro Lambda Wireless, Inc. 1503
Fremont, CA
www.microlambdawireless.com

Micro Systems Technologies, Inc. 2412
Lake Oswego, OR
www.mst.com

MicroApps 1457
Louisville, CO
www.ims2018.org

MicroCircuits Laboratories LLC 453
Kennett Square, PA
www.micrcircuitslabs.com

MicroFab, Inc. 1713
Manchester, NH
www.microfabnh.com

Microlab 932
Parsippany, NJ
www.microlabtech.com

Micro-Mode Products, Inc. 1751
El Cajon, CA
www.micromode.com

Microsanj 1728
Santa Clara, CA
www.microsanj.com

Microsemi Corp. 1635
Aliso Viejo, CA
www.microsemi.com

Microtech, Inc. 418
Cheshire, CT
www.microtech-inc.com

Microwave Applications Group 1316
Santa Maria, CA
www.magsmx.com

Microwave Circuits (GCG) 1735
Arcade, NY
www.diplexers.com

Microwave Communications Labs, Inc. 1249
St. Petersburg, FL
www.mcli.com

Microwave Development Labs Inc. 2312
Needham Heights, MA
www.mdllab.com

Microwave Dynamics 1629
Irvine, CA
www.microwave-dynamics.com

Microwave Journal 1834
Norwood, MA
www.mwjournal.com

Microwave Measurement Systems LLC 1760
State College, PA
www.mmstech.com

Microwave Product Digest 1315
Englewood Cliffs, NJ, United State
www.mpdigest.com

Microwave Products Group 515
Salisbury, MD
www.dovermpg.com

MicroWave Technology, Inc. 862
Fremont, CA
www.mwtinc.com

Microwave Theory & Techniques Society 1512
Piscataway, NJ
www.mtt.org

Media Sponsors

MEDIA PARTNERS:

Microwave Journal

Microwaves&RF

OFFICIAL MEDIA SOURCE OF THE MTT-SOCIETY:

IEEE microwave MAGAZINE
for the Microwave & Wireless Engineer

MEDIA SPONSORS:

everythingRF

HIGH FREQUENCY ELECTRONICS

RF Globalnet

MEDIA AFFILIATES:

EE EVALUATION ENGINEERING

MWoo RF - Microwave

Exhibiting Companies

Microwaves & RF 1941
Cleveland, OH
www.mwrf.com

Microwavefilters & TVC S.r.l. 2048
Cernusco Sul Naviglio, Italy
www.microwavefilters.it

Miczen Technologies Co., Ltd. 2439
Chengdu, Sichuan, China
www.miczen.com

MIG Microwave Innovation Group 1106
Bremen, Germany
www.mig-germany.com

Millimeter Wave Products, Inc. 2203
St. Petersburg, FL
www.miwv.com

Milliwave Silicon Solutions, Inc. 1433
Sam Jose, CA
www.milliwavess.com

Mini-Circuits 203
Brooklyn, NY
www.minicircuits.com

Mini-Systems, Inc. 818
N. Attleboro, MA
www.mini-systemsinc.com

Mitsubishi Electric US, Inc. 403
Cypress, CA
http://us.mitsubishielectric.com/en/

MKS Instruments Italy 552
Reggio Emilia, Italy
www.altersystem.com

Modelithics, Inc. 1642
Tampa, FL
www.modelithics.com

Modular Components 1013
Forest Hill, MD
www.modularcomp.com

Morion, Inc. 1107
San Jose, CA
www.morion-us.com

MOSIS 814
Marina Del Ray, CA
www.mosis.com

Mouser Electronics, Inc. 2206
Mansfield, TX
www.mouser.com

MPD Corporation 1848
Incheon, Korea (South)
www.mpdevice.com

MPI Corp. 648
Chupei City, Hsinchu County, Taiwan
www.mpi-corporation.com

MRSI Systems LLC 448
North Billerica, MA
www.mrsisystems.com

MtronPTI 1754
Orlando, FL
www.mtronpti.com

MUNICOM GmbH 2012
Traunstein, Bavaria, Germany
www.municom.de

MWee (Microwave Engineering Europe) 2417
New Holland, PA
www.microwave-eetimes.com

NAMICS Technologies, Inc. 953
San Jose, CA
www.namics.co.jp/e/

Nanjing MJK Electronic Engineering Co., Ltd. 2327
Nanjing, Jiangsu, China
www.njmjk.icoc.cc

Nanyang Technological University, Singapore 260
Singapore, China
www.ntu.edu.sg

National Instruments 1825
Austin, TX
www.ni.com

National Taiwan University 260
Taipei, Taiwan, China
www.ntu.edu.tw

NEL Frequency Controls 2727
Burlington, WI
www.nelfc.com

Netcom, Inc. 556
Wheeling, IL
www.netcominc.com

Networks International Corp. (NIC) 2212
Overland Park, KS
www.nickc.com

Noise XT 1555
Elancourt, France
www.noisext.com

Noisecom 932
Parsippany, NJ
www.noisecom.com

Noisewave Corporation 553
Whippany, NJ
www.noisewave.com

Norden Millimeter Inc. 1812
Placerville, CA
www.nordengroup.com

Northeast Electronics Corp. 312
Milford, CT
www.northeast.com

Nuhertz Technologies, LLC 1935
Mesa, AZ
www.nuhertz.com

Nuvotronics 1330
Durham, NC
www.nuvotronics.com

NuWaves Engineering 2541
Middletown, OH
www.NuWaves.com

NXP, USA, Inc. 739
Chandler, AZ
www.nxp.com

OEwaves, Inc. 1108
Pasadena, CA
www.oewaves.com

Ohmega Technologies, Inc. 2002
Culver City, CA
www.ohmega.com

OML, Inc. 1436
Morgan Hill, CA
www.omlinc.com

Microwaves&RF®

Get more value out of your inbox.

Get more of what you need to stay in the know with valuable insights and timely product news. Sign up today for one of our many newsletters.

MICROWAVE & RF TODAY

A twice-a-week newsletter about cutting-edge topics, news, products and technology developments in the microwave industry.

MICROWAVE & RF DEFENSE ELECTRONICS

A weekly newsletter about innovations in military research and development continuing to drive microwave and RF technology, the latest in electronic warfare, radar, satellite communications, drones and more.

MICROWAVES & RF PRODUCT SPOTLIGHT

A monthly newsletter about the latest product presented by various companies in the microwaves and RF industry.

