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Colocated and Distributed MIMO-Radar-MIMO-Communications

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Recent extreme crowding of the electromagnetic spectrum is leading to joint design of communications and radar systems with shared spectrum and hardware resources. Such synergistic systems have size-power-cost advantages arising from information sharing and improved safety [1]. Lately, these spectrum sharing solutions have been extended to multiple-input multiple-output (MIMO) array configurations in both radar and communications. In this talk, we present recent advances on both collocated and distributed joint MIMO-radar-MIMO-communications (MRMC) systems. In the colocated MIMO radar, the antennas are spaced so close to each other that the target cross-section appears identical to all the antennas of the array. This is not the case with the widely distributed MIMO, wherein the target cross-section may also be modeled as a random variable. As a result, such a system is also called statistical MIMO radar.

Broadly, there are two approaches for spectrum sharing in each case. In the "spectral coexistence" approach [2], radar and communications manage interference from each other with minimal changes in their respective hardware. Specifically, we present a novel approach to radar signal processing which allows the radar signal detection and parameter estimation using a much smaller number of measurements than required by Nyquist sampling. In the spectral co-design approach [3], we focus on millimeter-wave MRMC for autonomous vehicles. Major challenges in this case include a joint waveform design and performance criteria that would optimally trade-off between communications and radar objectives [4].

Finally, we discuss spectrum co-design for a statistical MRMC in the presence of a single and multiple moving targets. We exploit the connection between the achievable rate and the weighted minimum mean square error (WMMSE) to simultaneously design the radar waveform code, precoders of the full-duplex multi-user MIMO communications and the linear receive filters, subjected to performance constraints related to power and quality of service (QoS). The multiple target case is considered by re-designing data association algorithms for the co-designed system [5]. We conclude the talk with a deep learning approach to design hybrid beamforming of joint MRMC.

References

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