

Algebraic analysis of Toeplitz **decorrelation** techniques for direction-of-arrival estimation

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Abstract

In this paper, we investigate the correlation Toeplitz (CTOP) and averaging Toeplitz (AVTOP) decorrelation techniques, as applied towards direction of arrival (DOA) estimation of coherent narrowband sources with the multiple signals classification (MUSIC) algorithm. Numerical studies suggest that CTOP leads towards more accurate DOA estimation than AVTOP; however, no theoretical motivation for this performance gap has yet been presented. In this paper, we derive expressions for the Toeplitz matrices produced by the CTOP and AVTOP techniques, for a scenario involving a three-element uniform linear array and two coherent source signals in additive white Gaussian noise. These expressions lead to the claim that the accuracy of the CTOP technique can be attributed to its retention of source DOA information as independent sums (i.e. in a superposition form) in the Toeplitz matrix. The claim is supported by an investigation of the MUSIC spectra corresponding to the distinct Toeplitz matrices.