Sign up today at: mwrf.com/newsletters/signup

Exhibiting Companies

OMMIC 811
Limeil Brevannes, France
www.ommic.com

OPHIR RF, Inc. 532
Los Angeles, CA
www.ophirrf.com

Optenni 218
Espoo, Finland
www.optenni.com

Optiforms, Inc. 204
Temecula, CA
www.optiforms.com

Orban Microwave, Inc. 2008
Orlando, FL
www.orbanmicrowave.com

Orbel Corp. 1914
Easton, PA
www.orbel.com

Orient Microwave Corp. 948
Higashiomi, Shiga, Japan
www.orient-microwave.com

Pacific Microchip Corp. 2005
Culver City, CA
www.pacificmicrochip.com

Palomar Technologies 660
Carlsbad, CA
www.palomartechnologies.com

Pasquali Microwave Systems 657
Florence, Italy
www.pasquali-microwavesystems.com

Passive Plus, Inc. 309
Huntington, NY
www.passiveplus.com

Pasternack 2133
Irvine, CA
www.pasternack.com

Pentek 1433
Upper Saddle River, NJ
www.pentek.com

Phase Sensitive Innovations 962
Newark, DE
www.phasesensitiveinc.com

Pickering Interfaces, Inc. 2015
Grants Pass, OR
www.pickeringtest.com

Pico Technology 1715
Tyler, TX
www.picotech.com

Piconics, Inc. 2418
Tyngsboro, MA
www.piconics.com

Pivotone Communication Tech., Inc. 1212
Waxi, Jiangsu, China
www.pivotone.com

Planar Monolithics Industries, Inc. 1603
Frederick, MD
www.pmi-rf.com

Plexsa Manufacturing 954
Stellenbosch, Western Cape, South Africa
www.plexsa.com

Plextek RFI Ltd. 910
Saffron Walden, United Kingdom
www.plextekrfi.com

PM Industries, Inc. 1607
Beaverton, OR
www.pmindustriesinc.com

Pole/Zero Corp. 515
West Chester, OH
www.polezero.com

Polyfet RF Devices 1112
Camarillo, CA
www.polyfet.com

Polyflon, A Crane Co. Company 2214
Norwalk, CT
www.polyflon.com

Polyphase Microwave, Inc. 1805
Bloomington, IN
https://polyphasemicrowave.com

Powell Electronics Group 1160
Woburn, MA
www.ecmstockroom.com

PPG-Cuming Microwave 1035
Avon, MA
www.cumingmicrowave.com

Precision Connector, Inc. 1254
Franklin, IN
www.precisionconnector.com

Premix Oy 449
Rajamaki, Finland
www.premixgroup.com

Presidio Components, Inc. 439
San Diego, CA
www.presidiocomponents.com

Presto Engineering, Inc. 2202
San Jose, CA
www.presto-eng.com

pSemi 1349
San Diego, CA
www.psemi.com

Pure Pro Technology Co., Ltd. 1061
Beijing, China
www.unircable.com

Q Microwave, Inc. 1602
El Cajon, CA
www.qmicrowave.com

Qorvo 725
Greensboro, NC
www.rfmd.com

Quarterwave Corp. 2508
Rohnert Park, CA
www.quarterwave.com

Quest Microwave, Inc. 1130
Morgan Hill, CA
www.questmw.com

Questech Services Corp. 2414
Garland, TX
www.questlaser.com

Quik-Pak 809
San Diego, CA
www.icproto.com

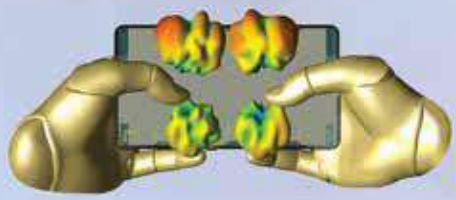
QuinStar Technology, Inc. 1303
Torrance, CA
www.quinstar.com

QWED Sp. z o.o 855
Warsaw, Poland
www.qwed.eu

Designing for a 5G Future: Will Your Device Be Ready?

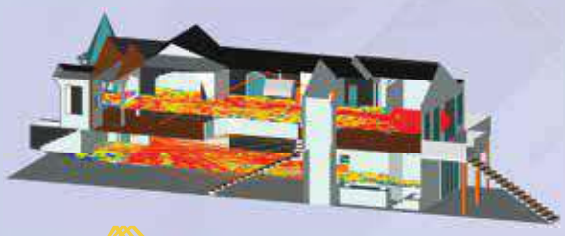
Remcom's Device Design Workflow

Full Wave Antenna Design



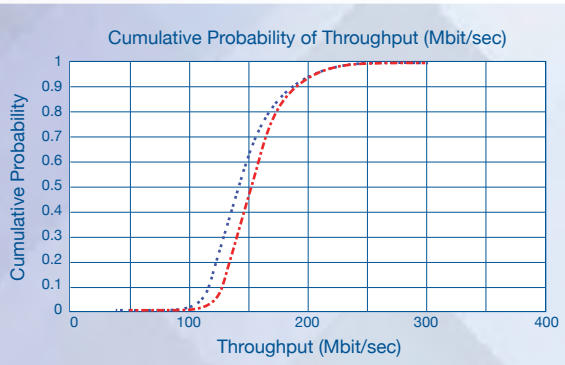
XFdtd

3D Propagation Modeling



Wireless InSite

Throughput Analysis



Are you confident your design approach is sufficient for meeting 5G performance standards?

Remcom's EM Simulation Software integrates antenna design, propagation visualization, and communication channel modeling to provide a comprehensive characterization of real-world device success.

Without throughput analysis, you could be missing a critical piece of the 5G puzzle.

Learn more at | **www.remcom.com/5g-mimo** ›››

REMCOM®

+1.888.7.REMCOM (US/CAN) | +1.814.861.1299 | **www.remcom.com**

Visit Remcom at IMS: Booth #1917

Exhibiting Companies

R&D Interconnect Solutions **1541**
South Plainfield, NJ
www.rdis.com

R&K Company Ltd. **549**
Fuji, Shizuoka, Japan
www.rk-microwave.com

RAF Electronic Hardware **2052**
Seymour, CT
www.rafhdwe.com

RCL Microwave, Inc. **658**
Apalachin, NY
www.rclmicrowave.com

RD Microwaves **216**
Booton, NJ
www.rdmmicrowaves.com

Reactel, Inc. **1703**
Gaithersburg, MD
www.reactel.com

RelComm Technologies, Inc. **1257**
Salisbury, MD
www.relcommtech.com

Reldan Metals Co. Div. of ARM, LLC. **2105**
South River, NJ
www.armmetals.com

Reliable Corporation **2007**
Naugatuck, CT
www.reliablecorp.com

Remcom, Inc. **1917**
State College, PA
www.remcom.com

Remote Sensing Solutions, Inc. **2402**
Barnstable, MA
www.remotesensingsolutions.com

Remtec, Inc. **2313**
Norwood, MA
www.remtec.com

Renaissance/Hxi **2525**
Harvard, MA
www.rec-usa.com

Resin Systems Corp. **1862**
Amherst, NH
www.resinsystems.com

Res-Net Microwave, Inc. **404**
Clearwater, FL
www.resnetmicrowave.com

Response Microwave, Inc. **2032**
Devens, MA
www.responsemicrowave.com

RF Depot, Inc. **1724**
Frederick, MD
www.rfdepotinc.com

RF Globalnet **1402**
Cranberry Township, PA
www.rfglobalnet.com

RF Morecom Korea **2109**
Kyunggi-Do, Korea (South)
www.rfmkorea.com

RFHIC Corp. **1755**
Anyang-Si, Gyeonggi-do, Korea (South)
www.rfhic.com

RF-Lambda USA LLC **749**
Plano, TX
www.rflambda.com

Rflight Communication Electronic Co., Ltd. **1334**
Nanjing. Tiangsu, China
www.rflight.cn

