

# IEEE International Symposium on Antennas & Propagation & USNC-URSI Radio Science Meeting

## JULY 10-15, 2022 • DENVER



You are cordially invited to the 2022 IEEE International Symposium on Antennas and Propagation and USNC-URSI Radio Science Meeting – AP-S/URSI 2022, from July 10–15, 2022, at the Hyatt Regency and Grand Hyatt, in Denver, Colorado, USA, the Mile High City. The conference is cosponsored by the IEEE Antennas and Propagation Society (AP-S) and the US National Committee (USNC) for the International Union of Radio Science (URSI). It is intended to provide an international forum for the exchange of information on state-of-the-art research in antennas, propagation, electromagnetic engineering, and radio science. It is exciting to have our conference in Denver, for the first time ever, and back in Colorado after 50 years.

Along with a highly illuminating and relevant technical program, you will experience outstanding conference amenities and hotels, as well as an exceptional social program, for a truly memorable joint AP-S/URSI Conference in July 2022 in Denver. We are preparing a comprehensive range of technical sessions, keynotes, invited talks, special sessions, student paper and design competitions, short courses, tutorials, exhibits, demonstrations, professional meetings, open forum discussions, and networking events. With its central location within the US, an extremely well-connected airport, and organized tours and activities within the city and its spectacular surroundings, our 2022 edition in Denver promises to be a great success.

The paper submission deadline is February 11, 2022. Conference website: [www.2022apsursi.org](http://www.2022apsursi.org)

### Steering and Organizing Committee

#### General Chair

Branislav Notaros  
[notaros@colostate.edu](mailto:notaros@colostate.edu)

#### Vice-General Chair

Dejan Filipovic  
[dejan.filipovic@colorado.edu](mailto:dejan.filipovic@colorado.edu)

#### Technical Program Chair

Andrew Peterson  
[afpeterson@gatech.edu](mailto:afpeterson@gatech.edu)

#### TPC Co-Chairs

Stephen Gedney  
[stephen.gedney@ucdenver.edu](mailto:stephen.gedney@ucdenver.edu)  
David Jackson  
[djackson@uh.edu](mailto:djackson@uh.edu)  
Karl Warnick  
[warnick@ee.byu.edu](mailto:warnick@ee.byu.edu)

#### Special Sessions Chairs

Randy Haupt  
[rhaupt@mines.edu](mailto:rhaupt@mines.edu)  
Reyhan Baktur  
[reyhan.baktur@usu.edu](mailto:reyhan.baktur@usu.edu)

#### Short Courses and Workshops Chairs

Zhen Peng  
[zvpeng@illinois.edu](mailto:zvpeng@illinois.edu)  
Pai-Yen Chen  
[pychen@uic.edu](mailto:pychen@uic.edu)

#### Student Paper Competition Chairs

Asimina Kiourti  
[kiourti.1@osu.edu](mailto:kiourti.1@osu.edu)  
John Young  
[john.c.young@uky.edu](mailto:john.c.young@uky.edu)  
Amanda Malone  
[amanda.malone@ieee.org](mailto:amanda.malone@ieee.org)

#### Student Design Contest Chairs

Mohamed Elmansouri  
[mohamed.elmansouri@colorado.edu](mailto:mohamed.elmansouri@colorado.edu)  
Glauco Fontgalland  
[fontgalland@dee.ufcg.edu.br](mailto:fontgalland@dee.ufcg.edu.br)

#### Young Professionals Chair

Jeanne Quimby  
[jeanne.quimby@nist.gov](mailto:jeanne.quimby@nist.gov)

#### Local Arrangements Chair

Olivera Notaros  
[olivera@colostate.edu](mailto:olivera@colostate.edu)

#### Publicity Chairs

Su Yan  
[su.yan@howard.edu](mailto:su.yan@howard.edu)  
Vladimir Okhmatovski  
[Vladimir.Okhmatovski@umanitoba.ca](mailto:Vladimir.Okhmatovski@umanitoba.ca)

