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## The Week At A Glance

### Sunday, June 10

**Full-Day Workshops**

- **WE2A:** Integrated mm-Wave & THz Sensing Technology for Automotive, Industrial and Healthcare
- **WE2B:** Advanced Integrated RF Filtering Circuits and Techniques
- **WE3A:** Synthesis Design and Frequency Generation/Synchronization for High-Performance Wireless Systems
- **WE3B:** High Power Efficiency Power Amplification for Emerging Wireless Communications Solutions from Devices to Circuits and Systems
- **WS1:** Millimeter-wave Systems; Manufacturing, Packaging and Built-in Self Test

**AM Workshops / Short Courses 08:00-11:50**

- *Coffee Break 09:40-10:10*

**PM Workshops / Short Courses 13:00–17:15**

- *Coffee Break 15:10–15:40*

**Boxed Lunch Distribution**

- 11:45–13:30
- PCC 100 Level

**Historical Exhibition**

- *Exhibition 08:00–17:00 | PCC 200 Level Bridge*

**IM/RFIC Reception & Industry Showcase**

- *Philadelphia Academy of Fine Arts*

### Monday, June 11

**Full-Day Workshops**

- **WE2A:** Integrated mm-Wave & THz Sensing Technology for Automotive, Industrial and Healthcare
- **WE2B:** Advanced Integrated RF Filtering Circuits and Techniques
- **WE3A:** Synthesis Design and Frequency Generation/Synchronization for High-Performance Wireless Systems
- **WE3B:** High Power Efficiency Power Amplification for Emerging Wireless Communications Solutions from Devices to Circuits and Systems
- **WS1:** Millimeter-wave Systems; Manufacturing, Packaging and Built-in Self Test

**AM Workshops / Short Courses 08:00-11:50**

- *Coffee Break 09:40-10:10*

**PM Workshops / Short Courses 13:00–17:15**

- *Coffee Break 15:10–15:40*

**Boxed Lunch Distribution**

- 11:45–13:30
- PCC 100 and 200 Levels

**Historical Exhibition**

- *Exhibition 08:00–17:00 | PCC 200 Level Bridge*

**RF Boot Camp 08:00–16:30 | PCC 109B**

### Tuesday, June 12

**Full-Day Workshops**

- **WE2A:** Integrated mm-Wave & THz Sensing Technology for Automotive, Industrial and Healthcare
- **WE2B:** Advanced Integrated RF Filtering Circuits and Techniques
- **WE3A:** Synthesis Design and Frequency Generation/Synchronization for High-Performance Wireless Systems
- **WE3B:** High Power Efficiency Power Amplification for Emerging Wireless Communications Solutions from Devices to Circuits and Systems
- **WS1:** Millimeter-wave Systems; Manufacturing, Packaging and Built-in Self Test

**AM Workshops / Short Courses 08:00-11:50**

- *Coffee Break 09:40-10:10*

**PM Workshops / Short Courses 13:00–17:15**

- *Coffee Break 15:10–15:40*

**Boxed Lunch Distribution**

- 11:45–13:30
- PCC 100 Level

**Historical Exhibition**

- *Exhibition 08:00–17:00 | PCC 200 Level Bridge*

**IM/RFIC Reception & Industry Showcase**

- *Philadelphia Academy of Fine Arts*

### Wednesday, June 13

**Full-Day Workshops**

- **WE2A:** Integrated mm-Wave & THz Sensing Technology for Automotive, Industrial and Healthcare
- **WE2B:** Advanced Integrated RF Filtering Circuits and Techniques
- **WE3A:** Synthesis Design and Frequency Generation/Synchronization for High-Performance Wireless Systems
- **WE3B:** High Power Efficiency Power Amplification for Emerging Wireless Communications Solutions from Devices to Circuits and Systems
- **WS1:** Millimeter-wave Systems; Manufacturing, Packaging and Built-in Self Test

**AM Workshops / Short Courses 08:00-11:50**

- *Coffee Break 09:40-10:10*

**PM Workshops / Short Courses 13:00–17:15**

- *Coffee Break 15:10–15:40*

**Boxed Lunch Distribution**

- 11:45–13:30
- PCC 100 Level

**Historical Exhibition**

- *Exhibition 08:00–17:00 | PCC 200 Level Bridge*

**IM/RFIC Reception & Industry Showcase**

- *Philadelphia Academy of Fine Arts*

### Thursday, June 14

**Full-Day Workshops**

- **WE2A:** Integrated mm-Wave & THz Sensing Technology for Automotive, Industrial and Healthcare
- **WE2B:** Advanced Integrated RF Filtering Circuits and Techniques
- **WE3A:** Synthesis Design and Frequency Generation/Synchronization for High-Performance Wireless Systems
- **WE3B:** High Power Efficiency Power Amplification for Emerging Wireless Communications Solutions from Devices to Circuits and Systems
- **WS1:** Millimeter-wave Systems; Manufacturing, Packaging and Built-in Self Test

**AM Workshops / Short Courses 08:00-11:50**

- *Coffee Break 09:40-10:10*

**PM Workshops / Short Courses 13:00–17:15**

- *Coffee Break 15:10–15:40*

**Boxed Lunch Distribution**

- 11:45–13:30
- PCC 100 Level

**Historical Exhibition**

- *Exhibition 08:00–17:00 | PCC 200 Level Bridge*

**IM/RFIC Reception & Industry Showcase**

- *Philadelphia Academy of Fine Arts*

### Friday, June 15

**Full-Day Workshops**

- **WE2A:** Integrated mm-Wave & THz Sensing Technology for Automotive, Industrial and Healthcare
- **WE2B:** Advanced Integrated RF Filtering Circuits and Techniques
- **WE3A:** Synthesis Design and Frequency Generation/Synchronization for High-Performance Wireless Systems
- **WE3B:** High Power Efficiency Power Amplification for Emerging Wireless Communications Solutions from Devices to Circuits and Systems
- **WS1:** Millimeter-wave Systems; Manufacturing, Packaging and Built-in Self Test

**AM Workshops / Short Courses 08:00-11:50**

- *Coffee Break 09:40-10:10*

**PM Workshops / Short Courses 13:00–17:15**

- *Coffee Break 15:10–15:40*

**Boxed Lunch Distribution**

- 11:45–13:30
- PCC 100 Level

**Historical Exhibition**

- *Exhibition 08:00–17:00 | PCC 200 Level Bridge*

**IM/RFIC Reception & Industry Showcase**

- *Philadelphia Academy of Fine Arts*
### Early Afternoon

- **PM Workshops 13:00–17:15**
  - Coffee Break 15:10–15:40 | PCC 100 Level
- **WSI: Towards Direct Digital RF Transceivers**
- **WSL: Ultra-Low-Power Transceiver SoC Designs for IoT Applications**

### Mid Afternoon

13:30–15:10 RMO3 Oral Sessions
- **RMO3A: RF Front-Ends for Emerging Wireless Paradigms** | PCC 201A
- **RMO3B: Mixed Signal Transmitters and Power Amplifiers** | PCC 200B
- **RMO3C: mm/mm-Wave CMOS Integrated Phased-Array Building Blocks** | PCC 204A

15:30–17:20 RMO4 Oral Sessions
- **RMO4A: Ultra-Low-Power Radios for Security, Ranging and Connectivity** | PCC 201A
- **RMO4B: Silicon Integrated mm-Wave Transmitters** | PCC 200B
- **RMO4C: Highly Efficient mm-Wave Oscillators with Wide Tuning Range** | PCC 204A

### Late Afternoon / Evening

- **RFTC Plenary Session**
  - 17:30–19:00 | PCC, Grand Ballroom
- **RFTC Reception & Industry Showcase**
  - 19:00–21:00 | Loews Hotel, Millennium Hall

### IMS Plenary Session
- 17:30–19:00 | PCC, Grand Ballroom
- **IMS Welcome Reception**
  - 19:30–20:30 | Reading Terminal Market

### Exhibition
- **Exhibition Only Time** 11:50–15:55
- **Exhibition** 15:55–17:15 | PCC Exhibit Hall

### Industry Workshops
- Industry Workshops 13:00–15:00 | PCC 105B, 106AB, 107B
- Industry Workshops 15:30–17:15 | PCC 105B, 106AB, 107B

### Linearity

- **PM Workshops / Short Courses 13:00–17:15**
  - Coffee Break 15:10–15:40 | PCC 100 Level
- **SMT: Fundamentals of Magnetic Resonance Imaging** CANCELLED
- **WMF: Automotive Radar and Vehicular Network Security**

### IMS closing Session / MBioC Opening Session
- 15:30–17:30 | PCC Grand Ballroom

### CANCELLED
- **SB: Using Active Fiber Optic for Distributed Antennas System (DAS) in 5G MMW Systems and Automotive Radar System** CANCELLED

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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](http://twitter.com/MTT_IMS)
- Follow us on Instagram:  [http://instagram.com/mtt_ims](http://instagram.com/mtt_ims)
- Like us on Facebook:  [http://www.facebook.com/IEEE.MTTS.IMS](http://www.facebook.com/IEEE.MTTS.IMS)
- Engage with fellow attendees on LinkedIn:  [http://www.linkedin.com/groups?gid=2375668](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](http://www.youtube.com/user/mttims)

Don’t forget to use the official IMS hashtag:  [#ims2018](#ims2018)

For the most up to date information visit:  [www.ims2018.org/mobile-apps-and-social-media](http://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.

For assistance, please email support@mtt.org.

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**FRIENDS ARE THE TRUE SCEPTRES OF PRINCES.**

*Benjamin Franklin*
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.
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.

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
Welcome to America’s First World Heritage City!

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.

**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. Try the One Day Individual Independence Pass for $13. Both provide unlimited travel on all SEPTA modes of transportation for a full day.

**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.

---

**PHILADELPHIA: THE CENTER OF IT ALL**

The only thing easier than getting to Philadelphia is getting around once you’re here. In Philadelphia, everything is just around the corner.

**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 Marriott 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
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. 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 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.

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 now. Every one of the following IMS Week activities will bring you back to IMS next year (in Boston)!

**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 RM02A: 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 Awards Luncheon
- IMS/ARFTG Joint Session Th2D: Innovative mm-wave Photonics for Millimeter-wave and 5G Applications
- IMS Focus Session Th2F: 5G Millimeter-Wave Beamformers and Phased-Arrays
- IMS/ARFTG Joint Session Th3D: Advanced High Frequency Large Signal Measurement Techniques
- IMS/ARFTG Joint Session Th3E: 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 Dr. Joe Taylor, K1JT, presentation at the Kimmel Center?

**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
- MITT-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? 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 MITT-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?”
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- 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 Last time to never heard 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, “Phibert”, 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.
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<th>Session</th>
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<td>Tu1C</td>
<td>Advances in Combiners and Dividers</td>
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<tr>
<td>Tu1C-1</td>
<td>Filtering Power Divider with Wide Stopband Using Open-Stub Loaded</td>
<td>Xun Luo, Guoan Wang,UESTC, China</td>
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<td>Coupled-Line and Hybrid Microstrip T-Stub/DGS Cell</td>
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<tr>
<td>Tu1C-2</td>
<td>An Ultra-Compact Folded Inductor Based Wideband Gysel Power Divider</td>
<td>Moez Karim Aziz, Georgia Tech, USA; Min-Yu Huang, Georgia Tech, USA; Sensen Li,</td>
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<td></td>
<td>for Multi-Band 5G Applications</td>
<td>Georgia Tech, USA; Edgar Garay, Georgia Tech, USA; Hua Wang, Georgia Tech, USA</td>
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<td>Tu1C-3</td>
<td>Compact Ridge Waveguide Gysel Combiner</td>
<td>Mohamed M. Fahmi, University of Waterloo, Canada; Raafat R. Mansour, University</td>
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<td>of Waterloo, Canada; Carlo Valenzano, University of Salford, Italy</td>
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<tr>
<td>Tu1C-4</td>
<td>Wide-Band Single-Ended-to-Balanced Power Divider with Broad-Band</td>
<td>Wenjie Feng, Wenquan Che, Quan Xue, SCUT, China; Chenwu Wang, NUST, China;</td>
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<td>Common-Mode Suppression</td>
<td>Roberto Gómez-García, Universidad de Alcalá, Spain</td>
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<td>Tu1C-5</td>
<td>A 3D Compact Wideband 16_16 BUTTER Matrix for 4G/3G Applications</td>
<td>Rafael D. Cerna, PUCP, Peru; Manuel A. Yarlequé, PUCP, Peru</td>
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<tr>
<td>Tu1D</td>
<td>Novel Microwave and Millimeter Materials, Devices, and Radiating</td>
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<tr>
<td>Tu1D-1</td>
<td>Integrated Polarization Converter for Planar Cross-Polarized</td>
<td>Waldy Dyab, École Polytechnique de Montréal, Canada; Ahmed A. Salk, École</td>
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<td></td>
<td>Millimeter Wave Components</td>
<td>Polytechnique de Montréal, Canada; Ke Wu, École Polytechnique de Montréal,</td>
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<tr>
<td>Tu1D-2</td>
<td>Design of Full-Metal Polarizing Screen Based on Circuit Modeling</td>
<td>Carlos Molero, IETR (UMR 6164), France; T. Debacker, EPFL, Switzerland; Maria</td>
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<td>Garcia-Vigueras, IETR (UMR 6164), France</td>
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<tr>
<td>Tu1D-3</td>
<td>Planar Orthomode Transducer Based on Effective Polarization-</td>
<td>Ahmed A. Salk, École Polytechnique de Montréal, Canada; Ke Wu, École</td>
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<td></td>
<td>Independent Coupling</td>
<td>Polytechnique de Montréal, Canada</td>
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<td>Tu1D-4</td>
<td>Volumetric Double Negative Metamaterial Composed of Planar Resonators</td>
<td>Jan Machac, Czech Technical University in Prague, Czech Republic</td>
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<tr>
<td>Tu1D-5</td>
<td>Magneto-Electric-Dipole-Based Leaky-Wave Radiating Structure with</td>
<td>Yue-Lung Lyu, Harbin Institute of Technology, China; Fan-Yi Meng, Harbin</td>
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<td>Reduced Frequency-Dependent Beam Squint</td>
<td>Institute of Technology, Technology, China; Ke Wu, École Polytechnique de</td>
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<td>Montréal, Canada; Quan Wu, Harbin Institute of Technology, China; Guo-Hui Yang,</td>
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<td>Harbin Institute of Technology, China; Cong Wang, Harbin Institute of Technology,</td>
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**202AB**

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<tr>
<th>Session</th>
<th>Title</th>
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<tbody>
<tr>
<td>Tu1G</td>
<td>Resonator-Based Sensors</td>
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<tr>
<td>Tu1G-1</td>
<td>Sensitivity and Selectivity Enhancement in Coupling Ring Resonator</td>
<td>Mohammad H. Zairi, University of British Columbia, Canada</td>
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<td></td>
<td>Sensors Using Splitting Resonant Frequencies</td>
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<tr>
<td>Tu1G-2</td>
<td>Substrate-Integrated Liquid-Permittivity Microwave Sensor with</td>
<td>Humberto Lobato-Morales, CICESE, Mexico; Ricardo A. Chávez-Pérez, CICESE, Mexico;</td>
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<td>Simultaneous Fixed-Reference Resonance</td>
<td>José L. Medina Monroy, CICESE, Mexico</td>
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<tr>
<td>Tu1H</td>
<td>Advanced Structures Using Additive Manufacturing Process</td>
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<tr>
<td>Tu1H-1</td>
<td>n-RIM: A Paradigm Shift in the Realization of Fully Inkjet-Printed</td>
<td>Syed Abdullah Niazen, Georgia Tech, USA; Aline Eid, Georgia Tech, USA; Manos M.</td>
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<td>Broadband Tunable FSS Using Origami Structures</td>
<td>Tentzeris, Georgia Tech, USA</td>
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<td>Tu1H-2</td>
<td>Smart Floating Balls: 3D Printed Spherical Antennas and Sensors for</td>
<td>Wenjing Su, Georgia Tech, USA; Shicong Wang, Georgia Tech, USA; Ryan Bahr,</td>
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<td></td>
<td>Water Quality Monitoring</td>
<td>Georgia Tech, USA; Manos M. Tentzeris, Georgia Tech, USA</td>
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<tr>
<td>Tu1H-3</td>
<td>3D Printed Coaxial Transmission Line Using Low Loss Dielectric and</td>
<td>Jumy Shen, North Carolina State University, USA; Michael D. Dickey, North</td>
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<td>Liquid Metal Conductor</td>
<td>Carolina State University, USA; David S. Ricketts, North Carolina State University,</td>
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<tr>
<td>Tu1G-3</td>
<td>Electromagnetic Rotary Encoders Based on Split Ring Resonators (SRR)</td>
<td>Javier Mata-Contreras, Universitat Autònoma de Barcelona, Spain; Cristian Herrojo,</td>
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<td></td>
<td>Loaded Microstrip Lines</td>
<td>Universitat Autònoma de Barcelona, Spain; Ferran Martín, Universitat Autònoma</td>
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<td>de Barcelona, Spain</td>
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**204C**

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<tr>
<td>Tu1H-4</td>
<td>Pushing Inkjet Printing to W-Band: An All-Printed 90-GHz Beamforming</td>
<td>John Kimonis, Nokia Bell Labs, USA; Shahi Naishan, Nokia Bell Labs, USA;</td>
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<td>Array</td>
<td>Yves Baeyens, Nokia Bell Labs, USA; Amit Singh, Nokia Bell Labs, USA; Manos M.</td>
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<td>Tentzeris, Georgia Tech, USA</td>
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**204C**

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<tr>
<td>Tu1H-5</td>
<td>2.4GHz Band Pass Filter Architecture for Direct Print Additive</td>
<td>Derar Hawatmeh, University of South Florida, USA; Thomas M. Weller, University</td>
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<td></td>
<td>Manufacturing</td>
<td>of South Florida, USA</td>
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### TECHNICAL SESSIONS

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

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<td><strong>Tu2C: Recent Developments in Passive Circuits</strong></td>
<td><strong>Tu2D: Advances in Modeling and Design Optimization</strong></td>
<td><strong>Tu2E: Radio to Terahertz Waves Toward Nanoscale Sensing, Imaging and Characterization of Biological Samples</strong></td>
<td><strong>Tu2G: Advances in Near-Range Radar Sensors</strong></td>
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<td>Chair: Holger Maune, Technische Universität Darmstadt</td>
<td>Chair: Jose Reyas-Sanchez, IETSD</td>
<td>Chair: Marco Farina, Università Politecnica delle Marche</td>
<td>Chair: Christian Waldschmidt, Universität Ulm</td>
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<tr>
<td>Co-Chair: Hualiang Zhang, UMass Lowell</td>
<td>Co-Chair: Q.J. Zhang, Carleton University</td>
<td>Co-Chair: Amaud Pothier, XLIM (UMR 7252)</td>
<td>Co-Chair: Lena Schulwitz, Maxar Technologies</td>
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<tr>
<td><strong>Tu2C-1: High-Power Wideband Low-Cost Limiters Using Cold Plasma</strong></td>
<td><strong>Tu2D-1: Efficient Simulation of Nonlinear Transmission Lines Using Empirical Interpolation and Projection-Based Model Order Reduction</strong></td>
<td><strong>Tu2E-1: Tracking Cancer Cells with Microfluidic High Frequency DEP Cytometer Implemented on BiCMOS Lab-on-Chip Platform</strong></td>
<td><strong>Tu2G-1: A Single-Chip Remotely Powered Transceiver with an Embedded Temperature Sensor</strong></td>
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<td>Zach Vander Missen, Purdue University, USA; Abbas Semnani, Purdue University, USA; Dimitrios Peroulis, Purdue University, USA</td>
<td>Behzad Nouri, Carleton University, Canada; Michel Nakhla, Carleton University, Canada</td>
<td>R. Marczak, F. Hjejle, T. Provent, S. Saada, C. Daimay, P. Blandy, A. Poither, XLIM (UMR 7252), France; B. Bessette, G. Begaud, S. Battu, M.O. Jauberteau, F. Laloue, HPC (R 3842), France; M. Inac, C. Baridiyan Kaynak, Mehmet Kaynak, IHP, Germany; Cristiano Palego, Bangor University, UK</td>
<td>Hengying Shan, Purdue University, USA; John Peterson III, Purdue University, USA; Alice Yi-Szu Jou, Purdue University, USA; Saeed Mohammad, Purdue University, USA</td>
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<td>Zhixian Deng, UESTC, China; Huizhen Jenny Qian, UESTC, China; Xun Luo, UESTC, China</td>
<td>Yiqing Xiao, McGill University, Canada; Roni Khazaika, McGill University, Canada</td>
<td>Reza Ebrahimi Ghiri, Texas A&amp;M University, USA; Elf Kaya, Texas A&amp;M University, USA; Kamran Entesati, Texas A&amp;M University, USA</td>
<td>Martin Geiger, Universität Ulm, Germany; Denis Schlotthauer, Universität Ulm, Germany; Christian Waldschmidt, Universität Ulm, Germany</td>
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<td><strong>Tu2C-3: A Cascaded Self-Similar Rat-Race Hybrid Coupler Architecture and Its Compact Fully Integrated Ka-Band Implementation</strong></td>
<td><strong>Tu2D-3: Sensitivity Analysis of X-Parameters Using the Harmonic Balance Derivative First Moment</strong></td>
<td><strong>Tu2E-3: Imaging of Sub-Cellular Structures and Organelles by an STM-Assisted Scanning Microwave Microscope at mm-Waves</strong></td>
<td><strong>Tu2G-3: Remote Measurement of Particle Streams with a Multistatic Dual Frequency Millimeter Wave Radar Sensor</strong></td>
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<td>Edgar Garay, Georgia Tech, USA; Min-Yu Huang, Georgia Tech, USA; Hua Wang, Georgia Tech, USA</td>
<td>Marco T. Kassis, McGill University, Canada; Rauff Boukhtitarian, McGill University, Canada; Dani Tannir, Lebanese American University, Lebanon; Roni Khazaika, McGill University, Canada</td>
<td>Marco Farina, Andrea Di Donato, Eleonora Paponi, Gianluca Fabi, Antonio Morini, Università Politecnica delle Marche, Italy; James C.M. Huang, Lehigh University, USA; Francesco Piacenza, INFCA, Italy; Ester Di Filippo, Tiziana Pietrangelo, Università di G. d’Annunzio, Italy</td>
<td>Alwin Reinhardt, Christian-Albrechts-Universität zu Kiel, Germany; Alexander Teplukh, Christian-Albrechts-Universität zu Kiel, Germany; Reinhard Knoechel, Christian-Albrechts-Universität zu Kiel, Germany; Michael Hoff, Christian-Albrechts-Universität zu Kiel, Germany</td>
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<td>Jiuyan Ren, UESTC, China; Huizhen Jenny Qian, UESTC, China; Jie Zhou, UESTC, China; Xun Luo, UESTC, China</td>
<td>Adam Cozman, Irania, France; Fabien Seyfert, Irania, France; Smaïn Amari, RMCC, Canada</td>
<td>Jinfeng Li, University of California, Irvine, USA; Zahra Nemati, University of California, Irvine, USA; Kameel Haddadi, IEMN (UMR 8520), France; Douglas C. Wallace, Lehigh University, USA; Peter J. Burke, University of California, Irvine, USA</td>
<td>Marc A. Mutschler, Hochschule Ulm, Germany; Christian Erhart, Hochschule Ulm, Germany; Thomas Walter, Hochschule Ulm, Germany; Christian Waldschmidt, Universität Ulm, Germany</td>
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<tr>
<td><strong>Tu2D-5: Rapid Design Tuning of Miniaturized Rat-Race Couplers Using Regression-Based Equivalent Network Surrogates</strong></td>
<td><strong>Tu2E-5: Full-Coverage Indoor SAR Imaging with a Vehicle-Based FMCW Radar System</strong></td>
<td><strong>Tu2E-6: Hand Gesture Recognition Using a Three-Dimensional 24GHz Radar Array</strong></td>
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<td>Piotr Kugan, Reykjavik University, Iceland; Stawomir Kozel, Reykjavik University, Iceland; John W. Bandler, McMaster University, Canada</td>
<td>Shengchao Lan, Harbin Institute of Technology, China; Zongdong He, KAIST, Korea; Kai Yao, Harbin Institute of Technology, China; Weichu Chen, Harbin Institute of Technology, China</td>
<td>Schistosoma Lan, Harbin Institute of Technology, China; Zongdong He, KAIST, Korea; Kai Yao, Harbin Institute of Technology, China; Weichu Chen, Harbin Institute of Technology, China</td>
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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.
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### 201B: Tom Brazil Memorial Session on Non-Linear Circuits
**Chair:** Christian Fager, Chalmers University of Technology  
**Co-Chair:** Anding Zhu, University College Dublin

