Neevan Ramalingam
Ph.D.
Electrical Engineering

Achievable rates for relay networks using superposition coding

Abstract:
We investigate the superposition strategy and its usefulness in terms of achievable information theoretic rates. The achievable rate of the superposition of block Markov encoding (decode-forward) and side information encoding (compress-forward) for the three-node Gaussian relay channel is analyzed. It is generally believed that the superposition can outperform decode-forward or compress-forward due to its generality. We prove that within the class of Gaussian distributions, this is not the case: the superposition scheme only achieves a rate that is equal to the maximum of the rates achieved by decode-forward or compress-forward individually.

We use the insight gathered on superposition forward scheme and devise a new coding scheme. The superposition coding scheme for communication over a network combines partial decode-forward with noisy network coding. This hybrid scheme is termed as superposition noisy network coding. The novel coding scheme is designed and analyzed for a single relay channel, single source multi-cast network and multiple source multi-cast network. The achievable rate region is determined for each case. The special cases of Gaussian single relay channel and two way relay channel are analyzed for superposition noisy network coding. The achievable rate of the proposed scheme is higher than the existing schemes of noisy network coding, compress-forward, lattice coding and binning.