Semi-blind channel estimation based on Modified CMA and unitary scrambling for massive MIMO systems

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Abstract

Pilot contamination is one of the main impairments in multi-cell massive Multiple-Input Multiple-Output (MIMO) systems. In order to improve the channel estimation in this context, we propose to use a semi-blind channel estimator based on the constant modulus algorithm (CMA). We consider an enhanced version of the CMA namely the Modified CMA (MCMA) which modifies the cost function of the CMA algorithm to the sum of cost functions for real and imaginary parts. Due to pilot contamination, the channel estimator may estimate the channel of a contaminating user instead of that of the user of interest (the user for which the Base Station wants to estimate the channel and then the data). To avoid this, we propose to scramble the users sequences before transmission. We consider different methods to perform unitary scrambling based on rotating the transmitted symbols (one Dimensional (1-D) scrambling) and using unitary matrices (two-Dimensional (2-D) scrambling). At the base station, the received sequence of the user of interest is descrambled leading to a better convergence of the channel estimator. We also consider the case where the Automatic Repeat reQuest (ARQ) protocol is used. In this case, using scrambling leads to a significant gain in terms of BLock Error Rate (BLER) due to the change of the contaminating users data from one transmission to another induced by scrambling.

Full Text

This preprint is available for download as a PDF.