#### Tu3B-1: High Frequency and Wideband Modulated Signal Generation Using Frequency Doubler
- Arthur Chung, University of Waterloo, Canada  
- Marwan Ben Rejeb, University of Waterloo, Canada  
- Yehia Betagg, University of Waterloo, Canada  
- Ali M. Dawish, U.S. Army Research Laboratory, USA  
- H. Alfred Hung, U.S. Army Research Laboratory, USA; Slim Boumaiza, University of Waterloo, Canada

#### Tu3B-2: Adaptive Principal Component Analysis for Online Reduced Order Paramater Extraction in Power Amplifiers for Behavioral Modeling and DPD Linearization
- Quynh Anh Pham, Universitat Politècnica de Catalunya, Spain  
- Gabriel Montoro, Universitat Politècnica de Catalunya, Spain; Pere L. Gilabert, Universitat Politècnica de Catalunya, Spain

#### Tu3B-3: SISO Digital Predistortion for Concurrent Dual-Band Power Amplifier Using Baseband Stiching Technique
- Jun Peng, UESTC, China; Songbai He, UESTC, China

#### 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

#### Tu3B-5: Analysis of Chipped Oscillators Under Injection Signals
- Franco Ramirez, Universidad de Cantabria, Spain  
- Sergio Sainco, Universidad de Cantabria, Spain  
- Mabel Pontón, Universidad de Cantabria, Spain  
- Almudena Suárez, Universidad de Cantabria, Spain

### 201C: Advances in Millimeter-Wave Integrated Waveguide Components and Transitions
**Chair:** Hjalti Sigmannson, University of Oklahoma  
**Co-Chair:** Ramal Samanta, Sony

#### Tu3C-1: Dual-Polarized Hybrid Junction Based on Polarization-Selective Periodic Wall
- Ahmed A. Soli, École Polytechnique de Montréal, Canada  
- Waldy Dyak, 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 Jošt, Technische Universität Darmstadt, Germany  
- Erwin 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
- Haidian Zhu, École Polytechnique de Montréal, Canada  
- Shu Mao, CityU, China; Qian 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; Kaxue Ma, UESTC, China; Yongqiang Wang, UESTC, China

#### Tu3C-5: Micromachined Silicon-Core Substrate-Integrated Waveguides with Coplanar-Probe Transitions at 220–330GHz
- Aleksandrov Kvitov, KTH, Sweden; Umer Shah, KTH, Sweden; Olekasndr Gutb, KTH, Sweden; Joachim Oberhammer, KTH, Sweden

#### Tu3C-6: Rigorous Model of Nonlinear Optomechanical Coupling in Microwave and Nano-Structured Resonant Cavities
- Davide Mencarelli, Matteo Stocchi, Luca Piersanti, Università Politecnica delle Marche, Italy

#### Tu3C-7: An Embedded Domain Decomposition Method for Time-Harmonic Electromagnetic Problems
- Jiaqing Lu, The Ohio State University, USA; Jiu-Fa Lee, The Ohio State University, USA

### 202AB: Advances in Numerical Modelling for Multi-Scale and Multi-Physics Applications
**Chair:** Werner Thiel, ANSYS  
**Co-Chair:** Johannes Rüxie, 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. Sarits, 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 Max-Well-Thermal Co-Simulation in Unstructured Meshes
- Kaiyu 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 Ohkmatovski, 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 Gui, University of California, Los Angeles, USA; Tatsoo Itoh, University of California, Los Angeles, USA; Yuanan Ethan Wang, University of California, Los Angeles, USA

#### Tu3D-6: Planar Semiconductor THz Antennas Using Spoo Plasmons for Surface Sensing
- Maximilian Bettenhausen, Universität Kassel, Germany; Friedhard Römer, Universität Kassel, Germany; Bernd Witzgamm, Universität Kassel, Germany; Julia Fleisch, Universität Osanbrück, Germany; Jacob Piehler, Universität Osanbrück, Germany; Changjiang You, Universität Osanbrück, Germany; Marcin Kazmierczak, IHP Germany; Subhajit Guha, IHP Germany; Giovanni Capellini, IHP Germany; Thomas Schröder, IHP Germany

#### Tu3D-7: An Embedded Domain Decomposition Method for Time-Harmonic Electromagnetic Problems
- Jiaqing Lu, The Ohio State University, USA; Jiu-Fa Lee, The Ohio State University, USA

### 203AB: Advances in Microwave and Terahertz Applications in Nanotechnology
**Chair:** Davide Mencarelli, Università Politecnica delle Marche  
**Co-Chair:** Luca Piersanti, Università Politecnica delle Marche

#### Tu3E-1: Future Antenna Miniaturization Mechanism: Magnetoelectric Antennas
- Hwaider Lin, Northeastern University, USA; Mohsen Ziaeebashi, Northeastern University, USA; Neville Sun, Northeastern University, USA; Xianfeng Liang, Northeastern University, USA; Hualiao Chen, Northeastern University, USA; Cunsheng Dong, Northeastern University, USA; Alexei Matyushov, Northeastern University, USA; Xinjun Wang, Northeastern University, USA; Yingguo Guo, Northeastern University, USA; Yuan Gao, Northeastern University, USA; Nian-Xiang Sun, Northeastern University, USA

#### Tu3E-2: Reconfigurable Spoo 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. Fadli, IEMN (UMR 8520), France; W. Wei, IEMN (UMR 8520), France; M. Deng, IMS (UMR 5218), France; S. Fregone, IMS (UMR 5218), France; W. Strupinski, PME, Poland; E. Pallecchi, IEMN (UMR 8520), France; H. Happe, IEMN (UMR 8520), France

#### Tu3E-4: Modelling of Solution Interconnect Extraction of Microwave Structures with Multiple Design Parameters in FDTD
- Daniel Jiao, The Ohio State University, USA; The Ohio State University, USA; S. Gillespie, University of Surrey, UK; Y. Young, University of Kent, UK; M. Skiniou, University of Surrey, UK; Peter H. Aaes, University of Surrey, UK
Tu3F: Biomedical Radar
Chair: Chung-Tse Michael Wu, Rutgers University
Co-Chair: Alfred Huang, U.S. Army Research Laboratory

Tu3F-1: Envelope Detection for a Double-Sideband Low IF CW Radar
Xujun Ma, Southeast University, China; Lianning Li, Southeast University, China; Xiaohu You, Southeast University, China; Jianshan Lin, University of Florida, USA

Tu3F-2: A Multi-Arc Method for Improving Doppler Radar Motion Measurement Accuracy
Songie Bi, University of California, Davis, USA; Xiaoming Gao, University of California, Davis, USA; Victor M. Lubecke, University of Hawaii at Manoa, USA; Olga Boris-Lubecke, University of Hawaii at Manoa, USA; Dennis Matthews, Cardiac Motion, USA; Xiaoguang Liu, University of California, Davis, USA

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; Li-Ting Hwang, National Sun Yat-sen University, Taiwan; Fu-Kang Wang, National Sun Yat-sen University, Taiwan; Tzy-Sheng Hong, National Sun Yat-sen University, Taiwan

Tu3F-4: Self-Injection-Locked AIA Radar Sensor Using PLL Demodulator for Noncontact Vital Sign Detection
Chao-Hsiung Tseng, Taiwan Tech, Taiwan; Li-Ye Yu, Taiwan Tech, Taiwan

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

Tu3G: Advances in Backscattering and RFID Circuits
Chair: Kazuya Yamamoto, Mitsubishi Electric
Co-Chair: Thomas Ussmueller, Universität Innsbruck

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. Vithala, University of California, Los Angeles, USA; Mau-Chung Frank Chang, University of California, Los Angeles, USA

Tu3G-2: Exploitation of Multi-Sine Intermodulation for Passive Backscattering UWB Localization
Massimo Del Prete,Università di Bologna, Italy; Nicolò Decorli, Università di Bologna, Italy; Diego Masotti, Università di Bologna, Italy; Davide Dardari, Università di Bologna, Italy; Alessandra Costanzo, Università di Bologna, Italy

Tu3G-3: Spectrally Efficient 4-PAM Ambient FM Backscattering for Wireless Sensing and RFID Applications
Spyridon N. Daskalakis, Heriot-Watt University, UK; Davide Monier, Heriot-Watt University, UK; Manos M. Tentzeris, Georgia Tech, USA; Nuno Borges Carvalho, Universidade de Aveiro, Portugal; Apostolos Georgiadis, University of California, Los Angeles, USA

Tu3G-4: Dual-Band High Order Modulation Ambient Backscatter
Ricardo Correia, Universidade de Aveiro, Portugal; Nuno Borges Carvalho, Universidade de Aveiro, Portugal

Tu3G-5: Intermodulation Uplink for Far-Field Passive RFID Applications
Nai-Chung Kuo, Bo Zhao, Ali M. Niknejad, University of California, Berkeley, USA

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

Tu3H: Novel Package/PCB Integration Concepts
Chair: Telesphor Kamgaing, Intel
Co-Chair: Rick Strudivant, AzUSA Pacific University

Tu3H-1: A Low Loss Patch-Based Phase Shifter Based on SISL Platform
Yongqiang Wang, UESTC, China; Kaihui Ma, UESTC, China; Ningyang Yan, UESTC, China

Tu3H-2: Substrate Integrated Gap Waveguide Bandpass Filters with High Selectivity and Wide Stopband
Ming Dong, Yunnan University, China; Dongyu Shen, Yunnan University, China; Xiuju 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

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

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 Katin, Analog Devices, USA

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

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15:00 – 15:10

TECHNICAL SESSIONS

Focus & Special Sessions

| Microwave Field, Device & Circuit Techniques | Passive Components | Active Components | Systems & Applications | Emerging Technologies & Applications | Focus & Special Sessions |
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.
His 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. Yamma Yost, W. L. Gore & Associates
Dr. David Yoo, Mitre Corporation
Dr. Yifei Li, UMass – Dartmouth
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

TUIF1-6: 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 Hueltel, Universitat Politècnica de Catalunya, Spain; Rafael Perea-Robles, Universitat Politècnica de Catalunya, Spain; David Garcia-Pastor, Universitat Politècnica de Catalunya, Spain; Marta González-Rodríguez, Universitat Politècnica de Catalunya, Spain; Jose M. González-Abreu, Universitat Politècnica de Catalunya, Spain

TUIF1-2: Fully Reconfigurable Dual-Mode Bandpass Filter
Wentao Lin, École Polytechnique de Montréal, Canada; Tae-Hak Lee, École Polytechnique de Montréal, Canada; He Wu, École Polytechnique de Montréal, Canada

TUIF1-7: Multi-Octave GaN MMIC Circulator for Simultaneous Transmit Receive Applications
Ali M. Dawish, U.S. Army Research Laboratory, USA; Mathew M. Biedka, University of California, Los Angeles, USA; Khamisouk Kingaro, U.S. Army Research Laboratory, USA; John Penn, U.S. Army Research Laboratory, USA; Edward A. Vivioes, U.S. Army Research Laboratory, USA; H. Alfred Hung, U.S. Army Research Laboratory, USA; Y. Ethan Wang, University of California, Los Angeles, USA

TUIF1-3: An Inductor-Based Real-Time Monitoring and Control System for Tunable CMEMS Filters
Mohammad Abu Khater, Purdue University, USA; Mahmoud Abdedfattah, Purdue University, USA; Michael D. Sinanis, Purdue University, USA; Dimitrios Peroulis, Purdue University, 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

TUIF1-4: 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

TUIF1-9: 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 Shammari, University of California, Santa Barbara, USA; Ahmed Hamza, University of California, Santa Barbara, USA; James F. Buckwalter, University of California, Santa Barbara, USA

TUIF1-5: Towards Improved Manufacturing Yield of Acoustic-Wave Ladder-Type Filters
Mohammad J. Almalkawi, Skyworks Solutions, USA

TUIF1-10: An X-Band Low Phase Noise Oscillator with High Harmonic Suppression Using SW Quarter-Wavelength Resonator
Zongzhi Dai, 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)
Qiantong Wu, University of California, Los Angeles, USA; Xiaoting Zou, University of California, Los Angeles, USA; Rui Zhu, University of California, Los Angeles, USA; Yuxuan 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 Seckic, 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 Shi, 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; Kaixi Akhrafaj, 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, NUST, 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; Huihui Liu, UESTC, China; Chunhao Zhao, UESTC, China; Yunchui Wu, UESTC, China; Kai Kang, UESTC, China

TUIF1-19: Input Harmonic Sensitivity in High-Efficiency GaN Power Amplifiers
Tahsif Shams, NXP Semiconductors, USA; Shishir Shukla, NXP Semiconductors, USA; Daman G. Holmes, NAP Semiconductors, USA; Rami Damaj, University of Calgary, Canada; Jeffrey K. Jones, NXP Semiconductors, USA; Fadhil M. Ghanouchi, 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; Sandeep lanfranco, Nokia Bell Labs, USA; Tapio Kolmonen, Nokia Bell Labs, Finland; Olli Pirainen, Nokia Bell Labs, Finland; Jarno K. Tankasen, Nokia Bell Labs, Finland; Shuichi Sakata, Mitsubishi Electric, Japan; Rui Ma, MERL, USA; Shintaro Shinjo, Mitsubishi Electric, Japan; Koji Yamanaoka, 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; Bjorn Hermann, Infineon Technologies, USA; Haedong Jang, Infineon Technologies, USA; Zuhair 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 Popović, University of Colorado Boulder, USA

TUIF1-23: Ruggedness Characterization of Bonding Wire Arrays in LDN/SMT-Based Power Amplifiers
Liang Liu, Ampelos, China; Long Ren, Ampelos, China
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.

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.

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.

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).
## TECHNICAL SESSIONS

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

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<td><strong>We1A: 5G Sub-Systems: From Predistortion to Complete Link</strong></td>
<td><strong>We1B: VHF/UHF Components and Analog Signal Processing</strong></td>
<td><strong>We1C: Planar Multiplexers and Multi-Band Filters</strong></td>
<td><strong>We1D: Advanced Behavioral Models of Devices and Systems</strong></td>
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| **Chair:** Jonathan Comeau, Anokiwave  
**Co-Chair:** Kate Remley, NIST | **Chair:** Marc Franco, Qorvo  
**Co-Chair:** Taylor Barton, University of Colorado Boulder | **Chair:** Sanghoon Shin, U.S. Naval Research Laboratory  
**Co-Chair:** Laya Mohammad, Qualcomm Technologies | **Chair:** Douglas Teeter, Qorvo  
**Co-Chair:** Rob Jones, Raytheon |
| **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 | **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 | **We1C-1: A High Isolation and Low Loss Duplexer Based on SISL Platform**  
Yutong Chu, UESTC, China; Kaikua Ma, UESTC, China; Yongqiang Wang, UESTC, China | **We1D-1: Automating the Accurate Extraction and Verification of the Cardinal Model via the Direct Measurement of Load-Pull Power Contours**  
Thoafukur Hussein, Al-Furat Al-Awsat Technical University, Iraq;  
Azam Al-Rawachi, Mosul University, Iraq;  
Johannes Benedikt, Cardiff University, UK;  
James Bell, Cardiff University, UK;  
Paul Tasker, Cardiff University, UK |
| **We1A-2: Optimized DPD Feedback Loop for M-MIMO Sub-6GHz Systems**  
André Prata, Jordan Svestka, Sérgio C. Piés,  
Ampleon, The Netherlands;  
Arnaldo S.R. Oliveira, Nuno Borges Carvalho, Universidade de Aveiro, Portugal | **We1B-2: Low-Loss Broadband Magnetcless Circulators for Full-Duplex Radios**  
Ahmed Kord, Dimitrios L. Sounas, Andrea Aliu, University of Texas at Austin, USA | **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 | **We1D-2: Non-Quasi-Static Large-Signal Model for RF LD MOS Power Transistors**  
Lei Zhang, 100P Semiconductors, USA;  
Herman Rueda, NXP Semiconductors, USA;  
Kevin Kim, NXP Semiconductors, USA;  
Peter H. Asen, University of Surrey, UK |
| **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, Huilhua Liu, Yunqiu Wu, Kai Kang, UESTC, China | **We1B-3: 400–5600MHz 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 | **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 | **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;  
Chuanji Ji, Georgia Tech, USA;  
David White, Cadence Design Systems, USA |
| **We1A-4: A 29–300GHz 64-Element Active Phased Array for 5G Application**  
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Qiang Zhang, Ya Shen, NEDI, China | **We1B-4: Continuously Tunable True-Time-Delay Phase Shifter Using Switchable Varactor-Tuned Transmission Lines**  
Huizhong Deng, Feng Lin, Beijing Institute of Technology, China | **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 | **We1D-4: Broadband Hammerstein-Wiener Mixer Modeling extracted by Large-Signal Vector Measurements**  
Alessandro Cidonial, Università di Firenze, Italy;  
Giovanni Collodi, Università di Firenze, Italy |
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Bayanor Alqiong, Han Ren, Washington State University, USA;  
Mh Zhou, University of North Texas, USA;  
Chang Chen, UESTC, China;  
Huailiang Zhang, UMass Lowell, USA | **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 | **We1D-5: A Dual-Input Canonical Piecewise-Linear Function-Based Model for Digital Predistortion of Multi-Antenna Transmitters**  
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Chao Yu, Southeast University, China;  
Xiao-Wei Zhu, Southeast University, China |
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Masayuki Taniguchi, NEC, Japan;  
Shinichiro Hori, NEC, Japan;  
Norio Kawa, NEC, Japan;  
Toshihide Kuwabara, NEC, Japan;  
Kazuaki Kunihira, NEC, Japan | **We1B-6: High Power Directional Coupler with Equal Tunable Coupling Value at 382MHz and 704MHz**  
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Karol Dobrzeniecki, SpaceForest, Poland;  
Język Julian Michalski, SpaceForest, Poland | **We1C-6: Millimeter-Wave Beamforming Antenna Arrays**  
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Tsunuo Defu, University of Tokyo, Japan;  
Yongqiang Wang, DataCom, China;  
Shang Chen, Texas A&M University;  
Zhaojun Fu, Fujitsu Laboratories, Japan | **We1D-6: A 54GHz Dual-Polarized Phased-Array Antenna for Millimeter-Wave Wireless Communications**  
Shuichi Yamashita, University of Tokyo, Japan;  
Yasunori Kikuchi, National Institute of Technology, Sendai;  
Shunsuke Ueno, NEC, Japan;  
Kazuyuki Horiuchi, NEC, Japan;  
Takahiro Nishimura, NEC, Japan;  
Shinji Kurokawa, NEC, Japan;  
Masayuki Taniguchi, NEC, Japan |
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<td>Yansong Yang, University of Illinois at Urbana-Champaign, USA; Tomás Manzanheque, University of Illinois at Urbana-Champaign, USA; Songbin Gong, University of Illinois at Urbana-Champaign, USA</td>
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<td>An S-Band Internally Matched Packaged GaN HEMT with Over 720W Peak Power and 58% PAE</td>
<td>Kwanjin Oh, Wavice, Korea; Sangmin Lee, Wavice, Korea; Heejun Kim, Wavice, Korea; Hieesoo Yoon, Wavice, Korea</td>
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<td>A Multi-Frequency MEMS-Based RF Oscillator Covering the Range from 11.7MHz to 1.9GHz</td>
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<td>Robin Irazaqui, University of Oklahoma, USA; Caleb Fulton, University of Oklahoma, USA</td>
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<td>A Multi-Mode Compact Size Multi-Coil Tuned Inductive Peaking ILFD for Low Injected Power Level</td>
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<td>A Novel Agile Phase-Controlled Beamforming Network Intended for 360° Angular Scanning in MIMO Applications</td>
<td>Valentina Palazzi, Università di Perugia, Italy; Paolo Mazzonato, Università di Perugia, Italy; Luca Roselli, Università di Perugia, Italy</td>
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<td>A 60-GHz Adaptively Biased Power Amplifier with Predistortion Linearizer in 90-nm CMOS</td>
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<td>An Ultra Low-Loss Silicon-Micromachined Waveguide Filter for D-Band Telecommunication Applications</td>
<td>James Campbell, Oleksandr Gubakov, Adrian Gomez, Aleksandr Krivovitch, Umer Shah, Joachim Oberhammer, KTH, Sweden; Lars Bolander, Yinggang Li, Ericsson, Sweden</td>
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**10:10 – 11:50 | Wednesday, 13 June 2018 | Pennsylvania Convention Center**

**201A**

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

Chair: Iarostanazhad, Nau Scientific

Co-Chair: Greg Lyons, MIT Lincoln Laboratory

**We2A-1: An Over-110GHz-Bandwidth 2:1 Analog Multiplexer in 0.25-μm InP DHBT Technology**

M. Nagatani, NTT; Japan; H. Wakiita, NTT; Japan; H. Yamazaki, NTT; Japan; M. Motoh, NTT; Japan; M. Iida, NTT; Japan; Y. Miyamoto, NTT; Japan; Hideyuki Nosaka, NTT; Japan

**We2A-3: An Echo-Canceller-Less NFC-TSV Hybrid 3D Interconnect for Simultaneous Bidirectional Vertical Communication**

Srinivasan Gopal, Sheikh Njam Ali, Joe Baylon, Deukhyun Heo, Washington State University; USA; Piawan Agarwal, MadLInear, USA

**201B**

**We2B: Advances in Mixers and Frequency Multipliers**

Chair: Hiroshi Okazaki, NTT DoCoMo

Co-Chair: Chinchun Meng, National Chiao Tung University

**We2B-1: 6–12GHz MMIC Double-Balanced Upconversion Mixer Based on Graphene Diode**

Alfred Hamed, RWTH Aachen University, Germany; Mohamed Saeed, RWTH Aachen University, Germany; Zeheng Wang, AMO, Germany; Mehmed Shayan, AMO, Germany; Daniel Neuhaeuser, AMO, Germany; Renato Negra, RWTH Aachen University, Germany

