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Likelihood Ascent Search Detection for Coded Massive MU-MIMO Systems to Mitigate IAI and MUI

N. R. Challa[1*] and K. Bagadi[1]**
[1] *VIT University, Vellore, India*
**ORCID: 0000-0001-9909-3849, e-mail: nagaraju.challa@vit.ac.in*
***ORCID: 0000-0003-1082-1972, e-mail: bkpraveen@vit.ac.in*

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Abstract—The main aim of massive multiuser multiple-input multiple-output (MU-MIMO) system is to improve the throughput and spectral efficiency in 5G wireless networks. The performance of MU-MIMO system is severely influenced by inter-antenna interference (IAI) and multiuser interference (MUI). The IAI occurs due to space limitations at each user terminal (UT) and the MUI is added when one UT is in the vicinity of another UT in the same cellular network. IAI can be mitigated through a precoding scheme such as singular value decomposition (SVD), and MUI is suppressed by an efficient multiuser detection (MUD) schemes. The maximum likelihood (ML) detector has optimal performance; however, it has a highly complex structure and involves the need of a large number of computations especially in massive structures. Thus, the neighborhood search-based algorithm such as likelihood ascent search (LAS) has been found to be a better alternative for mitigation of MUI as it results in near optimal performance with low complexity. Most of the recent papers are aimed at eliminating either MUI or IAI, whereas the proposed work presents joint SVD precoding and LAS MUD to mitigate both IAI and MUI. The proposed scheme can achieve a near-optimal performance with smaller number of matrix computations.

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1. INTRODUCTION

The ever rising demand for high data rate applications and the trend of drastically increasing numbers of wireless subscribers ignited researches to focus on advanced future wireless communication technologies such as massive multiuser multiple-input multiple-output (MU-MIMO) system [1, 2].

The MU-MIMO is a wireless communication technology that is designed to increases the capacity and performance according to the need of next generation 5G wireless systems [3]. Unlike the conventional MIMO, a massive MU-MIMO system has a base station (BS) equipped with a large number of antennas (from hundreds to a thousand). This BS is dedicated to communicate with several user terminals (UT) simultaneously, where each UT is equipped with fewer antennas [4].

The theoretical analysis of the communication system states that the massive MU-MIMO offers reliable communication [5]. However, the MU-MIMO system faces several baseband processing challenges such as inter-antenna interference (IAI) and multiuser interference (MUI) [6, 7]. The optimal performance cannot be achieved unless both IAI and MUI are moderated [8–11].

IAI occurs when the spacing between multiple antennas placed at each UT becomes much smaller than that of the conventional half-wavelength rule. Efficient precoding schemes can be used at each UT to mitigate IAI so that it is possible to enhance the accuracy of data transmission [12].

Linear precoding schemes such as matched filter (MF) [13], zero-forcing (ZF) [14] and minimum mean square error (MMSE) [15] are used for MU-MIMO systems to attain sub-optimal performance with less computational complexity. The nonlinear precoding schemes are capable of providing near-optimal performance, but their order of complexity is more elevated in practice [16–19].

Thus, there exists a clear trade-off between the performance and complexity while designing a precoding scheme for MU-MIMO system. So, there is a necessity of a precoding scheme that provides near-optimal performance with fewer mathematical computations [20].

CONFLICT OF INTEREST

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ADDITIONAL INFORMATION

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