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QR-TLS ESPRIT for source localization and frequency estimations
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Abstract
A subspace decomposition based algorithm for joint frequency of arrival (FOA) and direction of arrival (DOA) estimation is presented in this paper. The proposed method termed as QR-TLS ESPRIT, estimates the signal subspace by decomposing the received signal in a specially formed Toeplitz matrix. The structure of the matrix favors the application of QR factorization, which yields the signal subspace at the expense of less number of computations. A Total Least Squares (TLS) method is applied to obtain the frequency and angle estimates from the signal space. The proposed QR-TLS ESPRIT method provides several benefits: 1) It avoids the computations of applying computationally complex Eigen Value Decomposition (EVD) or Singular Value Decomposition (SVD) methods to obtain signal subspace alike conventional methods, 2) QR decomposition method, which is intrinsically applicable to numerical rank deficient problems, is used to extract signal subspace from the observation data matrix, 3) the TLS method is integrated with the QR which enhances the estimation accuracy in the presence of noisy measurements, 4) the proposed method can estimate the FOA and DOA from a small snapshot length of data which further reduces the computational time, and 5) the method works for both coherent as well as noncoherent sources without employing pre-whitening or spatial smoothing techniques. The performance of the proposed method is evaluated through simulations and the results are illustrated with respect to various received signal strength. © 2013 IEEE.

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