**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; Ajiyika More, University of California, Davis, USA; Shihao Hao, University of California, Davis, USA; Qun Jane Gu, University of California, Davis, USA

**201C**

**We2C: Filter Tuning, Synthesis, and Innovative Coupling Realizations**

Chair: Dimitra Psaltopoulou, University of Colorado Boulder

Co-Chair: Masaud Hannan, Intel

**We2C-1: An Efficient Technique for Tuning and Design of Wideband Filters**

Huaping Jia, University of Waterloo, Canada; Radlat R. Mansoor, University of Waterloo, Canada

**We2C-2: Coupling Matric Extraction Technique for Auto Tuning of Highly Lossy Filters**

Ranjan Das, IIT Bombay, India; Qingfeng Zhang, SUSTech, China; Abhishek Kandawal, SUSTech, China; Haiwen Liu, Xi’an Jiaotong University, China

**202A**

**We2A-4: A 16-Element 2.4 GHz Digital Array Receiver Using 2-D IIR Spatially-Bandpass Plane-Wave Filter**

Sijaw Pulipati, University of Akron, USA; Viduneth Anaraththa, University of Akron, USA; Arjuna Madanayake, University of Akron, USA

**We2B-3: An Active High Conversion Gain W-Band Up-Conversion Mixer for Space Applications**

M. Hossain, FBH, Germany; M. Hrobak, FBH, Germany; D. Stoppel, FBH, Germany; Wolfgang Heinrich, FBH, Germany; Y. Krozer, FBH, Germany

**We2C-3: A Novel Microstrip Symmetric Bandpass Filter Using Even/Odd-Mode Doublets**

Masataka Ohma, Saitama University, Japan; Makoto Kanomata, Saitama University, Japan; Zhengwan Ma, Saitama University, Japan; Xiaolong Wang, Saitama University, Japan

**202B**

**We2C-4: High Selectivity Filters in Coaxial SIW Based on Singlets and Doubles**

Stefano Sirici, Università Politecnica di Valenica, Spain; Miguel A. Sánchez-Soriano, Universidad de Alicante, Spain; Jorge D. Martinez, Università Politecnica de Valencia, Spain; Virginia E. Borra, Università Politecnica di Valenica, Spain

**We2C-5: A New Microstrip Bandstop Filter for Fully Canonical Cul-de-Sac Coupling Configuration**

Peng Luo, University of Waterloo, Canada; Olof Bengtsson, FBH, Germany; Ulrich Schnieder, FBH, Germany; Matthias Rudolph, Brandenburgische Technische Universität, Germany

**202C**

**We2A-5: A Wide-Range 130-nm CMOS Statical-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

**We2B-5: A High-Efficiency E-Band SiGe HBT Frequency Tripler with Broadband Performance**

Peigen Zhou, Southeast University, China; Jain Chen, Southeast University, China; Huanybo Li, Southeast University, China; Debin Hou, Southeast University, China; Pingyu Yan, Southeast University, China; Chao Yu, Southeast University, China; Wei Hong, Southeast University, China

**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 Ohma, Saitama University, Japan; Zhengwan Ma, Saitama University, Japan; Xiaolong Wang, Saitama University, Japan

**We2D-1: A Simple Method to Extract Trapping Time Constants of GaN HEMTs**

Luis 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

**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 Cloutier, Naanda Kumar Subramani, Vincent Gillet, Sylvain Laurent, Jean Christophe Nallatampy, Michel Prigent, Nathalie Deltimpe, Raymond Quére, XJIL (UMR 7252), France; Christophe Charbonniaud, AMCAD Engineering, France

**We2C-7: Half-Moote SIW Filters with Resonant Couplings Implementing Transmission Zeros**

Enrico Massoni, Nicolò Belmonte, Luca Perugini, Maurizio Bozzi, Università di Pavia, Italy; Giuseppe Macchiarrella, Politecnico di Milano, Italy

**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; Yonglin Guo, National University of Singapore, Singapore

**202D**

**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

**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
TECHNICAL SESSIONS

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**203AB**

**We2E: Ferrite, Ferroelectric, and Phase-Change Components**
Chair: Shamsur Maumuder, Worcester Polytechnic Institute
Co-Chair: Steven Sitzer, 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, Christopher R. Freeze, Anne Steiner, Robert A. York, University of California, Santa Barbara, USA

- **We2E-3: Intrinsically Switchable and Bandwidth Reconfigurable FBAR Filter Employing Electrostriction in Ferroelectric BST**
  Milad Zolfaghari, University of Michigan, USA; Suhyn Nam, University of Michigan, USA; Amir Mortazawi, University of Michigan, USA

- **We2E-4: Complete Methodology of Low-Loss Ultra-Wideband Junction Circulator**
  Hamza Turki, LIM (UMR 7252), France; Laure Huitema, LIM (UMR 7252), France; Thierry Moretini, LIM (UMR 7252), France; Bertrand Leroux, INOVEDS, France; Christophe Breuil, INOVEDS, France

- **We2E-5: Ferrimagnetic Garnets for Low Temperature Co-Fired Ceramics Microwave Circulators**
  L. Gassmy, Thales Research & Technology, France; V. Lauro, Lab-STICC (UMR 6285), France; R. Lebourgeois, Thales Research & Technology, France; P. Quefellec, Lab-STIC, (LIM UMR 6285), France

**204A**

**We2F: Tz 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; Lami 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_wiki_sk, 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**
  Laurens John, Matthias Ohringer, Sandrine Wagner, Christian Friesicke, Axel Tessmann, Arnulf Leuther, Fraunhofer IAF, Germany; Thomas Zwick, KIT, Germany

- **We2F-4: 220-255GHz Active + 6 Frequency Multiplier MMIC with InP HEMT Technology**
  Kangneop Lee, POSTECH, Korea; Hiroshi Hama-da, NTT, Japan; Hideaki Matsuzaki, NTT, Japan; Hideyuki Nosaka, NTT, Japan; Ho-Jin Song, POSTECH, Korea

**204B**

**We2G: Phased Array Systems and Applications**
Chair: Roberto Vincenti Gatti, Università di Pergugia, Italy
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

**204C**

**We2H: High Power Doherty Power Amplifiers**
Chair: Slim Boumaaza, University of Waterloo, Canada
Co-Chair: Manouchehr Ghanavat, Northrop Grumman Aerospace Systems

- **We2H-1: A 150W High Efficiency Integrated Doherty Amplifier for LTE-Advanced Applications**
  Alan Xu, NXP Semiconductors, China; Manel 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 Jiang, Infineon Technologies, USA; Richard Wilson, Infineon Technologies, USA

- **We2H-3: Digitally-Assisted Doherty Power Amplifier: Efficiency Enhancement and Linearity Improvement**
  Mir Masoud, 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 U, 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 Lu, Tsinghua University, China; Wenhua Chen, Tsinghua University, China; Zhengfei Feng, Tsinghua University, China
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 Resayat, Baylor University, USA; Chris Kappelmann, Baylor University, USA; Zachary Hays, Baylor University, USA; Lucia Hays, Baylor University, USA; Charles Baylis, Baylor University, USA; Edward A. Villezios, U.S. Army Research Laboratory, USA; Abbas Semnani, Purdue University, USA; Dimitris Pournis, 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. Reisch, McMaster University, Canada; Natalia K. Nikola, McMaster University, Canada

WEIF1-3: Active HEMT Based Envelope Detector for Ultra-Wideband Wireless Communication Systems
Bruno Cimoli, Technical University of Denmark, Denmark; Juan Sebastian Rodrigues Nolasco, Technical University of Denmark, Denmark; Arsen Tuthaner, Technical University of Denmark, Denmark; Tom Keinicke Johansen, Technical University of Denmark, Denmark; Juan José Vegas Olmos, Mellanox Technologies, Denmark

WEIF1-4: Curtained Digital Predistortion Model for Crosstalk in MIMO Transmitters
Praveen Jarasut, IIT Roorkee, India; Meenakshi Rawat, IIT Roorkee, India; Fedel M. Ghamoussi, University of Calgary, Canada

WEIF1-5: A RF-DAC Based 40Gb/s PAM Modulator with 1.2pJ/Bit Energy Efficiency at Millimeter-wave Band
Finda Solombeek, Chalmers University of Technology, Sweden; Zhengxia 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. Schaf, Hochschule Ulm, Germany; Johannes Iberle, Hochschule Ulm, Germany; Hubert Manti, 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. Niculescu, IMT Bucharest, Romania; A. Dinescu, IMT Bucharest, Romania; A. Stavrinidis, FORTH, Greece; I. Zidu, IMT Bucharest, Romania; G. Konstantinidis, FORTH, Greece

WEIF1-8: 55nm Ultra-Low-Power Local Oscillator for EPCglobal Gen2v2 Standardized Passive UHF RFID Tags
Georg Säd, Universität Innsbruck, Austria; Manuel Hechenblaikner, Universität Innsbruck, Austria; Manuel Fendik, 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. Salish, Warsaw University of Technology, Poland; P. Zagaje, Warsaw Military University, Poland; M. Bauwens, Dominion Microsystems, USA; D. Obi, IMT, Institute of Electronic Technology, Poland; J. Marczewski, Institute of Electronic 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 Thermocoefficient Imaging Guided Focused Microwave Therapy for Breast Cancer Treatment
Srishti Saraswat, University of Arizona, USA; Jinglai 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 Sheawood, Bangor University, UK; Daisy Man Yuen Hung, Bangor University, UK; Paul Cross, Bangor University, UK; Shaun C. Preston, Bangor University, UK; Cristiano Paleog, Bangor University, UK

WEIF1-13: Through The Wall Respiration Rate Detection Using Hilbert Vibrational Decomposition
Hankesh, IIT Delhi, India; Anjanan Basu, IIT Delhi, India; Mahesh P. Alegaonkar, IIT Delhi, India; Shibam 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 Armit, Metamaterials Commercialization Center, USA; Yanoslav A. Urdhumov, Metamaterials Commercialization Center, USA; David R. Nash, Metamaterials Commercialization Center, USA; Russell J. Hannigan, Metamaterials Commercialization Center, USA; Casey T. Teegiene, 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 Pournis, 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 Polosq, Ericsson, France; Haruichi Kanaya, Kyushu University, Japan

WEIF1-17: Nonlinear Resonant Circuits for Coupling-Insensitive Wireless Power Transfer Circuits
Omar Abdelsattar, 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; Jimyu 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; Yuanmao 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; Dina Yegnanarayanan, MIT Lincoln Laboratory, USA; Bradley T. Perry, MIT Lincoln Laboratory, USA

WEIF1-22: 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

WEIF1-23: A Polarization Independent Frequency Selective Surface Based on the Matsuyoshi Geometry
A. Gomes Neto, IPB, Brazil; T.R. de Sousa, IPB, Brazil; I.C. e Silva, IPB, Brazil; D.F. Mamedes, IPB, Brazil

WEIF1-24: Josephson Junction Microwave Modulator
Ofer Naaman, Northrop Grumman, USA; Joshua Strong, Northrop Grumman, USA; David Ferguson, Northrop Grumman, USA; Jonathan Egan, Northrop Grumman, USA; Nancy Jane Bailey, Northrop Grumman, USA; Robert Hinley, Northrop Grumman, USA

10:10 - 11:50 | Wednesday, 13 June 20187 | Pennsylvania Convention Exhibit Hall
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

Philadelphia, PA and the neighboring 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 Q=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)
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!

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/13_inquiring_glass.html]

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

BENJAMIN FRANKLIN
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.

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 worldwide 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.

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.

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 became 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.

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

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.

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.

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.
WEIF2-1: Millimeter-Wave Resonant Cavity for Complex Permittivity Measurements of Materials
Duane C. Karna, Battelle, USA; James C. Weatherall, Battelle, USA; Joseph Greca, Battelle, USA; Peter R. Smith, AASKI Technology, USA; Kevin Yam, Battelle, USA; Jeffrey Barber, DVS, USA; Barry T. Smith, DYS, 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; Jianyuan 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; Jianyuan 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 Angeletti, Università di Bologna, Italy; Gian Piero Gibiino, Università di Bologna, Italy; Troels Nielsen, Keysight Technologies, Denmark; Felice Francesco Farina, 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 Koziej, Reykjavik University, Iceland; Adrian Bekasiewicz, Gdta, R K 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; Jun-Guo Ma, Tianjin University, China; Qiu-Jian 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 Yao, 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 Lataine, Vrije Universiteit Brussel, Belgium; Yves Rolain, Vrije Universiteit Brussel, Belgium; Gerd Vandenest, Vrije Universiteit Brussel, Belgium; Sebastian Gustafsson, Chalmers University of Technology, Sweden; Guillaume Pailloncy, 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; Dongseok Choi, Samsung Electronics, Korea; Youngho Yoon, POSTECH, Korea; Wonbin Hong, POSTECH, Korea

WEIF2-12: RoF SpatiallyMax 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 García-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; Huiyan Jin, UESTC, China; Du Xu, UESTC, China; Shuai Ding, UESTC, China; Luigi Sestieri, Università di Pavia, Italy; Maurizio Bozzi, Università di Pavia, Italy; Luca Perregrini, Università di Pavia, Italy

WEIF2-14: Microstrip Crossover for Millimeter-Wave Applications
Kamar Al Khanjar, IWRM-EMT, Canada; Tarek Eijlstri, IWRM-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 Stripes
Lap K. Yeung, University of California, Los Angeles, USA; Yuanxin 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
Haiwei Xie, NUST, China; Kang Zhou, NUST, China; Chunhua Zhou, NUST, China; Wei Wu, NUST, China

WEIF2-20: High Isolation Superconducting Diplexer Designed with Double-Side Structure
Xiang Wang, Tsinghua University, China; Bei Wei, Tsinghua University, China; Binsong Cao, Tsinghua University, China; Xubo Guo, Tsinghua University, China

WEIF2-21: Relationship Between Band-Edge Steepness and Power-Handling Capability in Filters
Peng Zhu, 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; Binsong Cao, Tsinghua University, China

WEIF2-22: Multiband Filters with Positive or Negative Dispersive Cross-Couplings
Ahmad Hassad, XLIM (UMR 7252), France; Hussein Ezeddine, Jawaya University College, Lebanon; Johann Sence, XLIM (UMR 7252), France; Olivier Tantot, XLIM (UMR 7252), France; Stéphane Blia, 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. Arregi, Universidad Pública de Navarra, Spain; I. Arnedo, Universidad Pública de Navarra, Spain; F. Tefebre, Universidad Pública de Navarra, Spain; C. Arnold, Tesat Spacecom, Germany; M.A.G. Lasso, Universidad Pública de Navarra, Spain; J. Lorente, Tesat Spacecom, Germany
### TECHNICAL SESSIONS

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

#### 201A

**We3A: Novel Microwave Circuits and Systems Applications**
- **Chair:** Kavita Goverdhanam, U.S. Army CERDEC
- **Co-Chair:** Raj Poddar, Synergy Microwave

**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

**We3A-2: An Active Microwave Imaging Technique Using Spatial Frequency Sampling**
- Stavros Vakalis, Michigan State University, USA; Jeffrey A. Narz, Michigan State University, USA

**We3A-3: Linearity Enhancement of GaN Doherty Amplifier by Forward Gate Current Blocking Method**
- Ibrahim Khalil, Srinidhi Embar R., Geoffrey Tucker, NXP Semiconductors, USA

**We3A-4: An Ultra-Low-Power, High Gain Mixer for Smart Cities Applications**
- Rauanak Borwankar, Reinhold Ludwig, Yeheia Massoud, Worcester Polytechnic Institute, USA; Mohammad R. Haider, University of Alabama at Birmingham, USA

**We3A-5: Fully Printed Microwave Sensor for Simultaneous and Independent Level Measurements of 8 Liquids**
- Muhammad Akram Karimi, KAUST, Saudi Arabia; Muhammad Aslanian, XLRE ARC, Saudi Arabia; Asif Shamim, KAUST, Saudi Arabia

**We3B: Emerging RF Switch Technologies for 5G & 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 Bondulin, Northrop Grumman, USA; Nabil El-Hinnawy, Teweldz, 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; Kangni Lee, HRL Laboratories, USA; Daniel Zehnder, HRL Laboratories, USA; Hau-Ti, HRL Laboratories, USA

**We3B-4: Reversible, Fast Optical Switching of Phase Change Materials for Active Control of High-Frequency Functions**
- Arseni Ghalam, Cyril Guiles, Damien Passereux, Jean-Christophe Orlanges, Laure Huitema, Aurelian Crunteanu, XUM (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. Glenn Birdwell, U.S. Army Research Laboratory, USA; Mona Zaghloul, George Washington University, USA; Tony G. Ivanov, U.S. Army Research Laboratory, USA

**We3C: Microwave Acoustic Components for Wireless Applications**
- **Chair:** Amelie Hagelauer, FAU Erlangen-Nürnberg
- **Co-Chair:** Robert Weigel, FAU Erlangen-Nürnberg

**We3C-1: A Compact Intrinsically Switchable Filter Bank Employing Multifunctional Ferroelectric BST**
- Milad Zolfagharloo, University of Michigan, USA; Amir Mortazawi, University of Michigan, USA; Roberto Gómez-Garcia, Universidad de Alcalá, Spain

**We3D: A Compact Intrinsic Switchable Filter Bank Employing Multifunctional Ferroelectric BST**
- Kavita Goverdhanam, Ajay Poddar, Synergy Microwave

**We3E: Microwave Acoustic Components for Wireless Applications**
- **Chair:** Kavita Goverdhanam, U.S. Army CERDEC
- **Co-Chair:** Raj Poddar, Synergy Microwave

**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-ye Hashimoto, Chiba University, Japan

**We3E-2: A Compact Intrinsically Switchable Filter Bank Employing Multifunctional Ferroelectric BST**
- Milad Zolfagharloo, University of Michigan, USA; Amir Mortazawi, University of Michigan, USA; Roberto Gómez-Garcia, Universidad de Alcalá, Spain

**We3E-3: Multi-Band Acoustic-Wave-Lumped-Element Resonator-Based Bandpass Filters**
- Dimitra Psychogiou, University of Colorado Boulder, USA; Dakota J. Simpson, University of Colorado Boulder, USA; Roberto Gómez-Garcia, University of Alcalá, Spain

**We3E-4: Compact Size and Wideband Triplexer Using SAW Resonators and LC Components**
- Jung-Do Ha, Seok-Jae Lee, Wipf, Christian Wipf, Matthias Wietstruck, Mekhmet Kaynak, ON Semiconductor, Israel; Danny Elad, ON Semiconductor, Israel

**We3E-5: Silica-Based Packaging Structure for D-Band RF Module**
- Masaharu Ito, NEC, Japan; Tsunehisa Marumo, NEC, Japan

**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**
- Roeen 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 Marumo, NEC, Japan

**We3F-4: Substrate Integrated Waveguides for mm-Wave Functionalized Silicon Interposer**
- Matthieu Bertrand, L2E (UR2), France; Emmanuel Pistono, Giuseppe Aldin, Florence Podevin, MPF-LAHC (UMR 5130), France; Darin Kaddour, L2S (EA 3747), France; Vincent Puyal, CEA-LETI, France; Selin Toluay Wijd, Christian Wipf, Matthias Wietstruck, Mekhmet Kaynak, HZI, Germany; Philippe Ferrari, TIMA, France

**We3F-5: Multilayer TRL Calibration Standards for S-Parameter Measurement of Planar Goubau Lines from 0.75THz to 1.17THz**
- Juan Cabello-Sánchez, Chalmers University of Technology, Sweden; Helena Rodilla, Chalmers University of Technology, Sweden; Vladimir Draksinsky, Chalmers University of Technology, Sweden; Jan Stake, Chalmers University of Technology, Sweden
We3H-2: Yeast Cell Growth Monitoring Using Microwave Measurements Correlated to Optical Absorbance

Xiue Bao, Ilja Ocket, Ju Zheng, Juncheng Bao, Meng Zhang, Dries Kil, Vanessa Franssens, Bart Nauwelaers, Katholieke Universiteit Leuven, Belgium

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

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

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.
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!

