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Sum-Rate Performance of Massive MIMO Systems in Highly Scattering Channel with Semi-Orthogonal and Random User Selection[1]

Tasher Ali Sheikh*, Joyatri Bora, and Md. Anwar Hussain*****

North Eastern Regional Institute of Science and Technology, Arunachal Pradesh, India

**ORCID: 0000-0002-6014-4263, e-mail: tasher372@gmail.com*

***e-mail: jb@nerist.ac.in*

****e-mail: ah@nerist.ac.in*

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Abstract—The sum-rate performance of a massive MIMO system is dependent on the adequate user and antenna selection techniques. It is best when all the selected users are mutually orthogonal (MOU) and antennas are selected based on maximum channel gain. In the case, when number of antennas in massive MIMO is approximately hundreds, the computational complexity cost in joint user and antenna selection is very high. Semi-orthogonal user selection (SUS) is preferred to reduce interference and complexity cost. In highly scattering Rayleigh fading channel random user selection (RUS) technique can be used because of small loss of system sum-rate compared to SUS and MOU techniques. In this paper we propose a joint user and antenna selection algorithm where users are scheduled using semi-orthogonality measure and antenna selection is based on maximum channel gain. In addition, an algorithm for joint user and antenna selection is reported here with RUS for user selection and maximum channel gain for antenna selection. We explore the system sum-rate performance of a massive MIMO system using these algorithms for the case of a highly scattering Rayleigh fading channel. We consider various precoding techniques MMSE, ZFBF, and MRT and a range of SNR. We also explore the effect of spatial and multiuser diversity on system sum-rates using proposed algorithms. The sum-rate obtained by algorithms-1 is greater than the algorithm-2 about 1–3% but second one is much simpler.

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1. INTRODUCTION

Wireless multimedia communication which is the most prevalent now requires high data rate demand from the users on the service providers. Current developments in wireless communication systems are primarily focused on enhancing the user data rates with affordable price.

Massive MIMO has the potential to provide huge data rates with adoption of 5G technology [1]. In massive MIMO system, large number of base station (BS) antennas, which can be of the order of hundreds, can concurrently serve a number of users by limited transmitting power and spectrum within a cell. Because of high degree of freedom in massive MIMO system, the spectral efficiency is enhanced providing higher system sum-rate [2].

As massive MIMO is equipped with large number of antenna arrays and there are huge number of active users with single or multiple antennas, the computational complexity and cost is very high for joint user and antenna selection for the best system sum-rate performance [3]. By using semi-orthogonal user selection technique we reduce the computational cost, but the system sum-rate is compromised.

In the conventional multi-user MIMO (MU-MIMO) system for antenna and user selection it is considered that the number of users N is twice than the number of BS antennas M. This boosted the system capacity because of very high diversity gain. However, in the scenario of massive MIMO it is not possible

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