2019 IEEE International Symposium on
Antennas and Propagation
and
USNC-URSI National Radio Science Meeting

Final Program

7–12 July 2019
Hilton Atlanta
Atlanta, Georgia, U.S.A.
Conference at a Glance

Saturday, July 6
14:00-16:00 Strategic Planning Committee
16:15-17:15 APS Meetings Committee
17:15-18:15 JMC Meeting (Closed Session)
18:15-21:15 JMC Meeting, Dinner and Presentations
19:15-21:15 IEEE AP-S Constitution and Bylaws Committee Meeting & Dinner

Sunday, July 7
08:00-10:00 Past Presidents’ Breakfast
10:00-18:00 AdCom Meeting
19:30-22:00 Welcome Dessert Reception at the Georgia Aquarium

Monday, July 8
07:00-08:00 Amateur Radio Operators Breakfast
07:00-08:00 APS 2020 Committee Meeting
07:00-08:00 Industrial Initiatives
07:00-08:00 Membership Committee Meeting
07:00-08:00 Student Design Contest (Set-Up - Closed to Others)
07:00-08:00 Technical Committee on Antenna Measurement
08:00-11:40 Student Paper Competition
08:00-11:40 Technical Sessions
08:00-09:30 Student Design Contest (Demo for Judges - Closed to Others)
08:30-14:00 Standards Committee Meeting
09:30-12:00 Student Design Contest (Demo for Public)
09:40-11:00 Student Design Contest Judges Meeting
12:00-13:20 Distinguished Lecturer Lunch
12:00-13:15 Women in Engineering – Lunch and Speaker, Dawn Tilbury
12:00-13:00 Student Design Contest (Luncheon for Judges and Teams)
12:00-13:00 Young Professionals’ Committee Meeting
13:20-17:00 Technical Sessions
16:00-18:00 Interactive Forum Sessions
16:00-17:00 Future Symposia Meeting
18:45-22:00 Students and Young Professionals Experience “The Coke Side of Life” at the World of Coca Cola

Tuesday, July 9
07:00-08:00 Student Paper Competition Judges Committee Breakfast
07:00-08:00 Technical Committee On Antenna Measurements
07:30-09:30 Publications Committee Breakfast Meeting
08:00-11:40 A Discussion on the State of CEM Research: Reflections and Outlooks
08:00-11:40 Technical Sessions
09:00-13:00 Student Tour - NSI-MI Facility and Testing Chambers
10:00-11:40 Antennas for 5G and Future Networks: Perspectives and Opinions from Industry and Academia
12:00-13:20 Reviewers’ Lunch
13:00-16:00 FCC Amateur Radio License Exam
13:20-17:00 Technical Sessions
17:00-18:00 URSI Commission F Business Meeting
17:00-18:00 URSI Commission K Business Meeting
18:00-19:15 Awards Presentation
19:30-22:30 Celebratory Dinner

Wednesday, July 10
07:00-08:00 Student Paper Competition Judges Committee Breakfast
07:00-08:00 Technical Committee On Antenna Measurements
07:30-09:30 Publications Committee Breakfast Meeting
08:00-11:40 A Discussion on the State of CEM Research: Reflections and Outlooks
08:00-11:40 Technical Sessions
09:00-13:00 Student Tour - NSI-MI Facility and Testing Chambers
10:00-11:40 Antennas for 5G and Future Networks: Perspectives and Opinions from Industry and Academia
12:00-13:20 Reviewers’ Lunch
13:00-16:00 FCC Amateur Radio License Exam
13:20-17:00 Technical Sessions
17:00-18:00 URSI Commission F Business Meeting
17:00-18:00 URSI Commission K Business Meeting
18:00-19:15 Awards Presentation
19:30-22:30 Celebratory Dinner

Thursday, July 11
06:45-07:45 APS History Committee
08:00-11:40 Technical Sessions
08:00-09:00 Exhibitor Breakfast in Exhibit Hall
09:00-18:00 Technical Tour - “An Engineer’s Eye View” of the Mercedes Benz Stadium
12:00-15:00 Chapter Activities Committee Luncheon
12:00-13:20 AWPL Editors’ Lunch Meeting
12:00-13:20 Education Committee
12:00-13:20 IEEE Press Liaison Meeting & Lunch
13:00-16:00 FCC Amateur Radio License Exam
13:20-17:00 Technical Sessions
16:00-18:00 Interactive Forum Sessions
18:30-21:00 MGA/NTDC/SIGHT Dinner Meeting
19:00-22:00 USNC-URSI Strategic Planning Meeting

Friday, July 12
08:00-11:40 Technical Sessions
13:20-17:00 Technical Sessions
Welcome to the 2019 IEEE International Symposium on Antennas and Propagation and USNC-URSI Radio Science Meeting!

This year’s combined symposium and meeting event are being held in Atlanta, Georgia at the Hilton Atlanta Hotel located in the heart of the city and within walking distance to several local attractions, restaurants and venues. The Hilton is easily accessible via MARTA from Hartsfield-Jackson International Airport and a covered pedestrian sky-bridge connects the hotel to the MARTA station and the Peachtree Center Mall. Nearby attractions include the Center for Civil and Human Rights, the Centennial Olympic Park, the Georgia Aquarium, the World of Coca-Cola, the College Football Hall of Fame, the Martin Luther King Jr. National Historic Site and the CNN Center. A short cab ride from the hotel are the vibrant neighborhoods of Midtown, Virginia Highlands and Buckhead, with fine dining, shopping, museums and cultural events taking place every summer.

Atlanta is a city rich in history and robust with heritage. From its role in the American Civil War and Sherman’s destructive march through Atlanta streets, Georgia’s capital has been a place wrought with history-making events. Later, as Martin Luther King, Jr. made Atlanta the home of the Civil Rights Movement, this hub of the Southeast once again took center stage in events that would alter the course of history.

Today Atlanta is a thriving metropolis with Southern charm and world-class sophistication. Atlanta is also home to many professional sports teams including the Atlanta Braves baseball team, the Atlanta Falcons football team, the Atlanta Hawks basketball team and the Atlanta United soccer team. Both the Braves and Atlanta United have home games during the July symposium. Technical tours for Mercedes Benz Stadium are being scheduled, too!

This year’s technical program includes a wide range of technical sessions, workshops, and short courses, as well as numerous exhibits. It also has a number of activities dedicated specifically to students and young professionals.

This event is the premier international forum for the exchange of ideas on state-of-the-art research in antennas and propagation and radio science. Through a range of technical and social activities, it provides the opportunity to interact with the world’s leading experts in antennas and propagation and radio science from academia, industry, and government.

We welcome you to join us for an exciting program in Atlanta in July 2019!

General Co-Chairs
John Papapolymerou
Michigan State University

Manos Tentzeris
Georgia Institute of Technology
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<tr>
<th>Location</th>
<th>Morning</th>
<th>Afternoon</th>
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<tr>
<td>Ballroom C</td>
<td>MO-SP.1A: Low-Cost Phased Array Technology</td>
<td>MO-SP.1P: Application of Machine/Deep Learning and Uncertainty Quantification Techniques in Computational Electromagnetics</td>
</tr>
<tr>
<td>Ballroom D</td>
<td>MO-SP.2A: Emerging Technologies for Biomedical Applications</td>
<td>MO-SP.2P: Space-Time Modulated Metamaterials</td>
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<tr>
<td>Ballroom A</td>
<td>MO-UB.1A: Metamaterials</td>
<td>MO-A1.1P: Broadband Antennas</td>
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<tr>
<td>Ballroom B</td>
<td>MO-A5.1A: Antennas for 5G I</td>
<td>MO-A5.1P: Antennas for 5G II</td>
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<tr>
<td>Room 209/210</td>
<td>MO-A5.2A: Additively Manufactured Antennas and Structures</td>
<td>MO-A1.4P: Slot Antennas</td>
</tr>
<tr>
<td>Room 213/214</td>
<td>MO-A2.1A: Electromagnetic Measurements and Material Characterization I</td>
<td>MO-A2.1P: Electromagnetic Measurements and Material Characterization II</td>
</tr>
<tr>
<td>Room 203</td>
<td>MO-A5.3A: Millimeter-wave and Terahertz Antenna Design and Optimization</td>
<td>MO-UB.1P: THz, Millimeter-Wave and Nanoscale EM</td>
</tr>
<tr>
<td>Room 302</td>
<td>MO-A1.3A: Leaky-Wave and Travelling-Wave Antennas</td>
<td>MO-UB.2P: Antenna Array I</td>
</tr>
<tr>
<td>Room 303</td>
<td>MO-A1.4A: Broadband Antennas for 5G systems</td>
<td>MO-A2.2A: Analysis of Metamaterials and Metasurfaces</td>
</tr>
<tr>
<td>Room 304</td>
<td>MO-A4.1A: Remote Sensing</td>
<td>MO-A5.3P: Biomedical Applications of Electromagnetics I</td>
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<tr>
<td>Room 305</td>
<td>MO-A3.1A: Transient Simulations</td>
<td>MO-UB.3P: Time-Domain Methods</td>
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<tr>
<td>Room 211</td>
<td>MO-UB.2A: Frequency Selective Surfaces and Filters</td>
<td>MO-A1.5A: Spiral Antennas</td>
</tr>
<tr>
<td>Room 212</td>
<td>MO-UB.3A: Antenna Theory and Design I</td>
<td>MO-UB.5P: Antenna Theory and Design II</td>
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MO-UB.6P: Antenna Theory and Arrays
## Sessions at a Glance — Tuesday

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<th>Location</th>
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<tbody>
<tr>
<td>Ballroom C</td>
<td>TU-SP.1A: Memorial Session for Dr. R. C. Hansen</td>
<td>TU-SP.1P: Cybersecurity and Electromagnetic Systems: From DC to Daylight and from Wireless to Wired</td>
</tr>
<tr>
<td>Ballroom A</td>
<td>TU-UB.1A: Cognitive Radio I</td>
<td>TU-A5.1P: RFID Systems and Applications</td>
</tr>
<tr>
<td>Ballroom B</td>
<td>TU-A5.1A: 5G MIMO Antenna Technology</td>
<td>TU-A5.2P: Millimeter-wave Antennas</td>
</tr>
<tr>
<td>Room 204/205</td>
<td>TU-A2.1A: Metasurfaces for Beam Shaping</td>
<td>TU-UB.1P: Wireless Communications</td>
</tr>
<tr>
<td>Room 209/210</td>
<td>TU-A1.2A: Reflector Designs and Applications</td>
<td>TU-A5.3P: Recent Advances in 4G and 5G Antennas for Mobile Devices</td>
</tr>
<tr>
<td>Room 213/214</td>
<td>TU-A2.2A: Theoretical Electromagnetics I</td>
<td>TU-A2.1P: Frequency Selective Surfaces: Applications</td>
</tr>
<tr>
<td>Room 302</td>
<td>TU-UB.2A: Antenna Array II</td>
<td>TU-UB.2P: Antenna Array III</td>
</tr>
<tr>
<td>Room 303</td>
<td>TU-A5.3A: Biomedical Applications of Electromagnetics II</td>
<td>TU-A5.4P: Biomedical applications of Electromagnetics III</td>
</tr>
<tr>
<td>Room 304</td>
<td>TU-A3.1A: Hybrid Methods I</td>
<td>TU-UB.3A: Hybrid Methods II</td>
</tr>
<tr>
<td>Room 305</td>
<td>TU-A3.2A: Computational Methods for Coupling and Scattering</td>
<td>TU-A3.1P: Finite Element Methods</td>
</tr>
<tr>
<td>Room 211</td>
<td>TU-A2.3A: THz and Optical Metamaterials</td>
<td>TU-A5.4A: Additively Manufactured Antennas</td>
</tr>
<tr>
<td>Room 212</td>
<td>TU-A4.1A: Imaging and Scatterer Characterization</td>
<td>TU-A4.1P: Imaging Methods and Systems</td>
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### INTERACTIVE FORUM — TUESDAY

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<tr>
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<th>Afternoon</th>
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<tbody>
<tr>
<td>Boards 1-5</td>
<td>TUP-A4.1P: Millimeter-wave Propagation</td>
</tr>
<tr>
<td>Boards 6-15</td>
<td>TUP-A4.2P: Propagation and Scattering in Complex and Random Media</td>
</tr>
<tr>
<td>Boards 16-19</td>
<td>TUP-A4.3P: Propagation in Tunnel-like Environments</td>
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<tr>
<td>Boards 21-30</td>
<td>TUP-A4.4P: Wave Propagation in Atmospheric Environment</td>
</tr>
<tr>
<td>Boards 31-35</td>
<td>TUP-A4.5P: Wave Propagation in Indoor Environment</td>
</tr>
<tr>
<td>Boards 36-46</td>
<td>TUP-A4.6P: Wave Propagation in Urban and Suburban Environments</td>
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**Tuesday, July 9, Salon West**
<table>
<thead>
<tr>
<th>Location</th>
<th>Morning</th>
<th>Afternoon</th>
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<tbody>
<tr>
<td>Ballroom C</td>
<td>WE-SP.1A: Optically Transparent Antennas</td>
<td>WE-SP.1P: Time-Domain Computational Methods for Complex Electromagnetic and Multiphysics Problems</td>
</tr>
<tr>
<td>Ballroom D</td>
<td>WE-A1.1A: Broadband/Ultra Wideband Antennas and Systems I</td>
<td>WE-SP.2P: Design and Integration Aspects of Beyond 5G Communications for Mobile Devices</td>
</tr>
<tr>
<td>Room 204/205</td>
<td>WE-A1.4A: Frequency Reconfigurable and Tunable Antennas</td>
<td>WE-A1.3P: Multi-band Antennas II</td>
</tr>
<tr>
<td>Room 206/207</td>
<td>WE-A1.5A: Vehicular Antennas and Electromagnetics</td>
<td>WE-A1.4P: Reconfigurable Arrays</td>
</tr>
<tr>
<td>Room 209/210</td>
<td>WE-A2.1A: Wide- and Dual-Band Frequency Selective Surfaces</td>
<td>WE-A5.1P: Electromagnetic Energy Harvesting</td>
</tr>
<tr>
<td>Room 213/214</td>
<td>WE-A2.2A: IoT, 5G and mm-Wave Antennas and Components</td>
<td>WE-A2.1P: Electromagnetic Band Gap Structures</td>
</tr>
<tr>
<td>Room 203</td>
<td>WE-A3.1A: Optimization methods in EM designs</td>
<td>WE-A2.2P: Metasurfaces and Transmit/Reflect Arrays</td>
</tr>
<tr>
<td>Room 302</td>
<td>WE-A3.1A: Optimization methods in EM designs</td>
<td>WE-A1.5P: Broadband Arrays</td>
</tr>
<tr>
<td>Room 303</td>
<td>WE-A5.2A: Biomedical Applications of Antennas</td>
<td>WE-UK.1P: Implantable and Ingestible Devices</td>
</tr>
<tr>
<td>Room 304</td>
<td>WE-A4.1A: Methods of Inverse Scattering</td>
<td>WE-UK.2P: Biomedical Applications</td>
</tr>
<tr>
<td>Room 305</td>
<td>WE-A5.2A: Biomedical Applications of Antennas</td>
<td>WE-UB.1P: Fast Methods</td>
</tr>
<tr>
<td>Room 211</td>
<td>WE-UB.1A: MIMO Antennas and Systems</td>
<td>WE-UB.1P: Fast Methods</td>
</tr>
<tr>
<td>Room 212</td>
<td>WE-UB.3A: Microstrip Antennas and Printed Devices</td>
<td>WE-UF.1P: Point-to-Point Propagation Effects</td>
</tr>
<tr>
<td></td>
<td>WE-A2.2A: Theoretical Electromagnetics II</td>
<td>WE-A1.6P: Antenna Feeds and Matching Circuits III</td>
</tr>
<tr>
<td></td>
<td>WE-A1.6P: Antenna Feeds and Matching Circuits III</td>
<td>WE-UE.1P: Interference and Environmental Effects</td>
</tr>
<tr>
<td>Location</td>
<td>Morning</td>
<td>Afternoon</td>
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<tr>
<td>Ballroom C</td>
<td>TH-SP.1A: Advanced DGTD and FVTD Methods</td>
<td>TH-SP.1P: Innovative Reconfigurable and Multifunction Antenna Arrays</td>
</tr>
<tr>
<td>Ballroom B</td>
<td>TH-A2.1A: Nanoelectromagnetics</td>
<td>TH-A1.2P: Antennas for 5G and Wireless Applications</td>
</tr>
<tr>
<td>Room 204/205</td>
<td>TH-A2.2A: Cloaking/RCS Reduction and Absorption</td>
<td>TH-A1.3P: Electrically Small Antennas</td>
</tr>
<tr>
<td>Room 209/210</td>
<td>TH-A1.3A: Adaptive, Active and smart antennas</td>
<td>TH-A5.2P: Advances in Radar, Massive and Multiuser MIMO Antenna Systems</td>
</tr>
<tr>
<td>Room 213/214</td>
<td>TH-A1.4A: Antennas from Tesla to Today</td>
<td>TH-A2.1P: Metastructures for Antennas</td>
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<tr>
<td>Room 203</td>
<td>TH-A2.3A: Topics in Metamaterials and Metasurfaces</td>
<td>TH-A2.2P: Space-Time and Tunable Metastructures</td>
</tr>
<tr>
<td>Room 302</td>
<td>TH-A1.5A: Slot Arrays I</td>
<td>TH-UB.1P: EM Interaction and Coupling</td>
</tr>
<tr>
<td>Room 303</td>
<td>TH-UA.1A: Bioeffects and medical applications</td>
<td>TH-UK.1A: Human-body Interactions with Antennas and other Electromagnetic Devices</td>
</tr>
<tr>
<td>Room 305</td>
<td>TH-A3.1A: Integral Equation Methods II</td>
<td>TH-A3.3P: Integral Equation Methods III</td>
</tr>
<tr>
<td>Room 211</td>
<td>TH-UB.1A: Theoretical Electromagnetics III</td>
<td>TH-UB.2A: Guided Wave and Waveguiding Structures</td>
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**INTERACTIVE FORUM – THURSDAY**

<table>
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<tr>
<th>Location</th>
<th>Afternoon</th>
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<tbody>
<tr>
<td>Boards 1-9</td>
<td>THP-A1.1P: Antenna Theory I</td>
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<tr>
<td>Boards 11-20</td>
<td>THP-A1.2P: Antenna Theory II</td>
</tr>
<tr>
<td>Boards 21-29</td>
<td>THP-A1.3P: Antennas in Theory and Practice</td>
</tr>
<tr>
<td>Boards 31-38</td>
<td>THP-UF.1P: Microwave Remote Sensing</td>
</tr>
<tr>
<td>Boards 41-50</td>
<td>THP-UF.2P: Propagation and Remote Sensing in Complex and Random Media</td>
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Thursday, July 11, Salon West
<table>
<thead>
<tr>
<th>Location</th>
<th>Morning</th>
<th>Afternoon</th>
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<tbody>
<tr>
<td>Ballroom C</td>
<td>FR-SP.1A: Recent Advances in Multi-Material Additive Manufacturing for Antennas and Microwave Devices</td>
<td>FR-SP.1P: UWB Antenna Technologies for Radar</td>
</tr>
<tr>
<td>Ballroom D</td>
<td>FR-SP.2A: Antenna Innovations and Open Challenges for Small Satellites and CubeSats</td>
<td>FR-SP.2P: Topological Electromagnetics</td>
</tr>
<tr>
<td>Room 204/205</td>
<td>FR-A1.2A: Mutual Coupling in Antenna Arrays</td>
<td>FR-A2.1P: Novel Metasurfaces and Applications</td>
</tr>
<tr>
<td>Room 206/207</td>
<td>FR-A5.2A: Elements and Arrays for Sensing and Measurement</td>
<td>FR-A5.1P: 3D Printed Antennas and Structures</td>
</tr>
<tr>
<td>Room 213/214</td>
<td>FR-A2.1A: Design of Metamaterials and Metasurfaces</td>
<td>FR-A2.2P: Tunable and Reconfigurable Frequency Selective Surfaces</td>
</tr>
<tr>
<td>Room 203</td>
<td>FR-UA.1A: Antennas</td>
<td>FR-A5.2P: Sub-6 GHz MIMO Antenna Design</td>
</tr>
<tr>
<td>Room 302</td>
<td>FR-A5.4A: Cognitive Radio II</td>
<td>FR-A5.5A: On-Chip Antennas</td>
</tr>
<tr>
<td>Room 303</td>
<td>FR-A5.6A: Chamber Technology for MIMO Antenna Measurements</td>
<td>FR-A5.7A: Antennas for RFID applications</td>
</tr>
<tr>
<td>Room 304</td>
<td>FR-UC.1A: Target Detection and Tracking</td>
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<tr>
<td>Room 305</td>
<td>FR-A3.1A: Computational Electromagnetics II</td>
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<tr>
<td>Room 211</td>
<td>FR-A1.3A: Microstrip Antenna Arrays II</td>
<td>FR-A1.5P: Slot Arrays II</td>
</tr>
<tr>
<td>Room 212</td>
<td>FR-UB.1A: Imaging, Scattering and Remote Sensing</td>
<td>FR-A1.6P: Array Hardware Systems</td>
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**Registration**

The on-site Registration Desk is located on the **Lobby Level across from the Marketplace**. The Registration Desk may be reached by phone at 817-554-5378 during the regular operating hours shown below.

Registration will be open during the following hours:
- Sunday, July 7 ....................... 07:00 – 18:30 (Badge pick-up only: 18:30–20:30)
- Monday, July 8 ....................... 07:00 – 17:00
- Tuesday, July 9 ....................... 07:00 – 18:00
- Wednesday, July 10 ............... 07:00 – 18:00
- Thursday, July 11 .................. 07:30 – 18:00
- Friday, July 12 ...................... 07:30 – 17:00

**Devotions**

Room 301 is available for Devotions from 07:00–08:00 Monday, July 8 through Friday, July 12.

**Speaker Preparation Room**

Room 311 is the Speaker Preparation Room and is available from 08:00–17:00 daily Monday, July 8–Friday, July 12. The room contains a computer identical to those used in the presentation rooms. The speakers may use this room and equipment to test presentations prior to the scheduled presentation.

**Internet Access**

Wireless internet access (Wi-fi) is provided to all participants throughout the meeting space and lobby areas at the Hilton Atlanta. Attendees can connect to the **APS 2019** network. The access password is **ieeeaps2019**.

If you are staying at the Hilton Atlanta, please note that the complimentary access from your guest room will be different, and you should follow the instructions noted there.

**Morning and Afternoon Refreshment Break Locations**

Please note on Monday, July 8 and Friday, July 12, morning and afternoon breaks (at 09:40 and 15:00 respectively) will be held on **Level 2 in the Grand Ballroom and Salon Foyers**. Tuesday – Thursday, July 9 – 11, the breaks will be held in the **Salon East on the Exhibit Hall show floor**. Remember, too, that on Tuesday and Thursday, beginning at 16:00, there will be Poster Session Receptions in **Salon West**.
# Meeting and Event Schedule

## Saturday, July 6

<table>
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<tr>
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<tbody>
<tr>
<td>14:00-16:00</td>
<td>Strategic Planning Committee</td>
<td>Room 214</td>
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<tr>
<td>16:15-17:15</td>
<td>AP-S Meetings Committee</td>
<td>Salon East</td>
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<tr>
<td>17:15-18:15</td>
<td>JMC Meeting (Closed Session)</td>
<td>Salon East</td>
</tr>
<tr>
<td>18:15-21:30</td>
<td>JMC Meeting, Dinner and Presentations</td>
<td>Salon East</td>
</tr>
<tr>
<td>19:15-21:15</td>
<td>IEEE AP-S Constitution and Bylaws Committee Meeting &amp; Dinner</td>
<td>Room 214</td>
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## Sunday, July 7

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<td>Past Presidents’ Breakfast</td>
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<tr>
<td>10:00-18:00</td>
<td>AdCom Meeting</td>
<td>Salon East</td>
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<tr>
<td>19:30-22:00</td>
<td>Welcome Reception</td>
<td>Georgia Aquarium</td>
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## Monday, July 8

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<tbody>
<tr>
<td>07:00-08:00</td>
<td>Amateur Radio Operators Breakfast</td>
<td>Crystal Ballroom A</td>
</tr>
<tr>
<td>09:00-18:00</td>
<td>Technical Tour: “An Engineer’s Eye View” of the Mercedes Benz Stadium</td>
<td>Depart from Hilton Atlanta</td>
</tr>
<tr>
<td>12:00-13:20</td>
<td>Transactions on Antennas and Propagation Editorial Board Lunch Meeting</td>
<td>Crystal Ballroom A/F</td>
</tr>
<tr>
<td>17:00-18:00</td>
<td>URSI Commission A Business Meeting</td>
<td>Room 211</td>
</tr>
<tr>
<td>17:18-19:00</td>
<td>URSI Commission B Business Meeting</td>
<td>Room 212</td>
</tr>
<tr>
<td>17:18-19:00</td>
<td>URSI Commissions C/E (combined) Business Meeting</td>
<td>Room 209/210</td>
</tr>
</tbody>
</table>

## Tuesday, July 9

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>07:00-08:00</td>
<td>APS 2020 Committee Meeting</td>
<td>Crystal Ballroom C</td>
</tr>
<tr>
<td>07:00-08:00</td>
<td>AP Magazine Staff Meeting</td>
<td>Crystal Ballroom A</td>
</tr>
<tr>
<td>07:00-08:00</td>
<td>Industrial Initiatives</td>
<td>Crystal Ballroom B</td>
</tr>
<tr>
<td>07:00-08:00</td>
<td>Technical Committee on Antenna Measurement</td>
<td>Room 312</td>
</tr>
<tr>
<td>07:00-08:00</td>
<td>Membership Committee Meeting</td>
<td>Room 306</td>
</tr>
<tr>
<td>07:00-08:00</td>
<td>Student Design Contest (Set-Up - Closed to Others)</td>
<td>Level 2 Foyer</td>
</tr>
<tr>
<td>08:00-11:40</td>
<td>Student Paper Competition</td>
<td>Level 2 Foyer</td>
</tr>
<tr>
<td>08:00-09:30</td>
<td>Student Design Contest (Demo for Judges - Closed to Others)</td>
<td>Level 2 Foyer</td>
</tr>
<tr>
<td>08:30-14:00</td>
<td>Standards Committee Meeting</td>
<td>Room 307</td>
</tr>
<tr>
<td>09:00-12:00</td>
<td>Student Design Contest (Demo for Public)</td>
<td>Level 2 Foyer</td>
</tr>
<tr>
<td>09:40-11:00</td>
<td>Student Design Contest Judges Meeting</td>
<td>Room 306</td>
</tr>
<tr>
<td>12:00-13:20</td>
<td>Distinguished Lecturer Lunch</td>
<td>Room 301</td>
</tr>
<tr>
<td>12:00-13:15</td>
<td>Women in Engineering - Lunch and Speaker, Dawn Tilbury</td>
<td>Crystal Ballroom A/F</td>
</tr>
<tr>
<td>12:00-13:00</td>
<td>Student Design Contest (Luncheon for Judges and Teams)</td>
<td>Crystal Ballroom B</td>
</tr>
<tr>
<td>12:00-13:00</td>
<td>Young Professionals’ Committee Meeting</td>
<td>Crystal Ballroom C</td>
</tr>
<tr>
<td>16:00-17:00</td>
<td>Future Symposia Meeting</td>
<td>Crystal Ballroom C</td>
</tr>
<tr>
<td>18:45-22:00</td>
<td>Students and Young Professionals Experience &quot;The Coke Side of Life&quot;</td>
<td>World of Coca-Cola</td>
</tr>
</tbody>
</table>

## Wednesday, July 10

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>07:00-08:00</td>
<td>Student Paper Competition Judges Committee Breakfast</td>
<td>Crystal Ballroom A</td>
</tr>
<tr>
<td>07:00-08:00</td>
<td>Technical Committee On Antenna Measurements</td>
<td>Room 312</td>
</tr>
<tr>
<td>07:30-09:30</td>
<td>Publications Committee Breakfast Meeting</td>
<td>Crystal Ballroom C</td>
</tr>
<tr>
<td>08:00-11:40</td>
<td>Special Session Panel: A Discussion on the State of CEM Research</td>
<td>Grand Ballroom C</td>
</tr>
<tr>
<td>09:00-13:00</td>
<td>Student Tour - NSI/MI Facility and Testing Chambers</td>
<td>Depart from Hilton Atlanta</td>
</tr>
<tr>
<td>10:00-11:40</td>
<td>Special Session Panel: Antennas for 5G and Future Networks</td>
<td>Grand Ballroom D</td>
</tr>
<tr>
<td>12:00-13:20</td>
<td>Reviewers’ Lunch</td>
<td>Salon West</td>
</tr>
<tr>
<td>13:00-16:00</td>
<td>FCC Amateur Radio License Exam</td>
<td>Room 208</td>
</tr>
<tr>
<td>17:00-18:00</td>
<td>URSI Commission F Business Meeting</td>
<td>Room 211</td>
</tr>
<tr>
<td>17:00-18:00</td>
<td>URSI Commission K Business Meeting</td>
<td>Room 212</td>
</tr>
<tr>
<td>18:00-19:15</td>
<td>Awards Presentation</td>
<td>Grand Ballroom A-D</td>
</tr>
<tr>
<td>19:30-22:30</td>
<td>Celebratory Dinner</td>
<td>Salon West</td>
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## Thursday, July 11

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>06:45-07:45</td>
<td>APS History Committee</td>
<td>Crystal Ballroom C</td>
</tr>
<tr>
<td>08:00-09:00</td>
<td>Exhibitor Breakfast in Exhibit Hall</td>
<td>Salon East</td>
</tr>
<tr>
<td>09:00-18:00</td>
<td>Technical Tour - &quot;An Engineer’s Eye View&quot; of the Mercedes Benz Stadium</td>
<td>Depart from Hilton Atlanta</td>
</tr>
<tr>
<td>12:00-15:00</td>
<td>Chapter Activities Committee Luncheon</td>
<td>Crystal Ballroom A/F</td>
</tr>
<tr>
<td>12:00-13:20</td>
<td>AWPL Editors’ Lunch Meeting</td>
<td>Crystal Ballroom C</td>
</tr>
<tr>
<td>12:00-13:20</td>
<td>IEEE Press Liaison Meeting &amp; Lunch</td>
<td>Room 301</td>
</tr>
<tr>
<td>12:00-13:20</td>
<td>Education Committee</td>
<td>Crystal Ballroom B</td>
</tr>
<tr>
<td>13:00-16:00</td>
<td>FCC Amateur Radio License Exam</td>
<td>Room 208</td>
</tr>
<tr>
<td>18:30-21:00</td>
<td>MGA/NTDC/SIGHT Dinner Meeting</td>
<td>Crystal Ballroom A/F</td>
</tr>
<tr>
<td>19:00-22:00</td>
<td>USNC-URSI Strategic Planning Meeting</td>
<td>Room 301</td>
</tr>
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</table>
Special Session Panels

A Discussion on the State of CEM Research: Reflections and Outlooks

Wednesday, July 10, 08:00 - 11:40, Grand Ballroom C

Organizers & Discussion Moderators
Prof. Balasubramaniam Shanker (Michigan State University, US) and Prof. Marinos Vouvakis (University of Massachusetts Amherst, US)

Format
Two five-member round tables with discussion moderators

Topic
This special session will delve into a vigorous discussion on the current state of computational electromagnetics (CEM) research but also attempt to flesh-out potential research directions and opportunities in the area. We aim to foster a discussion on what new CEM capabilities are necessary to tackle emerging engineering or scientific applications and shed light on limitations of current state of art as we (as a society) grapple with increasingly rich electromagnetic environments.

We have invited a diverse group of world-renowned researchers, some of whom are CEM visionaries, accomplished EM developers, as well as leaders in cutting-edge and emerging engineering design disciplines that make use or will need advanced computational capabilities. The discussions will be organized into two round table, one before coffee break and one after that.

In addition to addressing questions posed by the moderators, the round tables will devote significant time in addressing questions from the audience.

Round Table 1 (first half of the session)
Prof. W.-C. Chew (Purdue University, US)
Prof. E. Michielssen (University of Michigan, US)
Dr. D Dault (US Air Force Research Lab, CREATE RF Group, US)
Prof. S. Maci (University of Siena, Italy)
Prof. M. Swaminathan (Georgia Institute of Technology, US)

Round Table 2 (second half of the session)
Prof. J.-F. Lee (The Ohio State University, US)
Prof. J. M. Jin (University of Illinois Urbana-Champaign, US)
Prof. Y. Rahmat-Samii (University of California Los Angeles, US)
Prof. C. Caloz (Ecole Polytechnic Montreal, Canada)
Prof. A. Neto (Technical University of Delft, The Netherlands)

Antennas for 5G and Future Networks: Perspectives and Opinions from Industry and Academia

Wednesday, July 10, 10:00 - 11:40, Grand Ballroom D
We have observed that many AP-S members are not familiar with the APS standards, recommendations and guides. Therefore, the Antennas & Propagation Standards Committee (APS/SC) is holding this short course to raise awareness of these documents. The important ones are related to terms and definitions (e.g. continuous misuse of “return loss”), antenna, RCS and near-field measurements.

Short Courses

**SC-2: IEEE-AP Standards Overview**
Vikass Monebhurrun, Vince Rodriguez, Lars Foged
Sunday, July 7, 08:00 - 17:00
Location: Room 209/210

This short course gives the participants an overview of the application, implementation, design and verification of base station antennas for 5G. In particular it is aimed at microwave, RF- and antenna engineers in the wireless area, but also useful for researchers looking for relevant research topics and system engineers needing a deeper understanding of the antenna component of their system. The course explains underlying theoretical and practical implementation aspects of base station antennas in mobile communication networks of today and in 5G networks but discusses also their design, requirements and verification.

**SC-3: Fully-Polarimetric Phased Array Far Field Modeling**
Joseph Hucks
Sunday, July 6, 08:00 - 12:00
Location: Room 211

In this tutorial, the methods used in industry by the instructor to model phased arrays, with all the effects of polarization in the far field, will be taught. Maxwell’s equations and their time-harmonic general solutions in the far field will be reviewed. First cut and general element patterns with arbitrary polarization will be discussed and developed, together with the very useful Ludwig-3 polarization basis. The effects of mutual coupling among phased array elements will also be summarized. As the array elements need to be translated and rotated into their desired positions and orientations, the effect of translations and rotations on far field patterns is discussed, with an introduction to rotation matrices and a brief excursion into tensor algebra to better understand the components of the rotation matrix. The relationship between quaternions and rotation matrices is also given. The general formula for the far field electric field of a general 3D phased array with arbitrary elements is developed. Examples with identical elements in the same orientation in either an arbitrary 3D array, or the more common rectangular planar array are discussed, together with the associated array factors. Conformal arrays are briefly discussed in the context of specification of their orientation. Basic elements of beamsteering and beamforming are discussed at the end. The course will be taught at a level that may be followed by those with a background in basic electromagnetics and linear algebra.
Electromagnetic metamaterials are artificial periodic structures engineered to control the propagation of waves and to achieve physical effects not attainable in natural materials - high-frequency magnetism, negative refraction, strong absorption, lensing, cloaking, and more. Research in metamaterials started three decades ago, if not earlier, and exploded in the 2000s as a quest for “perfect lenses,” “perfect absorbers,” etc. But, as the field of metamaterials matured, it became clear that ideal devices were not realizable because of losses, finite lattice cell sizes, and other factors. Undoubtedly, however, “imperfect” materials and devices will continue to be developed, and we can therefore expect a growing need for more sophisticated methods of their analysis and, more specifically, for accurate homogenization theories valid for any composition and size of the lattice cell.

The objective of homogenization (effective medium theory) is to describe a composite structure in terms of effective parameters accurately representing reflection, transmission and propagation of waves on the scale coarser than the lattice cell size.

The course introduces a homogenization methodology valid in both electrostatics and electrodynamics and applicable to an arbitrary size and composition of the lattice cell. Nonlocal effects can be included in the model, making order-of-magnitude accuracy improvements possible. We then travel backward in time and explore the connection between the new framework and the classical 19th - early 20th century theories of Clausius-Mossotti, Lorenz-Lorentz, Maxwell Garnett.

A particularly challenging problem for future research is to determine what effective material tensors are attainable for given constituents of a metamaterial with their given properties, and how the lattice cell could be designed to produce such tensors. For example, what is the maximum effective permeability achievable? Bounds for effective parameters are currently known only for relatively simple settings, such as static dielectric permittivity of mixtures with two ingredients. The methodology developed in this course may help to make progress toward solving a much broader set of problems of this kind. This methodology can also be extended to other areas - for example, acoustics or eddy current problems in laminated cores of electric machines.

SC-5: Beam Forming/Steering With Natural and Metamaterial Antennas and Fixed Beam Forming with Metaplates

Hisamatsu Nakano
Sunday, July 7, 08:00 - 12:00
Location: Room 213/214

The main disadvantage with forming a beam in a specific direction using an array antenna is that it requires multiple radiation elements, phase shifters, and signal processing circuits. The size, weight, and cost of such an antenna prohibit its use in modern portable transceivers. This short course describes how to overcome such issues, presenting recent progress in beamforming antennas. The course is composed of three chapters.

Chapter 1 describes beam-forming antennas that are fabricated using conventional natural materials. Each antenna is composed of a main radiation element and parasitic elements. A detailed discussion of beam forming in 2, 4, and 16 directions is presented. The presentation reveals the reconfigurability of the antenna characteristics, and includes the radiation pattern, input impedance, and gain, when the beam is steered around the antenna axis. Note that the radiation from these antennas is linearly polarized (LP).

Chapter 2 introduces circularly polarized (CP) beam-forming metamaterial antennas that can steer their beam in both the azimuth and elevation planes. The antenna height is chosen to be extremely small; on the order of lambda/100 at the operating frequency. This makes these antennas suitable for installation on the surface of moving objects, such as vehicles and satellites.

Chapter 3 presents high-gain antennas with a beam that can be tilted in specific directions. It is emphasized that these antennas do not use phase shifters; each antenna is composed of a single radiation source and N (= 1, 2, 3) inhomogeneous loop-based metaplates, which are placed above the radiation source. The mechanism for forming a tilted beam is explained and radiation beams with a tilt angle of 30 and 60 degrees from the zenith are demonstrated.
SC-6: Application of Deep Learning in Computational Electromagnetics

Maokun Li

Sunday, July 7, 13:00 - 17:00

Location: Room 209/210

In recent years, research in deep learning techniques has attracted much attention. With the help of big data technology, massive parallel computing, and fast optimization algorithms, deep learning has greatly improved the performance of many problems in the speech and image research. In this short tutorial, the presenter hopes to share some of his learnings in deep learning techniques, and discuss the potential and feasibility of applying deep learning in computational electromagnetics. The presenter hopes to explore the characteristics, feasibility, and challenges of deep learning methods in the field of computational electromagnetics through some preliminary research on solving Poisson’s equation, array antenna synthesis, electromagnetic imaging, etc.

SC-7: Origami-inspired shaped reconfigurable tunable RF structures using additive manufacturing technologies

Syed Abdullah Nauroze, Manos Tentzeris, Glaucio Paulino, H. Jerry Qi, Stavros V. Georgakopoulos, Sungjoon Lim

Sunday, July 7, 13:00 - 17:00

Location: Room 211

The proliferation of wireless market has driven the demand of smart RF systems with multi-functional sensing, energy harvesting and communication modules that can readily reconfigure their electromagnetic response depending on changes in their environment. This requires low-cost, compact, flexible and reconfigurable RF components that can be printed on-demand and scaled-to-large numbers. However, current systems are inadequate to meet these demands which can be largely attributed towards use of - 1) subtractive manufacturing technologies (SMTs) and 2) conventional tunability schemes that become non-linear and complicated as structure size increases.

Traditional SMTs are complicated, require specialized clean room environment and can only realize planar RF modules with high fabrication cost & time and moderate achievable performance. Moreover, their planar configuration can only support finite tunability mechanisms that can be broadly categorized into changing material properties, using complex electronics or micro-electromechanical (MEMS) structures. These techniques are typically power hungry, laborious, expensive with limited (discrete-state) tunability range making them impractical as the size of the structure increases. In comparison, mechanical tuning mechanisms features superior power handling capability, quality factor, linearity and wide-band (continuous range) tunability but their bulky size, heavy weight and low switching/tuning speed has restricted their use in modern communication systems.

The hidden link between the two approaches are smart 4D origami-inspired RF structures; that are designed to mimic nature’s wisdom of self-assemblage and shape-reconfiguration in a well-studied and controlled manner to achieve tunability through shape-morphing.

SC-8: Unbalanced Fed Ultra Low Profile Inverted L Antenna and Functional Antennas

Mitsuo Taguchi

Sunday, July 7, 13:00 - 17:00

Location: Room 212

Due to the development of wireless communication technology, low profile, high gain, multi-band, or wideband antennas are desired. This short course presents an unbalanced fed ultra low profile inverted L (ULPIL) antenna and the functional antennas composed of ULPIL antenna. At first, the principle of impedance matching is discussed by comparing with that in the inverted F antenna. Then the design of following functional antennas are presented.

SC-9: Surface Electromagnetics in Antenna Engineering: From EBG to Meta-surfaces and Beyond

Yahya Rahmat-Samii, Fan Yang

Sunday, July 7, 13:00 - 17:00

Location: Room 213/214

From frequency selective surfaces (FSS) to electromagnetic band-gap (EBG) ground planes, from impedance boundaries to Huygens metasurfaces, novel electromagnetic surfaces have been emerging in both microwaves and optics. Many intriguing phenomena occur on these surfaces, and novel devices and applications have been proposed accordingly, which have created an exciting paradigm in electromagnetics, the so-called “Surface Electromagnetics”. This short course will
review the development of various electromagnetic surfaces, as well as the state-of-the-art concepts and designs. Detailed presentations will be provided on the unique electromagnetic features of EBG ground planes and advanced metasurfaces. Furthermore, a wealth of antenna examples will be presented to illustrate promising applications of the surface electromagnetics in antenna engineering.


Omar F. Siddiqui  
Sunday, July 7, 13:00 - 17:00  
Location: Room 207

In the classical Electromagnetics textbooks, the microwave devices such as circulators, couplers, and filters are solved by non-systematic approaches such as even-odd mode analysis. Hence an electrical engineering student coming from the conventional circuit theory background encounters difficulties in understanding and solving microwave circuits. In this paper, we propose a modified node voltage analysis method in which the circuit branches are represented by their forward transmission matrices so that the electromagnetic wave propagation is taken care of. The Kirchhoff’s current rule, tailored for high frequencies, is applied to formulate the simultaneous node voltage equations which are subsequently solved by matrix inversion. Voltages and currents and the resulting S-parameters can then be calculated. From the node currents, a 2D voltage or current surface distribution can also be generated that can reveal the underlying propagation mechanisms for different microwave (non-radiating) circuits. Examples include filters, couplers, duplexers, and other novel designs.

In this workshop, I will present a systemic approach of solving voltages and currents for selected circuit designs from recently published papers. I will provide MATLAB codes for these circuits which can be further modified to be used in any other circuit design.

In the examples that I will provide from my own papers, the FTM method results strengthened the paper presentation and hence contributed to their acceptance in renowned journals such as IEEE Transactions on Microwave theory and techniques, Applied Physics Letters, and IEEE Access.

**Social Events**

**Welcome Reception at the Georgia Aquarium**

The Steering Committee has chosen a spectacular venue for the AP-S 2019 Welcome Reception, the Georgia Aquarium in Downtown Atlanta, the largest aquarium in the US. The Aquarium contains more than one hundred thousand animals, representing 700 species of fish and other sea creatures with notable specimens include whale sharks, beluga whales, California sea lions, bottlenose dolphins, and manta rays. Georgia Aquarium is a scientific institution that entertains and educates, features exhibits and programs of the highest standards, and offers engaging and exciting guest experiences that promote the conservation of aquatic biodiversity throughout the world.

NEWLY ADDED - A SPECTACULAR DOLPHIN SHOW! LOVED BY LOCALS AND TOURISTS ALIKE! Don’t miss the amazing bottlenose dolphins, and see how graceful, athletic and intelligent they are, as well as the relationships they have with their trainers. The show begins at 20:15, and theatre doors open at 19:45. Remember to consider the “splash zone” at Dolphin Coast, when selecting your seat!

**Transportation:** Shuttle Bus transportation will run between the Hilton Atlanta beginning at 19:00.

**Fee:** Complimentary for AP-S 2019 registered attendees and their guests. Delegates must indicate attendance during registration in order to receive a ticket.

**Women in Engineering - Lunch and Speaker**

Join the AP-S WIE for a special luncheon and speaker, Dawn Tilbury, Assistant Director to the Directorate for Engineering at the NSF and Professor at the University of Michigan. This event is open to all conference participants, but pre-registration is required. The scopes of interest of the WIE include increasing the participation of women within IEEE, gathering and disseminating information regarding the status of women, and initiatives for, by and on behalf of women in engineering and science.

**Date:** Tuesday, July 9  
**Time:** 12:00 - 13:15  
**Location:** Crystal Ballroom A/F  
**Fee:** Advance registration is required, and there is a $20.00 fee for the two-course, plated lunch. Please indicate your choice of entrée salad – vegetarian or with beef.
**Students and Young Professionals Experience “The Coke Side of Life” at the World of Coca Cola**

The World of Coca-Cola (WOCC) is one of Atlanta’s best tourist attractions. This year, APS 2019 Students and Young Professionals are invited to join this social activity at the museum, where you can experience the history of the world’s most famous beverage brand at the dynamic, multimedia home of the 134-year-old secret formula for Coca-Cola. Get closer than ever before to the vault containing the secret recipe, view more than 1,200 never-before-displayed artifacts and get a behind-the-scenes look at the bottling process. Take a trip around the world in a thrilling 4-D movie experience and tempt your taste buds with more than 100 beverages from around the world. Remember, Coca Cola is…the “Official Soft Drink of Summer!”

**Date:** Tuesday, July 9  
**Time:** 17:45 departure from the Hilton Atlanta  
**Location:** 121 Baker Street NW  
**Fee:** Advanced registration is required. $20.00 for Students and Young Professionals; only a limited number of tickets are available for advisors at $25.00.

**Reviewers’ Lunch**

The Reviewers’ Lunch is open to all reviewers of the last year for the APS Transactions and Journals.

**Date:** Wednesday, July 10  
**Time:** 12:00 - 13:20  
**Location:** Salon West  
**Fee:** Complimentary for all registered attendees, who participated in the APS Transactions and Journals review process during the last year. Advance registration is required. Please indicate your choice of entrée - chicken or vegetarian.

**Awards Presentation**

Please join the Antennas and Propagation Society’s Awards Committee, as they honor the distinguished accomplishments of the society’s professional community. This year’s IEEE Electromagnetics Award will be presented to Rick Ziolkowski, Professor Emeritus of Electrical and Computer Engineering at The University of Arizona. 2019 IEEE AP-S Fellows are recognized during this awards event. NOTE the format, introduced during the 2016 event, as the awards will be presented during a special evening session at the Hilton Atlanta, to be followed by the Celebratory Banquet, which is a ticketed event. The Awards Presentation is open to all conference registrants and their guests, but advance registration is required.

**Date:** Wednesday, July 10  
**Time:** 18:00 - 19:15  
**Location:** Grand Ballroom A–D  
**Fee:** There is no fee to attend the Awards Presentation, but advance registration is required. If you wish to join the awards recipients during this event, please register to attend.

**Celeboratory Banquet**

This evening’s Celebratory Banquet will take place in Salon West at the Hilton Atlanta. It is open to all conference registrants and their guests, and it requires a separate ticket purchase. A three-course plated dinner and wine will be served, and you’ll enjoy live music.

**Date:** Wednesday, July 10  
**Time:** 19:30 - 22:30  
**Location:** Salon West  
**Fee:** $70 (Advance Rate): $90 (On-Site Rate *)  
* Please note that a limited number of tickets will be available for sale at the On-Site Rate.

**Companion Program**

Companion Program hosts Judy Long, Sue Stone and Joanne Wilton will be onsite in the Companion Suite (Rooms 309-310) to welcome registered companions for breakfast each morning.

For additional information or any questions, please contact either of the co-chairs via e-mail:  
SueLStone@hotmail.com  
jjwilton@mindspring.com  
judimlong@swbell.net
Radio Amateurs are encouraged to display their call sign on their conference badge! In 2015, APS held the first-ever Amateur Radio breakfast meeting. Given the very favorable response, we continued these initiatives, now bringing us to our 5th Annual Amateur Radio Breakfast. Our efforts are supported by the Education and SIGHT Committees.

Welcome to Atlanta 2019, and further expansion of this special interest group.

ARRL will be publishing stories about our Amateur Radio activities at IEEE AP-S/URSI 2019. These activities will include:

**FCC Amateur Radio License Exam Session - Wednesday, July 10 and Thursday, July 11**

Volunteer Examiners from Boston will be onsite to administer FCC Amateur Radio License Exams to registered attendees of the 2019 AP-S/URSI Symposium. There are three FCC amateur radio license classes - Technician, General and Extra. On your application, which we recommend you complete in advance, you will be able to make your selection.

Note that there is no longer a Morse code requirement. The web sites [http://www.kb6nu.com/study-guides/](http://www.kb6nu.com/study-guides/) and [https://hamexam.org](https://hamexam.org) are valuable sources of study information.

If you plan to sit for the exam, please note that you will need the following:

- An NCVEC Form 605. Do not use the FCC Form 605. The form must have your FCC registration number on the form. The form may be downloaded here - [http://www.ncvec.org/downloads/ncvec605.pdf](http://www.ncvec.org/downloads/ncvec605.pdf)

A calculator with the memory erased and formulas cleared is allowed. You may not bring any written notes or calculations into the exam session. Slide rules and logarithmic tables are acceptable, as long as they’re free of notes and formulas. Cell phone must be silenced or turned off during the exam session and the phones’ calculator function may not be used. In addition, iPhones, iPads, Androids, smartphones, Blackberry devices and all similar electronic devices with a calculator capability, may NOT be used.

An advantage to taking the test at the symposium...no fee will be charged.

**FCC Amateur Radio License Exam Session - Wednesday, July 10**

- **Date:** Wednesday, July 10
- **Time:** 13:00 - 16:00
- **Location:** Room 208
- **Fee:** Complimentary, but advance registration is required.

**FCC Amateur Radio License Exam Session - Thursday, July 11**

- **Date:** Thursday, July 11
- **Time:** 13:00 - 16:00
- **Location:** Room 208
- **Fee:** Complimentary, but advance registration is required.

**Amateur Radio Operators Breakfast**

The Amateur Radio Breakfast Meeting is open to all conference participants who hold an amateur radio call sign, but pre-registration is required. The intent of the gathering is to gather support for APS student, outreach, SIGHT and educational activities involving amateur radio.

- **Date:** Monday, July 8
- **Time:** 07:00 - 08:00
- **Location:** Crystal Ballroom A
- **Fee:** Complimentary, but advance registration is required. An amateur radio license is also required for attendance.

**Amateur Radio special event station — Tuesday–Thursday, July 9–11**

The Amateur Radio special event station will be set up at Booth 73 in the Exhibit Hall in Salon West. Please drop by to see the station in operation. Other Amateur Radio demonstrations will be held throughout the week in and around the symposium venue. For more information, please contact Dave Michelson, VA7DM at davem@ece.ubc.ca.
Awards and Society Recognition

2019 IEEE AP-S Field Awards

Distinguished Achievement Award
George V. Eleftheriades, University of Toronto
“For pioneering contributions to metamaterials and metasurfaces, and their applications to antennas and sub-diffraction imaging.”

Chen-To Tai Distinguished Educator Award
Douglas H. Werner, The Pennsylvania State University
“For exemplary achievements in higher education as an inspiring teacher and mentor, and for innovative contributions to advancing knowledge in electromagnetics.”

John Kraus Antenna Award
Daniel Sievenpiper, University of California, San Diego
“For the creation and development of artificial impedance surfaces used in antenna design and scattering control”

Lot Shafai Mid-Career Award
Eva Antonino Daviu, Universitat Politècnica de València (Spain)
“For her contribution to the systematic design of antenna systems for practical applications using characteristic modes and promoting access of women to engineering”

Harrington-Mittra Computational Electromagnetics Award
Chi Hou Chan, City University of Hong Kong
“For fundamental contributions to fast solutions of integral equations using FFT with applications to scattering, antennas and interconnect structures in homogeneous and layered medium”

Donald G. Dudley, Jr. Undergraduate Teaching Award
Eng Leong Tan, Nanyang Technological University
“For excellence in teaching, student mentoring, and the development of mobile technologies and computational methods for electromagnetics education”

2019 IEEE AP-S Paper Awards

Sergei A. Schelkunoff Transactions Prize Paper Award
Francisco S. Cuesta, Ihar A. Faniayeu, Viktar S. Asadchy, and Sergei A. Tretyakov

Harold A. Wheeler Applications Prize Paper Award
Kenneth W. Brown

R. W. P. King Paper Award
Brandon W. Dowd and Rodolfo E. Diaz

Piergiorgio L. E. Uslenghi Letters Prize Paper Award
Casimir Ehrenborg and Mats Gustafsson

Edward E. Altschuler AP-S Magazine Prize Paper Award
Rick W. Kindt and John T. Logan

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Tayeb Denidni
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**ANTENNAS**
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**ELECTROMAGNETICS AND MATERIALS**
George Hanson  Michael Havrilla

**COMPUTATIONAL AND NUMERICAL TECHNIQUES**
Hakan Bagci  Dan Weile

**PROPAGATION AND SCATTERING**
Greg Durgin  Guido Lombardi

**ANTENNA APPLICATIONS AND EMERGING TECHNOLOGIES**
John Kimionis  Joshua Kovitz

AP-S Technical Program Super-Reviewers

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## URSI Commission Chairs

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<td>URSI A</td>
<td>Electromagnetic Metrology</td>
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<td>Fields and Waves</td>
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Special Sessions

MO-SP.1A: Low-Cost Phased Array Technology
Organizers: Jeffrey Herd and Paolo Rocca

MO-SP.2A: Emerging Technologies for Biomedical Applications
Organizers: Asimina Kiourti and Erdem Topsakal

MO-SP.1P: Application of Machine/Deep Learning and Uncertainty Quantification Techniques in Computational Electromagnetics
Organizers: Luis Gomez and Abdulkadir Yucel

MO-SP.2P: Space-Time Modulated Metamaterials
Organizers: Christophe Caloz and Zoé-Lise Deck-Léger

TU-SP.1A: Memorial Session for Dr. R. C. Hansen
Organizers: Jennifer Bernhard and William Liles

TU-SP.2A: International Collaborations on Next-Generation Radio Astronomical Instruments
Organizers: David Davidson and Karl F. Warnick

TU-SP.1P: Cybersecurity and Electromagnetic Systems: From DC to Daylight and from Wireless to Wired
Organizer: Johnson Wang

TU-SP.2P: Metasurfaces in Antenna Applications
Organizers: Stefano Maci and Sergei Tretyakov

WE-SP.1A: Optically Transparent Antennas
Organizers: James Schaffner, Zachary Silva, Hyok Song and Christopher R. Valenta

WE-SP.1P: Time-Domain Computational Methods for Complex Electromagnetic and Multiphysics Problems
Organizers: Yang Liu and Ali E. Yilmaz

WE-SP.2P: Design and Integration Aspects of Beyond 5G Communications for Mobile Devices
Organizers: Wonbin Hong and Rod Waterhouse

TH-SP.1A: Advanced DGTD and FVTD Methods
Organizers: Jian-Ming Jin and Jamesina Simpson

TH-SP.2A: Driving Forward: Advances in Propagation Modeling for Wireless Systems
Organizers: Christopher R. Anderson and Zhen Peng

TH-SP.1P: Innovative Reconfigurable and Multifunction Antenna Arrays
Organizers: Nicola Anselmi and Paolo Rocca

TH-SP.2P: Metasurfaces in Antenna Applications
Organizers: Stefano Maci and Sergei Tretyakov

FR-SP.1A: Recent Advances in Multi-Material Additive Manufacturing for Antennas and Microwave Devices
Organizers: Geoff Brennecka and Payam Nayeri

FR-SP.2A: Antenna Innovations and Open Challenges for Small Satellites and CubeSats
Organizers: Nacer Chahat and Joshua Kovitz

FR-SP.1P: UWB Antenna Technologies for Radar
Organizers: Jay McDaniel and F. Rodriguez-Morales

FR-SP.2P: Topological Electromagnetics
Organizers: Ali Hassani Gangaraj and Francesco Monticone
Presentations for finalists will be in the Level 2 Foyer on Tuesday, July 9, 08:00 – 11:40.