<table>
<thead>
<tr>
<th>AWARD TITLE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEEE Electronmagnetics Award</td>
<td>Tatsuo Itoh For contributions to electromagnetic modeling, artificial materials, microwave electronics, and antennas</td>
</tr>
<tr>
<td>Microwave Career Award</td>
<td>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.</td>
</tr>
<tr>
<td>Distinguished Service Award</td>
<td>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.</td>
</tr>
<tr>
<td>Distinguished Educator Award</td>
<td>Ching-Kuang Clive Tzuan 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.</td>
</tr>
<tr>
<td>Microwave Pioneer Award</td>
<td>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.</td>
</tr>
<tr>
<td>Microwave Application Award</td>
<td>Peter Siegel To recognize the most outstanding application of microwave theory and techniques by an individual or a team of individuals.</td>
</tr>
<tr>
<td>N. Walter Cox Award</td>
<td>Bela Szendreyi 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.</td>
</tr>
<tr>
<td>IEEE MTT-S Outstanding Young Engineer Award</td>
<td>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.</td>
</tr>
<tr>
<td>IEEE Microwave and Wireless Components Letters Tatsuo Itoh Prize</td>
<td>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.</td>
</tr>
<tr>
<td>Microwave Prize</td>
<td>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.</td>
</tr>
</tbody>
</table>
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:

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

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:

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

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

201A

Th1A: Advanced Technologies for Non-Planar Filters and Diplexers
Chair: Giuseppe Macchiarella, Politecnico di Milano
Co-Chair: Richard Snyder, RS Microwave

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; Zhe Zhu, University of Technology Sydney, Australia; Xi Zhu, University of Technology Sydney, Australia; Quan Xue, SCUT, China

Th1A-2: Pseudoecliptic Combine Filter in a Circularly Shaped Tube
Roman Tkadlec, CommScope, Italy; Giuseppe Macchiarella, Politecnico di Milano, Italy

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

Th1A-4: A Wideband Diplexer for Ka-Band Passive Inductively Coupled Load Measurement
D. Smaczka, ESA-VSC High Power RF Laboratory, Spain; C. Carceller, Marco Guglielmi, P. Soto, Vicente E. Baria, J. Ruiz, P. Gonzalez, Universitat Politècnica de València, Spain

Th1A-5: A Compact 28GHz Bandpass Filter Using Quartz Folded Waveguide
Rintashi Kajima, Manabu Nakahiri, Kei Matsutani, Katsuhito Kuroda, Kengo Oinaka, Masayoshi Koshino, Takaki Murata, Norio Nakajima, Murata Manufacturing, Japan

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

Th1A-7: A Compact Tunable Filtering Rat-Race Coupler
Mohamed E. Hagag, Dimitrios Peroulis, Purdue University, USA

2018

Th1B: Advanced Rectifiers and Energy Harvesters for Wireless Power Transfer
Chair: David Ricketts, North Carolina State University
Co-Chair: Kenjiro Nishikawa, Kagoshima University

Th1B-1: Accurate Analytical Model for Hybrid Ambient Thermal and RF Energy Harvester
Xiaojing Gu, École Polytechnique de Montréal, Canada; Lei Guo, École Polytechnique de Montréal, Canada; Moussa Harouna, École Polytechnique de Montréal, Canada; Simon Henriot, IMS (UMR 5218), France; Ke Wu, École Polytechnique de Montréal, Canada

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

Th1B-3: A 434MHz Dual-Mode Power Harvesting System with an On-Chip Coil in 120nm CMOS SOI for mm-Sized Implants
Hamed Rahmani, Aydin Babakhani, University of California, Los Angeles, USA

Th1B-4: GHz-Band High-Efficiency Rectifier Design Based on Multi-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 Horigo, University of Electro-Communications, Japan

Th1B-5: An Inverted-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

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

Th1C-1: Real-Time kHz to GHz Monitoring of Incubated Yeast Cell Growth Using Interdigitated Capacitors
Mohbata Chehlehcheghri, Katholieke Universiteit Leuven, Belgium; Vanessa Fransens, Katholieke Universiteit Leuven, Belgium; Ilja Ocket, Katholieke Universiteit Leuven, Belgium; Bart Nauwelaers, Katholieke Universiteit Leuven, Belgium

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; Han Li, Lehigh University, USA; Xuanhong Cheng, Lehigh University, USA; James C.M. Hwang, Lehigh University, USA

Samaneh Akbar, University of Manitoba, Canada; Ehtam Salimi, University of Manitoba, Canada; Michael Butler, NIBRT, Ireland; Douglas Thomson, University of Manitoba, Canada; Greg Bridges, University of Manitoba, Canada

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

202AB

Th1D: Advanced High Frequency Large Signal Measurement Techniques*
Chair: Matt King, Georgia Tech
Co-Chair: Nuno Carvalho, Universidade de Aveiro

Th1D-1: On-Chip High Impedance RMS Voltage Measurements at 265–300GHz
Sandeep Kshatry, University of Texas at Dallas, USA; Kenneth K. G, University of Texas at Dallas, USA

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 Buismans, Chalmers University of Technology, Sweden

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

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
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; Nezh T. Yardimb, University of California, Los Angeles, USA; Yi-Hsin Ou, University of Arizona, USA; Mona Jamahi, University of California, Los Angeles, USA; Kihang 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. Fernmann, IMRA America, USA

Th1E-4: Automatic Monitor-Based Tuning of RF Silicon Photonic True-Time-Delay Beamforming Networks
GBKhoon Choo, Texas A&M University, USA; Christi K. Madsen, Texas A&M University, USA; Samuel Palermo, Texas A&M University, USA; Kannan Entesar, 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 Rosenski, SSL
Co-Chair: Zaher Bardal, IMN Epiphany

Th1F-1: A 4 Element Phased Array Transmitter with Efficiency Enhancement Using Beamforming for High-Bandwidth WLAN Applications
Avraham Savag, Technion, Israel; Emanuel Cohen, Technion, Israel

Th1F-2: A Scalable Dual-Polarized 256-Element Ku-Band Phased-Array SATCOM Receiver with ±70° Beam Scanning
Abdurahman H. Aljubani, University of California, San Diego, USA; Tunay Kanar, University of California, San Diego, USA; Samet Zhir, 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; Chuncang 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 Khalimuddin Khan, u-blox, Ireland

Th1F-4: Digital Sequential PA for Flexible Efficiency Tuning Over Wide Power Back-Off Range
Andreas Wenzel, FBH, Germany; Wolfgang Heinrich, FBH, Germany

Th1F-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; New Wien, Technische Universität Darmstadt, Germany; Rolf Jakoby, Technische Universität Darmstadt, Germany; Wolfgang Heinrich, FBH, Germany; Olaf Bengtsson, FBH, Germany

204C

Th1H: Doherty and Load-Modulated Power Amplifiers
Chair: Paul Drafe, Qualcomm Technologies
Co-Chair: Kerrie Chen, University of Rhode Island

Th1H-1: Broadband and Linearity Enhanced Doherty Power Amplifier Using Complex-Valued Load Modulation
Koosu Fang, University of Waterloo, Canada; Hamed Golestaneh, University of Waterloo, Canada; Slim Boumaiza, University of Waterloo, Canada

Koosu 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 Wenzel, 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; New Wien, Technische Universität Darmstadt, Germany; Rolf Jakoby, Technische Universität Darmstadt, Germany; Wolfgang Heinrich, FBH, Germany; Olaf Bengtsson, FBH, Germany

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BENJAMIN FRANKLIN

READING MAKES A FULL MAN, MEDITATION A PROFOUND MAN, DISCOURSE A CLEAR MAN.
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<thead>
<tr>
<th>Session</th>
<th>Title</th>
<th>Chairs/Co-Chairs</th>
</tr>
</thead>
<tbody>
<tr>
<td>201A</td>
<td>Th2A: Synthesis and Design of Non-Planar Filters and Multiplexers</td>
<td>Chair: Ming Yu, Chinese University of Hong Kong Co-Chair: Vicente Borja, Universitat Politècnica de València</td>
</tr>
<tr>
<td>201B</td>
<td>Th2B: Recent Developments in Wireless Power Transfer Techniques</td>
<td>Chair: Paolo Mezzanotte, Università di Perugia Co-Chair: Kamran Ghorbani, RMIT University</td>
</tr>
<tr>
<td>201C</td>
<td>Th2C: Hyperthermia Treatment and Implants Wireless Powering</td>
<td>Chair: Robert Caverly, Technische Universität Wien Co-Chair: Abbas Omer, Universität Magdeburg</td>
</tr>
<tr>
<td>202A</td>
<td>Th2D: Innovative mm-Wave Calibration and Measurement Techniques*</td>
<td>Chair: Jon Martens, Amititsu Co-Chair: Andrea Ferrero, Keysight Technologies</td>
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**Thursday, 14 June 2018 | Pennsylvania Convention Center**

**THURSDAY**

**10:10 – 11:50**

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<thead>
<tr>
<th>Session</th>
<th>Title</th>
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</tr>
</thead>
<tbody>
<tr>
<td>201A</td>
<td>Th2A-1: Singly Terminated Network and Contiguous Multiplexer Design</td>
<td>Y. Yang, China Academy of Space Technology, China; Q. Wu, Xidian University, China; K. Yin, China Academy of Space Technology, China; M. Yu, Chinese University of Hong Kong, China</td>
</tr>
<tr>
<td>201B</td>
<td>Th2B-1: Design of Capacitive Coupler for Wireless Power Transfer Under Fresh Water Focusing on IQ Product</td>
<td>Masaya Tamura, Toyohashi University of Technology, Japan; Yasumasa Naka, Toyohashi University of Technology, Japan; Kousuke Murai, Toyohashi University of Technology, Japan</td>
</tr>
<tr>
<td>201C</td>
<td>Th2C-1: Microwave Ablation Applicator with Sensing Capabilities for Thermal Treatment of Malignant Tissue</td>
<td>Carolin Reimann, Technische Universität Darmstadt, Germany; Martin Schüller, Technische Universität Darmstadt, Germany; Sonke Schmidt, Technische Universität Darmstadt, Germany; Frank Hubner, Goethe-Universität Frankfurt, Germany; Babak Banafsh, Goethe-Universität Frankfurt, Germany; Thomas Vogt, Goethe-Universität Frankfurt, Germany; Ron Jakoby, Technische Universität Darmstadt, Germany</td>
</tr>
<tr>
<td>202A</td>
<td>Th2D-1: Miniature Antenna Probe System for 140–220GHz On-Wafer Radiation Pattern Measurements</td>
<td>Yu-Shao Jerry Shiao, NDL, Taiwan; Kain-Yu Chen, NDL, Taiwan; Guang-Hui Huang, NDL, Taiwan</td>
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**11:10 – 12:00**

<table>
<thead>
<tr>
<th>Session</th>
<th>Title</th>
<th>Chairs/Co-Chairs</th>
</tr>
</thead>
<tbody>
<tr>
<td>201A</td>
<td>Th2A-2: Accurate Design Procedure for Waffle-Iron Low-Pass Filter</td>
<td>I. Arnedo, Departamento de Ingeniería de Computadores, Universidad 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. Lasso, Universidad Pública de Navarra, Spain</td>
</tr>
<tr>
<td>201B</td>
<td>Th2B-2: Dual Transmitter Free-Positioning Wireless Power Transfer System with Optimum Switching Phase Technique</td>
<td>Ukyo Takeda, Keio University, Japan; Yasuke Inada, Keio University, Japan; Yasuke Kimoto, Keio University, Japan; Toru Kawaji, Keio University, Japan; Hiroki Ishikari, Keio University, Japan</td>
</tr>
<tr>
<td>201C</td>
<td>Th2C-2: Experimental Validation of Microstrip Circuitry for Microwave Tissue Heating with Magnetic Resonance Thermometry</td>
<td>Pegah Faridli, Kansas State University, USA; Punit Prakash, Kansas State University, USA</td>
</tr>
<tr>
<td>202A</td>
<td>Th2D-2: Effects Degrading Accuracy of CPW mTRL Calibration at W Band</td>
<td>G. N. Phung, FBH, Germany; F. L. Schmücke, FBH, Germany; R. Doemer, FBH, Germany; Wolfgang Heinrich, FBH, Germany; T. Probst, PTB, Germany; U. Al, PTB, Germany</td>
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**12:15 – 13:00**

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<th>Title</th>
<th>Chairs/Co-Chairs</th>
</tr>
</thead>
<tbody>
<tr>
<td>201A</td>
<td>Th2A-3: The Strongly-Coupled Resonator Triplet</td>
<td>Simone Bastioli, RS Microwave, USA; Richard V. Snyder, RS Microwave, USA; Giuseppe Macchiarella, Politecnico di Milano, Italy</td>
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<tr>
<td>201B</td>
<td>Th2B-3: The C-Band HYSTIC RF Energy Harvester Based on the Space Information, Communication and Energy Harvesting Technology</td>
<td>Shigeo Kawasaki, JAXA, Japan; Satoshi Yoshida, Kenjiro Nishikawa, Kagoshima University, Japan; Yoshinori Nakashika, Sophia University, Japan</td>
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<tr>
<td>201C</td>
<td>Th2C-3: Dual Modality Implant for Simultaneous Magnetic Nanoparticle Heating and Brachytherapy Treatment of Tumor Resection Cavities in Brain</td>
<td>Paul R. Stauffer, Darío B. Rodríguez, Thinh Nguyen, Laura Doyle, Voichita Bar-Ad, Wenyin Shi, Kevin D. Judy, Mark D. Hunzick, Thomas Jefferson University, USA; Robert Goldstein, AMF Life Systems</td>
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<td>202A</td>
<td>Th2D-3: A Novel TRM Calibration Method for Improved Modelling Accuracy at mm-Wave Frequency</td>
<td>Jiangtao Su, Hangzhou Dianzi University, China; Banggu Yang, CETC 41, China; Huijun Gao, Hangzhou Dianzi University, China; Xiwei Huang, Hangzhou Dianzi University, China; Xilin Cai, Hangzhou Dianzi University, China; Xiang Wang, Hangzhou Dianzi University, China; Fushun Nian, CETC 41, China</td>
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**13:15 – 14:00**

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<tr>
<td>201A</td>
<td>Th2A-4: Improved Fully Canonical W-Band Waveguide Filter</td>
<td>Daniel Miek, Christian-Albrechts-Universität zu Kiel, Germany; Alwin Reinhardt, Christian-Albrechts-Universität zu Kiel, Germany; Frank Dachnner, Christian-Albrechts-Universität zu Kiel, Germany; Michael Holt, Christian-Albrechts-Universität zu Kiel, Germany</td>
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<tr>
<td>201B</td>
<td>Th2B-4: A Low Complexity and Accurate Battery-Less Trackable Device</td>
<td>Daniel Belo, Universidade de Aveiro, Portugal; Diogo C. Ribeiro, Universidade de Aveiro, Portugal; Pedro Pinto, Universidade de Aveiro, Portugal; Nuno Borges Carvalho, Universidade de Aveiro, Portugal</td>
</tr>
<tr>
<td>201C</td>
<td>Th2C-5: Design of a RF-to-DC Link for In-Body IR-WP with a Capsule-Shape Rotation-Insensitive Receiver</td>
<td>Alex Pacini, Università di Bologna, Italy; Francesca Benassi, Università di Bologna, Italy; Diego Masotti, Università di Bologna, Italy; Alessandra Costarino, Università di Bologna, Italy</td>
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<tr>
<td>202A</td>
<td>Th2D-4: A Single-Element VNA Electronic Calibration in CMOS</td>
<td>Jun-Chau Chen, Stanford University, USA; Amin Arbabian, Stanford University, USA; Ali M. Niknejad, University of California, Berkeley, USA</td>
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**14:15 – 15:00**

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<tr>
<td>201A</td>
<td>Th2A-5: Miniature Triple-Mode Dielectric Resonator Filters</td>
<td>Mustafa S. Bakr, Technische Universität Graz, Austria; Ian C. Hunter, University of Leeds, UK; Wolfgang Bösch, Technische Universität Graz, Austria</td>
</tr>
<tr>
<td>201B</td>
<td>Th2B-5: Dynamic Impedance Matching of Multiple Loads in Wireless Power Transfer Using a Genetic Optimization Approach</td>
<td>Jordan Besnoff, Potomac Technologies, USA; Yehay Buchb, Potomac Technologies, USA; Kobi Scherni, Potomac Technologies, USA; David S. Ricketts, North Carolina State University, USA</td>
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<td>201C</td>
<td>Th2C-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</td>
<td>Hsin Gao, Marion K. Mattres-Kammeier, Peter Baltus, Technische Universität Eindhoven, The Netherlands</td>
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**15:15 – 16:00**

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<tr>
<td>201A</td>
<td>Th2A-6: Dielectric Tuning Screws for Microwave Filters Applications</td>
<td>Javier Ossorio, Universitat Politècnica de València, Spain; Vicente E. Borja, Universitat Politècnica de València, Spain; Marco Guglielmi, Universitat Politècnica de València, Spain</td>
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<tr>
<td>201B</td>
<td>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</td>
<td>Hsin Gao, Marion K. Mattres-Kammeier, Peter Baltus, Technische Universität Eindhoven, The Netherlands</td>
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**16:15 – 17:00**

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<tr>
<td>201A</td>
<td>Th2A-7: Dielectric Tuning Screws for Microwave Filters Applications</td>
<td>Javier Ossorio, Universitat Politècnica de València, Spain; Vicente E. Borja, Universitat Politècnica de València, Spain; Marco Guglielmi, Universitat Politècnica de València, Spain</td>
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<tr>
<td>201B</td>
<td>Th2B-7: 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</td>
<td>Hsin Gao, Marion K. Mattres-Kammeier, Peter Baltus, Technische Universität Eindhoven, The Netherlands</td>
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Th2E: Integrated Microwave Photonics for Millimeter-Wave and 5G Applications

Chair: James Buckwalter, University of California, Santa Barbara
Co-Chair: Ed Ackerman, Photonics

Th2F: 5G Millimeter-Wave Beamformers and Phased-Arrays

Chair: Gabriel Rebeiz, University of California, San Diego
Co-Chair: Aly Fathy, University of Tennessee

Th2H: Millimeter Wave Broadband Power Amplifiers

Chair: Charles Campbell, Dorvo
Co-Chair: Robert Leoni, Raytheon

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 of 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.
THF1-1: Interactive Forum #4
Chair: Aly Fathy, University of Tennessee; Co-Chair: Abbas Omar, Universität Magdeburg

THF1-1: Cryogenic Millimeter-Wave CMOS Low-Noise Amplifier
Milko Varonen, VTT Technical Research Centre of Finland, Finland; Kieran C. Cleary, Caltex, USA; Denizhan Karaca, Aalto University, Finland; Kari A. I. Halonen, Aalto University, Finland

THF1-2: A Compact 0.8dB Low Noise and Self-Packaged LNA Using SiGe Technology for 5G/6GHz WLAN Application
Zhenming Ke, UESTC, China; Shoulian Mou, UESTC, China; Kaike Ma, UESTC, China; Fanxu Meng, UESTC, China

THF1-3: Wideband 220–330GHz Turnstile OMT Enabled by Silicon Micromachining
Adrian Gomez-Torrent, KTH, Sweden; Umer Shah, KTH, Sweden; Joachim Oberhammer, KTH, Sweden

THF1-4: 140–220-GHz Distributed Antenna and Amplifier Co-Integrated in SiGe BiCMOS Process for UWB Receivers
Pietro Valente Testa, Technische Universität Dresden, Germany; Bernhard Klein, Technische Universität Dresden, Germany; Ronny Hahnel, Technische Universität Dresden, Germany; Corrado Carta, Technische Universität Dresden, Germany; Dirk Piettemeer, Technische Universität Dresden, Germany; Frank Ellinger, Technische Universität Dresden, Germany

THF1-5: 0.15mm², DC-70GHz Transistor Technology for 5G/6GHz WLAN Application
Mohamed Saeed, RWTH Aachen University, Germany; Ahmed Hamed, RWTH Aachen University, Germany; Saad Qayyum, RWTH Aachen University, Germany; Zhenxing Wang, AMD, Germany; Mehdiad Shafigh, AMD, Germany; Daniel Neumaier, AMD, Germany; Renato Negra, RWTH Aachen University, Germany

THF1-6: Spectrum Efficient D-Band Communication Link for Real-Time Multi-Gigabit Wireless Transmission
Veselin Vassilev, Zhongxia Simon He, Sona Carpenter, Herbert Zirath, Yu Yan, Ahmed Hassona, Jingling Chen, Chalmers University of Technology, Sweden; Mikael Horber, Ericsson, Sweden; Yinggang Li, Ericsson, Sweden; Jonas Hanryd, Ericsson, Sweden; Mingquan Bao, Ericsson, Sweden; Thomas Emanuelsson, Ericsson, Sweden

THF1-7: Non-Line-of-Sight Terahertz Imaging from a Single Viewpoint
Sai Kiran Doddaalla, Arizona State University, USA; Georgios C. Trichopoulos, Arizona State University, USA

THF1-8: 2.2-pl/Bit 30-Gbit/s Mach-Zehnder Modulator Driver in 22-nm FDSOI
Lastra Szilagyi, Technische Universität Dresden, Germany; Ronny Henkel, Technische Universität Dresden, Germany; David Harame, GLOBALFOUNDRIES, Germany; Frank Ellinger, Technische Universität Dresden, Germany

THF1-9: Photonic-Assisted Wideband Microwave Measurement
Yihan Li, IMRA America, USA; Naoya Kose, IMRA America, USA; Martin E. Fernmann, IMRA America, USA

THF1-10: 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 Anaryathna, University of Akron, USA; D.F. Coelho, University of Calgary, Canada; R.J. Cintra, Universidade Federal de Pernambuco, Brazil; A. Kalyanasundaram, University of Akron, USA

Ming-Hsin Tsai, TSMC, Taiwan; Sen-Ruei Hsu, TSMC, Taiwan; Chi-Kai Shen, National Taiwan University, Taiwan; Pei-Shen Wei, National Taiwan University, Taiwan; Chun-Hong Chen, TSMC, Taiwan; Tzong-Lin Wu, National Taiwan University, Taiwan

THF1-12: A Low-Profile Substrate Integrated Magneto-Electric Dipole Antenna Based on Folded Magnetic Wall for UWB Application
Xuqing Li, BUPT, China; Quanping Li, BUPT, China; Hua Zhu, BUPT, China; Jia Song, BUPT, China; Zhiang Qi, BUPT, China

Utpal Dey, Universität Stuttgart, Germany; Ian Hesselbarth, Universität Stuttgart, Germany

THF1-14: Laser Assisted Additive Manufacturing of CPW mm-wave Interdigital Capacitors
Ramin A. Ramirez, University of South Florida, USA; Di Lan, University of South Florida, USA; Eduardo A. Rojas-Nastucci, Emory-Riddle Aeronautical University, USA; Thomas M. Weiler, University of South Florida, USA

THF1-15: Aerosol Jet Printing of Millimeter Wave Transmission Lines on 3D Ceramic Substrates Made by Additive Manufacturing
Anthony Delage, XLM (UMR 7252), France; Nicolas Delhote, XLM (UMR 7252), France; Serge Verdeyme, XLM (UMR 7252), France; Barbara Bonnet, Thales Alenia Space, France; Ludovic Carpentier, CNES, France; Cindy Schick, 3Dceram, France; Thierry Chartier, IRCER (UMR 7115), France; Christophe Chaput, 3Dceram, France

THF1-16: 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; Manso M. Tengbergs, Georgia Tech, USA

THF1-17: Broadband Millimeter Wave Characterization of 3-D Printed Materials
Arthur C. Paolilla, Harris, USA; Chris Corey, Harris, USA; Diana Foster, Harris, USA; Joseph Desjardins, Harris, USA; Caitlin Smith, Harris, USA; Lauren Walters, Harris, USA

THF1-18: Preclinical Efficacy of a Microwave and Adrenaline Based Haemostat Utilising a Novel Co-Axial Cable Structure
Shaun C. Preston, Bangor University, UK; Paul Sibbons, NPMR, UK; Malcolm White, Creo Medical, UK; Christopher P. Hancock, Bangor University, UK

THF1-19: Complex Permittivity Extraction of Layered Biological Samples
Hanshitha Thippur Shivamurthy, Technische Universität Delft, The Netherlands; Vincenzo Mascara, Technische Universität Delft, The Netherlands; Raffaele Romano, Technische Universität Delft, The Netherlands; Andrea Neto, Technische Universität Delft, The Netherlands; Marco Spriolo, Technische Universität Delft, The Netherlands

THF1-20: All-Digital Beam Forming for SKA-Low: CTP Design and Verification
Rui Cao, KLAASA, China; Meining Wu, KLAASA, China; Xiaohui Tuo, KLAASA, China; Zhuang Li, KLAASA, China; Jinhong Zheng, KLAASA, China; Xiaodong Li, KLAASA, China; Xiaojing Wang, KLAASA, China; Quan Wang, KLAASA, China; Huaxiang Tang, KLAASA, China; Andrew Faulkner, University of Cambridge, UK; Eddy DeMarco, University of Cambridge, UK; Nima Razavi-Ghods, University of Cambridge, UK

THF1-21: 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

THF1-22: 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

THF1-23: 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; Kaisue Ma, UESTC, China; Yun He, UESTC, China; Ze Jian, UESTC, China

THF1-24: Performance of V-Band On-Chip Antennas in GlobalFoundries 45nm CMOS 50I Process for mm-Wave 5G Applications
Sensan Li, Georgia Tech, USA; Huy Thong Nguyen, Georgia Tech, USA; Tianjun 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
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 Juvinet, 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: Usman 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; Arve 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 recurrences 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 Thermobilatation 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

History

DSCS III Satellite, launched in 1982, in the thermal test facility at GE Aerospace, Valley Forge, PA. Photo provided by Mr. Herb Thal.
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**201A**

- **Th3A-1**: A Tunable Waveguide Filter Designed with a Constant Absolute Bandwidth Using a Single Tuning Element  
  Chair: Eric Naglich, U.S. Naval Research Laboratory  
  Co-Chair: Xiaoguang Liu, University of California, Davis

- **Th3A-2**: Tunable Multiband Bandpass-to-Bandstop RF Filters  
  Diankai J. Simpson, University of Colorado Boulder, USA; Roberto Gómez-García, Universidad de Alcalá, Spain; Dimitra Psychogiou, University of Colorado Boulder, USA

- **Th3A-3**: A Combine Tunable Filter with Loss Compensation Circuit  
  Arash Fouladi Azarnaminy, University of Waterloo, Canada; Raafat R. Mansour, University of Waterloo, Canada