Figures

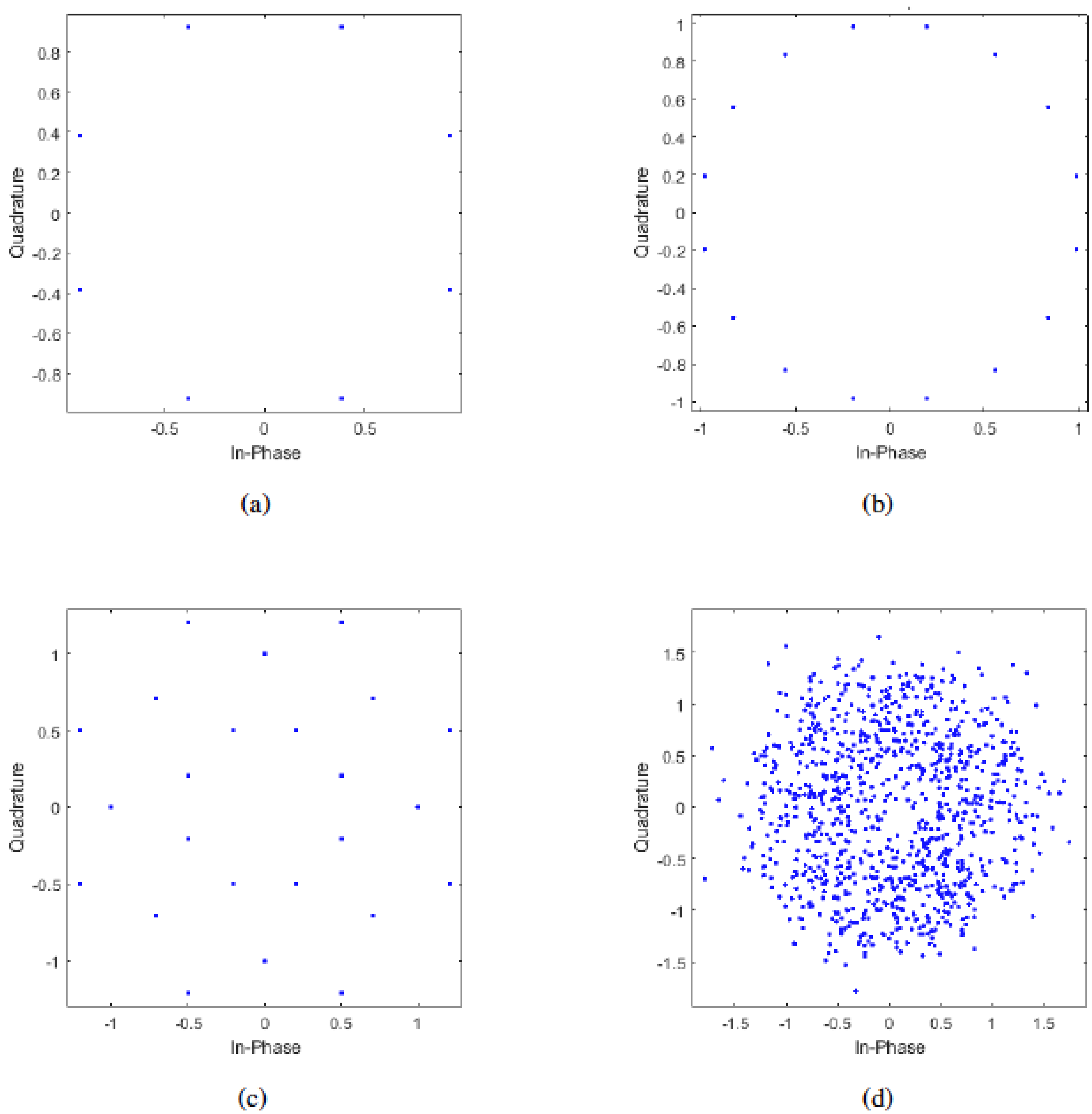

Figure 1

The constellation of scrambled 4-QAM data with : (a) 1-D scrambling using 8-PSK sequences (b) 1-D scrambling using 16-PSK sequences (c) 2-D unitary scrambling (d) 2-D unitary convolutional scrambling

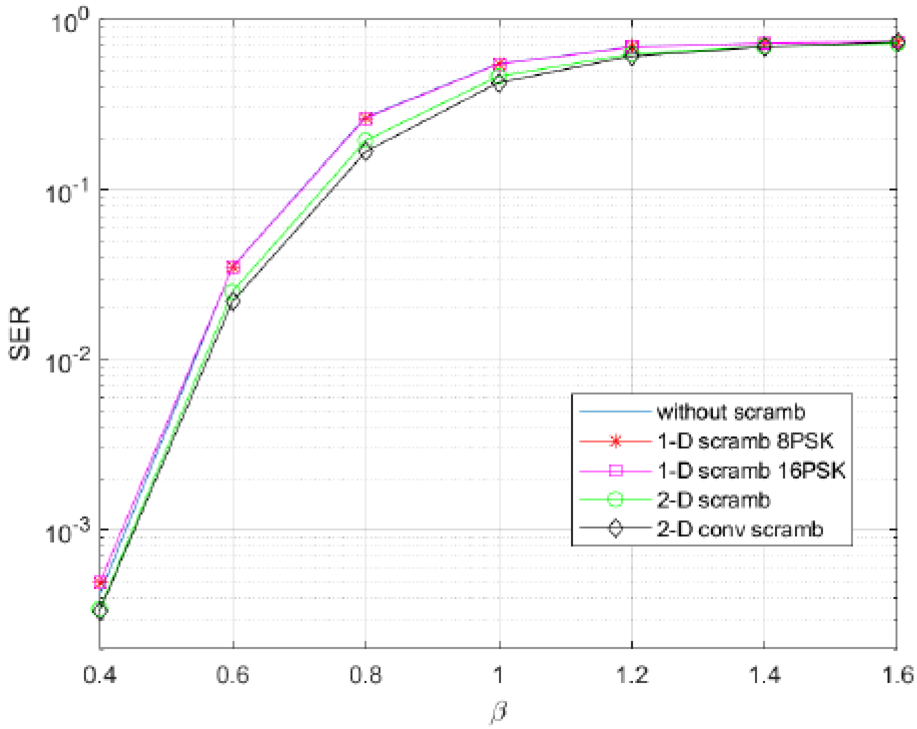

Figure 2

SER versus b for L = 3, M = 60, Eb=N0 = -2dB, for the CMA without scrambling, the CMA with 1-D scrambling and the CMA with 2-D scrambling.

