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Exploiting Compressive Sensing for MIMO Radar Image Resolution Enhancement

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ABSTRACT: In radar systems technology one of the main constraints is represented by the cross-range resolution, which is the radar capability to tracking targets at the same range but placed at different angles. This ability is dominated by the radar angular resolution. For co-located radar systems, increasing the antenna aperture is a straightforward approach to improve the corresponding system performance, however, increasing the number of elements in the antenna array raises the overall dimensions of the device and the complexity of the radar front-end. Recently, the adoption of specific transmitted signal waveforms has been considered as a viable approach to improve angular resolution, while limiting the number of antenna elements. This approach leads to the development of Multiple-Input Multiple-Output (MIMO) radars. MIMO radars are basic technology in improving spatial resolution due to their antennas and waveform diversity. Although the higher angular resolution is essential to achieve the desired target detection, the hardware cost of several transmitters and receivers and high energy consumption curb the use of MIMO radars in a wide-ranging network.

Compressive sensing (CS) is a recent technique that addressed to improve this limitation. CS theory states that a signal sparse in range-angle space can be recovered using far fewer samples than those needed by the Nyquist sampling criterion. Applying CS to the MIMO radar allows a considerable reduction in the number of antennas respects to a dense array based on the Nyquist criterion, while, achieving performance similar to the filled array based on Nyquist theory.

In this presentation, a new design of 2x2 CS-MIMO radar is reported that exploits the CS technique to provide a sparse linear framework on a MIMO radar in which transmitter and receiver antennas are positioned randomly, lastly, it is compared to standard MIMO radar as a benchmark. The comparison signifies that the angular resolution can be increased through a random array CS-MIMO by a factor of at least 2.9° regarding conventional MIMO.

BIOGRAPHY: Neda Rojhani received her Ph.D. degree in Electronic and Electromagnetism Engineering from the University of Florence, Florence, Italy, in 2019. She has currently collaborated with the Department of Information Engineering, University of Pisa. Her research interests include Ground-Based Radar (GB-SAR), Ground-Penetrating Radar (GPR), Multi-Input Multi-Output Radar (MIMO), Antenna theory, and Antenna design.

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