A Thesis for the Degree of Ph.D. in Engineering

A Study of Antenna and User Selection Schemes for Multiuser Massive MIMO Systems

August 2021

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Thesis Abstract

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Thesis Summary

In the 4th generation mobile communication system, high-speed data transmission is achieved by spatially parallel data transmission between the base station and multiuser using multiple-input multiple-output (MIMO) antennas. However, to meet the rapidly increasing traffic demand, further increase in speed and capacity is required. In mobile communication systems of the 5th generation and later, many antennas are placed in the base station, and multiuser massive MIMO (MU-Massive MIMO) Time Division Duplex (TDD) mobile communication system is promising. But, to maximize the effective use of the transmission power of the base station and maximize the throughput, it is necessary to select antenna sets with excellent propagation path conditions among many antennas of base station and users while reducing the amount of calculation. In this thesis, we propose methods to efficiently select the combination of base station (BS) antennas and multiusers with a small amount of calculation, then clarify the effectiveness of the proposed methods by computer simulation for MU-Massive MIMO systems with TDD mode. Evaluation results show that high throughput can be achieved based on channel gain (CG) and signal to interference and noise ratio (SINR). Chapter 1 describes the features of high-speed, large-capacity transmission technologies such as MU-Massive MIMO and beamforming, which are promising for mobile communications from the 5th generation onward. The issues regarding the selection of the BS antennas and receive users are described, and the purpose and position of this research are summarized. Chapter 2 describes the conventional research related to our research, then clarifies their problems. Chapter 3 describes the MU-Massive MIMO system model for our research works and presents a BS antennas and users selection scheme with a small amount of calculation. The proposed method is based on the Frobenius Norm of the channel information. The selection scheme is simplified by using complexity control factor for the preselection step. And then, the brute force search (BFS) fine tuning selection will be done based on assumption of deterministic MIMO channel to avoid the high computation of singular value decomposition (SVD) requirement for beamforming transmission in downlink communication. As a result of computer simulation, it is shown that the proposed method can reduce the amount of calculation required for selection while maintaining almost the same throughput as the conventional method. Chapter 4 proposes a BS antenna and multiuser selection method based on CG as well as SINR. In the proposed method, users with higher channel gains but lower interferences from surrounding users will be selected by discarding all users who give higher interferences to the selected users in the cell. This kind of selection can be done based on the fine-tuning BFS search on the CG-based and SINR-based users sets. Computation complexity of BFS search can be reduced based on the common users of CG-based and SINR-based users sets. As a results of computer simulation, it is shown that the proposed method achieves higher throughput and reduces the amount of calculation required for user selection compared to the conventional method. Chapter 5 is a conclusion that summarizes the content of the thesis and future issues.