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Optimal Selective Feedback Policies for Opportunistic Beamforming

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This paper studies the structure of downlink sum-rate maximizing selective decentralized feedback policies for opportunistic beamforming under finite feedback constraints on the average number of mobile users feeding back. Firstly, it is shown that any sum-rate maximizing selective decentralized feedback policy must be a threshold feedback policy. This result holds for all fading channel models with continuous distribution functions. Secondly, the resulting optimum threshold selection problem is analyzed in detail. This is a non-convex optimization problem over finite dimensional Euclidean spaces. By utilizing the theory of majorization, an underlying Schur-concave structure in the sum-rate function is identified, and the sufficient conditions for the optimality of homogenous threshold feedback policies are obtained. Applications of these results are illustrated for well known fading channel models such as Rayleigh, Nakagami and Rician fading channels, along with various engineering and design insights. Rather surprisingly, it is shown that using the same threshold value at all mobile users is not always a rate-wise optimal feedback strategy, even for a network with identical mobile users experiencing statistically the same channel conditions. For the Rayleigh fading channel model, on the other hand, homogenous threshold feedback policies are proven to be rate-wise optimal if multiple orthonormal data carrying beams are used to communicate with multiple mobile users simultaneously.

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