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Cooperative Relaying at Finite SNR--Role of Quantize-Map-and-Forward

Abstract:

This paper contributes to the design and analysis of Quantize-Map-and-Forward (QMF) relaying by optimizing its performance for small relay networks. QMF was proved to achieve the capacity of arbitrary networks within a bounded gap, as well as the optimal diversity-multiplexing tradeoff over slow fading networks. The initial QMF scheme has each relay performing the same operation, agnostic to the network topology and the channel state information (CSI); this facilitates the analysis for arbitrary networks, yet comes at a performance penalty for small networks and medium SNR regimes. This paper demonstrates the benefits we can gain for QMF if we optimize its performance by leveraging topological and channel state information. We show that for the N-relay diamond network, by taking into account topological information, we can exponentially reduce the QMF additive approximation gap from (N) bits/s/Hz [2] [4] to (logN) bits/s/Hz, while for the onerelay and two-relay networks, use of topological information and CSI can help to gain as much as 6 dB. Moreover, we explore what benefits we can realize if we jointly optimize QMF and halfduplex scheduling, as well as if we employ hybrid schemes that combine QMF and Decode-and-Forward (DF) relay operations.