Performance Improvement of Drone MIMO Relay Station Using Selection of Drone Placement

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***Abstract*— This paper evaluates multiple-input multiple-output (MIMO) transmission when a small autonomous unmanned aerial vehicle (drone) is used as a relay station. Although the propagation loss is reduced by using the drone relay station, it has the issue of increased spatial correlation due to the direct wave. Therefore, we clarify that the channel capacity characteristics of MIMO system using drone relay stations are improved by introducing a propagation environment control method (PECM) that selects drones in optimal arrangement from multiple drones.**

Keywords*— Drones; relay stations; MIMO; propagation path loss, propagation environment control method (PECM).

I. Proposed System

Although MIMO transmission widely which is used in mobile communication systems is effective in multipath environment, propagation loss in urban area is inversely proportional to the power of three to four of the propagation distance [1]. The authors have proposed a system that realizes an environment close to free space propagation loss by using drone as a relay station in the line-of-sight (LOS) environment [2]. In MIMO transmission under the LOS environment, the channel capacity characteristics deterioration due to direct waves occurred, but it was confirmed that channel capacity characteristics are improved by using the PECM that adds control to the drones' flight [2].

However, in the study in [2], a basic environment was assumed in which the propagation loss according to the transmission / reception distance is set as the signal-to-noise power ratio (SNR). In this paper, it is evaluated that channel capacity characteristics in case of designing a concrete hardware considering transmission power and antenna gain in optimum drone placement selection in the PECM.

II. Evaluation by Computer Simulation

Fig. 1 shows the comparison of the distance characteristics of the channel capacity with and without the introduction of the PECM for the proposed system assuming 4 x 4 MIMO. In this paper, as the PECM, we conducted a simulation to select 4 drone from among 8 drones so that the spatial correlation during MIMO transmission is lowered. Considering the millimeter wave in the fifth generation mobile communication system, the center frequency was set to 66 GHz. In addition, the transmission power is 20 dBm, the transmission and reception antenna gain is 10 dBm, the thermal noise power is -174 dBm / Hz, and the bandwidth is 20 MHz. Fig. 1 plots the channel capacity characteristic when the transmission / reception distance of the transmission / reception station is 10 to 200 m, the CDF value of 5%, 50% and 95%. From Fig. 1, the convergence of the channel capacity distribution and the increase of the upper limit value can be confirmed by the PECM.

III. Conclusion

In this paper, it is clarified that channel capacity characteristics are improved by introducing the PECM that selects the optimum drone layout for MIMO system using drone relay stations in millimeter wave band.

Acknowledgment

The part of this work was supported by the SCOPE #165004002, #185004002 and KAKENHI, Grant-in-Aid for Scientific Research (B) (17H01738, 17H03262).

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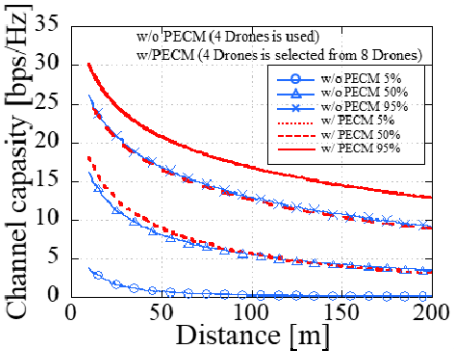

Fig. 1 Channel capacity versus distance.

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