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Nonlinear Iterative Precoding Algorithm for MIMO Multiuser Systems

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Abstract—A modification of the known linear precoding algorithm CLTD (closed-loop transmit diversity) intended for multiuser radio communication systems and using the MIMO technology has been proposed. The efficiency of the original precoding algorithm CLTD possessing a number of advantages as compared to earlier precoding methods based on complete information about the communication channel state is enhanced at the expense of introducing nonlinearity. The use of nonlinear procedure of ordered successive interference cancellation (OSIC) in forming the precoding matrix makes it possible to significantly increase the noise immunity of the entire system as a whole at the expense of a slight rise of algorithm computational complexity. In addition, the results of computer simulation are presented reflecting the efficiency of the proposed modification of the algorithm for forming a precoding matrix as compared to the original CLTD algorithm.

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1. INTRODUCTION

The current radio communication standards include the spatial processing of signals implying the use of MIMO (Multiple-Input-Multiple-Output) multi-antenna systems. The use of MIMO technology in communication systems makes it possible to significantly increase the capacity, but involves the need of solving many problems of signal processing.

The existing standards of the fourth generation communication systems stipulate the use of precoding, i.e., algorithms for preliminary signal processing at the transmitting side. The efficiency of precoding becomes apparent both for the case of single user MIMO systems and for the case of several users in Multiuser MIMO systems. The use of precoding enables us to transmit data through communication channel in the most effective way, ensure a high noise immunity, and eliminate the interuser interference at the expense of introducing specific predistortion into transmitted signals.

2. STATEMENT OF PROBLEM

Communication systems of the fourth generation provide for the use of codebook-based precoding algorithms [2] representing discrete precoding algorithms. Such algorithms imply the presence of a finite set of precoding matrices at the transmitting side. These matrices determine the predistortion introduced into signals transmitted over different spatial channels. Discrete precoding algorithms require the transmission of appropriate indicators via the feedback line from the receiver to transmitter for selecting the most suitable precoding matrix.

The precoding algorithms based on calculation of the precoding matrix by using data about the current state of communication channel or data about the correlation of fading in the channel can be more effective as compared to the discrete precoding algorithms. However, such “non-discrete” algorithms require a larger amount of information transmitted over the feedback line from the receiver to transmitter that may not be always implemented due to the frequency resource limitations.

The known linear precoding algorithms: ZF (zero forcing), MMSE (minimum mean square error), and BD (block diagonalization) described in [9, 13, 14] perform the calculation of precoding matrix on the basis of information about the current state of channel and possess not high computational complexity. The common nonlinear precoding algorithms, for example, THP (Tomlinson-Harashima Precoding) [5, 16] based on the Kosta precoder principle [1] and its modifications [16] ensure a high noise immunity as

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