RFMW, Ltd. **1135**
San Jose, CA
www.rfmw.com

Richardson Electronics, Ltd. **1052**
LaFox, IL
www.rellpower.com

Richardson RFPD **1014**
Phoenix, AZ
www.richardsonrfpd.com

RJR Technologies, Inc. **849**
Oakland, CA
www.rjrtechnologies.com

RLC Electronics, Inc. **1748**
Mount Kisco, NY
www.rlcelectronics.com

RN2 Technologies **1815**
Hwaseong-si, Gyeonggi-do, Korea (South)
www.RN2.co.kr

Rogers Corp. **939**
Chandler, AZ
www.rogerscorp.com

Rohde & Schwarz USA, Inc. **649**
Columbia, MD
www.rohde-schwarz.com

Roos Instruments, Inc. **2137**
Santa Clara, CA
www.roos.com

Rosenberger North America Akron, LLC **1841**
Akron, PA
www.rosenbergerna.com

ROSNOL RF/Microwave Technology Co., Ltd. **2216**
Taoyuan, Taiwan
www.rosnol.com

RS Simmons Co., LLC **554**
Exton, PA
www.resimmons.com

RUPPtronik **2012**
Bruckmhi, Germany
www.rupptronik.de

Rutgers University **260**
Piscataway, NJ
www.ece.rutgers.edu

SAF North America **350**
Aurora, CO
www.saftehnika.com

SAGE Millimeter, Inc. **1103**
Torrance, CA
www.sagemillimeter.com

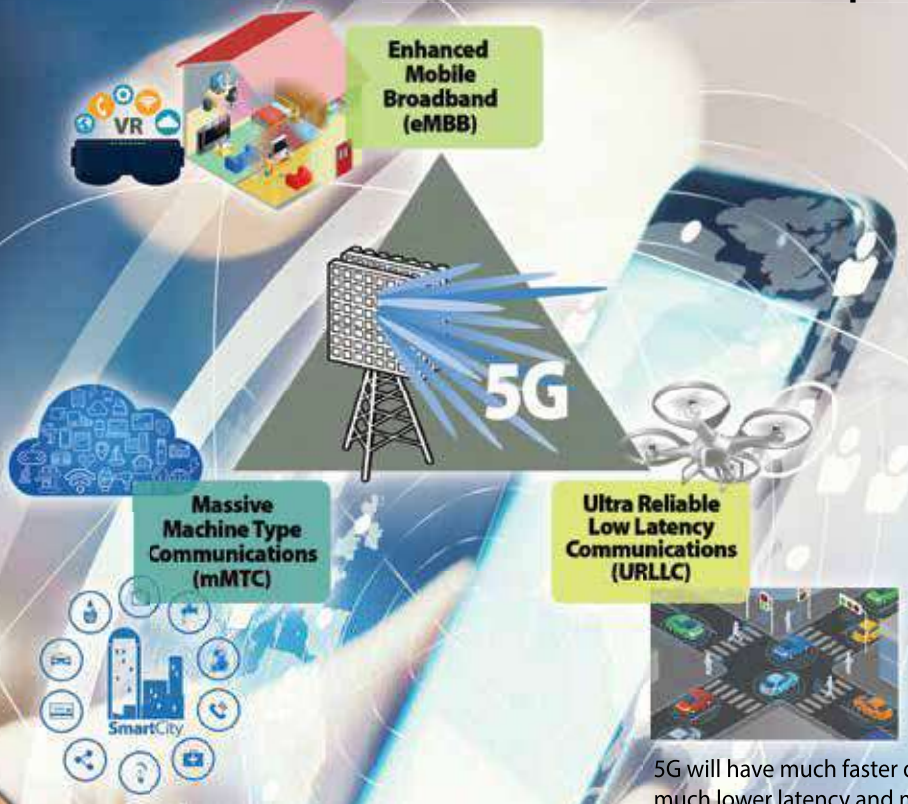
Sainty-Tech Communications Ltd. **1913**
Nanjing, China
www.sainty-tech.com

Samtec, Inc. **1651**
New Albany, IN
www.samtec.com

SANTIER **2108**
San Diego, CA
www.santier.com

We've got you covered for **5G!**

— from 600 MHz up to mmWave



Rogers Materials for Circuits from 600 MHz up to mmWave

Material	Dk	Df	Features
AMPLIFIERS /MICROWAVE RADIOS			
RO4350B™	3.48	0.0037	Processes Like FR-4. Integrated Thin-film Resistors
RO4835™ LoPro®	3.48	0.0037	High Oxidation Resistance
RO4360G2™	6.15	0.0038	Enables Circuit Size Reduction
RO3003™	3.00	0.0010	Lowest Loss
CLTE-MW™	3.05	0.0015	Low Loss, Thin
TC350™	3.50	0.0020	High Thermal Conductivity For High Power Handling
ANTENNAS			
AD255C™	2.55	0.0014	Low PIM, Cost Effective Solution
AD300C™	2.97	0.0020	Low PIM, Cost Effective Solution
RO4730G3™	3.00	0.0029	Low PIM
RO4533™	3.30	0.0025	High Thermal Conductivity For High Power Handling

Notes: Dk and Df are both measured at 10 GHz.

Circuit materials for the next generation of wireless communications

The next generation of wireless communications is the Fifth Generation (5G). 5G will have much faster data rates, much higher capacity, much lower latency and much higher connection density. It will enable many new use cases, such as 4K/8K video, AR/VR, industry robots, remote diagnostic, autonomous driving cars, and billions of IoT connections across various vertical industries. 5G will far outperform current 4G LTE-A networks, but the transition to 5G will require more advanced RF components to operate across low, mid and high frequencies. These RF components start with high-performance circuit materials from Rogers Corporation.

For circuits from 600 MHz up to mmWave

Rogers has you covered with circuit materials for next-generation 5G components, including massive MIMO antennas and GaN-based high-power-density amplifiers. Wireless network circuit designers have trusted in Rogers' high-performance circuit materials for nearly 30 years, since the earliest 1G analog systems to present-day 4G LTE-A systems.

ROGERS CORPORATION

Advanced Connectivity Solutions

USA - AZ, tel. +1 480-961-1382
EUROPE - BELGIUM, tel. +32 9 235 3611
www.rogerscorp.com/acs

Exhibiting Companies

San-tron, Inc. **1348**
Ipswich, MA
www.santron.com

Sawnics, Inc. **412**
CheonAn-Si, Chungnam-Do, Korea (South)
www.sawnics.com

Schmid & Partner Engineering AG **1835**
Zurich, CH, Switzerland
www.speag.com

Scientific Microwave Corp. **833**
St.-Laurent (Montreal), QC, Canada
www.smcq.com

Semi Dice, Inc. **1655**
Los Alamitos, CA
www.semidice.com

SemiGen **2009**
Londonderry, NH
www.semigen.net

SemiProbe, Inc. **2150**
Winooski, VT
www.semiprobe.com

SGMC Microwave **835**
Northridge, CA
www.sgmcmicrowave.com

Shaanxi Shinhom Enterprise Co., Ltd. **214**
Xi'an, Shaanxi, China
www.shinhom.com.cn

Shanghai AT Microwave Limited **2329**
Shanghai, Shanghai, China
www.atmicrowave.com

Shanghai Hexu Microwave Technology Co., Ltd. **2416**
Shanghai, China
www.hexumicrowave.com

Shanghai Huaxiang Computer Comm. Eng. **1307**
Shanghai, China
www.shx-sh.com

Shanghai Juncoax RF Technologies Co., Ltd. **2107**
Shanghai, China
www.juncoax.com

Shanghai RFocus Communication Technology Co., LTD. **2209**
Kunshan, Jiangsu, China
www.radio-focus.com

