Antenna Assignment for K-means Based User Clustering in Ultra-dense Distributed RAN

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1. Introduction

A cluster-wise distributed MU-MIMO is considered to be able to improve the link capacity and mitigate the computational complexity problem of ultra-dense RAN. From our previous study [1], user clustering and antenna assignment achieves higher link capacity of zero-forcing (ZF)-based cluster-wise MU-MIMO. In this paper, we propose a new antenna assignment method and compare it with the methods in [1].

2. System Model and Simulations

In this paper, we consider a cluster-wise ZF-based MU-MIMO downlink, in which U single-antenna users and A distributed antennas (DAs) are grouped into K clusters. Firstly, the well-known K-means algorithm is utilized to cluster users by their locations with an initial centroid setting to group users with strong mutual interference in the same cluster as far as possible. Then, each DA is assigned to corresponding user cluster to perform the ZF-based MU-MIMO as shown in Fig.1.

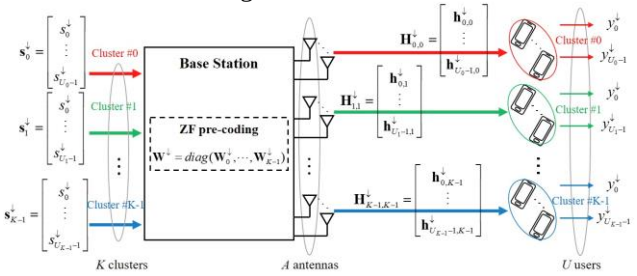

Fig. 1 Downlink transmission model of ZF-based cluster-wise distributed MU-MIMO.

In [1], we proposed two antenna assignment methods, i.e., shortest user-DA (U-A) distance-based one and shortest centroid-DA (C-A) distance-based one, those consider each user cluster as a whole. In order to make the number of users and that of DAs in each cluster meet the requirement of ZF, it may happen that DAs near some users are not assigned to the cluster of those users and consequently, those users have lower signal strength and higher inter-cluster-interference. To avoid this problem, we consider an DA assignment strategy based on each user. Different from the previous methods, we assign at least one DA to each user according to the shortest U-A distance criterion, accordingly, the assigned DAs joins the cluster of that user.

The proposed method is compared with previously proposed methods in terms of the sum capacity. In simulation, we consider a 1 x 1 normalized square BS cell area, over which A=128 DAs and U=64 users are randomly located. Throughout the simulation, a certain fixed DA distribution is used, while user distribution changes 1000 times. And the MIMO channel is characterized by the pathloss, shadowing, and Rayleigh fading. The sum capacity at CDF equals to 50% achievable by three DA assignment methods is plotted as a function of K in Fig. 2. As can be seen, irrespective of whether the propagation environment is characterized by only path loss or by shadowing and fading, the performance of proposed method is the best (5% improvement over C-A), followed by U-A distance-based method and C-A distance-based method. This is because it ensures that there is at least one DA close to each user and improves the signal strength of users.

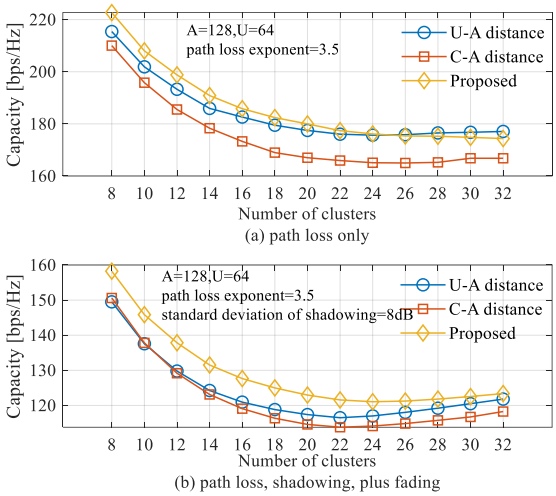

Fig. 2 Comparison of antenna assignment methods under different number of clusters.

3. Conclusion

In this paper, we proposed a new user-based DA assignment method to improve the sum capacity of ZF-based cluster-wise MU-MIMO. Compared with the previously proposed cluster-based DA assignment methods, it provides a maximum improvement of 5% over C-A method. Adaptive power allocation is left as our future study.

Acknowledgement

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Reference

[1] S. Xia, C. Ge, Q. Chen, F. Adachi, “A Study on Cluster-wise User-antenna Association in 5G Advanced Ultra-dense RAN” IEICE Technical Report, vol. 120, no. 29, RCS2020-11, pp. 7-12, May 2020.