

IEEE Synthetic Aperture Radar Standards Committee



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- John J. Santapietro (MITRE)
- Chris Barnes (GATECH)

IEEE Standards

- ◆ An IEEE standard is a document established by consensus that provides rules, guidelines, or best practices for salient technical aspects of SAR. It is a basis for comparison and a reference point against which other approaches, designs or algorithms can be evaluated.
- ◆ After publication, a well-written standard establishes uniform engineering or technical criteria, methods, processes, and practices.

Synthetic Aperture Standard Committee

- ◆ There is a recognition that across a variety of disciplines common theoretical, mathematical, and algorithmic techniques are employed:
 - ✦ Synthetic Aperture Radar
 - ✦ Synthetic Aperture Sonar
 - ✦ Synthetic Aperture Channel Sounding
 - ✦ Fourier Ptycography
 - ✦ Event Horizon Telescope
 - ✦ Medical Imaging

- ◆ The goal of the SASC is to establish IEEE Standards for each of these application areas while taking into account the common threads underlying these:
 - ✦ Data acquisition
 - ✦ Processing
 - ✦ Analysis and interpretation

Motivation for SAR Standards

- ◆ SAR is increasing being used in space-based and automotive radar applications. Having a uniform set of standards can enable system interoperability
- ◆ Standards can establish best practices and rules-of-thumb for implementing SAR algorithms in a broad range of applications
- ◆ Our interpretation of “SAR” is very broad; encompasses:
 - ✦ Standard SAR
 - ✦ Inverse SAR (ISAR)
 - ✦ Interferometric SAR/ISAR
 - ✦ Multichannel Radar
 - ✦ Multistatic Radar
 - ✦ MIMO Radar
 - ✦ Distributed radars
- ◆ Aspects for standardization:
 - ✦ Standard processing structures and algorithms (both hardware and software implementations)
 - ✦ Testing and benchmarking mechanisms
 - ✦ Waveforms
 - ✦ Operation across frequency bands
 - ✦ Synchronization of radars (for Multistatic operation)
 - ✦ Antenna spacing
 - ✦ Sampling
 - ✦ SAR/ISAR image quality assessment
 - ✦ SAR/ISAR image interpretation
 - ✦ SAR/ISAR image fusion (across aspects, frequency bands)

Sub-groups for IEEE SAR SA

- ◆ We recommend forming different sub-groups that will be in charge of standardizing different aspects of the IEEE SAR SA standard. Following are some suggested sub-groups:
 - ✦ Basic SAR processing sub-group: SAR, ISAR, InSAR, InISAR
 - ✦ Autofocusing and Calibration sub-group
 - ✦ Multichannel SAR sub-group: Co-located MIMO radars
 - ✦ Multistatic SAR sub-group: Distributed MIMO radars
 - ✦ SAR image quality sub-group
 - ✦ SAR image interpretation sub-group
 - ✦ Solopulse sub-group
 - ✦ Industry Focus#1: Automotive SAR sub-group
 - ✦ Industry Focus#2: Space-based SAR sub-group
- ◆ We will discuss the formation of these sub-groups in our meeting next meeting on May 04, 2022.

Meeting Minutes from last meeting (04/06/2022)

- ◆ Form sub-groups for next meeting to enable in-depth discussions and fleshing out the details of the various standardization topics
- ◆ Add Brian Sequeira, Armin Doerry, John J. Santapietro, and Chris Barnes to the Radar SG
- ◆ Brian Sequeira sent information regarding Image Interpretability Rating Scale
- ◆ Bill Correll confirmed that AESS radar standards 686 is only about definitions
- ◆ Stefano Tebaldini mentioned calibration procedures such as autofocusing should be included in RSG activities
- ◆ Include the radar RCS standard from AP-S society:
 - ◆ "IEEE Standard I 502: Standardization of Radar Cross-Section Test Procedures"
<https://standards.ieee.org/ieee/I502/6668/>
- ◆ Next meeting will be held on 12pm on May 04, 2022

BACKUP

Synthetic Aperture Radar: New Developments

• Fundamentals

- Requirements to avoid spatial and temporal aliasing
- Broad Areas: SAR, ISAR, InSAR, circular SAR, polarimetric SAR, SLAR, passive SAR, tomographic SAR

• Inverse Problems

- New autofocusing algorithms
- Sparse sampling approaches
- 3D Reconstruction
- Deconvolution
- Super-resolution
- Wideband

• Machine Learning

- Supervised and unsupervised learning
- Deep learning (CNN, LSTM)
- Reinforcement learning, Q-learning
- Generative models
- Transfer learning

• New Optimization Approaches

- Low-rank models
- Tensor processing
- Novel waveform designs
- Image denoising
- Graph-based approaches

• Unconventional Geometries

- FLoSAR
- Intelligent surfaces
- Bistatic SAR
- Distributed SAR
- Wide-angle SAR

• Unconventional Frequencies

- mm-Wave SAR
- sub-THz SAR

• Novel Applications

- Automotive SAR
- Spectrum-sharing
- Cognitive SAR
- MIMO-SAR
- Drone/UAV-borne SAR