CALL FOR PAPERS

IEEE Transactions on Computational Imaging
Special Section on Computational Imaging using Synthetic Apertures

Synthetic aperture (SA) systems are deployed in a variety of applications to make high-resolution spatial or temporal measurements with hardware that is inherently capable of much lower resolution. Examples include synthetic aperture radar (SAR), holographic cameras in optics, channel sounders in 5G communications, distributed radio telescopes in astronomy and many more. The term SA refers generically to a discrete measurement scheme together with an inverse problem solution that yields imaging performance better than the physical sensor can naturally attain, e.g., wider field-of-view, higher angular resolution. An SA may sample a propagating wavefield or environmental parameters in the signal domain via motion of an antenna or transducer, as in SAR or synthetic aperture sonar (SAS). Alternatively, an SA may sample in the k-space domain via different look angles around an object or scene, as in, spotlight SAR and SAS, or Fourier ptychography. Lastly, an SA may be constructed from a sparse array of sensors as in radiometry, seismology, or radio astronomy. The front end of an SA may be a conventional antenna, acoustic transducer, or a quantum sensor, such as a Rydberg probe, in advanced implementations.

Starting in February 2024, the IEEE Transactions on Computational Imaging (TCI) will include a Special Section of articles on ***Computational Imaging using Synthetic Apertures***. The special section will bring together several communities working on this highly interdisciplinary topic to disseminate recent research results across various SA applications. We solicit high-quality manuscripts that describe new and previously unpublished engineering or theoretical approaches in synthetic aperture applications relevant to the broader computational imaging community. Questions should be directed to the lead editors Peter Vouras (synthetic_aperture_twg@ieee.org) and Kumar Vijay Mishra (kvm@ieee.org). Topics of interest include the following areas:

Radar remote sensing is one of the foremost applications of synthetic apertures. The Special Section topics in this area include but are not limited to:

- Signal processing for image reconstruction, autofocusing, deconvolution, and calibration techniques in SAR, polarimetric SAR, inverse SAR (ISAR), interferometric SAR (InSAR), and interferometric ISAR (InISAR)
- Synthetic apertures in radar formed by distributed sensors, multichannel processing, tomographic/volume/3D stereo sensing, multistatic and multiview radar imaging
- Imaging techniques in advanced and novel applications, including maritime, polarimetric, automotive, space-based, forward looking, millimeter-wave, terahertz-band synthetic apertures
- Volumetric synthetic aperture geometries, including linear, curvilinear, flat/curved surface, circular, cylindrical, spiral, and spherical
- Exploitation of synthetic apertures in velocity SAR and multichannel interferometry
- Fusion of radar with other sensors using imaging and learning-based approaches
- Sparsity, compressive sensing, machine learning, and physics-based approaches to radar imaging
- Reconstructing SAR images from lossy compressed data
- Real-time imaging of moving objects using synthetic apertures
- Sky-facing THz SAR for imaging space objects in low earth orbit
- Satellite-to-satellite SAR

- 3D SAR image formation
- Simultaneously wide-angle and wideband SAR techniques
- Through-wall imaging with synthetic apertures
- New autofocusing algorithms due to very high-resolution requirements (millimeter wave radar and even higher)
- Fusion of images from multiple modalities

Integrated Imaging and Communications, including but not limited to:

- Synthetic aperture processing for joint communications and imaging
- Synthetic aperture holographic surfaces for imaging and communications
- Waveform design for integrated imaging and communications on synthetic aperture platforms
- Near-field beamforming for electrically large intelligent reflecting surfaces
- Imaging radars that use 5/6G waveforms

Synthetic aperture sonar (SAS), including but not limited to:

- Signal processing for image reconstruction (including broadband/multiple-input multiple-output systems/Circular/Multi-look/Volumetric or 3D imaging SAS)
- Aspect/Frequency-dependent imaging
- Interferometric SAS (InSAS) processing
- Platform motion estimation and compensation methods for imaging
- Sensor calibration for imaging
- Passive SAS imaging
- Inverse SAS imaging