Shanghai Ucwave Electroninc Engineering Co., Ltd. **2429**
Shanghai, China
www.ucwave.com.cn

Shanghai XinXun Microwave Technology Co., Ltd. **1155**
Shanghai, China
www.xinxunmc.com

Shengyi Technology Co., Ltd. **1961**
Dongguan, Guangdong, China
www.syst.com.cn

Shenzhen Huayang Technology Development Co., Ltd. **1606**
Shenzhen, Guangdong, China
www.htd-rf.com

Shenzhen Megmeet Electronics Co., Ltd. **2409**
Shenzhen, Guangdong, China
www.megmeet.com

Shenzhen Superlink Technology Co., Ltd. **854**
Shenzhen, Guangdong, China
www.slkcorp.com

Shenzhen Yulongtong Electron Co., Ltd. **1614**
Shenzhen, Guangdong, China
www.yulongtong.com

Shoulder Electronics Limited **1659**
Wuxi, Jiangsu, China
www.shoulder.cn

Siglent Technologies America, Inc. **1717**
Solon, OH
www.SiglentAmerica.com

Signal Hound **1714**
La Center, WA
www.signalhound.com

Signal Microwave **863**
Chandler, AZ
www.signalmicrowave.com

SignalCore, Inc. **2113**
Austin, TX
www.signalcore.com

Signatone **2432**
Gilroy, CA
www.signatone.com

Silicon Cert Laboratories **351**
Reading, PA
www.siliconcert.com

Sinclair Manufacturing Co. **1256**
Chartley, MA
www.sinclairmfg.com

SiTime **1433**
Santa Clara, CA
www.sitime.com

Skyworks Solutions, Inc. **509**
Woburn, MA
www.skyworksinc.com

Smiths Interconnect Americas, Inc. **1625**
Tampa, FL
www.smithsinterconnect.com

Societies Pavilion **1512**
Louisville, CO
www.ims2018.org

SOMACIS **1154**
Poway, CA
www.somacis.com

Sonnet Software, Inc. **541**
North Syracuse, NY
www.sonnetsoftware.com

Southeast University **260**
Nanjing, China
www.seu.edu.cn

Southwest Microwave, Inc. **1049**
Tempe, AZ
www.southwestmicrowave.com

SpaceForest **1235**
Gdynia, Poland
www.spaceforest.pl

Spanawave Corp. **1631**
Roseville, CA
www.spanawave.com

Exhibiting Companies

Spectrum Elektrotechnik 1130
Munich, Germany
www.spectrum-et.com

Speedlink 1433
Cupertino, CA
www.speed-us.com

SRTechnology Corp. 1909
Seoul, Korea (South)
www.srtechnology.com

SSI Cable Corp. 1802
Shelton, WA
www.ssicable.com

State Of The Art Inc. 451
State College, PA
www.resistor.com

Statek Corp. 1007
Orange, CA
www.statek.com

Stellar Industries Corp. 1319
Millbury, MA
www.stellarind.com

StratEdge Corp. 1649
Santee, CA
www.stratedge.com

Sumitomo Electric Device Innovations 1141
San Jose, CA
www.sei-device.com

Summit Interconnect 1056
Anaheim, CA
www.summit-pcb.com

Sung Won Forming 2014
Gyeonggi-do, Seoul, Korea (South)
www.swf.co.kr

Sunkyoung S.T Co., Ltd. 763
Hwaseong-Si, Gyeonggi-Do Korea (South)
www.sunkyoungst.com

Sunsight 857
Maitland, FL
www.sunsight.com

SuperApex Corporation 1953
Rolling Meadows, IL
www.superapexco.com

Suron 1158
Sarasota, FL
www.suron.com

Susumu International (USA) Inc. 2428
Palisades Park, NJ
www.susumu-usa.com

Suzhou Hexagon Communication Technologies Co., Ltd. 2441
Kunshan, Jiangsu, China
www.hexagontek.com

Suzhou Talent Microwave, Inc. 2506
Suzhou, Jiangsu, China
www.talentmw.com

SV Microwave, Inc. 903
West Palm Beach, FL
www.svmicrowave.com

Switzer 957
Buffalo, NY
www.switzermfg.com

Synergy Microwave Corp. 409
Paterson, NJ
www.synergymwave.com

Tabor Electronics 1440
Tel-Hanan, Israel
www.taborelec.com

Taconic 703
Petersburgh, NY
www.4taconic.com

Tactron Elektronik GmbH 2012
Martinsried, Germany
www.tactron.de

Tagore Technology, Inc. 206
Arlington, IL
www.tagoretech.com

Tai-Saw Technology Co., Ltd. 1615
Taoyuan, Taiwan
www.taisaw.com

TAP Microwave 2012
Chengdu, China
www.tapmicrowave.com

TDK-Lambda Americas 1207
Neptune, NJ
www.us.tdk-lambda.com/hp

Tecdia Inc. 839
Campbell, CA
www.tecdia.com

TechPlus Microwave, Inc. 550
Rocklin, CA
www.techplusmicrowave.com

Tech-X Corporation 2407
Boulder, CO
www.txcorp.com

Teledyne Coax 525
Hawthorne, CA
www.teledynecoax.com

Teledyne Defense Electronics 525
Hawthorne, CA
www.teledyne.com

Teledyne e2v Semiconductors 525
Saint-Wgreve, Isere, France
www.teledyne-e2v.com

Teledyne Microwave Solutions 525
Rancko Cordova, CA
www.teledynemicrowave.com

Teledyne Relays 525
Hawthorne, CA
www.teledynerelays.com

Teledyne Scientific 525
Thousand Oaks, CA
www.teledyne-si.com

Teledyne Storm Microwave 525
Thousand Oaks, CA
www.teledyne-si.com

Telegartner, Inc. 2112
Franklin Park, IL
www.telegartner.com

TeraProbes, Inc. 1253
Columbus, OH
www.teraprobes.com

Texas Instruments 2037
Dallas, TX
www.ti.com

The 41st Institute of CETC 1561
Quingdao, Shangdong, China
www.ei41.com

Exhibitors as of 20 April 2018

Exhibiting Companies

The Boeing Company 1814
Huntsville, AL
www.boeing.com

The Goodsystem Corp. 1762
Ansan-si, Gyeonggi-do, Korea (South)
www.thegsystem.com

The University of Texas at Dallas – ECE Department 260
Richardson, TX
www.utdallas.edu

THINFILMS, Inc. 961
Hillsborough, NJ
www.thinfilmsinc.com

Tianjin HiGaAs Microwave Technology Co., Ltd. 2314
Tianjian, China
www.higaas.com

Ticer Technologies 2130
Chandler, AZ
www.ticertechnologies.com

Times Microwave Systems 1248
Wallingford, CT
www.timesmicrowave.com

TMD Technologies Ltd. 755
Halethorpe, MD
www.tmdus.com

TMY Technology Inc. 2208
Taipei City, Taiwan
www.tmytek.com

Tooling Dynamics 208
York, PA
www.toolingdynamics.com

Top Dog Test 1661
Hayward, CA
www.topdogtest.com

TowerJazz 1333
Newport Beach, CA
www.towerjazz.com

TPT Wire Bonder 1855
Morganville, NJ
www.tpt-wirebonder.com

Transcat, Inc. 2234
Rochester, NY
www.transcat.com

Transcom, Inc. 913
Tainan City, Taiwan
www.transcominc.com.tw

Transline Technology, Inc. 2011
Anaheim, CA
www.translinetech.com

Triarchy Technologies Corp. 349
Surrey, BC, Canada
www.triarchytech.com

Tronser, Inc. 2003
Cazenovia, NY
www.tronserinc.com

TTE Filters (GCG) 1735
Arcade, NY
www.tte.com

TTM Technologies 2624
Toronto, ON, Canada
www.ttm.com

UIY Technology Co., Ltd. 2335
Shenzhen, Guangdong, China
www.uiy.com

Ulbrich 756
North Haven, CT
www.ulbrich.com

UltraSource, Inc. 1502
Hollis, NH
www.ultrasource.com

UMS (United Monolithic Semiconductors) 1015
Villebon / Yvette, France
www.ums-gaas.com