#### Finance Chair

Dejan Filipovic  
[dejan.filipovic@colorado.edu](mailto:dejan.filipovic@colorado.edu)

#### Sponsors Chairs

Albin Gasiewski  
[al.gasiewski@colorado.edu](mailto:al.gasiewski@colorado.edu)  
Neill Kefauver  
[w.neill.kefauver@lmco.com](mailto:w.neill.kefauver@lmco.com)

#### Exhibits Chairs

Payam Nayeri  
[pnayeri@mines.edu](mailto:pnayeri@mines.edu)  
Gregor Lasser  
[gregor.lasser@colorado.edu](mailto:gregor.lasser@colorado.edu)

#### URSI/AP-S Liaison

Steven Reising  
[steven.reising@colostate.edu](mailto:steven.reising@colostate.edu)

#### International Liaison

Ross Stone  
[r.stone@ieee.org](mailto:r.stone@ieee.org)

#### Women in Engineering and Radio Science

Cynthia Furse  
[cfurse@ece.utah.edu](mailto:cfurse@ece.utah.edu)  
Francesca Vipiana  
[francesca.vipiana@polito.it](mailto:francesca.vipiana@polito.it)  
Reyhan Baktur  
[reyhan.baktur@usu.edu](mailto:reyhan.baktur@usu.edu)

#### Regions 8–10 Outreach Coordinators

Albert Lysko  
[alysko@csir.co.za](mailto:alysko@csir.co.za)  
Felix Vega  
[jfvegas@unal.edu.co](mailto:jfvegas@unal.edu.co)  
Meisong Tong  
[mstong@tongji.edu.cn](mailto:mstong@tongji.edu.cn)

#### Social Programs and Hospitality

Olivera Notaros; Joanne Wilton;  
Susan Stone; Judy Long

[www.2022apsursi.org](http://www.2022apsursi.org)

---

## Paper Submission

Authors are invited to submit contributions for review and possible presentation at the symposium or meeting (the “conference”) on topics of interest to AP-S and USNC-URSI. Suggested topics and general information are listed on the conference website.

- AP-S submissions must be in standard IEEE two-column format and must be two pages in length.
- USNC-URSI submissions may be in either a one-page, one-column format with a minimum length of 250 words, or in the IEEE two-page, two-column format with a length of two pages.
- In all cases, only accepted and presented submissions that are in the IEEE two-page two-column format and substantially fill the two pages will be submitted for possible inclusion in IEEE Xplore if the author chooses submission to Xplore.
- All accepted and presented submissions will appear in the proceedings distributed at the conference.
- The presenting author will be required to register for the conference by the due date (to be announced) in order for their paper to be included in the conference.
- Detailed instructions, including formats and templates, are available on the conference website.
- Every effort will be made to complete the review process by March 15, so attendees have enough time for visas if needed.

---

## AP-S Student Paper Competition

Eligible entries in the Student Paper Competition must have only one student author, and that student must be the first author. Each additional coauthor must submit a signed letter indicating that his/her contribution is primarily advisory, to be uploaded at the time of paper submission. All Student Paper Competition entries will be evaluated using a double-blind review process, in addition to the normal review process used for all submissions to the conference. Detailed instructions are available on the conference website. For additional information, contact Asimina Kiourti ([kiourti.1@osu.edu](mailto:kiourti.1@osu.edu)) and John Young ([john.c.young@uky.edu](mailto:john.c.young@uky.edu)).

---

## AP-S Student Design Contest

All students are encouraged to form teams and participate in Student Design Contest. Each team should consist of 2 to 5 students, with at least 50% being undergraduate students. Detailed instructions can be found on the conference website. For additional information, email Mohamed Elmansouri ([mohamed.elmansouri@colorado.edu](mailto:mohamed.elmansouri@colorado.edu)) and Glauco Fontgalland ([fontgalland@dee.ufcg.edu.br](mailto:fontgalland@dee.ufcg.edu.br)).