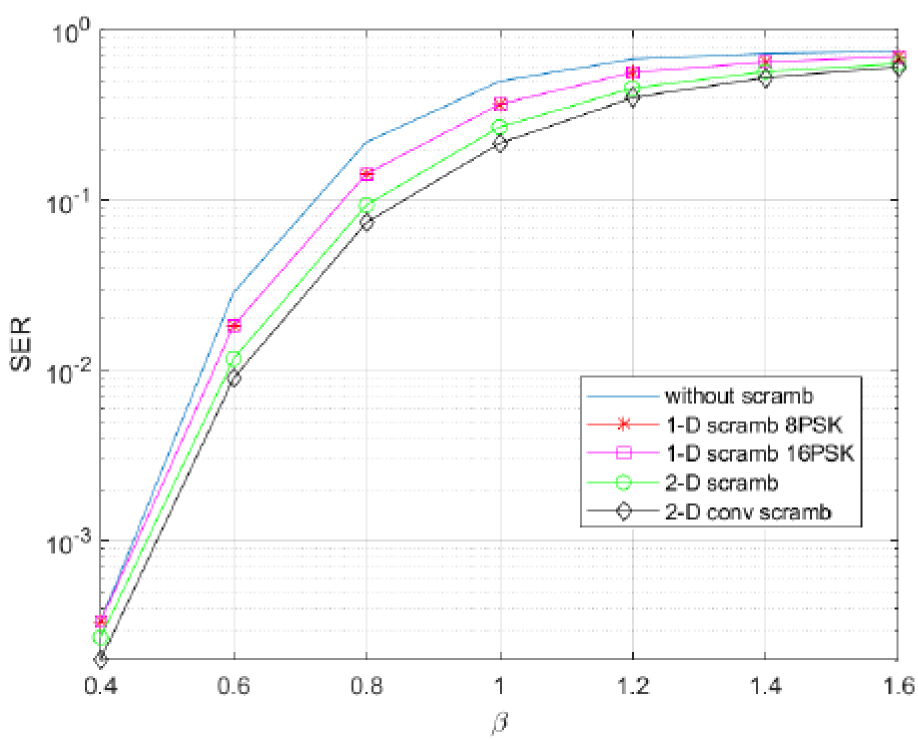

Figure 3

SER versus b for L = 3, M = 60, Eb=N0 = -2dB, for the MCMA without scrambling, the MCMA with 1-D scrambling and the MCMA with 2-D scrambling.

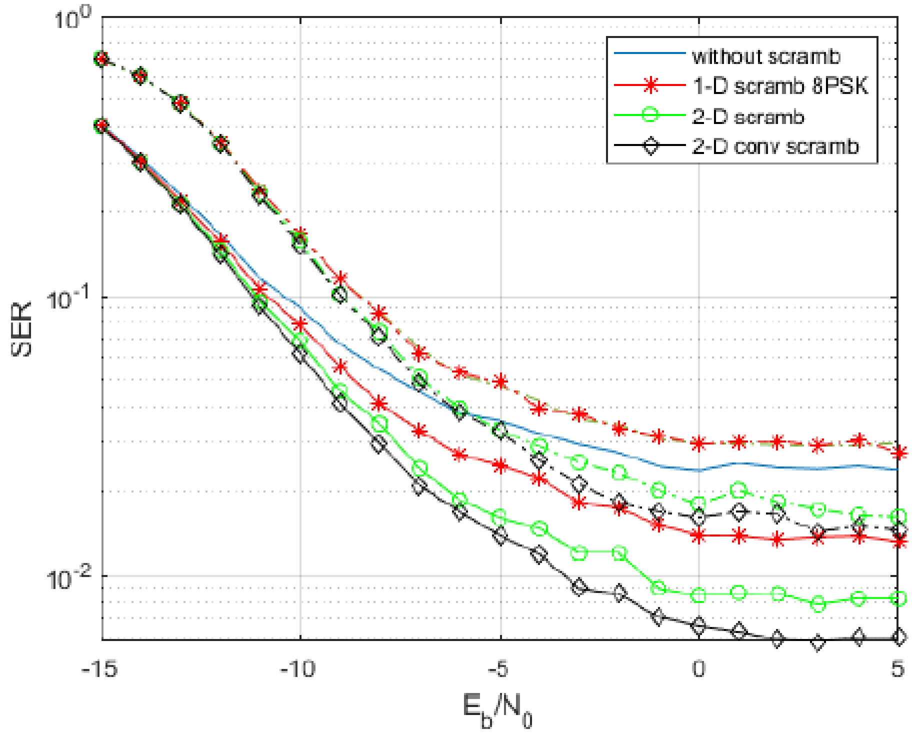

Figure 4

SER versus Eb=N0 for L = 3, M = 60, b = 0:6, for the CMA (dotted curves) and the MCMA (solid curves) without scrambling, with 1-D scrambling using 8PSK sequences, with 2-D scrambling and with 2-D convolutional scrambling

