A Tractable Method for Robust Downlink Beamforming in Wireless Communications

A. Mutapcic, S.-J. Kim, and S. Boyd

Proceedings Asilomar Conference on Signals, Systems, and Computers (ACSSC), pages 1224-1228, Asilomar, CA, Nov 2007.

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In downlink beamforming in a multiple-input multiple-output (MIMO) wireless communication system, we design beamformers that minimize the power subject to guaranteeing given signal-to-interference noise ratio (SINR) threshold levels for the users, assuming that the channel responses between the base station and the users are known exactly. In robust downlink beamforming, we take into account uncertainties in the channel vectors, by designing beamformers that minimize the power subject to guaranteeing given SINR threshold levels over the given set of possible channel vectors. When the uncertainties in channel vectors are described by complex uncertainty ellipsoids, we show that the associated worst-case robust beamforming problem can be solved efficiently using an iterative method. The method uses an alternating sequence of optimization and worst-case analysis steps, where at each step we solve a convex optimization problem using efficient interior-point methods. Typically, the method provides a fairly robust beamformer design within 5-10 iterations. The robust downlink beamforming method is demonstrated with a numerical example.