**Finalists**

A Dual-band Strain Sensor Based On Pop-up Half Wavelength Dipole Antenna  
Shaghayegh Soltani, Paul S. Taylor, John C. Batchelor,  
University of Kent, United Kingdom

A Machine Learning Based 77 GHz Radar Target Classification for Autonomous Vehicles  
Xiuzhang Cai, Kamal Sarabandi, University of Michigan, United States

An Improved Model for Static Field Micro-Particle Components on a Printed Transmission Line  
Nasim Soufizadeh-Balaneji, David Rogers, Benjamin D. Braaten, North Dakota State University, United States

Design of a Characteristic-Mode-Based Fully-Planar Antenna for Indoor In-Band Full-Duplex Radios  
Gianyi Li, Ting-Yen Shih, University of Idaho, United States

A Machine Learning-Based 77 GHz Radar Target Classification for Autonomous Vehicles  
Xiaoyi Wang, Christophe Caloz, Polytechnique Montréal, Canada

A Multi-Level Reconstruction Algorithm for Electrical Capacitance Tomography Based on Modular Deep Neural Networks  
Elizabeth Chen, Costas Sarris, University of Toronto, Canada

**Honorable Mentions**

A Compact Efficient D-Band Micromachined On-Chip Differential Patch Antenna for Radar Applications  
Wael Ahmad, Maciej Kucharski, Herman Ng, IHP - Leibniz-Institut für innovative Mikroelektronik, Germany; Dietmar Kissinger, Ulm University, Germany

A Dual-polarized FSS on a Single Substrate using Highly-coupled Interlayer Inductance  
Youngno Youn, Wonbin Hong, Pohang University of Science and Technology (POSTECH), Korea (South)

A Fast Macromodeling Approach to Simulate Complex Electromagnetic Surfaces  
Utkarsh Patel, Piero Triverio, Sean Hum, University of Toronto, Canada

A Low-Profile Wideband Connected Slot Array for Wide-Angle Scanning  
Yan Li, Shaoyi Xiao, Bing-Zhong Wang, University of Electronic Science and Technology of China, China

A Tri-Band Dual-Polarized Slot-Ring Antenna for Array Design  
Junyi Huang, Xun Gong, University of Central Florida, United States

A Tri-band Shared-Aperture Antenna for Wi-Fi MIMO and Beam-Scanning Wi-Gig Applications  
Yanran Ding, Yujian Cheng, University of Electronic Science and Technology of China (UESTC), China

A Well-Conditioned Differential Surface Admittance Formulation for Modeling Penetrable Media  
Shashwat Sharma, Piero Triverio, University of Toronto, Canada

A Wideband Frequency Beam Scanning Antenna Based on the Spoof Surface Plasmon Polaritons  
Jun Wang, Zhang-Cheng Hao, Southeast University, China; Lei Zhao, China University of Mining and Technology, China

Adaptive Beamforming in High-Interference Environments Using a Software-Defined Radio Array  
Daniel Gaydos, Payam Nayeri, Randy Haupt, Colorado School of Mines, United States

An Efficient Design Approach for Wideband Tightly Coupled Antenna Arrays  
Wenyang Zhou, Yikai Chen, Shiwen Yang, University of Electronic Science and Technology of China, China
An Independently Tunable Uniplanar Dual Band Band-Stop Frequency Selective Surface
Nibirh Jawad, Loïc Markley, University of British Columbia, Canada

Approximation of Reflectarray Cross-Polarization Response Using A Hybrid FEM-PO Method
Joshua Roper, Viasat Inc., United States; Andrew Peterson, Georgia Institute of Technology, United States

Augmented Unit Cells for Realizing TM-Polarized Huygens’ Metasurfaces
Gengyu Xu, Sean Hum, George V. Eleftheriades, University of Toronto, Canada

Design of a Planar Wideband Yagi-Uda Antenna for Millimeter Wave SAR Imaging Application
Yuan Gao, Mohammad Ghasr, Reza Zoughi, Missouri University of Science and Technology, United States

Dual-Linear or Dual-Circular Polarized Slot Excited ME-Dipole Antenna with Single-Layer Feeding
Nadeem Ashraf, Ahmed Kishk, Abdel Razik Sebak, Concordia University, Canada

Enabling High Efficiency Bandwidth Electrically Small Antennas through Direct Antenna Modulation
Jean Paul Santos, Foad Ferediou, Yuanxun Ethan Wang, University of California, Los Angeles, United States

Fast and Accurate Near-Field to Far-Field Transformation Using an Adaptive Sampling Algorithm and Machine Learning
Rezvan Rafiee Alavi, Rashid Mirzavand, Pedram Mousavi, University of Alberta, Canada

Flexible W-Band Rectifiers for 5G-powered IoT Autonomous Modules
Aline Eid, Jimmy Hester, Bijan Tehrani, Manos Tentzeris, Georgia Institute of Technology, United States

Frequency Independent Method for RCS Reduction of Dihedral Corners Using Metasurfaces
Anuj Modi, Constantine Balanis, Craig Bircher, Arizona State University, United States

Full Wave Solutions of Multiple Scattering Using 3D Vector Cylindrical Wave Expansions In Foldy-Lax Equations
Huanting Huang, Leung Tsang, University of Michigan, United States; Kung-Hau Ding, Air Force Research Laboratory, United States

Full-duplex Near-infrared Communication via Spatiotemporally-modulated Array Antennas
Mohammad Mahdi Salary, Hossein Mosallaei, Northeastern University, United States

Generalized Tensor FDTD Method for Sloped Plasmonic Interfaces
Qiming Zhao, Costas Sarris, University of Toronto, Canada

Graphene metasurface based tunable double split ring resonator for far infrared frequency region
Vishal Sorathiya, Shobhitkumar Patel, Marwadi Education Foundation, India

Low Angle Scanning Phased Arrays With Greater Than 50:1 Bandwidth
Alexander D. Johnson, Elias A. Alwan, John L. Volakis, Florida International University, United States

Massive MIMO Beamforming on a Chip
Christopher Merola, University of Massachusetts, United States; Marinos Vouvakis, University of Massachusetts Amherst, United States

Measuring GPS Transmit Antenna Pattern Using On-Orbit Receivers
Tianlin Wang, Christopher Ruf, Bruce Block, University of Michigan, United States; Andrew O’Brien, Ohio State University, United States

Microfluidic Switches with Integrated Actuation for Mm-Wave Beam-Steering Arrays
Enrique González, Gokhan Mumcu, University of South Florida, United States

Modified Floquet Scattering Matrix Method for Solving N-path Networks
Cody Scarborough, Anthony Grbic, University of Michigan, United States

Novel Electromagnetic Scattering Model for Carbon Nanotube Composites using the Multilayer Green’s Function Approach
Sumitra Dey, Deb Chatterjee, University of Missouri-Kansas City, United States; Edward J. Garboczi, National Institute of Standards and Technology, United States; Ahmed M. Hassan, University of Missouri-Kansas City, United States

Physics-Oriented Statistical Analysis of Information Transmission in Wave-Chaotic Environments
Shen Lin, Zhen Peng, University of New Mexico, United States

Serrodyne frequency translation using time-modulated metasurfaces
Zhanni Wu, Anthony Grbic, University of Michigan, United States

Sinuous Antenna Design for UWB Radar
Dylan Crocker, Sandia National Laboratories, United States; Waymond Scott, Georgia Institute of Technology, United States

The Huygens’ Box Antenna: Metasurface-Based Directive Antenna Beam-Steering with Dramatically Reduced Elements
Kayode A. Oyesina, Alex M. H. Wong, City University of Hong Kong, China

Transmission Line Models of Planar Slot Antennas
Ralph van Schelven, Daniele Cavallo, Andrea Neto, Delft University of Technology, Netherlands
Student Design Contest

The annual IEEE Antennas and Propagation Society (AP-S) Student Design Contest engages teams of undergraduate and graduate students to design practical devices and systems related to antennas and propagation, defined by an annual call for proposals. Teams are composed of a minimum of 50% undergraduates and are mentored by AP-S members.

This year’s topic was to propose a setup that characterizes/demonstrates the properties of an antenna system and provide educational material to explain these properties.

Each team prepared a proposal for the contest that was evaluated by a college of reviewers to narrow the field to six finalist teams. The finalists (in alphabetical order) are:

GUC - German University in Cairo (Egypt)
Title: DIY antenna characterization system using universal UHF RFID hemispherical dome
Members: Monica Wasy William, Nada Khaled Sayed Abdelhadi, Samar Abdelatty Sayed Elmeadawy, Yasmine Abdalla Zaghloul
Faculty Advisor: Hany Fathy Hammad

KnowAntenna - Universidade de Aveiro (Portugal)
Title: DIY antenna characterization setup
Members: Lucas Leitão, Manuel Neves, Guilherme Maniezo, Tânia Ferreira, Francisco Pinto
Faculty Advisor: João Nuno Matos, Armando Rocha

Team ACE - Brigham Young University (USA)
Title: Fast Antenna Pattern Measurements with Multipath Suppression
Members: Enoch Boekweg, Travis Bonner, Sean Crawford, Jacob Holtom, Shelby Larsen
Faculty Advisor: Karl Warnick

UNAL-APS- National University of Colombia (Colombia)
Title: UNAL-APS- National University of Colombia (Colombia)
Members: Cristian Felipe Cadavid Insuasti, Sebastián Chavez Martínez, Julian Navarrete Rubio, Leonardo Pérez
Faculty Advisor: John Jairo Pantoja Acosta

UNM - University of New Mexico (USA)
Title: Novel and Instructive Antenna Measurement Method
Members: Ralph Gesner, Arjun Gupta, John Argyres, Daniel Feaster, Delaney Heileman
Faculty Advisor: Christos Christodoulou

WPS-UTRGV - University of Texas Rio Grande Valley (USA)
Title: Electromagnetic Metasurface for Wireless Power System
Members: Tito Espino, Luis de la Garza, Daniel Salazar
Faculty Advisor: Nantakan Wongkasem
AP-S/URSI 2019 is pleased to welcome our Gold patrons: Raytheon, Georgia Tech Research Institute and NSI-MI; and Bronze patrons: AVL Technologies and Honeywell. In addition, we thank the Johns Hopkins Applied Physics Laboratory for supporting a poster session reception. Thank you for your support of AP-S/URSI 2019!

All attendees are invited to visit the patrons at their booths in the exhibition hall.
The Steering Committee of the 2019 IEEE International Symposium on Antennas and Propagation and USNC-URSI Radio Science Meeting would like to thank the following exhibitors for their participation.

**Booth** | **Exhibitor Name**
--- | ---
Booth 12 | Next Phase Measurements
Booth 13 | 412 TW Benefield Anechoic Facility (BAF)
Booth 15 | Georgia Tech Research Institute
Booth 16 | Copper Mountain Technologies
Booth 21 | Everbeing Intl Corp.
Booth 22 | Antenom Antenna Technologies
Booth 23 | NSI-MI Technologies
Booth 24 | TICRA
Booth 25 | Comsol, Inc.
Booth 26 | NSI-MI Technologies
Booth 31 | Raytheon
Booth 32 | Haleakala R&D Inc
Booth 33 | Remcom, Inc.
Booth 41 | IMST GmbH
Booth 42-43 | MVG | Microwave Vision Group
Booth 51 | WIPL-D
Booth 52 | Wiley
Booth 53 | HRL Laboratories
Booth 54 | Virginia Diodes Inc.
Booth 61 | Altair Engineering, Inc
Booth 62 | Amazon.com Inc
Booth 63 | Delta Sigma Company
Booth 64 | Antenna Measurement Techniques Association, Inc.
Booth 65 | Fraunhofer USA Inc. Center for Coatings and Diamond Technologies
Booth 71 | IEEE Electromagnetic Compatibility Society
Booth 72 | IEEE Microwave Theory and Techniques Society
Booth 73 | ARRL/North Fulton Amateur Radio League
Univ. Row | Johns Hopkins University Applied Physics Laboratory
Univ. Row | Michigan State University

**Exhibition Location and Hours**

Exhibits are located in Salon East, on the 2nd floor of the Hilton Atlanta, and are open to all attendees according to the following schedule:

- **Tuesday, July 9** ................. 09:00–18:00
- **Wednesday, July 10** ............. 09:00–18:00
- **Thursday, July 11** ............... 09:00–15:00
Everbeing is a world leading manufacturer of probe stations and micropositioners based in Taiwan. A probe station is an interface machine between the customer.

Delta Sigma Company

Delta Sigma began operations in January of 1990 in Hesperia, California. In July of 1997, we moved to Kennesaw, Georgia to be closer to the F-22 Raptor team which had moved from Palmdale, CA to Marietta, GA. We have over 40 years’ worth of experience in-house for all kinds of specialized LO (low observables) testing. We have built everything from the antenna to the cal target, radar, data collection & processing software, RF section, pylon, multi-axis target positioner, target, and motion controls for moving parts in/on the target. Since 2000, we have primarily focused on developing complex automated systems to replace manual aircraft manufacturing stations and eliminate bottlenecks in station cycle time. We understand machine vision, lasers, serves, precision motion control, and dozens of other technologies that can be applied to aircraft manufacturing. At DSC, we engineer all of our own designs and software and build all of our machines in-house from the ground up, resulting in a fully 100% custom automation solution for the customer.

http://www.deltasigmacompany.com

Amazon Project Kuiper is a long-term initiative to launch a constellation of Low Earth Orbit satellites that will provide low-latency, high-speed broadband connectivity to unserved and underserved communities around the world.

http://www.amazon.jobs/en/teams/projectkuiper

Altair Engineering, Inc

Altair is a leading provider of enterprise-class engineering software enabling innovation, reduced development times, and lower costs through the entire product lifecycle from concept design to in-service operation. Our simulation-driven approach to innovation is powered by our integrated suite of software which optimizes design performance across multiple disciplines encompassing structures, motion, fluids, thermal management, electromagnetics, system modeling and embedded systems, while also providing data analytics and true-to-life visualization and rendering.

http://www.altair.com/

Copper Mountain Technologies develops innovative and robust RF test and measurement solutions for engineers worldwide. We specialize in the creation of solutions that enable RF and Microwave engineers to extend their reach through access to lab-grade instrumentation at affordable prices. Copper Mountain Technologies’ world-class metrology and engineering resources work as an extension of your team. Copper Mountain Technologies is based in Indianapolis, IN, Copper Mountain Technologies began by developing telecom, RF & MW components, and test instrumentation for the European and Asian markets. Today, we provide VNAs for clients in close to 100 countries around the world. Our VNAs include an RF measurement module and a software application that runs on an external PC laptop or tablet and connects to the measurement hardware via USB interface. Users can take advantage of the latest operating systems, processing power, larger displays, and reliable performance of an external PC while realizing a lower total cost of ownership and application that runs on an external PC.

http://www.coppermountaintech.com

Comsol, Inc.

COMSOL Multiphysics® is a software environment for the modeling and simulation of any physics-based system with the ability to account for multiphysics phenomena. Optional add-on modules add discipline-specific tools for mechanical, fluid, electromagnetics, and chemical simulations, as well as CAD interoperability. Founded in 1986, COMSOL has U.S. offices in Burlington, MA; Los Angeles, CA; and Palo Alto, CA, in addition to numerous international offices and distributors. Additional information is available at www.comsol.com.

http://www.comsol.com/

Altair

Altair is a leading provider of enterprise-class engineering software enabling innovation, reduced development times, and lower costs through the entire product lifecycle from concept design to in-service operation. Our simulation-driven approach to innovation is powered by our integrated suite of software which optimizes design performance across multiple disciplines encompassing structures, motion, fluids, thermal management, electromagnetics, system modeling and embedded systems, while also providing data analytics and true-to-life visualization and rendering.

https://www.altair.com/

Antenom Antenna Technologies

Anten’it is the game-changing product of Antenom Antenna Technologies. Anten’it has metal and dielectric cells that are used to teach, design and build many antenna types at different frequencies.

http://www.antenit.com

ARRL/NORTH FULTON AMATEUR RADIO LEAGUE

The North Fulton Amateur Radio League, in conjunction with the American Radio Relay League, will provide demonstrations of and information on the amateur radio hobby. Two amateur radio licensing exam sessions will also be offered. Numerous prizes related to operating an amateur radio station and related technologies will be given away.

http://infarl.org

Composite Applications

Composite Applications is a software development and technical consulting company with a focus on the fields of embedded systems as well as data analytics and true-to-life visualization and rendering.

https://www.altair.com/

Everbeing

Everbeing is a world leading manufacturer of probe stations and micropositioners based in Taiwan. A probe station is an interface machine between testers and sample devices. With 27 years of history, we strive in producing reliable, precise, user-friendly products with affordable prices. Our inventory includes a broad range of probing accessories such as tips and tip holders. Our solutions cater to vast range of measurement applications which can be tailored to your specific needs.

http://www.everbeingprober.com
Fraunhofer USA Inc. Center for Coatings and Diamond Technologies
The Fraunhofer Center for Coatings and Diamond Technologies (CCD) offers diamond-related products including: doped and undoped diamond materials (NCD, PCD, SCD), boron doped diamond (BDD) electrodes, BDD microelectrode arrays (MEA), finished and semi-finished diamond products and diamond-like carbon (DLC) coatings. Contract research and development services are performed in the life science, advanced manufacturing, alternative energy, micro-electro-mechanical system, homeland-security, and defense sectors for companies ranging from start-ups to large businesses. Fraunhofer CCD is an ISO9001 certified operation.
http://ccd.fraunhofer.org

Georgia Tech Research Institute
At GTRI, we develop advanced technology solutions and large-scale system prototypes to address the most difficult problems in national security, economic development, and overall human betterment. The Georgia Tech Research Institute (GTRI) is the nonprofit, applied research division of the Georgia Institute of Technology (Georgia Tech). Founded in 1934 as the Engineering Experiment Station, GTRI has grown to more than 2,000 employees supporting eight laboratories in over 20 locations around the country, and performs more than $350 million of problem-solving research annually for government and industry. Each day, GTRI’s science and engineering expertise is used to turn ideas into workable solutions for our customers. We take the best ideas, often co-developed with our Georgia Tech academic partners, and turn them into systems applications that provide a significant technological advantage over other approaches. GTRI’s renowned researchers combine science, engineering, economics, policy and technical expertise to solve complex problems for the U.S. federal government, state and industry. We develop highly effective, practical solutions that we put into action. As a non-profit research institute, we are an objective partner who delivers workable solutions and manufacturable products. Our highly specialized laboratories and interdisciplinary research centers allow us to bring the right mix of talent, experience and creativity to every project.
https://www.gtri.gatech.edu/

Haleakala R&D Inc
Haleakala R&D is devoted to the research, development, prototyping, and commercialization of plasma antennas, plasma frequency selective surfaces, plasma wave guides, plasma coaxial cables, and plasma MRI/PET.
http://www.ionizedgasantennas.com

HRL Laboratories
Research Laboratory
http://www.hrl.com

IEEE Electromagnetic Compatibility Society
The IEEE Electromagnetic Compatibility (EMC) Society is the world’s largest organization dedicated to the development and distribution of information, tools and techniques for the prevention and containment of electromagnetic interference. EMC is increasingly important in many emerging technologies including wireless 5G and IoT, autonomous vehicles, and smart grid, to name a few. The Society’s field of interest includes standards, measurement techniques and test procedures, instrumentation, equipment and systems characteristics, interference control techniques and components, education, computational analysis, and spectrum management, along with scientific, technical, industrial, professional or other activities that contribute to this field. Explore the many benefits of EMC Society membership, from being part of the Young Professionals as well as having access to many Standards resources and Distinguished Lecturers. You can be engaged at the global and/or local Chapter level. The EMC Society has over 80 regional chapters in the Americas, Asia and Europe. Join today and give your career a much-needed boost.
http://www.emcs.org

IEEE Microwave Theory and Techniques Society
The IEEE Microwave Theory and Techniques Society (MTT-S) is a transnational society with more than 10,500 members and 190 chapters worldwide. Our society promotes the advancement of microwave theory and its applications, including RF, microwave, millimeter-wave, and terahertz technologies. For more than 60 years, the MTT-S has 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 into an exciting future, our 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 be the global focus for the promotion of the RF and microwave engineering profession, by advancing and distributing knowledge and supporting professional development.
https://www.mtt.org

IMST GmbH
IMST is a competence center and professional development house for antennas, high-frequency circuits, wireless modules, and complete communications systems. We provide individualized support to any customer during every phase of product development, from initial consulting to series production. IMST has added the resources of critical partnerships in the commercial marketplace and in the publicly sponsored research sector.
http://www.imst.de

Johns Hopkins University Applied Physics Laboratory
For more than 70 years, the Johns Hopkins University Applied Physics Laboratory (APL) has provided critical contributions to critical challenges with systems engineering and integration, technology research and development, and analysis. Our scientists, engineers, and analysts serve as trusted advisors and technical experts to the government, ensuring the reliability of complex technologies that safeguard our nation’s security and advance the frontiers of space. We also maintain independent research and development programs that pioneer and explore emerging technologies and concepts to address future national priorities. Founded in 1942 to aid a country at war, we provide solutions to national security and scientific challenges with systems engineering and integration, research and development, and analysis. Throughout our seven decades of service, we have focused on practical applications of our research in a wide range of scientific and technological fields; today, our four main sponsored areas of work include air and missile defense, asymmetric operations, force projection, and space science. Additionally, we continue to honor our enduring commitment to work with and inspire future generations of scientists, engineers, and researchers.
http://www.jhuapl.edu

Michigan State University
https://ece.msu.edu/
The Microwave Vision Group (MVG) is a premier supplier of antenna measurement and EMC testing solutions. Our systems allow users to visualize electromagnetic waves propagating in microwave frequencies and thus to evaluate the performance of antennas or devices under test. We are dedicated to the Telecommunications, Satellite, Aerospace & Defense, Automotive, and EMC/CE sectors as well as research institutes. MVG brings together the technical expertise, product portfolios and infrastructures of four industry leaders: SATIMO, ORBIT/FR, AEMI, Inc, & Rainford EMC. The result is an unrivaled spectrum of key technologies and system building blocks for antenna measurement and EMC activities. The Group provides the broadest range of measurement techniques available on the market: near-field and far-field antenna measurement, antenna technology, EMC testing, EMP, RF safety and industrial inspection, all under one roof. Combining electronic probe arrays and precision electro-mechanical systems, our research and engineering departments are consistent in developing cutting edge technologies and in aiming to meet evolving measurement requirements, including 5G developments. MVG is the natural choice for clients seeking complete, fast, accurate and reliable testing and measurement solutions.

http://www.mvg-world.com

Next Phase Measurements

Next Phase Measurements (NPM) is a California-based US company with a management team comprised of pioneers in the industry, recognized all over the world, having over 100 man-years of experience in antenna measurements. NPM is the distributor and Value-Added Reseller (VAR) across both American continents for Antenna Systems Solutions, a leading supplier of antenna measurement systems to the worldwide Aerospace, Defense, Commercial, Automotive, Wireless, Academic and Research markets.

http://www.npmeas.com

NSI-MI Technologies

With over 1000 systems sold worldwide, NSI-MI Technologies offers a comprehensive range of industry leading microwave test systems. These systems cover antennas, radomes and RCS and our unique blend of mechanical, RF and software engineering capabilities allow us to customize test systems to offer specialized solutions. NSI-MI supports the aerospace/defense, automotive, wireless and academic industries. Our wide range of products also allow us to offer solutions for material, production line or general automated component testing. Our global presence enables us to offer the highest quality service and support to ensure long term use of all test products supplied. We also offer extensive in-house test and measurement facilities covering frequencies from 250 MHz to 110 GHz.

http://www.nsi-mi.com

Raytheon

Raytheon provides state-of-the-art electronics, mission systems integration and other capabilities in the areas of sensing; effects; and command, control, communications and intelligence systems; as well as a broad range of mission support services.

https://www.raytheon.com/

Remcom, Inc.

Remcom provides electromagnetic simulation and 3D wireless prediction software for analyzing complex EM problems and antenna propagation. Visit our booth to see XFdrd’s new ESD simulation features: utilize ESD simulator waveforms, define the dielectric strength of materials, and easily locate weaknesses in their ESD design. In addition, we’ll be demonstrating our integrated solutions for end-to-end RF and 5G wireless design, including MIMO and array design, 5G urban small cells, fixed wireless access, and more.

http://www.remcom.com

TICRA

TICRA is the world's leading supplier of antenna modeling software for antenna industries, including spacecraft manufacturers and space agencies, earth-station antenna suppliers, defence industries and research institutions. With 45 years of experience in developing trusted solutions for the space industry, TICRA provides highly accurate EM simulation software for reflector antennas and related feed systems. Our expert engineers are available to customers through software support and consultancy services.

http://www.ticra.com

Virginia Diodes Inc.

VDI manufactures state-of-the-art test and measurement equipment for mm-wave and THz applications. These products include Vector Network Analyzer, Spectrum Analyzer and Signal Generator Extension Modules that extend the capability of high performance microwave measurement tools to higher frequencies. VDI’s component products include detectors, mixers, frequency multipliers and custom systems for reliable operation at frequencies between 50 GHz and 2 THz.


Wiley

Wiley, a global company, helps people and organizations develop the skills and knowledge they need to succeed. Our online scientific, technical, medical, and scholarly journals, combined with our digital learning, assessment and certification solutions help universities, societies, businesses, governments, and individuals increase the academic and professional impact of their work.

http://www.wiley.com

WIPL-D

WIPL-D with its high performance and high quality software products WIPL-D Pro, WIPL-D Pro CAD and Microwave Pro enables users worldwide to perform fast and accurate high-frequency simulations of antenna systems, microwave circuits and components, scatterers and EMC problems on today’s conventional computers. WIPL-D allows engineers to quickly generate new designs optimally specified and economically viable. WIPL-D stuff provides superb customer support and technical expertise within very short response-period and quick turn-around, making WIPL-D a valuable cooperator to the users.

http://www.wipl-d.com
Interactive Exhibition — Demonstration Program Summary

The exhibit hall will feature an Interactive Exhibition program. The Industrial Initiative Committee (IIC), a standing committee of the IEEE Antennas and Propagation Society chaired by Lars Jacob Foged, created the Interactive Exhibition program. The Interactive Exhibition allows exhibitors to demonstrate software and hardware in the exhibition hall. You will find hardware and software demonstrations in special demo stations in the exhibit hall during exhibit hours. Following is the list of demonstrations.

DEMONSTRATIONS HELD IN DEMO STATION 1

TUESDAY, JULY 9, 13:30 – 15:00

Altair

Hybrid Computational Techniques for Design and Placement Studies of Airborne Antennas using Altair Feko

With growing communications, nowadays there are increasingly sophisticated antenna systems with associated electronics aboard aircrafts. Advances in electromagnetic (EM) simulations have significantly improved the design process for such systems, resulting in reduced testing time and costs. In this demonstration, we will showcase hybrid computational techniques that are becoming popular to analyze and optimize antenna designs as well as antenna placement on airborne platforms. Hybrid solutions that combine, both full wave and asymptotic solutions can facilitate simulation of airborne antenna problems with less computational resources, but at the same time providing required accuracy. While full wave solutions (FEM/FDTD/MoM/MLFMM) are accurate, they are computationally expensive when applied to electrically large structures such as aircrafts. While asymptotic solutions (PO/RL-GO/UTD) may provide an alternative, they may not be suitable for modeling complex antenna geometries while mounted on the aircraft. For this demonstration, we will use commercial EM simulation tool, Altair Feko. Feko incorporates various hybrid solutions that combine, FEM/MoM/MLFMM, MoM/PO, MLFMM/PO, MoM/RL-GO and MoM/UTD, which allows for efficient analysis of airborne antennas. During the demonstration, a brief overview of hybrid computational methods will be presented. Use of these methods for different airborne antennas will be demonstrated.

Presenter: Dr. C. J. Reddy, Vice President-Business Development, Altair

WEDNESDAY, JULY 10, 10:30–12:00

WIPL-D

New Generation of 3D EM Simulation Tools - ULTRA Higher Order Bases in WIPL-D

The aim of the presentation is to demonstrate the new generation of basis functions implemented in WIPL-D software package. Classic polynomial higher order basis functions defined over quadrilaterals are regularly used with patches of maximum edge up to 2\(\lambda\) and expansion order up to 8. In this presentation we will demonstrate that these limits can be significantly extended if max-ortho bases are implemented by introducing the new concept of implementation of max-ortho HOBFs, which is based on representation of max-ortho HOBFs in terms of Legendre polynomials. Numerical results demonstrate effective usage of patches up to 20\(\lambda\) and expansion orders up to 61.

Significance of ultra-high order bases is demonstrated in the case of \(p\)-refinement, where decreasing of absolute error (e.g. down to 0.0001 dB for RCS) with increasing the order of bases will be presented. On the other hand the number of unknown coefficients and simulation time for electrically large problems is significantly reduced.

Presenter: Prof. Branko Kolundzija, WIPL-D

DEMONSTRATIONS HELD IN DEMO STATION 2

TUESDAY, JULY 9, 10:30–12:00

HRL Laboratories and Eastman Kodak Company

Transparent Antenna Appliques

Today’s world is more connected than ever with the Internet of Things (IoT) becoming more of a reality and less of an abstract concept, driving the proliferation of antennas. Designers and engineers have been working to hide these antennas in plain sight, but as the number of antennas increases creative options for antenna placement require new antenna designs and form
factors. Recently, there has been a recognition that the fabrication of optically transparent antennas would expand placement options to windows, displays, lighting and other glass surfaces.

We will demonstrate and discuss thin-film 4G-LTE and WiFi antenna appliques on polyethylene terephthalate (PET) with high transparency (>80%), low haze (<1.2%), and excellent antenna performance. This was a collaboration among Kodak, HRL, and General Motors and while the initial work presented here was focused on automotive application, the stage is set for future advances into the transparent antenna market. New designs for other communication bands are in progress and Kodak’s manufacturing facility enables volume production of any transparent antenna pattern.

Presenters: Carolyn Ellinger, Kodak, and Jim Schaffner, HRL

TUESDAY, JULY 9, 13:30–15:00
Johns Hopkins University / Applied Physics Lab

Johns Hopkins University / Applied Physics Lab Introduction and Example Projects

The Johns Hopkins University / Applied Physics Lab (JHU/APL) is a non-profit, University Affiliated Research Center (UARC) located in suburban Maryland that supports numerous US Government agencies by solving their most complex problems. In this presentation, staff members from the Air and Missile Defense Sector (AMDS) will provide an overview of JHU/APL, including its history, and discuss a few of the current efforts related to antennas and propagation that highlight the type of work that we perform for our sponsors.

Presenter: Michael Newkirk, Johns Hopkins University

WEDNESDAY, JULY 10, 10:30–12:00
Compass Technology Group, LLC

Microwave Material Measurements with a Table Top Fixture

Whether the application is antenna substrates, radomes, microwave components or electromagnetic interference (EMI) absorption, knowing the dielectric and magnetic properties of materials is an important part of microwave design. This hardware tutorial will show how to conduct free space characterization of materials at microwave frequencies. Specifically, a table top system based on wide band spot probes, along with a vector network analyzer will demonstrate the performance characteristics of different microwave materials. The procedures for determining intrinsic permittivity and permeability will be described, including calibration and mathematical inversion methods.

Presenter: John W. Schultz, Compass Technology Group

WEDNESDAY, JULY 10, 13:30–15:00
Antenom Antenna Technologies

Normal Mode Helix Antenna Design Experiment - A Real Hands-On Training “Build your antennas with your Hands”

The specialty of this demonstration is that the participants will design, build and measure their antennas in front of a network analyzer.

This demonstration starts with calculating theoretical dimensions for designing a normal mode helix antenna for a specific frequency. The participants will design their helix antennas via Anten’it Antenna Training Kits. They will follow the guidelines in the experiment sheets. The participants will then measure their antennas in front of a network analyzer and iterate their design by adding or removing new cells. Participants can also see the effect of building the helix antenna over a dielectric core instead of air.

This demonstration provides teaching and learning design of a normal mode helix antenna design.

Presenter: Umut Bulus, Antenom Antenna Technologies
# Technical Program Presentations

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### Possible Values
- **MO**: Monday
- **TU**: Tuesday
- **WE**: Wednesday
- **TH**: Thursday
- **FR**: Friday

- (Add P for Interactive Forum)
- **A1-A5**: AP-S Tracks
- **UA-UK**: URSI Commissions
- **SP**: Joint Special Sessions

- **1-5**: AM
- **A**: Morning
- **P**: Afternoon

### Sample
- **MO – A5 . 2 A**
  - Monday – AP-S Track 5 . 2nd Session AM (Morning)

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Low-Cost Phased Array Technology
Session Co-Chairs: Paolo Roccia, ELEDIA Research Center, University of Trento; Jeffrey Herd, MIT Lincoln Laboratory; Robert Mailloux, ELEDIA Research Center, University of Trento

MO-SP.1A.1 08:00
Rigid-Flexible Antenna Array (RFAA) for Cost-Effective Deployable Scanning Apertures
William Moulder, Rabindra Das, MIT Lincoln Laboratory, United States

MO-SP.1A.2 08:20
MARS CALL EARTH: A NOVEL ARRAY ANTENNA DESIGN FOR FUTURE PLANETARY MISSIONS
Yahya Rahmat-Samii, University of California, Los Angeles, United States

MO-SP.1A.3 08:40
Millimeter-wave technology for 5G applications: An industry view on current issues and challenges
Roberto Flamini, Christian Mazzucco, Renato Lombardi, Huawei Technologies, Italy

MO-SP.1A.4 09:00
Modular Phased Array Design Through a Tile-Dimension Tapering Approach
Nicola Anselmi, Dipartimento di Ingegneria Navale, Elettrica, Elettronica e delle Telecomunicazioni (DITEN– University of Genoa), Italy; Paolo Roccia, Andrea Massa, ELEDIA Research Center (ELEDIA@UniTN – University of Trento), Italy

MO-SP.1A.5 09:20
GaN-on-Si with CMOS Integration for Advanced, Low Cost Phased Arrays
Christopher Gallbraith, Chang-Lee Chen, Ryan Johnson, Richard Molnar, Jeffrey Knecht, Shireen Warnock, Dona-Ruth Yost, Matthew Cook, WeiLin Hu, Gianni Pinelli, Jeffrey Herd, Craig Keast, MIT Lincoln Laboratory, United States

Break 09:40

MO-SP.1A.6 10:00
Wideband Printed Antenna Arrays for 5G Mobile Applications
Wei Jian Foo, Kubilay Sertel, Ohio State University, United States

MO-SP.1A.7 10:20
Expanding the Capability of Printed Circuit Board (PCB) Based AESA Tile Radar for Civil and Defense Applications
Douglas Corson, Daniel Kramer, Nicholas Ahlquist, Alan Noll, MACOM Technology Solutions, United States

MO-SP.1A.8 10:40
High-Efficiency Low-Profile Feeds for UWB Arrays
Christopher Merola, University of Massachusetts, United States; Rick Kindt, Naval Research Laboratory, United States; Marinos Vouvakis, University of Massachusetts Amherst, United States

MO-SP.1A.9 11:00
An X-band, Mechanically Beam Steerable Lens Antenna Exploiting Risley Prism
Zongtang Zhang, Hung Luyen, John Booske, Nader Behdad, University of Wisconsin-Madison, United States

MO-SP.1A.10 11:20
A 1-bit Reconfigurable Reflectarray Element with Independent Dual-band Phase Controlling Capability
Hongjing Xu, Shenqiang Xu, Fan Yang, Maokun Li, Tsinghua University, China

Emerging Technologies for Biomedical Applications
Session Co-Chairs: Asimina Kiourti, Ohio State University; Erdem Topsakal, Virginia Commonwealth University

MO-SP.2A.1 08:00
Single-coil Dual-band Transmitting Antenna Design for Wireless Capsule Endoscopic Communication
Yunheo Peng, Kazuyuki Saito, Koichi Ito, Chiba University, Japan

MO-SP.2A.2 08:20
Harmonics-Enabled Antenna Alignment for High-Efficiency Wireless Power Transfer
Yongxin Guo, National University of Singapore, Singapore; Hao Zhang, National University of Singapore Suzhou Research Institute, China

MO-SP.2A.3 08:40
Characterization of Microchannel Arrays for Targeted Drug Delivery
Yang Hoo, Ahsan Noor Khan, Henry Giddens, Glob Sokhorukov, Queen Mary University of London, United Kingdom

MO-SP.2A.4 09:00
Implantable Titanium Nitrite Antenna for Continuous Glucose Monitoring
Ryan Green, Ryan Assi, Jessica Shafter, Modeline Hays, Shanze Eshai, Lynn Secundo, Vitaliy Avrutin, Nastassia Leswinski, Erdem Topsakal, Virginia Commonwealth University, United States

MO-SP.2A.5 09:20
Compact Dual-Band PIFA Based on a Slotted Radiator for Wireless Biomedical Implants
Nikit Pournoori, Shubin Ma, Lauri Sydnheimen, Leena Ukkanen, Tampere University, Finland; Yahya Rahmat-Samii, University of California, Los Angeles, United States; Toni Björninen, Tampere University, Finland

Break 09:40

MO-SP.2A.6 10:00
Computational Modeling of Current Flow in the Bipolar Cell Pathways of Degenerated Retina
Pragya Kosta, Kyle Laazos, University of Utah, United States; Ege Iseri, Javad Paknahad, Gianluca Laazi, University of Southern California, United States

MO-SP.2A.7 10:20
Matching Considerations for Wireless, Batteryless Brain Implants to High Impedance Electrodes
Katrina Guida, Asimina Kiourti, Ohio State University, United States

MO-SP.2A.8 10:40
Magnetic Induction-based Human Activity Recognition (MI-HAR)
Nagar Golestani, Mahta Moghaddam, University of Southern California, United States

MO-SP.2A.9 11:00
Design of an Interstitial Microwave Applicator for 3D Printing Antennas in the Body
Katrin Hall, Cynthia Furse, University of Utah, United States

MO-SP.2A.10 11:20
Cadaver Measurement Results Using Ultra-flexible Electro-textile MRI RF Coil
Daisong Zhang, Yahya Rahmat-Samii, University of California, Los Angeles, United States
Metamaterials

Session Co-Chairs: Igor Tsukerman, The University of Akron; Alexander Yakovlev, University of Mississippi

MO-UB.1A 08:00
An Equivalent ABCD-Matrix Approach for Multilayer Wire-Medium-Type Structures
Alexander B. Yakovlev, University of Mississippi, United States; Maria G. Silveirinha, University of Lisbon and Instituto de Telecomunicacoes, Portugal; George W. Hanson, University of Wisconsin-Milwaukee, United States; Chandra S. R. K. Kaipa, Independent Researcher, United States

MO-UB.1A.2 08:20
Accurate Homogenization of Layered Structures and a Breakdown of Effective Medium Theory
A M A Shafayyar Hassain, Igor Tsukerman, University of Akron, United States; Y. D. Chong, Nanyang Technological University, Singapore

MO-UB.1A.3 08:40
Avoiding Imaging Artifacts in Metamaterial Superlenses
Amin Aghaie, Kenneth Zhou, Luiz Markley, University of British Columbia, Canada

MO-UB.1A.4 09:00
Digital Metasurfaces Based on Spatio-Temporal Coding
Lei Zhang, Xiao Qing Chen, Shuo Liu, Qian Zhang, Jie Zhao, Jun Yan Dai, Guo Dong Bai, Xiang Wan, Qiang Cheng, Southeast University, China; Giuseppe Castaldi, Vincenzo Galdi, University of Sannio, Italy; Tie Jun Cai, Southeast University, China

MO-UB.1A.5 09:20
Nanometer-Scale Fabrication of Optical Metasurfaces Using Helium Ion Milling
Mitchell Sample, Ashwin K. Iyer, University of Alberta, Canada

Break 09:40

MO-UB.1A.6 10:00
2D Flat Lens Antenna Based on Metamaterials Printed Elements
Reuven Shoval, Ben-Gurion University of the Negev, Israel

MO-UB.1A.7 10:20
Free-space-matched left-handed metamaterials
Juan D. Baena, Ana C. Escobar, Universidad Nacional de Colombia, Colombia; Andrey Sayanskii, Stanislav B. Glybovski, ITMO University, Russia

MO-UB.1A.8 10:40
Nonlocal Metasurfaces Performing Optical Signal Processing on Two-Dimensional Images
Hyeong Kwon, University of Texas at Austin, United States; Andrea Cordaro, University of Amsterdam, Netherlands; Dimitrios Sounas, Wayne State University, United States; Albert Polman, AMOLF, Netherlands; Andrea Alù, CUNY Advanced Science Research Center, United States

Break 09:40

MO-UB.1A.9 11:00
Ultra-wideband Non Reciprocal Devices in Space-Time Modulated Transmission Lines
Yakov Hadas, Tel Aviv University, Israel; Amir Shlifinsky, Ben-Gurion University of the Negev, Israel

MO-UB.1A.10 11:20
Influence of NIC Accuracy on Properties of Self-oscillating Antennas and Metasurfaces
Leo Vince, Silvio Habans, Igor Krois, Ivan Basic, University of Zagreb, Croatia (Hrvatska)
Monday, July 8 08:00 - 11:40
Room 204/205

Beam Forming, Angle of Arrival and Pattern Synthesis
Session Co-Chairs: Ted Heath, Georgia Tech Research Institute; Joseph Hucks, Georgia Tech Research Institute; Paul Simmons, Georgia Tech Research Institute

MO-A1.1A.1 08:00
Directions of Arrival Estimation in Linear Sub-Arrayed Array Through Compressive Sensing
Mohammad Abdul Hannan, Paolo Rocca, ELEDIA Research Center (ELEDIA@UniTN – University of Trento), Italy

MO-A1.1A.2 08:20
AoA Estimation With Practical Antenna Arrays Using Neural Networks
Yaozhang Xiao, Zhengping Yun, Magdy Iskander, University of Hawaii at Manoa, United States

MO-A1.1A.3 08:40
Optimal Synthesis of Wideband Beamforming Weights for Monopulse Tracking Radar - The Linear Array Case
Le Trong Phuc Bu, Lorenzo Poli, Paolo Rocca, ELEDIA Research Center (ELEDIA@UniTN – University of Trento), Italy

MO-A1.1A.4 09:00
Application of Sparse Representation to Beamforming for Direction of Arrival Estimation
Jacob Campaño, Indr Gupta, Ohio State University, United States

MO-A1.1A.5 09:20
Optimal Thinning Techniques of Antenna Phased Arrays for Dual Band Operation
Ratem Gol, Reuven Shavit, Ben Gurion University of the Negev, Israel

Break 09:40

MO-A1.1A.6 10:00
Comparison Between Deterministic and Stochastic Methods for the Synthesis of Aperiodic Arrays
Guilia Buttazzoni, Fulvio Babich, Francesca Vatta, Massimiliano Comissa, University of Trieste, Italy

MO-A1.1A.7 10:20
A Generalized Technique to Accurately Predict Conformal Antenna Arrays
Hannah Johnson, George R. Bronner, Gregory Nelson, Matt Chon, University of California, Davis, United States; B.P. Kumar, California State University, United States

MO-A1.1A.8 10:40
Reduction of the Number of Phase Shifters in Linear Phased Antenna Arrays by using Evolutionary Multi-Objective Optimization
Juan L. Valle, Carlos A. Bizuela, Marco A. Panduro, Center for Scientific Research and Higher Education of Ensenada, Mexico; Alberto Reyna, Autonomous University of Tamaulipas, Mexico

MO-A1.1A.9 11:00
Phase-Controlled Beam-Scanning of Arbitrary Antenna Arrays with Far-Field Fixed Nulls
Guilia Buttazzoni, Fulvio Babich, Francesca Vatta, Massimiliano Comissa, University of Trieste, Italy

MO-A1.1A.10 11:20
A novel beam-steering method at the carrier frequency with time modulated array
Gang Ni, Chang He, Xiao-Ling Liang, Junping Geng, Weiran Zhu, Ronghong Jin, Shanghai Jiao Tong University, China

Monday, July 8 08:00 - 11:20
Room 206/207

Dielectric Resonator Antennas
Session Co-Chairs: Dustin Isleifson, University of Manitoba; A. Al-Rawi, Eindhoven University of Technology

MO-A1.2A.1 08:00
Band-notched Reconfigurable Rectangular Dielectric Resonator Antenna with Parasitic Elements
Benjia Liu, Jinghui Qiu, Hua Zong, Lifei Bao, Nannan Wang, Shengchang Lan, Harbin Institute of Technology, China

MO-A1.2A.2 08:20
Split Ring Loaded Dual-polarized Dielectric Resonator Antennas
Yaoxia Liu, Dustin Isleifson, Lutfullah Shafa, University of Manitoba, Canada

MO-A1.2A.3 08:40
Differentially Fed CODA Array with Phase Inverter for High Gain and Reduced Cross Polarization
Md Nazmul Hasan, Sungkyunkwan University, Korea (South); Roy B.V.B Simorangkir, Karu Esselle, Macquarie University, Australia; Saeideh Shad, Boise State University, United States

MO-A1.2A.4 09:00
Discussion on Series-Fed Parasitic DRA Array with Low Dielectric Constant Excited by SIW SLOTS
Wael M. Abdel-Wahab, University of Waterloo, Canada; Ying Wang, University of Ontario Institute of Technology, Canada; Safieddin Safavi-Naeini, University of Waterloo, Canada

MO-A1.2A.5 09:20
Point-to-Point Dielectric-Horn Integrated Resonator Antenna with Reduced Side Lobe Level
E. Babaloo, Sapienza Universita di Roma, Netherlands; A. Al-Rawi, A. Bart Smolders, Eindhoven University of Technology, Netherlands; R. Ciccheri, Sapienza Universita di Roma, Netherlands; Diego Cortelli, The Antenna Company, Netherlands

Break 09:40

MO-A1.2A.6 10:00
High Gain Ridge Gap Dielectric Resonator Antenna using FSS Superstrates
Mahi Bahmani Kokhki, Zahra Mousavirazi, Institut national de la recherche scientifique (INRS), Canada; Tayeb A. Denidni, National Institute of Scientific Research (INRS), Canada

MO-A1.2A.7 10:20
Design and Analysis of Stacked Equilateral Triangular DRA for Wide Band Application
Rinki Ghosal, Bhaskar Gupta, Jadavpur University, India

MO-A1.2A.8 10:40
Dual-band Rectangular Dielectric Resonator Antenna
Bharathi Anantha, Osmania University, India; Lakshminarayana Merugu, Bharat Institute of Engineering and Technology, India

MO-A1.2A.9 11:00
Pattern Reconfigurable Dielectric Resonator Antenna Actuated by Shorted Parasitic Elements
Beijia Liu, Jinghui Qiu, Shengchang Lan, Hua Zong, Nannan Wang, Harbin Institute of Technology, China
Additively Manufactured Antennas and Structures
Session Co-Chairs: Ahmed A. Kishk, Concordia University; Gregory Huff, Pennsylvania State University

MO-A5.2A 08:00
Slot-Excited Wideband Horn Antenna with Microstrip Line Feeding for Ka-Band Applications
Nadeem Ashraf, Ahmed Kishk, Abdel Razik Sebak, Concordia University, Canada

MO-A5.2A 08:20
Phased Array Antenna Element with Embedded Cavity and MMIC using Direct Digital Manufacturing
Narve Karac, University of South Florida, United States; Casey Perkins, Kenneth Church, Scipio Inc., United States; Bae-Ian Wu, Air Force Research Laboratory, United States; Jing Wang, University of South Florida, United States; Thomas Walker, Oregon State University, United States; Gokhan Mumcu, University of South Florida, United States

MO-A5.2A 08:40
Wrist-Worn RFID Antenna Printed on Additive Manufactured Flexible Substrate
João M. Felício, Instituto de Telecomunicações, Portugal; Sérgio A. Matos, Instituto de Telecomunicações/ISCTE-IUL, Portugal; António M. Almeida, Instituto de Telecomunicações/Instituto Superior Técnico, Portugal; Jorge R. Costa, Instituto de Telecomunicações/ISCTE-IUL, Portugal; Carlos A. Fernandes, Instituto de Telecomunicações/Instituto Superior Técnico, Portugal

MO-A5.2A 09:00
Additively Manufactured Cylindrical Array with Snap-fit Connector Integration
Anna Stume, Mark Dorsey, U.S. Naval Research Laboratory, United States; Ozlem Kilic, Catholic University of America, United States

MO-A5.2A 09:20
A Novel Diagnostics Method for Determining the Unknown Permittivity Profile of 3D Printed Lenses
Jordan Budhu, Yahya Rahmat-Samii, University of California, Los Angeles, United States

Break 09:40

MO-A5.2A 10:00
Additively Manufactured Circular-Linear Polarization Converter using Circular Waveguide
David Mitchell, Nicole Bohannon, Laboratory for Physical Sciences, United States

MO-A5.2A 10:20
Inkjet Printed Lange Coupler for Antenna Systems
Xiaoke He, Manos Tentzeris, Georgia Institute of Technology, United States

MO-A5.2A 10:40
Electroless Silver Plating of Additive Manufactured Trough Waveguide Mode Transducer and Antenna Structure
Anirto Bose, Anoop Tiwari, Texas A&M University, United States; Gregory Huff, Pennsylvania State University, United States

MO-A5.2A 11:00
Liquid Waveguide Antenna
Guan-Long Huang, Jia-jun Liang, Tao Yuan, Shenzhen University, China

MO-A5.2A 11:20
Ku-Band Low-Cost Focused Lens with Frequency-Scanning Features
Shihin Liu, Xianqi Lin, University of Electronic Science and Technology of China, China

Electromagnetic Measurements and Material Characterization I
Session Co-Chairs: Jon Wallace, Lafayette College; Adib Nashashibi, The University of Michigan

MO-A2.1A 08:00
Permittivity Characterization of Automotive Paint Material at W-Band Frequencies
Adib Nashashibi, Kamal Sarabandi, University of Michigan, United States; Hussein Shamim, Mohammed Aseeri, King Abdulaziz City for Science and Technology, Saudi Arabia

MO-A2.1A 08:20
Highly Accurate Liquid Permittivity Measurement using Coaxial Lines
Seyed Mirjahanmardi, Omar Ramahi, University of Waterloo, Canada

MO-A2.1A 08:40
EM Measurements of Glucose-Aqueous Solutions
Ali Eldin Omar, George Shaker, Saeeddin Safavi-Naeini, Raed M. Shubair, University of Waterloo, Canada

MO-A2.1A 09:00
4-40 GHz Permittivity Measurements of Indoor Building Materials
Jonathan Abel, Jon Wallace, Lafayette College, United States

MO-A2.1A 09:20
Measurement of Dielectric Constants of Liquid Crystals Using Double-Ridged Waveguide Cavity
Chengyong Yu, En Li, University of Electronic Science and Technology of China, China

Break 09:40

MO-A2.1A 10:00
Permittivity depth profile measurements of the Antarctic firn layer in the 0.4-2 GHz band
Roberto Olmi, Saverio Priori, Consiglio Nazionale delle Ricerche, Italy; Alberto Toccafondi, Federico Puggelli, University of Siena, Italy

MO-A2.1A 10:20
Characterization of Biological Tissues Using a Suspended Microstrip Ring Resonator
Nivedita Parthasarathy, Ramesh Abhari, Santa Clara University, United States

MO-A2.1A 10:40
Characterization of Oils and Oil Mixtures using Terahertz Time-Domain Spectroscopy
Khem Poudel, Seth Floyd, William Robertson, Middle Tennessee State University, United States

MO-A2.1A 11:00
Microwave performance measurement of InP powder under light irradiation
Yafeng Li, En Li, University of Electronic Science and Technology of China, China
Millimeter-wave and Terahertz Antenna Design and Optimization
Session Co-Chairs: Yang Hao, Queen Mary University of London; Andrea Neto, Delft University of Technology

**MO-A5.3A.1** 08:00
Analyzing Lens Based Focal Plane Arrays using Coherent Fourier Optics
Shahab Oddin Dabironezare, Giorgio Carluccio, Andrea Neto, Nina Llombart, Delft University of Technology, Netherlands

**MO-A5.3A.2** 08:20
Analysis of a Wideband Fabry-Pérot Cavity Antenna at 60 GHz using Grid Impedance Approximation
Ahmad Almutawa, Hamidreza Kazemi, Filippo Capolino, University of California, Irvine, Kuwait; David Jackson, University of Houston, United States

**MO-A5.3A.3** 08:40
Modified Luneburg Lens for THz Beam Steering Applications
Andre Sarker Andy, Queen Mary University of London, United Kingdom; Emma Newton, Sajad Haq, QinetiQ, United Kingdom; Yang Hao, Queen Mary University of London, United Kingdom

**MO-A5.3A.4** 09:00
Finger Blockage Mitigation Method for mmWave Beamforming Mobile Devices
Youngsoo Youn, Dongkwon Choi, Wonbin Hong, Pohang University of Science and Technology (POSTECH), Korea (South)

**MO-A5.3A.5** 09:20
Dual-band Phased Array Antenna on Metal for mmWave Mobile Application
Jungil Kim, Sung Soo Kim, Young Joong Yoon, Yonsei University, Korea (South); Hyunguk Kim, Daehan University College, Korea (South)

Break 09:40

**MO-A5.3A.6** 10:00
Leaky Lens Pulsed Photo-Conductive THz Emitters
Alessandro Garufo, Paolo Sberna, Giorgio Carluccio, Delft University of Technology, Netherlands; Juan Bueno, Netherland Institute of Space Research (SRON), Netherlands; Joshua Freeman, David Bacon, Lianhe Li, University of Leeds, United Kingdom; Jochem Baselmans, Netherland Institute of Space Research (SRON), Netherlands; Edmund Linfield, Alexander Davies, University of Leeds, United Kingdom; Nina Llombart, Andrea Neto, Delft University of Technology, Netherlands

**MO-A5.3A.7** 10:20
E-shaped Nano-antenna with Asymmetric Integrated Dielectric-plasmonic Waveguide
Zahra Manzoor, Missouri University of Science and Technology, United States; Mohammad Ali Panahi, University of California, Los Angeles, United States; Amin Pak, Simon University, Iran

**MO-A5.3A.8** 10:40
Array Optimization for Maximum Realized Gain in Terahertz Antenna with Lens
Galia Ghazi, Patience Sadiq-mashkenani, Reza Safian, imec, United States

**MO-A5.3A.9** 11:00
Millimeter-Wave Antenna with Improved Bandwidth and Isolation for MIMO Applications
Chunxu Mao, Pingjuan L. Werner, Douglas H. Werner, Pennsylvania State University, United States