---

## Short Courses/Workshops/Tutorials

Several short courses, workshops, and tutorials on topics of special and current interest will be solicited by the technical program committee and organized for the conference. In addition, colleagues who wish to organize a short course, workshop or tutorial should contact Zhen Peng ([zvpeng@illinois.edu](mailto:zvpeng@illinois.edu)) and Pai-Yen Chen ([pychen@uic.edu](mailto:pychen@uic.edu)) by December 10, 2021.

---

## Sponsorships

We have many outstanding opportunities for sponsorships of the conference and its various aspects. Interested parties should contact Albin Gasiewski ([al.gasiewski@colorado.edu](mailto:al.gasiewski@colorado.edu)) and Neill Kefauver ([w.neill.kefauver@lmco.com](mailto:w.neill.kefauver@lmco.com)).

---

## Exhibits

Industrial, academic, government, software, and book exhibits will be open during most of conference days. Exhibitor registration and additional information can be found on the conference website. Interested parties may contact Payam Nayeri ([pnayeri@mines.edu](mailto:pnayeri@mines.edu)) and Gregor Lasser ([gregor.lasser@colorado.edu](mailto:gregor.lasser@colorado.edu)).

---

## Special Sessions

Requests to organize special sessions for the conference should be submitted to Randy Haupt ([rhaupt@mines.edu](mailto:rhaupt@mines.edu)) and Reyhan Baktur ([reyhan.baktur@usu.edu](mailto:reyhan.baktur@usu.edu)) no later than November 30, 2021. Each proposal should include the title of the special session, a brief description of the topic, an indication of whether the proposed session is for AP-S, USNC-URSI, or is joint, and justification for its designation as a special session. Details and the template for the submission are posted on the conference website. Special sessions will be selected and finalized by December 15, 2021. At that time, additional instructions will be provided to the organizers of the special sessions chosen for inclusion in the conference. The associated papers or abstracts will be due February 11, 2022.

---

## Social Program

The social program for the AP-S/URSI 2022 Denver Conference includes a Welcome Reception, Students’ and Young Professionals’ Reception, Awards Celebratory Dinner, and Closing Reception, all with live entertainment and fun activities, as well as Women in Engineering Events and a rich Accompanying Persons/Families Program. We are working on organizing Childcare Services for our attendees and the following AP-S/URSI 2022 private tours: Tour of Spectacular Rocky Mountain National Park and Beautiful Resort Town of Estes Park; Tour of Breckenridge and Ultimate Mountain Trip; Tour of Royal Gorge Bridge and the Garden of the Gods; and Downtown Denver Capitol Hill History & Ghosts Tour. Welcome to sunny Colorado, with 300 days of sunshine a year!

# Conference Venue

Our conference venue consists of two outstanding nearby hotels in historic LoDo (Lower Downtown) Denver, the Hyatt Regency and Grand Hyatt, with spectacular conference spaces, ballrooms, meeting rooms, and excellent guestrooms at great conference rates. Our venue is at 5280 feet or 1609 meters (a mile) above sea level. Conference attendees will also enjoy unforgettable views of nearby mountain peaks, some reaching "14k" (fourteen thousand feet). Denver is a technological and touristic hub of the American West, an American metropolis dating to the Old West era. Many saloons once thrived in the "Mile High City," and LoDo is Denver's oldest neighborhood, home to some of the city's best-known restaurants, microbreweries, galleries, museums, shops, and entertainment venues. Denver is also a gateway for world-famous winter and summer resorts, hiking and walking trails, glacier lakes, and other natural wonders in the nearby Rocky Mountains. Conference participants should consider bringing their family and friends for a great combination of work and play. Along with many other opportunities nearby, we will organize a visit to the unique mountain town of Estes Park (7500 ft; 2286 m), the famed haunted Stanley Hotel, and the spectacular Rocky Mountain National Park, featuring Longs Peak, the 14,259-foot (4346 m) "fourteener," all top destinations when in Colorado!



