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Multi-Pair Two-Way Amplify-and-Forward Relaying with Very Large Number of Relay Antennas

Abstract:

In this paper, we investigate the performance of multi-pair two-way relaying, in which multiple pairs of users exchange information within pair, with the help of a shared relay. Each user has a single antenna, and the relay is equipped with very large number of antennas. The relay adopts the amplify-and-forward protocol, and the beamforming matrixes of maximum-ratio combining/maximum ratio transmission and zero-forcing reception/zero-forcing transmission are both considered. Due to array gain of antenna array, the power of each user or the relay (or both) can be made inversely proportional to the number of relay antennas, without compromising the performance. Thus, three power-scaling schemes are studied. Furthermore, the asymptotic spectral and energy efficiencies of the system are obtained analytically, when the number of relay antennas approaches to infinity. The asymptotic results are beneficial to provide more insightful understandings for the fundamental limits of the very large antenna system, and verified by the Monte-Carlo simulations. The analytical and simulation results reveal that very large antenna arrays in such system can average the small-scale fading, eliminate the inter-pair interference, and reduce the total power consumption.