

Widely-Linear Beamforming

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Abstract: Typically adaptive and non-adaptive beamformers form their weight vectors using the covariance matrix of the complex-valued array snapshots. An implicit assumption is that the covariance matrix formed from the real and imaginary parts of the snapshot has a particular structure. This structure is often summarized by stating that the covariance formed from the array snapshot and its transpose (not Hermitian transpose) is zero. We could also call these data "proper" Gaussian vectors. In this paper we derive beamformers for situations in which these implicit assumptions are violated. One interpretation of an adaptive beamformer is to minimize the output power subject to some constraint. For example in a bearing-time record an adaptive beamformer strives to put the minimum amount of "marking energy" on the display while still satisfying the constraints. We prove that the widely-linear beamformer equals or outperforms typical beamformers under this performance measure - regardless of the "true" distribution of the data. By reducing the marking energy one can improve the localization of broadband sources.