University of Waterloo, Centre for Intelligent Antenna and Radio Systems(CIARS) 260
Waterloo, ON, Canada
www.ciars.uwaterloo.ca

UTE Microwave Inc. 955
Asbury Park, NJ
www.utemicrowave.com

Vaunix Technology Corp. 548
Newburyport, MA
www.vaunix.com

Velocity Microwave 2403
Downers Grove, IL
www.4gte.com

VIDA Products, Inc. 1904
Rohnert Park, CA
www.vidaproducts.com

Viking Technology/Sanmina 352
Costa Mesa, CA
www.vikingtechnology.com

Viper RF Limited 1915
Newton Aycliffe, United Kingdom
www.viper-rf.com

Virginia Diodes Inc. 1341
Charlottesville, VA
www.virginiadiodes.com

Vishay Intertechnology, Inc. 1412
Malvern, PA
www.vishay.com

W. L. Gore & Associates, Inc. 1537
Landenberg, PA
www.gore.com

Waka Manufacturing Co., Ltd. 1613
Tokyo, Japan
www.waka.co.jp

Wave Tech Co., Ltd. 1153
Anyang, Gyeonggi, Korea (South)
www.wave-tech.co.kr

WAVEPIA Co., Ltd. 316
Osan-si, Gyeonggi-do, Korea (South)
www.wavepia.com

Wavesline Electronics, Inc. 557
Shanghai, China
www.wavesline.com

Wavetek Microelectronics Corporation 860
Hsinchu County, Taiwan
www.wtkmicro.com

Wavice, Inc. 2141
Hwaseong-si, Gyeonggi-do, Korea (South)
www.wavice.com

Visit our new website: www.mwee.com

news...
features...
products...
design...
white papers...
newsletter...
digital edition...

www.mwee.com

The only European Site dedicated to Microwave and RF offering News, Design, How-to articles as well as an ever growing library of Technical Papers.

european business press

Exhibiting Companies

Weije Electronics Co., Ltd. **1957**
Tainan City, Taiwan
www.rfconncable.com.tw

Weinschel Associates **1702**
Mount Airy, MD
www.weinschelassociates.com

Wenzel Associates, Inc. **907**
Austin, TX
www.wenzel.com

Werbel Microwave LLC **1857**
Whippany, NJ
www.werbelmicrowave.com

Werlatone, Inc. **1008**
Patterson, NY
www.werlatone.com

West Bond, Inc. **1816**
Anaheim, CA
www.westbond.com

WEVERCOMM Co., Ltd. **1710**
Suwon-Si, Korea (South)
www.wevercomm.com

Wiley **2219**
Hoboken, NJ
www.wiley.com

Wilkes University **260**
Wilkes-Barre, PA
www.wilkes.edu

WIN Semiconductors Corp. **415**
Tao Yuan Shien, Taiwan
www.winfoundry.com

Winchester Interconnect **1741**
Middlebury, CT
www.winconn.com

WIPL-D **2131**
Belgrade, Serbia
www.wipl-d.com

Wireless Telecom Group **932**
Parsippany, NJ
www.wtcom.com

Withwave Co., Ltd. **2325**
Suwon-si, Gyeonggi-do, Korea (South)
www.with-wave.com

Wolfspeed, A Cree Company **931**
Research Triangle Park, NC
www.wolfspeed.com/RF

Wuhan Gewei Electronics Technologies Co., Ltd. **215, 1433**
Wuhan, China
www.gewei-wh.com

Xi'an HengDa Microwave Technology Development Co., Ltd. **2249**
Xi'an, Shaanxi, China
www.hdmicrowave.com

XIAN PRECISIONRF ELECTRONICS CO., LTD. **1857**
Xi'an, Shaanxi, China
www.precisionrf.com

XMA Corporation **2236**
Manchester, NH
www.xmacorp.com

X-Microwave, LLC **1763**
Round Rock, TX
www.xmicrowave.com

Xpeedic Technology, Inc. **1705**
Bellevue, WA
www.xpeedic.com

Xperi **313**
Calabasas, CA
www.invensas.com

XYZTEC, Inc. **1362**
Clinton, MA
www.xyztec.com

Yokowo Co., Ltd. **1208**
Tokyo, Japan
www.yokowo.co.jp

Zhejiang Huazheng New Material Co., Ltd. **2055**
Hangzhou, China
www.hzccl.cn

Zhejiang Jiakang Electronics Co., Ltd. **2404**
Jiaxing, Zhejiang, China
www.jkelec.com

Zhuzhou Jiabang Refractory Metal Co., Ltd. **1657**
Changsha, Hunan, China
www.chinatungstens.com

Zik, Inc. **252**
The Woodlands, TX
www.zikcorporate.com

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

Download on the App Store

ANDROID APP ON Google play

For assistance, please contact IMS2018 Tech Support at support@mtt.org

RF Globalnet Connects The RF and Microwave World

- TIMELY, INDUSTRY SPECIFIC NEWS
- ORIGINAL EDITORIAL CONTENT
- RELEVANT PRODUCT LISTINGS
- TECHNICAL INSIGHT FROM INDUSTRY EXPERTS

Visit us at www.rfglobalnet.com to sign up for our free email newsletter.

RF Globalnet

www.rfglobalnet.com | (724) 940-7555 | info@rfglobalnet.com

WELCOME TO IMS2018 INDUSTRY WORKSHOPS

The Industry Workshops are a recent addition to the IEEE MTT-S International Microwave Symposium. IMS2018 will be the second year the Industry Workshops have been organized and held. These two-hour long workshops on contemporary topics of interest to the community, held in meeting rooms adjacent or close to the main exhibit area, include in-depth technical presentations from experts within the industry. The workshops are held Tuesday through Thursday of the IMS Microwave Week, to coincide with the IMS exhibition.

A total of twenty presenters from industry will be giving us a detailed look into their latest technology, tools and products. This year's topics cover test and measurement instruments and techniques, 5G, various simulation tools and applications, GaN, phase noise and data converters. Generous time has been allocated to enable in-depth discussions, audience participation, and an opportunity for all to ask questions to experts and interact with colleagues interested and knowledgeable on similar topics.

Workshops are held each day of the conference, in three parallel sessions, with typical start times 10:00, 13:00 and 15:15.

We hope you will find these sessions very informative and get a good view of the state of the art in RF, microwaves and millimeter waves topics.

