Robustness of Reinforcement Learning-based Interference Coordination for Distributed MU-MIMO

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1. Introduction

In our previous studies, we proposed a graph coloring-based algorithm for inter-cluster interference coordination in distributed MU-MIMO, named as RCN-GCA [1]. Recently, we also proposed a reinforcement learning-based interference coordination algorithm, named as RL-GCA [2]. Based on the computer simulation assuming a certain propagation environment, we have confirmed that our recently proposed RL-GCA significantly improves the link capacity compared with RCN-GCA and other non-intelligent GCA, such as Dsatur. We have also obtained an interesting result in terms of chromatic number (required minimum number of colors), i.e., less chromatic number does not necessarily lead to a better interference coordination. Under the assumed propagation environment, the best chromatic number which maximizes the achievable link capacity is shown to be 4.

In this paper, we compare the performances under different propagation environment in order to test the robustness of our proposed RL-GCA. The environment is simulated by generating the shadowing loss and Rayleigh fading for each user's location. The shadowing standard deviation is fixed as 8[dB], while the pathloss exponent is varied from 2 to 4.

2. Simulation Results

We assume a service area consisting of 96 users and 128 antennas. 6 user-clusters are formed for cluster-wise distributed MIMO. In Fig.1, the 50% sum capacity and 10% user capacity (note: x% capacity means the capacity at CDF=x% level) is plotted for RL-GCA, RCN-GCA, Dsatur, and the 1 color's case (no interference coordination). Among the RL-GCA, RCN-GCA, Dsatur, and the 1 color's case, the highest capacity is obtained by RL-GCA, followed by RCN-GCA and Dsatur. For the sum capacity, the RL-GCA is able to obtain an average 90% increase compared with 1 color's case while RCN-GCA and Dsatur is 78%. For the user capacity, the RCN-GCA and Dsatur achieves around 18 times higher capacity than the 1-color's case, while the RL-GCA is almost 23 times.

Also confirmed was that the chromatic number for RL-GCA equals 4 irrespective of the pathloss exponent, which provide further evidence for our previous conclusion that 4 could be the best chromatic number which maximizes the achievable link capacity.

3. Conclusion

In this paper, we tested the robustness of our proposed reinforcement learning-based interference coordination for cluster-wise distributed MU-MIMO under different propagation environment. The computer simulation confirmed that RL-GCA consistently improves the downlink capacity compared with graph coloring-based interference coordination algorithm under different propagation environments.

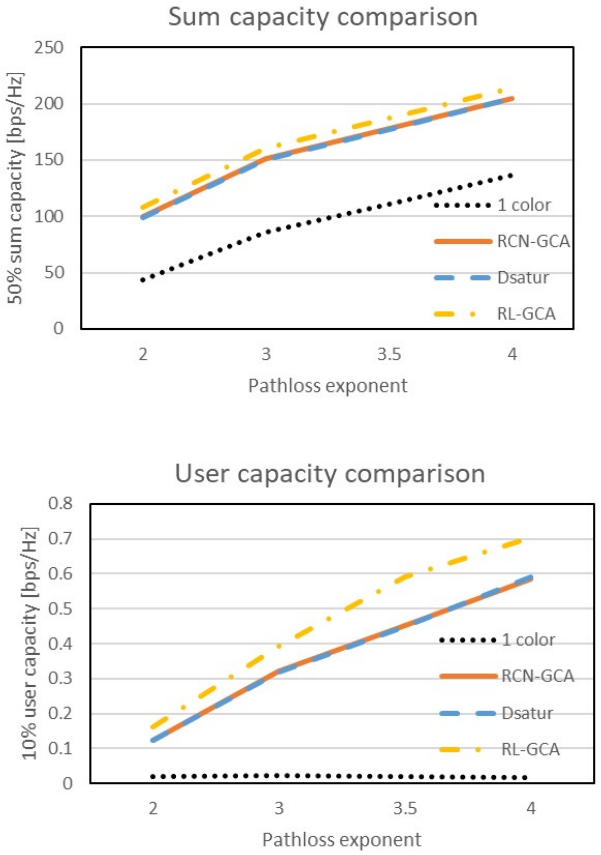

Fig. 1 Sum capacity and User capacity comparison

ACKNOWLEDGMENT

A part of this work was conducted under "R&D for further advancement of the 5th generation mobile communication system" (JPJ000254) commissioned by the Ministry of Internal Affairs and Communications in Japan.

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