**MO-A5.3A.10** 11:20
Modulating Surface Impedance of Surface Plasmon Polaritons for Leaky Wave Plasmonic Nanoantennas
Yuan Song Zeng, Shi-Wei Qu, University of Electronic Science and Technology of China, China

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Leaky-Wave and Travelling-Wave Antennas
Session Co-Chairs: Rafael Rodriguez Solis, University of Puerto Rico at Mayaguez; David R. Jackson, University of Houston

**MO-A1.3A.1** 08:00
Leaky-Wave Antenna on Holey EBG Based Gap-Waveguide
Maria Sato Medina, Rafael Rodriguez Solis, University of Puerto Rico at Mayaguez, United States

**MO-A1.3A.2** 08:20
Millimeter-Wave Metallic Bull’s-Eye Antenna with Wideband Broadside Radiation Characteristics
Glad Dragos, Queen’s University, Canada; Brad Jackson, California State University, Northridge, United States; Carlos Soavedra, Queen’s University, Canada

**MO-A1.3A.3** 08:40
Periodic Leaky-Wave Antenna with Modified Gielis-Shaped Patch Elements
Vignesh Shannugam Bhaskar, Eng Leong Tan, King Ho Holden Li, Nanyang Technological University, Singapore

**MO-A1.3A.4** 09:00
A Hybrid Uniform/Periodic Dual-Mode Dielectric Grating Leaky-Wave Antenna
Lubin Sun, Tsinghua University, China; Yuanxin Li, Sun Yat-sen University, China; Yue Li, Zhijun Zhang, Zhenghe Feng, Tsinghua University, China

**MO-A1.3A.5** 09:20
Low Cross Polarization Leaky-Wave Antenna Based on SIW-CRLH Transmission Line
Yang Liu, Hongjian Wang, Lihang Zhang, National Space Science Center, Chinese Academy of Sciences, China

Break 09:40

**MO-A1.3A.6** 10:00
Recent Advances in 1-D Leaky-Wave Antenna Theory
Walter Fuscaldo, Sapienza University of Rome, Italy; David Jackson, University of Houston, United States; Alessandro Galli, Sapienza University of Rome, Italy

**MO-A1.3A.7** 10:20
A Wideband Frequency Beam Scanning Antenna Based on the Spoof Surface Plasmon Polaritons
Jun Wang, Zhang-Cheng Hao, Southeast University, China; Lei Zhao, China University of Mining and Technology, China

**MO-A1.3A.8** 10:40
Microstrip-Fed Endfire Antennas with High Gain and Stable Radiation Pattern
Yuefeng Hou, Yue Li, Zhijun Zhang, Zhenghe Feng, Tsinghua University, China

**MO-A1.3A.9** 11:00
A Novel Conformal Travelling-Wave Circularly Polarized Microstrip Antenna Design
Stanislav Ogurtsov, Slavomir Kazelé, Reykjavik University, Iceland
Broadband Antennas for 5G systems
Session Co-Chairs: Nada Sekeljic, Intel; Daniel Segovia-Vargas, Universidad Carlos III de Madrid

MO-A1.4A.1 08:00
5G Broadband Antenna for sub-6 GHz Wireless Applications
Nada Sekeljic, Zhen Yoo, Hao-Han Nau, Intel, United States

MO-A1.4A.2 08:20
Design of a Wideband Vivaldi Antenna for 5G Base Stations
Paulo Fernandez-Martinez, Sergio Martin-Anton, Daniel Segovia-Vargas, Universidad Carlos III de Madrid, Spain

MO-A1.4A.3 08:40
MIMO Antenna for Indoor Low-Band 5G Base Stations
Jaime Molina-Benllure, Universitat Politècnica de València, Spain; Anbal Llango-Vargas, Universidad Nacional de Chimborazo, Ecuador; Dong Kook Park, Korea Maritime and Ocean University, Korea (South); Miguel Fernández-Bataller, Marta Cabedo-Fabrés, Universitat Politècnica de València, Spain

MO-A1.4A.4 09:00
Analog Beamforming System Using Rotman Lens for 5G Applications at 28 GHz
Essa Mjammarni, Abdelrazik Sebak, Concordia University, Canada

MO-A1.4A.5 09:20
ISGW Feed Slot-Coupled Magnetoelectric Dipole Antenna For 5G Applications
Huaqiang Zhang, Dongya Shen, Hong Yuan, Yunnan University, China

Analog and Digital Signal Processing

Monday, July 8 10:00 - 11:40
MO-A2.2A Room 303

Analysis of Metamaterials and Metasurfaces
Session Co-Chairs: Ariel Epstein, Technion - Israel Institute of Technology; Anthony Grbic, University of Michigan

MO-A2.2A.1 10:00
Rigorous Analytical Model for Metasurface Microscopic Design with Interlayer Coupling
Shahar Levy, Yaniv Kozhner, Ariel Epstein, Technion - Israel Institute of Technology, Israel

MO-A2.2A.2 10:20
Equivalent Circuit Models and Prony’s Analysis of Electromagnetic Designs Using Genetic Programming
 Gui Chao Huang, Scott Clemens, Magdy Iskander, Zhengang Yun, University of Hawaii, United States

MO-A2.2A.3 10:40
Modified Floquet Scattering Matrix Method for Solving N-path Networks
Cody Scarborough, Anthony Grbic, University of Michigan, United States

MO-A2.2A.4 11:00
Categorizing Metamaterials by using Equivalent Dielectric Approach
Abdulkhalok Nasi, Research Laboratory Smart Electricity & ICT, SECT, LR18ES44, Tunisia; Raj Mittra, University of Central Florida, United States; Hatem Rmili, King Abdulaziz University, Faculty of Engineering, Saudi Arabia

MO-A2.2A.5 11:20
Analysis of Phase Discretization Influence on the Monochromatic Aberrations of Focusing Metasurface Based on Generalized Rayleigh-Sommerfeld Diffraction Theory
Hongjun Chu, Jiaren Qi, Jinghui Qiu, Harbin Institute of Technology, China

Remote Sensing
Session Co-Chairs: Leung Tsang, University of Michigan; Robert Burkholder, Ohio State University

MO-A4.1A.1 08:00
Non-Destructive Dielectric Constant Measurement of Low-Loss Dielectric Slabs Using Wideband Autocorrelation Radiometry
Maryam Salim, University of Michigan, United States; Shurun Tan, Zhejiang University, China; Leung Tsang, University of Michigan, United States

MO-A4.1A.2 08:20
Evaporation Duct Refractivity Inversions from Fixed Transmitter-Fixed Receiver UWB Measurements
Luyao Xu, Caglar Yardim, Robert Burkholder, Ohio State University, United States; Denny P. Alaparthi, Qing Wang, Naval Postgraduate School, United States

MO-A4.1A.3 08:40
Multiple Scattering Solution of Passive Radiative Transfer Equations Applied to Forests
Yujia Zhu, Leung Tsang, University of Michigan, United States; Wenhua Ding, Harbin Institute of Technology, China

MO-A4.1A.4 09:00
Integrated Water Vapor Estimation through Microwave Propagation Measurements: First Experiment on a Ground-To-Ground Radio Link
Alberto Toccafondo, Fedorica Pugelli, Matteo Albani, University of Siena, Italy; Luca Facheris, University of Florence, Italy; Fabrizio Cuccoli, CNIT- National Inter-University Consortium for Telecommunications, Italy; Giovanni Maccioni, Francesco Montamolì, National Research Council of Italy (CNR), Italy; Alesia Cocini, Francesco Maniattini, WaveComm S.r.l., Italy; Luigi Velpi, RTW Ride The Wave S.r.l., Italy; Devis Dei, Florence Engineering S.r.l., Italy, Marco Gal, Laboratori Vicentia s.s.r., Italy

MO-A4.1A.5 09:20
Micro-Doppler Based Detection of Hovering UAVs
Limin Wang, Yang Li, Ning Zhang, Xinyang Wang, Harbin Institute of Technology, China; Wenhua Ding, Harbin Institute of Technology, China

MO-A4.1A.6 09:40
Modeling and Measurement of Ducted EM Propagation over the Gulf Stream
Qi Wang, Robert Burkholder, Ohio State University, United States

MO-A4.1A.7 10:00
Electromagnetic Scattering from Random Rough Surfaces with Multiple Elevations for GNSS-R Land Applications
Yujia Zhu, Leung Tsang, University of Michigan, United States

MO-A4.1A.8 10:20
Retrieval of Subsurface Properties of Layered Dielectric Structures Using Hybrid Global and Local Optimization
Aslon Eminian, Alireza Tabatabaeenejad, Richard Chen, Maha Maghaddam, University of Southern California, United States

MO-A4.1A.9 10:40
A Machine Learning Based First-Order Sea Clutter Region Extraction Method for HFSWR
Yang Li, Xinyang Wang, Ning Zhang, Harbin Institute of Technology, China; Wenhua Ding, Qiming Zhang, CSSC Marine Technology Co., Ltd, China; Wenhua Ding, Harbin Institute of Technology, China

MO-A4.1A.10 11:00
Maneuvering Target Detection Method Based on RD Spectrum of Skywave OTHR
Hui Zheng, Yang Li, Ning Zhang, Longshan Wu, Xinyang Wang, Wenhua Ding, Harbin Institute of Technology, China

Monday, July 8 10:00 - 11:40
MO-A2.2A Room 303

Monday, July 8 08:00 - 11:40
MO-A4.1A Room 304
## Transient Simulations
### Session Co-Chairs: Hakan Bagci, King Abdullah University of Science and Technology (KAUST); Tapan Sarkar, Syracuse University

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<th>Time</th>
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<th>Authors</th>
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<tr>
<td>08:00</td>
<td>Transient Diffraction Mechanism of Electromagnetic Scattering from Conducting Bodies based on the Approximation of Physical Optics</td>
<td>Hsi-Tseng Chou, Chen-Yi Chang, National Taiwan University, Taiwan</td>
</tr>
<tr>
<td>08:20</td>
<td>A Higher-order Explicit Marching-on-in-time for Analysis of Transient Acoustic Scattering from Rigid Objects</td>
<td>Rui Chen, Hakan Bagci, King Abdullah University of Science and Technology (KAUST), Saudi Arabia</td>
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<td>08:40</td>
<td>A Stabilized Marching-on-in-Degree Solution of Time Domain Combined Field Integral Equation</td>
<td>Ming-Da Zhu, Xidian University, China; Tapan Sarkar, Syracuse University, United States; Yu Zhong, Xidian University, China</td>
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<tr>
<td>09:00</td>
<td>Fast Multipole Time Domain Algorithm for the Scalar and Vector Wave Equation</td>
<td>Yifei Shi, Jiangsu University of Technology, China</td>
</tr>
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<td>09:20</td>
<td>Predicting Instability in Transient Simulations, using Complex Numerical Impulse Response</td>
<td>Amirreza Jalali Khalilabad, Ata Zadehgol, University of Idaho, United States</td>
</tr>
<tr>
<td>09:40</td>
<td>A Two-Component Compact 2-D FDFD Method for Waveguide Structures with ARPACK</td>
<td>Xiaoliang Gu, Xiaolin Jin, Jinxin Li, Bin Li, University of Electronic Science and Technology of China, China</td>
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<tr>
<td>10:00</td>
<td>Transient Analysis of Electromagnetic Scattering by Penetrable Objects Based on Time-Domain PMCHWT Equations</td>
<td>Qing Xu, Xi Yuan Du, Ze Yuan Lu, Mei Song Tong, Tongji University, China</td>
</tr>
<tr>
<td>10:40</td>
<td>A Hybrid Sub-Gridded FDTD for Efficient Time Reversal Simulation</td>
<td>Bao-Jun Jiang, Xiao-Kun Wei, Fu-Long Jin, Zhipeng Wang, Wei Shao, University of Electronic Science and Technology of China, China</td>
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<tr>
<td>11:00</td>
<td>Field Sampling Strategies for POD Model Order Reduction of Particle-in-Cell Simulations</td>
<td>Julio de Lima Nicolini, Dong-Yeap Na, Fernando Lisboa Texeira, Ohio State University, United States</td>
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</tbody>
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## Frequency Selective Surfaces and Filters
### Session Chair: Gregory Huff, Pennsylvania State University

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<th>Time</th>
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<tr>
<td>08:00</td>
<td>Plasmonic Metamaterial Based Dual-Band Filter</td>
<td>Nidhi Pandit, Rahul Kumar Jaiswal, Nagendra Prasad Pathak, Indian Institute of Technology, Roorkee, India</td>
</tr>
<tr>
<td>08:20</td>
<td>Leveraging Data Science to Characterize Additively Manufactured Electromagnetic Components</td>
<td>Deanna Sessions, Pennsylvania State University, United States; Andrew Gillman, UES Inc., United States; Alexander Cook, Nextflex, United States; Kazuko Foch, University of Dayton Research Institute, United States; Gregory Huff, Pennsylvania State University, United States; Philip Buskohl, Air Force Research Laboratory, United States</td>
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<tr>
<td>08:40</td>
<td>Terahertz Plasmonic Metamaterial Based Multi-band Band-Pass Filter Using Micro-Ring Resonator</td>
<td>Rahul Kumar Jaiswal, Nidhi Pandit, Nagendra Prasad Pathak, Indian Institute of Technology, Roorkee, India</td>
</tr>
<tr>
<td>09:00</td>
<td>Wideband BPF for 5G mm-wave Applications with Detailed Extraction of Poles and Zeros</td>
<td>Aqeela Saghir, Salman Arain, Abdul Quddious, Symeon Nikolaou, Photos Vryonides, Frederick Research Center, Frederick University, Cyprus</td>
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<td>09:20</td>
<td>Reflectionless perfect absorber based on hybridization of electric and magnetic resonant modes</td>
<td>Juan P. del Risco, Joan D. Banoa, Universidad Nacional de Colombia, Colombia; Andrey Sayorskiy, Stanislav B. Glybovski, ITMO University, Russia</td>
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## Spiral Antennas
### Session Chair: Hisamatsu Nakano, Hosei University

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<tr>
<td>10:00</td>
<td>Analysis of Cross- and X-Shaped Spiral Antenna Arrays for Amplitude-Comparison DF Systems</td>
<td>Eduardo Sakamura, Daniel Ferreira, Ildefonso Bianchi, Daniel Chagas da Nascimento, Diego Moná, Technological Institute of Aeronautics, Brazil</td>
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<tr>
<td>10:20</td>
<td>An Ultra-Wideband Edge-Fed Octagonal Four-Arm Archimedean Spiral Antenna</td>
<td>Sanghoon Lee, Michael E.D. Smith, Sensen Li, Hua Wang, Georgia Institute of Technology, United States</td>
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<td>10:40</td>
<td>Underwater Deployment and Performance of Curved Spiral Antennas in Mussel Backpacks</td>
<td>Robert Llaneras, Kumar Vijay Mishra, James Niemeier, Anton Kruger, University of Iowa, United States</td>
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<td>11:00</td>
<td>Bow-Spiral Antenna</td>
<td>Thi M. D. Tran, Marc Piette, Royal Military Academy, Belgium</td>
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<td>11:20</td>
<td>Performance Analysis of Azimuth-Only Amplitude-Comparison DF System in Operational Scenarios</td>
<td>Eduardo Sakamura, Daniel Ferreira, Ildefonso Bianchi, Daniel Chagas da Nascimento, Diego Moná, Technological Institute of Aeronautics, Brazil</td>
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</table>
Antenna Theory and Design I
Session Co-Chairs: Satish Sharma, San Diego State University; Kubilay Sertel, Ohio State University

MO-UB.3A.1 08:00
Wide Angle Beam Steering Cylindrical Parabolic Reflector with Phased Array as a Feed Source for Ku-Band Applications
Ghandhyam Mishra, Satish K Sharma, San Diego State University, United States; Jia-Chi Chieh, Randall Olsen, SPAWAR, United States

MO-UB.3A.2 08:20
Compressed Elliptical Geodesic Luneburg Lens for Ka-band Satellite Communications
Qingbi Liao, Oscar Quevedo-Teruel, KTH Royal Institute of Technology, Sweden

MO-UB.3A.3 08:40
Flexibility In Space: Challenges and Evolution In Satellite Antennas Specification, Design and Test
Sara Mugnaini, Eva Gonzalez Esteban, Inmarsat plc, United Kingdom

MO-UB.3A.4 09:00
Design of Dual-Polarized, Platform-Based HF Antennas for NVIS Applications Using the Characteristic Mode Theory
Kai Ren, Mohammad Ranjbar Nikkhah, Nader Behdad, University of Wisconsin-Madison, United States

MO-UB.3A.5 09:20
Voltage Doublert Rectenna Design with Surface Waves Suppression
Mohammad Farrouz, Public Authority for Applied Education and Training (PAAET), Kuwait

Break 09:40

MO-UB.3A.6 10:00
Non-Contact Characterization of Antenna Parameters via Network Calibration
Seckin Sahin, Niru K. Nahar, Kubilay Sertel, Ohio State University, United States

MO-UB.3A.7 10:20
Design of a Fast Antenna Tuner for a Synchronously Tuned Mobile HF/VHF Transmitter
Jacob Rissmiller, Jacob Peiffer, Layth Hozi, Erica Daly, SPAWAR Systems Center Pacific, United States

MO-UB.3A.8 10:40
A Novel Planar Microstrip Line Comparator Network for Monopulse Tracking Radar System
Hanxiang Zhang, Hon Ren, Bayaner Arigong, Washington State University, United States

MO-UB.3A.9 11:00
Full-wave synthesis procedure for the design of innovative metasurface devices
Modeste Bodehou, Christophe Groze, Université catholique de Louvain, Belgium; Enrica Martini, Stefano Maci, University of Siena, Italy

MO-UB.3A.10 11:20
Accurate Reconstruction of Antenna Radiation Pattern from Measurements in a Small Non-ideal Chamber
Layth Abdullah, University of Karbala, Iraq

Application of Machine/Deep Learning and Uncertainty Quantification Techniques in Computational Electromagnetics
Session Co-Chairs: Luis Gomez, Duke University School of Medicine; Cynthia Furse, University of Utah; Costas Sarris, University of Toronto

MO-SP.1P.1 13:20
Generalization Capabilities of Deep Learning Schemes in Solving Inverse Scattering Problems
Zhan Wei, Xudong Chen, National University of Singapore, Singapore

MO-SP.1P.2 13:40
Geometrically Stochastic Finite Difference Time Domain Method
Khadijah Masumnia-Bisheh, Tarbiat Modares University, Iran; Cynthia Furse, University of Utah, United States

MO-SP.1P.3 14:00
Fast Surrogate Model-Assisted Uncertainty Quantification via Quantized Tensor Train Decompositions
Luis Gomez, Duke University School of Medicine, United States; Abdulkadir Yuce, Nanyang Technological University, Singapore; Weitian Sheng, Cadence Design Systems, United States; Eric Michielssen, University of Michigan, United States

MO-SP.1P.4 14:20
Deep Convolutional Neural Network Approach for Solving Nonlinear Inverse Scattering Problems
Lianlin Li, Longgang Wang, Peking University, China; Daniel Ospina Acero, Fernando Teixeira, Ohio State University, United States

MO-SP.1P.5 14:40
Error Estimation and Uncertainty Quantification Based on Adjoint Methods in Computational Electromagnetics
Branislav Notaros, Jake Harman, Cam Key, Donald Estep, Colorado State University, United States; Troy Butler, University of Colorado Denver, United States

Break 15:00

MO-SP.1P.6 15:20
A Multi-Level Reconstruction Algorithm for Electrical Capacitance Tomography Based on Modular Deep Neural Networks
Elizabeth Chen, Costas Sarris, University of Toronto, Canada

MO-SP.1P.7 15:40
Deep Neural Network Representations of Transient Electrodynamic Phenomena
Oameed Nookoostaieen, Shu Wang, Zhen Peng, University of New Mexico, United States

MO-SP.1P.8 16:00
Fast and Accurate Near-Field to Far-Field Transformation Using an Adaptive Sampling Algorithm and Machine Learning
Rezvan Rafiee Alavi, Rashid Mirzavand, Pedram Mousavi, University of Alberta, Canada

MO-SP.1P.9 16:20
Experimental Microwave Target Identification Using Machine Learning
Clayton Kettlewell, Kyle Hetiananek, George Scott, Waleed Al-Sharkh, Blake Wilig, Ao-Addin Nabulsi, Somen Baidya, Ahmed M. Hassan, University of Missouri-Kansas City, United States

MO-SP.1P.10 16:40
Uncertainty Quantification of Radio Propagation Models Using Artificial Neural Networks
Aristeidis Seretis, Xingyi Zhang, Costas Sarris, University of Toronto, Canada
Space-Time Modulated Metamaterials
Session Co-Chairs: Christophe Caloz, Polytechnique Montréal; Andrea Alù, CUNY Advanced Science Research Center

MO-SP.2P.1 13:20
The Dawn of Spacetime Metamaterials
Christophe Caloz, Zoë-Lise Deck-Léger, École Polytechnique de Montréal, Canada

MO-SP.2P.2 13:40
Propagation in a Temporally Modulated Transmission Line: Exotic Band Structures and Reconfigurable Applications
Peter Halevi, Alexander Gómez Rojas, Instituto Nacional de Astrofísica, Óptica y Electronica (INAOE), Mexico

MO-SP.2P.3 14:00
Nonreciprocal Transmission through Locally Time-Modulated Bianisotropic Metamaterials
Ana Díaz-Rubio, Viktar Asadchy, Grigorii Ptitcyn, Mohammad Mirmoosa, Sergei Israilev, Aalto University, Finland

MO-SP.2P.4 14:20
Non-Reciprocity Based on Synthetic Momentum Bias
Ahmed Kord, University of Texas at Austin, United States; Dimitrios Sounas, Wayne State University, United States; Andrea Alù, CUNY Advanced Science Research Center, United States

MO-SP.2P.5 14:40
Nonreciprocal Metasurfaces through Biasing with Circularly Polarized Waves
Dimitrios Sounas, Wayne State University, United States

Break 15:00

MO-SP.2P.6 15:20
UWB Impedance Matching by Temporal Switching
Yakir Hadad, Tel Aviv University, Israel; Amir Shlivinski, Ben Gurion University of the Negev, Israel

MO-SP.2P.7 15:40
Linear Pulse Compression based on Space-Time Modulation
Xibi Chen, Fan Yang, Tsinghua University, China

MO-SP.2P.8 16:00
Harmonic-Modulated Nonlinear Metasurface Based on Generalized Phase Conjugation Principle
Ye Shi, Meckun Li, Tsinghua University, China

MO-SP.2P.9 16:20
Full-duplex Near-infrared Communication via Spatiotemporally-modulated Array Antennas
Mohammad Mahdi Salary, Hossein Masallaei, Northeastern University, United States

MO-SP.2P.10 16:40
Coding Programmable Metasurfaces Based on Deep Learning Techniques
Tao Shan, Maokun Li, Tsinghua University, China

Break 15:00

MO-SP.2P.11 16:00
A Slotted Square Patch Antenna with Wideband Filtering Characteristics
Manisha Kabra, Manish Kamber Mandel, Indian Institute of Technology, Kharagpur, India
Antennas for 5G II
Session Co-Chairs: Seckin Sahin, Ohio State University; Wonbin Hong, Pohang University of Science and Technology

MO-A5.1P.1 13:20
Wideband printed ridge gap waveguide differential feeding aperture antenna for millimeter wave applications
Islam Afifi, Magid Alzidani, Abdel Razik Sebak, Concordia University, Canada

MO-A5.1P.2 13:40
mmWave Double Cavity-Backed Slot Antenna featuring Electrically Small and Low-Profile
Jaehyun Choi, Junha Park, Woonbang Hwang, Pohang University of Science and Technology (POSTECH), Korea (South)

MO-A5.1P.3 14:00
Conformal Antipodal Vivaldi Antenna With Parasitic Elements For 5G Millimeter Wave Applications
Yuxiao He, John Papapolymerou, Michigan State University, United States

MO-A5.1P.4 14:20
A Novel Wideband Millimeter Wave Integrated Substrate Gap Waveguide Patch Antenna
Bingshui Huangfu, Dongya Shen, Yunnan University, China; Xiupu Zhang, Concordia University, Canada

MO-A5.1P.5 14:40
Silver Nanowire based Flexible, Transparent, Wideband Antenna for 5G Band Application
Weiwei Li, Azat Meredov, Atif Shamim, King Abdullah University of Science and Technology (KAUST), Saudi Arabia

Break 15:00

MO-A5.1P.6 15:20
An Aperture-Coupled Dual-Polarized Stacked Patch Antenna for Multi-Layer Organic Package Integration
Duxian Liu, Xiaoxiong Gu, Christian Baks, Alberto Valdes-Garcia, IBM T. J. Watson Research Center, United States

MO-A5.1P.7 15:40
Series Chained Patch Phased Array Antenna for mmWave 5G Mobile in Metal Bezel Design
Sang Soo Kim, Samsung Electronics, Korea (South); Sung Hoe Kim, Bae Jang Hwan, Young Joong Yoon, Yonsei University, Korea (South)

MO-A5.1P.8 16:00
Design of a Planar Wideband Yagi-Uda Antenna for Millimeter Wave SAR Imaging Application
Yuan Gao, Mohammad Ghazv, Reza Zoughi, Missouri University of Science and Technology, United States

MO-A5.1P.9 16:20
Millimeter-Wave Triple-Resonance Substrate Integrated Waveguide Cavity-Backed Slot Antenna With Cavity Resonator
Jang Hwan Bae, Jun Gi Jeon, Young Joong Yoon, Yonsei University, Korea (South); Hyungnak Kim, Daed Kim University College, Korea (South)
Novel Reconfigurable Antennas and Arrays
Session Co-Chairs: Sajid Asif, Sheffield University; Kurt Schab, Santa Clara University

**MO-A1.3P.1** 13:20
Dense Microvasculature in Structural Composites for Reconfigurable Parallel Wire Screens
- Kurt Schab, Santa Clara University, United States; Jason Patrick, Sarah Mann, North Carolina State University, United States

**MO-A1.3P.2** 13:40
Electronically Reconfigurable Dipole Antenna Using Integrated Passive Non-Volatile Solid-State Metal-Insulator-Metal Switches
- Jayakrishnan Methapattyarambu Purushothama, Etienne Perret, Universite Grenoble Alpes, France; Arnoud Vena, Birte Sori, Université de Montpellier 2, France

**MO-A1.3P.3** 14:00
On Changing the Impedance of a Reactive Surface Using Magneto-static Responsive Particles
- Jerika Cleveland, Dipankar Mitra, Jaco Lewis, Benjamin D. Braaten, North Dakota State University, United States; Jeffery Allen, Monica Allen, Air Force Research Laboratory, United States

**MO-A1.3P.4** 14:20
Center-Fed Circularly Polarized Omnidirectional Open-Helical Element Optimization
- Hanadz Krucikovich, Benjamin Bladow, Jeffrey Varness, Steven Schennum, Gonzaga University, United States

**MO-A1.3P.5** 14:40
Performance Analysis of Radially Polarized Conformal Array in DOA and Polarization Estimation
- Yifang Lu, Ling Huang, Nanyang Technological University, Singapore

**MO-A1.3P.6** 15:00
Design of a Terahertz Reconfigurable Reflectarray with Individually Controlled 1-bit Phasing Elements
- Hongjiang Xu, Shenheng Xu, Fan Yang, Tsinghua University, China; Shaobo Dun, Shixiong Liang, HeBei Semiconductor Research Institute, China

**MO-A1.3P.7** 15:20
Study of interconnecting switch currents in reconfigurable parasitic layer antennas
- Germán Augusto Ramírez Arroyave, Javier Leonardo Araquí Queijima, Universidad Nacional de Colombia, Colombia; Christian Ballesteros, Sebastian Blanch Boris, Jardi Romeu, Universitat Politècnica de Catalunya (UPC), Spain; Bedri Cetiner, Utah State University, United States; Luis Jofra Roca, Universitat Politècnica de Catalunya (UPC), Spain

**MO-A1.3P.8** 15:40
A MIMO Communication System with Fixed and Reconfigurable Band Notch Antennas
- Rashid Saleem, Aisam Qudus, University of Engineering and Technology (UET), Taxila, Pakistan; Farhan Shahtaque, COMSATS Institute of Information Technology (CIIT), Pakistan; Tayyab Shabbir, University of Engineering and Technology (UET), Taxila, Pakistan

**MO-A1.3P.9** 16:20
Design of High Gain Low Cost Beam-Steering Reflectarray Antenna
- Shafiq Kausar, Saeedeh Shad, Ahmed Kausar, Hani Mehraipyan, Baise State University, United States

**MO-A1.3P.10** 16:40
A Grounded ±45° Dual Slant Polarized Omnidirectional Antenna
- Mohammad Shahzad Sadiq, Conjun Ruan, Beihang University, China

Slot Antennas
Session Chair: Hiroyuki Arai, Yokohama National University

**MO-A1.4P.1** 12:20
MM-Wave Beam-Steering Slot Antenna using Gradient Relative-Permittivity FSS Superstrate
- Zahra Moussavizai, Mehri Barzani Kokhaki, National Institute of Scientific Research (INRS), Canada; Vahid Rafi, Aydin University, Turkey; Tayeb A. Denidni, National Institute of Scientific Research (INRS), Canada

**MO-A1.4P.2** 13:40
A Multilayer Dielectric Filled Radial Substrate Integrated Waveguide Slot Antenna
- Divnok Kumar Chandrappa, Shivanan Gupta, Abdel Razik Sebak, Concordia University, Canada

**MO-A1.4P.3** 14:00
Eigenmode Analysis of Printed-Ridge-Gap-Waveguide Cavity and Its Application to Antenna design
- Zhenjiang Zhao, Huan Li, Mohamad Mantash, Tayeb A. Denidni, National Institute of Scientific Research (INRS), Canada

**MO-A1.4P.4** 14:20
Dual Polarized Omni Cell Antenna with Cylindrical Loop Slot
- Bakar Rahoni, Hiroiyuki Arai, Yokohama National University, Japan

**MO-A1.4P.5** 14:40
Dual-Band Anti-Interference Slot Antenna Using Metamaterial Structure
- Zhi Zheng, Wei Wang, Hong-Tao Zhang, Yu-Yang Zheng, East China Research Institute of Electronic Engineering, China; Kai-Ling Liang, Shanghai Jiao Tong University, China

**MO-A1.4P.6** 15:00
VHF notch antenna integrated in an aircraft winglet
- Marta Martinez-Vazquez, Jardi Balcells-Ventura, IMST GmbH, Germany; Zdeněk Řezníček, Evektor, Czech Republic; Kai Goten, Stefan Steeger, Invent GmbH, Germany; Petr Vrchota, VZLU - Czech Aerospace Research Centre, Czech Republic

**MO-A1.4P.7** 15:20
Dual-Band Dual-Polarized SIW Filtering Antenna
- Manisha Kahar, Mrinal Kanti Mandal, Indian Institute of Technology, Kharagpur, India

**MO-A1.4P.8** 16:00
Integrated Substrate Gap Waveguide Circularly Polarized Slot Antenna
- DanDan You, Dongya Shen, Yunnan University, China; Xian-Ling Liang, Shanghai Jiao Tong University, China

**MO-A1.4P.9** 16:20
W band Substrate-integrated Slot Antenna-in-package Using Higher Order Mode
- En Zhang, Lian Zhou, Shanghai Jiao Tong University, China; Wan-Yan Yin, Zhejiang University, China

**MO-A1.4P.10** 16:40
Grounded ±45° Dual Slant Polarized Omnidirectional Antenna
- Muhammad Shahzad Sadiq, Conjun Ruan, Beihang University, China
### Electromagnetic Measurements and Material Characterization II

**Session Co-Chairs:** Loic Markley, University of British Columbia; Agostino Monorchio, University of Pisa

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<td>13:20</td>
<td>Q-band Free-Space Setup for Measuring Dielectric Properties</td>
<td>Mohamed Hassan, Cairo University, Egypt; Raffaello Goswami, Ahmed Kishk, Vincent Mooney-Chapin, Concordia University, Canada</td>
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<td>13:40</td>
<td>An application of the virtual transmission line model of an open-ended coaxial probe for dielectric properties characterization of biological tissues</td>
<td>Nunzia Fontana, Eliana Canicatti, Agostino Monorchio, University of Pisa, Italy</td>
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<td>14:00</td>
<td>Highly Sensitive Planar Microwaves Sensor</td>
<td>Ali Al-Bahi, King Saud University, Saudi Arabia; Omar Ramahi, University of Waterloo, Canada</td>
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<td>14:20</td>
<td>Experiments on Magnetic Diffusion in Metal Sheets</td>
<td>Razi Manthena, Darmindra Aswamugam, NASA Jet Propulsion Laboratory, United States</td>
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<td>14:40</td>
<td>A modified test fixture using parallel strips for measuring attenuation of the dielectric rod</td>
<td>Chong Gao, En Li, Chengyang Yu, Yafeng Li, University of Electronic Science and Technology of China, China</td>
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**Break 15:00**

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<td>15:20</td>
<td>Analysis of Multiple Objective Cost Functions for Free Space Material Characterization with Genetic Algorithms</td>
<td>Raenita Fenner, Loyola University, United States; Ryan Banks, Virginia Polytechnic Institute and State University, United States; Mark Dorsey, Naval Research Laboratory, United States</td>
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<td>15:40</td>
<td>A Method for the Measurement of RF Absorber using Spectral Domain Transformations</td>
<td>Vicente Rodriguez, Brett T. Walkenhorst, NIST/Alcatel-Lucent, United States; Igor G. Brug, Aerospace, United States</td>
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<td>16:00</td>
<td>A Novel Technique to Reduce Truncation Error in Near-Field Measurements</td>
<td>Marco Salucci, ELEDIA Research Center (ELEcTont Acoustics - University of Trento), Italy; Marco Donadello, ELEDIA Research Center (ELEcTont Acoustics - University of Cassino and Southern Lazio), Cassino, Italy</td>
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<tr>
<td>16:20</td>
<td>Accuracy Investigation of Single-Cut Near-Field Far-Field Transformation Technique Based on 2D Plane-Wave Expansion</td>
<td>Shintaro Ono, Ikuo Kura, Takashi Akiyama, Tokyo University of Agriculture and Technology, Japan</td>
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### THz, Millimeter-Wave and Nanoscale EM

**Session Chair:** Andrea Alù, CUNY Advanced Science Research Center

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<td>13:20</td>
<td>Low Loss Slotted Substrate Integrated Air Waveguide (SIW) Antenna Array for Millimeter-Wave Applications</td>
<td>Linfeng Li, Jie-Bang Yan, University of Alabama, United States</td>
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<td>13:40</td>
<td>MEMS-Suspended Bowtie Antenna Array for Microbolometer mmW Imaging Device</td>
<td>Mark Lust, Shangyi Chen, Nima Ghalichechian, Ohio State University, United States</td>
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<td>14:00</td>
<td>Design of a Sector Beam Planar SIW RADAR for Surveillance Applications at Millimeter Waves</td>
<td>Santi Concerto Pavone, Matteo Albanese, University of Siena, Italy</td>
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<td>14:20</td>
<td>Plasmonic-Enhanced Graphene/III-V Hybrid Optical Diode</td>
<td>Bowen Zheng, Ruoxue Xue, Hang Li, Sensong An, Hong Tang, Clayton Fowler, University of Massachusetts Lowell, United States; Jeelwan Kim, Massachusetts Institute of Technology, United States; Wei Gao, Xuanliang Zhang, University of Massachusetts Lowell, United States</td>
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<td>14:40</td>
<td>Coherent Excitation of Embedded Eigenstates in non-Hermitian PT-Symmetrical Systems</td>
<td>Aleksandr Krasnok, Zarko Sakotic, CUNY Advanced Science Research Center, United States; Norbert Cejkovský, Nikola Janjic, University of Novi Sad, Serbia; Andrea Alù, CUNY Advanced Science Research Center, United States</td>
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**Break 15:00**

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<td>15:20</td>
<td>Monitoring Health Status and Quality Assessment of Leaves Using Terahertz Frequency</td>
<td>Adnan Zahid, University of Glasgow, United Kingdom; Hasan Tahir Abbas, Texas A&amp;M University at Qatar, Qatar; Fawad Sheikh, Thomas Kaiser, Universiteit Dusseldorf-Essen, Germany; Ahmad Zoha, Muhammad Ali Imran, Qammar Hussain Abbas, University of Glasgow, United Kingdom</td>
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<tr>
<td>15:40</td>
<td>Monitoring Quality Control of Fruits Using Terahertz Sensing</td>
<td>Aftab Rizq, Xiyan University, China; Adnan Zahid, Muhammad Ali Imran, Qammar H. Abbas, University of Glasgow, United Kingdom; Akram Alomair, Queen Mary University of London, United Kingdom</td>
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<td>16:00</td>
<td>Wideband In-Situ Measurement of Soil Electrical Parameters Using Planar Dipole Antennas</td>
<td>Christelle Nasrany, Elias Nassar, Notre Dame University-Louaize, Lebanon</td>
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<td>16:20</td>
<td>Dielectric Sheets Broadband Characterization Using Short-ended Coplanar Waveguide</td>
<td>Abdelhamid Nasr, Komal Sarabandi, Abd Nasrash, University of Michigan, United States; Matt Doyle, Abdel Mohammed, ADC Automotive Americas R &amp; D, Inc., United States</td>
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Antenna Array I
Session Co-Chairs: Satish Sharma, San Diego State University; Felix Miranda, NASA GRC

MO-UB.2P.1 13:20
3D Printed Magneto-Electric Phased Array Antenna with Integrated Analog Beamforming for sub-6 GHz Frequency Band
Ghanshyam Mishra, Connor Laffey, Phillip Nguyen, Satish K Sharma, San Diego State University, United States

MO-UB.2P.2 13:40
Dual Polarized UWB Millimeter-Wave Phased Arrays
Alexander D. Johnson, Elias Alwan, John L. Volakis, Florida International University, United States

MO-UB.2P.3 14:00
Dual-Band Transmit-Array Antennas Exploiting Polarization-Rotating Elements
Konstantinos Mavrakakis, Hung Luyen, John Booske, Nader Behdad, University of Wisconsin-Madison, United States

MO-UB.2P.4 14:20
A Planar Multi-Beam Antenna Array
Shuguang Chen, Mahmoud Khalil, Steven Goodall, US Army, United States

MO-UB.2P.5 14:40
Wideband Design of Feed Structure for 2×2-Element Waveguide Slot Arrays by Filter Design Theory
Takashi Tomura, Jiro Hirokawa, Tokyo Institute of Technology, Japan

Break 15:00

MO-UB.2P.6 15:20
Investigations of All Metal Heat Sink Dual Linear Polarized Phased Array Antenna for Ku-Band Applications
Rudraishwarya Banerjee, Satish K Sharma, San Diego State University, United States; Jia-Chi Chieh, Randall Olsen, SPAWAR, United States

MO-UB.2P.7 15:40
Theory and Design of an Array of Skewed Stacked Dipoles
Cristina Yepes, Delft University of Technology, Netherlands; Eric Gandini, Stefania Monni, Frank E. van Vliet, TNO Defence, Safety and Security, Netherlands; Andrea Nata, Daniele Cavalli, Delft University of Technology, Netherlands

MO-UB.2P.8 16:00
3D Nolen Matrix Beamforming Phased Array
Han Ren, Bayaner Arigong, Washington State University, United States

MO-UB.2P.9 16:20
Unidirectional Bowtie Array Antenna with Titled Beams for Base Station Applications
Adam Mehrabani, Johns Hopkins University, United States; Maria Pour, University of Alabama in Huntsville, United States

MO-UB.2P.10 16:40
2D conformal wideband phased array antenna system
Minyoung Yoon, Seoul National University, Korea (South); Chang Park, Yonsei University, Korea (South); Sanghoon Jung, Seoul National University, Korea (South); Young Joong Yoon, Yonsei University, Korea (South); Youngseek Chung, Sangwook Nam, Kwangwoon University, Korea (South)

Biomedical Applications of Electromagnetics I
Session Co-Chairs: Francesca Vipiana, Politecnico di Torino; Brian Garner, Baylor University

MO-A5.3P.1 13:20
Theory of Electromagnetic-Based Communication within Bacterial Communities
Navid Barani, Kamal Sarabandi, University of Michigan, United States

MO-A5.3P.2 13:40
Experimental Validation of a Microwave Brain Scanner for Cerebrovascular Diseases Monitoring
Jorge A. Tobon Vasquez, Politecnico di Torino, Italy; Rosa Scapaticci, Institute for Electromagnetic Sensing of the Environment, National Research Council of Italy, Italy; Giovanna Turani, Politecnico di Torino, Italy; Gennaro Bellizzi, University of Naples Federico II, Italy; Nadine Joachimowicz, Université Paris-Diderot, France; Bernard Duchêne, CNRS, France; Mario R. Casu, Politecnico di Torino, Italy; Lorenzo Coccia, Institute for Electromagnetic Sensing of the Environment, National Research Council of Italy, Italy; Francesca Vipiana, Politecnico di Torino, Italy

MO-A5.3P.3 14:00
Passive Coil-Based Wearable Textile for Monitoring Cardiac Activity
Karen Zhu, Asimina Kiourti, Ohio State University, United States

MO-A5.3P.4 14:20
Measurement and Simulation of Various On-Body Antenna Utilizing a Modular Arm-Swinging Phantom Model for Wireless Body Area Network Applications
George Lee, Brian Garner, Yang Li, Baylor University, United States

MO-A5.3P.5 14:40
A Fast and Accurate Transfer Function Validation Strategy Using Rotational Invariant Lead Trajectories
Ya Wang, Jianfeng Zheng, Qingyan Wang, Ji Chen, University of Houston, United States

Break 15:00

MO-A5.3P.6 15:20
Focused Microwave Therapy Study on Realistic Breast Phantoms
Srishti Saraswat, Jinpil Tak, Waleed Ahmad, Hongbo Zhao, Chandra Priya Karunakaran, Russell S. Witte, Hua Xin, University of Arizona, United States

MO-A5.3P.7 15:40
Electromagnetic Components Realized on Conductive Wires: A Copper vs. E-Thread Comparison
Vijayanshu Mishra, Asimina Kiourti, Ohio State University, United States

MO-A5.3P.8 16:00
Channel Capacity Comparison between Quorum Sensing and Electromagnetic-Based Communication within Bacterial Communities
Navid Barani, Kamal Sarabandi, University of Michigan, United States

MO-A5.3P.9 16:20
Analysis and Design of Near-Field Plates in the Presence of Dielectric Media
Andrew Stikwasser, Timothy Skeansman, Ra‘id Awaadallah, Johns Hopkins University Applied Physics Laboratory, United States; William Anderson, JHU School of Medicine, United States

MO-A5.3P.10 16:40
A Near-Field Microwave Biosensor for Glucose Concentration Level Detection
Abdulrahman Alghamdi, Saeed Mohammad, Purdue University, United States; Rehah Alghamdi, Indiana State University, United States
Scattering, Diffraction and RCS
Session Co-Chairs: Christophe Caloz, Polytechnique Montréal; Guido Lombardi, Politecnico di Torino-ISMB

MO-A4.1P 13:20 Full Wave Solutions of Multiple Scattering Using 3D Vector Cylindrical Wave Expansions In Foldy-Lax Equations
Huanting Huang, Leung Tsang, University of Michigan, United States; Kung-Hau Ding, Air Force Research Laboratory, United States

MO-A4.1P.2 13:40 A Numerical Modelling Approach towards Radar Cross Section Characterization of Airborne Insects
Omar Akhaddi, Diego Pelizzo, Pennsylvania State University, United States; Mohammad Al-Khaldi, Ohio State University, United States; Julia Urbina, James Breakall, Michael Lanagan, Harford Patch, Christina Grazinger, Pennsylvania State University, United States

MO-A4.1P.3 14:00 Multiple Wedges Diffraction in Propagation Problems using the Generalized Wiener-Hopf Technique
Vito Daniele, Guido Lombardi, Rodolfo S. Zich, Politecnico di Torino-ISMB, Italy

MO-A4.1P.4 14:20 Scattering at Interluminal Interface
Zoé-Lise Deck-Léger, École Polytechnique de Montréal, Canada; Christophe Caloz, Polytechnique Montréal, Canada

MO-A4.1P.5 14:40 A non-iterative time-domain sidelobe suppression in doppler shifted LFM waveforms
Ehsan Shariati, Muhammad Dawood, New Mexico State University, United States

Break 15:00

MO-A4.1P.6 15:20 A Machine Learning Based 77 GHz Radar Target Classification for Autonomous Vehicles
Xiuzhang Cai, Kamal Sarabandi, University of Michigan, United States

MO-A4.1P.7 15:40 Improving Two Ends Precision of RCS Measurement Based on Spectral Extrapolation Technique
Chufeng Hu, Nanjing Li, Weijun Chen, Shuxia Guo, Northwestern Polytechnical University, China

MO-A4.1P.8 16:00 On Scattering of a Vector Cylindrical Wave by an Axisymmetric Semitransparent Reflector
Kiref Klionovski, Atif Shamim, King Abdullah University of Science and Technology (KAUST), Saudi Arabia

MO-A4.1P.9 16:20 Diffuse Scattering Characteristics of Rough Materials at mm-Wave Frequencies
Haikuo Tian, Xi Liao, Chongqing University of Posts and Telecommunications, China; Rui Zhang, China Research Institute of Radiowave Propagation, China; Yu Shao, Yang Wang, Chongqing University of Posts and Telecommunications, China

Time-Domain Methods
Session Co-Chairs: Zhen Peng, University of New Mexico; Su Yan, Howard University

MO-UB.3P.1 13:20 Learning and Compensating Numerical Dispersion Errors in FDTD with Artificial Neural Networks
Xingqi Zhang, Aristeidis Seretis, Castas Sanis, University of Toronto, Canada

MO-UB.3P.2 13:40 Simulation of a switched electrically small antenna using FDTD-XSPICE
Ryan Westerfer, Jonathan Andreassen, Georgia Tech Research Institute, United States

MO-UB.3P.3 14:00 A DGTD Algorithm with Dynamic h-Adaptation and Multirate Time Integration Techniques for EM-Plasma Interaction Simulations
Jiwei Qian, University of Illinois at Urbana-Champaign, United States; Su Yan, Howard University, United States; Jian-Ming Jin, University of Illinois at Urbana-Champaign, United States

MO-UB.3P.4 14:20 Multiple-Region FDTD Method for Multi-Angle Bi-Static Ground Penetrating Rader
Takaji Arima, Tokyo University of Agriculture and Technology, Japan; Toshiyuki Nishibori, Akhisar Uematsu, JAXA, Japan; Taro Uno, Tokyo University of Agriculture and Technology, Japan

MO-UB.3P.5 14:40 A New FDTD Perfectly Matched Layer (PML) Model Constructed by the Machine Learning
Hemeng Yao, Lijun Jiang, University of Hong Kong, China

Break 15:00

MO-UB.3P.6 15:20 A New Look at the Finite Element Particle-in-Cell Method
Zane Crawford, Scott O'Connor, John Lugisland, Balasubramaniam Shanker, Michigan State University, United States

MO-UB.3P.7 15:40 Space-time Parallel Methods for Multiscale Transient Electromagnetic Problems
Shu Wang, Zhen Peng, University of New Mexico, United States

MO-UB.3P.8 16:00 Comparison of Luebbers and Maloney implementations of complex objects composed with thin sheets in the FDTD grid
Afnan Alkandari, Fumie Costen, Jean-Pierre Berenger, University of Manchester, United Kingdom; Ryutarou Himeno, Hideo Yokota, Riken, Japan

Ming Dong, Ping Li, King Abdullah University of Science and Technology (KAUST), Saudi Arabia; Yifei Shi, Jiangsu University of Technology, China; Hakan Bagci, King Abdullah University of Science and Technology (KAUST), Saudi Arabia

MO-UB.3P.10 16:40 An Explicit Time Marching Scheme for Solving the Nyström-discretized Scalar Potential Integral Equation
Rui Chen, Hakan Bagci, King Abdullah University of Science and Technology (KAUST), Saudi Arabia
**Frequency Domain Methods**
Session Co-Chairs: Jin-Fa Lee, Ohio State University; Roberto Graglia, Politecnico di Torino

**MO-UB.4P**

**A Novel Dipole-Moment-Based Approach for Analyzing Scattering from Quasi-Periodic Structures**
Kapil Sharma, MathWorks, Inc., United States; Raj Mittra, University of Central Florida, United States

**MO-UB.4P.2**

Complex Antenna Simulation By Using Embedded Domain Decomposition
Jiaqing Lu, Jin-Fa Lee, Ohio State University, United States

**MO-UB.4P.3**

On the GPU/CPU Implementation of Direct Domain Decomposition Methods (D3M)
Javad Moshfegh, Dimitrios Makris, Marinos Vouvakis, University of Massachusetts Amherst, United States

**MO-UB.4P.4**

Analysis of Electromagnetic Wave Interactions on Nanostructures with Non-local Dispersion Effects using a Volume Integral Equation Solver
Doolos Aibek Uulu, Sadeed Sayed, Ping Li, Hakan Bagci, King Abdullah University of Science and Technology (KAUST), Saudi Arabia

**MO-UB.4P.5**

Integration of Singular Basis Functions for Plate Edges and Corners
Roberto Graglia, POLITECNICO DI TORINO, Italy; Andrew Peterson, Georgia Institute of Technology, United States; Paolo Petrini, POLITECNICO DI TORINO, Italy

**Break**

**MO-UB.4P.6**

On the Use of a Full-Wave Solver in the Solution of the Electroencephalography Forward Problem
Clément Henry, Adrien Merlini, Lyes Rahmouni, Francesco P. Andriulli, Politecnico di Torino, Italy

**MO-UB.4P.7**

Surface-Volume-Surface Electric Field Integral Equation for Solution of Scattering Problems on 3D Composite Metal-Dielectric Objects
Razo Ghaham, Vladimir Oktmatovski, University of Manitoba, Canada

**MO-UB.4P.8**

Modeling Focused CW Mm-Wave Scattering of a Penetrable Dielectric Slab Affixed to a Human Body
Ann Margenthaler, Corey Rappaport, Northeastern University, United States

**MO-UB.4P.9**

Construction and Application of Geometrically Optimal Curvilinear Surface Elements for Double Higher-Order MoM-SIE Modeling
Jake Harman, Cam Key, Sanja Manic, Bransislav Natarov, Colorado State University, United States

**MO-UB.4P.10**

Topology Optimization for Maxwell Solvers
Zane Crawford, Alejandro Diaz, Balasubramaniam Shankar, Michigan State University, United States

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**Antenna Theory and Design II**
Session Co-Chairs: Thomas Montoya, South Dakota School of Mines and Technology; Thomas Montoya, South Dakota School of Mines and Technology

**MO-UB.5P**

**MO-UB.5P.1**

A Novel Dipole-Moment-Based Approach for Analyzing Scattering from Quasi-Periodic Structures
Kapil Sharma, MathWorks, Inc., United States; Raj Mittra, University of Central Florida, United States

**MO-UB.5P.2**

Complex Antenna Simulation By Using Embedded Domain Decomposition
Jiaqing Lu, Jin-Fa Lee, Ohio State University, United States

**MO-UB.5P.3**

On the GPU/CPU Implementation of Direct Domain Decomposition Methods (D3M)
Javad Moshfegh, Dimitrios Makris, Marinos Vouvakis, University of Massachusetts Amherst, United States

**MO-UB.5P.4**

Analysis of Electromagnetic Wave Interactions on Nanostructures with Non-local Dispersion Effects using a Volume Integral Equation Solver
Doolos Aibek Uulu, Sadeed Sayed, Ping Li, Hakan Bagci, King Abdullah University of Science and Technology (KAUST), Saudi Arabia

**MO-UB.5P.5**

Integration of Singular Basis Functions for Plate Edges and Corners
Roberto Graglia, POLITECNICO DI TORINO, Italy; Andrew Peterson, Georgia Institute of Technology, United States; Paolo Petrini, POLITECNICO DI TORINO, Italy

**Break**

**MO-UB.5P.6**

On the Use of a Full-Wave Solver in the Solution of the Electroencephalography Forward Problem
Clément Henry, Adrien Merlini, Lyes Rahmouni, Francesco P. Andriulli, Politecnico di Torino, Italy

**MO-UB.5P.7**

Surface-Volume-Surface Electric Field Integral Equation for Solution of Scattering Problems on 3D Composite Metal-Dielectric Objects
Razo Ghaham, Vladimir Oktmatovski, University of Manitoba, Canada

**MO-UB.5P.8**

Modeling Focused CW Mm-Wave Scattering of a Penetrable Dielectric Slab Affixed to a Human Body
Ann Margenthaler, Corey Rappaport, Northeastern University, United States

**MO-UB.5P.9**

Construction and Application of Geometrically Optimal Curvilinear Surface Elements for Double Higher-Order MoM-SIE Modeling
Jake Harman, Cam Key, Sanja Manic, Bransislav Natarov, Colorado State University, United States

**MO-UB.5P.10**

Topology Optimization for Maxwell Solvers
Zane Crawford, Alejandro Diaz, Balasubramaniam Shankar, Michigan State University, United States

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**Antenna Theory and Arrays**
Session Chair: Nader Behdad, University of Wisconsin-Madison

**MO-UB.6P**

**MO-UB.6P.1**

A method for achieving 2-bit phase quantization for reconfigurable reflectarray antennas having single radiating layers
Hung Luyn, John Booske, Nader Behdad, University of Wisconsin-Madison, United States

**MO-UB.6P.2**

Design of Broadband VHF/UHF Antenna with Multiple Directional Beams
Ruyu Ma, Nader Behdad, University of Wisconsin-Madison, United States

**MO-UB.6P.3**

Design of a Fast, High Power RF Switch for a HF/VHF Direct Antenna Modulation System
Jacob Peiffer, Bruce Offord, Layth Hozi, Jacob Rissmiller, Erica Daly, SPAWAR Systems Center Pacific, United States

**MO-UB.6P.4**

Mixing Matrix Estimation of Frequency Hopping Signals Based on Single Source Points Detection
Yibing Li, Xiaoyu Geng, Xiaochen Guo, Qian Sun, Fang Ye, Tao Jiang, Harbin Engineering University, China
Memorial Session for Dr. R. C. Hansen
Session Co-Chairs: William Liles, Independent Consultant; Jennifer Bernhard, University of Illinois at Urbana-Champaign
TU-SP.1A.1 08:00
R. C. Hansen - His Life, His Awards and His Books
William Liles, Independent Consultant, United States
TU-SP.1A.2 08:20
Robert C. Hansen - Managing Antenna Expectations
Dean Paschen, FIRST RF Corporation, United States
TU-SP.1A.3 08:40
Electrically Small Antennas: Hansen’s Contribution and the State of the Art
Jacob Adams, North Carolina State University, United States
TU-SP.1A.4 09:00
Robert C. Hansen’s Phased Antenna Array Contributions
Steven Holland, Milwaukee School of Engineering, United States
TU-SP.1A.5 09:20
REVISING THE GENERALIZED 3-PARAMETER APERTURE DISTRIBUTION AND HANSEN’S 1-PARAMETER DISTRIBUTION
Yahya Rahmat-Samii, University of California, Los Angeles, United States
Break 09:40
TU-SP.1A.6 10:00
Array Synthesis in the Autocorrelation Domain - Proof and Research Tracks
Mohammed Abdul Hannan, Lorenzo Poli, Giacomo Oliven, Andrea Massa, ELEDIA Research Center (ELEDIA@UniTN – University of Trento), Italy
TU-SP.1A.7 10:20
Wideband Matching of Closely Spaced Arrays Using a Simplified Algorithm
Ronald J. Marhefka, Consultant, United States
TU-SP.1A.8 10:40
Phased Array Bandwidth Defined by Beam Squint and Pulse Dispersion
Randy Haupt, Colorado School of Mines, United States
TU-SP.1A.9 11:00
Optimization of Array Antenna Power Patterns Using Woodward Lawson and Schelkunoff’s Polynomial Techniques
Sambitam Rana, California State University, United States
TU-SP.1A.10 11:20
Tight Bounds on the Bandwidth of Small Multiresonant Electric Dipole Antennas
Howard Stuart, LOS Innovations, United States

