

Compute-and-Forward on a Multiaccess Relay Channel: Coding and Symmetric-Rate Optimization

Abstract:

We consider a system in which two users communicate with a destination with the help of a half-duplex relay. Based on the compute-and-forward scheme, we develop and evaluate the performance of coding strategies that are of network coding spirit. In this framework, instead of decoding the users' information messages, the destination decodes two integer-valued linear combinations that relate the transmitted codewords. Two decoding schemes are considered. In the first one, the relay computes one of the linear combinations and then forwards it to the destination. The destination computes the other linear combination based on the direct transmissions. In the second one, accounting for the side information available at the destination through the direct links, the relay compresses what it gets using lattice-based Wyner-Ziv compression and conveys it to the destination. The destination then computes the two linear combinations, locally. For both coding schemes, we discuss the design criteria, and derive the allowed symmetric-rate. Next, we address the power allocation and the selection of the integer-valued coefficients to maximize the offered symmetric-rate; an iterative coordinate descent method is proposed. The analysis shows that the first scheme can outperform standard relaying techniques in certain regimes, and the second scheme, while relying on feasible structured lattice codes, can at best achieve the same performance as regular compress-and-forward for the multiaccess relay network model that we study. The results are illustrated through some numerical examples.