

Editorial

Advances in Radar Technologies

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“As first shown by Hertz, electric waves can be completely reflected by conducting bodies. In some of my tests I have noticed the effects of reflection and detection of these waves by metallic objects miles away”

(Guglielmo Marconi, Radio Telegraphy, Proc. Inst. Radio Eng., vol. 10, 1922)

...the history of RADAR technology in Italy begun...

The Navy Officer (later on Professor at University of Pisa) Ugo Tiberio made a theoretical study on the detection of objects by electromagnetic waves and developed the radar equation

(Ugo Tiberio, “Misura di distanze per mezzo di onde ultracorte (Radiotelemetria),”

Alta Frequenza, Maggio 1939, Torino, Italy)

Even after a century of research and study in the field, radar systems with enhanced features are in high demand for surveillance, tracking, and imaging applications, required for both civilian and military contexts. Advanced radar technologies are needed to face the problem of complex environments, with changing electromagnetic properties of targets, such as vehicles, ships, buildings, and terrain, for different frequencies, polarimetric modes, and configurations.

This special issue collects 12 papers from 37 authors belonging to different countries and institutions. It summarizes the most recent developments and ideas on emerging radar technologies, with particular focus addressed to the following issues:

- (i) compressive sensing applied to large array diagnosis, directions-of-arrival estimation, and through-the-wall imaging,
- (ii) software defined radar approach,
- (iii) flexible, multimode radar solutions,

- (iv) radar data processing techniques,
- (v) compact and broadband antennas useful for sonar and imager radar,
- (vi) usage of micro-Doppler radar signals for human detection,
- (vii) circulating codes in space-time radar waveforms,
- (viii) mitigation techniques for interference from a similar radar.

In the paper by S. Costanzo et al. entitled “*Radar array diagnosis from undersampled data using a compressed sensing/sparse recovery technique*”, the problem of large arrays diagnosis is faced by adopting an equivalent sparse formulation to accurately detect fault elements from undersampled data.

M. Carlin et al. in the paper “*Bayesian compressive sensing as applied to directions-of-arrival estimation in planar arrays*”

adopted a probabilistic version of compressive sensing which is successfully applied for estimating the directions of arrival of multiple electromagnetic signals impinging on planar arrays.

The paper by E. Cristofani et al. entitled "*Performance of 2D compressive sensing on wide-beam through-the-wall imaging*" explores the application of compressive sensing to minimize the amount of data required for accurate reconstructions of through-the-wall imaging scenes.

In the paper by S. Costanzo et al., entitled "*High resolution software defined radar system for target detection*," a software defined approach is proposed to design a compact and low-cost L-band software defined radar system which is useful for landslides monitoring.

The same approach is adopted in the paper by S. Costanzo et al. entitled "*Multiband software defined radar for soil discontinuities detection*," which uses an orthogonal frequency-division multiplexing technique to perform the dielectric characterization of multilayer structures, such as soils with dispersive features.

The paper by S. Costanzo et al. entitled "*Multimode/multifrequency low frequency airborne radar design*" presents the design of a flexible and low cost airborne radar that is able to easily switch between two different operational modes, namely, a sounder or SAR imager.

In the paper by A. R. Laganà et al. entitled "*Modeling and processing L-band ground based radar data for landslides early warning*," the approaches commonly used in SAR data processing for deformations imaging are generalized to the case of ground-based, nonsynthetic radar operating in the L-band.

In the paper by F. Venneri et al. entitled "*Tunable reflectarray cell for wide angle beam-steering radar applications*," an electronically tunable reflectarray element is presented to design beam-steering arrays suitable for radar applications.

In the paper by S. Costanzo and A. Costanzo entitled "*Compact U-slotted antenna for broadband radar applications*," a modified U-shaped microstrip patch antenna with reduced size and broadband features is presented to be usefully applied for low-frequency penetrating radar.

In the paper by D. Tahmoush and J. Silvius entitled "*Radar measurement of human polarimetric micro-doppler*," extensive polarimetric micro-Doppler walking signatures are collected and analyzed to reveal different characteristics of human motions.

The paper by G. Babur et al. entitled "*Space-Time radar waveforms: circulating codes*" describes a novel solution to transmit only one waveform circulating from one antenna element to another (or from one subarray to another) with a very small relative time shift.

In the paper by G. Galati and G. Pavan entitled "*Noise radar technology as an interference prevention method*," mitigation techniques based on waveform diversity supplied by Noise Radar Technology are discussed to face the problem of interferences from several similar radar systems operating in a small environment with limited allocated bandwidths, such as in the marine radar context.

The focus theme treated in this special issue owns a particular multidisciplinary feature, so it is able to attract and

integrate various different expertise, leading to scientific and economical returns of significant impact.

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