International Collaborations on Next-Generation Radio Astronomical Instruments
Session Co-Chairs: David Davidson, Curtin University; Karl Warnick, Brigham Young University
TU-SP.2A.1 08:00
The Square Kilometre Array Observatory
Maria Guzman Lobato, Mark Watson, Gerhard Swart, Mark Bowen, Peter Dewdney, Square Kilometre Array (SKA) Organisation, United Kingdom
TU-SP.2A.2 08:20
Primary Beams of the MeerKAT Radio Telescope: Measurements and Simulations
Dirk De Villiers, Stellenbosch University, South Africa; Khan Asad, South African Radio Astronomy Observatory, South Africa; Oleg Sminov, Rhodes University, South Africa; Robert Lehmeier, EMSS Antennas (Pty) Ltd, South Africa; Matthieu De Villiers, Justin Jones, South African Radio Astronomy Observatory, South Africa
TU-SP.2A.3 08:40
The SKA Aperture Array Verification System: Measured Digitally-Beam-Formed Radiation Patterns
Giuseppe Vione, Fabio Pasinella, Stefania Matteoli, Lorenzo Corso, Giuseppe Addamo, Oscar Antonio Peveini, CNR-IEIIT, Italy; Eloy de Lara Acea, Edgar Colin Beltran, Nima Razavi Ghods, University of Cambridge, United Kingdom; Pietro Boli, INAF-OA, Italy; Giuseppe Pupillo, INAF-IRA, Italy; Andrea Maria Lingua, Marco Picozzi, Iacopo Acardi, Politecnico di Torino, Italy; Kris Zach Adams, Alessio Magno, University of Malta, Malta
Break 09:40
TU-SP.2A.4 10:00
Sparse-Regular Array Design for SKA Mid Frequency Aperture Array
Brandi Kipper, Dirk De Villiers, Stellenbosch University, South Africa; Ian Geralt Bij de Vaate, ASTRON and Stellenbosch University, Netherlands; David Davidson, ICRAR-Curtin and Stellenbosch University, Australia
TU-SP.2A.5 10:20
Geometry Optimization of a Phased Array Feed on the Arecibo Telescope for Maximum Survey Efficiency
Karl Warnick, Jakob Kuebler, Brigham Young University, United States; German Cartes Medellin, Cornell University, United States
TU-SP.2A.6 10:40
Radiation Efficiency Calculation of the Murchison Widefield Array Using a Power Wave Based Framework
Daniel Ung, Adrian Sutinjo, David Davidson, Melanie Johnston-Hollitt, Steven Tingay, Curtin University, Australia
TU-SP.2A.7 11:00
New Receiver Technology for Radio Astronomy: A Technology Update from CSIRO and FAST
Alex Dunning, Mia Baquiran, Ron Beresford, Michael Boume, Mark Bowen, Michael Brothers, John Bunton, Nick Carter, Santiago Castillo, Yuqing Chen, Wan Cheng, Yoon Cheng, Paul Doherty, Daniel George, Grant Harrison, Douglas Hayman, Konapathipillai Jeganathan, Henry Kamausk, Simon Mackay, Les Rall, Paul Roberts, Peter Roush, Saan Siverson, Robert Shaw, Ken Smart, Stephanie Smith, John Tuthill, Tassos Tzounis, Veronica-Clare Venables, CSIRO, Australia; Rendong Nan, Chengjin Jin, Yan Zhu, Yang Cao, Xiangwei Shi, Jinyou Song, Jinglong Yu, Jin Fan, Yooling Yue, Lei Qian, Dong Bin, Chinese Academy of Sciences, China
TU-SP.2A.8 10:40
Antenna Phase Center Analysis for the LOFAR Radio Telescope
Paola Di Ninna, Pietro Boli, Renzo Nesti, Giuseppe Pupillo, INAF, Italy; Giuseppe Vione, National Research Council of Italy (CNR), Italy; Stefan Wijnholds, ASTRON, Netherlands
TU-SP.2A.9 11:00
Cornelis Vertegaal, Mark Bentum, Eindhoven University of Technology, Netherlands
Cognitive Radio I
Session Co-Chairs: Jonathan Chisum, University of Notre Dame; Nader Behdad, University of Wisconsin-Madison

TU-UB.1A.1 08:00
Paraffin-Based RF Microsystems for Millimeter Wave Reconfigurable Antennas
Behnam Ghassemiparvin, Nima Ghalichechian, Ohio State University, United States

TU-UB.1A.2 08:20
High Radiation Efficiency Phase-change Material Antennas with Conductive Inclusions
David Connolly, Jonathan Chisum, University of Notre Dame, United States

TU-UB.1A.3 08:40
Beam-direction and Beam-width Switchable Monopole Antenna using Smart Shape Memory Hinges based Origami Reflectors
Syed Imran Hussain Shah, Sungjoon Lim, Chung Ang University, Korea (South)

TU-UB.1A.4 09:00
Electronically reconfigurable, 1-bit reflectarray antennas using polarization rotating unit cells
Hung Luyn, John Booske, Nader Behdad, University of Wisconsin-Madison, United States

TU-UB.1A.5 09:20
A Compact 1-Bit Reconfigurable Folded Reflectarray Antenna
Yuehe Ge, Zhenglong Wang, Guowei Li, Huaqiao University, China

Break 09:40

TU-UB.1A.6 10:00
Effects of Spectral Interference on High-Accuracy Ranging in Coherent Distributed Arrays
Serge Mjahdibghab, Jeffrey Nanzer, Michigan State University, United States

TU-UB.1A.7 10:20
An Analog RF System with High Isolation for Simultaneous Transmit and Receive (STAR)
Nicholas Trudeau, Carlene Goodbody, Kwei Jih Lu, Turku Karacolak, Washington State University Vancouver, United States

TU-UB.1A.8 10:40
Ultra-Wideband Frequency Reconfigurable RF Front-End with Bandwidth Tunability
Anthony Nunez, Stavros V. Georgakopoulos, Elias A. Alwan, Florida International University, United States

TU-UB.1A.9 11:00
Transmit-Receive Antenna Isolation Using a Passively Tuned Balun for Simultaneous Transmit and Receive (STAR) Applications
Alexander Hovsepian, Satheseeth Boja Venkatakrishnan, John L. Volakis, Florida International University, United States

TU-UB.1A.10 11:20
Improved Self-Interference Suppression in Wideband STAR
Satheseeth Boja Venkatakrishnan, Alexander Hovsepian, Florida International University, United States; Toshihumi Nakatani, Hooman Ghajari, Jonman Yen, Xentific Technologies, United States; John L. Volakis, Florida International University, United States

5G MIMO Antenna Technology
Session Co-Chairs: Satish Sharma, San Diego State University; Buon Kiong Lau, Lund University

TU-A5.1A.1 08:00
A Broadside Three-Port Antenna for 5G Massive MIMO Antenna Systems
Li Ying Nia, Xian Qi Lin, University of Electronic Science and Technology of China, China; Buon Kiong Lau, Lund University, Sweden

TU-A5.1A.2 08:20
A Capacity Reconfigurable Multimode Origami MIMO Antenna
Nicholas Russa, Constantin Z. Zekkos, Stavros V. Georgakopoulos, Florida International University, United States

TU-A5.1A.3 08:40
A LTE Band Integrated 5G Antenna Design using Characteristic Mode Analysis
Javid Ganie, Chitra Singh, Kamrud Jha, Shrip Mata Vilasino Devi University, India; Satish Sharma, San Diego State University, United States

TU-A5.1A.4 09:00
Effect of Antenna Element Separation on Capacity of MIMO Systems Including Mutual Coupling
Tomislav Marinovic, Katholieke Universiteit Leuven, Belgium; Amirashkan Farsaei, TU Eindhoven, Netherlands; Rob Maaskant, Chalmers University of Technology, Sweden; Adrian Lahuerta Laveira, Katholieke Universiteit Leuven, Sweden; Martin Johansson, Ulf Gustavsson, Ericsson, Sweden; Guy A. E. Vandenbosch, Katholieke Universiteit Leuven, Belgium

TU-A5.1A.5 09:20
Effect of Antenna Coupling on the SNR Improvement of Mm-Wave Massive MIMO for 5G
Vahid Ezzati, Mohammad Fakharzadeh, Farouhar Fazanaz, Sharif University of Technology, Iran; Mohammadreza Ranjbar Neerin, University of Wisconsin-Madison, United States

Break 09:40

TU-A5.1A.6 10:00
4x4 MIMO Antenna Elements Fed by Microstrip Ridge Gap Waveguide
Abdelmoniem Hassan, Ahmed Kissk, Concordia University, Canada

TU-A5.1A.7 10:20
Design of an Antipodal Bowtie Array MIMO Antenna for 5G Mobile Applications
Dabaran Ganguly, Yatia Antor, Royal Military College of Canada, Canada; Anil Samagni, Chinmay Soha, Indian Institute of Space Science and Technology, India

TU-A5.1A.8 10:40
A Dual-band and Dual-polarized Aperture Antenna for 5G Millimeter-wave Applications
He-Sheng Lin, Yi-Cheng Lin, National Taiwan University, Taiwan

TU-A5.1A.9 11:00
Path loss compensated pattern diversity antennas for mmWave 5G indoor base stations
Karthikeya GS, Mahesh P. Abegaonkar, Shiban K. Koul, Indian Institute of Technology, Delhi, India

TU-A5.1A.10 11:20
5G MIMO Antenna System for Mobile Terminals
Anping Zhao, Zhouyou Ren, Shenzhen Sunway Communication Co., Ltd, China
Metasurfaces for Beam Shaping
Session Co-Chairs: Shulabh Gupta, Carleton University; Brian Raeker, University of Michigan

TU-A2.1A 08:00
Broadband WAIM Metasurface Structure for Electronically Beam Scanning
Holographic Antenna for Ku-Band Satellite Communications
Athin Mehdi-Spou, Matoen Szeng, Ryan Swenson, Kymeta Corporation, United States

TU-A2.1A 08:20
All-Dielectric Compound Metaoptics
Brian Raeker, Anthony Galic, University of Michigan, United States; You Zhou, Jason Valentine, Vanderbilt University, United States

TU-A2.1A 08:40
Reflection-Cancelling Dielectric Huygens’ Metasurface Pair for Wideband Millimeter-Wave Beam-Forming
Mohamed K. Emara, Carleton University, Canada; Takashi Tomura, Jiro Hirokawa, Tokyo Institute of Technology, Japan; Shulabh Gupta, Carleton University, Canada

TU-A2.1A 09:00
Impedance-matched circular polarization selective surfaces with spin-selective phase modulation
Minseok Kim, George V. Eleftheriades, University of Toronto, Canada

TU-A2.1A 09:40
An Ultrathin Flexible Metasurface for Half Mirror and QWP Operation
Yasar Saifullah, Fuqiang Zhang, Guo-Min Yang, Feng Xu, Fudan University, China

TU-A2.1A 10:00
The Huygens’ Box Antenna: Metasurface-Based Directive Antenna Beam-Steering with Dramatically Reduced Elements
Kayode A. Oyesina, Alex M. H. Wong, City University of Hong Kong, China

TU-A2.1A 10:40
A Switchable Reflection-Type Linear/Circular Polarizers Based on Active Metasurface
You Li, You Li, You Li, Qunsheng Cao, Qunsheng Cao, Qunsheng Cao, Yi Wang, Yi Wang, Yi Wang, Nanjing University of Aeronautics and Astronautics, China

Material and Structural Antenna Reconfigurability
Session Co-Chairs: Giuseppe Vecchi, Politecnico di Torino; Hany Hammad, German University in Cairo

TU-A1.1A 08:00
Reconfigurable Antenna Based on Liquid Crystals for Continuous Beam Scanning with a Single Control
Enrica Martin, Sandi Pavez, Matteo Albani, Stefano Maci, University of Siena, Italy; Valerio Martorelli, Ingegneria dei Sistemi, Italy; Giorgio Giodanengo, Istituto Superiori Maria Boa, Italy; Antonio Ferraro, Romeo Bechererlito, National Research Council of Italy (CNR), Italy; Giovanni Toso, ESA-ESTEC, Netherlands; Giuseppe Vecchi, Politecnico di Torino, Italy

TU-A1.1A 08:20
Modular, Reconfigurable Block Cell Antenna Concept for Millimeter-wave 5G
Moonho Cho, Junho Park, Wonbin Hong, Pohang University of Science and Technology (POSTECH), Korea (South)

TU-A1.1A 08:40
A Deployable and Reconfigurable Origami Antenna for Extended Mobile Range
Gian Carraro, Nicholas Russo, Constantinou L. Zekkos, Stavros V. Georgakopoulos, Florida International University, United States

TU-A1.1A 09:00
Frequency-Reconfigurable mmWave Antenna Loaded with Capacitive Structure Integrated within a Microstrip Line
Jaehyun Choi, Junho Park, Youngsang Yoon, Woosang Hwang, Wonbin Hong, Pohang University of Science and Technology (POSTECH), Korea (South)

TU-A1.1A 09:20
Reconfigurable RHCP-to-LP Helical Antenna Made of Pure Water
Zhan Ren, Shishan Qi, Wen Wu, The Ministerial Key Laboratory of JGMT, China; Zhangxiang Shen, Nanyang Technological University, China

TU-A1.1A 09:40
Effect of Electrolyte on a 2D Surface-Based Reconfigurable Liquid Metal Antenna
Feng Xie, Mei Song Tang, Tongji University, China; Jacob Adams, North Carolina State University, United States

TU-A1.1A 10:00
Optimization of an Adaptive Antenna Array Excitations Employing Genetic Algorithm
Abdolakar Hamza, Hussein Attia, Sharif Sheikh, King Fahd University of Petroleum and Minerals (KFUPM), Saudi Arabia; Muhammad Iqbal, FAST, Pakistan; Essam Hassan, Formerly with KFUPM, Saudi Arabia

TU-A1.1A 10:40
A WIDEBAND Modified Elliptical Antipodal Vivaldi antenna array fed with four stage Wilkinson Power Divider
Hany Hammad, German University in Cairo, Egypt

TU-A1.1A 11:00
Experimental Investigation of Active Antenna
Igor Shirokov, Elena Shirokova, Sevastopol State University, Russia
Reflector Designs and Applications
Session Co-Chairs: Carey Rappaport, Northeastern University; John Papapolymerou, Michigan State University

TU-A1.2A.1 08:00
Reflector Antenna Optimisation with Multi-level Coordinate Search
Oscar Borries, Erik Jørgensen, Michael Forum Palvig, Tonny Rubæk, TICRA, Denmark

TU-A1.2A.2 08:20
Optimization of Feed Chains and Large Reflectors
Peter Meincke, Michael Forum Palvig, Niels Vesterdal Larsen, Erik Jørgensen, TICRA, Denmark

TU-A1.2A.3 08:40
Design of Polarizing Cells for Broadband Reflectors
Samara Gharbieh, Institute of Electronic and Telecommunication in Rennes, IETR, INSA Rennes, France and CRSI, Lebanese University, Faculty of Engineering, EDST, Tripoli, Lebanon; Maria Garcia-Vigueras, Renauld Loison, Institute of Electronic and Telecommunication in Rennes, IETR, INSA Rennes, France; Ali Harmouch, CRSI, Lebanese University, Faculty of Engineering, EDST, France; Akil Jrad, LEPA, Lebanese University, Faculty of Sciences, EDST, Tripoli, Lebanon

TU-A1.2A.4 09:00
Gain-Maximization of FPA-fed Reflectors by Means of Linear Regression
S. Narayanan, National and Kapodistrian University of Athens, Greece; Ali Al-Rawi, A. Dubok, B.P. de Hon, A. Bart Smolders, Eindhoven University of Technology, Netherlands

TU-A1.2A.5 09:20
Design And Analysis Of FengYun3 Microwave Humidity Sounder(FY3MHS) Antenna
Hongjian Wang, NIJKS, China

Break 09:40

TU-A1.2A.6 10:00
Electromagnetic Gap Leakage Analysis for the SKA Mid-Frequency Dish
Manel Verha, South African Radio Astronomy Observatory, South Africa; Pietro Bolli, Italy National Institute of Astrophysics, Italy

TU-A1.2A.7 10:20
The Bifocal Microwave Microscope
Carey Rappaport, Ann Morgenthaler, Northeastern University, United States

TU-A1.2A.8 10:40
Influence of rough surface on the electrical performance of reflector antenna based on fractal function
Shuo Zhang, Wei Wang, Hong Boa, Congsi Wang, Xidian University, China

TU-A1.2A.9 11:00
A K-band SIW High Gain Planar Antenna with Parabolic Metalized Via-holes Reflector
Wei Li, Ying Suo, Bowen Cai, Harbin Institute of Technology, China

Theoretical Electromagnetics I
Session Co-Chairs: Arthur Yaghjian, Electromagnetics Research; Andrea Alù, CUNY Advanced Science Research Center

TU-A2.2A.1 08:00
Time-Domain Force and Hidden Momentum for a Perfectly Conducting Sphere
Arthur Yaghjian, Electromagnetics Research, United States

TU-A2.2A.2 08:20
Diffraction by a Truncated Slab Filled by Dielectric Material
Vito Daniele, Guido Lambardi, Rodolfo S. Zich, Politecnico di Torino/IMM, Italy

TU-A2.2A.3 08:40
Zero-Forward Scattering for Omnidirectional Incidence using non-Hermitian Particles
Yun Jing Zhang, Mao Sang Tong, Tongji University, China; Andrea Alù, University of Texas at Austin, United States

TU-A2.2A.4 09:00
Gauge Transformations for Recasting Potential Representations
Ramakrishna Janaswamy, University of Massachusetts, United States

TU-A2.2A.5 09:20
Demonstration of Group Delay Modulation Based on EIT Using LC Circuits
Zhe Chen, Xiaoli Lin, University of Electronic Science and Technology of China, China

Break 09:40

 TU-A2.2A.6 10:00
Analysis of a Chiral Helix Metamaterial Using Eigenmode Expansion Method and Characteristic Mode Theory
Nadia Kari, ESYCOM Lab, Univ. Paris-Est, France; Ozuem Chukwuka, Divitha Saranathan, IFSIAR, COSYS, LEOST, France; Jean Marc Lahnerte, Francois Sarracin, ESYCOM Lab, Univ. Paris-Est, France

TU-A2.2A.7 10:20
Relation between Complex Propagation Constant and Complex Eigenmodes in Lossy Traveling-Wave Structures
Daniel King, Shudhaj Gupta, Carleton University, Canada

TU-A2.2A.8 10:40
Mathematical Modeling of a Smart Antenna Based on Hybrid Beam-forming Technique
Ahmed Kausar, Shafran Kausar, Hani Mehrpouyan, Baise State University, United States

TU-A2.2A.9 11:00
High Frequency Diffraction by Thick Loaded Conducting Slits – H Polarization Case–
Khanh Nam Nguyen, Hiroshi Shirai, Chuo University, Japan

TU-A2.2A.10 11:20
Measurement of dispersion characteristic of slow-wave system by microwave network cascade method
Yong Gao, En Li, Gaofeng Guo, University of Electronic Science and Technology of China, China
Tuesday, July 9 08:00 - 11:40
TU-A5.2A  Room 203

Terahertz Antennas
Session Co-Chairs: Georgios Trichopoulos, Arizona State University; Niru K. Nahar, Ohio State University

TU-A5.2A.1  08:00
Two-Port, Common Aperture, High-Isolation, Dual-Polarized Sub-Millimeterwave Antenna System Based on Spatial Power Divider
Tanner Douglas, Kamal Sarabandi, University of Michigan, United States

TU-A5.2A.2  08:20
High Bandwidth Porovskite based Antenna for High-Resolution Biomedical Imaging at Terahertz
Abdoolabast Abolmous, Glasgow University, United Kingdom; Syeda Fizaah Jilani, Hasan Abbas, Akram Alamnayi, Queen Mary University of London, United Kingdom; Muhammad Ali Imran, Qamar H. Abbas, University of Glasgow, United Kingdom

TU-A5.2A.3  08:40
Generation of mW Average Power in the sub-mm Wavelength Band by Pulsed Photoconductive Connected Array
Alessandro Guarro, Paolo Sbenna, Giorgio Carluccio, Delft University of Technology, Netherlands; Joshua Freeman, David Bacon, Lianhe Li, University of Leeds, United Kingdom; Juan Bueno, Jochem Baselmans, SRON, Netherlands; Edmond Limfied, Alexander Davies, University of Leeds, United Kingdom; Nuina Lombart, Andrea Neto, Delft University of Technology, Netherlands

TU-A5.2A.4  09:00
Fly’s Eye Lens Phased Array for Submillimeter Waveband Communication
Nuina Lombart, Sjoerd Bosma, Darwin Blanca, Delft University of Technology, Netherlands; Maria Alonso-del-Pino, Cecile Jung-Kubiak, NASA Jet Propulsion Lab, California Institute of Technology, United States

TU-A5.2A.5  09:20
A Wideband High-Gain Horn Antenna for 140GHz Short-Range Wireless Communication
Chaojun Ma, Hao Yu, Southern University of Science and Technology of China, China

TU-A5.2A.6  10:00
High Gain Constrained Lens Antenna on BCB Substrate for 300-GHz Applications
Adham Mahmoud, David Gonzalez-Ovejero, Mauro Ettorre, Delft University of Technology, Netherlands; Christian Canestri, Domenico Gaetano, Pietro Bio, Antonio Manna, Elettronica S.p.A., Italy

TU-A5.2A.7  10:20
A High Performance Terahertz Metalens
Hang Li, Sensong An, Bowen Zheng, Hong Tang, Clayton Fowler, Wei Gao, University of Massachusetts Lowell, United States; Rensheng Zhang, Jun Ding, East China Normal University, China; Hualiang Zhang, University of Massachusetts Lowell, United States

TU-A5.2A.8  10:40
Toward Large-Scale Dynamically Reconfigurable Apertures Using Graphene
Panagiotis Theofanopoulos, Georgios Trichopoulos, Arizona State University, United States

TU-A5.2A.9  11:00
Equivalent Circuit Model for Reconfigurable Far-Infrared Filter Employing Vanadium Dioxide
Lucas Newton, Niru K. Nahar, Ohio State University, United States

TU-A5.2A.10  11:20
Full D-band Coplanar to Rectangular Waveguide Transition for UTC-PD Application
Carista Wang, Yuan Tao, Junsheng Yu, Beijing University of Posts and Telecommunications, China; Xiaodong Chen, Queen Mary, University of London, United Kingdom

Tuesday, July 9 08:00 - 11:40
TU-UB.2A  Room 203

Antenna Array II
Session Co-Chairs: Maria Pour, University of Alabama in Huntsville; Mohammad Ali, University of South Carolina

TU-UB.2A.1  08:00
Textile Antenna Arrays and their Environmental Durability
Matthew Nichols, Alexander D. Johnson, Elias A. Alwan, John L. Volakis, Florida International University, United States

TU-UB.2A.2  08:20
A Broadband Dipole Array Based on Bandstop Frequency Selective Surfaces
Hong Tang, Bowen Zheng, Sensong An, Hang Li, Hualiang Zhang, University of Massachusetts Lowell, United States

TU-UB.2A.3  08:40
3D-Printed Double-Ridged Waveguide Array Antenna targeting High-Efficiency Ku-band SatCom on The Move Applications
Francesco Filika, ST Microelectronics, France; Nour Nachabe, Polytech’lab, France; Frédéric Gumesello, ST Microelectronics, France; Cyril Luxey, Polytech’lab, France

TU-UB.2A.4  09:00
Design of a Size-Reduced, 15-Element, Circularly-Polarized, Yagi-Uda Antenna
Kevin Leon, James Howell, Sungkyun Lim, Georgia Southern University, United States

TU-UB.2A.5  09:20
3D Array Synthesis for Future Radar Array Antenna Design
Xiao Xiao, Yulong Lu, Nanyang Technological University, Singapore

TU-UB.2A.6  10:00
High Gain Low Side Lobe Wideband Patch Array with High Forward to Backward Ratio
Bhuvana Padival, Mohammad Ali, University of South Carolina, United States

TU-UB.2A.7  10:20
An Innovative UWB Connected Array for Multifunctional Applications
Christian Censi, Domenico Gaetano, Pietro Bio, Antonio Manna, Elettronica S.p.A., Italy

TU-UB.2A.8  10:40
The Onset of Grating Lobes in Arrays of Electrically Large Apertures: A Study for Lenslet Arrays
Nicholas Este, Nicolas Garcia, Jonathan Chisum, University of Notre Dame, United States

TU-UB.2A.9  11:00
Mitigation of Mutual-coupling Effects in Millimeter-wave Automotive Radars
Bunak Obreg, Ohio State University, United States; Alexei H. Ame, John Cabagno, Carlos Velasquez, Alp Electric NA, Inc., United States; Lucas Newton, Kibyll Sertel, Niru K. Nahar, Ohio State University, United States

TU-UB.2A.10  11:20
A Modified-Binomial Linear Array with Reduced Grating Lobes and One-Wavelength Element Spacing
Zabed Iqbal, Anderson Young, Maria Pour, University of Alabama in Huntsville, United States
Biomedical Applications of Electromagnetics II
Session Co-Chairs: Magda El-Shenawee, University of Arkansas; Susan Hagness, University of Wisconsin-Madison

TU-A5.3A.1 08:00
Wearable Electromagnetic Head Imaging Using Magnetic-based Antenna Arrays
Abdulrahman Alqadami, Anthony E. Stancombe, Nghia Nguyen-Trong, Konstanty Bialkowski, Amin Abbosh, University of Queensland, Australia

TU-A5.3A.2 08:20
Recording Critical Epilepsy Indicators using a Fully-Passive Wireless System
Carolina Moncion, Satheesh Bojja Venkatarkrishnan, Jorge Riera Diaz, John L. Volakis, Florida International University, United States

TU-A5.3A.3 08:40
Determining the Maximum Local Specific Absorption Rate of a Multiple-Antenna Transmitter Using K-Order Electric Field Models
Dinh Thanh Le, Kun Li, Soichi Watanabe, National Institute of Information and Communications Technology (NICT), Japan; Teruo Onishi, NTT DOCOMO, Inc., Japan

TU-A5.3A.4 09:00
Cancer Classification of Freshly Excised Murine Tumors with Ordered Orthogonal Projection
Tanny Chavez, Tyler Bowman, Jingxian Wu, Magda El-Shenawee, University of Arkansas, United States; Keith Bailey, Oklahoma State University, United States

TU-A5.3A.5 09:20
Fast prediction of MRI RF-induced heating for a generic stent with arbitrary orientation using ANN
Xiaohua Ji, Jianfeng Zhang, Ji Chen, University of Houston, United States

Break 09:40

TU-A5.3A.6 10:00
Impacts of MRI frequency on RF-induced Heating for External Fixation with Insulating Material
Rui Yang, Jianfeng Zhang, Yu Wang, Ran Guo, Ji Chen, University of Houston, United States

TU-A5.3A.7 10:20
Extraction of Lung Water Content from Computerized Tomography Scans
Zhengqing Yun, Magdy Iskander, University of Hawaii, United States

TU-A5.3A.8 10:40
Evaluation of an Inversion Algorithm for Noninvasive Specific Absorption Rate Applications
Mano Phaneuf, Payam Majabi, University of Manitoba, Canada

TU-A5.3A.9 11:00
Influence of 3T MRI coil modeling on EM exposure estimation using a human model
Mikhail Kozlov, Nikolaus Weiskopf, Harald Möller, Max Planck Institute for Human Cognitive and Brain Sciences, Germany

TU-A5.3A.10 11:20
Optimization of microwave hyperthermia array applicators using field interpolation
Massimiliano Zanoli, Hans Dobrowolski, Chalmers University of Technology, Sweden

Hybrid Methods I
Session Co-Chairs: Weng Cho Chew, Purdue University; Ozlem Ozgun, Hacettepe University

TU-A3.1A.1 08:00
Hybrid Solver Via Equivalence Principle Algorithm
Joseph Rutherford, Riverside Research, United States; Weng Cho Chew, Purdue University, United States

TU-A3.1A.2 08:20
A Novel Numerical Technique for Analyzing Metasurfaces
Ozlem Ozgun, Hacettepe University, Turkey; Raj Mittra, University of Central Florida, United States; Mustafa Kuzuoglu, Middle East Technical University, Turkey

TU-A3.1A.3 08:40
Approximation of Reflectarray Cross-Polarization Response Using A Hybrid FEM-PO Method
Jishoo Raper, Viasat Inc., United States; Andrew Peterson, Georgia Institute of Technology, United States

TU-A3.1A.4 09:00
Hybrid Method of FDTD/PO for EM Scattering Simulation of Electrically Large Targets
Shuo Liu, Bin Zou, Lamei Zhang, Harbin Institute of Technology, China

TU-A3.1A.5 09:20
Aggressive Space Mapping Technique for Reconfigurable Hexagonal Patch Antenna Design
Akinwale Fabamoti, Olouwale Famoiri, Rabiu Zakariyya, Fujian Lin, University of Science and Technology of China, China; Fan Jiang, Qingsha Cheng, Southern University of Science and Technology of China, China; Olouwasegun Samefun, Erastus Ogunti, Federal University of Technology Akure, Nigeria

Hybrid Methods II
Session Co-Chairs: Eric Michielssen, University of Michigan; C J Reddy, Altair Engineering Inc

TU-UB.3A.1 10:00
Advanced Computational Tools for the Multidisciplinary Design Optimization of Airborne Radomes
Gopinath Gampala, Eamon Whalen, Katelyn Hunter, Sarthak Mishra, C J Reddy, Altair Engineering Inc., United States

TU-UB.3A.2 10:20
Hybrid Parabolic Equation – Integral Equation Solvers for Analyzing Long Range Propagation Over Complex Terrain
Eric Michielssen, Max Bright, University of Michigan, United States; Julius Kosuma, Facebook Research, United States

TU-UB.3A.3 10:40
Direct Domain Decomposition Method Finite Element Boundary Element Hybrid (D3M-FEBE)
Nash Lochner, Marias Vouvakis, University of Massachusetts Amherst, United States

TU-UB.3A.4 11:00
BEM-FEBI Formulation Through ‘PECification’
Nash Lochner, University of Massachusetts, United States; Marias Vouvakis, University of Massachusetts Amherst, United States
Computational Methods for Coupling and Scattering
Session Co-Chairs: Mei Song Tong, Tongji University; Atef Elsherbeni, Colorado School of Mines
TU-A3.2A.1 08:00
A Platform Green’s Function Method for In-Situ Antenna Analysis and Design
Shu Wang, Zhen Peng, University of New Mexico, United States
TU-A3.2A.2 08:20
ADMM based Consensus and Sectioning Norm-1 Regularized Algorithm for Imaging with a CRA
Juan Heredia-Juesas, Luis Tirado, Ali Molaei, Jose Angel Martinez-Lorenzo, Northeastern University, United States
TU-A3.2A.3 08:40
Electromagnetic Coupling Analysis of Printed Circuit Board Traces using Characteristic Mode Analysis
Kalyan Durbhakula, John Lancaster, Ahmed M. Hassan, Deb Chatterjee, Anthony Caruso, University of Missouri-Kansas City, United States; James Hunter, Yuanzhuo Liu, Anthony Caruso, Missouri University of Science and Technology, United States
TU-A3.2A.4 09:00
Electromagnetic Interference of Unmanned Aerial Vehicles: A Characteristic Mode Analysis Approach
Mohamed Hamdalla, Ahmed M. Hassan, Anthony Caruso, University of Missouri-Kansas City, United States; James Hunter, Yuanzhuo Liu, Anthony Caruso, Missouri University of Science and Technology, United States
TU-A3.2A.5 09:20
Identification of Suspicious Mass in Biological Tissues Using Resonance Parameters Extracted from Late Time Response
Marwa Bannis, Egyptian Russian University, Egypt; Fatma El Hefnawi, National Authority for Remote Sensing, Electronic Research Institute, Egypt; Atef Elsherbeni, Colorado School of Mines, United States
Break 09:40
TU-A3.2A.6 10:00
RCS of Complex Targets via Compressive Sensing
Xiang Li, Mustapha Taghoub, University of Ottawa, Canada
TU-A3.2A.7 10:20
Austin RCS Benchmark Suite Developments
Jonathan Kelley, University of Texas at Austin, United States; Clifton Courtney, David A. Chamulak, Lockheed Martin Aeronautics Company, United States; Ali E. Yilmaz, University of Texas at Austin, United States
TU-A3.2A.8 10:40
RCS Enhancement Using Topology Optimization
Aseim Elfrgani, C J Reddy, Altair Engineering Inc., United States
TU-A3.2A.9 11:00
An Entire-Domain Analysis of Very Large 2-D Scatterers in TM mode Using Gegenbauer Polynomials
Jovana Perovic, Dragom Ilcan, University of Belgrade, Serbia

THz and Optical Metamaterials
Session Chair: Douglas H. Werner, Pennsylvania State University
TU-A2.3A.1 08:00
Three-dimensional Nanoantenna Inverse-design
Sawyer D. Campbell, Pennsylvania State University, United States; Danny Z. Zhu, United States
TU-A2.3A.2 08:20
Tunable Hybrid Terahertz Metamaterials Based on VO2 Phase Transition
Liu Kang, Pennsylvania State University, United States; Shengqiang Wang, Wuhan Textile University, China; Sawyer D. Campbell, Douglas H. Werner, Pennsylvania State University, United States
TU-A2.3A.3 08:40
Polarization-independent and broadband THz coherent perfect absorber based on black phosphorus bifacial metasurfaces
Tianjing Guo, Christos Argyropoulos, University of Nebraska-Lincoln, United States
TU-A2.3A.4 09:00
Metasurface based far infrared solar absorber
Chammy Jani, Marwadi University, India; Shabhitkumar Patel, Marwadi Education Foundation, India
TU-A2.3A.5 09:20
Waveguide Surface on Textile for Body Area Network
Fabien Ferrero, Rania Khalifeh, Leonardo Lizzi, Universite Cote d’Azur, France

Additively Manufactured Antennas
Session Chair: Premjeet Chahal, Michigan State University
TU-A5.4A.1 10:00
A Novel 3D and Inkjet Printed Pressure-sensing Button-shaped Resonator
Yapu Cui, Wenjing Su, Manos Tentzeris, Georgia Institute of Technology, United States
TU-A5.4A.2 10:20
On the Surface Roughness and Smoothing in the 3D Printed THz Reflectors
Saim Adilell, Prateek Juyal, Alenka Zajić, Georgia Institute of Technology, United States
TU-A5.4A.3 10:40
Compact and High Gain half-sphere Dielectric Antenna Using 3D printing Technology
Enass Usama, Pizzardi University of Technology, Poland; Mohamed Basha, University of Waterloo, Canada; Rafael Kienz, Pizzardi University of Technology, Poland; Sofiadin Sallai-Noeini, University of Waterloo, Canada
TU-A5.4A.4 11:00
A 3D Printed UHF Passive RFID tag for Plastic Components
Sananjan Karuppuswami, Mohd Itwat Mahd Ghazali, Saikat Mandal, Deepak Kumar, Amanpreet Kaur, Premjeet Chahal, Michigan State University, United States
TU-A5.4A.5 11:20
3D Printed Inverted-F Antenna and Temperature Sensor Using Microfluidics Technologies
Shi Cong Wang, Mei Song Tong, Tongji University, China; Yang Yang Guan, Manos Tentzeris, Georgia Institute of Technology, United States
**Imaging and Scatterer Characterization**

Session Co-Chairs: Marco Salucci, ELEDIA Research Center, University of Trento; Magda El-Shenawee, University of Arkansas

**TU-A4.1A.1** 08:00
Image Reconstruction of Freshly Excised Human Breast Tumors using Terahertz Electrical Properties

Nagma Vohra, Tyler Bowman, Magda El-Shenawee, University of Arkansas, United States; Keith Bailey, Oklahoma State University, United States

**TU-A4.1A.2** 08:20
Experimental Demonstration of the Shadow Projection Algorithm for Near-Field Microwave Imaging of Buried Objects in Layered Media

Kai Ren, University of Wisconsin-Madison, United States; Robert Burkholder, Ohio State University, United States

**TU-A4.1A.3** 08:40
Automatic Permittivity Characterization of a Weak Dielectric Attached to Human Body Using Wideband Radar Image Processing

Mahshid Asri, Carey Rappaport, Northeastern University, United States

**TU-A4.1A.4** 09:00
Focused CW Mm-Wave Characterization of Lossy Penetrable Dielectric Slab Affixed to Human Body

Mohammad Tajdini, Carey Rappaport, Northeastern University, United States

**TU-A4.1A.5** 09:20
Electromagnetic Deep Learning Technology for Radar Target Identification

Abdelfattah M. Aref, Royal Military College of Canada, Canada; Said M. Mikki, University of New Haven, United States; Yahia Antar, Royal Military College of Canada, Canada

**Break** 09:40

**TU-A4.1A.6** 10:00
Locating Scattering Centers Using Compressive PSD Estimation

Ismail Jouny, Lafayette College, United States

**TU-A4.1A.7** 10:20
A Microwave Tomography System Using Time-Reversal Imaging

John Boroushewitz, Jason Merlo, Christopher Oakley, Lital Udai, Jeffrey Naronz, David MacFarlane, Emily Huff, Michigan State University, United States; Saptarshi Mukherjee, Lawrence Livermore National Laboratory, United States

**TU-A4.1A.8** 10:40
Detection of Scatterers Inside Metal Containers via VLF Signals of Opportunity

Nathan Opalinski, Edward Slevin, Roderick Gray, Manis Cohen, Georgia Institute of Technology, United States; Vijay Varma, Mark Bolkowski, University of Colorado Denver, United States; Sarah Patch, University of Wisconsin-Milwaukee, United States

**TU-A4.1A.9** 11:00
Opportunistic Equivalent Sources for Field Synthesis - Potentialities and Future Trends

Marco Salucci, Andrea Massa, ELEDIA Research Center (ELEDIA@UniTn – University of Trento), Italy

**TU-A4.1A.10** 11:20
Primitive Scatterer Reconstruction for Target Scattering in SAR images

Yongchen Li, Zhichang Liang, Science and Technology on Electromagnetic Scattering Laboratory, China

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**Cybersecurity and Electromagnetic Systems: From DC to Daylight and from Wireless to Wired**

Session Co-Chairs: Johnson Wang, Wang Electro-Opto Corporation; Andrew Peterson, Georgia Institute of Technology

**TU-SP.1P.1** 13:20
Cyber Resilience via Modeling & Simulation and Operations Analysis

Ambrose Kam, Lockheed Martin, United States

**TU-SP.1P.2** 13:40
Solving Cybersecurity Problem by Symmetric Dual-Space Formulation—Physical and Cybernetic

Johnson Wang, Wang Electro-Opto Corporation, United States

**TU-SP.1P.3** 14:00
Antenna-on-Display (AoD) for Millimeter-wave 5G Mobile Devices

Junho Park, Wonbin Hong, Pohang University of Science and Technology (POSTECH), Korea (South)

**TU-SP.1P.4** 14:20
Design of Ultra-Wideband Circularly Polarized CPW-Fed Antenna with a Metasurface Substrate

Ashwani Kumar, Prashant Choudhary, Delhi University, India; Raj Mittra, University of Central Florida, United States

**TU-SP.1P.5** 14:40
A Novel Dual-band 28/38 GHz Slotted Microstrip MIMO Antenna for 5G Mobile Applications

Mohamed I. Ahmed, Electronics Research Institute, Egypt; H. M. Marzouk, A. A. Shaoian, Zagazig University, Egypt

**Break** 15:00

**TU-SP.1P.6** 15:20
Antenna Pattern Evaluation of 28GHz band Massive MIMO Antenna RF Frontend Module for 5G

Takuzo Kitamura, Satoshi Yamaguchi, Hikaru Watanabe, Hideki Maruishi, Hideyuki Nakamizo, Kai Totsuru, Manabu Saka, Akihiro Uozaki, Towa Fukuwara, Naotomo Yoneda, Mitsubishi Electric Corporation, Japan

**TU-SP.1P.7** 15:40
Analysis and design of mm-wave phased array antennas for 5G access

Risto Valkonen, Efstratios Doumanis, Nokia Bell Labs, Finland

**TU-SP.1P.8** 16:00
A Compact Probe for EM Side-Channel Attacks on Cryptographic Systems

Frank Werner, Georgia Institute of Technology, United States; Antionnie Djordjevic, University of Belgrade, Serbia; Alenka Zajić, Georgia Institute of Technology, United States

**TU-SP.1P.9** 16:20
Scanning Properties of Slot-Fed Dielectric Resonator Antenna Arrays for 5G Wireless Communications

Ali Al-Rawi, A. Bart Smolders, Eindhoven University of Technology, Netherlands; Diego Garatelli, The Antenna Company, Netherlands

**TU-SP.1P.10** 16:40
Spread Spectrum Techniques for Interference Mitigation in Large Bandwidth

Md Rakibur Rahman, Sarathb Bajaj Venkataramanan, Elias A. Alwan, John L. Volakis, Florida International University, United States
**Metasurfaces in Antenna Applications**
Session Co-Chairs: Stefano Maci, Università degli Studi di Siena; Anastasios Papathanasopoulos, UCLA

**Tuesday, July 9** 13:20 - 17:00
**TU-SP.2P** Special Session Grand Ballroom D

**TU-SP.2P.1** 13:20
Single Antenna Beam Scanning via Reconfigurable Vanadium Dioxide (VO2) Metasurface
Jack Eichenberger, Nima Ghalichechian, Ohio State University, United States

**TU-SP.2P.2** 13:40
A Wideband High-Gain Conical Short Horn based on a Metasurface-corrected Lens
Kaiing Liu, Yuehe Ge, Huazhao University, China

**TU-SP.2P.3** 14:00
Bistatic RCS of a One-Dimensional Metasurface Leaky-Wave Antenna
Subramanian Ramalingam, Constantine Balanis, Craig Birtcher, Arizona State University, United States; Hussein Shaman, King Abdulaziz City for Science and Technology, Saudi Arabia

**TU-SP.2P.4** 14:20
Radiation of Forward and Backward Leaky Waves in Sinusoidally-Modulated Metasurfaces
Subramanian Ramalingam, Constantine Balanis, Craig Birtcher, Arizona State University, United States; Hussein Shaman, King Abdulaziz City for Science and Technology, Saudi Arabia

Break 15:00

**TU-SP.2P.5** 15:20
A Novel Deployable Compact Lens Antenna Based on Gradient-Index Metamaterials
Anastasios Papathanasopoulos, Yahya Rahmat-Samii, University of California, Los Angeles, United States

**TU-SP.2P.6** 15:40
Dynamic Beam Steering by Metaguides and Multilattices
A N M Shahriyar Hossain, Igor Tsukerman, University of Akron, United States

Break 16:00

**TU-SP.2P.7** 16:00
Bandwidth Enhancement of Square-Ring Antenna Using Surface Waves on Metasurface
Mohammed Alhabib, Constantine Balanis, Craig Birtcher, Arizona State University, United States; Hussein Shaman, King Abdulaziz City for Science and Technology, Saudi Arabia; Saud Saeed, Prince Sattam bin Abdulaziz University, Saudi Arabia

**TU-SP.2P.8** 16:20
Directivity Enhancement of Antipodal Vivaldi Antenna using Broadband Metasurface Lens
Omer Yesilyurt, Gonul Turhan Sayan, Middle East Technical University, Turkey

**TU-SP.2P.9** 16:40
A Meta-Surface Antenna Array Decoupling (MAAD) Method for Two Linear Polarized Compact Antenna Elements at 3.5GHz
Jiayin Guo, Feng Liu, Luyu Zhao, Xidian University, China

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**RFID Systems and Applications**
Session Co-Chairs: Etienne Perret, Univ. Grenoble Alpes, Grenoble INP, LCIS; Premjeet Chahal, Michigan State University

**Tuesday, July 9** 13:20 - 17:00
**TU-A5.1P** Special Session Grand Ballroom A

**TU-A5.1P.1** 13:20
A PSK Modulation Scheme for Sensor Integrated RFID
Sakat Mondal, Deepak Kumar, Sarmajit Kanaparwami, Mohd Hwaf Mohd Ghazali, Amranpee Kau, Premjeet Chahal, Michigan State University, United States

**TU-A5.1P.2** 13:40
Gesture Recognition Using A Portable and Flexible Meta-Atom Panel and Machine Learning
Mahdi Najizadeh, Po-Yen Chen, University of Illinois at Chicago, United States

**TU-A5.1P.3** 14:00
Characterization of Chipless RFID Tag in a 3-Dimensional Reading Zone
Raphaël Tavernier de Alencar, Nicolas Barbet, Marco Garbati, Etienne Perret, Univ. Grenoble Alpes, Grenoble INP, LCIS, France

**TU-A5.1P.4** 14:20
UHF Rectenna for Implanted and Free space Communications
Adamantia Chletsou, Ibrahim Kagan Aksoyak, John Papapolymerou, Ahmet Cagri Ulusoy, Michigan State University, United States

**TU-A5.1P.5** 14:40
Machine Embroidered Wearable e-textile Wideband UHF RFID Tag Antenna
Yufang Jiang, Ting Long, Yuxian Fang, Zhiyun Hu, Lulu Xu, University of Manchester, United Kingdom

Break 15:00

**TU-A5.1P.6** 15:20
Spatial characterization of the ambient backscatter communication performance in line-of-sight
Kammel Rachedi, Institut Langevin, France; Dinh Thuy Phan Huy, Orange Gardens, France; Abdelwahab Ouir, Julien de Rosny, Institut Langevin, France

**TU-A5.1P.7** 15:40
The Future of Backscatter in Precision Agriculture
Spyridon Daskalakis, Heriot-Watt University, United Kingdom; Stylonos Assimakis, Queen’s University Belfast, United Kingdom; George Goussitis, Heriot-Watt University, United Kingdom; Manos Tentzeris, Georgia Institute of Technology, United States; Apostolos Georgiadis, Heriot-Watt University, United Kingdom

**TU-A5.1P.8** 16:00
Broadband MST sensor probes based on a SP3T MEMs switch
Massimo Donelli, Mohammedhusen Manekiya, University of Trento, Italy; Jacopo Iannacci, Fondazione Bruno Kessler (FBK), Italy

**TU-A5.1P.9** 16:20
Orientation insensitive UHF RFID Tag Antenna with polarization diversity using Characteristic Mode Analysis
Abubakar Sharif, Jun Ouyang, University of Electronic Science and Technology of China, China; Mohamed Ali Iman, Qammer Hussain Abbasi, University of Glasgow, United Kingdom

**TU-A5.1P.10** 16:40
Analysis of Calibration-Free Detection Techniques for Frequency-Coded Chipless Radiofrequency Identification
Ye-Min Jiang, Jin-An Lin, Jyun-Yi Jhang, Bo-Lin Lin, Yen-Sheng Chen, National Taipei University of Technology, Taiwan
### Millimeter-wave Antennas

**Session Co-Chairs:** Ahmed A. Kishk, Concordia University; Seckin Sahin, Ohio State University

**TU-A5.2P.1**

**13:20**

**Wideband Millimeter-Wave Dielectric Resonator Antenna**  
Yazan Al-Alem, Ahmed Kishk, Concordia University, Canada

**TU-A5.2P.2**

**13:40**

**High Gain Millimeter-Wave Slot Antenna with Symmetric Radiation Characteristics**  
Yazan Al-Alem, Ahmed Kishk, Concordia University, Canada

**TU-A5.2P.3**

**14:00**

**A Series-fed Cavity-back Patch Array Antenna for a Miniaturized 77GHz Radar Module**  
Chen-Pang Chao, Shang-Hung Yang, Chiu-Ming Tang, Chang-Fa Yang, National Taiwan University of Science and Technology (Taiwan Tech), Taiwan; Wen-Hsuan Lin, Jiaotong University of Science and Technology Inc., Taiwan; Chun-Yi Chao, XMMSE Co., Ltd, Taiwan; Ike Lin, WaveFidelity Inc., Taiwan

**TU-A5.2P.4**

**14:20**

**Wideband, Wide Angle Radome Design for mw-Mm-Wave Automotive Radar Systems**  
Murad Md Sajjad Hosain, Syed An Mazzum Saequeb, Ohio State University, United States; Abeel H. Argec, John Cabigao, Carlos Valosquez, Alp Electric NA, Inc., United States; Kobly Sertel, Niru K. Nahar, Ohio State University, United States

**TU-A5.2P.5**

**14:40**

**Low-Cost and High-Gain W-Band Circularly Polarized SIW Slot Antenna**  
Hao Liu, University of Electronic Science and Technology of China, China; Aryanang Qin, Southwest Jiaotong University, China; Ziqiang Xu, Zhao Yang, University of Electronic Science and Technology of China, China

**Break**

**15:00**

**TU-A5.2P.6**

**15:20**

**K/Ka Dual-Band Dual-Polarized Gap Waveguide Array Antenna**  
Miguel Fernando-Rocher, Alegría Valero-Nogueira, Jose Ignacio Herranz-Hernando, Universitat Politècnica de València, Spain

**TU-A5.2P.7**

**15:40**

**Modeling the Effects of Gaseous Absorption and Attenuation due to Clouds for a 72 GHz Terrestrial Link**  
Ralph Lyndon Geaner, Christos Christodoulou, University of New Mexico, United States; Steven Lass, David Murrell, Air Force Research Laboratory, United States; Eugene Hong, Applied Technology Associates, United States; Nicholas Tarasenko, Air Force Research Laboratory, United States

**TU-A5.2P.8**

**16:00**

**Ridge Gap Array Antenna with Inter-Element Spacing of a Wavelength**  
Mohammadahdi Farahani, Institut national de la recherche scientifique (INRS), Canada; Tayeb A. Dandini, National Institute of Scientific Research (INRS), Canada; Mourad Medli, Université du Québec en Abitibi-Témiscamingue (UQAT), Canada

**TU-A5.2P.9**

**16:20**

**Array of stacked leaky wave antennas based on gap waveguide technology**  
Nafsika Memeletzoglou, Eva Rajo-Iglesias, Universidad Carlos III de Madrid, Spain

**TU-A5.2P.10**

**16:40**

**A Stepped-Ring Fabry Perot Cavity Antenna for Millimeter Wave Applications**  
Qing-Yi Guo, Hang Wang, City University of Hong Kong, China

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### Wireless Communications

**Session Co-Chairs:** John Volakis, Florida International University; Giulia Buttazzoni, University of Trieste

**TU-UB.1P.1**

**13:20**

**A Simple Method for Including the Antenna Pattern in Interfered Wireless Communications**  
Massimiliano Comi, Fulvio Babich, Francesca Varte, Giulia Buttazzoni, University of Trieste, Italy

**TU-UB.1P.2**

**13:40**

**Analysis of full-duplex AF Relaying under Imperfect Channel State Information**  
Kath Dogle, Nadir Hakem, Université du Québec en Abibhi-Témiscamingue (UQAT), Canada

**TU-UB.1P.3**

**14:00**

**mm-Wave Varactor Reconfigurable Microstrip Patch Antennas using GaN on Sapphire Technology**  
Mohammad Ali, Norman Mattax, MVS Chandrashekhar, Gragory Semin, University of South Carolina, United States

**TU-UB.1P.4**

**14:20**

**UWB Reconfigurable RF Self-Interference Cancellation Filter for Simultaneous Transmit and Receive System**  
Md Nural Anwar Tarek, Elias A. Alwan, Florida International University, United States

**TU-UB.1P.5**

**14:40**

**Intelligent Anti-Jamming Decision Method Based on the Mutation Search Artificial Bee Colony Algorithm for Wireless Systems**  
Fang Ye, Zhiyuan Zhou, Hongbo Tian, Qian Sun, Yibing Li, Tao Jiang, Harbin Engineering University, China

**Break**

**15:00**

**TU-UB.1P.6**

**15:20**

**A Four-Element Digital Array Receiver at 2.4 GHz Using a Single Frequency-Multiplexed ADC**  
Ayjna Modanoyake, Najoth Akram, Elias A. Alwan, Satheesh Barij Vankatakrishnan, John L. Volakis, Florida International University, United States; Soumyajit Mandal, Case Western Reserve University, United States; Leonid Belostotski, University of Calgary, Canada

**TU-UB.1P.7**

**15:40**

**Bandwidth Extension of Planar Microstrip-to-Waveguide Transition by Via-Hole Locations at Both Sides of Microstrip Line**  
Nguyen Thanh Tuan, Kono Sakekibara, Nobuyoshi Kikuma, Nagoya Institute of Technology, Japan

**TU-UB.1P.8**

**16:00**

**Performance analysis of full-duplex relaying over Rayleigh-Rician fading channels**  
Kaffi Dogle, Nadir Hakem, Université du Québec en Abibhi-Témiscamingue (UQAT), Canada

**TU-UB.1P.9**

**16:20**

**Experimental Evaluation of Intersymbol Interference in Non-Far Region Transmission using 30-GHz Band Large Array Antennas**  
Tobuuko Ruckkwaen, Kiyomichi Araki, Takashi Tomura, Jiro Hirokawa, Makoto Ando, Tokyo Institute of Technology, Japan

**TU-UB.1P.10**

**16:40**

**4×4 Broadband Butler Matrix and Its Application in Antenna Arrays**  
Kai-Ran Xiang, Fu-Chang Chen, South China University of Technology, China
Pattern Reconfigurable Antennas
Session Co-Chairs: Wael Abdel-Wahab, University of Waterloo; Karu P. Esselle, Macquarie University

**TU-A1.1P.1 13:20**
NEW PATTERN RECONFIGURABLE ANTENNA WITH 4 U-SLOTS FOR MIMO APPLICATIONS
Saeed Haydhah, Rifaqat Hussein, Mohammad Sharawi, King Fahd University of Petroleum and Minerals (KFUPM), Saudi Arabia

**TU-A1.1P.2 13:40**
A Yagi-Uda Pattern Reconfigurable Antenna for WiMAX Application
Sagiru Gaya, Hussein Attia, King Fahd University of Petroleum and Minerals (KFUPM), Saudi Arabia; Abdelhady Mahmut, Benha University, Egypt; Mohammad Sharawi, Polytechnique Montréal, Canada; Sharff Sheikh, King Fahd University of Petroleum and Minerals (KFUPM), Saudi Arabia

**TU-A1.1P.3 14:00**
2-D Pattern Reconfigurable Array Antenna with Excitation Phase Difference Circuit
Hikaru Watanabe, Takashi Maruyama, Narihiro Nakamoto, Toru Fukasawa, Naofumi Yoneda, Mitsubishi Electric Corporation, Japan

**TU-A1.1P.4 14:20**
Implementation of a Pattern-Reconfigurable Antenna for modern wireless sensor network applications
Muamba Mukandi Leingthone, Hakem Nadir, Université de Québec en Abitibi-Témiscamingue, Canada

**TU-A1.1P.5 14:40**
A Dual-Band Beam-Switching Antenna Using Square Active Frequency Selective Surfaces
Hifa Houssein, Ghada Elzwawi, INRS, Canada; Tayeb A. Denidni, National Institute of Scientific Research (INRS), Canada

