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Distributed Reed Muller Code with Multiple Relays for Cooperative Broadband Wireless Networks[1]

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Abstract—The authors have investigated the bit-error rate (BER) performance of Reed-Muller coded cooperative single-carrier frequency domain equalization (RMCC-SC-FDE) scheme and Reed-Muller coded cooperative OFDM (RMCC-OFDM) scheme incorporating multiple relays and multiple antennas. The maximum ratio combining (MRC) technique is utilized for OFDM/SC-FDE signal detection at the destination terminal. The joint soft maximum likelihood decoding (JSMLD) and the joint majority logic decoding (JMLD) are employed at the destination terminal. The deployment of multiple relays have invigorated the BER performance of RMCC-OFDM and RMCC-SC-FDE schemes. Numerical results demonstrate that the RMCC-SC-FDE scheme exhibits a better BER performance over the RMCC-OFDM scheme in identical conditions. Furthermore, the simulated results reveal that the RMCC-SC-FDE and RMCC-OFDM schemes not only yield a better BER performance gain over their corresponding non-cooperative coded counterpart schemes but also outperform the turbo coded cooperative SC-FDE and turbo coded cooperative OFDM schemes, respectively, under identical conditions.

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1. INTRODUCTION

Coded cooperative diversity plays a useful role in mitigating the harsh effect of channel distortion that is caused by multipath fading pervasively present in wireless communication systems. The idea of coded cooperative communication was introduced in [1]. Various channel codes like turbo code [2], low-density parity check code (LDPC) [3], and the polar code [4] have been implemented in coded cooperative communication. Nevertheless, all the aforementioned channel codes yield a better bit-error rate (BER) performance for longer length channel code. Furthermore, the above-mentioned channel codes entail an exorbitant encoding and decoding complexity. Since there are so many practical applications, where communication devices do not need high computational power, this situation eventually invokes an added latency in the overall system [5]. Thus, a shorter length code like Reed-Muller (RM) code has been utilized in coded cooperation scenario to overcome such kinds of issues. The RM coded cooperation encompasses a low encoding and decoding complexity. Furthermore, the partial encoding at the relay terminal substantially reduces the latency in the coded cooperative communication system [6]. Thus, RM codes still find their place in the current rapidly developing and competitive world.

The second biggest impairment in a broadband wireless communication is the phenomena of inter-symbol interference (ISI) that deleteriously effect the BER performance of any wireless communication system [7]. To circumvent these exacerbated effects of ISI, two broadband wireless techniques are prominently considered in the literature [8]. They are the OFDM technique [9, 10] and the single-carrier frequency domain equalization (SC-FDE) technique [11].

Most of the existing works on coded cooperation network appreciate the enhancement of BER performance of the communication system over frequency flat fading channels [12]. However, from the

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CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

ADDITIONAL INFORMATION

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