Linearly and Quadratically Constrained Minimum Variance Adaptive Beamforming by a Dual-Domain Approach

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Abstract

In this paper, a new paradigm for adaptive beamforming is proposed by extending Frost's linearly constrained minimum variance (LCMV) beamforming and by formulating the beamforming problem as a quadratic minimization problem under two constraints: One is the conventionally-used linear constraint and the other is an additional general quadratic constraint. An efficient adaptive algorithm is proposed to implement the proposed beamformer based on a dual-domain approach and its properties are analyzed. As a specific application example of the proposed beamformer, relaxed zero-forcing beamforming is proposed to enhance the performance of the conventional adaptive beamformers by incorporating available interference side information. The relaxed zero-forcing beamformer minimizes the output variance under a classical linear distortionless constraint and a quadratic constraint that bounds the power of residual interference in the beamformer output. Numerical results are provided to evaluate the performance of the proposed algorithm, and the numerical results show that the proposed adaptive beamformer significantly outperforms the conventional adaptive algorithms based on the LCMV framework.