

## Link Regimes Analysis for Partial Decode-Forward Two-Way Relay Transmission

### Abstract:

We propose a composite decode-forward (DF) scheme for the two-way relay channel in the full-duplex mode by combining coherent, independent, and partial relaying strategies. The relay partially decodes each user's information in each block and forwards this information coherently with the source user to the destination user in the next block as in block Markov coding. In addition, the relay independently broadcasts a binning index of both users' decoded information parts in the next block as in independent network coding. Each technique has a different impact on the relay power usage and the rate region. We further consider the independent and partial DF scheme for its more practical channel state information requirements, and derive in closed-form link regimes when this scheme achieves a strictly larger rate region than just time sharing between its constituent techniques, direct transmission, and independent DF relaying, and when it reduces to a simpler scheme. The analytical approach is based on maximizing the weighted composite DF sum rate and comparing with the outermost time-sharing line connecting corner points of rate regions of the constituent techniques. Numerical results demonstrate significant rate gains by performing link adaptation of the composite scheme based on the identified link regimes.