Break 15:00

**TU-A1.1P.6 15:20**
PCB Bowing Effects on 60 GHz Switched-Beam Antenna Modules
Prabhat Baniya, Kathleen Melde, University of Arizona, United States

**TU-A1.1P.7 15:40**
Radiation Pattern Reconfigurable Horn Antenna
Mehtem Tanagardi, Utah State University, United States; Md Asaduzzaman Towfiq, i5 Technologies Inc., United States; Bedn Cetina, Utah State University, United States

**TU-A1.1P.8 16:00**
A Passive Beam Reconfigurable Antenna System for Millimeter-wave Applications
Affan Aziz Baba, Reheel Hashmi, Karu Esselle, Macquarie University, Australia; Manik Artygolle, Defence Science and Technology Group, Australia

**TU-A1.1P.9 16:20**
A Novel Bio-Inspired Quasi-Yagi Helical Antenna with Beam Direction and Beamwidth Switching Capability using Origami DNA
Syed Ilham Hussain Shah, Sungjoon Lim, Chung-Ang University, Korea (South)

**TU-A1.1P.10 16:40**
Fluidically Beam-Steering Metasurfaced Antenna
Aqeel Naqvi, Sungjoon Lim, Chung-Ang University, Korea (South)

Recent Advances in 4G and 5G Antennas for Mobile Devices
Session Co-Chairs: Jiang Zhu, Google, Inc.; Hongwei Liu, Futurewei Technologies, Inc

**TU-A5.3P.1 13:20**
A Compact Wideband Dual-polarized Millimeter Wave Antenna for 5G Smartphones
Menglou Rao, Kamal Sarabandi, University of Michigan, United States

**TU-A5.3P.2 13:40**
A Fundamental Study of Folded Monopole Antenna with Robustness to Metal
Yuta Nakagawa, Naobumi Michishita, Hisashi Morishita, National Defense Academy, Japan

**TU-A5.3P.3 14:00**
Co-design of Conformal 4G LTE and mmWave 5G Antennas for Smartphones
Iraes Magrey, Karthikkeya GS, Shibin K. Kaul, Indian Institute of Technology, Delhi, India

**TU-A5.3P.4 14:20**
A 5G Antenna Array Placed Close to a 4G Antenna
Takashi Yamagajo, Manabu Kai, Fujitsu Laboratories Limited, Japan

**TU-A5.3P.5 14:40**
Eight-element MIMO Antenna with Tightly-arranged Pairs for 5G Mobile Terminal
Changxiang Deng, Xin Lv, Beijing Institute of Technology, China

Break 15:00

**TU-A5.3P.6 15:20**
On the Integration of Antennas With Touch Sensor Panels
Sameer Sharma, Andrea Luttgen, Costas Sarris, University of Toronto, Canada

**TU-A5.3P.7 15:40**
Dual Functional MIMO Antenna System for mm-Wave 5G and 2 GHz 4G Communications
Emad Al Abbas, Muhammad Ikram, Amin Abbosh, University of Queensland, Australia

**TU-A5.3P.8 16:00**
An Octa-Band Antenna for LTE Mobile Handsets without Ground Clearance
Daiwei Huang, Zhengwei Du, Tsinghua University, China

**TU-A5.3P.9 16:20**
A Side-Edge Frame Printed Eight-Element Antenna Array for Quad-Band MIMO Operations in the 5G Smartphone
Hongwei Wang, Yiming He, Guanyi Yang, Shanghai University, China
<table>
<thead>
<tr>
<th>Session Co-Chairs:</th>
<th>Frequency Selective Surfaces: Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shulabh Gupta, Carleton University; Rhonda Franklin, University of Minnesota, Twin Cities</td>
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</tbody>
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**TU-A2.1P.1**
**Development of High Aperture Efficiency Fabry-Perot Cavity Antenna System**
Aditya Dave, Rhonda Franklin, University of Minnesota, Twin Cities, United States

**TU-A2.1P.2**
**Development of High Gain Virtual-Element Arrays with Fabry-Perot Cavity Antenna Systems**
Aditya Dave, Rhonda Franklin, University of Minnesota, Twin Cities, United States

**TU-A2.1P.3**
**Improvement in FSS-Based Sensor Sensitivity by Miniaturization Technique**
Mahboobeh Mahmoodi, Kristen M. Donnell, Missouri University of Science and Technology, United States

**TU-A2.1P.4**
**A Low-cost Light-weight 3D-printed Choke Ring for Multipath Mitigation for GNSS Antennas**
Mohamed R. Emara, Khalid Madihoun, Rawan Madhoun, Shulabh Gupta, Carleton University, Canada

**TU-A2.1P.5**
**A Compact Metasurface Based Cross Polarization Converter for X Band Applications**
Umer Farooq, Adnan Iftekhar, Muhammad Junaid Naghdi, Muhammad Fatimah Shatique, Muhammad Seerad Khan, Comsaat University, Pakistan; Raed M. Shubair, Massachusetts Institute of Technology, United States

**TU-A2.1P.6**
**FSS and Meta-material Based Low Mutual Coupling MIMO Antenna Array**
Shengyuan Luo, Yingsong Li, Tao Jiang, Beiming Li, Harbin Engineering University, China

**TU-A2.1P.7**
**C-Band Multi-Beam Planar Lens Antenna Based on Frequency Selective Surface**
Ying Suo, Hongyong Wang, Wei Li, Harbin Institute of Technology, China

**TU-A2.1P.8**
**An Improved Model for Static Field Micro-Particle Components on a Printed Transmission Line**
Nasim Soltanizadeh-Balanejji, David Rogers, Benjamin D. Braaten, North Dakota State University, United States

**TU-A2.1P.9**
**On Modal Excitation Using Capacitive Coupling Elements and Matching Network**
Hanieh Aliakbari, Buon Kiong Lau, Lund University, Sweden

**TU-A2.1P.10**
**Design and Characterization of a Dual-Band Impedance Transformer Based on an Embedded MTM-EBG**
Jacob Brown, Ashwin K. Iyer, University of Alberta, Canada

**TU-A1.2P.2**
**On Modal Excitation Using Capacitive Coupling Elements and Matching Network**
Hanieh Aliakbari, Buon Kiong Lau, Lund University, Sweden

**TU-A1.2P.3**
**Design and Characterization of a Dual-Band Impedance Transformer Based on an Embedded MTM-EBG**
Jacob Brown, Ashwin K. Iyer, University of Alberta, Canada

**TU-A1.2P.4**
**Ultra-wideband Planar Marchand Balun Design for the Pyramidal Sinuous Antenna**
Carlo Van Niekerk, Stellenbosch University, South Africa

**TU-A1.2P.5**
**A 1x4 power divider capable of implementing any phase difference output based on a slow-wave substrate integrated waveguide**
Chenchen Wang, Jiuling Zhang, Beijing University of Posts and Telecommunications, China; Zhanqi Zheng, Institute of Microelectronics, Chinese Academy of Sciences, China; Xiongzhui Zhu, Beijing University of Posts and Telecommunications, China

**TU-A1.2P.6**
**Coaxial Marchand Balun - Design and Fabrication**
Michael Johnston, Carlo Van Niekerk, Dirk De Villiers, Stellenbosch University, South Africa

**TU-A1.2P.7**
**Compact Comparator for Dual-Polarized Monopulse Array Based on Novel Eight-Port Coupler**
Kaija Ding, Ahmed Kishk, Concordia University, Canada

**TU-A1.2P.8**
**A Novel Hybrid Coupler Design based on the Concept of Balanced Loaded Transmission Lines**
Stefano Maddio, Giuseppe Pelosi, Monica Righini, Stefano Selleri, University of Florence, Italy

**TU-A1.2P.9**
**Dual-Polarized Antenna With High Isolation Using Hybrid Balun Circuit**
Zhongqian Niu, University of Electronic Science and Technology of China, China; Daotong Li, Chongqing University, China; Youzhong Zhang, Yonggang Zhang, Bo Zhang, Yong Fan, University of Electronic Science and Technology of China, China

**TU-A1.2P.10**
**New dual-polarized slot-coupled antenna for wireless applications**
Farid Shokouhi, Zaker Hossain Firouzeh, Reza Sefian, Isfahan University of Technology, Iran
Antenna Array III
Session Co-Chairs: Hualiang Zhang, University of Massachusetts, Lowell; Saeed Khan, Kansas State University
TU-UB.2P.1 13:20
Light Weight and Large Beamwidth Antenna Array for 2.4/5.8 GHz WLAN Applications
Saber Soltani, Bowen Zheng, Hong Tang, University of Massachusetts Lowell, United States; Chang Chen, University of Science and Technology of China, China; Hualiang Zhang, University of Massachusetts Lowell, United States
TU-UB.2P.2 13:40
The High Efficiency and Low Cost Massive MIMO Array Antenna for Sub-6GHz 5G Base Station
Jungmin Park, Seungtae Ko, Youngsun Kim, Youngsub Kim, Youngju Lee, Samsung Electronics, Korea (South)
TU-UB.2P.3 14:00
Antenna with Parasitic Radiators for Front-to-Back Ratio Enhancement
Youngsub Kim, Seungtae Ko, Jungmin Park, Youngju Lee, Samsung Electronics, Korea (South)
TU-UB.2P.4 14:20
Perfect Absorption by an Array of Lossy Dipoles Located Close to a Ground Plane
Ofer Markish, Daniel Silverstein, Yehuda Leviatan, Technion - Israel Institute of Technology, Israel
TU-UB.2P.5 14:40
Design of an Active Scalable Phased Array Antenna System
Kai Yao, Shengchang Lan, Lingxing Ye, Guoxuan Zhang, Gang Lu, Liqia Chen, Harbin Institute of Technology, China
Break 15:00
TU-UB.2P.6 15:20
An UTD Rapid Phased Array Antenna Coupling Package
Henry Zhang, Ryan From, Ruben Llamas, Quang Nguyen, Phong Tran, Boeing, United States
TU-UB.2P.7 15:40
Design and Analysis for Log Periodic Dipole Antenna Array for Low Altitude Source Search using Multirotor Unmanned Aerial Vehicles (UAV)
Saeed Khan, Kansas State University, United States
TU-UB.2P.8 16:00
Optimal Synthesis of Maximally Robust Antenna Arrays by Means of Circular Interval Arithmetics
Nicola Anselmi, Mohammad Abdul Hannan, Paolo Rocca, ELEDIA Research Center (ELEDIA@UniTN - University of Trento), Italy
TU-UB.2P.9 16:20
Robust Fast Jamming Signal Nulling Using Particle Swarm Optimization Algorithm Implemented on FPGAs
Ngiho Tran, Farshid Tamjid, Farhan Quaiyum, Aly E. Fathy, University of Tennessee at Knoxville, United States; Ozlem Kilic, Catholic University of America, United States
TU-UB.2P.10 16:40
Effects of a shorting post on the impedance characteristic of TCDA antenna
Seongjung Kim, Sangwook Nam, Seoul National University, Korea (South)

Biomedical applications of Electromagnetics III
Session Co-Chairs: Magdy Iskander, University of Hawaii; Zhengqing Yun, University of Hawaii; Susan Hagness, University of Wisconsin-Madison
TU-AS.4P.1 13:20
Mapping Lung Water Signal Distribution on Human Chest and Prediction of Lung Water Content
Zhengqing Yun, Scott Clements, Yuanzhang Xiao, Ruthanne Peron, Magdy Iskander, University of Hawaii, United States
TU-AS.4P.2 13:40
Study of Bending Effects on a Dual-Band Implantable Antenna
Mohammad Haemini, University of North Dakota, United States; Sima Zagheganian, PAOT Inc., United States
TU-AS.4P.3 14:00
Folding-Dependent vs. Folding-Independent Flexible Antennas on E-Textiles
Kevan Alharbi, Asmina Kiourti, Ohio State University, United States
TU-AS.4P.4 14:20
An experimental Procedure and Initial Results of RF Propagation in Human Subjects
Sajid M. Asif, University of Sheffield, United Kingdom; Adnan Hikko, Umer Farooq, Comcasts University, Pakistan; Jared Hansen, Ryan Shrik, Benjamin D. Brain, D. L. Ewert, North Dakota State University, United States; Keith Maile, Boston Scientific, United States
TU-AS.4P.5 14:40
On the Decoupling Robustness of Distributed Magnetic Traps in Biological Loaded Dual Tuned MR coils
Nunzia Fontana, Danila Brazi, Filippo Costa, University of Pisa, Italy; Gianluigi Tiberi, London South Bank University, United Kingdom; Agostino Manochio, University of Pisa, Italy
Break 15:00
TU-AS.4P.6 15:20
Classification of Anomalies with Open-Ended Coaxial Probes
Tuba Yilmaz, Istanbul Technical University, Turkey; Ercem Topakol, VCU, Turkey; Ibrahim Akduman, Istanbul Technical University, Turkey
TU-AS.4P.7 15:40
Liquid Metal Broadband Monopole for Stretchable Electronics
Nathan Seongheon Jeong, Amanda Koh, University of Alabama, United States
TU-AS.4P.8 16:00
Effect of Temperature Sensor Location and Measurement Time on Evaluation of the Calibration Factor of the Lead Electromagnetic Model
Mikhail Kozlov, Max Planck Institute for Human Cognitive and Brain Sciences, Germany; Wolfgang Kainz, Food and Drug Administration, United States
TU-AS.4P.9 16:20
Improved Reconstruction Method Based on k-Means by Finding Peak Density Automatically in Microwave Induced Thermocoustic Tomography
Shuangli Liu, Zhiqin Zhao, University of Electronic Science and Technology of China, China; Xiong Wang, Daqin Zhang, Shanghitech University, China
TU-AS.4P.10 16:40
Research on Electromagnetic Positioning Calibration Technology Based on Kriging Interpolation
Xingjie Wang, Tao Jiang, Yingjung Li, Yibing Li, Fang Yi, Harbin Engineering University, China; Bin Cao, Marine Design & Research Institute of China, China
Finite Element Methods
Session Co-Chairs: Branislav Notaros, Colorado State University; Dan Jiao, Purdue University

TU-A3.1P 13:20
The Dual Weighted Residual and Error Estimation in Double Higher-Order FEM
Jake Harmon, Branislav Notaros, Colorado State University, United States

TU-A3.1P.2 13:40
Truncating Matrix-free Time-Domain Method with PML for Solving 3-D Open Region Problems
Zhangchao Wei, Dan Jiao, Purdue University, United States

TU-A3.1P.3 14:00
Distributed NUMA Implementation of a Direct Solver for DDM Preconditioning
Dimitrios Makris, Marinos Vouvakis, University of Massachusetts Amherst, United States

TU-A3.1P.4 14:20
Parallel Direct Domain Decomposition Methods (D3M) for Finite Elements
Javad Moshfegh, Dimitrios Makris, Marinos Vouvakis, University of Massachusetts Amherst, United States

TU-A3.1P.5 14:40
Linear-Complexity H2-Based Direct Sparse Solver for Electromagnetic and Multiphysics Analysis
Miaomiao Ma, Dan Jiao, Purdue University, United States

High Frequency and Asymptotic Techniques
Session Co-Chairs: Deb Chatterjee, University of Missouri-Kansas City; Cagatay Tokgoz, Lamar University

TU-A3.2P 15:20
Anisotropic Slab Scattering: A High Frequency Solution
Manushanker Balasubramanian, Douglas H. Werner, Pennsylvania State University, United States

TU-A3.2P.2 15:40
Radiation from a Non-conformal Antenna Array on an Electrically Large Conducting Convex Surface
Babajide Salau, Manthan Shah, Cagatay Tokgoz, Lamar University, United States

TU-A3.2P.3 16:00
On the Location of Transverse Electric Surface Wave Poles for Electrically Thick Substrates
Kalyan Durhakula, Deb Chatterjee, Ahmed M. Hassan, University of Missouri-Kansas City, United States

TU-A3.2P.4 16:20
Special Functions for Radiation from Sources Close to an Electrically Large Conducting Convex Surface
Babajide Salau, Manthan Shah, Cagatay Tokgoz, Lamar University, United States

TU-A3.2P.5 16:40
Analysis of Rotated Corrugated Parallel Plate Waveguide Using Asymptotic Corrugation Boundary Conditions
Wei-Yu Lai, Malcolm Ng Mou Kehn, National Chiao Tung University, Taiwan

Computational Electromagnetics I
Session Co-Chairs: Ali Yilmaz, University of Texas at Austin; Yaniv Brick, Ben-Gurion University of the Negev

TU-A3.3P 13:20
2D Physical Optics Analysis of the Focal Region of Parallel-Plate Waveguide Lenses
Thomas Ströber, Mouna Erfane, Centre National de la Recherche Scientifique (CNRS), France

TU-A3.3P.2 13:40
Multiphysics Modeling of Crosstalk Effect in Graphene-Encapsulated Cu Nano-Interconnects
Shuzhan Sun, Dan Jiao, Purdue University, United States

TU-A3.3P.3 14:00
The Use of Singular Basis Functions for Precise EM Analysis of Axially Symmetric Metallic Antennas
Aleksandra Kmetta, Branka Kalundzija, University of Belgrade, Serbia

TU-A3.3P.4 14:20
Error Prediction in Electromagnetic Simulations Using Machine Learning
Bariscan Kansu, Ozgur Ergul, Middle East Technical University, Turkey

TU-A3.3P.5 14:40
Implications of Recompression for Grid-Based Low-Rank Approximation Techniques
Jonathan Kelley, Tian Yao, University of Texas at Austin, United States; Yonei Brick, Ben Gurion University of the Negev, Israel; Ali E. Yilmaz, University of Texas at Austin, United States

TU-A3.3P.6 15:20
All-Frequency Stable Potential-Based Formulation for Electromagnetic Modeling and Simulation
Su Yan, Howard University, United States

TU-A3.3P.7 15:40
Accurate Solution of Electromagnetic Scattering by Penetrable Objects with Changeable Shapes
Li Zhang, Yin Xuan Zhu, Han Yu Shi, Mei Song Tang, Tongji University, China

TU-A3.3P.8 16:00
Approximate Inverse of the Rao-Wilton-Glisson Basis Functions Gram Matrix via Monopolar Representation
Jonas Komprast, Josef Knapp, Thomas E. Elbert, Technical University of Munich, Germany

TU-A3.3P.9 16:20
Corrosion-Related Magnetostatic Field Analysis
John Young, Robert Pfeiffer, Robert Adams, University of Kentucky, United States; Stephen Gedney, University of Colorado Denver, United States

TU-A3.3P.10 16:40
Efficient Full-Wave Method For Analysing Transmit-Arrays Through an Equivalent Dielectric Description
Sergio Motas, Instituto de Telecomunicacoes, Instituto Universitario de Lisboa (ISCTE-IUL) Lisbon, Portugal; Jorge Costa, Instituto de Telecomunicacoes, Instituto Universitario de Lisboa, Portugal; Parviz Nazeri, University of Toronto, Canada; Eduardo Lima, Carlos A. Fernandez, Instituto de Telecomunicações, Portugal; Nelson Fonseca, ESA Antenna and Sub-Millimeter Wave Section, Netherlands
Educational Advances
Session Chair: Marcus Walden, Plextek

TU-AS.5.P 13:20
Modern Approaches and Self-Evaluation Tools for Teaching Electromagnetics
Alessandro Polo, Matteo Solaci, Giacomo Oliveri, Paolo Racca, Andrea Massa, ELEDIA Research Center (ELEDIA@UniTN – University of Trento), Italy

TU-AS.5.P 13:40
The Flipped Classroom Approach to Engineering Electromagnetics: A Case Study
Morris Cohen, Alenka Zajić, Georgia Institute of Technology, United States

TU-AS.5.P 14:00
Anten’it: A Hardware for Antenna Design and Education
Umut Bulus, Antenom Antenna Technologies Inc., Turkey

TU-AS.5.P 14:20
A WiFi Based Electromagnetic Visual Aid
Malcolm Simpson, Kiersten Kerby-Patel, University of Massachusetts Boston, United States

TU-AS.5.P 14:40
Spinning Magnets in Electromagnetic Education
Marcus Walden, Plextek, United Kingdom

High-Frequency and Millimeter Wireless Metrology
Session Co-Chairs: Matthew Simmons, National Institute of Standards and Technology; Christopher Holloway, National Institute of Standards and Technology

TU-UA.1.P 13:20
Novel 1256-Element Circularly-Polarized Metal-Only Reflectarray Using Spiral Slots
Kendrick Henderson, Nima Ghalechian, Ohio State University, United States

TU-UA.1.P 13:40
Overview of Dielectric Resonator Antennas for 5G Cellular Communication
Abas Sabouni, Wilkes University, United States

TU-UA.1.P 13:40
A Rydberg Atom-Based Mixer for Phase and Weak Signal Detection
Matthew Simons, Abdulaziz Haddad, University of Colorado, United States; Joshua Gordon, Christopher Holloway, National Institute of Standards and Technology, United States

TU-UA.1.P 13:40
User Proximity Analysis of Compact PIFA for MIMO Applications
Hari Shankar Singh, Thapar Institute of Engineering and Technology, India; Raed M. Shubair, Massachusetts Institute of Technology, United States

TU-UA.1.P 13:40
Fully-Metallic Leaky-Wave Antenna with Low Dispersion for 60 GHz Point-to-Point Communications
Qiao Chen, Oskar Dohlberg, Oscar Quevedo-Tenue, KTH Royal Institute of Technology, Sweden

Imaging Methods and Systems
Session Co-Chairs: Jeffrey Nanzer, Michigan State University; Francesca Vipiana, Politecnico di Torino

TU-A4.1.P 13:20
Dual Frequency Processing of Subsampled Measurements in W-band
Yasmine Hesham Mohamed Ibrahim, Claire Megliaccio, Jérôme Lanten, Jean-Yves Dauvignac, Laurent Brachier, Université Côte d’Azur, CNRS UMR 7248, LEAT, France

TU-A4.1.P 13:40
Transmit Pattern Analysis for Active Incoherent Microwave Imaging
Stavros Vakalis, Jeffrey Nanzer, Michigan State University, United States

TU-A4.1.P 13:40
A Method for Detection of Walls and Large Flat Surfaces in Through-the-wall SAR Imaging
Behzad Yektakhor, Kamal Sarabandi, University of Michigan, United States

TU-A4.1.P 14:20
Microwave Imaging Technology for In-line Food Contamination Monitoring
Laura Farina, National University of Ireland Galway, Ireland; Rasa Scapaticci, Institute for Electromagnetic Sensing of the Environment, National Research Council of Italy, Italy; Jorge A. Toban Vasquez, Javier Rivera, Politecnico di Torino, Italy; Amelie Litman, Institut Fresnel, France; Lorenzo Cocco, Institute for Electromagnetic Sensing of the Environment, National Research Council of Italy, Italy; Francesca Vipiana, Politecnico di Torino, Italy

TU-A4.1.P 14:40
A Physical Optics Simulator for Dielectric Bodies Characterization Using a Multistatic Radar
Marcos Arias, Lorena Perez-Eijo, Yolanda Rodriguez-Vaqueiro, Borja Gonzalez-Valdes, José Vázquez-Caba, Oscar Ribaños-Lopez, Antonio Pino, Universidad de Vigo, Spain; Yun Alvarez, Universidad de Oviedo, Spain

TU-A4.1.P 15:00
Array of Antennas for a GPR system on board a UAV
Yolanda Rodriguez-Vaqueiro, José Vázquez-Cabo, Borja Gonzalez-Valdes, Antonio Pino, Universidad de Vigo, Spain; Yun Alvarez, Universidad de Oviedo, Spain

TU-A4.1.P 15:20
Global Maxwell Tomography using an 8-channel radiofrequency coil: simulation results for a tissue-mimicking phantom at 7T
Ilias Giannakopoulos, Skolkovo Institute of Science and Technology, Russia; José Semollés, Massachusetts Institute of Technology, United States; Bei Zhang, New York University, United States; Luca Daniel, Jacob White, Massachusetts Institute of Technology, United States; Ricardo Lattanzio, New York University, United States

TU-A4.1.P 15:40
Elevation Imaging Based on Vortex Electromagnetic Wave
Ruiming Li, Haoquan Hu, Shiwen Lei, Zhipeng Lin, Bo Chen, University of Electronic Science and Technology of China, China
Optically Transparent Antennas
Session Co-Chairs: Christopher Valenta, Georgia Tech Research Institute; Hyok Jae Song, HRL Laboratories

WE-SP.1A.1 08:00
Characterization of Optically Transparent Copper Micro-Wire Transmission Lines
Christopher Liston, Carolyn Ellinger, Kevin O’Connor, Eastman Kodak Company, United States

WE-SP.1A.2 08:20
Dual-Band WiFi Applique Antenna
Hyok J. Song, James H. Schaffner, HRL Laboratories, LLC, United States; Timothy Tahy, Duane S. Carper, Eray Yasan, General Motors, LLC, United States

WE-SP.1A.3 08:40
2.5 GHz Meshed Inset-Fed Patch Antenna
Zachary Silva, Georgia Institute of Technology, United States; Charles Hunter, Christopher Valenta, Georgia Tech Research Institute, United States; Gregory Durgin, Georgia Institute of Technology, United States

WE-SP.1A.4 09:00
Transparent Microstrip Antennas for CubeSats
Xinya Liu, David Jackson, Eric Ingram, Ji Chen, University of Houston, United States; Murilo Seko, University of Sao Paolo, Brazil

WE-SP.1A.5 09:20
Field Performance of A Novel Wideband Optically Transparent GNSS Antenna
Eray Yasan, Independent Researchers, United States; Hyok J. Song, HRL Laboratories, LLC, United States; Timothy Tahy, General Motors, LLC, United States; James H. Schaffner, HRL Laboratories, LLC, United States; Duane S. Carper, General Motors, LLC, United States; Arthur Bekaryan, HRL Laboratories, LLC, United States

Wednesday, July 10 08:00 - 11:20
WE-A1.1A  Grand Ballroom A
Broadband/ Ultra Wideband Antennas and Systems I
Session Co-Chairs: Miguel Ferrando-Bataller, Universitat Politècnica de València; Félix Vega-Stevro, National University of Colombia

WE-A1.1A.1 08:00
Prediction of Impulse Response of a Flexible Wide-band Antenna for WBAN Applications
Sherif R. Zahran, Arab Academy for Science, Technology & Maritime Transport, Egypt; Mahmoud A. Abdalla, Military Technical College, Egypt; Luigi Boccio, University of Calabria, Italy

WE-A1.1A.2 08:20
Dual Polarized THz Imaging FPA in 22nm CMOS
Sven van Berkel, Satoshi Malotaux, Bart van den Bogert, Marco Spinti, Daniele Cavollo, Andrea Neto, Nuria Llombart, Delft University of Technology, Netherlands

WE-A1.1A.3 08:40
Wideband Single-Pixel THz Imager in 28nm CMOS
Sven van Berkel, Satoshi Malotaux, Marco Spinti, Daniele Cavollo, Andrea Neto, Nuria Llombart, Delft University of Technology, Netherlands

WE-A1.1A.4 09:00
On the Bandwidth of Loop Antennas using Characteristic Mode Analysis
Daniel Antonio Santillán-Hara, Universitat Politècnica de València, Spain; Fadnaas Abderrazak, University of Tunis El Manar (UTM), Tunisia; Eva Antonino-Daviu, Miguel Ferrando-Bataller, Universitat Politècnica de València, Spain

WE-A1.1A.5 09:20
Extremely Wideband Imaging Antenna with Uniform Radiation Patterns
Umair Naeem, Vincent Fusco, Queen’s University Belfast, United Kingdom; Michael Keaveney, Mike O’Shea, James Braslin, Analog Devices Inc., Ireland

Break 09:40

WE-A1.1A.6 10:00
Design Considerations in a Graded Index Flat Dielectric Lens for an Impulse Radiating Antenna
Fernando Albarracin-Vargas, Felix Vega-Stevro, National University of Colombia, Colombia; Christoph Bae, Kostis Orfanakis, Thomas Musch, Ruhr-University of Bochum, Germany

WE-A1.1A.7 10:20
A Broadband Multimode Antenna Based on the Theory of Characteristic Mode
Wei Su, Shaker Akraraki, Queen Mary University of London, United Kingdom; Qianyun Zhang, BaoHeng University, China; Yue Gao, Queen Mary University of London, United Kingdom

WE-A1.1A.8 10:40
GPR Bowtie Antennas with Reduced Induction Footprints for Dual-Modality Detectors
Wouter van Verre, Xiaoyang Gao, Frank Podd, David Daniell, Anthony Peyton, University of Manchester, United Kingdom

WE-A1.1A.9 11:00
A Modified Magnetoelectric Dipole Antenna
Lijia Chen, Shengmin Jiang, Daping Wang, Shufeng Zhang, Shengchang Lan, Harbin Institute of Technology, China
## IoT, 5G and mm-Wave Antennas and Components

**Session Co-Chairs:** Atif Shamim, King Abdullah University of Science and Technology (KAUST); Muhammad Ali, Georgia Institute of Technology

<table>
<thead>
<tr>
<th>Time</th>
<th>Presentation</th>
<th>Authors/Institutions</th>
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<tr>
<td>08:00</td>
<td><strong>Ultra-Wideband, Glass Package-Integrated Power Dividers for 5G and mm-Wave Applications</strong></td>
<td>Muhammad Ali, Atom Watanabe, Tong-Hong Lin, Manas Tentzeris, Rao Tummala, Georgia Institute of Technology, United States; Puluagurtha Markandeya Raj, Florida International University, United States</td>
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<tr>
<td>08:20</td>
<td><strong>Analysis of Lossy SIW Patch Antenna for Near-Field Communications</strong></td>
<td>Muhammad Khan, David Jackson, University of Houston, United States; Chatwin Lansdowne, NASA Johnson Space Center, United States</td>
</tr>
<tr>
<td>08:40</td>
<td><strong>77 GHz Screen Printed, Flexible, Beam-Switching Antenna Array for Wearable Radar Applications</strong></td>
<td>Azat Meredov, Kirill Klonovski, Atif Shamim, King Abdullah University of Science and Technology (KAUST), Saudi Arabia</td>
</tr>
<tr>
<td>09:00</td>
<td><strong>High-Isolation, Low Cross-Polarization, Differential-Feed, Dual-Polarized Patch Antenna Array for a 2.45 GHz Retrordirective System Application</strong></td>
<td>Jiangjie Zeng, Xianqi Lin, Yongmu Yang, University of Electronic Science and Technology of China, China</td>
</tr>
<tr>
<td>09:20</td>
<td><strong>Low-Cost and Highly Flexible Antenna for 2.4 GHz IoT applications</strong></td>
<td>Denis Le Goff, Yochan Song, Louis Barbier, Tan-Huot Chio, Koenraad Mouthaan, National University of Singapore, Singapore</td>
</tr>
<tr>
<td>09:40</td>
<td><strong>Effects of MWT Radiation on Sidelobe Levels in mm-Wave Microstrip Array Antenna</strong></td>
<td>Eunsu Noh, Kangwook Kim, Gwangju Institute of Science and Technology, Korea (South)</td>
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<td>09:40</td>
<td><strong>Design of Modified Sierpinski Gasket Fractal Antenna for Tri-band Applications</strong></td>
<td>Youcef Braham Chaouche, Mourad Nedil, Université du Québec en Abitibi-Témiscamingue (UQAT), Canada; Boualam Hammache, ET Laboratory, University of Mentouri Brothers Constantine 1, Algiers; Massinissa Belazzoug, ETA Laboratory, University of Bardo Bou Arredj, Algeria</td>
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<tr>
<td>10:00</td>
<td><strong>A K/Ka Shared-Aperture DRA Array with High Isolation</strong></td>
<td>Heba I. El-Sawaf, Wael M. Abdel-Wahab, Safeddin Safavi-Naeini, University of Waterloo, Canada</td>
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<td>10:20</td>
<td><strong>A Dual Band Circular Polarized Antenna Array based on the Sequential Arrangement of Non-identical Disc Patches</strong></td>
<td>Stefano Maddia, Giuseppe Pelosi, Monica Righini, Stefano Selleri, University of Florence, Italy</td>
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<tr>
<td>10:40</td>
<td><strong>A Dual-Band Circularly Polarized Pyramidal Horn Antenna</strong></td>
<td>Fres Ayoub, University of New Mexico, United States; Emil Ardelean, Air Force Research Laboratory, United States; Chris Chistodoulou, University of New Mexico, United States; David Murrell, Steven Lane, Air Force Research Laboratory, United States</td>
</tr>
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<td>11:00</td>
<td><strong>Copper Ring as Superstrate Layer to Generate Dual Band Circularly Polarized Microstrip Patch Antenna for X-Band Applications</strong></td>
<td>Halappa Gajera, University of Mysore, India</td>
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<tr>
<td>11:20</td>
<td><strong>Low-Profile Differentially-Fed Multi-Band Dual-Polarized Antennas</strong></td>
<td>Xuanbo Wang, Yaehui Cui, RongLin Li, South China University of Technology, China</td>
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## Multi-band Antennas I

**Session Co-Chairs:** Christos G. Christodoulou, University of New Mexico; Pedram Mousavi, University of Alberta

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<td>08:00</td>
<td><strong>Tuning Range Enhancement of a Frequency-Agile Tri-band Slot Antenna</strong></td>
<td>Saajd M. Alias, Mohammad Anbiyaei, Aadam Nori, Kenneth Ford, Timothy D’Farrell, Richard Langley, University of Sheffield, United Kingdom</td>
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<tr>
<td>08:20</td>
<td><strong>Compact, Multi-Band, Slot Antenna</strong></td>
<td>Abdullah Hoskote, Anthony Pesin, Jean-Yves Le Naour, Ali Louzie, Technicolor Research and Innovation, France</td>
</tr>
<tr>
<td>08:40</td>
<td><strong>A Dual-band Strain Sensor Based On Pop-up Half Wavelength Dipole Antenna</strong></td>
<td>Shaghayegh Soliani, Paul S. Taylor, John C. Batchelor, University of Kent, United Kingdom</td>
</tr>
<tr>
<td>09:00</td>
<td><strong>A Low-Profile Bull’s-eye Antennas for Dual-Band Applications</strong></td>
<td>Mohammad Mahdi Honari, University of Alberta, Canada; Kamal Sarabandi, University of Michigan, United States; Pedram Mousavi, University of Alberta, Canada</td>
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<td><strong>K/Ka Shared-Aperture DRA Array with High Isolation</strong></td>
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<td>Xuanbo Wang, Yaehui Cui, RongLin Li, South China University of Technology, China</td>
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</table>
Frequency Reconfigurable and Tunable Antennas
Session Co-Chairs: Sima Noghanian, University of North Dakota; Mei Song Tong, Tongji University

WE-A1.4A.1  08:00
Origami-Enabled Frequency Reconfigurable Dipole Antenna
Md Rayhan Khan, Constantinos L. Zekios, Shubhendu Bhattacharj, Stavros V. Georgakopoulos, Florida International University, United States

WE-A1.4A.2  08:20
3D Printed Modular Origami Inspired Dielectrics for Frequency Tunable Antennas
Yingwei Wu, Andrea Vallecchi, Yenfong Yang, Zhang You, Christopher Stevens, Ekaterina Shamonina, Patrick Grant, University of Oxford, United Kingdom

WE-A1.4A.3  08:40
A Frequency-Tunable Dual-Band Single-Layer Shorted Multi-Ring Microstrip Antenna Fed by an L-probe with Varactor Diodes
Toru Ikeda, Sakuyoshi Saito, Yoshi Kimura, Saitama University, Japan

WE-A1.4A.4  09:00
Slot Based Frequency Reconfigurable and UWB Sensing MIMO Antennas for CR Applications
Rifqiyat Hussain, King Fahd University of Petroleum and Minerals (KFUPM), Pakistan; Muhammad Umar, Anna Kamara, National University of Sciences and Technology (NUST), Pakistan; Mohammad Sharawi, Polytechnique Montréal, Canada

WE-A1.4A.5  09:20
Planar Frequency-Tunable Quad-Band Antenna with Independently Controllable Bands
Saif M. Asif, Adham Naji, Mohammad Anbiyaei, Kenneth Ford, Timothy O’Farrell, Richard Langley, University of Sheffield, United Kingdom

WE-A1.4A.6  09:40
Patch Antenna Array With Continuous Frequency and Polarization Tuning For 5G Mid-Band Communications
Muhammad Ikram, Nghia Nguyen-Trong, Amin Abbosh, University of Queensland, Australia

WE-A1.4A.7  10:00
Design Guidelines for a Novel Tunable Aperture- Coupled Microstrip Patch Antenna
Prasad Shastry, Bradley University, United States; Krishna Kathodda, Google, United States

WE-A1.4A.8  10:20
Flexible Reconfigurable Antenna Robust to Folding in Wearable Applications
Luca Santamaria, Khai Nguyen, Fabien Ferreira, Robert Staraj, Leonardo Lizz, Université Côte d’Azur, ONRS, LEAF, France

WE-A1.4A.9  11:00
A Bandwidth Reconfigurable Multiband Fractal Antenna For Wireless Applications
Youcef Brahmi Chouchou, Mourad Nedil, Université du Québec en Abitibi-Témiscamingue (UQAT), Canada; Idriss Messouedene, Higher school for computer science, Algeria

WE-A1.4A.10  11:20
A Frequency-Reconfigurable Magnetic Monopole Antenna Based on Quarter-Mode Substrate Integrated Waveguide
Huan Qian Xiong, Si Gu Wang, Yi Min Fan, Mei Song Tong, Tongji University, China

Vehicular Antennas and Electromagnetics
Session Co-Chairs: Nathan Jeong, The University of Alabama; Tayfun Ozdemir, Virtual EM Inc.

WE-A5.1A.1  08:00
A Glass-Integrated Ferrite FM Antenna for Vehicle Telematics
Md Fahim Chowdhury, Yang-Ki Hong, Hoyun Won, Woncheol Lee, Minkyung Choi, University of Alabama, United States

WE-A5.1A.2  08:20
Development of a Rear Glass Antenna System for a Hatchback Vehicle
Song Heun Lee, Hyundai Motor Company, Korea (South); Frank Mierke, Continental Automotive, Germany

WE-A5.1A.3  08:40
Low-Profile, Vehicle Roof-Top Mounted Broadband Antenna for V2X
Martin (Wooseop) Lee, Nathan Seongheon Jeong, University of Alabama, United States

WE-A5.1A.4  09:00
Virtual Drive Testing based on Automotive Antenna Measurements for Evaluation of Vehicle-to-X Communication Performances
Francesco Saccardi, Alessandra Scannavini, Lucia Scialacqua, Lars Jacob Foged, Microwave Vision Italy SRL, Italy; Nicolas Gross, Amaud Gandois, Stephane Doaghe, Per Olav Iversen, Microwave Vision Group Industries, France

WE-A5.1A.5  09:20
A V2X Communication System Test on Sea
Shravan Kumar Kalyankar, Hieu Nguyen Thanh, Yee Hui Lee, Yang Liang Guan, Nanyang Technological University, Singapore

Break  09:40

WE-A5.1A.6  10:00
Covariance Matrix Evaluation of a Diversity Slot Antenna for Vehicular Communications
Abed Pour Sahrab, Petros Karadimas, Yingke Huang, University of Glasgow, United Kingdom

WE-A5.1A.7  10:20
Polarization-Diversity Conformal VHF Antenna with Near-Perfect Radiation Efficiency for Small UAVs
Tayfun Ozdemir, Chris Davis, Virtual EM Inc., United States

WE-A5.1A.8  10:40
A Compact Platform-Based Antenna for an Unmanned Ground Vehicle
Mohammad Ramzi Khakshur, Nader Behdad, University of Wisconsin-Madison, United States; Fikadu T. Dagefu, Army Research Laboratory, United States

WE-A5.1A.9  11:00
Automotive RADAR Front-End with Added Target Estimation in Elevation Plane
Umair Naeem, Dimitry Zelenchuk, Vincent Fusco, Queen’s University Belfast, United Kingdom; Michael Keaveney, Mike O’Shea, James Breslin, Analog Devices Inc., Ireland

WE-A5.1A.10  11:20
Antenna Modeling on Complex Platforms Via Sparse Constrained Equivalent Distributions
Leo Tchorowski, Inder Gupta, Ohio State University, United States
Wide- and Dual-Band Frequency Selective Surfaces
Session Co-Chairs: Raj Mittra, University of Central Florida; Tayeb A. Denidni, National Institute of Scientific Research (INRS)

WE-A2.1A.1 08:00
Parametric Analysis of a Dual Band Polarized Frequency Selective Surface
Andrei – Marius Silaghi, Alido De Sabata, University Politehnica Timisoara, Romania; Ladislau Matekovits, Politecnica di Torino, Italy

WE-A2.1A.2 08:20
Design of Polarized Dual-Band Unit-Cell for Wideband FSS in Ku Band
Lamine N.A Bamogho, Jean-Jacques Laurin, École Polytechnique de Montréal, Canada

WE-A2.1A.3 08:40
Design of Frequency Selective Surfaces for Wide Frequency and Angular Responses
Nathawut Homsup, Raj Mittra, University of Central Florida, United States

WE-A2.1A.4 09:00
Cross Dipole FSS Bandwidth Enhancement
Yassine Zouaoui, Larbi Talbi, Khelfa Hettak, Université du Québec en Outaouais, Canada

Break 09:40

WE-A2.1A.6 10:00
A Dual-polarized FSS on a Single Substrate using Highly-coupled Interlayer Inductance
Youngtae Youn, Wonbin Hong, Pohang University of Science and Technology (POSTECH), Korea (South)

WE-A2.1A.7 10:20
Wideband Multilayer 45-Degree Polarizer (2-6GHz)
Wafaa Abdou-Abdallah, Muhammad Saeeed Khan, Athanasios Konstantinidis, Emirats Technology and Innovation Center (ETIC), Khalifs University (KU), United Arab Emirates

WE-A2.1A.8 10:40
Design of a Dual-Band Band-stop Frequency Selective Surface
Wei Li, Ying Suo, Hongfei Ye, Harbin Institute of Technology, China

WE-A2.1A.9 11:00
An Ultra-thin Wideband 3-D Frequency Selective Raspsoer based on Ferrite Absorber and Slow Wave Structure
Yi Hao Wang, Shishan Qi, Wen Wu, The Ministerial Key Laboratory of JGMY, China; Zhangxian Shen, Nanjing University of Science and Technology, China

WE-A2.1A.10 11:20
Frequency-Selective Raspsoer with Tri-resonant Absorption Band
Zhaifei Wang, Jiadui Fu, Harbin Institute of Technology, China; Qingcheng Zeng, Nanjing University of Aeronautics and Astronautics, China; Huan Li, Université de Québec, Canada; Tayeb A. Denidni, National Institute of Scientific Research (INRS), Canada

Antenna Feeds and Matching Circuits II
Session Co-Chairs: Carl Pfeiffer, Defense Engineering Corp.; Brett T. Walkenhorst, NSI-MI Technologies

WE-A1.5A.1 08:00
SW-to-Mini-Coaxial Vertical Transition for Low Profile MM-Wave PCB-to-PCB Assembly
Wael M. Abdel-Wahab, University of Waterloo, Canada; Hussam Al-Saedi, University of Technology, Iraq; Andeshir Painzah, Ahmad Ehsanpour, Safieddin Safavi-Naeini, University of Waterloo, Canada

WE-A1.5A.2 08:20
H-Plane Metallic RWG-to-SIW Transition Using Aperture Coupling
Wael M. Abdel-Wahab, Safieddin Safavi-Naeini, University of Waterloo, Canada

WE-A1.5A.3 08:40
A Compact Broadband Phase-Inverter-Based Two-Section Forward Coupler for Sub-6-GHz Band
Robin Jeanty, Shih-Yuan Chen, National Taiwan University, Taiwan

WE-A1.5A.4 09:00
UWB Millimeter-Wave 180 degree Hybrid Couplers
Carl Pfeiffer, Thomas Steffen, Defense Engineering Corp., United States; Boris Tamosic, Air Force Research Laboratory, United States

WE-A1.5A.5 09:20
2-Port Antenna with Matching Network for Dual-band IoT Terminal
Luca Santamaria, Tran Quang Khanh Nguyen, Leonardo Lize, Fabien Ferrero, Robert Staraj, Université Côte d’Azur, CNRS, LEAT, France

Break 09:40

WE-A1.5A.6 10:00
3:1 Bandwidth Dual Polarized Feeds for Compact Range and Near-Field Probes
German Cortes-Medellin, Brett T. Walkenhorst, NSI-MI Technologies, United States

WE-A1.5A.7 10:20
Finite Metal Wall Effects of W-Band Circular Polarized Horn Antenna with Inbuilt Polarizer
Ghanshyam Mishra, San diego state university, United States; Satish K Sharma, San Diego State University, United States; Jia-Chi Chiuh, SPWRA, United States

WE-A1.5A.8 10:40
Search-Based Design of Digital Non-Foster Antenna Match for High-Speed Low-Impedance Converters
Vinit Katariya, Thomas Weldon, University of North Carolina at Charlotte, United States

WE-A1.5A.9 11:00
X-Band Waveguide Coupler with Low Ripple and Losses
Alok Vivek, Shahid Baheshti University, Iran; Omid Mannouchehri, University of Illinois at Chicago, United States; Mahdi Khorasani, Tarbiat Modares University, Iran; Danilo Erricolo, University of Illinois at Chicago, United States
Array System Technologies
Session Co-Chairs: Jacob Houck, Georgia Tech Research Institute; Sunita Bhagat, Johns Hopkins Applied Physics Laboratory

WE-A1.6A.1 08:00
Bi-Static Simultaneous Transmit And Receive (STAR) Antenna Array System
Parthap Valole Prasanthkumar, Aman Samayian, Mohamed Elmoamani, Ljubodrag Boskovic, Dajin Filipovic, University of Colorado at Boulder, United States; Sudhakar Rao, Northrop Grumman Aerospace Systems, United States

WE-A1.6A.2 08:20
Wideband Optically-steered phased array antenna using a Dual-Electrode Mach-Zehnder Modulator
Daniel Marín, Maria Concepcion Santos, Jordi Romeu, Josep Prat, Luis Jofre Roca, Universitat Politecnica de Catalunya (UPC), Spain

WE-A1.6A.3 08:40
Near-Field Measurement Study for Over-the-Horizon Radar Transmit Beamformers
Simon Henault, Defence Research and Development Canada, Canada

WE-A1.6A.4 09:00
Using MIMO to Extend the Operating Band of Over-the-Horizon Radar Transmit Beamformers to Lower Frequencies
Simon Henault, Defence Research and Development Canada, Canada

WE-A1.6A.5 09:20
An Unified Equation for Active Reflection Coefficient in 4D Antenna Arrays including Mutual Coupling Effect
Feng Yang, Shuwen Yang, Kaixi Chen, Fang Wang, Yikai Chen, University of Electronic Science and Technology of China (UESTC), China

Break 09:40

WE-A1.6A.6 10:00
Broadband Array Antennas For Curved Geometries
Shamimsha Modak, Hung Tran, George R. Branner, University of California, Davis, United States; Preetham Kumar, California State University, Sacramento, United States

WE-A1.6A.7 10:20
Reducing the Number of Phase Shifters in Circular Arrays of Circular Subarrays for a Wide-Scanning Pattern
Elizan Ibarra, CICESE Research Center, Mexico; Marco A. Panduro, Center for Scientific Research and Higher Education of Ensenada, Mexico; Alberto Reyna, Universidad Autonoma de Tamaulipas, Mexico; David Cavarrobias, Roberto Conte, CICESE Research Center, Mexico; Eduardo Muñoz, Universidad Nacional Autónoma de México, Mexico

WE-A1.6A.8 10:40
Wideband Two-Beam Antenna array Fed by Modified Butler Matrix
Ji-Peng Chen, Fu-Chang Chen, South China University of Technology, China

WE-A1.6A.9 11:00
Generation of dual-beam orbital angular momentum vortex beam using transmit arrays
Rui Xi, Xi'an University, China; S. Ang, Kaoru Porter, University of Arkansas, United States; Long Li, Xi'an University, China

WE-A1.6A.10 11:20
Two-Way Phase Shifter with Equal Phase Shift
Zahra Rahimian Omam, Suren Goyal, University of Waterloo, Canada; Ali Pourbazi, Saeid Nikmehr, University of Tabriz, Iran; Shahraddin Safavi-Naeini, University of Waterloo, Canada

Biomedical Applications of Antennas
Session Co-Chairs: Dirk Manteuffel, Leibniz University Hannover; Arash Ebadi-Shahrivar, University of Notre Dame

WE-A5.2A.1 08:00
Investigation on Resolution of Thermoacoustic Imaging Based on Compressive Sensing: A Simulation Study
Baosheng Wang, Yifei Sun, Chenze Li, Xiong Wang, ShanghaiTech University, China

WE-A5.2A.2 08:20
Mutual Coupling Reduction in Wideband Electromagnetic Medical Imaging Antenna Array Using Compact Electromagnetic Band Gap
Abdulrahman S. M. Alqadami, Nghia Nguyen-Trong, Konstanty Bialkowski, Amin Abbosh, University of Queensland, Australia

WE-A5.2A.3 08:40
Slot Antenna Design with Optimized On-Body Pattern for Eyewear Applications
Lukas Berkelmann, Dirk Manteuffel, Leibniz University Hannover, Germany

WE-A5.2A.4 09:00
A Modified Vivaldi Antenna with Low Self-reflectivity for Bone Health Detection
Gang Lu, Shengchang Lan, Kang Zhang, Kai Yao, Li-chun Chen, Weichu Chen, Harbin Institute of Technology, China

WE-A5.2A.5 09:20
A Slot Antenna for Non-invasive Detection of Blood Constituents Concentrations
Jessica Hanna, Joseph Costantine, Roswanda Kang, Azood El, Youssef Tenk, American University of Beirut, Lebanon; Ali Ramadan, Faisal Bin Sultan University, Saudi Arabia

Break 09:40

WE-A5.2A.6 10:00
Evaluation of Bannisters Subsurface-to-Air Model for Implanted Antennas
Saba Meshkour, Lukas Berkelmann, Dirk Manteuffel, Leibniz University Hannover, Germany

WE-A5.2A.7 10:20
Codebook Requirements for Estimating Multi-Antenna SAR in Linear Time
Arash Ebadi-Shahrivar, Patrick Fay, Bertrand Hochwald, University of Notre Dame, United States; David Love, Purdue University, United States

WE-A5.2A.8 10:40
Near-field Electrically Small Sensors Array with PCA for Microwave Breast Tumor Detection
Maged Aldhooeabi, Saeed Bamatraf, Thamer Almoneef, Omar Ramahi, University of Waterloo, Canada

WE-A5.2A.9 11:00
A Fast Method to Estimate Peak Local SAR under MRI With RF Shimming
Shuo Song, Jianfeng Zheng, Ji Chen, University of Houston, United States
Methods of Inverse Scattering
Session Co-Chairs: Maokun Li, Tsinghua University; Xudong Chen, National University of Singapore

WE-A4.1A.1  08:00
Full Sparsity in Compressive Processing for Non-Linear Inverse Scattering
Nicola Anselmi, Andrea Massa, ELEDIA Research Center (ELEDIA@UniTN – University of Trento), Italy

WE-A4.1A.2  08:20
A convenient rewriting to the 2D inverse scattering problem based on the reduced scattered field
Martina Teresa Bevacqua, Tommaso Isenia, Università Mediterranea di Reggio Calabria, Italy

WE-A4.1A.3  08:40
Microwave Imaging of Strong Scatterers through a Multi-Resolution Contraction Integral Equation Method
Marco Salucci, ELEDIA Research Center (ELEDIA@UniTN – University of Trento), Italy; Kwen Xu, Key Lab of RF Circuits and Systems of Ministry of Education, Hangzhou Dianzi University, Hangzhou, China, China; Yu Zhong, Institute of High Performance Computing, A*STAR, Singapore, Singapore

WE-A4.1A.4  09:00
Study on Different Representations of Contrast for Inverse Scattering Problems
Tiantian Yin, Zhun Wei, Xudong Chen, National University of Singapore, Singapore

WE-A4.1A.5  09:20
Multi-Scale Compressive Processing for Inverse Scattering within the Contrast Source Formulation
Marco Salucci, Lorenzo Poli, Nicola Anselmi, Andrea Massa, ELEDIA Research Center (ELEDIA@UniTN – University of Trento), Italy

WE-A4.1A.6  10:00
Exploiting Sparsity in Adaptive Relevance Vector Machine for Reconfigurable Soft-Field Tomography
Daniel Ospina Acero, Fernando Teixeira, Ohio State University, United States; Qusai M. Marashdeh, Tech4Imaging LLC, United States

WE-A4.1A.7  10:20
Statistical Bayesian Inversion of Ultra-deep Electromagnetic LWD Data: Trans-dimensional Markov Chain Monte Carlo with Parallel Tempering
Quyang Shen, Jiefu Chen, University of Houston, United States; Haoming Wang, Chevron Corporation, United States; Yueqin Huang, Geantech Consulting LLC, United States

WE-A4.1A.8  10:40
Three-dimensional Joint Inversion of Acoustic and Electromagnetic Data Based on Contrast Source Inversion
Xiaojian Song, Maokun Li, Fan Yang, Shenzhen University, China; Aria Abubakar, Schlumberger, United States

WE-A4.1A.9  11:00
A Multi-Resolution Evolutionary Programming Technique For GPR Applications
Maryam Hajebi, Hormozgan University, Iran; Ahmad Hoorfar, Villanova University, United States

WE-A4.1A.10  11:20
3D Electromagnetic Inverse Scattering by Magneto-Dielectric Objects with Arbitrary Anisotropy in Layered Uniaxial Media
Feng Han, Jiawen Li, Jianliang Zhuo, Xiamen University, China; Hai Liu, Guangzhou University, China
**MIMO Antennas and Systems**

*Session Co-Chairs: Mehrbod Mohajer, Qualcomm Inc.; Mats Gustafsson, Lund University*

- **WE-UB.1A.1** Multi-beam Antennas Based on Modified Luneburg Lens  
  Muhammad Tursunniyaz, Hung Luyen, John Booske, Nader Behdad, University of Wisconsin, United States

- **WE-UB.1A.2** Antenna Performance Evaluations in 8×8 MIMO Access Points  
  Mehrbod Mohajer, Adil Hussain, Eyal Hochdorf, Andy Friedfeld, Steve Beaudin, Qualcomm Inc., United States

- **WE-UB.1A.3** Millimeter-wave Rotman lens-based radar system on the move for disaster rescue applications  
  Toan Vo Dai, Ozlem Kilic, Catholic University of America, United States

- **WE-UB.1A.4** Radiation modes and fundamental limitations on MIMO antennas  
  Mats Gustafsson, Casimir Ehrenborg, Lund University, Sweden

- **WE-UB.1A.5** Asymmetric Beamwidth Beamforming Antenna Using Rotman Lens  
  In-Ryeol Kim, Dong-Woo Kim, Jae-Beom Jin, Soon-Soo Oh, Chosun University, Korea (South)

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**EBG, UWB and RFID based Antennas**

*Session Chair: Abas Sabouni, Wilkes University*

- **WE-UB.2A.1** Tunable True Time Delay Engine for UWB mm-Wave Beamforming  
  Raed Almhmadi, Kubilay Sertel, Ohio State University, United States

- **WE-UB.2A.2** RFID Tag Localization for Tires using Support Vector Machine Learning  
  Robert Burkholder, Ohio State University, United States