Murat Eron
IMS2018 Industry Workshops Chair

Industry Workshops

10:00 – 17:15 | **Tuesday, 12 June 2018** | PCC Rooms 105B, 106AB and 107B

SESSION TIME	EVENT COMPANY	SESSION TITLE	SPEAKERS
10:00 – 12:00	Nuhertz Technologies, LLC	Exceptionally Fast, Easy, and Flexible Optimization of the Electromagnetic (EM) Planar Filter Frequency Response using Nuhertz Filter Solutions.	Jeff Kahler – Nuhertz Technologies, LLC
10:00 – 12:00	North Carolina State University	Design, Fab and Test Your Own Passive Planar Microwave Component	John Dunn – National Instruments David S. Ricketts – North Carolina State University
10:00 – 12:00	Keysight Technologies	Millimeter-wave Measurement Insights Workshop	Jean Marc Moreau, Suren Singh – Keysight Technologies
13:00 – 15:00	University of Belgrade	Extended Limits in Full Wave Simulations of Complex MW Circuits and Antennas	Branko Kolundzija – School of Electrical Engineering, University of Belgrade
13:00 – 15:00	Rohde & Schwarz USA, Inc	How Integration of Data Converters Simplify Designs in Various Industries	Markus Loerner – Rohde & Schwarz
13:00 – 15:00	Rohde & Schwarz USA, Inc.	Advanced Techniques for Phase Noise and Jitter Measure-ments for High Power, Very High Frequency, Pulsed or Modulated Signals	Kay-Uwe Sander, Martin Stumpf – Rohde & Schwarz USA, Inc.
15:15 – 17:15	MiG Microwave Innovation Group	Practical Antenna Design Including Feed-Networks	Fritz Arndt – MIG Microwave Innovation Group
15:15 – 17:15	National Instruments	Understanding System Simulation	Joel Kirshman – National Instruments
15:15 – 17:15	FormFactor, Inc.	Best Practices for On-Wafer Test and Measurement from GHz thru THz	Gavin Fisher, Craig Kirkpatrick – FormFactor, Inc.

Industry Workshops

10:00 – 17:15 | **Wednesday, 13 June 2018** | PCC Rooms 105B, 106AB and 107B

SESSION TIME	EVENT COMPANY	SESSION TITLE	SPEAKERS
10:00 – 12:00	Rohde & Schwarz USA, Inc.	Best Practices in Wafer-Level Millimeterwave and THz Testing	Volker Herrmann – Rohde & Schwarz USA, Inc.
10:00 – 12:00	Keysight Technologies	Accelerating Design Validation for 5G New Radio	Sheri DeTomasi, Randy Becker, Daren McClearnon – Keysight Technologies
10:00 – 12:00	Mician, Inc.	Simulation and Optimization of SIW Components Using Mician µWave Wizard™	Ralf Ihmels – Mician, Inc.
15:15 – 17:15	EMSCAN	Using Very-Near-Field Scanners for Self-Interference Debugging in Communication Circuits	Arturo Mediano – EMSCAN University of Zaragoza
15:15 – 17:15	Analog Devices, Inc.	RF Technologies Enabling 5G Systems	Thomas Cameron – Analog Devices, Inc.
15:15 – 17:15	Keysight Technologies	How to Model When You Don't Have a Model	Al Lorona – Keysight Technologies

10:00 – 17:15 | **Thursday, 14 June 2018** | PCC Rooms 105B, 106AB and 107B

SESSION TIME	EVENT COMPANY	SESSION TITLE	SPEAKERS
10:00 – 12:00	Wolfspeed, A Cree Company	A Practical Approach to Using GaN Devices to Solve System Level Challenges	Simon Wood – Wolfspeed, A Cree Company
10:00 – 12:00	IHP GmbH	Photonic SiGe BiCMOS Technology for Broadband Integrated Communication Circuits	Renè Scholz, Dietmar Kissinge, Mehmet Kaynak – IHP
10:00 – 12:00	National Instruments	Design, Fab, and Test Your Own Antenna	Derek Linden – National Instruments
13:00 – 15:00	Microwave Measurement Systems LLC	Freespace Non-destructive Methods for Material Characterization, Process Control and Antenna Mapping	Vasundara Varadan – Microwave Measurement Systems LLC
13:00 – 15:00	Analog Devices, Inc.	Full Stack Deployed Modem Design with Software Defined Radio	Travis Collins, Robin Getz – Analog Devices Inc.

WELCOME TO IMS2018 MICROAPPS

Welcome to IMS2018 Microwave Applications Seminars (MicroApps). The titles and presenters for each presentation are provided in this IMS2018 Exhibition Catalog. We have 74 individual 15 minute presentations from exhibitors spread over the three days, June 12 - 14. The presentations are color coded by general topic, in the program, to allow you to quickly locate your area of interest. MicroApps are targeted for the working Engineer and Technician. They are presentations of company application notes. Anyone attending IMS can hear the MicroApps presentations. They are presented in the MicroApps Theater in the exhibition hall. The full presentations are posted on the IMS2018 Virtual Resource Center during the symposium and for a short period following the symposium. You can also meet with the presenters in their exhibition booth to discuss what you heard during their presentation and need to learn more about. All you need is a minimum exhibition pass or a guest pass to enter the exhibition hall. We look forward to meeting you at the MicroApps Theater during IMS2018.

