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**IEEE Transactions on Radar Systems (T-RS)**

*Special Section on*

*Fully Digital Arrays for Radar: From Architectures to Algorithms*

## Aims and Scope

Fully digital arrays are of tremendous interest because they offer the possibility to exploit the full potential of multi-antenna radar systems. The general definition involves independent digital control at each transmit element as well as sampling and digitization at each individual receive element. Consequently, the ensuing radar system can achieve unprecedented operational and design freedom to perform a wide variety of sensing and multi-function modes.

The hardware components assigned to the transmitting and receiving elements can be purely digital or analog, with combined analog/digital mixed architectures being the common choice today. Fully digital phased arrays, multiple-input multiple-output (MIMO) systems, and multichannel/MIMO synthetic aperture radars are variants of fully digital arrays. MIMO radar systems are the state-of-the-art in automotive radar and commercial radar personnel security screening systems. Fully digital arrays are attractive for electronic warfare, will be the basis for future medical, gesture, or people-movement tracking radars, and for joint communication and sensing (JCS) applications as they are envisaged for 6G.

Even though the fully digital signal control and processing enables unparalleled radar performance and flexibility, fully digital arrays for radar still involve many challenges. Mastering the enormous hardware and signal processing effort requires highly integrated circuits and modules, advanced manufacturing, packaging, assembly and interconnect technologies, powerful computing capabilities, robust signal processing, and clever choices for radar system architectures. Distortions like element crosstalk and element synchronization errors, noise, phase noise, quantization errors, clock jitter, antenna phase center errors, frequency and angle dependent element transfer function, drift, aging, and manufacturing tolerances must be addressed. New techniques for signal predistortion and equalization, as well as for calibration and testing, are of great interest.

On the application side, fully digital transmit control facilitates new horizons in advanced waveforms, where the multiplicative increase in degrees-of-freedom arising from coupling between transmit signal structure and spatial angle is an emerging design space to be explored. To fully exploit the information within the multitude of acquired signals, novel signal processing concepts and algorithms are required, such as multidimensional versions of image reconstruction, range-Doppler processing, target detection, and tracking. The extreme amounts of data likewise imply interesting prospects for machine-learning-based radar signal processing, such as for scene understanding and classification/identification. In contrast, the heavy data burden also suggests the need for data compression driven by notions of sparse design and compressive sensing processing.

Collectively, this special section will serve as a venue to highlight a broad cross-section of the different hardware, systems engineering, signal processing, and application-driven research underway on fully digital arrays for radar.

## Topics of Interest include:

**All applications with radar as the primary focus involving:**

- Fully digital phased array radar concepts, MIMO radar, multi-channel SAR / MIMO-SAR systems, sub-systems, architectures, and applications
- Multichannel radar RFIC; radar-specific packaging, assembly, and interconnect technologies
- Signal modeling and algorithms for fully digital array radar systems, e.g., multidimensional forms of image reconstruction, range-Doppler processing, target detection & tracking, scene understanding, sparse array processing, data compression, compressive sensing, and machine-learning-based signal processing
- Digital array design, multiplexing, and waveform design in multichannel / MIMO radar
- Distortion analysis, error compensation, calibration, and signal predistortion concepts for digital radar arrays

## Important Dates:

Manuscript submission due: 15 February 2023
First review completed: 1 April 2023
Revised manuscript due: 1 May 2023
Second review completed: 31 May 2023
Final manuscript due: 14 June 2023
Publication date: Summer 2023

Submitted manuscripts will be reviewed according to standard T-RS procedures for regular papers. Prospective authors should visit https://ieee.atyponrex.com/journal/tradar-ieee for additional information. When submitting, use the category **Fully Digital Arrays**. Manuscripts deemed to be outside the scope of the special section but otherwise still appropriate for T-RS will be redirected internally.