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Pergroup and Joint Optimization of Max-Dmin Precoder for MIMO with LDPC Coding Using QAM Modulation

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Abstract—MIMO technology not only offers diversity and capacity gains, but also provides higher spectral efficiency and significant link reliability over SISO systems. Many methods are developed to exploit the diversity offered by multi-antenna systems such as Alamouti code and spatial multiplexing that do not require transmitter-side channel status information (Tx-CSI). Other power allocation optimization techniques, also known as precoding, require a full or partial Tx-CSI. These techniques aim to transform the signal before transmission according to different criteria, among which the minimal Euclidean distance seems to be very effective and continues to interest the researchers. Given perfect channel state information at both sides of the communication, we propose in this paper a novel design of wireless transmission schemes that joint the minimal Euclidean distance precoder and error correction coding based on the non-binary low-density parity-check code (NB-LDPC), to finally determine a power allocation optimization solution that adapts a linear precoding block to an NB-LDPC encoded MIMO transmission. In this paper we use a quadrature amplitude modulation (QAM), over a Rayleigh fading channel with a maximum likelihood detection. Simulations results in term of bit error rate confirmed that NB-LDPC codes are particularly well suited to be jointly used with precoding schemes based on the maximization of the minimum Euclidean distance criterion.

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1. INTRODUCTION

The continued development of mobile systems and social networks is driving an exponential increase in data traffic, pushing cellular networks to their capacity limits.

Modern wireless communications, such as the LTE and LTE-A standards [1] and particularly fifth-generation (5G) [2, 3] cellular networks respond to this need, and replacing the current generation in some years. These modern cellular networks require a high data rate with low transmission latency. Especially, high-rate coding, high-order modulation and Multiple-Input Multiple Output (MIMO) technology are essential tools for achieving high data rates.

The advantages of MIMO technology are generally provided by open loop and closed loop techniques [4, 5]. Open loop techniques, such as spatial coding (STC) and spatial multiplexing (SM) [6], are used without the need for Channel State Information (CSI) at the transmitter. To overcome the multipath effect and to improve the robustness of SM systems, closed loop linear pre-coding techniques may be used at the transmitter.

The precoding techniques principle [7] is following: when the channel knowledge is available to the transmitter, a transmit signal is pre-multiplied by a precoding matrix so that the inter-symbol interference (ISI) in the receiver is greatly reduced. This knowledge of the channel characteristics makes possible the anticipation of any damage caused by the propagation to obtain a favorable “global” transmission channel.

CSI at the transmitter (CSIT) can be obtained via a feedback link, but it is difficult to achieve a perfect CSIT in a MIMO system with a rapidly evolving channel. As a result, transmitters in many MIMO systems have no knowledge of the current channel. This motivates the use of limited feedback link precoding methods.

Considering the CSI at the receiver, the antenna power allocation strategies can be realized by the joint optimization of the linear precoder (at the transmitter) and the decoder (at the receiver). This optimization is

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