Best regards,

Jim Weiler
IMS2018 MicroApps Chair

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

Download on the App Store

ANDROID APP ON Google play

For assistance, please contact IMS2018 Tech Support at support@mtt.org

MICROAPPS SCHEDULE – TUESDAY, 12 JUNE
BOOTH 1457

09:45 – 10:00	Software Defined Radio 'System on Module'	
10:00 – 10:15	Practical Direction Finding With Software Defined Radios	Travis Collins – Analog Devices Inc.
10:15 – 10:30	Modeling of AM-PM Characteristics in GaN HEMT Transistors	Jiang Liu, Miriam Calvo, Kevin Kellog, Hugo Morales, Larry Dunleavy – Modelithics, inc
10:30 – 10:45	Recent Advances in GaN Pallets for Radar Applications	Apet Barsegyan – Integra Technologies Inc.
10:45 – 11:00	Improved Efficiency in Wideband PA's	Chris Day – Analog Devices, Inc.
11:00 – 11:15	Utilizing Network Synthesis to Streamline Power Amplifier Design Flows	Chris Bean – National Instruments
11:15 – 11:30	1600W True Surface Mount Packaged Pre-Matched Transistor Lowers Manufacturing Costs on Next Generation Avionics Systems	Damian McCann – Microsemi Corp.
11:30 – 11:45	High Speed Small Envelope Optical Transceivers for Harsh Environments	John Evans – API Technologies
11:45 – 12:00	Silicon Technology for Space Applications	Umesh Jayamohan – Analog Devices, Inc.
12:00 – 12:15	Advanced Component Pad Features for High Accuracy RF and Microwave Design Simulation	Laura Levesque – Modelithics, Inc.
12:15 – 12:30	Design Flow Integration for Advanced Multi-Chip RF	Dustin Hoekstra – National Instruments, Mike Yore – Qorvo
12:30 – 12:45	Usage of Spring-Loaded Probes for Functional Test of RF Applications	Matthias Zapatka – INGUN USA, INC. Don Feuerstein – INGUN USA, Inc. - Applied Engineering Solutions Nebiat Awano, Sergiy Royak – INGUN Pruefmittelbau GmbH Stephan Grensemann – INGUN Southeast Asia
12:45 – 13:00	Improvements in Pnoise-HBnoise Make Sampled Noise Analysis Easier and More Intuitive for Designers	Art Schaldenbrand – Cadence Design Systems, Inc.
13:00 – 13:15	The Performance and Consistency Advantage of Ion Beam Etching Over Chemical	James Barrett, Tom Perkins – Ion Beam Milling
13:15 – 13:30	Impact of Low-loss Materials in mmWave Applications: From Material Characterization to Industrial Cases	Jan Järveläinen – Premix Oy
13:30 – 13:45	EMI Shielding for High Frequency Applications	Mazen Shehaiber – 3G Shielding Specialties
13:45 – 14:00	Material and Circuit Influences for PIM Related Issues	John Coonrod – Rogers Corp.
14:00 – 14:15	Printed Circuit Board (PCB) Layout Considerations for Optimal Phase Locked Loop (PLL) Performance	Ian Collins – Analog Devices International
14:15 – 14:30	Vendor Parts Synthesis (VPS) Automates Selection of RLC Components for Fast RF PCB Board Realization	Rulon VanDyke, How-Siang Yap – Keysight Technologies
14:30 – 14:45	JESD204C Technology in Data Converters	Del Jones – Analog Devices, Inc.
14:45 – 15:00	Time Domain Electromagnetic-Circuit Co-Simulation	Gregory Moss – Remcom, Inc.
15:00 – 15:15	Extremely Fast GPU Based Simulation of MW Circuits and Antennas	Branko Mrdakovic – WIPL-D
15:15 – 15:30	Design of an IoT MIMO Antenna	Derek Linden – National Instruments
15:30 – 15:45	Avoid Costly Mistakes in Designing Phased Array Systems	Dr. Murali S Murthy Upmaka – Keysight Technologies
15:45 – 16:00	Complete X-Band 2x2 Phased-Array Antenna Design and Simulation	David Vye, Andy Hughes – National Instruments
16:00 – 16:15	Advanced Antenna Design Using µWave Wizard	Ralf Ihmels – Mician, Inc.
16:15 – 16:30	ADAS Automotive Radar Systems	John Dunn – National Instruments
16:30 – 16:45	3D Electromagnetic Analysis: Applications and Methods	Isabella Bedford – Modelithics, Inc.
16:45 – 17:00	Fast Design and Optimization of Passive Microwave Components and Antennas Including Feed-Networks by WASP-NET	Fritz Arndt – MIG Microwave Innovation Group

DEVICES | CAD AND MODELING | TEST & MEASUREMENT | MANUFACTURING, MATERIALS | CIRCUIT & SYSTEM DESIGN | FEATURE PRESENTATION

MICROAPPS SCHEDULE – WEDNESDAY, 13 JUNE
BOOTH 1457

09:45 – 10:00	Measurement Accuracy of Vector Network Analysis	Volker Herrmann – Rohde & Schwarz USA, Inc.
10:00 – 10:15	2 Port Calibration for Blindmate Connectors	Mario Torres – Micro-Mode Products, Inc.
10:15 – 10:30	Accurate Cable Measurement Technique Using an Automatic Calibration Module With a VNA	Brian Walker – Copper Mountain Technologies
10:30 – 10:45	New Power Measurement Techniques for Today's Demanding RF World	Lawrence Wilson – Rohde & Schwarz USA, Inc.
10:45 – 11:00	Meeting the Thermal Challenges for the Design of High Power GaN HEMT Devices	Dustin Kendig – Microsanj
11:00 – 11:15	Tunable and Fixed Filtering Solutions Enhances Dynamic Range and Flexibility of 4G-LTE Measurements	Rafi Hershtig – K&L Microwave
11:15 – 11:30	Envelope Bandwidth and Other Lesser Known RF Detector IC Specifications	Eamon Nash – Analog Devices, Inc.
11:30 – 11:45	Faster S-Parameter Measurements From Below 2 K to 675 K Using Automatic Fixture Removal (AFR)	David Daughton – Lake Shore Cryotronics Andy Owen – Keysight Technologies
11:45 – 12:00	Using Near-Field Scanners for Self-Interference Debugging in Communication Circuits	Arturo Mediano – EMSCAN-University of ZaraGoza
12:00 – 12:15	Components for 5G – What is new	Markus Loerner – Rohde & Schwarz USA, Inc.
12:15 – 12:30	5G mmW Beamformer IC Test Challenge and Solution	Osamu Kusano – Keysight Technologies
12:30 – 12:45	New Techniques for 5G Transmitter Measurements	Lawrence Wilson – Rohde & Schwarz USA, Inc.
12:45 – 13:00	Techniques for Monitoring RF Pollution	Robin Getz – Analog Devices, Inc.
13:00 – 13:15	Fully Automated Probe Calibration and Measurement of Devices On-Wafer	Craig Kirkpatrick – FormFactor, Inc.
13:15 – 13:30	Digital Phase Noise Testing for Ultra-Low Noise Oscillators	Guillaume BRES-SAIX – Noise XT
13:30 – 13:45	Noise Figure Measurements for Multiport Applications	Volker Herrmann – Rohde & Schwarz USA, Inc.
13:45 – 14:00	Applications for 110GHz Load Pull and Noise Parameter Extraction	Vince Mallette – Focus Microwaves Inc.
14:00 – 14:15	Demystifying Phase Coherent Signal Generation	Mathieu Caillet – Rohde & Schwarz USA, Inc.
14:15 – 14:30	A Survey of OTA Test Solutions and How to Optimize for Your Application	Jay Banwait – National Instruments
14:30 – 14:45	Advanced Techniques for Spurious Search in RF and Microwave Devices	Kay-Uwe Sander – Rohde & Schwarz USA, Inc.
14:45 – 15:00	Simplify High Channel-Count Systems Through Integrated RF Sampling Transceiver IC	Kang Hsia, Russell Hoppenstein – Texas Instruments
15:00 – 15:15	A New Way of Thinking About High Power Microwave System Design Using Solid State Microwave Generators	John Mastela – Richardson Electronics
15:15 – 15:30	The Benefits, Challenges, and Implementation of Translation Loop PLLs	Ian Collins – Analog Devices International
15:30 – 15:45	Waveguide Tunable Filter with Constant Bandwith	Shunxi Jiang, Shi Yin – Pivotone Communication
15:45 – 16:00	Application of a 40 GHz Contiguous Sextuplexer to Efficiently Combine or Divide Multiple Signals	Hermanus Swanepoel – Plexsa Manufacturing
16:00 – 16:15	Simple, Space Saving Methods to Manage Microwave Local Oscillator (LO) Harmonics	Marty Richardson – Analog Devices, Inc.
16:15 – 16:30	TFLE-Thin Film Lumped Elements LC Filters	Rafi Hershtig – K&L Microwave
16:30 – 16:45	Aluminum Nitride vs. Beryllium Oxide for High Power Resistor Products	Ken Peters – Smiths Interconnect (Former RF Labs)
16:45 – 17:00	IEEE MTT-S How to Write a Paper for IMS or Transactions	Michael Steer – IEEE-MTT-S

