

算法研究

视距相关信道下考虑非理想CSI的多用户MIMO收发联合设计

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摘要:

在FDD模式多用户MIMO(Multi-input Multi-output)系统下行链路中, 由于信道估计、反馈信道等存在误差, 使得发送端获取理想信道状态信息(CSI, channel state information)十分困难。针对获得非理想CSI的多用户MIMO系统, 考虑在基站和各用户的天线分别具有相关性并引入视距分量的信道条件下, 提出了一种新的基于块对角化的MMSE准则收发联合设计算法。该算法首先通过块对角化消除用户间的共信道干扰, 然后针对存在信道估计误差的用户信道依据MMSE准则分别迭代求解每个用户预编码和解码矩阵。论文设计出一种基于训练序列的信道估计误差算法, 并获得等效信道模型, 使得收发端获得的信道状态信息更有实际意义。本文假设反馈信道理想, 发射端可以完整得到信道估计矩阵。在MMSE准则下, 推导获得了Lagrange乘子的解析解, 避免了求解非线性方程的复杂过程, 显著降低了计算复杂度。和已有算法相比, 该算法不仅可以获得良好的误码性能还可以对各用户进行独立优化, 处理更加灵活。仿真分析了视距分量、信道相关性以及信道估计误差对算法性能的影响。仿真结果表明, 该算法误码性能良好, 算法收敛快, 并且对信道估计误差带来的影响有较好的抑制作用。

关键词: 多用户MIMO; 预编码; 块对角化; 最小均方误差; 信道估计误差

Multi-user MIMO Transceiver Design in LOS Correlated Channels with Imperfect CSI

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Abstract:

Multi-user MIMO (multi-input multi-output) system has been studied in number of papers in recent years. In this paper, a novel multi-user transceiver algorithm is proposed for the system. In the multi-user MIMO system under FDD mode for the downlink, because of the channel estimation error and feedback channel error, it is difficult to obtain the perfect channel state information (CSI) at transmitter. With the consideration of both the line-of-sight(LOS) component and the correlation at both the transmitter and users, a minimum sum MSE criterion MIMO transceiver design algorithm based on block diagonalization is proposed. It is supposed that there is only imperfect CSI at both ends of the link. Firstly, the proposed algorithm eliminates the co-channel interference (CCI) among all the users through block diagonalization (BD), and then computes the precoding and decoding matrices by iteratively for users' channel with channel estimation error. This paper deduces a channel estimation error algorithm and obtains an equivalent channel model based on training sequence, which makes the CSI obtained by transmitter and receiver more practical. We provide feedback channel is perfect, so the transmitter could obtain the channel estimation matrix with estimation error only. The analytic solution of Lagrange factor is obtained by using MMSE criterion, avoiding the complicated nonlinear equation, so that the computational complexity distinctly is reduced. Compared with the existing transceiver design algorithm, the proposed not only has good bit error, but also optimizes the transceivers of the users independently and flexibly. The influence of LOS component, correlation of the channel and channel estimation error on the performance of the algorithm is investigated. The simulation results shows that the proposed algorithm has a better BER performance compared with BD algorithm, only needs 4 iterations to convergence when the SNR is 20dB and the negative effect of the channel estimation error on the performance has been suppressed effectively.

Keywords: multi-user MIMO precoding block diagonalization MMSE; channel estimation error

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