Synthetic aperture sounding, including but not limited to:

- Sparse sampling lattices for synthetic aperture channel sounding
- Simultaneous blind calibration and angle estimation using synthetic apertures
- Scene reconstruction from inverse problem solutions of wideband environmental measurements made using signals of opportunity
- Environmental and electromagnetic modeling of sounding systems toward improved computational imaging

Synthetic aperture radiometry, including but not limited to:

- Optimized and minimally redundant array geometries for wideband radiometry
- Performance effects of cell interference on space-borne radiometry and mitigation techniques

- Calibration approaches for radiometer elements
- Vertical atmospheric profiling using ground-based radiometry
- Time synchronization and drift compensation for space-borne radiometer arrays
- Corrections for correlated noise effects in radiometer arrays

Synthetic aperture radio astronomy, including but not limited to:

- The image formation process
- Interference mitigation techniques
- Non-coplanar arrays and polarimetric imaging
- Calibration methods
- Sparse reconstruction
- Deconvolution and linear inversion methods

Quantum synthetic apertures, including but not limited to:

- Imaging with apertures and arrays of receivers or detectors employing a quantum process, interaction, or particle including atom-based field sensors, single photon detectors, and other quantized systems like nitrogen vacancy diamonds
- Processing and detection schemes leveraging a quantum mechanical interaction, like entanglement, for enhanced performance including quantum illumination, quantum two-mode squeezing, ghost imaging, and other quantum imaging techniques
- Theoretical performance bounds for quantum sensors in synthetic aperture imaging applications
- Implementation of quantum information processing techniques, including the study of these techniques, for any other synthetic aperture domains

Synthetic apertures in optics, including but not limited to:

- Ptychography and holography
- Light field and integral imaging using an array of cameras or lenses
- Structured illumination techniques for super-resolution imaging
- Non-line-of-sight imaging
- Novel experimental demonstrations for optical synthetic apertures
- Algorithm developments for optical synthetic apertures
- Aberration-correction methods and algorithms
- Techniques to form images and video of dynamic samples
- Long-range optical imaging using synthetic aperture techniques for 6G cell phone cameras
- Diffraction tomography methods for 3D imaging
- Developments in phase retrieval algorithms for synthetic aperture formation

- Novel sampling strategies including compressed sensing and data-driven sampling
- Machine learning methods for synthetic aperture formation, including neural light fields and diffractive neural networks

Synthetic apertures in medical imaging, including but not limited to:

- Synthetic aperture ultrasonics and ultrasound
- Synthetic aperture magnetometry
- Artificial intelligence (AI), Deep Learning (DL), or Machine Learning (ML) for scan time reduction and/or improvement in resolution
- Model or physics-based image reconstruction in low signal-to-noise-ratio scenarios
- Techniques for ultrasound image reconstruction with synthetic apertures
- Synthetic aperture ultrasound image reconstruction methods for flow visualization
- Synthetic aperture ultrasound for high resolution image reconstruction
- 3D Ultrasound imaging using synthetic aperture techniques

Synthetic apertures in seismic imaging, including but not limited to:

- Reverse time migration methods
- High-resolution reconstruction techniques
- Imaging from undersampled or interpolated measurements
- Design of data acquisition geometries

Submission site: https://mc.manuscriptcentral.com/tci-ieee

Manuscript submission begins: February 01, 2024

While manuscripts can be submitted at any time after the launch of this special section, we encourage interested authors to submit their manuscript by 01 July 2024 to be considered for the inaugural 2024 issue.

Authors are encouraged to adhere to the following deadlines:

- **If a paper is submitted by July 1, 2024, the manuscript will be published in 2024;**
- **If a paper is submitted between July 2, 2024 and July 1, 2025, the manuscript will be published in 2025;**
- **If a paper is submitted between July 2, 2025 and July 1, 2026, the manuscript will be published in 2026.**

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