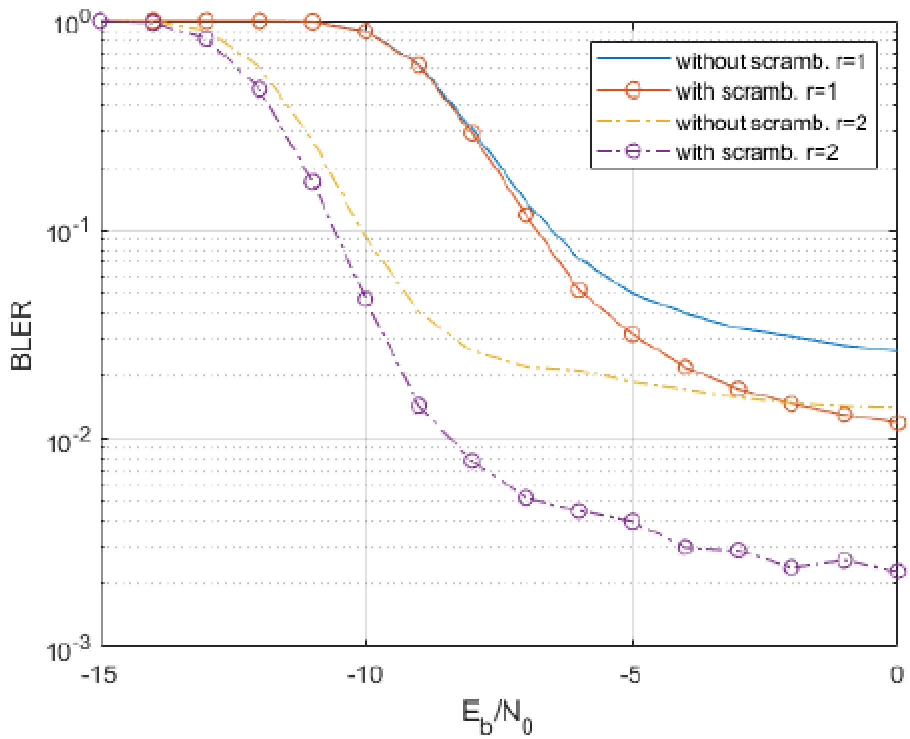

Figure 5

BLER versus Eb=N0 for L = 3, M = 60, b = 0:7 for the MCMA without scrambling and the MCMA with 8-PSK scrambling for 2 transmissions (scenario 1).

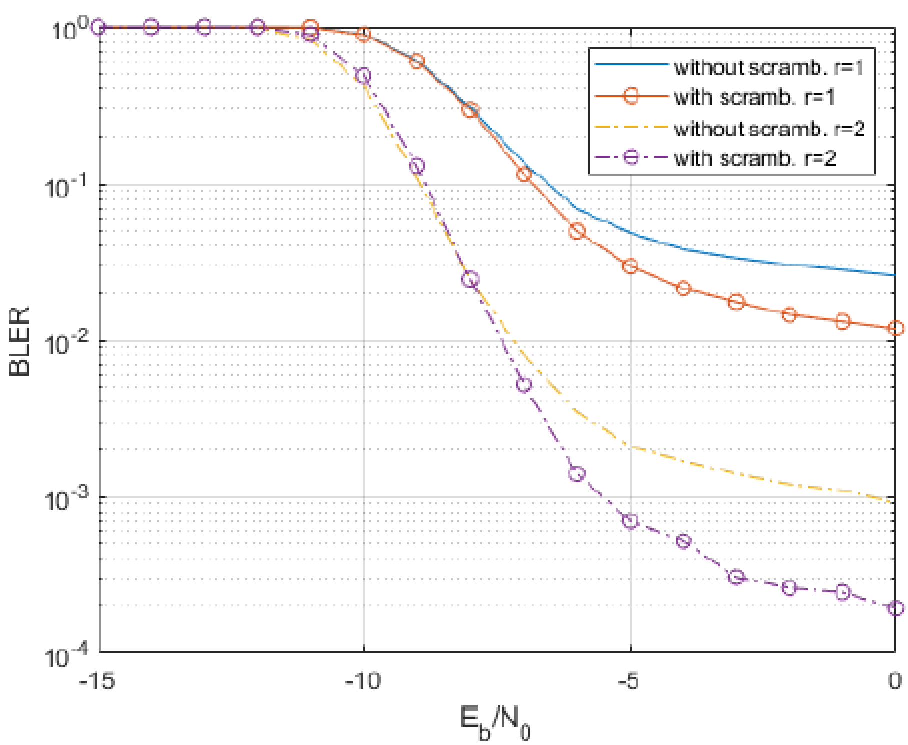

Figure 6

BLER versus Eb=N0 for L = 3, M = 60, b = 0:7 for the MCMA without scrambling and the MCMA with 8-PSK scrambling for 2 transmissions (scenario 2).