## AP-S Topics

### Antennas

1. Antenna theory
2. Antenna feeds and matching circuits
3. Mutual coupling in antenna arrays
4. Dielectric resonator antennas
5. Microstrip antennas, arrays, and circuits
6. Slotted and guided wave antennas
7. Phased-array antennas
8. Reflector and reflectarray antennas
9. Electrically small antennas
10. Broadband/ultra-wideband antennas
11. Multi-band antennas
12. Adaptive, active, and smart antennas
13. Reconfigurable antennas and arrays
14. Antenna measurements

### Electromagnetics & Materials

15. Electromagnetic theory
16. Electromagnetic material properties and measurements
17. Frequency-selective surfaces

18. Electromagnetic bandgap materials
19. Metamaterials and metasurfaces
20. Nano-electromagnetics
21. Electromagnetic education

### Computational & Numerical Techniques

22. Computational electromagnetics
23. High-frequency and asymptotic methods
24. Integral-equation methods
25. FDTD methods
26. FEM methods
27. Hybrid methods
28. Techniques for transient simulations
29. Optimization methods in EM designs
30. Parallel and special-processor-based numerical methods

### Propagation & Scattering

31. Indoor, urban, terrestrial, and ionospheric propagation

32. Propagation and scattering in random or complex media
33. Scattering, diffraction, and RCS
34. Inverse scattering and imaging
35. Remote sensing

### Antenna Applications & Emerging Technologies

36. Biomedical applications
37. MIMO implementations and applications
38. Mobile and PCS antennas
39. RFID antennas and systems
40. Ultra-wideband systems
41. Vehicular antennas and electromagnetics
42. Software-defined/cognitive radio
43. On-chip antennas
44. Wireless power transmission and harvesting
45. 3D printed antennas and structures
46. Millimeter-wave and sub-mm-wave antennas
47. Terahertz, infrared, and optical antennas

## Commission A Electromagnetic Metrology

USNC CHAIR: Jeanne Quimby  
[jeanne.quimby@nist.gov](mailto:jeanne.quimby@nist.gov)

- A.1. Microwave to sub-millimeter measurements/standards
- A.2. Quantum metrology and fundamental concepts
- A.3. Time and frequency
- A.4. Time-domain metrology, EM-field metrology
- A.5. EMC and EM metrology
- A.6. Noise
- A.7. Materials
- A.8. Bioeffects and medical applications
- A.9. Antennas
- A.10. Impulse radar
- A.11. Interconnect and packaging
- A.12. Test facilities
- A.13. THz metrology
- A.14. High-Frequency and millimeter wireless metrology

## Commission B Fields & Waves

USNC CHAIR: Branislav Notaros  
[notaros@colostate.edu](mailto:notaros@colostate.edu)

### Antennas

- B.1. Antenna theory, design, and measurements
- B.2. Antenna arrays and systems
- B.3. Microstrip and printed antennas, circuits, and devices
- B.4. Antenna feeds and reflector and reflectarray antennas

### Propagation, Scattering, Sensing

- B.5. Electromagnetic propagation, scattering, and interaction
- B.6. Guided-wave structures and systems
- B.7. Imaging, inverse scattering, and remote sensing
- B.8. Wireless sensors, networks, and communication

### Numerical Methods

- B.9. Integral-equation methods
- B.10. Finite-element, finite-difference, and hybrid methods
- B.11. Computational electromagnetics, analysis, and optimization

### Theory, Materials, Education

- B.12. Electromagnetic theory
- B.13. Metamaterials and complex media
- B.14. Electromagnetics education
  - Devices, Systems, Applications
- B.15. RF and microwave devices, structures, and systems
- B.16. THz and optical antennas, devices, and systems
- B.17. Biomedical applications of fields and waves

## Commission C Radio Communication and Signal Processing Systems

USNC CHAIR: Eric L. Mokole  
[eric.mokole@outlook.com](mailto:eric.mokole@outlook.com)

