NOMA 에서 UAV 사용자를 활용한 유연한 페어링 성능 분석

이만희, 신수용*
금오공과대학교

fordmore@kumoh.ac.kr, *wdragon@kumoh.ac.kr

On the performance analysis of flexible pairing between GU and UAV in NOMA

Man Hee Lee, Soo Young Shin*
Kumoh National Institute of Technology

Abstract

This paper presents the performance of flexible pairing between ground user (GU) and UAV with non-orthogonal multiple access (NOMA). In a cell, UAV travels in different path to give the diversity of movement to make a flexible pairing. To do this pairing, UAV channel modeling is required as a special case. Moreover, the height and distance of UAV is included to calculate the variance of channel considering path loss. Our research approach is shown that UAV is considered as a pairing user for NOMA in order to maximize the sum capacity. The analysis of proposed system is derived and simulated in varying as variables of UAV characteristic. Monte Carlo-based analytic and simulation results are validated in terms of sum capacity with height and distance of UAV.

Ⅰ. Introduction

In recent years, non-orthogonal multiple access (NOMA) has been considered as predominant and leading radio access technology (RAT) to improve spectral efficiency in 3GPP. NOMA exploits nonorthogonal resources to overcome the limited number of available channel resources. Furthermore, NOMA is proved its superiority in terms of overall system capacity.[1]

Following these research trends, an increasing number of studies have focused on investigating the use of non-orthogonal multiple access (NOMA) with unmanned aerial vehicles (UAVs).[2] UAVs are used as sub base station (BS) and provide multiple connection over the cell. In [3], the placement and power allocation (PA) for a NOMA-UAV network were proposed. In [4], the max-min rate optimization problem was formulated under constraints of the total power, total bandwidth, UAV altitude, and antenna beam width.

In this paper, the performance of flexible pairing within the routine is evaluated for UAV surveillance in a cell. In the conventional network, UAV is used as BS for serving wireless access to other users. On the other hands, this paper considers UAV as one of users in NOMA. The analysis of sum capacity is derived and

Ⅱ. System model

A UAV can be cell center user (CCU) or cell edge user (CEU) depending on given routine. Fig. 1 illustrates the wireless communication scenario involving a single UAV and multiple ground users (GUs).

In this network, the base station (BS) serves a UAV and GUs which are equipped with a single antenna. The signal received by the i th user from BS can be expressed as

$$y_i = h_i \sum_{i=1}^{N} \sqrt{\rho \phi_i} x_i + n_i \qquad (1)$$

where h_i the Rayleigh fading channel between BS and multiple users, x_i is transmitted signal and n_i denotes the additive white Gaussian noise (AWGN) with zero mean and variance σ^2 for ith user.

The received signal-to-interference-noise-ratio (SINR) at the ith user is represented as

$$\gamma_i = \frac{\rho |h_i|^2 \phi_i}{\rho |h_i|^2 \sum_{k=2}^{K} \phi_k + \sigma^2} \qquad (2)$$

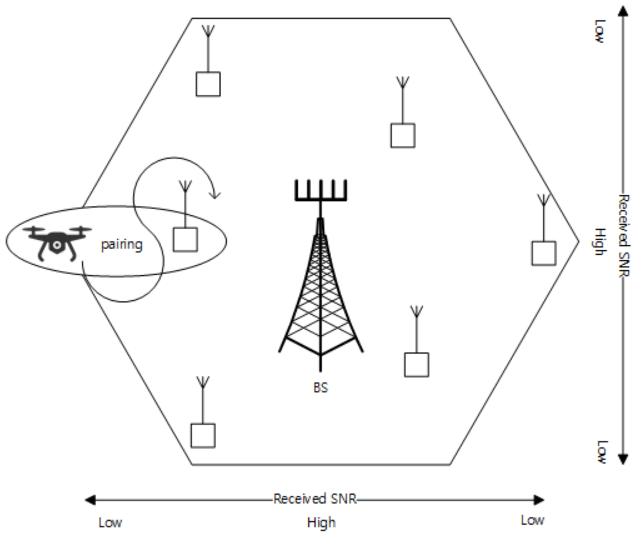

Figure 1 System model

Ⅲ. Simulation results & Conclusion

In this paper, Monte Carlo-based simulation results are performed to evaluate the proposed pairing schemes compared with the conventional scheme.

Furthermore, both analytical and simulation results are validated.

The system bandwidth is normalized to $B = 1$ and radius of the cell is also normalized. Here, the maximum distance is defined as $d = 1$. According to our system model, we assume a pairing between UAV within flexible location and GU within fixed location. To maximize LoS characteristic, the power allocation coefficient are $\phi_1 = 0.2$ and $\phi_2 = 0.8$.

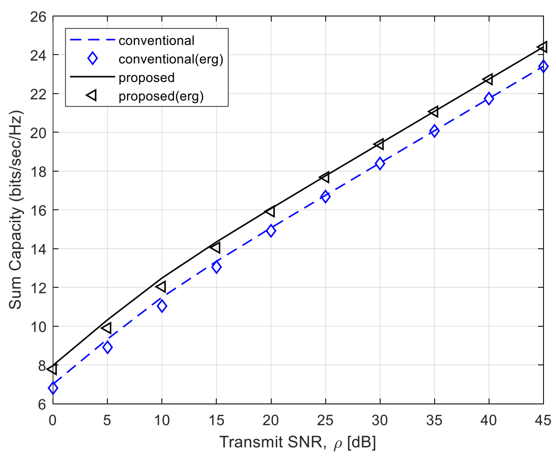

Figure 2 Sum capacity w.r.t transmit SNR

In Fig. 2, the enhancement of sum capacity is represented as a comparison of the proposed and conventional scheme with respect to SNR ρ [dB] when UAV is located at the CCU. The distance between BS and UAV and between BS and GU are $d_1 = 0.2$, $d_2 = 1$.

The power allocation coefficients are $\phi_1 = 0.2$, $\phi_2 = 0.8$, respectively. The path loss for UAV and GU is equal to $v = 4$. The height of UAV is assumed as two times higher than GU.

This paper presents the performance of flexible pairing between GU and UAV with NOMA. The UAV channel modeling is required to do a flexible pairing because the UAV travels different path and location.

Hence, the height and distance of UAV determines the covariance of channel with path loss component. The analysis of sum capacity is derived and simulated in varying with height and distance of UAV. Monte Carlo-based simulation and analytic results are validated to maximize LoS characteristic.

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References

[1] J. Cui, Y. Liu, A. Nallanathan, "Multi-agent reinforcement learning-based resource allocation for UAV networks", IEEE Transactions on Wireless Communications, 19(2), pp. 729-743, 2019.

[2] X. Liu, J. Wang, N. Zhao, Y. Chen, S. Zhang, Z. Ding, F. R. Yu, "Placement and power allocation for NOMA-UAV networks" IEEE Wireless Communications Letters, 8(3), pp. 965-968, 2019.

[3] A. A. Nasir, H. D. Tuan, T. Q. Duong, H. V. Poor, "UAVenabled communication using NOMA" IEEE Transactions on Communications, 67(7), pp. 5126-5138, 2019.

[4] T. Hou, Y. Liu, Z. Song, X. Sun, Y. Chen, "Multiple antenna aided NOMA in UAV networks: A stochastic geometry approach", IEEE Transactions on Communications, 67(2), pp. 1031-1044, 2018.