- **Th3A-4**: A 42-nm CMOS SFI for Transmit Rejection with Code Selective Filters  
  Hussam A. Shammary, 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

- **Th3A-5**: A Compact Tunable Bandpass Filter Using Switchable Varactor-Tunable Dual-Mode Resonator  
  Minjoo Jung, Yonsei University, Korea; Byung-Wook Min, Yonsei University, Korea

- **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-1**: Determination of the Complex Permittivity of High Loss Liquids with a Novel Reentrant Cavity  
  David Marqués-Villanueva, Universitat Politècnica de València, Spain; Felipe Peñaranda-Fox, Universitat Politècnica de València, Spain; Antoni J. Canós, Universitat Politècnica de València, Spain; Beatriz Garcia-Baños, Universitat Politècnica de València, Spain; José M. Catalá-Civera, Universitat Politècnica de València, Spain

- **Th3B-2**: Effects of Average Power-Handling Capability on DC-Sputtering Aluminium 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-Hee Wang, National Cheng Kung University, Taiwan; Shou-Jinn Chang, National Cheng Kung University, Taiwan

- **Th3B-3**: A 2D Coupled Electromagnetic, Thermal and Fluid Flow Model: Application to Layered Microwave Heat Exchangers  
  Ali A. Moheskar, Worcester Polytechnic Institute, USA; Joseph M. Gaone, Worcester Polytechnic Institute, USA; Burt S. Tilley, Worcester Polytechnic Institute, USA; Vadim Y. Yakovlev, Worcester Polytechnic Institute, USA

- **Th3B-4**: Acoutical Behavior of Fully-Printed, BST MIM Varactor Modules in High Power Matching Circuits  
  Daniel Kienemund, Technische Universität Darmstadt, Germany; Nicole Bohn, KIT, Germany; Thomas Fork, COMET, Switzerland; Mike Arebrot, COMET, Switzerland; Wlodek Bigler, COMET, Switzerland; Joachim R. Binder, KIT, Germany; Rolf Jakoby, Technische Universität Darmstadt, Germany; Holger Maune, Technische Universität Darmstadt, Germany

- **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. Kopec, Warsaw University of Technology, Poland; J. Krupka, Warsaw University of Technology, Poland

**201C**

- **Th3C-1**: An Energy-Efficient Wirelessly Powered Millimeter-Scale Neurostimulator with Optimized Inductive Loop Antenna and Custom Rectifier  
  Hongming Lu, University of California, Los Angeles, USA; Jing-Ping 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

- **Th3C-2**: A Programmable RF Transmitter for Wideband Thermooptical Spectroscopic Imaging  
  Hao Nan, Stanford University, USA; Amin Abhari, Stanford University, USA

- **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 Horig, National Sun Yat-sen University, Taiwan

- **Th3C-4**: Non-Contact Beat-to-Beat Blood Pressure Measurement Using Continuous Wave Doppler Radar  
  Heng Zhao, NUIST, China; Xu Gu, NUIST, China; Hong Hong, NUIST, China; Yusheng Li, NUIST, China; Xiaohua Zhu, NUIST, China; Changli Li, Texas Tech University, USA

- **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, Ching-Lung Yang, National Cheng Kung University, Taiwan

- **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-1**: A 169.6GHz Hybrid Mode-Switching Push-Push Oscillator with 21.7% Tuning Range and 180-dBc/Hz FoM in 28nm CMOS Technology  
  Yi Yang, UESTC, China; Hui-Hsin Jenny Qian, UESTC, China; Xin Luo, UESTC, China

- **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; Sheik Nijam Ali, Washington State University, USA; Deukhyoun Heo, Washington State University, USA

- **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 Kyo Hwang, KAIST, Korea; Dong Min Kang, KAIST, Korea; Seong Jun Cho, KAIST, Korea; Chul Woo Byeon, Wonkwang University, Korea; Chul Soon Park, KAIST, Korea

- **Th3D-4**: A 17.5-dBm Output Power 11.2% DC-to-RF Efficiency Low Phase Noise CMOS Quadrate Voltage-Controlled Oscillator  
  Kuan-Huei Lu, National Central University, Taiwan; Guan-Lin Huang, National Central University, Taiwan; Hong-Yeh Chang, National Central University, Taiwan

- **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; Andreas Hengstler, FAU Erlangen-Nürnberg, Germany; Vadim Issakov, Infineon Technologies, Germany
13:30 – 15:10 | Thursday, 14 June 2018 | Pennsylvania Convention Center

**203AB**

**Th3E: Advances in Semiconductor Monolithic Integrated Circuit Technology**

**Chair:** Amine Ezeddine, Amcom Communications
**Co-Chair:** Cynthia Hang, Raytheon

**Th3E-1: A New Integrated K-Band Analog Vector Sum Phase Shifter**
Fatemeh Akbar, University of Michigan, USA; Amir Mortazawi, University of Michigan, USA

**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

**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

**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

**Th3E-5, 12W, 30% PAE, 40GHz Power Amplifier MMIC Using a Commercially Available GaN/Si Process**
Joel Moron, OMIC, France; Rémy Leblanc, OMIC, France; François Lecourt, OMIC, France; Peter Frilli, OMIC, France

**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; Huaiz 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; Huaiz Lu, Peking University, China; Kaushik Sengupta, Princeton University, USA

**Th3F-3: Scalable mm-Wave 4-Channel Radar SoC with Vector Modulators and Demodulatory CHIRP and Phased Array Applications**
Herman Jall E/kepler Universität Linz, Austria; Dietmar Kissinger, IBM T.J. Watson Research Center, USA

**Th3F-4: A 256-QAM 39GHz Dual-Channel Transceiver Chipset with LTCC Package for 5G Communication in 65nm CMOS**
Zhilin Chen, Zhengdong Jiang, Zhiging Liu, Yuxuan Cheng, Lin Zhang, Dong Chen, Jinghui Zhang, Shoudian Sun, Jianyu Dong, Pengqiu Liu, You Zhou, Hualu Liu, Chenzi Zhao, Yunqiu Wu, Kai Kang, IESTC, China; Xianghua Li, Jianping Zhao, Huawei Technologies, China

**Th3F-5, 300-GHz, 100-Gb/s InP-HEMT Wireless Transceiver Using a Commercially Available GaN/Si Process**
 Hiroshi Hamada, NTT, Japan; Takuya Fujimura, Tokyo Institute of Technology, Japan; Ibrahim Abdo, Tokyo Institute of Technology, Japan; Kerichi Okada, Tokyo Institute of Technology, Japan; Ho-In 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**
Chaoyang Li, GLOBALFOUNDRIES, USA; Omar E-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**
Shinrin 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 Peter, Maciej Włodzimierz Wagner, Roger Luzar, Hermann Massler, Peter Brückner, Fraunhofer IAF, Germany; Rudiger Quay, Fraunhofer IAF, Germany
Adjournment sine die
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 bridled 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/](https://www.conginst.org/2015/01/05/what-is-a-sine-die-adjournment/)

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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:

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 Cecil 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 (Welf1) 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 Propulsion 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
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.

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<th>SPONSORING TECHNICAL COMMITTEE/S</th>
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<td>TC-2 (Microwave Acoustics)</td>
<td>Carrier Aggregation BAW Quadplexer Module</td>
<td>Holger Maune</td>
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<tr>
<td>TC-5 (Microwave High-Power Techniques)</td>
<td>14th High Efficiency Power Amplifier Student Design Competition</td>
<td>James Komiak, Kamal Samanta</td>
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<td>TC-6 (Microwave and Millimeter-wave Integrated Circuits), TC-14 (Microwave Low Noise Techniques), TC-16 (Microwave Systems) and TC-20 (Wireless Communications)</td>
<td>Wide bandwidth Mobile Com Receiver Module</td>
<td>Rüdiger Quay, Nils Pohl, and Roger Kaul</td>
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<tr>
<td>TC-7 (Microwave and Millimeter-wave Solid State Devices) with endorsement/support of TC-6 (Microwave and Millimeter-wave Integrated Circuits)</td>
<td>16 QAM Radio Design</td>
<td>David S. Ricketts</td>
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<tr>
<td>TC-8 (Filters and Passive Components)</td>
<td>Reconfigurable Bandpass Filter Design</td>
<td>Eric Naglich, Sanghoon Shin</td>
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<td>TC-10 (Biological Effects and Medical Applications) is the main sponsor, TC-20 (Wireless Communications) is co-sponsor.</td>
<td>High-Sensitivity Fast-Response Motion Sensing Radar</td>
<td>José María Muñoz Ferreras, Fu-Kang Wang, Chung-Tse Michael Wu and Olga Boric-Lubecke</td>
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<td>TC-15 (Microwave Field Theory)</td>
<td>Elucidating the Physics of Microwaves through Experimental and Software-Based Demonstrations</td>
<td>Costas Sarris</td>
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<td>TC-17 (HF/VHF/UHF Technology)</td>
<td>High-Efficiency Power Amplifier for 475 kHz</td>
<td>Frederick H. Raab</td>
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<td>TC-22 (Signal Generation and Frequency Conversion)</td>
<td>High Dynamic Range Mixer</td>
<td>Edmar Camargo, Bert Henderson</td>
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<tr>
<td>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)</td>
<td>Tunable Low Phase Noise X-Band (8-12 GHz) Voltage Controlled Oscillator</td>
<td>Ajay Poddar, Bert Henderson</td>
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<tr>
<td>TC-24 (RFID Technologies)</td>
<td>Backscatter Radio</td>
<td>Valentina Palazzi, Thomas Ußmüller and John Kimionis</td>
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<tr>
<td>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.</td>
<td>Wearable Microwave Energy Harvesting</td>
<td>Simon Humour, Luciano Tarricone</td>
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</table>
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: Zara 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 Pschogou, 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: Vansong 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: Qin 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: Masatake 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 Zolfaghariloo 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
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
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 Srl.

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
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*
FOR EVERY MINUTE SPENT IN ORGANIZING, AN HOUR IS EARNED.

BENJAMIN FRANKLIN
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.
<table>
<thead>
<tr>
<th>Name</th>
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<td>Peter Aalen</td>
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<td>Mohamed Abouzahra</td>
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RFIC Plenary Session

17:30 – 19:00 | Sunday, 10 June 2018 | Pennsylvania Convention Center, Grand Ballroom

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

ABSTRACT:
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

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 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

Industry showcase and Student Paper Finalists list continued on page 64
# RFIC Technical Sessions

08:00 – 09:40 | Monday, 11 June 2018 | Pennsylvania Convention Center

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<th>201A</th>
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<tr>
<td><strong>RM01A: Building Blocks for 5G Transceivers</strong>&lt;br&gt;Chair: Steven Turner, BAE Systems&lt;br&gt;Co-Chair: Waheed Khalil, The Ohio State University</td>
<td><strong>RM01B: Advances in Packaging, Modeling and Optical Phased Arrays</strong>&lt;br&gt;Chair: Richard Chan, Qorvo&lt;br&gt;Co-Chair: Tzung-Yin Lee, Skyworks Solutions</td>
<td><strong>RM01C: Techniques for High-Performance Frequency Synthesis</strong>&lt;br&gt;Chair: Salvatore Levantino, Politecnico di Milano&lt;br&gt;Co-Chair: Joseph Carr, BAE Systems</td>
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<td><strong>RM01A-1: A 25.1–27.6GHz Tunable-Narrowband Digitally-Calibrated Merged LNA-Vector Modulator for 5G Phased Arrays</strong>&lt;br&gt;Rahul Singh, Carnegie Mellon University, USA; Susnata Mondal, Carnegie Mellon University, USA; Jeyanandh Paramesh, Carnegie Mellon University, USA</td>
<td><strong>RM01B-1: Chip-Package-PCB Co-Design of Power Combiners in SESUB and WLCS Technology with Re-Distribution Layers</strong>&lt;br&gt;Thanh Vinh Dinh, LaMIPS, France; Sidina Wane, Energy-Vision, France; Dominique Leséneléchâl, LaMIPS, France; Philippe Descamps, LaMIPS, France; Laurent Leyssenne, Thales, France; Damienne Bajon, ISAE, France</td>
<td><strong>RM01C-1: A 15.6–18.2GHz Digital Bang-Bang PLL with -63dBc In-Band Fractional Spur</strong>&lt;br&gt;Dmytro Cherniak; Politecnico di Milano, Italy; Luigi Grimoldi; Politecnico di Milano, Italy; Fabio Padovan; Infineon Technologies, Austria; Matteo Basioli; Infineon Technologies, Austria; Roberto Nonis; Infineon Technologies, Austria; Carlo Samori, Politecnico di Milano, Italy; Salvatore Levantino, Politecnico di Milano, Italy</td>
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<td><strong>RM01A-2: A Robust Reconfigurable Front-End for Non-Contiguous Multi-Channel Carrier Aggregation Receivers</strong>&lt;br&gt;Dror Regen, Toga Networks, Israel; Shimi Shilo, Toga Networks, Israel; Junping Zhang, Huawei Technologies, China</td>
<td><strong>RM01B-2: An Efficient mm-Wave Integrated Circuit Synthesis Method with Accurate Scalable Passive Component Modeling</strong>&lt;br&gt;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</td>
<td><strong>RM01C-2: A 14nm FinFET Sub-Picosecond Jitter Fractional-N Ring PLL for 5G Wireless Applications</strong>&lt;br&gt;Seungjin Kim, Samsung, Korea; Byungki Han, Samsung, Korea; Mingyu Cho, Samsung, Korea; Seunggyun Oh, Samsung, Korea; Jongwoo Lee, Samsung, Korea; Thomas Byungghak Cho, Samsung, Korea</td>
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| **RM01A-3: A True Time Delay 16-Element 4-Beam Digital Beamformer**<br>Sumin Jang, University of Michigan, USA; Rundao Lu, University of Michigan, USA; Jaehun Jeong, Broadcom, USA; Michael P. Flynn, University of Michigan, USA | **RM01B-3: A Low Power PWM Optical Phased Array Transmitter with 16° Field-of-View and 0.8° Beamwidth**<br>Reza Fatemizadeh, Caltech, USA; Arooin Khachatryan, Caltech, USA; Ali Hajimiri, Caltech, USA | **RM01C-3: A 1.33mW, 1.6ps, Integrat-
ed-Jitter, 1.8–2.7GHz Ring-Oscillator-Based Fractional-N Injection-Locked DPLL for Internet-of-Things Applications**<br>Jiang Gong, Yuming He, Ao Ba, Yeo-Hong Liu, Johan Dijkhuis, Stefano Tiera, Christian Bachmann, Kathleen Philips, Holst Centre, The Netherlands; Masoud Babaei, Technische Universiteit Delft, The Netherlands |
| **RM01B-4: A CMOS-SOI Power Amplifier Technology Using EDNMOS for Sub 6GHz Wireless Applications**<br>Rui Tze Toh, GLOBALFOUNDRIES, Singapore; Shyam Parthasarathy, GLOBALFOUNDRIES, India; Shaoqiang Zhang, GLOBALFOUNDRIES, Singapore; Madabasi Govindarajan, GLOBALFOUNDRIES, India; Qin Shuang Wang, GLOBALFOUNDRIES, Singapore; Kook Wai Johnny Chew, GLOBALFOUNDRIES, Singapore; Luis Andia, GLOBALFOUNDRIES, Singapore; Shaopeng Zhang, GLOBALFOUNDRIES, Singapore | **RM01C-4: A 10GHz Digital Phase Noise Filter with 14dB Noise Suppression and -127dBc/Hz Noise Sensitivity at 1MHz Offset**<br>Tongqing Hu, University of California, Davis, USA; Shihui Hao, University of California, Davis, USA; Qun Jane Gu, University of California, Davis, USA | **RM01C-5: A 5.5–7.3GHz Analog Fractional-N Sampling PLL in 28-nm CMOS with 75fsmax Jitter and -249.7dB FoM**<br>Wanghua Wu, Samsung, USA; Chih-Wei Yao, Samsung, USA; Kunal Godbole, Samsung, USA; Ronghua Ni, Samsung, USA; Pei-Yuan Chiang, Samsung, USA; Yongning Han, Samsung, USA; Yongrong Zuo, Samsung, USA; Ashutosh Verma, Samsung, USA; Ivan Siu-chuang Lu, Samsung, USA; Sang Won Son, Samsung, USA; Thomas Byungghak Cho, Samsung, Korea |

**MONDAY**

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<td><strong>RM01B-4: A 10GHz Digital Phase Noise Filter with 14dB Noise Suppression and -127dBc/Hz Noise Sensitivity at 1MHz Offset</strong>&lt;br&gt;Tongqing Hu, University of California, Davis, USA; Shihui Hao, University of California, Davis, USA; Qun Jane Gu, University of California, Davis, USA</td>
<td><strong>RM01C-5: A 5.5–7.3GHz Analog Fractional-N Sampling PLL in 28-nm CMOS with 75fsmax Jitter and -249.7dB FoM</strong>&lt;br&gt;Wanghua Wu, Samsung, USA; Chih-Wei Yao, Samsung, USA; Kunal Godbole, Samsung, USA; Ronghua Ni, Samsung, USA; Pei-Yuan Chiang, Samsung, USA; Yongning Han, Samsung, USA; Yongrong Zuo, Samsung, USA; Ashutosh Verma, Samsung, USA; Ivan Siu-chuang Lu, Samsung, USA; Sang Won Son, Samsung, USA; Thomas Byungghak Cho, Samsung, Korea</td>
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<td>MONDAY</td>
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| **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  
| **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, Bangang Liu, Takeshi Nakamura, tayuya Fujimura, Masaru Kawabuchi, Ryo Kubozoe, Toshiyuki Miura, Daiki Matsumoto, Kenichi Okada, Tokyo Institute of Technology, Japan; Naoki Oshima, Kenichi Motoi, Shinichi Horii, Kazuaki Kunihito, Tomoya Kaneko, NEC, Japan;  
| **RM02B-1: A 22nm FDSOI Technology Optimized for RF/mmWave Applications**  
| **RM02C: ADC-Based RF/Mixed-Signal Systems and Wireline Transceiver Techniques**  
Chair: Yueling Zhang, 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-Hong Wong, Yiel 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 ΔΣ 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**  
Alirea 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  
| **RM02A-2: A Wideband High-Power Multi-Standard 23–31GHz 2×2 Quad Beamformer Chip in SiGe with >15dBm OP1dB Per Channel**  
Berktag Ustundag, University of California, San Diego, USA; Kerim Kibaroğlu, University of California, San Diego, USA; Mustafa Sayginer, University of California, San Diego, USA; Gabriel M. Rebeiz, University of California, San Diego, USA  
| **RM02B-2: f0 Enhancement of CMOS Transistor Using Isolated Polysilicon Gates**  
Xi Sung Luo, MIT, USA; Moe Z. Win, MIT, USA; Kiat Seng Yeo, SUPE, Singapore  
| **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  
| **RM02A-3: A Dual-Polarized Dual-Beam 28GHz Beamformer Chip Demonstrating a 24Gbps 64-QAM 2×2 MIMO Link**  
Kerim Kibaroğlu, 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  
| **RM02B-3: A Small Signal AC Model Using Scalable Drain Current Equations of AlGaN/GaN MIS Enhancement HEMT**  
H. Aoki, Tokyo Hietsi University, Japan; N. Kuroda, ROHM, Japan; Y. Nakamura, ROHM, Japan; K. Chikamatsu, ROHM, Japan; K. Nakahara, ROHM, Japan  
| **RM02C-3: A Methodology for Accurate DFE Characterization**  
Alirea Sharif-Bakhtiar, University of Toronto, Canada; Anthony Chan Carusone, University of Toronto, Canada  
| **RM02A-4: A 28GHz Packaged Chireix Transmitter with Direct On-Antenna Outphasing Load Modulation Achieving 55%/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  
| **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; Jingjing Zhang, UCAS, China; Jian Zhou, NUDT, China; Jingjing Luo, Shenzhen University, China  
| **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 of vision systems have improved considerably thanks to the ubiquitous usage 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 usage. 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.