- **WE-UB.2A.3** Improving the Efficiency of Flexible Antenna for Biomedical Applications using EBG structure  
  Abas Sabouni, Wilkes University, United States

- **WE-UB.2A.4** Dislocation of Lattice Points for Impedance Matching of a Photonic Bandgap Cavity Resonator  
  Ning Zhou, Illinois Institute of Technology, United States; Terry Smith, Geoff Waldschmidt, Alireza Nasiri, Argonne National Laboratory, United States; Thomas Wong, Illinois Institute of Technology, United States

- **WE-UB.2A.5** CPW Fed Slotted Patch Antenna for UWB Applications  
  Girish Awadhwal, UIT, India; Sambiram Renganathan, California State University, United States

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**Microstrip Antennas and Printed Devices**

*Session Co-Chairs: Sungkyun Lim, Georgia Southern University; Tutku Karacolak, Washington State University Vancouver*

- **WE-UB.3A.1** Ultra Wideband Balanced Feeds for Scanning Arrays  
  Ireen S. Sefa, Alexander D. Johnson, Sathesh Bajja Venkatarkrishnan, John L. Vokakis, Florida International University, United States

- **WE-UB.3A.2** A Double Sided Bow-tie Antenna Array for Broadband Communications and Performance Study of Controlling Ground Plane  
  Md. Rababi Hasan, Carlene Goodbody, Toan Nguyen, Tutku Karacolak, Washington State University Vancouver, United States

- **WE-UB.3A.3** Design of a Directive UHF RFID Tag Antenna for a Pavement Embedded System  
  Louryn Smith, Dean Lucsen, Sungkyun Lim, Georgia Southern University, United States

- **WE-UB.3A.4** A Low-cost CPW-fed Conformal Antenna for Wearable Applications  
  Ali Arif, Muhammad Zubair, Muhammad Qasim Mehmoood, Kazi Riaz, Information Technology University, Pakistan

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**Theoretical Electromagnetics II**

*Session Chair: Christophe Caloz, Polytechnique Montréal*

- **WE-A2.2A.1** Theoretical Modal Analysis of Square Waveguides filled with Effectively Skew Uniaxial Media  
  Walid Dyab, Prince Sultan University, Saudi Arabia; Ahmed Sakr, Stanford University, United States; Ke Wu, Polytechnique Montréal, Canada

- **WE-A2.2A.2** Compact Dual-Mode Ridge Waveguide Dual-Band Filter  
  Ya Xia, Fu-Chang Chen, South China University of Technology, China

- **WE-A2.2A.3** Analysis of a 200-GHz OAM Radio Link Using a Generalized Friis Transmission Equation  
  Woo Jin Byun, Electronics and Telecommunications Research Institute, Korea (South); Yang Heui Cho, Mokwon University, Korea (South)

- **WE-A2.2A.4** Acceleration of Laser-Driven Light Sails with Size Comparable to the Beam  
  Oscar Cespedes Vicente, Christophe Caloz, Polytechnique Montréal, Canada

- **WE-A2.2A.5** Geometric Improvements on Solar Cells for Reducing Reflections  
  Barisan Karaosmanoglu, Behre Nur Bica, Ozgur Ergul, Middle East Technical University, Turkey
**Time-Domain Computational Methods for Complex Electromagnetic and Multiphysics Problems**

Session Co-Chairs: Ali Yilmaz, University of Texas at Austin; Yang Liu, Lawrence Berkeley Laboratory

**WE-SP.1P.1**

A DGTD-Based Multiscale Simulator for Electromagnetic Multiphysics Problems
Su Yan, Howard University, United States; Jian-Ming Jin, University of Illinois at Urbana-Champaign, United States

**WE-SP.1P.2**

3D Multiscale Unconditionally Stable Time-Domain Modeling of Nonlinear RF Thin Film Magnetic Devices
Zhi Yao, Han Cui, Rüstü Umut Tok, Yuanxun Ethan Wang, University of California, Los Angeles, United States

**WE-SP.1P.3**

Implicit time integration schemes in electromagnetic-micromagnetic and quantum problems
Xueyang Wang, Marco Menarini, University of California, San Diego, United States; Amir Natan, Amir Boag, Tel Aviv University, Israel; Vitaliy Lomakin, University of California, San Diego, United States

**WE-SP.1P.4**

Fast evaluation of retarded electromagnetic potentials for quantum calculations
Dor Gabay, Amir Natan, Amir Boag, Tel Aviv University, Israel; Ali E. Yilmaz, University of Texas at Austin, United States

**WE-SP.1P.5**

Accelerated Cartesian Harmonics based framework for acceleration of retarded potentials
Daniel Dault, Naveen Nair, Balasubramaniam Shanker, Michigan State University, United States

**WE-SP.2P.1**

Overview of 5G mm-Wave Antenna Design Solutions in Cellular Phones: AiP, AiA, and AiAiP
Hsin-Chu Huang, viva Mobile Communication Co., Ltd, China

**WE-SP.2P.2**

Design and Analysis of Mobile Phone Antenna System with Integration of LTE 4G, Sub-6G and Millimeter Wave 5G Technologies
Guangli Yang, Shanghai University, China

**WE-SP.2P.3**

Millimeter-Wave Antenna Arrays with Beam Steering for 5G Mobile Terminals
Shuai Zhang, Gert Frølund Pedersen, Aalborg University, Denmark

**WE-SP.2P.4**

Gain Enhancement of mm-wave On-chip Antenna through Functional Packaging
Haoran Zhang, Atif Shamim, King Abdullah University of Science and Technology (KAUST), Saudi Arabia

**WE-SP.2P.5**

Antenna Design Considerations for 5G Millimeter-Wave Cellular Communications
Sunmin Yun, Hosaeng Kim, Joonho Byun, Samsung Electronics, Korea (South)

**WE-SP.2P.6**

Performance Comparison of Silicon Substrates for IC-Waveguide Integration based on a Contactless Transition at mm-Wave frequencies
Alhassan Aljarosha, Piyush Kaul, A. Bart Smolders, Marion Matters-Kammerer, Rob Moaskant, Eindhoven University of Technology, Netherlands

**WE-SP.2P.7**

A Dual-Band Millimeter-Wave Antenna for 5G Mobile Applications
Chong-Zhi Han, Guan-Long Huang, Tao Yuan, Shenzhen University, China; Chow-Yen-Desmond Sim, Feng Chia University, Taiwan
**Wednesday, July 10**

**WE-A1.1P**

**Broadband / Ultra Wideband Antennas and Systems II**

Session Co-Chairs: Kathryn Smith, University of North Carolina at Charlotte; Mei Song Tong, Tongji University

13:20

**WE-A1.1P.1**

Printed Cactus Monopole Antenna with Enhanced Impedance Bandwidth

Eric Eveleigh, Alexander Beaverstone, Natalia Nikolaou, McMaster University, Canada

13:40

**WE-A1.1P.2**

High gain circularly polarized stacked circular patches loaded with a circular sector notches and vertical ground ring for UHF RFID universal reader

Hany Hamood, German University in Cairo, Egypt

14:00

**WE-A1.1P.3**

Graphene-based Textile Ultra Wideband Antennas for Integrated and Wearable Applications

Isidoro Iñanez Labiano, Syed Fizah Jalani, Queen Mary University of London, United Kingdom; Muhammad Said Ergakas, Casun Kocabas, University of Manchester, United Kingdom; Elif Oztun-Yenigen, Royal College of Art, United Kingdom; Akram Alomainy, Queen Mary University of London, United Kingdom

14:20

**WE-A1.1P.4**

Design of Compact UWB Coplanar Waveguide-Fed Modified Sierpinski Carpet Fractal Antenna

Abdennour Ben Terki, Mourad Nedil, Youcef Braham Chaouche, Université du Québec en Abitibi-Témiscamingue (UQAT), Canada

14:40

**WE-A1.1P.5**

A Wideband Endfire Antenna Using SWG-HIS Hybrid Structure

You-Long Jin, Yu-Ming Wu, Xiao Ding, Institute of Applied Physics, University of Electronic Science and Technology of China, China

Break

15:00

**WE-A1.1P.6**

A Novel UWB Antenna For Wireless Communication Systems Using Genetic Algorithms

Mohammed Cherif Derbal, Abdelbaki Zeghdoud, Mourad Nedil, Université du Québec en Abitibi-Témiscamingue (UQAT), Canada

15:20

**WE-A1.1P.7**

Design of Large-Band Highly Directive Antenna in the Millimeter Waves Range at 80 GHz

Habiba Hafidollah Ouslimani, Fanhong Meng, Paris Lumière University Paris Nanterre, France

16:00

**WE-A1.1P.8**

Design and Simulation of a Polygonal Discone Antenna for Simplified Fabrication and Reconfigurability

Mohamad Fazeli, Kathryn Smith, University of North Carolina at Charlotte, United States

16:20

**WE-A1.1P.9**

Elliptical Disk Cavity Backed Antenna for UWB Systems

Carlos Ramiro Peñañuel-Ojeda, Anibal Llanga-Vargas, Marta Cabedo-Fabrés, Miguel Ferrando-Botiller, Universitat Politècnica de València, Spain

16:40

**WE-A1.1P.10**

Wideband Omnidirectional Circularly Polarized Antenna for Millimeter-Wave Applications Using Printed Artificial Anisotropic Polarizer

Chen Ding, Kwai-Man Luk, State Key Laboratory of Terahertz and Millimeter Waves, China

**Wednesday, July 10**

**WE-A1.2P**

**Microstrip Antennas, Circuits and Design I**

Session Co-Chairs: Sima Noghanian, University of North Dakota; Christos G. Christodoulou, University of New Mexico

13:20

**WE-A1.2P.1**

Data Acquisition Circuit for Identification of RF Signals’ Direction of Arrival

Tarcisio Augusto de Bonfim Gripp, Bernardo Mascarín Fabiani, Eduardo dos Santos Silveira, Daniel Chagas do Nascimento, Technological Institute of Aeronautics, Brazil

13:40

**WE-A1.2P.2**

An Air Gap Loaded Low Profile Microstrip Antenna with Hanging Post Integrated Patch Surface: A New Approach to Reduce Cross Polarization Radiation

Subhradeep Chakraborty, Central Electronics Engineering Research Institute, India; Tanmoy Sarkar, Burdwan University, India; Atmakuru Nagaraju, Central Electronics Engineering Research Institute, India; Sudipto Chattopadhyay, Ulk Singh, Mizoram University, India

14:00

**WE-A1.2P.3**

A Compact, Zero-Power and Low-Noise Harmonic-Transponder for Liquid and Moisture Sensing

Liang Zhu, Pai-Yen Chen, University of Illinois at Chicago, United States

14:20

**WE-A1.2P.4**

Two Element Series Fed Origami Antenna

David Rohde, Sima Noghanian, University of North Dakota, United States; Yihsiang Chang, Illinois State University, United States; Satish K Sharma, San Diego State University, United States

14:40

**WE-A1.2P.5**

Time-Varying Phase Control for Frequency Translation

Dabijit Sankar, Cody Scarborough, Zhamni Wu, Anthony Grbic, University of Michigan, United States

Break

15:00

**WE-A1.2P.6**

Off-Body Dipole Antenna with Dogbone-Shaped AMC Bending on the Human Arm

Abdelbaki Zeghdoud, Mourad Nedil, Université du Québec en Abitibi-Témiscamingue (UQAT), Canada

15:20

**WE-A1.2P.7**

Peel-off and Stick Antennas for Small Unmanned Aerial Vehicles

Jayakrishnan Vijayamohan, Firas Ayoub, Manos Patriarhi, Christos Christodoulou, University of New Mexico, United States; James Lyke, Air Force Research Laboratory, United States

15:40

**WE-A1.2P.8**

Closely-Spaced Resonant Cavity Antennas For Meeting ETSI Class-2 Specifications

Astran Kiyani, Rashed Hashini, Karu Esselle, Macquarie University, Australia

16:00

**WE-A1.2P.9**

Closely-Spaced Resonant Cavity Antennas For Meeting ETSI Class-2 Specifications

Astran Kiyani, Rashed Hashini, Karu Esselle, Macquarie University, Australia
**Multi-band Antennas II**
Session Co-Chairs: Zhongxiang Shen, Nanyang Technological University; Gregory Mitchell, Army Research Laboratory

**WE-A1.3P**

WE-A1.3P.1 13:20
**Study of a Method for Increasing Isolation Between Closely Spaced Elements integrated in Multi-Standard Multi-Antenna Systems**
Lamia Sadaoui, Luca Santamaria, Leonardo Lizi, Robert Staraj, University Cote d’Azur, CNRS, France

WE-A1.3P.2 13:40
**Compact, Dual-Band, Hybrid Monopole-ASA, Antenna**
Abdullah Haskou, Anthony Pesin, Jean-Yves Le Naour, Ali Louzir, Technicolor Research and Innovation, France

WE-A1.3P.3 14:00
**Millimeter-Wave SIW Cavity-Backed Dual-Band Self-Complementary Log-Periodic Antenna**
Abdessalem Talbi, Mourad Nedil, Université du Québec en Abitibi-Témiscamingue (UQAT), Canada

WE-A1.3P.4 14:20
**Measured versus Simulated Results of a Dual Band, Hybrid Substrate, and Shared Aperture Antenna**
Gregory Mitchell, Theodore Anthony, Army Research Laboratory, United States

WE-A1.3P.5 14:40
**A Novel Design of Multiband Antenna Based on Non-dominated Sorting Genetic Algorithm**
Si Ce Wang, Yun Jie Mao, Min Jun Li, Han Kai Yang, Mei Sang Tong, Tongji University, China

Break 15:00

WE-A1.3P.6 15:20
**Multiport Enhance Gain Shared Aperture Antenna for S/X-Band Synthetic Aperture Radar Applications**
Venkata Kishore Kothapudi, Vijay Kumar, Vellore Institute of Technology, India

WE-A1.3P.7 15:40
**A Dual-Band Bifilar Helical Antenna With Parasitic Parallelogram Loops**
Weihua Tan, Zhangxiang Shen, Nanyang Technological University, Singapore

WE-A1.3P.8 16:00
**Band-Notched Filtering Crossed Dipole Antenna Without Extra Circuit**
Yashui Zhang, Yonghong Zhang, Yong Fan, University of Electronic Science and Technology of China, China; Dao tong Li, Chongqing University, China

WE-A1.3P.9 16:20
**A CSRR and SRR Based Ultrawideband MIMO Antenna with Band-Notched Characteristics**
Hangmei Li, Zha Jiang, Harbin Institute of Technology, China

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**Reconfigurable Arrays**
Session Co-Chairs: Constantin Zekios, Florida International University; Randy Haupt, Colorado School of Mines

**WE-A1.4P**

WE-A1.4P.1 13:20
**Two-Element Compact Antenna Arrays using Decoupling Networks and Phase Shifters for Four-Band Switching Diversity**
Kengo Nishimoto, Yasuhito Nishimaki, Naofumi Yoneda, Mitsubishi Electric Corporation, Japan

WE-A1.4P.2 13:40
**A Thick Origami Four-Patch Array**
Muhammad Hamza, Constantin Z. Zekios, Stavros V. Georgakopoulos, Florida International University, United States

WE-A1.4P.3 14:00
**A Tightly Coupled Array Loaded On a Miura-Ori Pattern**
Muhammad Hamza, Constantin Z. Zekios, Stavros V. Georgakopoulos, Florida International University, United States

WE-A1.4P.4 14:20
**Wide Beam Coverage Dipole Antenna Array with Parasitic Elements for UAV Communication**
Dong-Gueun Seo, Chang-Hyun Jeong, Yo-Seong Choi, Jeong-Soo Park, Ye-Yeong Jeong, Wong-Sang Lee, Gyeongsang National University, Korea (South)

Break 15:00

WE-A1.4P.5 15:20
**Waveguide-Fed Lens Based Beam-Steering Antenna For 5G Wireless Communications**
Saedeh Shad, Shafaq Kausar, Hani Mehrpouyan, Boise State University, United States

WE-A1.4P.6 15:40
**A Tri-Band Dual-Polarized Slot-Ring Antenna for Array Design**
Junyi Huang, Xin Gong, University of Central Florida, United States

WE-A1.4P.7 16:00
**A Reconfigurable Wideband Feeding Network for Polarization Diverse Antenna Arrays**
Youssef Tawk, Joseph Costantine, American University of Beirut, Lebanon

WE-A1.4P.8 16:20
**Reconfigurable Antenna For Automotive Radar System**
Ji Dong, Lei Zhang, Institute of Microelectronics, Tsinghua University, China
Electromagnetic Energy Harvesting
Session Co-Chairs: Aline Eid, Georgia Institute of Technology; Rushi Vyas, University of Calgary

WE-A5.1P.1
A Dual-band Electromagnetic Energy Harvesting Surface
Faruk Erkmen, Omar Ramahi, University of Waterloo, Canada

WE-A5.1P.2
Analysis of Multi-Stage Voltage Doubler for RF Energy Harvesting
Alex Mouapi, Nadir Hakem, Nahi Kandil, Université du Québec en Abitibi-Témiscamingue (UQAT), Canada

WE-A5.1P.3
High Efficiency RF Energy Harvester for IoT Embedded Sensor Nodes
Stylianos Assimonis, Queen’s University Belfast, United Kingdom; Spyridon Daskalakis, Georgia Institute of Technology, United States; Vincent Fusco, Queen’s University Belfast, United Kingdom; Manos Tentzeris, Georgia Institute of Technology, United States; Apostolos Georgiadis, Heriot-Watt University, United Kingdom

WE-A5.1P.4
Flexible W-Band Rectifiers for 5G-powered IoT Autonomous Modules
Aline Eid, Jimmy Hester, Bijan Tehrani, Manos Tentzeris, Georgia Institute of Technology, United States

WE-A5.1P.5
Wideband Metasurface for Microwave Energy Harvesting
Ahmed Ashoor, Omar Ramahi, University of Waterloo, Canada

WE-A5.1P.6
Dual Polarizations Single-feed Cross-Dipole Energy Harvesting Surface
Ahmed Ashoor, Omar Ramahi, University of Waterloo, Canada

WE-A5.1P.7
A Performance Analysis of Schottky Diode to support RF Energy Harvesting
Alex Mouapi, Nadir Hakem, Nahi Kandil, Université du Québec en Abitibi-Témiscamingue (UQAT), Canada

WE-A5.1P.8
Optical Plasmonic Nano-Antennas Array for Energy Harvesting Applications
Patrizia Livreri, University of Palermo, Italy

WE-A5.1P.9
A Dual-band Rectenna with Improved RF-DC Sensitivity for Wireless Energy Harvesting
Sichong Li, Fadhel Ghannouchi, Rushi Vyas, University of Calgary, Canada

WE-A5.1P.10
4x4 Circularly Polarized Antenna Array for Ambient RF Energy Harvesting
Osama Dardeer, Ain Shams University, Egypt; Hala Elshafey, Esmat Abdallah, Electronics Research Institute, Egypt; Hoda Elshafey, Ain Shams University, Egypt

Electromagnetic Band Gap Structures
Session Co-Chairs: Sharif Sheikh, King Fahd University of Petroleum and Minerals; Mohammad Ali, University of South Carolina; Dmitriy Oshmarin, UCI

WE-A2.1P.1
A Simple Technique for EBG Design for Monopole Antenna Isolation Improvement
Ahmed Arman, Mohammad Ali, University of South Carolina, United States; Terry Vogler, Boeing, United States

WE-A2.1P.2
Modified EBG Design Circuit Model for Isolation Improvement Between Monopole Antennas
Ahmed Arman, Mohammad Ali, University of South Carolina, United States; Terry Vogler, Boeing, United States

WE-A2.1P.3
Pulse Generation using a Degenerate Band Edge Structure
Dmitriy Oshmarin, Hamidreza Kazemi, Ahmed Abdelshafy, Filippo Capolino, University of California, Irvine, United States

WE-A2.1P.4
Tiling of Supershaped Electromagnetic Band Gap Structures
Shady Keyrouz, Bedilu Adela, Diego Capolino, The Antenna Company, Netherlands

WE-A2.1P.5
Microstrip Antenna Array with Reduced Mutual Coupling Using Slotted-Ring EBG Structure for 5G Applications
Oludayo Sokunbi, Hussein Attia, Sharif Sheikh, King Fahd University of Petroleum and Minerals (KFUPM), Saudi Arabia

Break 15:00

WE-A2.1P.6
Dispersion Engineered Space-Time Modulated Transmission Line
Donald DiMarzio, Northrop Grumman, United States; Stéphane Larouche, NG Next, Northrop Grumman Corporation, United States; Philip Hon, Vesna Radisic, Northrop Grumman, United States

WE-A2.1P.7
External magnetic field induced conical singularities in the isofrequency surface of a ferrite-semiconductor metamaterial
Ilia Fedorin, National Technical University of Ukraine “Igor Sikorsky Kyiv Polytechnic Institute”, Ukraine

WE-A2.1P.8
A Compact EBG for High Isolation Between Two Very Closeby Wire-Antennas for RFID Tags
Jinyoung Kwon, Heejun Park, Changyong Kim, Hwangseung Lee, Sungtae Kang, Incheon National University, Korea (South); Jaekyoung Kim, National IoT Industry Promotion Agency, Korea (South)

WE-A2.1P.9
Three-Dimensional Bandstop Frequency-Selective Structures Based on Gielis-Shaped Loop Resonator
Vignesh Shanmugam Bhaskar, Eng Leong Tan, King Ho Holden Li, Nanyang Technological University, Singapore

WE-A2.1P.10
Composite Lattice Structure Frequency-selected Radome Design
Jiahe Mei, Tao Jiang, Yingsong Li, Yibing Li, Fang Ye, Harbin Engineering University, China; Bin Cao, Marine Design & Research Institute of China, China
Metasurfaces and Transmit/Reflect Arrays
Session Co-Chairs: Anthony Grbic, University of Michigan; Hyeaegh Kwon, University of Texas at Austin; Andrea Alù, University of Texas at Austin

WE-A2.2P.1 13:20
Transmitarray based Metasurface Lens Antenna
Asif Ahmed, Md. Rakunuzzaman Robel, Wayne S. T. Rowe, RMIT University, Australia

WE-A2.2P.2 13:40
X-Band Reflective Electromagnetic Beam Controlling Metasurfaces
Hangmin Li, Hangmin Li, Xuming Man, Xuming Man, Harbin Institute of Technology, China

WE-A2.2P.3 14:00
Omega-bianisotropic Wire-Loop Huygens’ Metasurface for Wide-Angle Refraction
Michael Chen, George V. Eleftheriades, University of Toronto, Canada

WE-A2.2P.4 14:20
A Circuit-based Approach to the Synthesis of 2-D Omega Materials
Luke Szymanski, Anthony Grbic, University of Michigan, United States

Break 15:00

WE-A2.2P.6 15:20
Metasurface from Hyperuniform Disordered Distribution
Haoyang Zhang, Yang Hao, Queen Mary University of London, United Kingdom

WE-A2.2P.7 15:40
Effect of Applying Meta-surface Reflector with Two Types Reflection Characteristics on 2×2 LOS MIMO
Ryuji Kose, Takeshi Fukusako, Akira Matsushima, Kumamoto University, Japan

WE-A2.2P.9 16:20
Towards Decreasing Side Lobes Produced by Near-Field Phase Gradient Metasurfaces
Khushboo Singh, Muhammad Usman Afzal, Karu Esselle, Maria Kavoleva, Macquarie University, Australia

Break 15:00

WE-A2.2P.10 16:40
An Efficient and Broadband Metalens for X Band
Yamina Sadique, Muhammad Zubair, Information Technology University, Pakistan; Muhammad Mahmod Ali, GIK Institute of Engineering Science & Technology, Pakistan; Muhammad Qasim Mahmood, Information Technology University, Pakistan

Broadband Arrays
Session Co-Chairs: John Volakis, Florida International University; Carl Pfeiffer, Defense Engineering Corp.

WE-A1.5P.1 13:20
One Dual-Polarization 10-40 GHz Planar Array Antenna For Satellite Communication
Yujie Liu, Yang Hao, Queen Mary University of London, United Kingdom

WE-A1.5P.2 13:40
Low Angle Scanning Phased Arrays With Greater Than 50:1 Bandwidth
Alexander D. Johnson, Elias A. Alwan, John L. Volakis, Florida International University, United States

WE-A1.5P.3 14:00
Optimization of A Wideband Planar Sparse Array Based on Danzer Aperiodic Tiling
Shaoqing Hu, Tao Chu, Shiwen Yang, University of Electronic Science and Technology of China, China

WE-A1.5P.4 14:20
An Efficient Design Approach for Wideband Tightly Coupled Antenna Arrays
Lifang Zhang, Hongjian Wang, Yang Liu, Key Laboratory of Microwave Remote Sensing, National Space Science Center (NSSC), University of Chinese Academy of Sciences (UCAS), China

WE-A1.5P.5 14:40
Modeling of circularly-polarized CTS arrays
Michele Del Mastro, University of Rennes 1, France; Francesco Foglia Manzillo, Maciej Smierzchalski, CEA-Leti, Minatec Campus, France; David Gonzalez-Ovejero, University of Rennes 1, France; Philippe Pouliquen, Patrick Pathier, Direction Générale de l’Armement (DGA), France; Ronan Scoulou, Mauro Fettouze, University of Rennes 1, France

Break 15:00

WE-A1.5P.6 15:20
A Broadband Array with Unbalanced Feeds: Elements and Power Combiners Based on the Fragmented Aperture Principle
David Landgren, Georgia Tech Research Institute, United States; Theresa Brunasso, D & S Microwave Inc., United States; Kenneth Allen, Daniel Dykas, Joshua Kovitz, Jonathan Perez, James Dee, Jeremy Marsh, Charles Hunter, Glenn Smith, Georgia Tech Research Institute, United States

WE-A1.5P.7 15:40
Lossy Antenna Arrays with Frequency-Independent Beamwidth
Carl Pfeiffer, Thomas Steffen, Defense Engineering Corp., United States; George Kakos, Air Force Research Laboratory, United States

WE-A1.5P.8 16:00
Modeling of circularly-polarized CTS arrays
Michele Del Mastro, University of Rennes 1, France; Francesco Foglia Manzillo, Maciej Smierzchalski, CEA-Leti, Minatec Campus, France; David Gonzalez-Ovejero, University of Rennes 1, France; Philippe Pouliquen, Patrick Pathier, Direction Générale de l’Armement (DGA), France; Ronan Scoulou, Mauro Fettouze, University of Rennes 1, France

WE-A1.5P.9 16:20
Wideband Aperiodic Linear Array Synthesis with MOEA/D
Chuang Yan, Peng Yang, Linong Jian, Feng Yang, University of Electronic Science and Technology of China, China

WE-A1.5P.10 16:40
Millimeter-Wave Wideband Circularly Polarized Antenna Array Using SIW-Fed S-Dipole Elements
Long Zhang, Yuan He, Si-Wai Wong, Zhenzhou University, China; Steven Goo, University of Kent, United Kingdom
**Implantable and Ingestible Devices**

*Session Chair: Luis Gomez, Duke University School of Medicine*

**WE-UK.1P.1**  
13:20  
**Array of Non-Resonant Coils for Receiver Size Reduction in Wireless Power Transfer Applications**  
Danilo Brizi, University of Pisa, Italy; John Stang, University of Southern California, United States; Apostolos Monochou, University of Pisa, Italy; Gianluca Lazzi, University of Southern California, United States

**WE-UK.1P.2**  
13:40  
**Computationally Designed Focal Deep Transcranial Magnetic Stimulation (dTMS) Coils**  
Luis Gomez, Lari Koponen, Rana Hamdan, Stefan Goetz, Angel Peterchev, Duke University School of Medicine, United States

**WE-UK.1P.3**  
14:00  
**Maximization of the Efficiency in a Multi-Coil Wireless Power Transfer Systems for Biomedical Applications**  
Manjunath Machnoor, University of Southern California, United States; Danilo Brizi, University of Pisa, Italy; John Stang, Gianluca Lazzi, University of Southern California, United States

**WE-UK.1P.4**  
14:20  
**A Computational Network Model of Healthy Mammalian Retina Connectome**  
Ege Ileri, Javad Paknahad, Guobao Chen, University of Southern California, United States; Pragya Kasta, Kyle Loizos, University of Utah, United States; Gianluca Lazzi, University of Southern California, United States

**WE-UK.1P.5**  
14:40  
**Numerical Analysis of AIMD Lead Tolerances Using the Lead Electromagnetic Model**  
Mikhael Kazof, Max Planck Institute for Human Cognitive and Brain Sciences, Germany; Wolfgang Kainz, Food and Drug Administration, United States

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**Biomedical Applications**

*Session Chair: Kubilay Sertel, Ohio State University*

**WE-UK.2P.1**  
15:20  
**Full Wave Numerical Model for Thermooptical Imaging of the Human Breast with a Concave 1.5D Ultrasound Array**  
Hongbo Zhao, Shuifan Lan, Jingyi Liu, Weleed Ahmed, Min Liang, Chandra Priya Karunakaran, Russell S. Wietse, Hao Xin, University of Arizona, United States

**WE-UK.2P.2**  
15:40  
**Morphological Feature Extraction in Biomedical Samples using Polarimetric Terahertz Imaging**  
Maruf Md Najibul Hossain, Niz K. Nahar, Kubilay Sertel, Ohio State University, United States

**WE-UK.2P.3**  
16:00  
**Optimization of a Fully-Passive Neurosensor for Recording Neural Activity of a Free-Moving Animal: Characterization of Rat Skin Dielectric Properties**  
Carolina Mancio, Satheesh Bujia Venkatarakrishnan, Jorge Riera Diaz, John L. Volakis, Florida International University, United States

**WE-UK.2P.4**  
16:20  
**Microwave Characteristics of an Open Coplanar Waveguide Line-Based Glucose Droplet**  
Hoe-Jo Lee, Dongguk University, Korea (South)

**WE-UK.2P.5**  
16:40  
**UWB Rotation Scanning System for Breast Imaging**  
Huihui Wang, Lin Sun, Zhenhuan Hu, Shenzhen Terahertz Science and Technology Co. Ltd., China; Dan Pan, Rui Wu, Xiaofeng Zhang, Fan Yang, Shenzhen ET Medical Technology Co. Ltd., China
**Integral Equation Methods I**
Session Co-Chairs: Vijay Harid, University of Colorado Denver; Shanker Balasubramaniam, Michigan State University

**WE-UB.2P.1**
Residual Error Based Mesh Refinement for Surface Integral Equations
Jorge A. Taboan Vasquez, Politecnico di Torino, Italy; Zhen Peng, University of New Mexico, United States; Jin-Fa Lee, Ohio State University, United States; Giuseppe Vecchi, Francesca Vipiana, Politecnico di Torino, Italy

**WE-UB.2P.2**
A Refinement-Free Calderon preconditioner for the Symmetric Formulation of the EEG Forward Problem
John Ortiz, Luys Rahmouni, Politecnico di Torino, Italy; Simon B. Adrian, Technical University of Munich, Germany; Francesco P. Andriulli, Politecnico di Torino, Italy

**WE-UB.2P.3**
Novel Closed-Form Layered Medium Greens Function Approximation Via Discretization of the Scattered Field Formulation of the Spectral Differential Equation
Xinbo Li, Vladimir Okhmatskiy, University of Manitoba, Canada

**WE-UB.2P.4**
On the Use of Machine Learning Strategies in Preconditioning Electromagnetic Integral Equations
Davide Consoli, Adrian Meolini, Francesco P. Andriulli, Politecnico di Torino, Italy

**WE-UB.2P.5**
On a Refinement-Free Strategy for Preconditioning Electromagnetic Integral Equations in the High Frequency Regime
Alexandra Dély, Adrian Meolini, Politecnico di Torino, Italy; Simon B. Adrian, Technical University of Munich, Germany; Francesco P. Andriulli, Politecnico di Torino, Italy

**WE-UB.2P.6**
Modeling Low Frequency Magnetic Field Shielding using the Locally Corrected Nyström Method
Vijay Harid, Mark Golkowski, Stephen Gedney, Ronald Rorrer, University of Colorado Denver, United States; Morris Cohen, Nathan Opalinski, Georgia Institute of Technology, United States; Sarah Patch, University of Wisconsin-Milwaukee, United States

**WE-UB.2P.7**
Modeling of High-Q Cavity with Surface Integral Equation Discontinuous Galerkin (IEDG) Method
Chong Hyun Lee, Xuejie Tian, Jingyue Zhang, Jin-Fa Lee, Ohio State University, United States; William L. Langston, Brian Zinser, Lorena I. Basilio, Salvatore Campione, Sandia National Laboratories, United States

**WE-UB.2P.8**
Analytical Models for L-Probe fed Microstrip Antennas
Bidisha Barman, Deb Chatterjee, Anthony Caruso, University of Missouri at Kansas City, United States

**WE-UB.2P.10**
Efficient Modeling of Thin Sheet in Multilayered Uniaxial Media
Shobin Zeng, Donald Whitt, Jiefu Chen, University of Houston, United States

**Point-to-Point Propagation Effects**
Session Co-Chairs: Tracy Haack, Naval Research Laboratory; David Michelson, University of British Columbia

**WE-UF.1P.1**
A Classification Scheme for Wireless Channel Models Across the Development Life Cycle
David Michelson, University of British Columbia, Canada; Nada Golmie, Camillo Gentile, Jeanne Quny, Kate Ramley, National Institute of Standards and Technology, United States; Yvo de Jong, Ken Grove, Communications Research Centre Canada, Canada

**WE-UF.1P.2**
UHF Mountain Propagation: Measurements and Modelling
Roger Lang, George Washington University, United States; Daniel Breton, ERDC Cold regions Research & Engineering Labs, United States; Can Suer, George Washington University, United States; Caitlin Haedrich, ERDC Cold regions Research & Engineering Labs, United States

**WE-UF.1P.3**
Measurements of Radiowave Propagation in a Partially Constructed Building
Andrew Austin, Michael Neve, Kevin Sowerby, University of Auckland, New Zealand

**WE-UF.1P.4**
Challenges in Modeling Shipboard Wireless Propagation Environments
David Michelson, Yiqing Huang, Zahra Vaji, Arash Rizvi, University of British Columbia, Canada

**WE-UF.1P.5**
Terrestrial Trunked Radio Propagation Simulation in Subways
Levent Yilmazturk, Yoksel Proje, Turkey

**WE-UF.1P.6**
RF Propagation Characterization in the Arctic
Zachary Burchfield, Thomas Hanley, Ethan Miller, Hysous Kil, David Dziewiecki, Kirk Shawhan, Andrew Riel, Johns Hopkins University Applied Physics Laboratory, United States

**WE-UF.1P.7**
Comparison of Measured and Predicted Propagation during CASPER East Field Campaign using Different Methods of Environmental Estimation
Douglas Pastore, Matthew Stanek, Daniel Greenway, Coastal Carolina University, United States; Qi Wang, Robert Burkholder, Ohio State University, United States; Tracy Haack, Naval Research Laboratory, United States; Qing Wang, Naval Postgraduate School, United States; Erin Hackett, Coastal Carolina University, United States

**WE-UF.1P.8**
Impact of Assimilating in-situ Data Sources on Model Predictions of Refractivity, Ducting and EM Propagation
Tracy Haack, David Flagg, Daniel Tyndall, Teddy Holt, Naval Research Laboratory, United States

**WE-UF.1P.9**
Blending Surface Layer, NWP Model and Climatological Refractivity Profiles: Methods and Issues
Paul Frederiksson, Naval Postgraduate School, United States

**WE-UF.1P.10**
A Blending Algorithm for Atmospheric Refractivity Using 1-Dimensional Boundary Layer Modeling
Qing Wang, Kuan-min Kang, Hway-Jen Chen, Naval Postgraduate School, United States; Denny P. Alagappu, Mass Landing Marine Laboratory, United States; Ryan Yamaguchi, Paul Frederiksson, Naval Postgraduate School, United States
Antenna Feeds and Matching Circuits III
Session Co-Chairs: Ting-Yen Shih, University of Idaho; Ray Lewis, Viasat

WE-A1.6P 13:20
Design of a Characteristic-Mode-Based Fully-Planar Antenna for Indoor In-Band Full-Duplex Radios
Qianyi Li, Ting-Yen Shih, University of Idaho, United States

WE-A1.6P 13:40
A Substrate Integrated Waveguide Filtering Slot Antenna Array
Ricardo Lovato, Xun Gong, University of Central Florida, United States

Compact Comparator for 2-D Monopulse Array Based on Novel Eight-Port Coupler
Kejia Ding, Ahmed Kishk, Concordia University, Canada

Broadband Optimization of a High Power UHF Band Cylindrical Sleeve Dipole Antenna
Ray Lewis, Viasat Inc., United States

Ultra-Wideband Antenna Array based on Orbital Angular Momentum
Massimo Donelli, Mohammedhusen Manekiya, University of Trento, Italy; Viviana Mulloni, Giada Marchi, Fondazione Bruno Kessler (FBK), Italy

Interference and Environmental Effects
Session Co-Chairs: Lawrence Cohen, Naval Research Laboratory; Danilo Erricolo, University of Illinois at Chicago

WE-UE.1P 15:20
Suitability of Consumer Software-defined Radios for Precompliance Radiated Emissions Testing
William Stevers, Edward Rothwell, Michigan State University, United States

Measurement of Radiation Power from an Aircraft FMCW Radar Altimeter for Investigating Spectrum-Sharing Conditions with Wireless Avionics Intra-Communication Systems
Shunichi Futatsumori, Norihiko Miyazaki, Electronic Navigation Research Institute, National Institute of Maritime, Port and Aviation Technology, Japan; Tetsuya Sakuguchi, Takashi Hikage, Hokkaido University, Japan

Detection of Interference in Dedicated Short-Range Communications Networks
Quinn Ramsay, Hamed Noori, David Michelson, University of British Columbia, Canada

Green’s Function Method for Classical and Statistical Electromagnetics
Zhen Peng, University of New Mexico, United States
Driving Forward: Advances in Propagation Modeling for Wireless Systems
Session Co-Chairs: Alenka Zajić, Georgia Institute of Technology; Zhen Peng, University of New Mexico

TH-SP.2A.1 08:00
Configuration of Network Level Algorithms for Wireless Train Control Systems using Physics-Based Propagation Models
Neeraj Sood, Sami Baroudi, Xingqi Zhang, Jorg Liebeherr, Costas Sarris, University of Toronto, Canada

TH-SP.2A.2 08:20
Parameter Estimation for Stochastic Channel Models using Temporal Moments
Ayush Bharti, Ramoni Adeogun, Troels Pedersen, Aalborg University, Denmark

TH-SP.2A.3 08:40
Physics-Oriented Statistical Analysis of Information Transmission in Wave-Chaotic Environments
Shen Lin, Zhen Peng, University of New Mexico, United States

TH-SP.2A.4 09:00
K-factor and Correlation Analysis of a 2×2 MIMO Off-body Channel Inside a Mine
Moulay El Hassan El Azhari, Université du Québec en Abitibi-Témiscamingue (UQAT), Canada; Larbi Talbi, Université du Québec en Outaouais, Canada; Mourad Nedil, Université du Québec en Abitibi-Témiscamingue (UQAT), Canada

TH-SP.2A.5 09:20
Performance Analysis of Time-modulated Array in Digital Communication System
Qianwei Zeng, Peng Yang, Feng Yang, Yin Lu, Yuyi Gan, University of Electronic Science and Technology of China, China

Break 09:40

TH-SP.2A.6 10:00
Propagation Modeling for Air-Ground Channel over Rough Sea Surface in Low Altitudes
Zhuangzhuang Cui, Ke Guan, Danping He, Bo Ai, Zhangdui Zhong, Beijing Jiaotong University, China

TH-SP.2A.7 10:20
How Many Antennas Do We Need for Massive MIMO Channel Sounding? – Validating Through Measurement
Thomas Choi, Francois Rottenberg, Peng Luo, University of Southern California, United States; Jianzhong Zhang, Samsung Research America Inc., United States; Andreas F. Molisch, University of Southern California, United States

TH-SP.2A.8 10:40
Path Loss Model as a Function of Antenna Height for 300 GHz Chip-to-Chip Communications
Jimbang Fu, Prateek Juyal, Alenka Zajić, Georgia Institute of Technology, United States

TH-SP.2A.9 11:00
A Path Loss Model for Through the Soil Wireless Communications in Digital Agriculture
Abdul Salam, Purdue University, United States

Multi-band antennas for Mobile Communications
Session Co-Chairs: Xinhu Ren, Google; Ata Zadehgol, University of Idaho

TH-A1.1A.1 08:00
Dual-Band Eight-Antenna MIMO Array for 5G Smartphone
Peng Yang, Kaxi Yan, Yuyi Gan, Feng Yang, University of Electronic Science and Technology of China, China

TH-A1.1A.2 08:20
A Tri-band Shared-Aperture Antenna for Wi-Fi MIMO and Beam-Scanning Wi-Gig Applications
Yinan Ding, Yujian Cheng, University of Electronic Science and Technology of China (UESTC), China

TH-A1.1A.3 08:40
An Ultra-thin Triple-band Smartwatch Antenna with Support of Several Wireless Application Bands
Amireza Jalili Khatibabadi, Ata Zadehgol, University of Idaho, United States

TH-A1.1A.4 09:00
A Compact Tri-Band Antenna for Vehicle Communication and Navigation Applications
Shan Jiang, Chang Chen, Dingyuan Zhang, Weidong Chen, University of Science and Technology of China, China; Huiliang Zhang, University of Massachusetts Lowell, United States

TH-A1.1A.5 09:20
A MIMO Antenna Array for 5G Mobile Terminals
Lijin Chen, Daqing Wang, Shufeng Zhang, Li Xiu, Shengmin Jiang, Shengchang Lan, Huazhong Institute of Technology, China

Break 09:40

TH-A1.1A.6 10:00
Dual Band Graphene Nanoflakes Printed Compact Monopole Antenna for Low Cost WiFi Applications
Ting Leng, Kewen Pan, Yutong Jiang, Zhiun Hu, University of Manchester, United Kingdom; Habiba Ouaslimani, Université Paris Ouest Nanterre La Défense, France; Mahmoud A. Abdalla, Military Technical College, Egypt

TH-A1.1A.7 10:20
A Low-Profile Dual-Band Dual-Polarized Base Station Antenna Array for Sub-6 GHz Applications
Yufeng Zhu, Yikai Chen, Shiweng Yang, University of Electronic Science and Technology of China, China

TH-A1.1A.8 10:40
Low Profile Tri-Bands Antenna for Wireless Applications
Ali Al-Azzaz, Basrah university, Iraq; Nuhad Mahla, Iraq University, Iraq; Mohamed Moray, Texas A&M University-TexasKana, United States; Frances Harackiewicz, Southern Illinois University Carbondale, United States

TH-A1.1A.9 11:00
A Novel Triple Band Antenna for WLAN Application
Xiao Jia Huang, Hong Qin Zheng, Han Yu Shi, Yin Xuan Zhu, Mei Song Tong, Tongji University, China

TH-A1.1A.10 11:20
A Capacitive Loaded CRLH in Reversal Triple band MIMO Antenna
Mahmoud A. Abdalla, Military Technical College, Egypt; Ahmed Elmomayy, Taka Ghaly, October University for Modern Sciences and Arts (MSA), Egypt
Nanoelectromagnetics
Session Co-Chairs: Amir Zaghloul, United States Army Research Laboratory; Rhonda Franklin, University of Minnesota, Twin Cities

TH-A2.1A.1 08:00
Novel Electromagnetic Scattering Model for Carbon Nanotube Composites using the Multilayer Green’s Function Approach
Sumitra Dey, Deb Chatterjee, University of Missouri-Kansas City, United States; Edward J. Garboczi, National Institute of Standards and Technology, United States; Ahmed M. Hassan, University of Missouri-Kansas City, United States

TH-A2.1A.2 08:20
Susceptibility of Nanoparticles Studied by Landau-Lifshitz-Gilbert and Sneck’s Equations
Quang Nguyen, Amir Zaghloul, Army Research Laboratory, United States

TH-A2.1A.3 08:40
Optimization of Coplanar Waveguide Structure for Ultra Wideband Integrated Electro-optic Mach Zehnder Modulator
Farzaneh Arab Juneghani, Reza Safian, Imec Florida, United States

TH-A2.1A.4 09:00
Slow light at the nanoscale based on active epsilon-near-zero plasmonic waveguides
Ying Li, Christos Argyropoulos, University of Nebraska-Lincoln, United States

TH-A2.1A.5 09:20
Signal Enhancement for Ferromagnetic Resonance Measurement of Magnetic Nanowire array
Yali Zhang, Joseph Um, Bethanie Stadler, Rhonda Franklin, University of Minnesota, Twin Cities, United States

Break 09:40

TH-A2.1A.6 10:00
A Ferromagnetic Resonance Measurement System for Small Volume Magnetic Nanowires
Yali Zhang, Joseph Um, Bethanie Stadler, University of Minnesota, United States; Rhonda Franklin, University of Minnesota, Twin Cities, United States

TH-A2.1A.7 10:20
On Propagation Losses due to In-Vivo Electromagnetic Nanoscale Communication
Sarah Hussein, Youmni Ziade, Beirut Arab University, Lebanon; Raed M. Shubair, Massachusetts Institute of Technology, United Arab Emirates

TH-A2.1A.8 10:40
Performance Parameter Optimization of Graphene Enhanced Surface Plasmon Resonance Biosensors
Mariam M. Moussilli, Abdul Rahman El Falou, Beirut Arab University, Lebanon; Raed M. Shubair, Massachusetts Institute of Technology, United States

TH-A2.1A.9 11:00
Design of Transmitting Nano-Dipole Antenna Using a Subwavelength Laser Excitation Method
Amer Abu Arisheh, Jordan University of Science and Technology, Jordan; Said Mikki, University of New Haven, United States; Nihad Dh, Jordan University of Science and Technology, Jordan

TH-A2.1A.10 11:20
Ultra-Deep Sub-Wavelength Mode Confinement in Graphene Waveguides
Ramin Erandi, Zaker Hossein Firouzabadi, Reza Safian, Abolghasem Ziaei-Mardini, Nazhad, Isfahan University of Technology, Iran

Cloaking / RCS Reduction and Absorption
Session Co-Chairs: Francesca Monticone, Cornell University; Amit Mehta, Swansea University

TH-A2.2A.1 08:00
On Broadband Active Cloaking
Aobo Chen, Francesca Monticone, Cornell University, United States

TH-A2.2A.2 08:20
Design of Waveform-Selective Mantle Cloaks for Antenna Applications
Stefano Vellucci, “Roma Tre” University, Italy; Alessio Monti, Mirko Barbuto, “Niccolò Cusano” University, Italy; Alessandra Toscano, Filiberto Bilotti, “Roma Tre” University, Italy

TH-A2.2A.3 08:40
Numerical Investigation on Graphene Based Mantle Cloaking of a PEC Cylinder
Carola Rizza, Ladiolau Matekovits, Politecnico di Torino, Italy

TH-A2.2A.4 09:00
Perfect Penetrable Cloaking Using Gain-Less and Loss-less Biaxial Anisotropic Metasurfaces
Anuj Modi, Constantine Balanis, Craig Birtcher, Arizona State University, United States

TH-A2.2A.5 09:20
Frequency Independent Method for RCS Reduction of Dihedral Corners Using Metasurfaces
Yoan Fang, Yutong Jiang, Kewen Pan, Zhirun Hu, University of Manchester, United Kingdom

TH-A2.2A.7 10:20
Ring Resonator Metamaterials for Radar Cross Section Reduction
Nikolay Litov, Apar Pall, Amit Mehta, Swansea University, United Kingdom

TH-A2.2A.8 10:40
Ultra-wideband RCS Reduction Based on Reflection Phase Cancellation and Tunable Absorption
Xianliang Zeng, Linxi Zhang, Guobin Wan, Northwestern Polytechnical University, China

TH-A2.2A.9 11:00
Design of A Metamaterial Absorber With Ultra-Wide Angle Incidence
Yuming Wu, Xiao Ding, Zhipeng Wang, University of Electronic Science and Technology of China, China

TH-A2.2A.10 11:20
Simulation Design of Dual Band Metamaterial Absorber Based on the Fractal Structure
Mohamed Edries, Higher Institute of Engineering El Sharouk City, Egypt; Hesham A. Mohamed, Electronics Research institute, Egypt; Sherif S. Fekal, Banha University, Egypt; Mohamed A. El-mansy, Higher Institute of Engineering El Sharouk City, Egypt; Hala A. Mansour, Banha University, Egypt
**Microstrip Antenna Arrays I**

Session Co-Chairs: Dimitra Psychogiou, University of Colorado at Boulder; Adam Mehrabani, Johns Hopkins University

**TH-A1.2A.1** 08:00

**A Compact Series Array for Vehicular Communication in the C-Band**
Stefano Maddio, Giuseppe Pelosi, Monica Righini, Stefano Selleri, University of Florence, Italy

**TH-A1.2A.2** 08:20

**Broadband Linear Antenna Arrays with Frequency-Invariant Half-Power Beamwidth**
Dakota Simpson, Dimitra Psychogiou, University of Colorado at Boulder, United States

**TH-A1.2A.3** 08:40

**A Circularly Polarized Patch Antenna Array for Ku-Band Data-Link**
Muhammad Saeed Khan, Wafa Abdouni-Abdallah, Hamid Al Marri, Ammar Alenezi, Emirates Technology and Innovation Center (ETIC), Khalifa University (KU), United Arab Emirates

**TH-A1.2A.4** 09:00

**A SIW Uniform Circular Antenna Array for 5G Applications Fed By a Radially-symmetric Eight-way SIW Power Divider**
Alireza Pourghorban Saghati, Alireza Pourghorban Saghati, Kamran Entesari, Texas A&M University, United States

**TH-A1.2A.5** 09:20

**Design of a 1×4 CPW Microstrip Antenna Array on PET substrate for Biomedical Applications**
Umer Farooq, Adnan Iftikhar, Adnan Fida, Muhammad Saeed Khan, Sajid M. Asif, University of Sheffield, United Kingdom; Raed M. Shubair, Massachusetts Institute of Technology, United States

Break 09:40

**TH-A1.2A.6** 10:00

**A Massive MIMO Array Antenna Incorporating Filtering Sub-Arrays**
Hamidreza Memarzadeh, Gary Xu, Samsung Research America Inc., United States

**TH-A1.2A.7** 10:20

**A Low-Profile Wideband Connected Dipole Array with Compact Balun and Power Divider**
Linfeng Li, Jie-Bang Yan, University of Alabama, United States

**TH-A1.2A.8** 10:40

**A Directive Circularly Polarized Planar Yagi Array Antenna**
Yang Cheng, Yuanfan Dong, University of Electronic Science and Technology of China, China

**TH-A1.2A.9** 11:00

**Broadband Dual Linear Polarized (DLP) Antenna Array for Energy Harvesting System**
Dalia Elsheakh, Electronics Research Institute, Egypt

**TH-A1.2A.10** 11:20

**A Novel Broadband Microstrip Array Antenna with Beam Tilt**
Min Guo, Min Wang, Yuan-Bo Shang, Ming-Ming Fang, Science and Technology on Electromagnetic Scattering Laboratory, China

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**Adaptive, Active and smart antennas**

Session Co-Chairs: Jacob J. Adams, North Carolina State University; John Sanford, University of California, San Diego

**TH-A1.3A.1** 08:00

**Design of a Miniature Reactive Beam Forming Network**
John Sanford, University of California, San Diego, United States

**TH-A1.3A.2** 08:20

**Design of Miniaturized ESPAR Antenna for Next Generation Communication Systems**
Shafaq Kausar, Ahmed Kausar, Hani Mehrpouyan, Boise State University, United States; Hamood Rahman, National University of Sciences & Technology, Pakistan

**TH-A1.3A.3** 08:40

**Gain Optimization of a Seven Element ESPAR Antenna**
Ahmed Kausar, Shafaq Kausar, Hani Mehrpouyan, Boise State University, United States

**TH-A1.3A.4** 09:00

**IoT Equipment Structure with Reduced Risk of Damage on Attachable to Manhole Cover**
Yasumitsu Ban, Manabu Kai, Fujitsu Laboratories Limited, Japan

Break 09:40

**TH-A1.3A.5** 10:00

**Direction of Arrival Estimation using Root-Transformation Matrix Technique**
Shouwen Dai, Jammer H. Abbas, Minghui Li, Muhammad Ali Imran, University of Glasgow, Singapore

**TH-A1.3A.6** 10:20

**A Dodecahedron Sequential Rotation Antenna Array for Space Division Multiple Access**
Lisa Benetti, Stefano Maddio, Giuseppe Pelosi, Monica Righini, Stefano Selleri, University of Florence, Italy

**TH-A1.3A.7** 10:40

**A Circular Polarized Four-Beam Antenna for Direction of Arrival Applications at 2.45GHz**
Stefano Maddio, Giuseppe Pelosi, Monica Righini, Stefano Selleri, University of Florence, Italy

**TH-A1.3A.8** 11:00

**Ringing Effects Due to Non-ideal Components in Direct Antenna Modulation Transmitters**
Danyang Huang, Jacob Adams, North Carolina State University, United States; Kurt Schab, Santa Clara University, United States

**TH-A1.3A.9** 11:20

**Matching of Small Transmitting Antenna using Non-Foster-inspired Two-transmitter System**
Silvia Hrabar, University of Zagreb, Croatia (Hrvatska)
**Antennas from Tesla to Today**  
Session Co-Chairs: Magdalena Salazar Palma, University Carlos III; Olutola Jonah, Ford Motor Company

**TH-A1.4A.1** 
The Tesla Antenna and its Unique Design  
Tapan Sarkar, Syracuse University, United States; Magdalena Salazar Palma, Universidad Carlos III de Madrid, Spain

**TH-A1.4A.2** 
Role of the Parkes Radiotelescope in the First Moon Landing  
Trevor Bird, Antengenuity, Australia

**TH-A1.4A.3** 
How the Lualualei VLF Antenna was Designed  
Ted Simpson, University of South Carolina, United States

**TH-A1.4A.4** 
Dualband Multi-Constellation GNSS Antenna  
Olutola Jonah, Leo Lancot, Ford Motor Company, United States

**TH-A1.4A.5** 
Mechanically-Rotating Electret ULF/VLF Antenna Transmitter  
Chen Wang, Yong Cui, Beihang University, China; Minsong Wei, University of California, Berkeley, United States

**TH-A1.4A.6** 
A novel structure for VHF band dipole antenna miniaturization  
Jiawei Long, En Li, Hu Zheng, Yihang Tu, University of Electronic Science and Technology of China, China

**TH-A1.4A.7** 
Challenges for Antenna Design at mm-Waves  
Shafaq Kausar, Ahmed Kausar, Hani Mehrpouyan, Boise State University, United States

**TH-A1.4A.8** 
Design of RFID antenna using metamaterials for microwaves applications  
Amina Bendaoudi, Mohamed Debab, Djillali Liabes University of Sidi Bel Abbés, Algeria

**TH-A1.4A.9** 
Simulation and Experiment of a Loaded Ultra-small Symmetric Dipole Antenna  
Shu Lin, Jian-Lin Jiao, Zhuang Chen, Cai-Tian Yang, Hong-Jun Zhang, Harbin Institute of Technology, China

**TH-A1.4A.10** 
Compact UWB Slotted Pentagonal Patch Antenna for Radar and Communication  
Farah Mahf Izla, Nur Hidayah Kamaludin, Noran Abdal Malek, Sarah Mohamad, International Islamic University Malaysia, Malaysia

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**Topics in Metamaterials and Metasurfaces**  
Session Co-Chairs: Davide Ramaccia, Roma Tre University; Justin Kasemodel, Raytheon Space and Airborne Systems