- C.1. Cognitive radio, software-defined wireless systems, and waveform diversity
- C.2. Computational imaging and inverse methods
- C.3. Information theory, coding, modulation, and detection
- C.4. MIMO and MISO systems
- C.5. Radar systems, target detection, localization, and tracking
- C.6. Radio communication systems
  - C.6.1. Internet of Things
  - C.6.2. 5G
  - C.6.3. Electromagnetic spectral harmony
- C.7. Sensor networks, and sensor array processing and calibration
- C.8. Signal and image processing
- C.9. Spectrum and medium utilization
  - C.9.1. Electromagnetic modeling of systems and environments
- C.10. Synthetic aperture and space-time processing
- C.11. Ground-penetrating radar (GPR)
- C.12. Distributed, multi-modality, electromagnetic, autonomous systems

## Commission D Electronics and Photonics

USNC CHAIR: Negar Ehsan  
[negar.ehsan@nasa.gov](mailto:negar.ehsan@nasa.gov)

- D.1. Electronic devices, circuits, and applications
- D.2. Photonic devices, circuits, and applications
- D.3. Physics, materials, CAD, technology and reliability of electronic and photonic devices, in radio science and telecommunications
- D.4. Wide bandgap materials
- D.5. THz electronics
- D.6. Reconfigurable RF

## Commission E Electromagnetic Environment and Interference

USNC CHAIR: Larry Cohen  
[lawrence.cohen@nrl.navy.mil](mailto:lawrence.cohen@nrl.navy.mil)

- E.1. Electromagnetic environment
  - E.1.1. Electromagnetic noise of natural origin
  - E.1.2. Manmade noise
- E.2. Electromagnetic compatibility measurement technologies
- E.3. Electromagnetic compatibility standards
- E.4. Legal aspects of electromagnetic compatibility
- E.5. Electromagnetic radiation hazards
- E.6. Electromagnetic compatibility education
- E.7. Computational electromagnetics in electromagnetic compatibility
  - E.7.1. Computer Modeling
  - E.7.2. Model Validation
  - E.7.3. Statistical Analysis

- E.8. Effects of natural and intentional emissions on system performance
  - E.8.1. Crosstalk
  - E.8.2. Effects of transients
  - E.8.3. System analysis
  - E.8.4. Signal integrity
  - E.8.5. Electromagnetic compatibility in communication systems
  - E.8.6. Statistical analysis
- E.9. High-power electromagnetics
  - E.9.1. Electrostatic discharge
  - E.9.2. Electromagnetic pulse and lightning
  - E.9.3. Transients
  - E.9.4. Power transmission
- E.10. Spectrum compatibility issues, usage and management

## Commission F Wave Propagation and Remote Sensing

USNC CHAIR: Kamal Sarabandi  
[saraband@umich.edu](mailto:saraband@umich.edu)

- F.1. Point-to-point propagation effects
  - F.1.1. Measurements
  - F.1.2. Propagation models
  - F.1.3. Multipath/mitigation
  - F.1.4. Land or water paths
  - F.1.5. Scattering/diffraction
  - F.1.6. Indoor/outdoor links
  - F.1.7. Mobile/fixed paths
  - F.1.8. Horizontal/slant paths
  - F.1.9. Surface/atmosphere interactions
  - F.1.10. Numerical weather prediction
  - F.1.11. Dispersion/delay
  - F.1.12. Natural/manmade structures
- F.2. Microwave remote sensing of the Earth
  - F.2.1. Atmospheric sensing
  - F.2.2. Ocean and ice sensing
  - F.2.3. Field campaigns
  - F.2.4. Interferometry and SAR
  - F.2.5. Subsurface sensing
  - F.2.6. Scattering/diffraction
  - F.2.7. Radiation and emission
  - F.2.8. Propagation effects
  - F.2.9. Urban environments
  - F.2.10. Soil moisture & terrain
- F.3. Propagation and remote sensing in complex and random media

## Commission K Electromagnetics in Biology and Medicine

USNC CHAIR: Majid Manteghi  
[manteghi@vt.edu](mailto:manteghi@vt.edu)

- K.1. Body-area networks
- K.2. Dosimetry and exposure assessment
- K.3. Electromagnetic and mixed-mode imaging and diagnostics
- K.4. Therapeutic and rehabilitative applications
- K.5. Implantable and ingestible devices
- K.6. Human-body interactions with antennas and other electromagnetic devices