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Sparse Sensor Array Design and Processing for High-Resolution Sensing

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Abstract

Array signal processing is a critical technology underpinning applications such as radar sensing, wireless communications, and medical imaging. It enables key functions including directional beamforming, interference mitigation, multiuser access, direction finding, signal localization, and computational imaging. Modern radar and wireless systems increasingly demand higher spatial resolution and improved estimation accuracy. However, these requirements often impose significant hardware costs due to large array apertures and a high number of sensors.

Sparse sensor array design and processing address these challenges by offering low-complexity solutions that enhance sensing capabilities while reducing the required number of array elements. This talk will focus on signal direction-of-arrival (DOA) estimation and will present recent advances in sparse array concepts, design strategies, and signal processing methods that achieve high spatial resolution and increased degrees of freedom with significantly reduced complexity. These developments leverage recent breakthroughs in compressive sensing, convex optimization, and machine learning. Techniques for minimizing difference-lag redundancies and exploiting frequency diversity will be discussed, providing valuable insights into efficient and cost-effective array signal processing solutions across a wide range of applications.

Bio

Dr. Yimin D. Zhang is a Professor at the Department of Electrical and Computer Engineering, Temple University, Philadelphia, PA. He received his B.Sc. degree from Xidian University, China, and his Ph.D. degree from the University of Tsukuba, Japan. His research interests lie in the areas of statistical signal and array processing, compressive sensing, convex optimization, machine learning, information theory, and time-frequency analysis with applications to radar sensing, wireless communications, and satellite navigation. Dr. Zhang is a Senior Area Editor for IEEE Transactions on Signal Processing and an Associate Editor for Signal Processing. He serves as a member of the Sensor Array and Multichannel (SAM) Technical Committee and a member of the EURASIP Signal Processing for Multisensor Systems (SPMuS) Technical Area Committee. His publications on array signal processing have received the 2018 and 2021 IEEE Signal Processing Society Young Author Best Paper Awards, the 2019 IET Communications Premium Award, and the 2021 EURASIP Best Paper Award for Signal Processing. He is a Fellow of the IEEE, a Fellow of SPIE, and a Distinguished Lecturer of the IEEE Signal Processing Society.