**TH-A2.3A.1** 
An Easily Fabricated 3D Design for Increased Permittivity Range in Artificial Dielectric Layers  
Mohamed Fazeli, University of North Carolina at Charlotte, United States; Justin Kasemodel, Raytheon Space and Airborne Systems, United States; Kathryn Smith, University of North Carolina at Charlotte, United States

**TH-A2.3A.2** 
Complex Transformation Optics and Generalized Double Negative Layers  
Hayrettin Odabasi, Eskisehir Osmangazi University, Turkey; Fernando Teixeira, Ohio State University, United States

**TH-A2.3A.3** 
Broadband dispersion engineering of CRLH Transmission Lines for low signal distortion in backward regime  
Alessandro Bizzi, Davide Ramaccia, Alessandro Toscano, Filiberto Bilotti, Roma Tre University, Italy

**TH-A2.3A.4** 
Ultra-compact wave-based solvers for fractional-calculus equations  
Aobo Chen, Francesco Monchino, Cornell University, United States

**TH-A2.3A.5** 
Measurement of Hybrid Genetic Programming Synthesized Artificial Magnetic Conductors  
Scott Clemons, Hawaii Advanced Wireless Technologies Institute, United States; Gui Chao Huang, University of Hawaii, United States; Magdy Iskander, Zhengqing Yun, Hawaii Advanced Wireless Technologies Institute, United States

**TH-A2.3A.6** 
Electromagnetically Induced Transparency in Metamaterials Using Theory of Characteristic Modes  
Ozlem Anthony Chukwuka, Divitha Seetharamdoo, Hassanein Rabah, Univ. Lille Nord de France - IFSTTAR, France

**TH-A2.3A.7** 
Development of X-Band Material-Inspired Sensors for Dielectric Constant Detection  
Mark Ruiz, Nantakan Wongkasem, University of Texas Rio Grande Valley, United States

**TH-A2.3A.8** 
2D Periodic Leaky-Wave Antennas in the Microwave and Optical Regimes  
Sohini Sengupta, Energous Corporation, United States; David Jackson, University of Houston, United States; Ahmad Almutawa, Hamdane Kazemi, University of California, Irvine, United States; Stuart Lang, University of Houston, United States; Filippo Capolino, University of California, Irvine, United States

**TH-A2.3A.9** 
Spread-Spectrum Camouflaging based on Time-Modulated Metasurface  
Xiaoyi Wang, Christophe Caloz, Polytechnique Montréal, Canada

**TH-A2.3A.10** 
Directional Monopole Antenna with Low Back-Radiation using Metamaterial Absorber  
Heejun Jeong, Sungjoon Lim, Chung-Ang University, Korea (South)
Slot Arrays I
Session Co-Chairs: Xun Gong, University of Central Florida; Saranraj Karuppuswami, Michigan State University

TH-A1.5A.1 08:00
A Compact and High Gain Dielectric-Loaded 60GHz Multi-Stepped Waveguide Antenna Array
Saeideh Shad, Hani Mehrpouyan, Boise State University, United States

TH-A1.5A.2 08:20
Compact Slot Antenna Array for 5G Communications
Tiago Varum, Joao Matos, Instituto de Telecomunicacoes, Portugal

TH-A1.5A.3 08:40
Empty Substrate Integrated Waveguide Planar Slot Antenna Array for 5G Wireless Systems
Zia Ullah Khan, Akram Alomainy, Queen Mary University of London, United Kingdom; Tian Hong Loh, National Physical Laboratory, United Kingdom

TH-A1.5A.4 09:00
2 × 2 and 4 × 4 MIMO Antennas for 5G mm-Wave Wireless Communication
Shaker Alkaraki, Yue Gao, Queen Mary University of London, United Kingdom

TH-A1.5A.5 09:20
1D Slotted Waveguide Antenna with Controlled Beamwidth and Sidelobe Level Ratio
Hilal M. El Misilmani, Beirut Arab University, Lebanon; Mohammed Al-Hosseini, Lebanese Center for Studies and Research, Lebanon

Break

TH-A1.5A.6 10:00
High Gain Dual Polarized Omni Antenna for four channel MIMO Applications
John Sanford, University of California, San Diego, United States

TH-A1.5A.7 10:20
A Four-Corner-Fed Slotted Waveguide Sparse Array for Near-Field Focusing
Miao Zhang, Bolin Jiang, Xiamen University, China; Hiro Hirokawa, Tokyo Institute of Technology, Japan; Qing Huo Liu, Duke University, United States

TH-A1.5A.8 10:40
An Electronically-Steerable Parasitic Array Radiator (ESPAR) Using Microstrip-Line-Fed Cavity-Backed Slot Antennas in the E Plane
Wei Ouyang, Xun Gong, University of Central Florida, United States

TH-A1.5A.9 11:00
Analyzing the Coupling from Radiating Slots in a Double-Layered Radial Line Slot Array Antenna
Nat Nishat Yasmin Koli, Muhammad Usman Aziz, Karu Esselle, Macquarie University, Australia; Md Zahidul Islam, Teleaus:Information and Communications Engineering Company, Australia

TH-A1.5A.10 11:20
A Dual Band and Dual Circular Polarization Radial Line Slot Antenna
Jinwei Zhao, Fang Yang, Rui Wang, Zhiyu Xing, Jianhua Yang, University of Electronic Science and Technology of China, China

Bioeffects and medical applications
Session Chair: Matthew Simmons, National Institute of Standards and Technology

TH-UA.1A.1 08:00
Real-Time Thermoooustic Thermometry for Focused Microwave Therapy
Chandra Praya Karunakaran, Srishti Sarawat, Jinpil Tak, Hongbo Zhao, Hannah Schmitz, Waheed Ahmad, Hao Xin, Russell S. Witte, University of Arizona, United States

TH-UA.1A.2 08:20
Antenna Configuration and Transmission Medium to Optimize Malignant Cell Destruction
Sean Bovier, Abbas Sabouni, Wilkes University, United States

TH-UA.1A.3 08:40
Characterization of Temperature Effect on the Dielectric of Aqueous Solutions
Yang Zhou, Wei Lin, University of Texas Rio Grande Valley, United States

TH-UA.1A.4 09:00
Study on the Fluorescence spectra characteristics and Growth curve of Escherichia coli
Wenjing Xie, Panpan Zhu, Ying Liu, Hao Lu, Qi Tang, Caiqin Han, Jiangsu Normal University, China

TH-UA.1A.5 09:20
Automatic and Accurate Non-contact Obstructive Sleep Apnea Detection using Wavelet Information Entropy Spectrum
Fugui Qi, Jiang Wang, Fourth Military Medical University, China; Aly E. Fathy, University of Tennessee at Knoxville, United States

Human-body Interactions with Antennas and other Electromagnetic Devices
Session Chair: Khem Poudel, Middle Tennessee State University

TH-UK.1A.1 10:00
Wireless Power Transfer for Medical Implants
Khem Poudel, Middle Tennessee State University, United States; Madhav Pant, University of Technology Sydney, Australia

TH-UK.1A.2 10:20
Influence of External Cables on EM Exposure Investigated with a Human Model in a 3T MRI Coil
Nikhil Khosla, Nikolaus Weiskopf, Harald Müller, Max Planck Institute for Human Cognitive and Brain Sciences, Germany

TH-UK.1A.3 10:40
Performance evaluations of microwave snare
Kazuyuki Saito, Masashi Sugiyama, Chiba University, Japan

TH-UK.1A.4 11:00
Color Selectivity using Electrical Stimulation of Retinal Ganglion Cells: Computational Study
Javad Paknahad, University of Southern California, United States; Kyle Laizos, Prague Kosta, University of Utah, United States; Ege Iseri, Guanbo Chen, John Stang, Gianluca Lazii, University of Southern California, United States

TH-UK.1A.5 11:20
A Real-time Hand Gesture Recognition System using 24 GHz Radar Array
Guoyan Zhang, Kang Zhang, Shengchang Lan, Yuxuan Liu, Liya Chen, Harbin Institute of Technology, China
Novel Radar Techniques
Session Chair: Jeffrey Nanzer, Michigan State University

TH-A4.1A.1 08:00
Millimeter-Wave Localization of Multiple Targets Using TDOA and Wideband Frequency Modulation
Liang Gong, Stavros Vakalis, Jeffrey Nanzer, Michigan State University, United States

TH-A4.1A.2 08:20
Gaussian Process Regression for Array Interpolation
Arjun Gupta, Christos Christodoulou, Manuel Martinez Ramon, University of New Mexico, United States; Jose Luis Rojo Alvarez, Universidad Rey Juan Carlos, Spain

TH-A4.1A.3 08:40
Adaptive Equalization Super-Resolution Time Delay Estimation with High Accuracy and Low Complexity
Food Fereidoony, Ali Jishi, Maziar Hedayati, Yuanxun Ethan Wang, University of California, Los Angeles, United States

TH-A4.1A.4 09:00
A New Millimeter Wave FMCW Radar Target Simulator Based on Frequency Synchronization
Mohammad Chavoshi, Shahed Shahir, Mohammad-Reza Nezhad-Ahmadi, Safieddin Safavi-Naeini, University of Waterloo, Canada

Inverse Scattering and Imaging
Session Chair: Giacomo Oliveri, ELEDIA Research Center, University of Trento

TH-A4.2A.1 10:00
A Total-Variation Compressive Processing Approach to Two-Dimensional Field Reconstruction
Baozhu Li, Nanjing Normal University, China; Giacomo Oliveri, Nicola Anselmi, Andrea Massa, ELEDIA Research Center (ELEDIA@UniTn – University of Trento), Italy; Wei Ke, Wanchun Tang, Nanjing Normal University, China

TH-A4.2A.2 10:20
Joint Stripmap/Spotlight Synthetic Aperture Radar enabled by Element-Level Digital Arrays
Joseph Garry, James Conway, Richard Tillman, Johns Hopkins University Applied Physics Laboratory, United States

TH-A4.2A.3 10:40
Turntable ISAR Imaging of a Circular Array
Kris Buchanan, Sara Wheeland, Drew Overturf, Oren Sternberg, Naval Information Warfare Center Pacific, United States

TH-A4.2A.4 11:00
Comparison of Propagation Losses in THz and Optical Non-Line-of-Sight Imaging
Yiran Cui, Georgios Trichopoulos, Arizona State University, United States

TH-A4.2A.5 11:20
Simplified Synthetic Electrode Strategy for Electrical Capacitance Volume Tomography
Shah Chowdhury, Fernando Texeira, Ohio State University, United States; Qassim M. Marashdeh, Tech4Imaging LLC, United States

Integral Equation Methods II
Session Co-Chairs: Matthys Botha, Stellenbosch University; Dan Jiao, Purdue University

TH-A3.1A.1 08:00
MoM Analysis of Conducting Surface-to-Wire Structures in Multilayered Uniaxial Media
Shubin Zeng, Donald Wilton, Jiefu Chen, University of Houston, United States

TH-A3.1A.2 08:20
6-D Integrals for Numerical Evaluation by Double Application of the Divergence Theorem
Javier Rivero, Francesca Vipiana, Politecnico di Torino, Italy; Donald Wilton, University of Houston, United States; W. A. Johnson, Consultant, United States

TH-A3.1A.3 08:40
Fast Algorithms for Converting an FMM-Based Representation of Electrically Large Integral Operators to a Minimal-Rank H2-Matrix
Chang Yang, Miaomiao Ma, Dan Jiao, Purdue University, United States

TH-A3.1A.4 09:00
Potential-Based TDIEs for Dielectric Regions Using Magnetic Currents
Thomas Roth, Sbandria National Laboratories, United States; Weng Cho Chew, Purdue University, United States

TH-A3.1A.5 09:20
A Fast Macromodeling Approach to Simulate Complex Electromagnetic Surfaces
Utkarsh Patel, Piero Triverio, Sean Ihm, University of Toronto, Canada

TH-A3.1A.6 10:00
An Efficient Basis-Free Loop-Star Preconditioner Using Sparse Direct Solvers
Yi-Ru Jeong, Ali E. Yilmaz, University of Texas at Austin, United States

TH-A3.1A.7 10:20
Highly Accurate 3D EM Modeling Based on Ultra High Order Basis Functions
Branko Kolundzija, Aleksandra Knezevic, Dragom Olican, University of Belgrade, Serbia; Milan Kostic, WIPL-D d.o.o., Serbia

TH-A3.1A.8 10:40
Efficient and accurate electromagnetic scattering analysis of perfectly conducting thick plates
Eduard Ubeda, Ivan Sekulić, Juan M. Rius, Universitat Politècnica de Catalunya (UPC), Spain

TH-A3.1A.9 11:00
Novel SIE Formulations for Accurate and Stable Analysis of Near-Zero-Index Materials
Boranjo Karasmanoglou, Utku Ozmu, Oszur Ergul, Middle East Technical University, Turkey

TH-A3.1A.10 11:20
Novel Integral Equation Formulation for the Analysis of Capacitive Step Discontinuities
Fernando Daniel Queveda Pereira, Celia Gómez Molina, Alejandro Alvarez Malum, Universidad Polytécnica de Cartagena, Spain; Vicente Enrique Borra Esteb, Marco Boggio, Universidad Polytécnica de Valencia, Spain
Theoretical Electromagnetics III
Session Chair: Piergiorgio L. E. Uslenghi, University of Illinois at Chicago

TH-UB.1A.1 08:00
Completeness of the Characteristic Mode Expansion
Mats Gustafsson, Lund University, Sweden; Mislav Capek, Czech Technical University in Prague, Czech Republic; Kurt Schab, Santa Clara University, United States

TH-UB.1A.2 08:20
Exact Geometrical Optics Scattering by a Class of Metallic Wedges Under Multiple Plane Waves Illumination
Piergiorgio L. E. Uslenghi, University of Illinois at Chicago, United States

TH-UB.1A.3 08:40
Difference Between a Zenneck Wave and a Surface Wave
Tapan Sarkar, Syracuse University, United States; Magdalena Salazar Palma, Universidad Carlos III de Madrid, Spain

TH-UB.1A.4 09:00
An Analytical Spectral Formulation to Determine the Antenna Phase Center
Santi Concetto Pavone, Matteo Albani, University of Siena, Italy

TH-UB.1A.5 09:20
Novel Finite-Energy Spatiotemporally Confined Waves in Free Space and in the Presence of Temporal Dispersion
Ioannis Besieris, Virginia Polytechnic Institute and State University, United States; Amr Shaarawi, American University in Cairo, Egypt

Guided Wave and Waveguiding Structures
Session Co-Chairs: Abdel Razik Sebak, Concordia University; Jiro Hirokawa, Tokyo Institute of Technology

TH-UB.2A.1 10:00
Design of Printed RGW Crossover for Millimeter Wave Beam Switching Network
Mohamed Ali, Islam Afifi, Abdel Razik Sebak, Concordia University, Canada

TH-UB.2A.2 10:20
Analysis and design of a 30 GHz printed ridge gap Ring-crossover
Islam Afifi, Mohamed Ali, Abdel Razik Sebak, Concordia University, Canada

TH-UB.2A.3 10:40
Design of 48x32-slot Corporate-feed Plate-laminating Waveguide Antenna with Circular Polarization
Jiro Hirokawa, Shuki Wai, Takashi Tomura, Tokyo institute of Technology, Japan

TH-UB.2A.4 11:00
Design of a Highly Efficient Transition from Guided Mode of the Microstrip to the TM Mode of the Spoot Surface Plasmon Poloriton
Rahul Kumar Jaiswal, Nidhi Pandit, Nagendra Prasad Pathak, Indian Institute of Technology, Roorkee, India

TH-UB.2A.5 11:20
Equivalent Transverse Electromagnetic Modes and Effective medium inside Waveguide
Yiu Li, Tonghua University, China

Novel Energy Harvesting Techniques
Session Co-Chairs: Sima Noghanian, University of North Dakota; Pai-Yen Chen, University of Illinois

TH-A5.1A.1 08:00
Optimal Number of Coils for Wireless Power Transfer through Cascaded Resonator Systems
Connor Badowich, Loïc Markley, University of British Columbia, Canada

TH-A5.1A.2 08:20
Efficient and Misalignment-Robust PT-Symmetric Wireless Power Transfer
Maryam Sakhdari, Pai-Yen Chen, University of Illinois, United States

TH-A5.1A.3 08:40
Ultra-Low Power Pulse Width Detector for RF Wake-Up Receivers
Ahmed Abed Benbuk, Nour Kouzayha, Fatima Asadallah, Joseph Costantine, Zaher Dawy, American University of Beirut, Lebanon

TH-A5.1A.4 09:00
Performance Comparison between Single and Multiple Implanted Receivers in a Hybrid Power/Data Transfer System
Reem Shaddad, Applied Science Private University, Jordan; Sima Noghanian, University of North Dakota, United States

TH-A5.1A.5 09:20
A Retro-reflective Scheme for Wireless Power transmission in Fully Enclosed Environments
Xin Wang, Xueqi Wang, Nanjing University of Aeronautics and Astronautics, China; Mingyu Lu, West Virginia University Institute of Technology, United States

Communication Systems
Session Co-Chairs: Gregory Huff, Pennsylvania State University; Jean-Francois Chamberland-Tremblay, Texas A&M University

TH-UC.1A.1 10:00
Low Cost Millimeter Wave Antenna for 5G Base Station
Junesook Lee, Dohyuk Ha, JunSig Kum, Kwanghyun Bok, Jinsu Heo, Jungyub Lee, YoungJu Lee, Samsung Electronics, Korea (South)

TH-UC.1A.2 10:20
6G-Next Decade Wireless Technology
Kapal Dev, Politecnico di Milano, Italy; Saeedeh Shazhdar, Air University, Pakistan

TH-UC.1A.3 10:40
Reconfigurable RF Front-Ends for Collocated DSRC and Millimeter-Wave Vehicle to Vehicle Communication
Sadhnyaa Reddy Govindaraju, Elias A. Alwan, Florida International University, United States

TH-UC.1A.4 11:00
A NOVEL METHOD FOR ESTIMATION OF MORE DOA WITH LESS ANTENNAS
Dah Guy Luc Hermann Segba, Nadir Hakem, Université du Québec en Abitibi-Témiscamingue (UQAT), Canada
Innovative Reconfigurable and Multifunction Antenna Arrays
Session Co-Chairs: Paolo Roccu, ELEDIA Research Center, University of Trento; Nicola Anselmi, ELEDIA Research Center, University of Trento; Randy Haupt, Colorado School of Mines

TH-SP.1P.1 13:20
Massive MIMO Beamforming on a Chip
Christopher Moraola, University of Massachusetts, United States; Marinos Vouvakis, University of Massachusetts Amherst, United States

TH-SP.1P.2 13:40
A Reconfigurable K/Ka Band Filtenna Using a Double Arm Ring Resonator
Manos Papathan, E. Ayoub, Christos Christodoulou, University of New Mexico, United States; Michael Chrysosamallis, Democritos University of Thrace, Greece

TH-SP.1P.3 14:00
Beam Reconfiguration Using Imaging Reflector Antennas
Sudhakar Patnaik, Northrop Grumman Aerospace Systems, United States; Philip Venezia, Custom Microwave Incorporated, United States

TH-SP.1P.4 14:20
Experimental Studies on Reconfigurable Multi-beam Antennas Using a Software Defined Radio Digital Beamformer
Payam Nayeri, Randy Haupt, Colorado School of Mines, United States

TH-SP.1P.5 14:40
Capacity-Driven Design of Clustered Array Architectures for New Generation 5G M-MIMO Systems
Giorgio Gattoceti, Giancarlo Olivieri, Andrea Massa, ELEDIA Research Center (ELEDIA@UniTN - University of Trento), Italy

Break 15:00

TH-SP.1P.6 15:20
Wideband Vector Antenna using Radiation Pattern Reconfigurability for 3-D Direction Finding
Johan Duploy, Christophe Morlaaz, ENM, France; Hervé Aubert, LAAS-CNRS, France; Patrick Potier, Philippe Poulignen, Direction Générale de l’Armement (DGA), France

TH-SP.1P.7 15:40
Design of a Reconfigurable Metal-Plasma L-Band Transmit-Array Antenna
Giulia Mansouri, University of Padova, Italy; Paolo Roccu, ELEDIA Research Center, Italy; Mohammad Abdul Hannan, ELEDIA Research Center (ELEDIA@UniTN - University of Trento), Italy; Federico Boulos, ELEDIA Research Center, Italy; Antonio-D. Capobianco, Paolo De Carlo, University of Padova, Italy; Alberto Toazzi, ASI - Italian Space Agency, Italy

TH-SP.1P.8 16:00
Transmit Beamforming Based on 4D Antenna Arrays with Pseudo-Random Orthogonal Time Sequences
Kajin Chen, Shiwen Yang, Yikai Chen, Shi-Wei Qu, University of Electronic Science and Technology of China, China; Paolo Roccu, Andrea Massa, University of Trento, Italy

TH-SP.1P.9 16:20
Development of Sub-Millimeter Wave Graphene Switched Antennas
Panagiotis Theocharopoulos, Georgias Trikopoulos, Arizona State University, United States

TH-SP.1P.10 16:40
An Electrically-Large and Multiply-Fed Holographic Antenna Based on Waveguide-Fed Metasurfaces
Timothy Skilesman, David Shrekenhamer, Ra’d Awadallah, Johns Hopkins University Applied Physics Laboratory, United States
Broadband, Wideband and High-Gain Printed Antennas
Session Co-Chairs: Boules A. Mouris, KTH Royal Institute of Technology; Reena Dahle, State University of New York (SUNY) at New Paltz

Compact Microstrip Patch Antennas on 3-D Printed Substrates with Dielectric Loading
Nicholas Piaquadio, Reena Dahle, State University of New York (SUNY) at New Paltz, United States

TH-A1.1.P.2 13:40
A High Gain Rectenna For Energy Harvesting Applications
Mohammed Cherif Derbal, Mourad Nedil, Université du Québec en Abitibi-Témiscamingue (UQAT), Canada

TH-A1.1.P.3 14:00
Wide-Band Series-Fed Patch Antenna Array with Low Side Lobes
Mahmoud Shirazi, Reza Safian, IMEC Nanoelectronics, United States

TH-A1.1.P.4 14:20
Open Multi-Slot Wideband MIMO Antennas with Microstrip Feed Line for 4G LTE
Taylor Moat, Saeed Latif, Georgios Lazarou, University of South Alabama, United States

TH-A1.1.P.5 14:40
Bandwidth Enhancement of Microstrip Patch Antenna using Superstrate Copper Ring for X-Band Applications
Halappa Gajera, University of Mysore, India

Break 15:00

TH-A1.1.P.6 15:20
An Interior Parasitic Patch Antenna with Wide Isolation Bandwidth for Simultaneous Transmit and Receive (STAR)
KueiJih Lu, Carlene Goodbody, Tutku Karacolak, Washington State University Vancouver, United States; Nghi Tran, University of Akron, United States

TH-A1.1.P.7 15:40
Analysis of U-slot Patch Using Characteristic Mode Analysis and Coupled Mode Theory
John Borchardt, Tyler Lapointe, Sandia National Laboratories, United States

TH-A1.1.P.8 16:00
Manipulation of Microstrip Antenna Directivity and Radiation Pattern using Negative Index Metamaterials
Ramiro Valdez, Nanrakan Wongkasem, University of Texas Rio Grande Valley, United States

TH-A1.1.P.9 16:20
CPW-fed Compact Polarization Diversity UWB MIMO Cup-Antenna
Mohamed I. Ahmed, Electronics Research Institute, Egypt; Mai I. Ahmed, Zagazig University, Egypt

TH-A1.2.P.1 13:20
Design Consideration of Synthetic Phased-Array Antenna Systems for 5G Mobile Wireless Network
Eugene Ngai, Hann-Jann (RF-Tech) Consultancy, United States

TH-A1.2.P.2 13:40
Electromagnetic Field Exposure Evaluation for 5G in Millimeter Wave Frequency Band
Thomas Basikolo, Takahiro Yoshida, Masanori Sakurai, Microwave Factory Company Ltd., Japan

TH-A1.2.P.3 14:00
Hybrid Beam-forming Smart Antenna for 5G Networks
Ahmed Kausar, Shafaq Kausar, Hani Mehnpouyan, Boise State University, United States

TH-A1.2.P.4 14:20
Modeling of Sub-Millimeter Wave Coplanar Waveguide Graphene Switches
Panagiotis Theofanopoulos, Georgios Trichopoulos, Arizona State University, United States

TH-A1.2.P.5 14:40
Multi-Broadband Microstrip Antenna for LTE Smartphone Applications
Mohamed Shaker Eidgeny, Electronics Research Institute, Egypt

Break 15:00

TH-A1.2.P.6 15:20
Compact Microstrip Patch Antenna Utilizing Low Cost Solution Cast Nanomagnetic Thin Film
Yuxiao He, Michigan State University, United States; Eric Drew, Z. John Zhang, Georgia Institute of Technology, United States; John Papapolymerou, Michigan State University, United States

TH-A1.2.P.7 15:40
A Large Scale FDTD Analysis of Cross Polarization Characteristics for Wireless Link Design of 4.4 GHz-band WAIC Systems inside and outside Aircraft Cabin
Tetsuya Sakiguchi, Takashi Hikage, Manabu Yamamoto, Toshio Nojima, Hokkaido University, Japan; Shunichi Futatsumori, Kazuyoshi Morikawa, Akiko Nakamura, Naruto Yamamoto, Electronic Navigation Research Institute, National Institute of Maritime, Port and Aviation Technology, Japan

TH-A1.2.P.8 16:00
Antenna Arrangement Suitable for Self-Interference Reduction in Short Range Full-Duplex MIMO
Shota Odajima, Naoki Hanma, Atsuto Kawagoe, Iwate University, Japan

TH-A1.2.P.9 16:20
Dual Beam High Gain Antenna for 5th Generation Communication System using Metasurface Lens
Amit Kumar Singh, Seong-Ook Park, Korea Advanced Institute of Science and Technology (KAIST), Korea (South)

TH-A1.2.P.10 16:40
RF Channel Propagation Modeling for Wireless Sensor Networks in Intelligent Transportation Systems
Fausto Granda, Universidad de las Fuerzas Armadas ESPE, Ecuador; Leyre Aznárez, Mikel Cobaya-Echarri, César Vargas-Rosales, Tecnologica de Monterrey, Mexico; Pau López-Izuri, Francisco Falcone, Universidad Publica de Navarra, Spain
Electrically Small Antennas
Session Co-Chairs: Yuanxun Ethan Wang, University of California, Los Angeles; Edward Slevin, Georgia Institute of Technology

Thursday, July 11 13:20 - 17:00
TH-A1.3P
Room 204/205

TH-A1.3P.1
13:20
Analysis of Multi-Antenna Proximity on Performance of Electrically Small Antennas
Shreya Singh, Dan Sievenpiper, University of California, San Diego, United States; Faisal Alsallum, Hatin Bakhtiari, King Abdullah City for Science and Technology, Saudi Arabia

TH-A1.3P.2
13:40
Enabling High Efficiency Bandwidth Electrically Small Antennas through Direct Antenna Modulation
Jean Paul Santos, Food Fereidoony, Yuanxun Ethan Wang, University of California, Los Angeles, United States

TH-A1.3P.3
14:00
Highly Miniaturized Microstrip Antenna with Slots and a Superstrate for RFID Applications
Yiyang Yu, University of Electronic Science and Technology of China, China; Haoran Zhang, Arif Shami, King Abdullah University of Science and Technology (KAUST), Saudi Arabia

TH-A1.3P.4
14:20
Mars Exploration: Wideband Frequency Reconfigurable Electrically Small Multi-Turn Loop Antenna Using MEMS Switch
Yubin Cai, Dassang Zhang, Yahya Rahmat-Samii, University of California, Los Angeles, United States

TH-A1.3P.5
14:40
Observed Q and Gravitationally-Small Antenna Behavior of a Binary Black Hole Radiator
Christopher Daniel, Kathryn Smith, Thomas Weldon, University of North Carolina at Charlotte, United States

Break
15:00

TH-A1.3P.6
15:20
Analysis for Miniaturization of a Spiral Antenna using Inductive and Resistive Loading
Il-Gwon Kim, Kyeong-Yang Cho, Jong-Gwan Yook, Yonsei University, Korea (South); Tae-Seung Song, Korea Testing Laboratory, Korea (South)

TH-A1.3P.7
15:40
Time-Domain Matching for Broadband VLF/LF Electrically-Short Radiators
Edward Slevin, Nate Opalinski, Parker Singletary, Lee Thompson, Morris Cohen, Georgia Institute of Technology, United States; Mark Golkowski, University of Colorado Denver, United States

TH-A1.3P.8
16:00
Demonstration of Electrically Small Antennas Operating Below 400 MHz
Nithanth Vinshabadoss, Rodenick Quaye, Rashaudnda Henderson, University of Texas at Dallas, United States

TH-A1.3P.9
16:20
A Compact Electrically Tunable VHF Antenna
Carl Pfeiffer, Defense Engineering Corp., United States; Fikadu T. Dagefu, Army Research Laboratory, United States

TH-A1.3P.10
16:40
A compact dual band ring antenna with embedding grounded patches
Yuju Li, Jiade Yuan, Fuzhou University, China; Zhizhang (David) Chen, Fuzhou University, China and Dalhousie University, Canada

Application of Microstrip and Printed Antennas
Session Co-Chairs: Shubhendu Bhardwaj, The Florida International University; Chunxu Mao, Pennsylvania State University; Tutku Karacolak, Washington State University Vancouver

Thursday, July 11 13:20 - 17:00
TH-A1.4P
Room 206/207

TH-A1.4P.1
13:20
High Gain Broadband Antenna for Point to Point Communication Systems
Md Arshuzzaman Towfiq, IT Technologies Inc, United States; Bedri Cetiner, Abdurazag Khalat, Utah State University, United States

TH-A1.4P.2
13:40
Dual-Polarized Armband Embroidered Textile Antenna for On-/Off-Body Wearable Applications
Chunxu Mao, Pennsylvania State University, United States; Dieff Vital, Florida International University, United States; Pingjuan L. Werner, Douglas H. Werner, Pennsylvania State University, United States; Shubhendu Bhardwaj, Florida International University, United States

TH-A1.4P.3
14:00
A Comparison of Path Loss Variations in Soil using Planar and Dipole Antennas
Abdul Salam, Purdue University, United States

TH-A1.4P.4
14:20
Miniaturized SIW-CBS Planar TX/RX Antenna Arrays For Microwave CW/FMCW Doppler Radars
Nadav Naseh, Reza Ebrahimi Ghini, Kamran Entesari, Texas A&M University, United States

TH-A1.4P.5
14:40
Microstrip Antenna Design for Underground Water Pipeline Monitoring Sensor
Manuel Ricardo Pérez Carquéña, Ivonne Neira, Pontificia Universidad Javeriana, Colombia

Break
15:00

TH-A1.4P.6
15:20
A Compact High Gain X-Band Patch Antenna for Cube and Small Satellite Applications
Shiou-Li Chen, National Space Organization (NSPO), National Applied Research Laboratories (NARL), Taiwan

TH-A1.4P.7
15:40
Novel High-Performance, Dual-Polarized, Crossed-Vertically-Fed Microstrip Antenna Array for Multifunction Phased Array Radar Application
Hadi Saeidi-Manesh, Shahrokh Saiedi, Guang Zhang, University of Oklahoma, United States

TH-A1.4P.8
16:00
A 24 GHz ISM Band Doppler Radar System for Moving Target Sensing
Sangyoon Kim, Jihoon Bang, Kyuseung Koom, Jaehoon Choi, Hanyang University, Korea (South); Dong Kyoo Kim, Youjin Kim, Electronics and Telecommunications Research Institute, Korea (South)

TH-A1.4P.9
16:20
Fabric Antenna for Temperature Sensing over ISM Frequency Band
Isidoro Ibanez Labiano, Akram Alomainy, Queen Mary University of London, United Kingdom

TH-A1.4P.10
16:40
Investigations of Wideband Microstrip Unit Cell Topologies at 28 GHz for Flat Lens Antenna Applications
Zohre Pourgholamhossein, Tayeb A. Denidni, National Institute of Scientific Research (INRS), Canada
Advances in Radar, Massive and Multiuser MIMO Antenna Systems
Session Co-Chairs: Said Mikki, University of New Haven; Ivan Ndiip, Fraunhofer-Institut fuer Zuverlassigkeit und Mikrointegration

TH-A5.2P.1 13:20
Effective Figure of Merit Definition for MIMO UWB Radar Channels Selection
Fugui Qi, Jianqi Wang, Fourth Military Medical University, China; Ozlem Klic, Catholic University of America, United States; Aly E. Fathy, University of Tennessee at Knoxville, United States

TH-A5.2P.2 13:40
On the Phase-Error Tolerance of Virtual Antenna Arrays in MIMO Radars
Rabia Syeda, Martin Bearden, A. Burt Smolders, Eindhoven University of Technology, Netherlands

TH-A5.2P.3 14:00
Wireless Frequency Synchronization for Coherent Distributed Antenna Arrays
Serge Mghabghab, Hassna Ouassal, Jeffrey Nanzer, Michigan State University, United States

TH-A5.2P.4 14:20
Investigation of Channel Correlation in Indoor Wideband Massive MIMO Systems
Munir Temic, Yongwei Zhang, Emad Alsuwa, Leith Danooon, University of Manchester, United Kingdom

TH-A5.2P.5 14:40
An Efficient FB-based Underground Channel Estimation for MIMO Mm-Wave Systems
Widad Belaoura, National Polytechnic School, Algeria; Khalida Ghanem, Center of Development of Advanced Techniques (CDTA), Algeria; Hicham Bousbia-Salah, National Polytechnic School, Algeria

Break

TH-A5.2P.6 15:20
Estimation of the Cross-Correlation Green’s Function for MIMO Systems
Debdeep Sarker, Royal Military College, Canada; Said Mikki, University of New Haven, United States; Yahia Antar, Royal Military College of Canada, Canada

TH-A5.2P.7 15:40
Range and Capacity Optimization of a 10Gbps Access PointEmploying 12 MIMO Chains
John Sanford, University of California, San Diego, United States; Saied Ansari, Quantenna Inc., United States

TH-A5.2P.8 16:00
Deep Learning Design for Joint Antenna Selection and Hybrid Beamforming in Massive MIMO
Ahmed E. Elbiri, Duzce University, Turkey; Kumar Vijay Mishra, University of Iowa, United States

TH-A5.2P.9 16:20
A Novel Multi-user Spatial Modulation-based Code Division Multiple Access Scheme
Khalida Ghanem, Center of Development of Advanced Techniques (CDTA), Algeria; Moudad Nefli, Université du Québec en Abitibi-Témiscamingue (UQAT), Canada; Fatima Bernahmo, Hicham Bousbia-Salah, National Polytechnic School (ENP), Algeria

TH-A5.2P.10 16:40
Multi-user Communication by Electromagnetic Vortex Based on Time Modulated Array
Yiqing Liu, Chong He, Ronghong Jin, Junping Geng, Xian-Ling Liang, WeiRen Zhu, Shanghai Jiao Tong University, China

TH-A5.2P

Metastructures for Antennas
Session Co-Chairs: Mirko Barbuto, Niccolò Cusano University; Hisamatsu Nakano, Hosei University

TH-A2.1P.1 13:20
Double Metalloop Antenna
Hisamatsu Nakano, Tomoki Abe, Junji Yamouchi, Hosei University, Japan; Amit Mehra, Swansea University, United Kingdom

TH-A2.1P.2 13:40
A Rectangular Waveguide Antenna with Filtering and Beam-steering Capabilities
Mirko Barbuto, Alessio Monti, Niccolò Cusano University, Italy; Filiberto Bilotti, Alessandro Toscana, Roma Tre University, Italy

TH-A2.1P.3 14:00
An Ultra-Thin Compact Highly Efficient 90°-Section CRLH-EBG Based Antenna for ISM Applications
Mohamed El Atrash, October University for Modern Sciences and Arts (MSA), Egypt; Mahmoud A. Abdalla, Military Technical College, Egypt; Abdelaziz A. Aboulhosn, Sara S. Abd-Alwahhab, October University for Modern Sciences and Arts (MSA), Egypt

TH-A2.1P.4 14:20
Wideband Low-Profile Quasi-Yagi Antenna Using Artificial Magnetic Conductor
Jian Ren, Yingzeng Yin, Xidian University, China

TH-A2.1P.5 14:40
Reconfigurable Metasurface Lens Thin Antenna with 3-State Unit Cells in 28-GHz Band
Mingji Wu, Keishi Kasaka, Eiji Hankui, NEC Corporation, Japan

Break

TH-A2.1P.6 15:20
Vortex-Beam Emitter Based on Spoof Surface Plasmon Polaritons
Jia Yuan Yin, Li-Xin Guo, Xidian University, China

TH-A2.1P.7 15:40
Dual-Band High-Gain Circularly Polarized Patch Antenna Using Metasurface Joysmita Chatterjee, Akhilesh Mohan, Vivek Dixit, Indian Institute of Technology, Kharagpur, India

TH-A2.1P.8 16:00
A Low Profile Flexible Circularly Polarized Antenna for Wearable and WLAN Applications
Mohamed El Atrash, October University for Modern Sciences and Arts (MSA), Egypt; Mahmoud A. Abdalla, Military Technical College, Egypt; Sherif R. Zahran, Arab Academy for Science, Technology & Maritime Transport, Egypt; Abdelrahman M. Al, October University for Modern Sciences and Arts (MSA), Egypt

TH-A2.1P.9 16:20
A Wideband Compact Filtering Array Antenna Using Two Sections L-CRLH Impedance Transformer
Mohamed A. Abdalla, Military Technical College, Egypt; Hessam Hassan, Yasmin Hammoud, October University for Modern Sciences and Arts (MSA), Egypt; Mohammad Ameen, Raghvendra Chaudhary, Indian Institute of Technology, India
### Space-Time and Tunable Metastructures

**Session Co-Chairs:** Sawyer Campbell, the Pennsylvania State University; Amit Mehta, Swansea University

**TH-A2.2P.1 13:20**

**Space-time modulated cloaks for breaking reciprocity of antenna radiation**

Davide Ramaccia, Roma Tre University, Italy; Dimitrios Sounas, Wayne State University, United States; Andrea ALO, CUNY Advanced Science Research Center, United States; Alessandro Tassano, Filiberto Bilotti, Roma Tre University, Italy

**TH-A2.2P.2 13:40**

**Serrrodyne frequency translation using time-modulated metasurfaces**

Zhanni Wu, Anthony Grbic, University of Michigan, United States

**TH-A2.2P.3 14:00**

**Time-modulated reflective metasurface for the control of the reflected signal frequency**

Davide Ramaccia, Roma Tre University, Italy; Dimitrios Sounas, Wayne State University, United States; Andrea ALO, CUNY Advanced Science Research Center, United States; Alessandro Tassano, Filiberto Bilotti, Roma Tre University, Italy

**TH-A2.2P.4 14:20**

**Direction-of-Arrival (DOA) Estimation based on Space-time-Modulated Metasurface**

Xiaoyi Wang, Christophe Caloz, Polytechnique Montréal, Canada

**TH-A2.2P.5 14:40**

**VO2-based Active Terahertz Chiral Metamaterials**

Lei Kang, Pennsylvania State University, United States; Shengxiang Wang, Wuhan Textile University, China; Sawyer D. Campbell, Pingjun L. Werner, Douglas H. Werner, Pennsylvania State University, United States

**Break**

**TH-A2.2P.6 15:20**

**Towards Generalized Transistor-based Magnetless Nonreciprocal Metasurface**

Guillaume Lavigne, Christophe Caloz, Polytechnique Montréal, Canada

**TH-A2.2P.7 15:40**

**Reconfigurable Metamaterials Formed Through a Combination of Nanowire Assemblies with Top-Down Fabricated Nanoantennas**

Lei Kang, Sawyer D. Campbell, Douglas H. Werner, Pennsylvania State University, United States

**TH-A2.2P.8 16:00**

**Tunable Multiband Devices Based on ON/OFF Switches in Metamaterials SOR for WIFI Application**

Bachir Belkadi, Zebrir Mahdjoub, Mohamed Lamine Seddiki, University of Sidi Bel Abbés, Algeria; Meurnat Nedil, Université du Québec en Abitibi-Témiscamingue (UQAT), Canada

**TH-A2.2P.9 16:20**

**A Wearable Reconfigurable Electromagnetic Metamaterial Absorber using Artificial Magnetic Inclusions**

Mohammed Bhati-Suwailam, Sultan Qaboos University, Oman; Thamer Almoneef, Prince Sattam bin Abdulaziz University, Saudi Arabia; Akram Alomainy, Queen Mary University of London, United Kingdom

**TH-A2.2P.10 16:40**

**Graphene metasurface based tunable double split ring resonator for far infrared frequency region**

Vishal Sarathiya, Shebhirkumar Patel, Marwadi Education Foundation, India

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### EM Interaction and Coupling

**Session Co-Chairs:** Salvatore Campione, Sandia National Laboratories; Raphael Kastner, University of Pennsylvania

**TH-UB.1P.1 13:20**

**Developing High Isolation Planar RX-TX Ku Band Phased Arrays for Unmanned Aerial Systems (UAS)**

Jakob Kunzler, Karl Warnick, Brigham Young University, United States

**TH-UB.1P.2 13:40**

**Optimal Coil Design for Maximum Power Transfer Efficiency in Resonantly Coupled Systems**

Maryam Heidarian, Samuel J. Burgess, Radhakrishna Prabhu, Nazila Fough, Robert Gordon University, United Kingdom

**TH-UB.1P.3 14:00**

**Near field Electromagnetic Cloaking of Monopole Antennas for Mutual Coupling Reduction using 3-D Confocal Elliptical Meta-Surface Cloaks**

Waleed Ahmad, Jinpil Tak, University of Arizona, United States; Alexander B. Yakovlev, University of Mississippi, United States; Hao Xin, University of Arizona, United States

**Break 15:00**

**TH-UB.1P.4 15:20**

**Practical Considerations for Resonant Near Field Wireless Power Transfer over Common Ground**

Saeed Khan, Kansas State University, United States

**TH-UB.1P.5 15:40**

**Modeling shielded cables in Xyce based on transmission-line theory**

Salvatore Campione, Aaron Pung, Larry Warne, William L. Langston, Ting Mei, Sandia National Laboratories, United States

**TH-UB.1P.6 16:00**

**Half-Way Duality and the Fractional Curl Operator**

Raphael Kastner, University of Pennsylvania, United States

**TH-UB.1P.7 16:20**

**A Wideband Low-frequency Near-field Measurement System for Detecting Electromagnetic Emission from Biological Cells**

Mengluo Rao, Seyed Mohammad Amjadi, Kamal Sarabandi, University of Michigan, United States

**TH-UB.1P.8 16:40**

**Propagation Characteristics of a Reconfigurable Plasmonic Rectangular Groove Grating Waveguide Using Periodically Photoinduced Plasma**

Kazuo Nishimura, Ryukoku University, Japan
### Sensing and Imaging in Challenging Environments
Session Co-Chairs: Carey Rappaport, Northeastern University; Timothée Marchal, LAAS-CNRS

**TH-A3.1P.1** 13:20
On the Performance of Polarimetric Subtraction Technique for the Detection of Bunkers in the Presence of Surface Clutter
DaFan Liu, Army Research Laboratory, United States

**TH-A3.1P.2** 13:40
Structural Effect on Image Quality Degradation in Ground-Penetrating Radar Array
Samuel Wagner, Anh-Vu Pham, University of California, Davis, United States

**TH-A3.1P.3** 14:00
Imaging of Walking Human Behind the Wall Using Impulse Radar
DoQui Lee, Brandon Fang, Plinio Morita, Jennifer Boger, William Melek, George Shaker, University of Waterloo, Canada

**TH-A3.1P.4** 14:20
Dual-Polarized Through-Wall Repeater for the Wireless Reading of Millimeter-wave Passive Sensors
Timothée Marchal, Julian Philippe, Dominique Henry, Maria-Valeria De Paolis, Anthony Coutou, Pans Patrick, Aubert Hervé, LAAS-CNRS, France

**TH-A3.1P.5** 14:40
Analysis of multistatic vehicle-drone Ground Penetrating Radar configurations for mine detection
Maria Garcia-Fernandez, University of Oviedo, Spain; Ann Margenthaler, Northeastern University, United States; Yuri Alvarez-Lopez, Fernando Las-Heras, University of Oviedo, Spain; Carey Rappaport, Northeastern University, United States

**Break** 15:00

**TH-A3.1P.6** 15:20
Experimental Imaging Results of a UAV-mounted Downward-Looking mm-wave Radar
WeiTe Zhang, Juan Heredia-Juesas, Mithun Diddi, Luis Tirado, Hanumant Singh, Jose Angel Martinez-Lorenzo, University of Oviedo, Spain

**TH-A3.1P.7** 15:40
A Vanadium Dioxide Microbolometer in the Transition Region for Millimeter Wave Imaging
Shanxi Chen, Mark Lust, Nima Ghahremanee, Ohio State University, United States

**TH-A3.1P.8** 16:00
Selection of Incident Electric fields for Estimating the Calibration Factor of the Lead Electromagnetic Model
Mikhail Kazlov, Max Planck Institute for Human Cognitive and Brain Sciences, Germany; Wolfgang Kanz, Food and Drug Administration, United States

**TH-A3.1P.9** 16:20
Multimode Horn for a Monopulse Subsystem
Hongjian Wang, NMRS, NSSC, CAS, China

**TH-A3.1P.10** 16:40
Forward Transmission Matrix Analysis of Lorentz Sensor For High Permittivity Detection
Omar Siddiqui, Taibah University, Saudi Arabia

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### Finite-Difference Time-Domain Methods
Session Co-Chairs: Christophe Guiffaut, CNRS; Atef Elsherbeni, Colorado School of Mines

**TH-A3.2P.1** 13:20
Oblique Thin wire for nonuniform FDTD method
Christophe Guiffaut, Alain Reineix, CNRS, France

**TH-A3.2P.2** 13:40
Field interpolation with generalized barycentric coordinates in conformal FDTD schemes
Nicolas Bui, Christophe Guiffaut, Alain Reineix, XLIM Institute, University of Limoges/CNRS, France

**TH-A3.2P.3** 14:00
A stable sub-gridding with time and spatial refinements for the FDTD method
Francis Denanot, Christophe Guiffaut, Alain Reineix, University of Limoges, France

**TH-A3.2P.4** 14:20
Oblique Incidence PML Reflection Analysis for Cylindrical FDTD
Mohammed Hadi, Atef Elsherbeni, Colorado School of Mines, United States

**TH-A3.2P.5** 14:40
Numerical Stability Analysis of M1-D LOD-FDTD Method for Inhomogeneous Coupled Transmission Lines
Ding Yu Heh, Eng Leong Tan, Nanyang Technological University, Singapore

**TH-A3.2P.6** 15:00
Break

**TH-A3.2P.7** 15:20
A Stable 3-D FDTD Method with Multiple Embedded Reduced-Order Models
Xinyue Zhang, Piero Triverio, University of Toronto, Canada

**TH-A3.2P.8** 15:40
FDTD Simulations Of The Impedance Of A Dipole Antenna in A Plasma
Edmund Spencer, Saeed Latif, University of South Alabama, United States

**TH-A3.2P.9** 16:00
Explicit Unconditionally Stable Symmetric Positive-Semi-Definite FDTD Subgridding Algorithm with Analytical Removal of Unstable Modes
Kaiyuan Zeng, Dan Jiao, Purdue University, United States

**TH-A3.2P.10** 16:20
Consideration of Poynting Localized Energy Around Radiators: An FDTD-based Investigation
Debdeep Sarkar, Royal Military College, Canada, Canada; Said Nikki, University of New Haven, United States; Yahia Antar, Royal Military College of Canada, Canada

**TH-A3.2P.11** 16:40
FDTD Modeling of a Dipole Antenna above Metasurface Using Surface Impedance Boundary Condition
Akihide Kurahara, Taru Uno, Takuji Arima, Tokyo University of Agriculture and Technology, Japan
Integral Equation Methods III
Session Co-Chairs: Francesco P. Andriulli, Politecnico di Torino; Robert Adams, University of Kentucky

TH-A3.3P.1
13:20
Binormalized Factorizations for Magnetostatic Integral Equations
Robert Adams, Owen Wilkerson, John Young, Stephen Gedney, University of Kentucky, United States

TH-A3.3P.2
13:40
On a Unified Approach Towards the Modeling of Nonlocal Hydrodynamic Nonclassical Response from Plasmonic Nanopolarizations
Xuezhi Zheng, Maria Kupresak, Victor V. Moshchalkov, Katholieke Universiteit Leuven, Belgium; Raj Mittra, University of Central Florida, United States; Guy A. E. Vandenbosch, Katholieke Universiteit Leuven, Belgium

TH-A3.3P.3
14:00
A Well-Conditioned Differential Surface Admittance Formulation for Modeling Penetrable Media
Shashwat Sharma, Piero Triverio, University of Toronto, Canada

TH-A3.3P.4
14:20
Solving Realistic Multiscale and Composite Problems using an Integral Equation Domain Decomposition Approach
Victor F. Martin, University of Extremadura, Spain; Diogo M. S. Silva, University of Pennsylvania, United States; David Lorios, José Manuel Taboada, Luis Landesa, University of Extremadura, Spain; Jose L. Rodriguez, Fernando Obelleiro, University of Vigo, Spain

TH-A3.3P.5
14:40
Reconstruction of Anisotropic Dielectric Objects Based on Integral Equation Method
Qing Xu, Xi Yuan Du, Ze Yuan Lu, Yi Fan Zhang, Mei Song Tong, Tongji University, China

Break
15:00

TH-A3.3P.6
15:20
The Effect of Antenna in the Forward Model of Near Field Microwave Imaging Systems
Akın Dalkılıç, ASELSAN Inc., Turkey; Lale Alatan, Middle East Technical University, Turkey

TH-A3.3P.7
15:40
A Novel Scheme for Evaluating Hypersingular Volume Integrals over Tetrahedral Elements
Hong Qin Zheng, Yin Xuan Zhu, Han Yu Shi, Mei Song Tong, Tongji University, China

TH-A3.3P.8
16:00
Optimization of a Microwave Tomography Algorithm Using the DDA as a Fast Forward Solver
Samar Hasounehdejegh, Andreas Flöger, Mikael Persson, Chalmers University of Technology, Sweden; Paul Meaney, Dartmouth College, United States

TH-A3.3P.9
16:20
Accurate Solution of Electromagnetic Scattering by Conducting Objects Based on Nystrom Method
Shu Na Jiang, Han Kai Yang, Li Zhang, Mei Song Tong, Tongji University, China

TH-A3.3P.10
16:40
Acceleration of Finite Periodic Structures Analysis through Full-Domain Basis for Matrix Compression
Alberto Senne, Luis Landesa, José Manuel Taboada, University of Extremadura, Spain
TH-A4.1P 13:20 - 14:40  Room 212

Engineered Scattering Surfaces
Session Chair: Matthys Botha, Stellenbosch University

TH-A4.1P.1 13:20
Design of Ultra-Broadband RCS-Reduction Checkerboard Surface Using AMC Circuit Model
Meshaal Alyahya, Constantine Balanis, Craig Birtcher, Arizona State University, United States; Hussein Shamon, Woleed Alomar, King Abdulaziz City for Science and Technology, Saudi Arabia; Saud Saeed, Prince Sattam bin Abdulaziz university, Saudi Arabia

TH-A4.1P.2 13:40
Physical Optics Modeling of Scattering by Checkerboard Structure for RCS Reduction
Meshaal Alyahya, Constantine Balanis, Craig Birtcher, Arizona State University, United States; Hussein Shamon, Woleed Alomar, King Abdulaziz City for Science and Technology, Saudi Arabia

TH-A4.1P.3 14:00
Radar Cross Section Reduction of A Foldable Microstrip Patch Array
Akash Biswas, Muhammad Hamza, Constantinos L. Zekos, Stavros V. Georgakopoulos, Florida International University, United States

TH-A4.1P.4 14:20
Design and Fabrication of Engineered Reflector for Wideband Linear-to-Circular Polarization Converter
Mourad Ibrahim, Prince Sultan University, Saudi Arabia; Abdellady Mahmoud, Amr Awamny, Banha University, Egypt; Zhi Hua Jiang, Wei Hong, Southeast University, China; Mustafa K. Taher Al-Nuaimi, Shenzhen University, China

TH-UB.2P 15:20 - 17:00  Room 212

Propagation Phenomenon and Effects
Session Chair: Leung Tsang, University of Michigan

TH-UB.2P.1 15:20
Effective surface impedance of anisotropic surface roughness
Stephane Larouche, Jesse Tice, Vesna Radisic, NG Next, Northrop Grumman Corporation, United States

TH-UB.2P.2 15:40
A Partially Coherent Approach for Scattering of Electromagnetic Waves from Random Layered Media with 3D Rough Interfaces
Mohammadreza Sanamzadeh, Leung Tsang, University of Michigan, United States

TH-UB.2P.3 16:00
E-Glass and Wall Effects of 60 GHz Applications in a Residential Home Environment
Dylan Rice, Sungkyun Lim, Georgia Southern University, United States; J.R. Fleisch, ARRIS Enterprises, Inc., United States

TH-UB.2P.4 16:20
60 GHz Modeling Study for an Access Point in a Residential House
Dean Lucien, Sungkyun Lim, Georgia Southern University, United States; J.R. Fleisch, ARRIS Enterprises, Inc., United States

TH-UB.2P.5 16:40
Radiation of a Satellite Array Antenna in Dispersive Atmospheric Environments
Changseong Kim, Jun Heo, Yong Bae Park, Ajou University, Korea (South)

FR-SP.1A 08:00 - 11:40  Grand Ballroom C

Recent Advances in Multi-Material Additive Manufacturing for Antennas and Microwave Devices
Session Co-Chairs: Payam Nayeri, Colorado School of Mines; Geoff Brennecka, Colorado School of Mines

FR-SP.1A.1 08:00
Multi-Material Additive Manufacturing as an Enabling Technology for Antennas and Microwave Devices: An Overview
Geoff Brennecka, Payam Nayeri, Colorado School of Mines, United States

FR-SP.1A.2 08:20
Fabrication and Characterization of 3D-Printed Ku-band Frequency Scanning Slotted Waveguide Antenna Array
Runchen Zhao, Grant Senger, Nima Ghalichechian, Ohio State University, United States

FR-SP.1A.3 08:40
Reversibly Reconfigurable Liquid Metal Antennas Using 3D Printed Microfluidics
Vivek Bharambe, Jimin Ma, Michael Dickey, Jacob Adams, North Carolina State University, United States

FR-SP.1A.4 09:00
A Novel 60-cm Nonspherical 3-D Printed Voxelized Lens Antenna: Design, Fabrication and Measurement
Yahya Rahmat-Samii, Jordan Budhu, University of California, Los Angeles, United States; Richard Hodges, Douglas Hofmann, Donald Ruffatto, NASA Jet Propulsion Lab, California Institute of Technology, United States

FR-SP.1A.5 09:20
Multi-Material 3D Printed Gradient Dielectric Lens Antennas at mm-Wave Frequencies
Henry Goldens, Yang Hao, Queen Mary University of London, United Kingdom

Break 09:40

FR-SP.1A.6 10:00
Agile Prototyping of E-band Devices
Grant Heileman, Applied Technology Associates, United States; Firas Ayoub, University of New Mexico, United States; Derek Doyle, Air Force Research Laboratory, United States; Christos Christodoulou, University of New Mexico, United States