MICROAPPS SCHEDULE – THURSDAY, 14 JUNE
BOOTH 1457

09:45 – 10:00	Integrated DAC and Buffer Amp Addresses the 5G Bandwidth Challenge for Instrumentation	Tom Spargo, Randy Oltman – Analog Devices, Inc.
10:00 – 10:15	Overview of the 5G New Radio Physical Layer	David Hall – National Instruments
10:15 – 10:30	Fundamentals of Frequency Multiplication	Doug Jorgesen – Marki Microwave
10:30 – 10:45	Simulating Throughput as a 5G Device Design Metric	Jeff Barney, Ryan Ohs – Remcom
10:45 – 11:00	Advanced Methods to Analyze Ultra Wideband Automotive Radar Signals	Laura Sanchez – Rohde & Schwarz USA, Inc.
11:00 – 11:15	The Impact of PTH Via's on PCB RF Performance	John Coonrod – Rogers Corp.
11:15 – 11:30	A Comparison of On-Wafer Microwave Measurement Performance of Production Probes Versus Analytic Probes	Craig Kirkpatrick – FormFactor, Inc.
11:30 – 11:45	PCIe Gen4 - Gen5 – How to Measure the Real Jitter Performance of a SSC Clock	Martin Stumpf – Rohde & Schwarz USA, Inc.
11:45 – 12:00	Reducing SWaP + C (a Focus on DC Power)	Misha Pierre-Mike – Evans Capacitor Company
12:00 – 12:15	Design of 1.0 mm Edge Launch Connectors and Board Laminate Formulation for 110 GHz Applications	Eric Gebhard – Signal Microwave Svetlana Sejas Garcia – Isola
12:15 – 12:30	Testing Multi Antenna GPS Systems	Lawrence Wilson – Rohde & Schwarz
12:30 – 12:45	Highly Linear Microwave Mixers	Christopher Marki – Marki Microwave
12:45 – 13:00	Settling Time Measurements on Wideband Frequency Hopping Signals Used in RADAR and Communication Systems	Kay-Uwe Sander – Rohde & Schwarz USA, Inc.
13:00 – 13:15	Advanced Front-End Module Test Including Wide Band Impedance Control	Vince Mallette – Focus Microwaves Inc.
13:15 – 13:30	Generating Sub-30fs Jitter JESD204B Clock-SYSREF Pairs up to 7.5GHz	Chris Pearson – Analog Devices, Inc.
13:30 – 13:45	Measurement Setup for Pulse to Pulse Phase Stability for RADAR Applications	Wolfgang Wendler – Rohde & Schwarz USA, Inc.
13:45 – 14:00	Highly Agile Wideband RF Transeiver: 100MHz to 6GHz, High Performance, Fast Hopping, Synchronized 2 Transmitter, 2 Receiver, and Observation Receiver in a 12mm x 12mm Footprint	Larry Hawkins – Analog Devices, Inc.

DEVICES | CAD AND MODELING | TEST & MEASUREMENT | MANUFACTURING, MATERIALS | CIRCUIT & SYSTEM DESIGN | FEATURE PRESENTATION

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

Download on the App Store

ANDROID APP ON Google play

For assistance, please contact IMS2018 Tech Support at support@mtt.org

Notes

Notes

Notes

Performance Over Time

You can't afford to wonder if your cables are impacting your results. You expect your cables to be reliable. You need your cables to last.

But, with 75% of cables failing during installation or operation, your cable selection needs to be more than an afterthought. Choosing authentic GORE® Microwave/RF Test Assemblies is the only way to be sure your cables will stand up to the rigors of everyday use in demanding applications.

GORE® PHASEFLEX® Microwave/RF Test Assemblies – for proven performance, time and again. Learn what sets GORE® Microwave/RF Test Assemblies apart at:

www.gore.com/test

Insist on authentic GORE® Microwave/RF Test Assemblies – the proven purple performer.

GORE

60 YEARS OF IMPROVING LIFE

Visit us at IMS 2018, Booth 1537

precision repeatability durability

Follow us on

RF Engineering Expertise Meets Custom Design Solutions

NIC

www.nickc.com

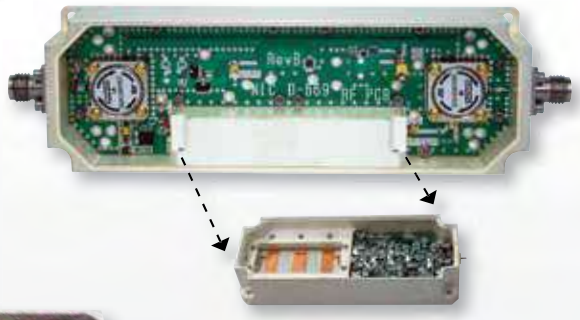
Visit NIC's Booth #2212 at IMS 2018

Filter/Diplexer LNA's

1 MHz - 18 GHz

TX-RX Assemblies

1 MHz - 8 GHz



Switches

(SP2T to SP20T)

1 MHz - 18 GHz

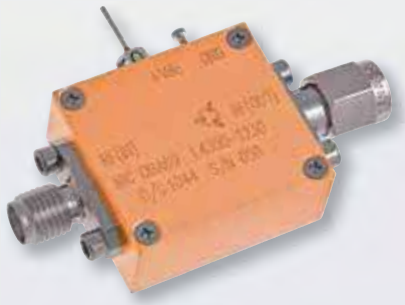
Filters

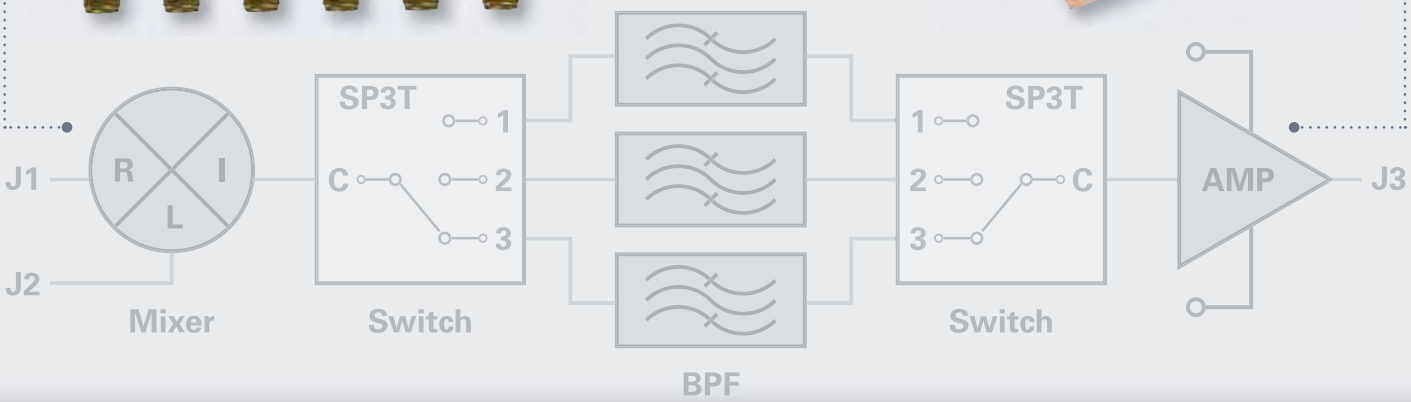
1 MHz - 26 GHz

Amplifiers

(Power Amplifiers + LNA's)

1 MHz - 18 GHz





Radar | UAV | EW | Guidance & Navigation | Communications | GPS & Satellite

ISO 9001:2008
AS9100C
CERTIFIED

NIC NETWORKS INTERNATIONAL CORPORATION

913.685.3400
15237 Broadmoor
Overland Park, KS
e-mail: sales@nickc.com