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.
## RFIC Technical Sessions

### Monday, 11 June 2018

**Pennsylvania Convention Center**

### 13:30 – 15:10

#### 201A: RF Front-Ends for Emerging Wireless Paradigms

**Chair:** Ramesh Harjani, University of Minnesota  
**Co-Chair:** Leon van den Dovers, Qualcomm

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<td>Fully-Integrated Non-Magnetic 180nm SOI Circulator with &gt;1W P1dB, &gt;50dBm IIP3 and High Isolation Across 1.85VSWR</td>
<td>Aravind Nagulu, Columbia University, USA; Andrea Aliu, CUNY Advanced Science Research Center, USA; Harish Krishnaswamy, Columbia University, USA</td>
<td>Columbia University, USA; Cornell University, USA; Columbia University, USA</td>
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<td>RMO3A-2</td>
<td>Full Duplex Circulator-Receiver Phased Array Employing Self-Interference Cancellation via Beamforming</td>
<td>Mahmood Barani, Dastjerdi, Columbia University, USA; Negar Reisakian, Columbia University, USA; Tingun Chen, Columbia University, USA; Gil Zussman, Columbia University, USA; Harish Krishnaswamy, Columbia University, USA</td>
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<td>mixer-First MIMO Receiver with Multi-Port Impedance Tuning for Decoupling of Compact Antenna Systems</td>
<td>Charley Wilson III, North Carolina State University, USA; Jacob Dean, North Carolina State University, USA; Brian A. Floyd, North Carolina State University, USA</td>
<td>North Carolina State University, USA; Cornell University, USA; North Carolina State University, USA</td>
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<td>RMO3A-4</td>
<td>An 8-Element, 1–3GHz Direct Space-to-Information Converter for Rapid, Compressive-Sampling Direction-of-Arrival Finding Utilizing Pseudo-Random Antenna-Weight Modulation</td>
<td>Matthew Bajor, Columbia University, USA; Tanbir Haque, Columbia University, USA; Guoziang Han, Columbia University, USA; Chyan Zhang, Columbia University, USA; John Wright, Columbia University, USA; Peter R. Kinget, Columbia University, USA</td>
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<td>RMO3A-5</td>
<td>An FDD/FD Capable, Single Antenna RF Front End from 800MHz to 1.2GHz with Baseband Harmonic Predistortion</td>
<td>Hazal Yilok, Cornell University, USA; Thomas Tapen, Cornell University, USA; Zachariah Boynton, Cornell University, USA; Emory Enroth, Cornell University, USA; Alyssa Apsel, Cornell University, USA; Ayoasha C. Molnar, Cornell University, USA</td>
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<td>RMO3B-1</td>
<td>A 1W Quadrature Class-G Switched-Capacitor Power Amplifier with Merged Cell Switching and Linearization Techniques</td>
<td>Si-Wook Yoo, Michigan State University, USA; Shih-Chang Hung, Michigan State University, USA; Sang-Min Yoo, Michigan State University, USA</td>
<td>Michigan State University, USA; Michigan State University, USA; Michigan State University, USA</td>
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<td>RMO3B-2</td>
<td>A 0.19mm² 128mW 0.8–1.2GHz 2-Beam 8-Element Digital Direct to RF Beamforming Transmitter in 40nm CMOS</td>
<td>Boy 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</td>
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<td>RMO3B-3</td>
<td>A Wide-Band Transmitter and Low-Noise PLL for a Highly Integrated 4T-4R-2F ZIF Transceiver in 28nm</td>
<td>P. Liutman, Qorvo, USA; S. Akhtar, Texas Instruments, USA; S. Finocchiaro, Texas Instruments, USA; F. Dantoni, Texas Instruments, USA</td>
<td>Qorvo, USA; Texas Instruments, USA; Texas Instruments, USA; Texas Instruments, USA</td>
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<td>RMO3C-1</td>
<td>A 1W Quadrature Class-G Switched-Capacitor Power Amplifier with Merged Cell Switching and Linearization Techniques</td>
<td>Si-Wook Yoo, Michigan State University, USA; Shih-Chang Hung, Michigan State University, USA; Sang-Min Yoo, Michigan State University, USA</td>
<td>Michigan State University, USA; Michigan State University, USA; Michigan State University, USA</td>
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<td>Qorvo, USA; Texas Instruments, USA; Texas Instruments, USA; Texas Instruments, USA</td>
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<td>RMO3C-4</td>
<td>A Ka-Band CMOS 360° Reflective-Type Phase Shifter with ±0.2dB Insertion Loss Variation Using Triple-Resonating Load and Dual-Voltage Control Techniques</td>
<td>Peng Gu, Southeast University, China; Dixian Zhao, Southeast University, China</td>
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<td>RMO3C-5</td>
<td>A Low-Loss and Small-Size 28GHz CMOS SPDT Switches Using Switched Inductor</td>
<td>Wonho Lee, KAIST, Korea; Songcheol Hong, KAIST, Korea</td>
<td>KAIST, Korea; KAIST, Korea</td>
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<td>RMO3C-6</td>
<td>A Ka-Band CMOS Digital-Controlled Phase-Invariant Variable Gain Amplifier with 4-Bit Tuning Range and 0.5° dB Resolution</td>
<td>Yongcan Yi, Southeast University, China; Dixian Zhao, Southeast University, China; Xiaohu You, Southeast University, China</td>
<td>Southeast University, China; Southeast University, China; Southeast University, China</td>
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<td>A Ka-Band CMOS Digital-Controlled Phase-Invariant Variable Gain Amplifier with 4-Bit Tuning Range and 0.5° dB Resolution</td>
<td>Yongcan Yi, Southeast University, China; Dixian Zhao, Southeast University, China; Xiaohu You, Southeast University, China</td>
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<td>RMO3C-8</td>
<td>A 5-Bit, 0.25dB Step Variable Attenuator at E-Band</td>
<td>Tater N. Ross, Huawei Technologies, Canada; Kimia T. Ansari, Huawei Technologies, Canada; Sam Tiller, Huawei Technologies, Canada; Morris Repeta, Huawei Technologies, Canada</td>
<td>Huawei Technologies, Canada; Huawei Technologies, Canada; Huawei Technologies, Canada; Huawei Technologies, Canada</td>
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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: Germot Hueber, NXP Semiconductors
Co-Chair: David Wentzloff, University of Michigan

RM04B: Silicon Integrated mm-Wave Transmitters

Chair: Q. Jane Gu, University of California, Davis
Co-Chair: Mona Hella, Rensselaer Polytechnic Institute

RM04C: Highly Efficient mm-Wave Oscillators with Wide Tuning Range

Chair: Foster Dai, Auburn University
Co-Chair: Ruonan Han, MIT

201B

RM04A-1: A Secure TOF-Based Transceiver with Low Latency and Sub-cm Ranging for Mobile Authentication Applications

Hainan Song, Tsinghua University, China; Zhendong Ding, Tsinghua University, China; Woogeun Rhee, Tsinghua University, China; Zhihua Wang, Tsinghua University, China

RM04B-1: Q-Band CMOS Transmitter System-on-Chip for Protected Satellite Communication

T. LaRocca, Northrop Grumman, USA; R. Snyder, Northrop Grumman, USA; R. Jia, Northrop Grumman, USA; O. Forbsham, Northrop Grumman, USA; N. Datta, Northrop Grumman, USA; W. Wu, Northrop Grumman, USA; Y. Yang, Northrop Grumman, USA

RM04C-1: A -195dBc/Hz FoM, 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. Shiri, University of British Columbia, Canada; H. Djahanshahi, Micosemi, Canada; R. Zavari, Micosemi, Canada; S. Mirabbasi, University of British Columbia, Canada; S. Shekhari, University of British Columbia, Canada

204A

RM04A-2: A 264-µW 802.15.4a-Compliant IR-UWB Transmitter in 28nm FinFET for Wireless Sensor Network Application

Renzhil Liu, Intel, USA; Brent R. Carthon, Intel, USA; Stefano Pellerano, Intel, USA; Farhana Sheikh, Intel, USA; Divya Shee Vemparaala, Intel, USA; Ahmed Ali, University of Texas at Dallas, USA; V. Sriravasa Somayazulu, Intel, 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

RM04C-2: A 31.8–40.8GHz Continuously Wide-Tuning VCO Based on Class-B Oscillator Using Single Varactor and Inductor

Japol Lee, ETRI, Korea; Dong-Woo Kang, ETRI, Korea; Young Ae Baek, ETRI, Korea; Bontae Koo, ETRI, Korea

204B

RM04A-3: A 485µW 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 Fathy, 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

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

RM04C-3: A Dual-Core 60GHz Push-Push VCO with Second Harmonic Extraction by Mode Separation

Vadim Issakov, Infineon Technologies, Germany; Fabio Pedovani, Infineon Technologies, Austria

204C

RM04A-4: A 217GHz -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

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 Soon Suh, KAIST, Korea; Dong Min Kang, KAIST, Korea; Joon Hyung Kim, KAIST, Korea; Chul Woo Byeon, KAIST, Korea; Chul Soo Park, KAIST, Korea

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 Fröhlich, Technische Universität Dresden, Germany; Corrado Carta, Technische Universität Dresden, Germany; Frank Etlinger, Technische Universität Dresden, Germany

204A


Rabia Tugre Yazicioglu, MIT, USA; Phillip Nadeau, Analog Devices, USA; Daniel Richman, D. E. Shaw Research, USA; Chiraag Juekar, MIT, USA; Kapil Vaidya, IIT Bombay, India; Anantha P. Chandrakasan, MIT, USA

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

RM04C-5: A 20.7–31.8GHz Dual-Mode Voltage Waveform-Shaping Oscillator with 195.8dBc/Hz FoM in 28nm CMOS

Yiyang Shu, UESTC, China; Haizhen Jenny Qian, UESTC, China; Xun Luo, UESTC, China
# RFIC Technical Sessions

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

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<td><strong>RTU1B: Submillimeter Wave and Terahertz ICs</strong>&lt;br&gt;Chair: Hossein Hashemi, University of Southern California&lt;br&gt;Co-Chair: Vidya Jain, Anokiwave</td>
<td><strong>RTU1C: mm-Wave Radar and Beamforming Transceivers</strong>&lt;br&gt;Chair: Vito Giannini, Uhnder&lt;br&gt;Co-Chair: Pierre Busson, STMicroelectronics</td>
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<td><strong>RTU1A-1: A Continuous-Mode 23.5–41GHz Hybrid Class-F/F-1 Power Amplifier with 46% Peak PAE for 5G Massive MIMO Applications</strong>&lt;br&gt;Tso-Wei Li, Georgia Tech, USA; Hua Wang, Georgia Tech, USA</td>
<td><strong>RTU1B-1: A 410GHz OOK Transmitter in 28nm CMOS for Short Distance Chip-to-Chip Communications</strong>&lt;br&gt;Alexander Staendaert, Katholieke Universiteit Leuven, Belgium; Patrick Reynaert, Katholieke Universiteit Leuven, Belgium</td>
<td><strong>RTU1C-1: A 35GHz mm-Wave Pulse Radar with Pulse Width Modulated by SDM Realizing Sub-mm Resolution for 3D Imaging System</strong>&lt;br&gt;Shunli Ma, Fudan University, China; Jincheng Zhang, Fudan University, China; Tienxiang Wu, Fudan University, China; Junyan Ren, Fudan University, China</td>
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<td><strong>RTU1A-2: A Compact 75GHz PA with 26.3% PAE and 24GHz Bandwidth in 22nm FinFET CMOS</strong>&lt;br&gt;Steven Callender, Intel, USA; Stefano Pellerano, Intel, USA; Christopher Hull, Intel, USA</td>
<td><strong>RTU1B-2: A 308–317GHz Source with 4.6mW Peak Radiated Power and On-Chip Frequency-Stabilization Feedback in 0.13um BiCMOS</strong>&lt;br&gt;Chen Jiang, University of Michigan, USA; Mohammad Aaseef, KACST, Saudi Arabia; Andrea Cathelin, STMicroelectronics, France; Ehsan Afshari, University of Michigan, USA</td>
<td><strong>RTU1C-2: Monitoring Architecture for a 76–81GHz Radar Front End</strong>&lt;br&gt;Karthik Subburaj, Panjay Gupta, Karthik Ramasubramaniam, Dheeraj Shetty, Rohit Chattopadhyay, Shankar Ram Narayanan, Anjan Prasad Eswaran, Sriram Murali, Indu Prathap, Sachin Bharadwaj, Sumeer Bhata, Raj Ganeshwar, Santanu Raychaudhuri, Texas Instruments, India; Brian Ginsburg, Krishnananth Sambur, Sreekiran Samalla, Dan Breen, Tim Davis, Zahir Parkar, Zeshan Ahmad, Neeraj Nayak, Meysam Mosallam, Eunyoung Seok, Karan Bhatia, Tom Altus, Vito Giannini, VeriRial Synthesis, Texas Instruments, USA</td>
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<td><strong>RTU1A-3: A K-Band Power Amplifier with 26-dBm Output Power and 34% PAE with Novel Inductance-Based Neutralization in 90-nm CMOS</strong>&lt;br&gt;Wei-Cheng Huang, National Taiwan University, Taiwan; Jung-Lin Lin, National Taiwan University, Taiwan; Yu-Hsuan Lin, National Taiwan University, Taiwan; Hwei Wang, National Taiwan University, Taiwan</td>
<td><strong>RTU1B-3: A 280GHz +9dBm TRP Dense 2D Multi Port Radiator in 65nm CMOS</strong>&lt;br&gt;Nadav Baidana, Tel Aviv University, Israel; Samuel Jameson, Tel Aviv University, Israel; Eran Socher, Tel Aviv University, Israel</td>
<td><strong>RTU1C-3: A 151-to-173GHz FMCW Transmitter Achieving 14dBm Pout with Synchronized Injection-Locked Power Amplifiers and Five In-Phase Power Combining Doubblers in 65nm CMOS</strong>&lt;br&gt;Shunli Ma, Fudan University, China; Tienxiang Wu, Fudan University, China; Jincheng Zhang, Fudan University, China; Junyan Ren, Fudan University, China</td>
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<td><strong>RTU1A-4: A 14.8dBm 20.3dB Power Amplifier for D-Band Applications in 40nm CMOS</strong>&lt;br&gt;Dragan Simic, Katholieke Universiteit Leuven, Belgium; Patrick Reynaert, Katholieke Universiteit Leuven, Belgium</td>
<td><strong>RTU1B-4: Heterodyne Sensing CMOS Array with High Density and Large Scale: A 240-GHz, 32-Unit Receiver Using a De-Centralized Architecture</strong>&lt;br&gt;Zhi Hu, MIT, USA; Cheng Wang, MIT, USA; Ruonan Han, MIT, USA</td>
<td><strong>RTU1C-4: A True Time Delay-Based SiGe Bi-Directional T/R Chipset for Large-Scale Wideband Timed Array Antennas</strong>&lt;br&gt;Moon-Kyu Cho, Georgia Tech, USA; Ickhyun Song, Georgia Tech, USA; John D. Cressler, Georgia Tech, USA</td>
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<td><strong>RTU1A-5: A 31GHz 2-Stage Reconfigurable Balanced Power Amplifier with 32.6dB Gain, 25.5% PAEmax and 17.9dBm Pout in 28nm FD-SOI CMOS</strong>&lt;br&gt;Florent Torres, STMicroelectronics, France; Magali De Mato, IMS (UMR 5218), France; Andrea Cathelin, STMicroelectronics, France; Eric Kerherve, IMS (UMR 5218), France</td>
<td><strong>RTU1B-5: Proximal-Field Radiation Sensors for Millimeter-Wave Integrated Radiators</strong>&lt;br&gt;Aminreza Safaripour, Caltech, USA; Bahar Asghari, Caltech, USA; Ali Hajimiri, Caltech, USA</td>
<td><strong>RTU1C-5: A 57–71GHz Beamforming SiGe Transceiver for 802.11ad-Based Fixed Wireless Access</strong>&lt;br&gt;Erik Olofors, Sivers IMS, Sweden; Mikael Andressson, Sivers IMS, Sweden; Torgil Kjellberg, Sivers IMS, Sweden; Håkan Berg, Sivers IMS, Sweden; Lars Aspemyr, Sivers IMS, Sweden; Richard Nilsson, Sivers IMS, Sweden; Klas Brink, Sivers IMS, Sweden; Robin Dahlbäck, Sivers IMS, Sweden; Dapeng Wu, Sivers IMS, Sweden; Niclof Stjoppe, Sivers IMS, Sweden; Mats Carlsson, Sivers IMS, Sweden</td>
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## RFIC Technical Sessions

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

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<td><strong>RTU2B: Wireless Transceivers and Transmitters for Connectivity and Cellular</strong>&lt;br&gt;Chair: Magnus Wiklund, Qualcomm&lt;br&gt;Co-Chair: Yuan-Hung Chung, MediaTek</td>
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<td><strong>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</strong>&lt;br&gt;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</td>
<td><strong>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</strong>&lt;br&gt;Chia-Hsin Wu, Chris Hunter, Jongdae Bae, Huijung Kim, Jisoo Chang, Inhyo Ryu, Seungwon Jun, Byungwan Ha, Won Ko, Jonghyun Yim, Sangwook Han, Taewan Kim, Daeyoung Yoon, Inyoung Choi, Sangyun Lee, Qing Liu, Myonggyun Kim, Jioong Lee, Shinwoong Kim, Byungvak Cho, Samsung, Korea; Alexander Thousardides, Michael Cowell, Jacob Sharpe, Samsung Cambridge Solution Centre, UK</td>
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<td><strong>RTU2A-2: A Compact 75GHz LNA with 20dB Gain and 4dB Noise Figure in 22nm FinFET CMOS Technology</strong>&lt;br&gt;Woorim Shin, Intel, USA; Steven Callender, Intel, USA; Stefano Pellerano, Intel, USA; Christopher Hull, Intel, USA</td>
<td><strong>RTU2B-2: An Asymmetrical Parallel-Combined Cascade CMOS WiFi 5GHz 802.11ac RF Power Amplifier</strong>&lt;br&gt;Sergey Anderson, DSP Group, Israel; Nadav Snir, DSP Group, Israel</td>
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<td><strong>RTU2A-4: Circuit Techniques for Enhanced Channel Selectivity in Passive Mixer-First Receivers</strong>&lt;br&gt;Edward C. Szoka, Cornell University, USA; Alyosha C. Molnar, Cornell University, USA</td>
<td><strong>RTU2B-4: A Wideband Transmitter for LTE-A HPUE Using CIM3 Cancellation</strong>&lt;br&gt;Yangjian Chen; MediaTek, UK; Arnaud Werquin; MediaTek, UK; Mohammed Hassain; MediaTek, UK; Christophe Beghein, MediaTek, UK; Bernard Tenbroek; MediaTek, UK; Jon Strange; MediaTek, UK; Chi-Tsan Chen; MediaTek, Taiwan; Tsung-Han Wu; MediaTek, Taiwan; Yen-Hong Chen; MediaTek, Taiwan; Chien-Shiun Chiu; MediaTek, Taiwan</td>
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<td><strong>RTU2A-5: A 750µW -88dBm-Sensitivity CMOS Sub-Harmonic Phase-Tracking Receiver</strong>&lt;br&gt;Bingwei Jiang, HKUST, China; Howard C. Luong, HKUST, China</td>
<td><strong>RTU2B-5: A 40nm 4-Downlink and 2-Uplink RF Transceiver Supporting LTE-Advanced Carrier Aggregation</strong>&lt;br&gt;Tzung-Han Wu, MediaTek, Taiwan; Yuan-Yu Fu, MediaTek, Taiwan; Sheng-He Tseng, MediaTek, Taiwan; Ying-Tsang Lu, MediaTek, Taiwan; Yangjian Chen, MediaTek, UK; Chien-Shan Chiou, 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; U-Shin Lai, MediaTek, Taiwan; Chao-Wei Wang, MediaTek, Taiwan; Chih-Hao Eric Sun, MediaTek, Taiwan; Yen-Hong Chen, MediaTek, Taiwan; Chien-Shiun Chiu, MediaTek, Taiwan; Shih-Chieh Yen, MediaTek, Taiwan; Guang-Kaai Dehng, MediaTek, Taiwan; George Chien, MediaTek, Singapore; Bernard Tenbroek, MediaTek, UK</td>
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**RFIC Technical Sessions**

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

### RTUIF: Interactive Forum

**Chair:** Ranjit Gharpure, University of Texas at Austin  
**Co-Chair:** Mohyee Mikhemar, Broadcom

#### RTUIF-1: Power Amplifier with Temperature Adaptive Biasing for Improved DEVM

Hamza Najari, IMS (UMR 5218), France; Christophe Corder, 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

Enkhbayarsgal Ganstog, Cornell University, USA; Ivan Bukreyev, Cornell University, USA; Frank Lane, MicComm, 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. Bahyenas, 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 Böck, Technische Universität Berlin, Germany

#### RTUIF-9: A Crosstalk-Immune Sub-THz All-Surface-Wave 1/O Transceiver in 65-nm CMOS

Yuan Liang, Nanyang Technological University, Singapore; Chih Chye Boon, Nanyang Technological University, Singapore; Hao Yu, SUSTC, China

#### RTUIF-10: 300GHz OOK Transmitter Integrated in Advanced Silicon Photonics Technology and Achieving 200Gb/s

E. Lacombe, STMicroelectronics, France; C. Belem-Goncalves, STMicroelectronics, France; C. Luaux, Polytech’Lab (EA 7498), France; F. Gianesello, STMicroelectronics, France; C. Durand, STMicroelectronics, France; D. Giota, STMicroelectronics, France; G. Ducournau, IEMN (UMR 8520), France

#### RTUIF-11: A 2.56Gb/s 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

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**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  
RM048-1 | 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 IM, Sweden  
RTUI1C-5 | 9:20

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**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 1.8S VSWR**

Aravind Nagulu, et al.  
Columbia University, USA; CUNY Advanced Science Research Center, USA  
RM03A-1 | 13:30
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 – 09:30 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 envelope, 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 description order is optimized to reinforce the model convergence capabilities. 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**

11:40 – 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.

**Awards Luncheon**
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. A non-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
D-1  
**Experimental Study on Crosstalk Reduction between Integrated Inductors Up To Millimeter-Wave Regime**  
15:40 – 16:00 PM  

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 PM  
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 instrumented 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-Hernández, CICESE; Andrés 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  
Andréj 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; YUSAki 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. Bilyova, 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 Ramabadrn, 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 Marcon, 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  
Thaalfukar 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
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 bridled 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.
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<th>Session</th>
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<th>FR1B: Neuroimplants and Miniaturized Devices</th>
<th>FR1C: Bio-Tissue and Cell Modelling</th>
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<td>Chair</td>
<td>Christian Damm, Universität Ulm and Simon Hemour, IMS (UMR 5218)</td>
<td>Iiana Mahbub, University of North Texas and Yong Xin Guo, National University of Singapore</td>
<td>James Hwang, Lehigh University and Pai-Yen Chen, Wayne State University</td>
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<td>Dietmar Kissinger, IHP, Germany</td>
<td>Gianluca Lazzi, University of Southern California, USA</td>
<td>A. Denzi, Università di Roma La Sapienza, Italy; C. Merla, ENEA, Italy; F.M. Andre, VAT (UMR 8203), France; T. García-Sanchez, VAT (UMR 8203), France; F. Apollonio, Università di Roma La Sapienza, Italy; M. Libert, Università di Roma La Sapienza, Italy</td>
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<td>1A-2</td>
<td>A Compact Energy Efficient CMOS Permittivity Sensor Based on Multiharmonic Downconversion and Tunable Impedance Bridge</td>
<td>A Ka-Band Beamformer for Wireless Power Transfer to Body Area Networks</td>
<td>Development of a Tissue Dielectric Properties Model Based on Maxwell-Fricke Mixture Theory</td>
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<td>G. Vlachogiannakis, Z. Hu, H. Thippur Shrivamurthy, A. Neto, M.A.P. Pertijs, L.C.N. de Vreede, M. Spirito, Technische Universität Delft, The Netherlands</td>
<td>Nicholas D. Saiz, Stanford University, USA; Gabriel Buckmaster, Stanford University, USA; Thomas H. Lee, Stanford University, USA</td>
<td>Sevde Etoz, University of Wisconsin-Madison, USA; William Greisch, University of Wisconsin-Madison, USA; Christopher L. Brace, University of Wisconsin-Madison, USA</td>
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<td>1A-3</td>
<td>Homodyne and Heterodyne Terahertz Dielectric Sensors: Prototyping and Comparison in BiCMOS Technology for Lab-on-Chip Applications</td>
<td>NEMS Magnetoelectric Antennas for Biomedical Application</td>
<td>Reproducibility Evaluation of Composite Dielectric Materials Based on an Error Propagation Model</td>
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<td>Defu Wang, IHP Germany; Klaus Schmalz, IHP Germany; Mohamed Hussein Eissa, IHP Germany; Johannes Borrgäär, 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</td>
<td>Hwaider Lin, Northeastern University, USA; Mohsen Zaeimabadi, Northeastern University, USA; Neville Sun, Northeastern University, USA; Xianfeng Liang, Northeastern University, USA; Huailuo Chen, Northeastern University, USA; Cunzheng Dong, Northeastern University, USA; Alexei Matyushov, Northeastern University, USA; Xinjun Wang, Northeastern University, USA; Yinque Guo, Northeastern University, USA; Yuan Gao, Northeastern University, USA; Nian X. Sun, Northeastern University, USA</td>
<td>Bik Hattenhorst, Ruhr-Universität Bochum, Germany; Christoph Baer, Ruhr-Universität Bochum, Germany; Thomas Musch, Ruhr-Universität Bochum, Germany</td>
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<td>1A-4</td>
<td>Towards High-Transconductance Graphene High-Speed Biosensors</td>
<td>UHF RFID Sensor Tag Antenna Concept for Stable and Distance Independent Remote Monitoring</td>
<td>Molecular Dynamics Simulations in Service of Microwave Dielectric Analysis of Biomolecules</td>
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<td>W. Wei, IEMN (UMR 8520), France; S. Mheddbi, IEMN (UMR 8520), France; P. Tilmant, IEMN (UMR 8520), France; H. Haep, IEMN (UMR 8520), France; E. Pallecchi, IEMN (UMR 8520), France</td>
<td>Lukas Gortschacher, Technische Universität Graz, Austria; Wolfgang Bösch, Technische Universität Graz, Austria; Jasmin Grosinger, Technische Universität Graz, Austria</td>
<td>M. Cifra, Czech Academy of Sciences, Czech Republic; J. Pruden, Czech Academy of Sciences, Czech Republic; D. Havlena, Czech Academy of Sciences, Czech Republic; O. Krivosudský, Czech Academy of Sciences, Czech Republic</td>
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FRIF1: Interactive Forum
Chair: Hung Cao, University of Washington