FR-SP.1A.7 10:20
A 3-D Printing Ka-band Twisted Waveguide Filter with Filtering and Polarization Rotation
Y Song, Jun Xu, Fan Zhang, Xi He, Xiaoyan Li, Ying Sun, Shengjian Xu, University of Electronic Science and Technology of China, China

FR-SP.1A.8 10:40
Tunable 3D-Printed Coaxial-Cavity Filters with Mixed Electromagnetic Coupling
Kshitij Sadasivan, Dimitra Psychogiou, University of Colorado at Boulder, United States

FR-SP.1A.9 11:00
Printed 5G Reconfigurable Wireless Modules Using Additive Manufacturing Techniques
Tong-Hong Lin, Manos Tentzeris, Georgia Institute of Technology, United States

FR-SP.1A.10 11:20
Microstrip Patch Antennas with Controlled Pattern Tilt using Multi-Material Additive Manufacturing for Piecewise Planar Conformal Arrays
Payam Nayeri, Geoff Brennecka, Colorado School of Mines, United States
**Antenna Innovations and Open Challenges for Small Satellites and CubeSats**
Session Co-Chairs: Joshua Kovitz, Georgia Tech Research Institute; Nacer Chahat, Jet Propulsion Laboratory

- **FR-SP.2A.1** 08:00
  A Review of JPL Deployable CubeSat Antennas
  Nacer Chahat, Emmanuel Decossas, Tom Cwilk, NASA Jet Propulsion Lab, California Institute of Technology, United States

- **FR-SP.2A.2** 08:20
  Metal-only Modulated Metasurface Antenna for Cubesat Platforms
  David Gonzalez-Quejero, Centre National de la Recherche Scientifique (CNRS), France; Adham Mahmoud, Xavier Marvan, Université de Rennes 1, France; Mauro Ettorre, Centre National de la Recherche Scientifique (CNRS), France; Ronan Soulaou, Université de Rennes 1, France; Stefano Magi, University of Siena, Italy; Gautam Chattopadhyay, Nacer Chahat, NASA Jet Propulsion Lab, California Institute of Technology, United States

- **FR-SP.2A.3** 08:40
  X-band Synthetic Aperture Radar in SmallSats: Developing a Deployable Phased Array at SmallSat Timescales
  Wyman Williams, Kathy Bowland, James Dee, Joshua Kovitz, Georgia Tech Research Institute, United States

- **FR-SP.2A.4** 09:00
  High-Frequency CubeSat Platform Scattering Using Higher-Order Method of Moments
  Jakob Rosenkrantz de Lasson, Oscar Barres, Cecilia Cappellini, Tonny Rubæk, VTCA, Denmark

- **FR-SP.2A.5** 09:20
  Design of a Quasi-optical Si/GaAs W-Band Beam-Forming Metasurface Antenna
  Okan Yurduseven, Choonsoo Lee, Nacer Chahat, NASA Jet Propulsion Lab, California Institute of Technology, United States; David Gonzalez-Quejero, Mauro Ettorre, Ronan Soulaou, IETR, University of Rennes 1, France; Gautam Chattopadhyay, NASA Jet Propulsion Lab, California Institute of Technology, United States

**Break** 09:40

- **FR-SP.2A.6** 10:00
  Design and Measurements of a 1m Ka-Band Mesh Deployable Reflector Antenna for CubeSats
  Yahya Rahmat-Samii, Vignesh Manohar, University of California, Los Angeles, United States; Richard Hodges, NASA Jet Propulsion Lab, California Institute of Technology, United States; Gregg Freebury, Tendaq LLC, United States

- **FR-SP.2A.7** 10:20
  Measuring GPS Transmit Antenna Pattern Using On-Orbit Receivers
  Tianlin Wang, Christopher Rut, Bruce Black, University of Michigan, United States; Andrew O’Brien, Ohio State University, United States

- **FR-SP.2A.8** 10:40
  Deployable Circularly Polarized UHF Printed Loop Antenna for Mars Cube One (MarCO) CubeSat
  Emmanuel Decossas, NASA Jet Propulsion Lab, California Institute of Technology, United States; Phillip E. Walkemeyer, Canvas Technology, United States; B. Savannah Velasco, California State Polytechnic University - Pomona, United States; Nacer Chahat, NASA Jet Propulsion Lab, California Institute of Technology, United States

- **FR-SP.2A.9** 11:00
  In-Orbit Test Strategy and Results for GX Multibeam Antenna
  Sara Mugnaini, Marc Benhamou, Immarsat plc, United Kingdom

- **FR-SP.2A.10** 11:20
  X-Band Archimedean Spiral Antenna Array with Sloped-Wall Backing Cavity
  Katelyn Isbell, Yang-Ki Hong, Wonchael Lee, Hayun Won, Minyeong Choi, University of Alabama, United States
Circulary Polarized Patch and Printed Antennas
Session Co-Chairs: Maria Pour, University of Alabama in Huntsville; Atef Elsherbeni, Colorado School of Mines

**FR-A1.1A.1** 08:00
All-Metal Dual-Frequency Circularly Polarized High Gain Antenna for potential Europa Lander
Nacer Chahat, John Luke Wolff, Brant Cook, Polly Estabrook, NASA Jet Propulsion Lab, California Institute of Technology, United States

**FR-A1.1A.2** 08:20
A Circularly Polarized Planar 2×2 Dipole Array Antenna Fed by a Modified 4-way Gysel Power Divider
Eunyoung Park, Sangki Kim, Pusan National University, Korea (South); Nathan Seongheon Jeong, University of Alabama, United States

**FR-A1.1A.3** 08:40
Analysis of Circular Polarization Properties of 4×4 Arrays at Ka-band
Lukasz Greda, Wahid Elmanss, Achim Dreher, German Aerospace Center (DLR), Germany

**FR-A1.1A.4** 09:00
A Defected Ground Structure for Circularly Polarized (CP) Microstrip Antenna Design
Kun Wei, Bo-Cheng Zhu, Peking University, China; Ming-Liang Tao, Yue-Xian Wang, Northwestern Polytechnical University, China

**FR-A1.1A.5** 09:20
Omnidirectional Triple-Band Printed Dipole Antenna Based on a Dual Frequency SRRs
Nilton Santos-Valdivia, Patricia Castillo-Áraníbar, Universidad Católica San Pablo, Peru; Daniel Segovia-Vargas, Alejandro García-Lampérez, Universidad Carlos III de Madrid, Spain

Break 09:40

**FR-A1.1A.6** 10:00
Compact Broadband Circularly Polarized Microstrip Antenna With a Cross-slotted Ground Plane
Ruipan Zhang, Jiawai Huang, Jun Ding, Guohua Zhai, East China Normal University, China

**FR-A1.1A.7** 10:20
A Shared-Aperture Broadband Circularly Polarized Antenna for Satellite Communications and Navigation
Yu-Yang Zheng, C.C. Liu, East China Research Institute of Electronic Engineering, China; Yan Ran Ding, University of Electronic Science and Technology of China, China

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Mutual Coupling in Antenna Arrays
Session Co-Chairs: Adam Mehrabani, Johns Hopkins University; Chris Merola, University of Massachusetts

**FR-A1.2A.1** 08:00
Mutual Coupling and Failure analysis in Phased Antenna Arrays
Abdelmoniem Hassan, Ahmed Kishk, Concordia University, Canada

**FR-A1.2A.2** 08:20
A Characteristic Mode Based Decoupling Approach
Sandip Ghosal, Anjum De, Ajay Chakraborty, Indian Institute of Technology, Kharagpur, India; Raed M. Shubair, Massachusetts Institute of Technology, United States

**FR-A1.2A.3** 08:40
A Compact 2 by 2 Printed Yagi-Uda Antenna Array with Enhanced Isolation and Gain
Nivedita Parthasarathy, Ramesh Abhari, Santa Clara University, United States

**FR-A1.2A.4** 09:00
A Broadband H-Plane Patch Antenna Decoupling Technique
Soroush Rasti Boroujeni, Safieddin Safavi-Naeini, University of Waterloo, Canada

**FR-A1.2A.5** 09:20
Reduced Active Impedance Variation By Using Time Modulated Array
Mohammad Hassain Manzahi, Mohammad Fakharzadeh, Mahmoud Akbari, Sharif University of Technology, Iran; Safieddin Safavi-Naeini, University of Waterloo, Canada

Break 09:40

**FR-A1.2A.6** 10:00
Coupling Reduction of Printed Yagi Antenna Arrays for Millimeter-wave Imaging Applications
Mostafa Alvandian, University of Tehran, Iran; Mohammad Fakharzadeh, Sharif University of Technology, Iran; Mohammadreza Ranjbar Naeini, University of Wisconsin-Madison, United States

**FR-A1.2A.7** 10:20
Does Low Mutual Coupling Imply Low Antenna Correlation?
Xiaoming Chen, Muhammad Abdullah, Qinlong Li, Shihao Zhu, Hongyu Shi, Anxue Zhang, Xi’an Jiaotong University, China

**FR-A1.2A.8** 10:40
Coupling Effects on Polarization-Agile Patch Antenna Arrays
Jianju Chen, Shih-Yuan Chen, National Taiwan University, Taiwan; Jennifer Bernhard, University of Illinois at Urbana-Champaign, United States

**FR-A1.2A.9** 11:00
A Novel Self-restrained Decoupling Technique for Two Antennas
Min Li, Heming Yao, Lijun Jiang, University of Hong Kong, China
Elements and Arrays for Sensing and Measurement
Session Co-Chairs: Xuan Hui Wu, Minnesota State University, Mankato; DEBASHISH CHAKRAVARTY, INDIAN INSTITUTE OF TECHNOLOGY, KHRAGPUR

FR-A5.2A.1 08:00
A Log-Periodic based Broadband Reject Filter for Dielectric Constant Characterization
Moussa Bteich, Joseph Costantine, Rozwoda Kani, Youssef Tawk, American University of Beirut, Lebanon; Ali Ramadan, Fahad Bin Sultan University, Saudi Arabia; Assaad Eid, American University of Beirut, Lebanon

FR-A5.2A.2 08:20
Excitation of Circularly Polarized Wave In Substrate Integrated E-Plane Waveguide
Venkata Naga Kalyan Ram Akunuru, Xuan Hui Wu, Minnesota State University, Mankato, United States

FR-A5.2A.3 08:40
New potential of a direct printed LoRa antenna
Camille Delfaut, Fondation Grenoble INP, France; Tan-Phu Vuong, IMEP- LaHC, France; Nadège Reverdy-Bruas, Denis Curtin, LGP2, France; Cecile Venet, Schneider, France

FR-A5.2A.4 09:00
Dual-port Stacked Annular Ring Microstrip Patch Antenna with Vertical Pins for Isolation Enhancement
Guangjun Wen, Youhan Xie, University of Electronic Science and Technology of China, China; Haobing Zhang, Southwest China Research Institute of Electronic Equipment, China; Wenxian Zheng, Shenzhen Intellifusion Technologies Co., China; Daniele Inserra, University of Electronic Science and Technology of China, China

FR-A5.2A.5 09:20
Circularly Polarized Proximity Feed Patch Antenna for FMCW Radar
Anindya Ghosh, Debashish Chakravarty, Indian Institute of Technology, Kharagpur, India

Break 09:40

FR-A5.2A.6 10:00
A Dual Band UWB antenna for WCE Systems
Arifin Farhadur, Pran Kanai Saha, Bangladesh University of Engineering and Technology, Bangladesh

FR-A5.2A.7 10:20
Single Antenna Changeover Switch for UHF RFID Communications and RF Energy Harvesting
Paul S. Taylor, Robert Hanne, John C. Batchelor, University of Kent, United Kingdom

FR-A5.2A.8 10:40
N-Way Spatial Power Combining in SIW for High Power Generation MMICs-Scalability Bounds
Artem Roev, Marianna Ivashina, Chalmers University of Technology, Sweden; Rob Maaskant, Marian Matters-Kammerer, Eindhoven University of Technology, Netherlands

FR-A5.2A.9 11:00
Evaluation of Electromagnetic Time Reversal Spatial Focusing (EMTR-SF)
Ahmed Abdelraheem, Dimitrios Panoulis, Purdue University, United States

FR-A5.2A.10 11:20
Wide-angle scanning conformal array antenna based on the QCTO
Wei Huang Fan, Juan Lei, National Key Laboratory of Antennas and Microwave Technology, China

Wireless Power Transfer
Session Co-Chairs: Boules A, Mouris, KTH Royal Institute of Technology; Constantinos Zakios, Florida International University

FR-A5.3A.1 08:00
Misalignment Resilient, Near Field Wireless Power Transfer (WPT) Antennas using Anchor Shape
Deff Vital, Shubhendu Bhardwaj, John L. Volakis, Florida International University, United States

FR-A5.3A.2 08:20
Simultaneous High Data Rate Communication and Highly Efficient Wireless Power Transfer Through a Coplanar Link
Mahmoud Sharafi, Constantinos L. Zakios, Stavros V. Georgakopoulos, Florida International University, United States

FR-A5.3A.3 08:40
Retro-directive Array Antenna With Parabolic Shape Structure for Short-range Microwave Power Transfer
Sol Kim, Jeong-Woo Kim, Jin-Woo Kim, Gho Kim, Jong-Won Yu, Korea Advanced Institute of Science and Technology (KAIST), Korea (South)

FR-A5.3A.4 09:00
Simultaneous Wireless Power & Data Transmission for Wearable Applications
Mahmoud Sharafi, Constantinos L. Zakios, Stavros V. Georgakopoulos, Florida International University, United States

FR-A5.3A.5 09:20
Design and Characterization of a Compact Rectenna for Structural Health Monitoring Applications
Alassane Sidibe, Alexandru Takacs, Abderrahim Okba, Hervé Aubert, LAAS-CNRS, Université de Toulouse, CNRS, INP, F-31400 Toulouse, France

Break 09:40

FR-A5.3A.6 10:00
A Dual-Polarized Multi-Antenna Structure for Simultaneous Transmission of Wireless Information and Power
Boules A. Mouris, KTH Royal Institute of Technology, Sweden; Christos I. Kolitsidas, Ericsson, Sweden; Ragnar Thobaben, KTH Royal Institute of Technology, Sweden

FR-A5.3A.7 10:20
Uniplanar Rectenna Designs Matched with either Active or Passive DC-to-DC Converter
Abdul Quddious, Photos Vryonides, Symeon Nikolaou, Frederick University, Cyprus; Marco A. Antoniades, University of Cyprus Nicosia, Cyprus

FR-A5.3A.8 10:40
A new Gradient Descent Positioning Method in Wireless Sensor Network Based on Received Signal Strength
Hussein Hijazi, Nahi Kandil, Nour Zahrou, Nadiir Hokem, Université du Québec en Abitibi-Témiscamingue (UQAT), Canada

FR-A5.3A.9 11:00
Design of a Compact High-Gain Slotted Trapezoidal Antenna at 2.45 GHz For Energy Harvesting
Mohamed Mansour, Haruichi Kanaya, Kyushu University, Japan
FR-A2.1A  Room 213/214

**Design of Metamaterials and Metasurfaces**

Session Co-Chairs: Do-Hoon Kwon, University of Massachusetts, Amherst; Sawyer D. Campbell, Pennsylvania State University

**FR-A2.1A.1**  08:00

A Two-Dimensional LC-Network Metamaterial on an Irregular Grid

Do-Hoon Kwon, University of Massachusetts Amherst, United States

**FR-A2.1A.2**  08:20

Multi-objective Optimization of Meta-atoms

Eric B. Whiting, Sawyer D. Campbell, Douglas H. Werner, Pingjuan L. Werner, Pennsylvania State University, United States

**FR-A2.1A.3**  08:40

Metasurface Design Using Electromagnetic Inversion

Trevor Brown, Chaitanya Narendran, University of Manitoba, Canada; Youssef Vahidzadeh, Christophe Caizar, Ecole Polytechnique de Montreal, Canada; Puyan Majdali, University of Manitoba, Canada

**FR-A2.1A.4**  09:00

Dual-Band Negative Permittivity Metamaterial using Crossed Loop Resonator

Soumen Pandit, Priyadip Ray, Akhilesh Mohan, Indian Institute of Technology, Kharagpur, India

**FR-A2.1A.5**  09:20

Metasurface Design for Cross-polarization Conversion and Absorption Applications

Afzal Ahmed, Fahad Ahmed, Farooq Ahmad Tahir, National University of Sciences and Technology (NUST), Pakistan

Break

**FR-A2.1A.6**  10:00

Broadband Linear to Circular Reflection Polarization Converter

Filippo Costi, Simone Genovesi, Agostino Monorchio, University of Pisa, Italy; Shangjun Zhang, Yichun Cui, Jiaqi Liu, Beijing Institute of Space Long March Vehicle, China

**FR-A2.1A.7**  10:20

Dielectric metasurface for wave focusing and vortex beam generation

Valery Odit, Irina Munina, Mikhail Odit, St. Petersburg Electrotechnical University LETI, Russia

**FR-A2.1A.8**  10:40

Design of Multilayered Meta-Lenses for Image Resolution Enhancement

Mark Ruiz, Mantrakan Wongkam, University of Texas Rio Grande Valley, United States

**FR-A2.1A.9**  11:00

A Metasurface with Controlled Angular Phase Dispersion for Continuous Illumination Angles

Ying Li, Jun Yang, Guangsheng Dong, Hefei University of Technology, China; Qi Zhu, University of Science and Technology of China, China

**FR-A2.1A.10**  11:20

Wideband Anisotropic Unit Cell Design for Perfect Cross-Polarization Conversion

Maurad Ibrahim, Prince Sultan University, Saudi Arabia; Abdellady Mahmoud, Benha University, Egypt; Amr Awamry, Benha University, Egypt; Zhi Hao Jiang, Wei Hong, Southeast University, China; Mustafa K. Tahan Al-Nuaimi, Shenzhen University, China

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FR-UA.1A  Room 203

**Antennas**

Session Co-Chairs: Steven Weiss, US Army Research Laboratory; Andrew Bogle, University of Dayton

**FR-UA.1A.1**  08:00

Design of a Wideband Circularly Polarized Patch Antenna for GNSS Applications

Farnaz Foroughian, University of Tennessee, United States; Aly E. Fathy, University of Tennessee at Knoxville, United States

**FR-UA.1A.2**  08:20

A Ground-based Ultra-wideband Ultra-high Frequency Mills Cross Array for Ice Sounding

Joshua Nun, Jie Yan, Siva Prasad Gogineni, Christopher D. Simpson, Charles O’Neill, University of Alabama, United States

**FR-UA.1A.3**  08:40

Development and Measurement of Conformal Antennas in the VHF/UHF Band

Steven Weiss, Army Research Laboratory, United States

**FR-UA.1A.4**  09:00

Miniaturized Circular Microstrip Patch Antennas with Conical Radiation Patterns

Sajin Naik, Maria Pou, University of Alabama in Huntsville, United States

**FR-UA.1A.5**  09:20

Coherently Driven Antennas

Aeksanct Krasnok, Andrea Alù, CUNY Advanced Science Research Center, United States

Break

**FR-UA.1A.6**  10:00

Design, Realization and Measurements of a Conical Metahorn with Symmetric Radiation pattern and Low Cross-Polarization

Valentina Sazio, Fondazione Link, Italy; Patrizio De Vita, Ingegneria dei Sistemi, Italy; Andrea Giacomini, Microwave Vision Italy SRL, Italy; Enrica Martini, University of Siena, Italy; Francesco Caminita, Wave Up Srl, Italy; Marco Faenzi, University of Siena, Italy; Marco Sabbadin, ESA-ESTEC, Netherlands; Giuseppe Vecchi, Politecnico di Torino, Italy; Stefano Maci, University of Siena, Italy

**FR-UA.1A.7**  10:20

Design, realization and experimental characterization of a 40dB gain metasurface antenna

Gabriele Minniti, Francesco Caminita, Wave Up Srl, Italy; Enrica Martini, University of Siena, Italy; Cristiano Della Giovampaola, Wave Up Srl, Italy; Marco Sabbadin, ESA-ESTEC, Netherlands; Fabrizio De Paolis, ESA-ECSAT, Netherlands; Stefano Maci, University of Siena, Italy

**FR-UA.1A.8**  10:40

A compact size and low profile rectangular slot monopole antenna for UWB body centric applications

Joshua Naik, James Isah Musa Danjuma, University of Bradford, United Kingdom; Mobayode O. Akinsolu, Waxham Glyndwr University, United Kingdom; Buhan Muhammad, Eya Eya, Raed Abd-Alhameed, James M. Nos, University of Bradford, United Kingdom; Bo Liu, Waxham Glyndwr University, United Kingdom

**FR-UA.1A.9**  11:00

Low profile dual-pol isoflux antenna based on artificial impedance surface

Francesca Caminita, Wave Up Srl, Italy; Rodolfo Ravenni, Paolo Campoana, Thales Alenia Space Italia, Italy; Gabriele Minniti, Wave Up Srl, Italy; Enrica Martini, University of Siena, Italy; Marco Sabbadin, ESA-ESTEC, Netherlands; Stefano Maci, University of Siena, Italy

**FR-UA.1A.10**  11:20

Design of Broadband Biconical Antenna with Improved Radiation Pattern over 3-40GHz

Srebnny Saily, Chosun University, Korea (South); Il-Yong Lee, Jong-Hyuk Lim, Jong-II Lee, Sung-Won Park, National Radio Research Agency, Korea (South); Soon-Soo Oh, Chosun University, Korea (South)
Cognitive Radio II
Session Chair: Chinmoy Soha, Indian Institute of Space Science and Technology
FR-A5.4A
Room 302

Friday, July 12
08:00 - 09:40

On-Chip Antennas
Session Chair: Jayanti Venkataraman, Rochester Institute of Technology
FR-A5.5A
Room 302

Friday, July 12
10:00 - 11:40

Chamber Technology for MIMO Antenna Measurements
Session Chair: Lars J. Foged, Microwave Vision Italy
FR-A5.6A
Room 303

Friday, July 12
08:00 - 09:40

Antennas for RFID applications
Session Chair: Francesca Vipiana, Politecnico di Torino
FR-A5.7A
Room 303

Friday, July 12
10:00 - 11:40
### Target Detection and Tracking
Session Co-Chairs: Edward Rothwell, Michigan State University; Amir Zaghloul, United States Army Research Laboratory

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<td>Mode Selection Effect in Dual-Circular Polarized OAM Transmission</td>
<td>Naoki Honma, Kazunari Yun, Hiro University, Japan</td>
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<td>FR-UC.1A.2</td>
<td>Crosstalk-Based Calibration for High Accuracy Ranging Using Software-Defined Radios</td>
<td>Anton Schlegel, Sarghaghghagh, Jeffrey Nanzer, Michigan State University, United States</td>
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<td>FR-UC.1A.3</td>
<td>Multiple Scattering Points Generator for Multi-Target</td>
<td>Hae-Chang Jeong, Gak-Gyu Choi, Dae Woong Woo, Jae Sik Kim, So-Su Kim, Agency for Defense Development, Korea (South)</td>
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<td>FR-UC.1A.4</td>
<td>SDR-Based Wireless Time Alignment for Coherent Distributed Beamforming</td>
<td>Pratik Chattrejje, Jeffrey Nanzer, Michigan State University, United States</td>
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<td>Radar Signal Synchronization by Multi-Layer Modularization Implementation of Phase Shifters in the Beamforming Network of Phased Array of Antennas</td>
<td>Chen-Yi Chang, Hsi-Tseng Chou, National Taiwan University, Taiwan</td>
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<td>FR-UC.1A.6</td>
<td>Implementing Spectrally-Sparse, Wideband Waveforms in Multi-Channel Software-Defined Radios for High-Accuracy Ranging</td>
<td>Anton Schlegel, Sean Ellison, Jeffrey Nanzer, Michigan State University, United States</td>
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<td>Norm Optimization using Machine Learning Approach for Autofocus in mmWave SAR Imaging</td>
<td>Jin-Woo Kim, Joong-Wook Kim, Sol Kim, Ghoo Kim, Jong-Won Yu, Korea Advanced Institute of Science and Technology (KAIST), Korea (South)</td>
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<td>Estimating the Depth of Buried Radioactive Sources using Ground Penetrating Radar and a Gamma Ray Detector</td>
<td>Ikachukwu Okaegbu, Michael Aspinall, Lancaster University, United Kingdom; Kelvin Gamage, University of Glasgow, United Kingdom</td>
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<td>FR-UC.1A.9</td>
<td>A Golay Complementary Coded Through-the-Wall Radar for Moving Target Indication</td>
<td>Kun Yan, Xin Liu, Shengbo Ye, Guangyou Fang, Chinese Academy of Sciences, China</td>
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### Computational Electromagnetics II
Session Co-Chairs: Branislav Notaros, Colorado State University; Ahmad Hoorfar, Villanova University

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<td>Numerical Analysis on Multipactor Effects in Coaxial Cables via Particle-in-Cell Algorithm</td>
<td>Dong-Keap Na, Indranil Nayak, Fernando Teixeira, Ohio State University, United States</td>
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<td>FR-AC.1A.2</td>
<td>Mimicking Antenna Near-Field Measurements using Full Wave Solvers For Error Characterization</td>
<td>Vignesh Manohar, Yahya Rahmat-Samii, University of California, Los Angeles, United States</td>
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<td>Automatic Generalized Quadrilateral Surface Meshing in Computational Electromagnetics by Discrete Surface Ricci Flow</td>
<td>Cam Key, Branislav Notaros, Colorado State University, United States</td>
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<td>Fast Method for First-Principles-Based Parasitic Extraction of Integrated Circuit Layout</td>
<td>Li Xue, Dan Jiao, Purdue University, United States</td>
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<td>Predicting MRI RF Exposure for Complex-shaped Medical Implants Using Artificial Neural Network</td>
<td>Qianlong Lan, Jianfeng Zheng, Ji Chen, University of Houston, United States</td>
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<td>Preliminary Study on Differences between Full- and Sub-Structure Characteristic Modes</td>
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<td>Reflection Behavior of Metasurface Using Full wave and Characteristic Mode Analyses</td>
<td>Mohammed Alhabib, Constantine Balanis, Craig Birtcher, Arizona State University, United States; Husein Shamsan, King Abdulaziz City for Science and Technology, Saudi Arabia</td>
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<td>FR-AC.1A.8</td>
<td>Surface Reconstruction of Large Reflector Antennas Based on a Hybrid of CMA-ES and HIO Algorithms</td>
<td>Yuehao Xu, Qian Ye, Shanghai Jiao Tong University, China; Ahmad Hoorfar, Villanova University, United States</td>
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Microstrip Antenna Arrays II
Session Co-Chairs: Gokhan Mumcu, University of South Florida; Enrique Gonzalez, University of South Florida

FR-A1.3A.1 08:00
Comparison of the Radiation Characteristics for Balanced- and Unbalanced-Feed Grid Array Antennas Composed of Rectangular Loop Cells
Taro Kawano, National Defense Academy, Japan; Hisamatsu Nakano, Hosei University, Japan

FR-A1.3A.2 08:20
Microfluidic Switches with Integrated Actuation for mm-Wave Beam-Steering Arrays
Enrique Gonzalez, Gokhan Mumcu, University of South Florida, United States

FR-A1.3A.3 08:40
Low-Cost Dual-Polarized 60 GHz Patch Antenna Array in PCB Process
Haiyang Xia, Jincan Hu, Lianming Li, Tao Zhang, Xidian University, China

FR-A1.3A.4 09:00
Simulation Design of Beam-scanning Self-phase-shift Dipole Array Based on Liquid-metal Materials
Xuefeng Zhang, Shu Lin, Zhiyuan Sun, Yang Li, Hongjun Zhang, Alexander Denisov, Harbin Institute of Technology, China

FR-A1.3A.5 09:20
Design of a Rotman lens antenna array for wide-scan and beam uniformity applications
Rui Wang, Feng Yang, Yang Yang, Yi Yan, University of Electronic Science and Technology of China (UESTC), China

Microstrip Antennas, Circuits and Design II
Session Chair: Mona Zaghloul, George Washington University

FR-A1.4A.1 10:00
Nonreciprocal Radiation Pattern Metasurface Transformer
Razvan Radanamin Bahnemiri, George Washington University, United States; Sajjad Taravati, University of Concordia, Canada; Shahrokh Ahmadi, Mona Zaghloul, George Washington University, United States

FR-A1.4A.2 10:20
On the Placement of Particle Containing Cylindrical Cavities in a Grounded Dielectric Substrate to Change the Impedance of a Printed Reactive Surface
Jenka Cleveland, Dipankar Mitra, Jacob Lewis, Benjamin D. Braaten, North Dakota State University, United States; Jefery Alls, Monica Allen, Air Force Research Laboratory, United States

FR-A1.4A.3 10:40
Electromagnetic Simulation of CMOS On-Chip Spiral Inductors in 5 GHz band
Takashi Hirata, Tokyo City University, Japan; Ning Li, Chuo University, Japan; Kenichi Okada, Tokyo Institute of Technology, Japan; Takeshi Imai, Masaharu Sogabe, SHI-ATEX Co., Ltd., Japan

FR-A1.4A.4 11:00
Dual-Polarized Filtering Antenna Using SRR Without Extra Circuit
Daotong Li, Chongqing University, China; Yaohui Zhang, Yonghong Zhang, Yong Fan, University of Electronic Science and Technology of China, China

FR-A1.4A.5 11:20
RCS Reduction of a Microstrip Antenna Using Cross Polarization Conversion Metasurface
Mustafa K. Taher Al-Huaimi, Yejun He, Shenzhen University, China

Imaging, Scattering and Remote Sensing
Session Co-Chairs: Vladimir Okhmatovski, University of Manitoba; Su Yan, Howard University

FR-UB.1A.1 08:00
On Elimination of Ill-posedness in the Inverse Problem via Separation of Partial Scattered Field Using New Antenna Array Concept
Md Jamil Feroj, Lotfollah Shafai, Vladimir Okhmatovski, University of Manitoba, Canada

FR-UB.1A.2 08:20
Deep Tissue Biomedical Imaging Using a Wearable Sensor
Md Asiful Islam, Bangladesh University of Engineering and Technology, Bangladesh; John L. Volakis, Florida International University, United States

FR-UB.1A.3 08:40
High-Resolution J-Band Radar with Continuous 360o Imaging Capability for Autonomous Vehicle Applications
Adib Nasrashidi, Abdulrahman Altaepe, University of Michigan, United States; Hussein Shanmugam, Abdulrahman Altaepe, University of Michigan, United States

FR-UB.1A.4 09:00
Optimizing for Spatial Frequency Coverage vs. Point-Spread Function Sidelobe Level in Active Incoherent Microwave Imaging Arrays
Sean Ellison, Stavros Vakalis, Jeffrey Narbee, Michigan State University, United States

FR-UB.1A.5 09:20
Drone-based RF Monitoring System for Agriculture Applications
Tsotne Kvelashvili, Ozlem Kilic, Catholic University of America, United States; Aly E. Fathy, University of Tennessee at Knoxville, United States

FR-UB.1A.6 10:00
A Resonant-Free Integral Formulation for EM Scattering from Electrically Large High-Q Cavities
Su Yan, Howard University, United States

FR-UB.1A.7 10:20
Data Averaging Enhancements of the Predictive Accuracy of Machine-Learning-Based Microwave Sensing for Estimating Cranberry Fruit Yields
Alex Haufler, John Booske, Susan Hagness, University of Wisconsin-Madison, United States

FR-UB.1A.8 10:40
Sparse-aperture qualitative inverse scattering using a multipole formulation
Matthew Burnside, Hatim Alqadah, Naval Research Laboratory, United States

FR-UB.1A.9 11:00
Angle Estimation Using an Active 38 GHz Interferometric Radar
Stavros Vakalis, Liang Gong, Eric Klinefelter, Jeffrey Narbee, Michigan State University, United States

FR-UB.1A.10 11:20
Analysis of Radar Cross Section of a FSS Radome Mounted on a Cylindrical PEC body
Hukeun Shin, Daeyeong Yoon, Yong Bae Park, Ajou University, Korea (South)
UWB Antenna Technologies for Radar
Session Co-Chairs: Fernando Rodriguez-Morales, University of Kansas; Jay McDaniel, University of Oklahoma

FR-SP.1P.1 13:20
Wideband 3D Printed Conformal Dielectric Antenna with End-fire Radiation
Jin Huang, Beijing Institute of Technology, China; Shengjian Chen, University of Adelaide, Australia; Zhenghui Xue, Beijing Institute of Technology, Australia; Withawat Withayachumnankul, Christophe Fumeaux, University of Adelaide, Australia

FR-SP.1P.2 13:40
A High Gain Broadband Quasi-Yagi Dielectric Lens Antenna for 5G and Millimeter Wave Applications
Essa Mujammami, Abdel Razik Sebak, Concordia University, Canada

FR-SP.1P.3 14:00
Performance of Multi-Arm Sinuous Antenna in Analog and Digital Angle of Arrival Estimation
Mohamed Elmansouri, Dejan Filipovic, University of Colorado at Boulder, United States; Paul Hoover, L-3 Communications, Randtron Antenna Systems, United States

FR-SP.1P.4 14:20
Signal to Noise Ratio Budget of a Pico-Seconds Pulsed Radar System for Stand-Off Imaging
Arturo Fiorellini Bernardis, Paulo Souza, Andrea Neto, Nuia Llombart, Delft University of Technology, Netherlands

FR-SP.1P.5 14:40
A circularly polarized printed monopole antenna for Radar application
Takafumi Fujimoto, Tomoyuki Ohara, Chai-Eu Guan, Nagasaki University, Japan

Break 15:00

FR-SP.1P.6 15:20
Sinuous Antenna Design for UWB Radar
Dylan Crocker, Sandia National Laboratories, United States; Waymond Scott, Georgia Institute of Technology, United States

FR-SP.1P.7 15:40
An Acorn-shaped Folded Bowtie Antenna for UWB Radar Application
Guangyao Yang, Shengbo Ye, Yicai Ji, Guangyou Fang, Key Laboratory of Electromagnetic Radiation and Sensing Technology, Chinese Academy of Sciences, Beijing 100190, China, China

FR-SP.1P.8 16:00
An Ultra-wideband (16-40 GHz) mmWave Antenna for Automotive Radar and 5G Applications
Muhammad Awais, Arslan Riaz, Wasif Tanveer Khan, Lahore University of Management Sciences, Pakistan

FR-SP.1P.9 16:20
Design of a High-Gain, Wideband, Circularly Polarized Slot Antenna
Zahid Iqbal, University of Alabama in Huntsville, United States; Songkyun Lim, Georgia Southern University, United States

Topological Electromagnetics
Session Co-Chairs: Francesco Monticone, Cornell University; Ali Hassani Gangaraj, Cornell University

FR-SP.2P.1 13:20
Topological electromagnetics in complex scenarios: Non-reciprocal, non-Hermitian, non-linear, and non-local material structures
S. Ali Hassani Gangaraj, Francesca Monticone, Cornell University, United States

FR-SP.2P.2 13:40
Topological Delay Lines
Mykhailo Tymchenko, University of Texas at Austin, United States; Sander Mann, Advanced Science Research Center, United States; Andrea Alù, CUNY Advanced Science Research Center, United States

FR-SP.2P.3 14:00
Circular-Polarization Biased Topological Insulators
Dimitrios Sounas, Wayne State University, United States

FR-SP.2P.4 14:20
Topological Metasurfaces for Robust One-dimensional Waves
D'Adalin Bisharat, Daniel Sievenpiper, University of California, San Diego, United States

FR-SP.2P.5 14:40
Manipulating surface waves and nanoscale torques with nonreciprocal platforms
S. Ali Hassani Gangaraj, Francesca Monticone, Cornell University, United States

Break 15:00

FR-SP.2P.6 15:20
A New Design Tool for Shaping the Radiation Pattern of Patch Antennas
Mirza Sabutko, Niccolò Cusano University, Italy; Mohammad Ali Miri, City University of New York, United States; Andrea Alù, CUNY Advanced Science Research Center, United States; Filiberto Bilotti, Alessandro Tascaro, Roma Tre University, Italy

FR-SP.2P.7 15:40
Rigorous analysis of a reciprocal PTD-symmetric structure supporting a back-scattering protected edge mode
Enrica Martini, University of Siena, Italy; Mario G. Silveirinha, University of Lisbon, Portugal; Stefano Masi, University of Siena, Italy

FR-SP.2P.8 16:00
Non-Hermitian Doping of Epsilon-Near-Zero Media
Marino Coppolaro, Massimo Moccia, Giuseppe Castaldi, University of Sannio, Italy; Nader Engheta, University of Pennsylvania, United States; Vincenzo Galdi, University of Sannio, Italy

FR-SP.2P.9 16:20
Band Structures and Modal Fields in Topological Acoustics: An Integral Equation Formulation
Shurun Tan, Zhejiang University, China; Leung Tsang, University of Michigan, United States
## Microstrip Antenna Analysis and Design

Session Co-Chairs: Nathan Jeong, University of Alabama; Sangkil Kim, Pusan National University

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<td>Mechanical Tension Effects on Cylindrical Truncated-Corner Microstrip Antennas</td>
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<td>FR-A1.1P.2</td>
<td>Augmenting a Patch Antenna with a Hybrid Particle Swarm Optimization Algorithm</td>
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<td>General Design Equations For 3-Way Unequal-Split Bagley Power Dividers</td>
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<td>FR-A1.1P.4</td>
<td>Effect of curved ground plane on electrical performance of microstrip antenna</td>
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<td>End-Fire CP Millimeter-Wave Antenna Loaded with Perforated Dielectric Slab</td>
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<td>Half Ellipse Magnetic Dipole Antenna for Wide Beam-Width and Low Cross-Polarization</td>
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<td>FR-A1.1P.8</td>
<td>Negative Group Delay Folded Circuit with Distributed Broadside Parallel Line</td>
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<td>FR-A1.1P.9</td>
<td>Folded 1-bit Transmitarray with Reduced Height</td>
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## Reconfigurable Reflectarrays

Session Co-Chairs: Ahmed A. Kishk, Concordia University; Xun Gong, University Of Central Florida

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<td>A tunable ferroelectric unit cell for wideband beam-steering reflectarray antennas</td>
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<td>FR-A1.2P.2</td>
<td>Steerable Spiral Slot Reflectarray at 66 GHz Using Micromachined Movable Silicon Slab</td>
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<td>Ultra-Low-Loss, Binary-State Elements for a Mechanically Actuated Reconfigurable Reflectarray</td>
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<td>Near Field Focusing using a Circularly Polarized Reconfigurable Reflectarray</td>
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<td>FR-A1.2P.5</td>
<td>EBG Antenna for Automotive Applications</td>
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<td>Low-Profile Electronically Tunable Low-Loss Single Layer Reflectarray Element</td>
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<td>FR-A1.2P.8</td>
<td>X-Band Reconfigurable Reflectarray Element using Frequency Selective Surface</td>
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<tr>
<td>FR-A1.2P.9</td>
<td>Design of A Beam Scanning Reconfigurable Reflectarray at Ku-Band</td>
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Novel Metasurfaces and Applications
Session Co-Chairs: Yang Hao, Queen Mary University of London; Alexander Yakovlev, University of Mississippi

FR-A2.1P 13:20
Metamaterial Application in a Circular Microstrip Antenna Developed for the Detection of Partial Discharges
George Victor Rocha Xavier, Edson Guedes da Costa, Alexandre Jean René Serres, Camila Caroline Rodrigues de Albuquerque, Federal University of Campina Grande, Brazil

FR-A2.1P 13:40
Rotational Doppler Effect of Spinning Metasurface in Radar System
Baiyang Liu, Hongchu Chu, Henry Giddens, Yang Hao, Queen Mary University of London, United Kingdom; Ronglin Li, South China University of Technology, China

FR-A2.1P 14:00
Parallel-Plate Waveguides Formed by Arbitrary Impedance Sheets
X. Ma, Northwestern Polytechnical University, China; Mohammad Mirmoosa, S.A. Tretyakov, Aalto University, Finland

FR-A2.1P 14:20
Metagrating-Inspired Approach for Suppressing Reflections in H-Plane Waveguide Bends
Liran Biniashvili, Ariel Epstein, Technion - Israel Institute of Technology, Israel

FR-A2.1P 14:40
Augmented Unit Cells for Realizing TM-Polarized Huygens’ Metasurfaces
Gangyu Xu, Sean Hun, George V. Eleftheriades, University of Toronto, Canada

FR-A2.1P 15:00
A Metasurface Inspired Approach for Reconfigurable Reflectors
Rui Wang, Feng Yang, Peng Yang, Xiao Ma, University of Electronic Science and Technology of China (UESTC), China

FR-A5.1P 13:20
3D Printed Antennas and Structures
Session Co-Chairs: Premjeet Chahal, Michigan State University; Kevin Cook, Georgia Tech Research Institute

FR-A5.1P 13:40
Study of 3D printed HoneyComb Microwave Absorbers
Vincent Lavo, Azar Maalouf, Alexis Chevalier, Lab-STICC / UBO, France; Fabrice Comblet, Lab-STICC / ENSTA Bretagne, France

FR-A5.1P 14:00
3D Printed 2.45 GHz Yagi-Uda Loop Antenna Utilizing Microfluidic Channels and Liquid Metal
Aji Bayo Adeyeye, Ryan Bahr, Manos Tentzeris, Georgia Institute of Technology, United States

FR-A5.1P 14:20
An Offset-Fed Wideband 3D Printed Aperture Coupled Trapezoidal Dielectric Resonator Antenna
Ami Desai, Peyam Noyei, Colorado School of Mines, United States

FR-A5.1P 14:40
3D Printed Inhomogeneous Microwave Lense of an Arbitrary Shape
Amir Sanfor, Corey Webster, Forecast3D Inc, United States

FR-A5.1P 15:00
A 3D Printed Fragmented Aperture Antenna
Kevin Cook, David Richardson, Justin Hray, James Dee, Christopher Howard, Georgia Tech Research Institute, United States

FR-A5.1P 15:20
A 3D Printed Compact PIFA for 5G Applications
Mohd Ifwat Mohd Ghazali, Saranraj Karuppuswami, Saikat Mondal, Premjeet Chahal, Michigan State University, United States

FR-A5.1P 15:40
Design and Test of 3-D Printed Spherical Ground Planes for Monopole Antennae
Eli Mehmet, Reena Dahle, State University of New York (SUNY) at New Paltz, United States

FR-A5.1P 16:00
A 3-D Printed Circularly Polarized Filtering Antenna
Yi Zhang, Jun Xu, Xi He, Fan Zhang, Ying Sun, Xiaoyan Li, Bo Liu, University of Electronic Science and Technology of China, China
Radiators and their Array Integration
Session Co-Chairs: Jeffrey Connor, Georgia Tech Research Institute; James Skala, Georgia Tech Research Institute
FR-A1.3P 13:20
A Wide Coverage S-Band Array with Dual Polarized Connected Bowtie Antenna Elements
Prabhat Khanal, Jian Yang, Marianna Ivashina, Chalmers University of Technology, Sweden; Anders Håk, Ruihan Luo, SAAB AB, Sweden
FR-A1.3P.2 13:40
Potentialities of Reduced Beamforming Antennas using Magneto-Electric Dipoles
Abdul-Sattar Kaddour, Jonick Mielbrandt, Hala Azeine, Cyrille Menodier, Marc Thevenot, Univ. Limoges, CNRS, XLim, France; Philippe Pouliquen, Patrick Peter, Direction Générale de l’Armement (DGA), France; Maxime Ramier, Centre national d’études spatiales, France
FR-A1.3P.3 14:00
Dual-Polarized Planar Phased Array Antenna With Semi-Open Cavity Structures
Peng Zhang, Shi-Wei Qu, University of Electronic Science and Technology of China, China
FR-A1.3P.4 14:20
A 60 GHz LTCC Magneto-Electric Dipole Phased Array with Symmetric Hybrid Feeding Network
Tao Zhang, Zhangming Zhu, Xihuan University, China; Lianming Li, Haiyang Xiao, Tie Jun Cui, Southeast University, China
FR-A1.3P.5 14:40
Broad Band and Wide Scan SIW Cavity-backed Phased Arrays for 5G Applications
Hao Liu, University of Electronic Science and Technology of China, China; Anyong Qing, Southwest Jiaotong University, China; Zhengdong Yu, Shengzhang Zhang, RDW Technology Co., Ltd, Chengdu, China
Break 15:00
FR-A1.3P.6 15:20
A Planar Ultrawideband Wide-angle Scanning Tightly Coupled Array Loaded With Metal Strips
Zhiguo Jiang, Shaoqiu Xiao, Zhixin Yao, University of Electronic Science and Technology of China, China
FR-A1.3P.7 15:40
A Low-Profile Wideband Connected Slot Array for Wide-Angle Scanning
Yan Li, Shaoqiu Xiao, Bing-Zhong Wang, University of Electronic Science and Technology of China, China
FR-A1.3P.8 16:00
SIW-Backed Array with Compensated Mutual Coupling for Wide-Angle Scanning
Fei-Lang Jin, Xiao Ding, Zhipeng Wang, Wei Shao, University of Electronic Science and Technology of China, China
FR-A1.3P.9 16:20
A Deployable Metamaterial Reflectarray Antenna for Microsatellite Application
Amit Kumar Singh, Seong-Ok Park, Korea Advanced Institute of Science and Technology (KAIST), Korea (South)

Tunable and Reconfigurable Frequency Selective Surfaces
Session Co-Chairs: Ladislau Matekovits, Politecnico di Torino; Constantinos Zekios, Florida International University
FR-A2.2P 13:20
Fully Inkjet-printed Tunable Hybrid n-Ripple Miura (n-RiM) Frequency Selective Surfaces
Syed Abdullah Nauroze, Manos Tentzeris, Georgia Institute of Technology, United States
FR-A2.2P.2 13:40
An Independently Tunable Uniplanar Dual Band Band-Stop Frequency Selective Surface
Nilan Jawod, Loïc Markley, University of British Columbia, Canada
FR-A2.2P.3 14:00
A Dual-Band Origami FSS
Akash Biswas, Constantinos L. Zekios, Stavros V. Georgakopoulos, Florida International University, United States
FR-A2.2P.4 14:20
Dual beam end-fire antenna using cantilever-enabled Frequency Selective Surfaces
Kamlan Payne, Jay K. Lee, Syracuse University, United States; Kevin Xu, Jun H. Choi, University at Buffalo, The State University of New York, United States
Break 15:00
FR-A2.2P.5 15:20
Beam Steering Using Active Superstrate Antenna for WLAN Applications
Nasheenwa Shaab, Sana Ilyas, Aimen Raza, Tayyab Hassan, National University of Sciences and Technology (NUST), Pakistan
FR-A2.2P.6 15:40
Higher Order Plasma-Based Tunable Absorber Using Magneto-Dielectric Substrates
Yuting Zhao, Yingsong Li, Harbin Engineering University, China; Xiaoguang Liu, University of California, Davis, United States
FR-A2.2P.7 16:00
A Novel Dual Polarized Tunable Frequency Selective Surface With Varactors
Yuting Zhao, Yinggang Li, Harbin Engineering University, China; Xiaoguang Liu, University of California, Davis, United States
FR-A2.2P.8 16:20
Blind Analysis of Switchable Frequency Selective Surface Based on Flexible Composite Substrate
Mohamed Elhendi, Syed Muzahir Abbas, Raheel Hashmi, Macquarie University, Australia; Ladislau Matekovits, Politecnico di Torino, Italy; Karu Esselle, Macquarie University, Australia
FR-A2.2P.9 16:40
Thick Frequency Selective Surfaces for High Power Microwave Applications
Xi-Wen Xiao, Chien-Hao Liu, National Taiwan University, Taiwan
FR-A2.2P.10 17:00
Preliminary Study of a Cylindrical Microstrip Metasurface Using the State Space Method
Barbara Cappello, Ladislau Matekovits, Politecnico di Torino, Italy; Krishna Naishadham, Georgia Institute of Technology, United States
Sub-6 GHz MIMO Antenna Design
Session Chair: Hao Xin, University of Arizona

FR-A5.2P.1 13:20
Origami Multimode Ring Antenna Based on Characteristic Mode Analysis
Nicholas Russo, Constantinas L. Zakos, Stavros V. Georgakopoulos, Florida International University, United States

FR-A5.2P.2 13:40
A Reconfigurable UWB MIMO Antenna for Indoor and Outdoor Communication Applications
Narayan Agnihotri, Adnan Kantemur, Jinpil Tak, Hao Xin, University of Arizona, United States

FR-A5.2P.3 14:00
Dual-band Printed Monopole Antenna for Indoor MIMO Applications
Mohamed Morsy, Texas A&M University-Texarkana, United States

Friday, July 12 15:20 - 17:00
Room 203

Polarization Reconfigurable Antennas
Session Chair: Andrew Bogle, University of Dayton

FR-A1.4P.1 15:20
Polarization and Bandwidth Reconfigurable Rectangular Dielectric Resonator Antenna
Beijia Liu, Changhui Wang, Jinghui Qiu, Nannan Wang, Shengchang Lan, Huo Zang, Harbin Institute of Technology, China

FR-A1.4P.2 15:40
Research on Polarization-Reconfigurable Holographic Metasurface
Mai Li, Ming-Chun Tang, Chaoming University, China; Yaqiu Zhang, University of Electronic Science and Technology of China, China

FR-A1.4P.3 16:00
Polarization Reconfigurable Patch Antenna With a Continuously Rotatable Polarization Plane
Makoto Sano, Makoto Higaki, Toshiba Corporation, Japan

FR-A1.4P.4 16:20
A High-Gain Quad-Polarization Reconfigurable Antenna
Guoying Lin, Yuehui Cui, RongLin Li, South China University of Technology, China

FR-A1.4P.5 16:40
Dual-Band and Dual-Polarized Reconfigurable Beam-Steering Array for WLAN Applications
YuYi Gan, Peng Yang, Feng Yang, University of Electronic Science and Technology of China, China

Friday, July 12 15:20 - 16:40
Room 211

Array Hardware Systems
Session Co-Chairs: Christopher Edmonds, Georgia Tech Research Institute; Glenn Hopkins, Georgia Tech Research Institute

FR-A1.6P.1 15:20
Balanced-Diplexer Frequency Division Duplex Subarray for X-band Phased Array
Elie Tianang, Mohamed Elmansour, Ljubodrag Boskovic, Dejan Filipovic, University of Colorado at Boulder, United States

FR-A1.6P.2 15:40
1D Array Antennas In Tandem for a Large Gain and Moving the Direction of the End-Fire Beam
Changhyeong Lee, Heejun Park, Gwangyun Namgung, Sungak Kang, Incheon National University, Korea (South); Yong-Seok Lim, Korea Electronics Technology Institute, Korea (South)

FR-A1.6P.3 16:00
Wide-Angle Scanning Phased Array Antenna
Bowen Ji, Gu Yang, Company of Brave Sky Technology, China

FR-A1.6P.4 16:20
A SIW Leaky-Wave Beam Scanning Array
Xiao Ding, Yu-Ming Wu, Fu-long Jin, Zhi-Peng Wang, Bing-Zhong Wang, University of Electronic Science and Technology of China, China
Millimeter-wave Propagation
Session Co-Chairs: Alenka Zajić, Georgia Institute of Technology; Dmitry Chizhik, Nokia Bell Labs
TUP-A4.1P.1 Path Loss and Directional Gain Measurements at 28 GHz for Factory Automation
Dmitry Chizhik, Jinfeng Du, Reinaldo Valenzuela, Juergen Otterbach, Rolf Fuchs, Johannes Kappenborg, Nokia Bell Labs, United States
TUP-A4.1P.2 Tilt MIMO Channel Characterization for Wireless Data Center-Like Environment
Chia-Lin Cheng, Seun Sangodoyin, Alenka Zajić, Georgia Institute of Technology, United States
TUP-A4.1P.3 Implementation and Evaluation of Uniform Grid Space Partition for Ray Tracing in Communication
Hang Mi, Bo Ai, Ke Guan, State Key Laboratory of Rail Traffic Control and Safety, Beijing Jiaotong University, China; Lijun Zhu, Tianyun Shui, Hui Mei, Chenji Liu, Jiangxi Mobile Communication Company Limited, China
TUP-A4.1P.4 A High-Performance Computing Cloud-Based Ray-Tracing Platform – CloudRT
Wei Liu, China Mobile Group Design Institute Co., Ltd., China; Ke Guan, Danping He, Beijing Jiaotong University, China; Yehing Ren, China Mobile Group Design Institute Co., Ltd., China; Wencui Shen, Liang Zhou, Jiangxi Mobile Communication Company Limited, China
TUP-A4.1P.5 The Influence of Satellite Links over 5G mmWave Terrestrial Channel in Typical Urban Scenario
Lei Ma, Ke Guan, Beijing Jiaotong University, China; Wulong Li, Jiangxi Mobile Communication Company Limited, China; Dong Yan, Beijing Jiaotong University, China; Wei Sun, Hang Qi, China Mobile Group Design Institute Co., Ltd., China

Propagation and Scattering in Complex and Random Media
Session Co-Chairs: Vikass Moneburrun, Centrale Supelec; David Geroski, University of Michigan
TUP-A4.2P.1 A Modified Beckmann-Kirchhoff Scattering Model for Slightly Rough Surfaces at Terahertz Frequencies
Fawad Sheikh, Thomas Kaiser, University of Duisburg-Essen, Germany
TUP-A4.2P.2 Modeling of Power Delay Profile in the Desktop Size Metal Cavity at 300 GHz
Jinbang Fu, Prateek Juyal, Alenka Zajić, Georgia Institute of Technology, United States
TUP-A4.2P.3 Full Wave Analysis for Estimating Wave Attenuation In a Random Volume of Metallic Wires Using Monte Carlo Simulation
David Geroski, Kamal Sarabandi, University of Michigan, United States
TUP-A4.2P.4 Fully-Coherent Electromagnetic Scattering Model for 3D Dense Random Volumes
Mostafa Zaky, Kamal Sarabandi, University of Michigan, United States
TUP-A4.2P.5 Applicability of SSTDR Analysis of Complex Loads
Evan Benoit, Naveen Kumar Tumkur Jayakumar, Samuel Kingston, Mashrad Uddin Saleh, Michael Scarrella, University of Utah, United States; Joel Harley, University of Florida, United States; Cynthia Furse, University of Utah, United States
TUP-A4.2P.6 Accuracy of the approximation of Dyadic Green’s Function for Multilayered Uniaxial Anisotropic Medium
Hui-Ling Hu, Ping-Ping Ding, Fudan University, China
TUP-A4.2P.7 Finite Element Domain Decomposition Method for Rough Sea Surface Scattering
Ozlem Ozgun, Hacettepe University, Turkey; Mustafa Kazuoglu, Middle East Technical University, Turkey
TUP-A4.2P.8 A Target Recognition-Based NLOS Identification Algorithm
Weikun Lyu, Yanjiang Li, Zhe Lin, Chen Huang, Ruisi He, Beijing Jiaotong University, China
TUP-A4.2P.9 Quantitative Evaluation on Memory Characteristics of High-Speed Railway Fading Channel
Huimin Zhang, Siyu Lin, Jianwen Ding, Beijing Jiaotong University, China
TUP-A4.2P.10 Millimeter-Wave Channel Measurement Based Ray-Tracing Calibration and Analysis in Metro
Chunfu Zheng, Zibang Xu, Danping He, Ke Guan, Bo Ai, Beijing Jiaotong University, China; Juan Moreno Garc’a Loayza, Universidad Politécnica de Madrid, Spain
**Propagation in Tunnel-like Environments**

Session Chair: Nadir Hakem, Université du Québec en Abitibi-Témiscamingue

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