Capacity Enhancement for Index Modulation based RIS-OAM Communication

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***Abstract*—Orbital angular momentum (OAM) based wireless communication has been proposed as a potential scheme for enhancing the capacity due to the OAM mode multiplexing. However, deploying OAM in wireless communication need many assumptions to avoid limitation. In this paper, a novel index modulation scheme for reconfigurable intelligent surface (RIS) assisted OAM communication is proposed to improve capacity and energy efficiency.**

***Index Terms*—Orbital angular momentum, reconfigurable intelligent surface, index modulation, capacity, 6G**

I. Introduction

Orbital angular momentum (OAM) has been considered as one of the potential multiplexing solutions for beyond 5G and 6G wireless communication. In the OAM system, mode division multiplexing (MDM) is proposed to improve channel capacity by using the OAM mode orthogonality without consuming more frequency and time resources [1]. However, OAM-MDM is not enough to satisfy the higher level of requirement for future wireless communication.

Moreover, deploying OAM in radio communication has some challenges such as beam divergence and alignment between transmitter and receiver antenna. Therefore, most of the previous works for the OAM systems have focused on the short-range and line of sight (LoS) environment with perfect alignment. To further improve channel capacity and overcome limited coverage, several researchers start to integrate OAM with other techniques such as reconfigurable intelligent surface (RIS) and index modulation (IM). In [2], the author proposed the basic geometrical model of RIS-assisted OAM with one uniform circular array (UCA) antenna for the transmitter and receiver and one RIS.

In this paper, the integration index modulation for RIS assisted OAM communication system is proposed to enhance the channel capacity. To extend [3], [4] for RIS-OAM-IM system, both activation of both OAM mode combination and sub-group RIS can be the additional index information.

II. System Model

In this paper, we assumed a base station, a user, and a RIS for the proposed system. Each transceiver has a singular UCA antenna with N antenna elements. The transceiver UCA can generate total L OAM modes. The RIS consists of total I reflecting elements and then can be divided into subgroup K including I/K subgroup elements. In the transmitter, each active mode can convey an M-ary quadrature amplitude modulation (QAM) symbol. The transmitted OAM beam can change the direction by reflecting activated subgroup RIS to the receiver. Here, the optimal phase shift scheme needs to be considered to further improve the performance. Based on this, the spectral efficiency for the proposed system can be defined as follow

$$R = L_A \log_2 M + \left\lfloor \log_2 \binom{L}{L_A} \right\rfloor + \left\lfloor \log_2 \binom{K}{K_A} \right\rfloor, \quad (1)$$

where L_A denotes the number of active modes and K_A is the number of active subgroup RIS.

III. Conclusion

In this paper, we investigate a novel IM scheme for RIS assisted OAM system to enhance capacity and cover the Non LoS condition. However, for the practical scenario, beam steering and optimal phase shift algorithms in RIS to the receiver will be considered in the future.

References

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