FRIF1-1: Accuracy Enhancement of Doppler Radar-Based Heartbeat Rate Detection Using Chest-Wall Acceleration
Mehdad 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 Benchikhi, INRS-EMT, Canada; Homa Arab, INRS-EMT, Canada; Serioja Ovidiu Tatu, INRS-EMT, Canada

FRIF1-3: Robust Radar-Based Human Motion Recognition with LL-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 Thermoaoustic Imaging
Daqun 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; Ahmed Hoorfar, Villanova University, USA

FRIF1-7: Acoustic Transmission of Biomedical Data via the Intercommunication System of an MRI
Viktoria Kalpen, Universität Innsbruck, Austria; Fabian Eichlin, 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, Fukukoku Institute of Technology, Japan; Toru Manoyama, 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. Maboth, University of North Riau, USA

FRIF1-10: Improving the Efficiency of Magnetic Induction-Based Wireless Body Area Network (WBAN)
Negar Golestani, University of Southern California, USA; Matfa Moghaddam, University of Southern California, USA

FRIF1-11: Numerical Evaluation of Sensitivity of Microwave Metamaterial and Microstrip TL Sensors to Blood Glucose Concentration
Jan Vhna, ELEDIA@CTU, Czech Republic; David Vhna, ELEDIA@CTU, Czech Republic; Luis Diaz, ELEDIA@CTU, Czech Republic; Ondej Fiser, ELEDIA@CTU, Czech Republic

Jan-Christoph Edelmann, Universität Innsbruck, Austria; S. Bergmuller, Universität Innsbruck, Austria; D. Mair, Universität Innsbruck, Austria; Gilbert Prokop, Universität Innsbruck, Austria; Thomas Ussmueller, Universität Innsbruck, Austria

FRIF1-13: 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 Chaubana, DRDO, India; Ashesh Gupta, DRDO, India

FRIF1-14: Characterization of Microwave Dickie Radiometer for Non-Invasive Tissue Thermometry
Sathy Priya Sugumar, IIT Madras, India; C.V. Krishnamurthy, IIT Madras, India; Kavitha Aniruchalain, IIT Madras, India

FRIF1-15: A Highly Sensitive RF Biosensor Based on Splitter/Combiner Configuration for Single-Cell Characterization
Abdulrahman Aghamadi, 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; Xiapeng 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 Meeo, G. Matrone, PE, Eoin Lopez, A. Martelloso, M. Pasian, M. Bozzi, L. Perregini, A. Mazzanti, Italy; F. Svelto, Università di Roma La Sapienza, Italy; G. Sacco, Università di Roma La Sapienza, Italy

FRIF1-19: Preliminary Measurements of Magnetic Nanoparticles as Potential Biomarkers for Impedance Flow Cytometry
Pawe Barmuta, Katholieke Universiteit Leuven, Belgium; Isabella Kamiaka, Polish Academy of Sciences, Poland; Chunghao Bao, Katholieke Universiteit Leuven, Belgium; Tomislav Markov, Katholieke Universiteit Leuven, Belgium; Ilija 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. Comal, Cardiff University, UK; A. Abouabkar, 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; Xiapeng Wang, Southeast Missouri State University, USA; Ranvirra Joshi, Texas Tech University, USA; Wenbing Zhao, Cleveland State University, USA

FRIF1-23: NanoNeuroRFID: A Low Loss Brain Implantable Device Based on MagnetoElastic Antenna
Mohsen Ziaembashi, Northeastern University, USA; Hwaiden Lin, Northeastern University, USA; Zhiquang Wang, Northeastern University, USA; Huahao Chen, Northeastern University, USA; Shadi Enam, 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. Fuzzi, 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

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<td><strong>FR2A: Microwave Imaging and MRI</strong>&lt;br&gt;Chair: Abbas Omar, Universität Magdeburg and Xudong Chen, National University of Singapore</td>
<td><strong>FR2B: Microwave and Antennas for Wireless Power and Wearables</strong>&lt;br&gt;Chair: Aydin Farajidavar, New York Institute of Technology and Simon Hemour, IMS (UMR 5218)</td>
<td><strong>FR2C: Biosensors</strong>&lt;br&gt;Chair: Arnaud Pothier, XLIM (UMR 7252) and Ping-shan Wang, Clemson University</td>
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<tr>
<td><strong>FR2A-1: (Invited) Recent Advances in RF Aspects of Magnetic Resonance Imaging</strong>&lt;br&gt;Robert Caverly, Villanova University, USA</td>
<td><strong>FR2B-1: (Invited) RF in Medicine: Current Status and Future Directions of Antennas and Wireless Power</strong>&lt;br&gt;Yongxin Guo, National University of Singapore, Singapore</td>
<td><strong>FR2C-1: (Invited) Biosensors for Measuring the Dielectric Response of Single Cells to Applied Stress</strong>&lt;br&gt;Gregory Bridges, University of Manitoba, Canada</td>
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<td><strong>FR2A-2: Real-Time Microwave Imaging of Breast Phantoms with Constrained Deconvolution of Planar Data</strong>&lt;br&gt;D. Tajik, McMaster University, Canada; F. Foroutan, McMaster University, Canada; D.S. Shumakov, Health Canada, Canada; A.D. Pitcher, McMaster University, Canada; E.A. Ewyleigh, McMaster University, Canada; N.K. Nikolova, McMaster University, Canada</td>
<td><strong>FR2B-2: Evaluating the Microwave Performance of Epidermal Electronics with Equivalent Transmission Line Modeling</strong>&lt;br&gt;Tammy Chang, Stanford University, USA; Jonathan A. Fan, Stanford University, USA; Thomas H. Lee, Stanford University, USA</td>
<td><strong>FR2C-2: A Four-Layer Phantom for Testing in-vitro Microwave-Based Sensing Approach in Intra-Cranial Pressure Monitoring</strong>&lt;br&gt;Jacob Velander, Uppsala University, Sweden; Syaiful Redzwanz, Uppsala University, Sweden; Mauricio D. Perez, Uppsala University, Sweden; Noor Badanash Aadan, 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</td>
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<tr>
<td><strong>FR2A-3: A Fast Algorithm for Microwave Biomedical Imaging with Inhomogeneous Background</strong>&lt;br&gt;Kuwen Xu, Hangzhou Dianzi University, China; Yu Zhong, A*STAR, Singapore; Xudong Chen, National University of Singapore, Singapore</td>
<td><strong>FR2B-3: High Efficiency Wireless Power Transfer System Using Spiral DGS Resonators Through Biological Tissues</strong>&lt;br&gt;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. Pokhare, Kyushu University, Japan</td>
<td><strong>FR2C-3: Microwave Noninvasive Blood Glucose Monitoring Sensor: Penetration Depth and Sensitivity Analysis</strong>&lt;br&gt;Heungjae Choi, Cardiff University, UK; Steve Lusti, Swansea University, UK; Ian Beattie, Université du Luxembourg, Luxembourg; Adrian Porth, Cardiff University, UK</td>
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<td><strong>FR2A-4: Realization of Breast Tissue-Mimicking Phantom Materials: Dielectric Characterization in the 0.3-50GHz Frequency Range</strong>&lt;br&gt;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</td>
<td><strong>FR2B-4: High-Q Implantable Resonator for Wireless Power Delivery</strong>&lt;br&gt;L. Di Trocchio, IMS (UMR 5218), France; J.-L. Lachaud, IMS (UMR 5218), France; C. Dejous, IMS (UMR 5218), France; A. Kuhn, IMS (UMR 5255), France; S. Hemour, IMS (UMR 5218), France</td>
<td><strong>FR2C-4: Microwave Sensing Based on Peelable Microfluidic Thin Film Resonator</strong>&lt;br&gt;Rong Wang, University of Hong Kong, China; Li Jun Jiang, University of Hong Kong, China</td>
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**IMBioC Technical Sessions**

10:50 – 12:20 | **Friday, 15 June 2018** | Pennsylvania Convention Center

**10:50 - 11:20**

**11:20 - 11:40**

**11:40 - 12:20**

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**FRIDAY**
## 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

- **FR3A-1: (Invited) Biomedical Radars Using Self-Injection-Locking Technology**
  T-S. Jason Hong, National Sun Yat-Sen University, Taiwan

- **FR3A-2: Multi-Target Vital-Signs Monitoring Using a Dual-Beam Hybrid Doppler Radar**
  Mehrdad Nosrati, Stevens Institute of Technology, USA; Shahram Shahrzadi, New York University, USA; Negar Tavassolian, Stevens Institute of Technology, USA

- **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

- **FR3A-4: Monitoring of Healing Progress of Cranial Vault Using One-Dimensional Pulsed Radar Technique**
  Dooin Lee, University of Waterloo, Canada; George Shaker, University of Waterloo, Canada; Daniel Nowinski, Uppsala University Hospital, Sweden; Robin Augustine, Uppsala University, Sweden

- **FR3A-5: A Supervised Learning Approach for Real Time Vital Sign Radar Harmonics Cancellation**
  Justin J. Sahuka, 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 Redwan, 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 Momcon, 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 Arofati, New York Institute of Technology, USA; Aydin Fanijadiavar, New York Institute of Technology, USA

### 201C

**FR3C: Bio-Tissue Characterization**

Chair: Kotia 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. Tamira, LAAS, France; A. Zede, LAAS, France; G. Poincu, 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 Shayama, NTT, Japan; Kayo Waki, University of Tokyo, Japan

- **FR3C-3: Validation of Clausius-Mossotti Function in Single-Cell Dielectrophoresis**
  Xiaolan Du, Lehigh University, USA; Xiao Ma, Lehigh University, USA; Hang Li, Lehigh University, USA; Yeong Ning, Lehigh University, USA; Xuanhong Cheng, Lehigh University, USA; James C.M. Hwang, Lehigh University, USA
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<tr>
<td><strong>FR4A: Pulsed Fields for Biomedical Applications</strong>&lt;br&gt;Chair: Roberto Gómez-García, Universidad de Alcalá and Xiaoyang Liu, University of California, Davis</td>
<td><strong>FR4B: Biomedical Signal Monitoring and Communication</strong>&lt;br&gt;Chair: Chung-Tse (Michael) Wu, Rutgers University and Hung Cao, University of Washington</td>
<td><strong>FR4C: Bio-Tissue Characterization II</strong>&lt;br&gt;Chair: Abbas Omar, Universität Magdeburg and Perry Li, Abbott Laboratories</td>
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<td><strong>FR4A-1: Miniature Flexible Planar Microwave and RF Energy Delivery Structure for New Endoscopic Procedures — Design and Initial Pre-Clinical Data</strong>&lt;br&gt;Chris Hancock, Bangor University, UK; Steve Morris, Creo Medical, UK; Zacharias Tsiamoulos, St. Mark’s Hospital, UK; Brian Saunders, St. Mark’s Hospital, UK</td>
<td><strong>FR4B-1: Soft Wearable Sensors for Precise Physiological Signals Measurements Based on the Fabric-Substrate Complementary Split-Ring Resonator</strong>&lt;br&gt;Po-Kai Chan, National Cheng Kung University, Taiwan; Ta-Chung Chang, National Cheng Kung University, Taiwan; Kuan-Wei Chen, National Cheng Kung University, Taiwan; Chi-Lung Yang, National Cheng Kung University, Taiwan</td>
<td><strong>FR4C-1: (Invited) Material Characterization for the Detection of African Trypanosomes Using RNA-Derived Surface Layers with mm-Wave and THz Sensors</strong>&lt;br&gt;Mario Muen, Technische Universität Darmstadt, Germany; Robert Knief, Technische Universität Darmstadt, Germany; H. Ulrich Göringer, Technische Universität Darmstadt, Germany; Christian Damm, Universität Ulm, Germany</td>
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<td><strong>FR4A-2: Non-Contact Picosecond Pulsed Electric Fields Up Regulate 50X2 Gene Expression in Mesenchymal Stem Cells</strong>&lt;br&gt;Ross A. Petrella, Old Dominion University, USA; Peter A. Mollica, Old Dominion University, USA; Martina Zampini, Old Dominion University, USA; Shu Xiao, Old Dominion University, USA; Robert D. Bruno, Old Dominion University, USA; Patrick C. Sachs, Old Dominion University, USA</td>
<td><strong>FR4B-2: Characterization of Passive Wireless Electrocardiogram Acquisition in Adult Zebras</strong>&lt;br&gt;Silvia 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</td>
<td><strong>FR4C-2: Measuring Ion-Pairing in Buffer Solutions with Microwave Microfluidics</strong>&lt;br&gt;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</td>
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| **FR4A-3: A Microwave Ablation System for the Visualisation and Treatment of Pulmonary Nodules and Tumours**<br>Shaun C. Preston, Bangor University, UK; William Taplin, Bangor University, UK; Aaron W. Jones, Bangor University, UK; Chris Hancock, Bangor University, UK | **FR4B-3: A Miniature Wireless 64-Channel System for Monitoring Gastrointestinal Activity**<br>Amit Jalan-Khoshakhil, New York Institute of Technology, USA; Wahib Arafat, New York Institute of Technology, USA; Zaid Abukhalil, 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 | **FR4C-3: Discrimination of Glioblastoma Cancer Stem Cells by Measuring Their UHF-Dielectrophoresis Crossover Frequency**<br>R. Manzack, C. Daley, P. Blondy, A. Potthier, XLIM (UMR 7252), France; S. Saada, B. Bessette, G. Begaud, S. Bautu, M.O. Jauberteau, F. Laloue, NIST, USA|}
| **FR4A-4: Electropermeabilization of Isolated Cancer Stem Cells with a Novel and Versatile Nanosecond Pulse Generator**<br>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 | **FR4B-4: Wireless Passive Monitoring of Electrocardiogram in Firefighters**<br>Tai Le, University of Washington, USA; Miguel Huerta, University of Washington, USA; Alexander Moravec, University of Washington, USA; Hung Cao, University of Washington, USA | **FR4C-4: Ferromagnetic Resonance Characterization of Magnetic Nanowires for BioLabel Applications**<br>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 |
| **FR4A-5: Flexible Ablation Device with Single Applicator Structure that Supports both Radiofrequency and Microwave Energy Delivery**<br>Patrick Burn, Bangor University, UK; Pallav Shah, Imperial College London, UK; Chris Hancock, Bangor University, UK | **FR4B-5: Bone Conduction: A Feasible Concept for Ear-to-Ear Communication?**<br>Jan-Christoph Edelmann, Universität Innsbruck, Austria; Gilbert Prokop, Universität Innsbruck, Austria; Thomas Ussmueller, Universität Innsbruck, Austria | **FR4C-5: Effect of Thickness Inhomogeneity in Fat Tissue on In-Body Microwave Propagation**<br>Noor Badarish Anan, Jacob Veleander, Syaful Redwan, Mauricio D. Perez, Thieneo Voigt, Robin Augustine, Uppsala University, Sweden; Emadeldine Hassan, Umeå University, Sweden; Taco J. Blakhuis, 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

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IMBioC Student Paper Competition Finalists:

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: Hojatollah Fallahi, Kansas State University
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.”
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.

**AGENDA:**

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<td>08:00–08:05</td>
<td>Welcome and 5G Summit Overview: <strong>Debabani Choudhury</strong>, Intel Labs</td>
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<td>08:05–08:15</td>
<td>‘Overview on 5G Initiative’, <strong>Ashutosh Dutta</strong>, IEEE 5G Initiative</td>
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<td>08:15–08:55</td>
<td>‘Bringing the World Closer Together’, <strong>Jin Bains</strong>, Facebook</td>
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<td>08:55–09:35</td>
<td>‘AT&amp;T’s Perspectives on 5G Services’, <strong>David Lu</strong>, AT&amp;T</td>
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<td>09:35–09:50</td>
<td>Coffee Break</td>
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<td>11:10–11:50</td>
<td>‘5G Automotive Challenges and Opportunities’, <strong>Timothy Talty</strong>, General Motors</td>
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<td>11:50–12:00</td>
<td>**Boxed Lunch Pickup</td>
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| 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  
| 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                                                            |
| 15:50–16:30 | ‘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            |
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.

   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 Bellouar; 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 Sebastian; Delft University of Technology; Andrei Vladimirescu; TU Delft, ISER UC Berkeley; Edoardo Charbon; EPFL, Kavli Institute of Nanoscience Delft, Intel
## WORKSHOPS

### WSC

**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 Slaman; GLOBALFOUNDRIES

### WSD

**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

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WSE 08:00 – 17:15

Integrated Mm-Wave & THz Sensing Technology for Automotive, Industrial and Healthcare

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; Ruinan Han; MIT
9. Silicon based Multispectral Terahertz Imaging; Richard Al Hadi; UCLA
10. An Integrated-Circuit Approach to Terahertz Nearfield Imaging; Ulrich 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.

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

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**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 spur (~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-range wave. 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 Differentiable 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, Beguereut 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

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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

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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 Peletku, 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

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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 chairman.

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 Sheanwood, 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 Steitzer, 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 Frühauf; Chalmers University, Sweden**
2. **Electromagnetic Tomography For Human Brain Imaging: Application For Detection Of Stroke, Traumatic Brain Injuries And Brain Tumor; Sergii Semenov, Ali Fard; EMTensor GmbH**
3. **Multiport VNA System for Microwave Imaging; Sebastian Poltschak, Andreas Haderer, Reinhard Feger, Andreas Steitzer; 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

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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-changing (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

   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

   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; Qorvo, Richardson, TX

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

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WME 08:00 - 17:15

Digital Pre-Distortion and PostCorrection 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 nonlinearity 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 Balthwaltze, 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 Wipline Receivers; Anthony Cardoso, University of Toronto, Canada
6. Digital PostCorrection 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, Willingham, MA, USA; Yi 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 Wipline 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, Fukutoro Hamaoka, Masanori Nakamura, Hideyuki Nosaka, Toshikazu Hashimoto, Yutaka Miyamoto; NTT Network Innovation Laboratories, Kanagawa, Japan; Shigeru Kanazawa; NTT Device Innovation Center, Kanagawa, Japan
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; Roll 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 nonthermal 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 preprocessed 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 Hercow; Harvard Medical School, DanaFarber Cancer Institute, Boston, Massachusetts, USA
2. Microwave Assisted Electroporation; Seonke 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 Dominon 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 Macrofluidic Devices and Cellular Interactions; Ilia Ocket; ESAT-TELEMIC, Telecommunications and Microwaves, Kasteelpark Arenberg 10
6. Dosimetry for RF and nsPEF Biomedical Investigation; Philippe Lequeux; Xilim, CRNS-University of Limoges, France; Delia Arnaud-Cormos; Xilim, CRNS-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 Subcellular 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
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 Robin; 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, Canada
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

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 Rebiz; 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
Automotive Radar and Vehicular Network Security

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 signals from different automotive radars. 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

Advanced Applications of Nonlinear Vector Network Measurements for broadband RF Power Amplifiers Design and Linearization

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
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 thousands 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; Hensoldt - 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. Affordable 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
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
Ultra-Low-Power Nanowatt to Microwatt Receivers for the Internet of Things

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 attendees.

1. Recent Trends in Ultra-Low Power Radios;
   David Wentzloff; University of Michigan
   Patrick Mercier; University of California, San Diego
   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

RF Front-Ends for Enhanced Mobile Communications Towards 5G

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 mobile 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; Ampelion Netherlands B.V., Netherlands
4. Modular Phased-Array Solution with Beam-Steering Antennas for 5G Millimeter-Wave RAN;
   Nebojsa Maletic1, Andrea Malignaggi1, Dietmar Kissing1,2; Presenter: Nebojsa Maletic, 1HP; 2Technische Universität Berlin
5. Front-End Module Architecture & Silicon Technology Front-End for 5G Radio Interface;
   Anirban Bandypadhyay; 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. Venyeyen
8. Challenges and Opportunities of mm-Wave for 5G Mobile Radio;
   Jonathan Jensen; Intel Corporation, Hillsboro, USA
9. 28GHz CMOS Phased-Array Transceiver for 5G New Radio;
   Kenichi Ozaka; Tokyo Institute of Technology, Japan
10. mmWave RF Front-Ends for 5G; Barend van Liempt; imec vzw, Belgium; Mark Ingels; imec vzw, Belgium
Advanced Synthesis Techniques for Reduced Size Filtering Networks

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 equipment 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 multi-band 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 Politècnica de València; Vicente Borja; Universitat Politècnica de València
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
Techniques Passive Devices for Multi-band Systems

**Sponsor:** IMS

**Organizers:** Dimitra Kyzouliou, 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 multifunctional transceivers 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 Valdés-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 Alcalá
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

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
4. Intermodulation Mitigation in Concurrent Multi-band PAs using Multi-band Predistortion Techniques; Fadhel Ghanouchi; 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
Module Integration and Packaging/IC Co-Integration for Millimeter-wave Communications and 5G

Sponsor: IMS; RFCF
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 arrays 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 System; 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; Yu-Chin Ou; Qualcomm
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
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 will 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 Vreee; Delft University of Technology; Morteza Alavi; Delft University of Technology

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**WFJ** 08:00 – 17:15

**WFK** 08:00 – 17:15

**WFJ**

**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 for 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 Structures: 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**

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**WFJ**

**Design of Matching Networks for Optimal Performance of Power Amplifiers and Transmitters**

**Sponsor:** IMS

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9. **Quasi-load insensitive class-E for Doherty and Outphasing Transmitters:**
   - Leo de Vreee; Delft University of Technology; Morteza Alavi; Delft University of Technology

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**WFJ**

**The New GaN: Advancements in Novel-materials based GaN Microwave and mm-Wave Technologies**

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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 Structures: 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
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SFB 13:30 – 17:15
Using active Fiber Optic for Distributed Antenna System (DAS) System in 5G MIMO System and Automobile Radar System
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<td>Cambridge University Press</td>
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www.cst.com

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### Exhibiting Companies

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<td>MegaPhase</td>
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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 Materials for Circuits from 600 MHz up to mmWave

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<td>CLTE-MW™</td>
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<td>3.50</td>
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<td>0.0025</td>
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Notes: Dk and Df are both measured at 10 GHz.

