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Source compression in two-way two-relay network using Compute-and-Forward relaying

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Abstract:

In this paper, the performance of relaying network that employs vector quantization with Compute-and-Forward (CF) relaying technique in AWGN and Rayleigh fading channel is analyzed. Radio relaying is needed when the source and destination cannot directly communicate with each other. Source compression techniques of optimum vector quantization and lattice quantization is employed at source nodes. Physical layer network coding (PNC) with compute and forward relaying is an ingenious relaying scheme that exploits the broadcast nature of wireless channel and forwards the linear combination of signals received from multiple nodes. On the reception of linear equations of messages from the relay nodes, source nodes are capable of extracting the data intended for them. The end-to-end error performance at the source nodes is analyzed. As the performance of CF relaying is sensitive to channel estimation error, we estimate the channel using Least Square (LS) and Minimum Mean Square Estimation (MMSE) channel estimation algorithms. The sum-rate of nearly 7 bits/s/Hz for AWGN channel at 20dB SNR in compute-and-forward relaying is achieved which is only 3.75bits/s/Hz for decode-and-forward relaying (DF). Thus source compression techniques with efficient CF relaying in PNC is a promising technique to improve the efficiency in wireless relaying networks.

Keywords: Vector quantization**;** Physical layer network coding; Compute-and-Forward relaying

I. Introduction:

Interference in wireless communication is an unavoidable obstacle in the multiuser environment. Physical layer network coding is a new signal processing technology that harnesses the interference by combining the linear signals received from multiple nodes at the intermediate relay nodes. PNC with compute and forward relaying is an ingenious relaying scheme that exploits the broadcast nature of wireless channel and forwards the linear combination of signals received from multiple nodes. Algebraic codes such as lattice codes ensure that linear combination of codewords is again a valid codeword. The relay nodes in compute-and-forward relaying decode integer linear equation of messages instead of decoding individual messages. On receiving enough number of such linear equations, the user nodes can extract the other user's message. Vector quantization technique at the source nodes reduces the rate at which the source can transmit its message. The achievable rate for the two-way two-relay network over Additive White Gaussian Noise channel and Rayleigh fading channel is analyzed for decode-and-forward relaying and compute-and-forward relaying strategies.

S. Katti, et al. proposed a novel method named analog network coding in which instead of forwarding packets, routers forward the interfering signals (not the mixed bits) and the destination leverages network-level