On the BLER and Spectral Efficiency Performance of Two-Way Relay Channel Algorithms on Rayleigh-faded Channels

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Abstract:

This paper analyzes the block error rate and spectral efficiency performances of two variants of the Two-Way Relay Channel (2wRC) scheme, the first one denoted as 2wRC using only the relay path, while the second one called Enhanced-2wRC (2wRCE), using both the direct Base station - User Terminal (BS-UT) and the relayed paths in a Hard Network Decoding (HND) method at destinations, over Rayleigh block-faded channels in a generic cellular environment. It presents the derivation of the theoretical expressions of the Block Error Rate (BLER) and effective spectral efficiency provided by the studied schemes, using an approximate method to compute the BLER ensured by the channel-code, and validates them by comparison to simulation results. The performances of 2wRC and 2wRCE are analyzed for different modulation orders and for various positions of the UT vs. the BS and Relay Node (RN), and compared to the performances of the two-hop relaying (OwR) and of the non-cooperative direct transmission (ncd) in the same environment. The theoretical and simulation results show that 2wRCE provides the lowest BLER and highest spectral efficiency while observing a target BLER, for almost all positions of the UT within the cell. The impact of the employment of higher-order modulations in the relaying phase upon the 2wRCEs' BLER and spectral efficiency are also studied, pointing out the possibility to use adaptively either the ncd transmission or the cooperative 2wRCE whose parameters could also be used adaptively, to ensure the highest spectral efficiency under a target BLER.