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We’ve got you covered for 5G! — from 600 MHz up to mmWave

— from 600 MHz up to mmWave

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<td>Sonnet Software, Inc.</td>
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<td>Southeast University</td>
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<td>Speedlink</td>
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<td>SR Technology Corp.</td>
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<td>State Of The Art Inc.</td>
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<td>Statek Corp.</td>
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<td>Sumitomo Electric Device Innovations</td>
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<td>Anaheim, CA</td>
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<td>Sung Won Forming</td>
<td>2014</td>
<td>Gyeonggi-do, Seoul, Korea (South)</td>
<td><a href="http://www.swf.co.kr">www.swf.co.kr</a></td>
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<td>SuperApex Corporation</td>
<td>1953</td>
<td>Rolling Meadows, IL</td>
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<td>Susumu International (USA) Inc.</td>
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<td>Suzhou Hexagon Communication Technologies Co., Ltd.</td>
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<td>Tactron Elektronik GmbH</td>
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<td>Tagore Technology, Inc.</td>
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<td>Tai-Saw Technology Co., Ltd.</td>
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<td>Teledyne e2v Semiconductors</td>
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<td>Teledyne Scientific</td>
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<td>Telegartner, Inc.</td>
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<td>TeraProbes, Inc.</td>
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<td>Texas Instruments</td>
<td>2037</td>
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<td>The 41st Institute of CETC</td>
<td>1561</td>
<td>Qingdao, Shangdong, China</td>
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Exhibitors as of 20 April 2018
## Exhibiting Companies

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<td>The Boeing Company</td>
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<td>The Goodsystem Corp.</td>
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<td>Ansan-si, Gyeonggi-do, Korea (South)</td>
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<td>The University of Texas at Dallas – ECE Department</td>
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<td>UMS (United Monolithic Semiconductors)</td>
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<td>University of Waterloo, Centre for Intelligent Antenna and Radio Systems(CIARS)</td>
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<td>Waterloo, ON, Canada</td>
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<td>UTE Microwave Inc.</td>
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<td>Wavetek Microelectronics Corporation</td>
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<td>Hsinchu County, Taiwan</td>
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Exhibiting Companies

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<td>Wuhan Gewei Electronics Technologies Co., Ltd.</td>
<td>215, 1433</td>
<td>Wuhan, China</td>
</tr>
<tr>
<td>Xi'an HengDa Microwave Technology Development Co., Ltd.</td>
<td>2249</td>
<td>Xi'an, Shaanxi, China</td>
</tr>
<tr>
<td>XIAN PRECISIONRF ELECTRONICS CO., LTD.</td>
<td>1857</td>
<td>Xi'an, Shaanxi, China</td>
</tr>
<tr>
<td>XMA Corporation</td>
<td>2236</td>
<td>Manchester, NH</td>
</tr>
<tr>
<td>X-Microwave, LLC</td>
<td>1763</td>
<td>Round Rock, TX</td>
</tr>
<tr>
<td>Xpeedic Technology, Inc.</td>
<td>1705</td>
<td>Bellevue, WA</td>
</tr>
<tr>
<td>Xperi</td>
<td>313</td>
<td>Calabasas, CA</td>
</tr>
<tr>
<td>XYZTEC, Inc.</td>
<td>1362</td>
<td>Clinton, MA</td>
</tr>
<tr>
<td>Yokowo Co., Ltd.</td>
<td>1208</td>
<td>Tokyo, Japan</td>
</tr>
<tr>
<td>Zhejiang Huazheng New Material Co., Ltd.</td>
<td>2055</td>
<td>Hangzhou, China</td>
</tr>
<tr>
<td>Zhejiang Jiakang Electronics Co., Ltd.</td>
<td>2404</td>
<td>Jiaxing, Zhejiang, China</td>
</tr>
<tr>
<td>Zhuzhou Jiabang Refractory Metal Co., Ltd.</td>
<td>1657</td>
<td>Changsha, Hunan, China</td>
</tr>
<tr>
<td>Zik, Inc.</td>
<td>252</td>
<td>The Woodlands, TX</td>
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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
RF Globalnet Connects The RF and Microwave World

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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

<table>
<thead>
<tr>
<th>SESSION TIME</th>
<th>EVENT COMPANY</th>
<th>SESSION TITLE</th>
<th>SPEAKERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>10:00 – 12:00</td>
<td>Nuhertz Technologies, LLC</td>
<td>Exceptionally Fast, Easy, and Flexible Optimization of the Electromagnetic (EM) Planar Filter Frequency Response using Nuhertz Filter Solutions.</td>
<td>Jeff Kahler – Nuhertz Technologies, LLC</td>
</tr>
<tr>
<td>10:00 – 12:00</td>
<td>North Carolina State University</td>
<td>Design, Fab and Test Your Own Passive Planar Microwave Component</td>
<td>John Dunn – National Instruments, David S. Ricketts – North Carolina State University</td>
</tr>
<tr>
<td>10:00 – 12:00</td>
<td>Keysight Technologies</td>
<td>Millimeter-wave Measurement Insights Workshop</td>
<td>Jean Marc Moreau, Suren Singh – Keysight Technologies</td>
</tr>
<tr>
<td>10:00 – 12:00</td>
<td>University of Belgrade</td>
<td>Extended Limits in Full Wave Simulations of Complex MW Circuits and Antennas</td>
<td>Branko Kolundzija – School of Electrical Engineering, University of Belgrade</td>
</tr>
<tr>
<td>13:00 – 15:00</td>
<td>Rohde &amp; Schwarz USA, Inc</td>
<td>How Integration of Data Converters Simplify Designs in Various Industries</td>
<td>Markus Loerner – Rohde &amp; Schwarz</td>
</tr>
<tr>
<td>13:00 – 15:00</td>
<td>Rohde &amp; Schwarz USA, Inc.</td>
<td>Advanced Techniques for Phase Noise and Jitter Measurements for High Power, Very High Frequency, Pulsed or Modulated Signals</td>
<td>Kay-Uwe Sander, Martin Stumpf – Rohde &amp; Schwarz USA, Inc.</td>
</tr>
<tr>
<td>15:15 – 17:15</td>
<td>MiG Microwave Innovation Group</td>
<td>Practical Antenna Design Including Feed-Networks</td>
<td>Fritz Arndt – MiG Microwave Innovation Group</td>
</tr>
</tbody>
</table>
## Industry Workshops

10:00 – 17:15  | **Wednesday, 13 June 2018**  | PCC Rooms 105B, 106AB and 107B

<table>
<thead>
<tr>
<th>SESSION TIME</th>
<th>EVENT COMPANY</th>
<th>SESSION TITLE</th>
<th>SPEAKERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>10:00 – 12:00</td>
<td>Rohde &amp; Schwarz USA, Inc.</td>
<td>Best Practices in Wafer-Level Millimeterwave and THz Testing</td>
<td>Volker Herrmann – Rohde &amp; Schwarz USA, Inc.</td>
</tr>
<tr>
<td>10:00 – 12:00</td>
<td>Keysight Technologies</td>
<td>Accelerating Design Validation for 5G New Radio</td>
<td>Sheri DeTomasi, Randy Becker, Daren McClearnon – Keysight Technologies</td>
</tr>
<tr>
<td>10:00 – 12:00</td>
<td>Mician, Inc.</td>
<td>Simulation and Optimization of SIW Components Using Mician µWave Wizard™</td>
<td>Ralf Ihmels – Mician, Inc.</td>
</tr>
<tr>
<td>15:15 – 17:15</td>
<td>Keysight Technologies</td>
<td>How to Model When You Don’t Have a Model</td>
<td>Al Lorona – Keysight Technologies</td>
</tr>
</tbody>
</table>

10:00 – 17:15  | **Thursday, 14 June 2018**  | PCC Rooms 105B, 106AB and 107B

<table>
<thead>
<tr>
<th>SESSION TIME</th>
<th>EVENT COMPANY</th>
<th>SESSION TITLE</th>
<th>SPEAKERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>10:00 – 12:00</td>
<td>Wolfspeed, A Cree Company</td>
<td>A Practical Approach to Using GaN Devices to Solve System Level Challenges</td>
<td>Simon Wood – Wolfspeed, A Cree Company</td>
</tr>
<tr>
<td>10:00 – 12:00</td>
<td>IHP GmbH</td>
<td>Photonic SiGe BiCMOS Technology for Broadband Integrated Communication Circuits</td>
<td>René Scholz, Dietmar Kissinge, Mehmet Kaynak – IHP</td>
</tr>
<tr>
<td>10:00 – 12:00</td>
<td>National Instruments</td>
<td>Design, Fab, and Test Your Own Antenna</td>
<td>Derek Linden – National Instruments</td>
</tr>
<tr>
<td>13:00 – 15:00</td>
<td>Microwave Measurement Systems LLC</td>
<td>Freespace Non-destructive Methods for Material Characterization, Process Control and Antenna Mapping</td>
<td>Vasundara Varadan – Microwave Measurement Systems LLC</td>
</tr>
<tr>
<td>13:00 – 15:00</td>
<td>Analog Devices, Inc.</td>
<td>Full Stack Deployed Modem Design with Software Defined Radio</td>
<td>Travis Collins, Robin Getz – Analog Devices Inc.</td>
</tr>
</tbody>
</table>
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.

For assistance, please contact IMS2018 Tech Support at support@mtt.org
<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Speaker/Company</th>
</tr>
</thead>
<tbody>
<tr>
<td>09:45 - 10:00</td>
<td>Software Defined Radio ‘System on Module’</td>
<td></td>
</tr>
<tr>
<td>10:00 - 10:15</td>
<td>Practical Direction Finding With Software Defined Radios</td>
<td>Travis Collins – Analog Devices Inc.</td>
</tr>
<tr>
<td>10:15 - 10:30</td>
<td>Modeling of AM-PM Characteristics in GaN HEMT Transistors</td>
<td>Jiang Liu, Miriam Calvo, Kevin Kellogg, Hugo Morales, Larry Dunleavy – Modelithics, Inc</td>
</tr>
<tr>
<td>10:30 - 10:45</td>
<td>Recent Advances in GaN Pallets for Radar Applications</td>
<td>Apet Barsegyan – Integra Technologies Inc.</td>
</tr>
<tr>
<td>10:45 - 11:00</td>
<td>Improved Efficiency in Wideband PAs</td>
<td>Chris Day – Analog Devices, Inc.</td>
</tr>
<tr>
<td>11:00 - 11:15</td>
<td>Utilizing Network Synthesis to Streamline Power Amplifier Design Flows</td>
<td>Chris Bean – National Instruments</td>
</tr>
<tr>
<td>11:30 - 11:45</td>
<td>High Speed Small Envelope Optical Transceivers for Harsh Environments</td>
<td>John Evans – API Technologies</td>
</tr>
<tr>
<td>11:45 - 12:00</td>
<td>Silicon Technology for Space Applications</td>
<td>Umesh Jayamohan – Analog Devices, Inc.</td>
</tr>
<tr>
<td>12:00 - 12:15</td>
<td>Advanced Component Pad Features for High Accuracy RF and Microwave Design Simulation</td>
<td>Laura Levesque – Modelithics, Inc.</td>
</tr>
<tr>
<td>12:15 - 12:30</td>
<td>Design Flow Integration for Advanced Multi-Chip RF</td>
<td>Dustin Hoekstra – National Instruments, Mike Yore – Qorvo</td>
</tr>
<tr>
<td>12:30 - 12:45</td>
<td>Usage of Spring-Loaded Probes for Functional Test of RF Applications</td>
<td>Matthias Zapata – INGUN USA, INC.</td>
</tr>
<tr>
<td>13:00 - 13:15</td>
<td>The Performance and Consistency Advantage of Ion Beam Etching Over Chemical</td>
<td>James Barrett, Tom Perkins – Ion Beam Milling</td>
</tr>
<tr>
<td>13:30 - 13:45</td>
<td>EMI Shielding for High Frequency Applications</td>
<td>Mazen Shehaiber – 3G Shielding Specialties</td>
</tr>
<tr>
<td>13:45 - 14:00</td>
<td>Material and Circuit Influences for PIM Related Issues</td>
<td>John Coonrod – Rogers Corp.</td>
</tr>
<tr>
<td>14:00 - 14:15</td>
<td>Printed Circuit Board (PCB) Layout Considerations for Optimal Phase Locked Loop (PLL) Performance</td>
<td>Ian Collins – Analog Devices International</td>
</tr>
<tr>
<td>14:15 - 14:30</td>
<td>Vendor Parts Synthesis (VPS) Automates Selection of RLC Components for Fast RF PCB Board Realization</td>
<td>Rulon VanDyke, How-Siang Yap – Keysight Technologies</td>
</tr>
<tr>
<td>14:30 - 14:45</td>
<td>JESD204C Technology in Data Converters</td>
<td>Del Jones – Analog Devices, Inc.</td>
</tr>
<tr>
<td>14:45 - 15:00</td>
<td>Time Domain Electromagnetic-Circuit Co-Simulation</td>
<td>Gregory Moss – Remcom, Inc.</td>
</tr>
<tr>
<td>15:00 - 15:15</td>
<td>Extremely Fast GPU Based Simulation of MW Circuits and Antennas</td>
<td>Branko Mrdakovic – WIPL-D</td>
</tr>
<tr>
<td>15:15 - 15:30</td>
<td>Design of an IoT MIMO Antenna</td>
<td>Derek Linden – National Instruments</td>
</tr>
<tr>
<td>15:30 - 15:45</td>
<td>Avoid Costly Mistakes in Designing Phased Array Systems</td>
<td>Dr. Murali S Murthy Upmaka – Keysight Technologies</td>
</tr>
<tr>
<td>15:45 - 16:00</td>
<td>Complete X-Band 2x2 Phased-Array Antenna Design and Simulation</td>
<td>David Vye, Andy Hughes – National Instruments</td>
</tr>
<tr>
<td>16:00 - 16:15</td>
<td>Advanced Antenna Design Using μWave Wizard</td>
<td>Ralf Ihmels – Mician, Inc.</td>
</tr>
<tr>
<td>16:15 - 16:30</td>
<td>ADAS Automotive Radar Systems</td>
<td>John Dunn – National Instruments</td>
</tr>
<tr>
<td>16:30 - 16:45</td>
<td>3D Electromagnetic Analysis: Applications and Methods</td>
<td>Isabella Bedford – Modelithics, Inc.</td>
</tr>
<tr>
<td>16:45 - 17:00</td>
<td>Fast Design and Optimization of Passive Microwave Components and Antennas Including Feed-Networks by WASP-NET</td>
<td>Fritz Arndt – MIG Microwave Innovation Group</td>
</tr>
<tr>
<td>Time</td>
<td>Title</td>
<td>Speaker(s)</td>
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<tr>
<td>09:45 - 10:00</td>
<td>Measurement Accuracy of Vector Network Analysis</td>
<td>Volker Herrmann – Rohde &amp; Schwarz USA, Inc.</td>
</tr>
<tr>
<td>10:00 - 10:15</td>
<td>2 Port Calibration for Blindmate Connectors</td>
<td>Mario Torres – Micro-Mode Products, Inc.</td>
</tr>
<tr>
<td>10:15 - 10:30</td>
<td>Accurate Cable Measurement Technique Using an Automatic Calibration Module With a VNA</td>
<td>Brian Walker – Copper Mountain Technologies</td>
</tr>
<tr>
<td>10:30 - 10:45</td>
<td>New Power Measurement Techniques for Today’s Demanding RF World</td>
<td>Lawrence Wilson – Rohde &amp; Schwarz USA, Inc.</td>
</tr>
<tr>
<td>10:45 - 11:00</td>
<td>Meeting the Thermal Challenges for the Design of High Power GaN HEMT Devices</td>
<td>Dustin Kendig – Micronasaj</td>
</tr>
<tr>
<td>11:00 - 11:15</td>
<td>Tunable and Fixed Filtering Solutions Enhances Dynamic Range and Flexibility of 4G-LTE Measurements</td>
<td>Rafi Hershtig – K&amp;L Microwave</td>
</tr>
<tr>
<td>11:15 - 11:30</td>
<td>Envelope Bandwidth and Other Lesser Known RF Detector IC Specifications</td>
<td>Eamon Nash – Analog Devices, Inc.</td>
</tr>
<tr>
<td>11:30 - 11:45</td>
<td>Faster S-Parameter Measurements From Below 2 K to 675 K Using Automatic Fixture Removal (AFR)</td>
<td>David Daughton – Lake Shore Cryotronics Andy Owen – Keysight Technologies</td>
</tr>
<tr>
<td>11:45 - 12:00</td>
<td>Using Near-Field Scanners for Self-Interference Debugging in Communication Circuits</td>
<td>Arturo Mediano – EMSCAN-University of Zaragoza</td>
</tr>
<tr>
<td>12:00 - 12:15</td>
<td>Components for 5G - What is new</td>
<td>Markus Loemer – Rohde &amp; Schwarz USA, Inc.</td>
</tr>
<tr>
<td>12:15 - 12:30</td>
<td>5G mmW Beamformer IC Test Challenge and Solution</td>
<td>Osamu Kusano – Keysight Technologies</td>
</tr>
<tr>
<td>12:30 - 12:45</td>
<td>New Techniques for 5G Transmitter Measurements</td>
<td>Lawrence Wilson – Rohde &amp; Schwarz USA, Inc.</td>
</tr>
<tr>
<td>12:45 - 13:00</td>
<td>Techniques for Monitoring RF Pollution</td>
<td>Robin Getz – Analog Devices, Inc.</td>
</tr>
<tr>
<td>13:30 - 13:45</td>
<td>Noise Figure Measurements for Multiport Applications</td>
<td>Volker Herrmann – Rohde &amp; Schwarz USA, Inc.</td>
</tr>
<tr>
<td>13:45 - 14:00</td>
<td>Applications for 110GHz Load Pull and Noise Parameter Extraction</td>
<td>Vince Mallette – Focus Microwaves Inc.</td>
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<tr>
<td>14:00 - 14:15</td>
<td>Demystifying Phase Coherent Signal Generation</td>
<td>Mathieu Caillet – Rohde &amp; Schwarz USA, Inc.</td>
</tr>
<tr>
<td>14:15 - 14:30</td>
<td>A Survey of OTA Test Solutions and How to Optimize for Your Application</td>
<td>Jay Banwait – National Instruments</td>
</tr>
<tr>
<td>14:30 - 14:45</td>
<td>Advanced Techniques for Spurious Search in RF and Microwave Devices</td>
<td>Kay-Uwe Sander – Rohde &amp; Schwarz USA, Inc.</td>
</tr>
<tr>
<td>14:45 - 15:00</td>
<td>Simplify High Channel-Count Systems Through Integrated RF Sampling Transceiver IC</td>
<td>Kang Hsia, Russell Hoppenstein – Texas Instruments</td>
</tr>
<tr>
<td>15:00 - 15:15</td>
<td>A New Way of Thinking About High Power Microwave System Design Using Solid State Microwave Generators</td>
<td>John Mastela – Richardson Electronics</td>
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<tr>
<td>15:15 - 15:30</td>
<td>The Benefits, Challenges, and Implementation of Translation Loop PLLs</td>
<td>Ian Collins – Analog Devices International</td>
</tr>
<tr>
<td>15:30 - 15:45</td>
<td>Waveguide Tunable Filter with Constant Bandwidth</td>
<td>Shunxi Jiang, Shi Yin – Pivotone Communication</td>
</tr>
<tr>
<td>15:45 – 16:00</td>
<td>Application of a 40 GHz Contiguous Sextuplexer to Efficiently Combine or Divide Multiple Signals</td>
<td>Hermanus Swanepoel – Plexsa Manufacturing</td>
</tr>
<tr>
<td>16:00 – 16:15</td>
<td>Simple, Space Saving Methods to Manage Microwave Local Oscillator (LO) Harmonics</td>
<td>Marty Richardson – Analog Devices, Inc.</td>
</tr>
<tr>
<td>16:15 – 16:30</td>
<td>TFLE-Thin Film Lumped Elements LC Filters</td>
<td>Rafi Hershtig – K&amp;L Microwave</td>
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<tr>
<td>16:30 – 16:45</td>
<td>Aluminum Nitride vs. Beryllium Oxide for High Power Resistor Products</td>
<td>Ken Peters – Smiths Interconnect (Former RF Labs)</td>
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<tr>
<td>16:45 – 17:00</td>
<td>IEEE MTT-S How to Write a Paper for IMS or Transactions</td>
<td>Michael Steer – IEEE-MTT-S</td>
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<tr>
<td>Time</td>
<td>Session Title</td>
<td>Speaker/Institution</td>
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</tr>
<tr>
<td>09:45 - 10:00</td>
<td>Integrated DAC and Buffer Amp Addresses the 5G Bandwidth Challenge for Instrumentation</td>
<td>Tom Spargo, Randy Oltman – Analog Devices, Inc.</td>
</tr>
<tr>
<td>10:00 - 10:15</td>
<td>Overview of the 5G New Radio Physical Layer</td>
<td>David Hall – National Instruments</td>
</tr>
<tr>
<td>10:15 - 10:30</td>
<td>Fundamentals of Frequency Multiplication</td>
<td>Doug Jorgesen – Marki Microwave</td>
</tr>
<tr>
<td>10:30 - 10:45</td>
<td>Simulating Throughput as a 5G Device Design Metric</td>
<td>Jeff Barney, Ryan Ohs – Remcom</td>
</tr>
<tr>
<td>10:45 - 11:00</td>
<td>Advanced Methods to Analyze Ultra Wideband Automotive Radar Signals</td>
<td>Laura Sanchez – Rohde &amp; Schwarz USA, Inc.</td>
</tr>
<tr>
<td>11:00 - 11:15</td>
<td>The Impact of PTH Via’s on PCB RF Performance</td>
<td>John Coonrod – Rogers Corp.</td>
</tr>
<tr>
<td>11:30 - 11:45</td>
<td>PCIe Gen4 - Gen5 – How to Measure the Real Jitter Performance of a SSC Clock</td>
<td>Martin Stumpf – Rohde &amp; Schwarz USA, Inc.</td>
</tr>
<tr>
<td>11:45 - 12:00</td>
<td>Reducing SWaP + C (a Focus on DC Power)</td>
<td>Misha Pierre-Mike – Evans Capacitor Company</td>
</tr>
<tr>
<td>12:00 - 12:15</td>
<td>Design of 1.0 mm Edge Launch Connectors and Board Laminate Formulation for 110 GHz Applications</td>
<td>Eric Gebhard – Signal Microwave</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Svetlana Sejas Garcia – Isola</td>
</tr>
<tr>
<td>12:15 - 12:30</td>
<td>Testing Multi Antenna GPS Systems</td>
<td>Lawrence Wilson – Rohde &amp; Schwarz</td>
</tr>
<tr>
<td>12:30 - 12:45</td>
<td>Highly Linear Microwave Mixers</td>
<td>Christopher Marki – Marki Microwave</td>
</tr>
<tr>
<td>12:45 - 13:00</td>
<td>Settling Time Measurements on Wideband Frequency Hopping Signals Used in RADAR and Communication Systems</td>
<td>Kay-Uwe Sander – Rohde &amp; Schwarz USA, Inc.</td>
</tr>
<tr>
<td>13:00 - 13:15</td>
<td>Advanced Front-End Module Test Including Wide Band Impedance Control</td>
<td>Vince Mallette – Focus Microwaves Inc.</td>
</tr>
<tr>
<td>13:30 - 13:45</td>
<td>Measurement Setup for Pulse to Pulse Phase Stability for RADAR Applications</td>
<td>Wolfgang Wendler – Rohde &amp; Schwarz USA, Inc.</td>
</tr>
<tr>
<td>13:45 - 14:00</td>
<td>Highly Agile Wideband RF Transceiver: 100MHz to 6GHz, High Performance, Fast Hopping, Synchronized 2 Transmitter, 2 Receiver, and Observation Receiver in a 12mm x 12mm Footprint</td>
<td>Larry Hawkins – Analog Devices, Inc.</td>
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</table>
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.

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  1 MHz - 18 GHz

- **Switches**
  (SP2T to SP20T)
  1 MHz - 18 GHz

- **TX-RX Assemblies**
  1 MHz - 8 GHz

- **Filters**
  1 MHz - 26 GHz

- **Amplifiers**
  (Power Amplifiers + LNA’s)
  1 MHz - 18 GHz

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- **UAV**
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- **Guidance & Navigation**
- **Communications**
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