

An MM Based Hybrid Precoding in NOMA mMIMO with SWIPT

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ABSTRACT: Non-orthogonal multiple access (NOMA) is considered in millimeter-wave (mmWave) massive MIMO systems. It proves to provide better spectrum efficiency. In addition to that simultaneous wireless information and power transfer (SWIPT) could be considered as a suitable solution to maximize the energy efficiency. Further mMIMO and NOMA are used as wireless technologies of Air Interfaces in order to satisfy the rate requirement in enhanced mobile broadband (eMBB) application group. In this paper, a Minorization-Maximization (MM) based hybrid precoding is used along with the simultaneous wireless information and power transfer (SWIPT) to achieve higher spectrum and energy efficiency

KEYWORDS:NOMA, mMIMO, SWIPT, hybrid precoding

I. INTRODUCTION

Millimeter-wave (mmWave) mMIMO is emerging as a promising techniques for 5G wireless communications, as it provides wider bandwidth and high spectrum efficiency. Each antenna is allocated with a dedicated radio frequency (RF) in order to realize the fully digital signal processing in conventional MIMO systems. Thus, very large number of antennas required, which leads to large number of RF chains and its significantly results in huge cost for setup and leads to more energy consumption. This issue can be overcome by using hybrid precoding (HP) and it proves to significantly reduce the number of required RF chains in mmWave massive MIMO systems without an obvious performance loss.

In addition to that NOMA in mMIMO could be considered to increase the spectral efficiency. With the help of superposition coding (SC) and successive interference cancellation (SIC), more than one user can be supported in NOMA at each beam which makes it different from that of conventional mMIMO. This paper proposes a Minorization Maximization (MM) based precoding scheme which obtains the optimal precoding matrix by iterating work to increase the sum rate. The concept of SWIPT is introduced, so that both information and energy could be extracted from the same received RF signals, which can be realized by power splitting receivers in practice.

II. RELATED WORK

Wireless communications have become indispensable in this modern world. The number and variety of devices are increasing significantly and the same spectrum is being reused for same applications for number of times. Various communication techniques have evolved throughout every decade. As the world is progressing to the next gen 5G technology various techniques of communication are required to meet the expectations. NOMA can suitably used for 5G technology as it can increase the spectral efficiency to a greater extent when compared to the 4G[1]. It is also used in latest technologies like IOT to meet the requirements of QoS (quality of service)[2]. NOMA follows the concept of superposition coding (SC) and successful interference cancellation. In order to increase the sum rate a new Minorization-maximization (MM) based hybrid precoding is used[3]. SWIPT can be further used to achieve a higher spectrum and to increase the energy efficiency[4]. Thus, NOMA proves to be a suitable communication technique for 5G and other upcoming technologies.

III. PROPOSED METHOD

The proposed method makes use of the concept of MM based hybrid precoding. While using NOMA a new type of interference occurs which is called intra cluster interference (ICI) which is eliminated by SIC. Due to the sharing of frequency and time of users another interference called multi-cluster interference also occurs in NOMA and it can be suppressed by precoding before transmission. Since more than one user share a same method of precoding, a new precoding vector should be designed on basis of multiuser channel matrix.

In this paper a two layer hybrid precoding in NOMA-mMIMO is used which uses MM based precoding as digital part of hybrid precoding. Initially a clustering scheme is followed in which two suitable users are combined in a group. Then, a power allocation scheme is made use of to achieve the power difference required by NOMA for SIC. After evaluating the results it can be proved that the proposed method is better in performance on average sum rate and user fairness than the conventional zero forcing hybrid precoding method. It can be proved that as number of antennas equipped on the base station increases the average sum rate increases.

The concept of SWIPT is applied before precoding as each user can extract both information and energy from the RF signals that is received by this. Power splitting receiver is used to extract information and energy separately. Initially one user is selected per beam by cluster head algorithm and then according to the selected cluster head for the beam, the analog precoding is done. Then the user grouping is done on the basis of correlation of users' equivalent channel. After that by selecting the users with the strong equivalent channel gain in each beam, the digital HP is done.

Finally, by jointly optimizing power allocation for mmWavemMIMI-NOMA and power splitting factors for SWIPT (an interactive algorithm which is optimized to solve non-convex problem) the maximum sum rate can be obtained. The final result which is to be obtained can be used to prove that HP-based mMIMO NOMA with SWIPT can be used to achieve higher spectrum efficiency and energy efficiency when compared to that of conventional ZF based precoded MIMO NOMA.

IV. FLOW CHART

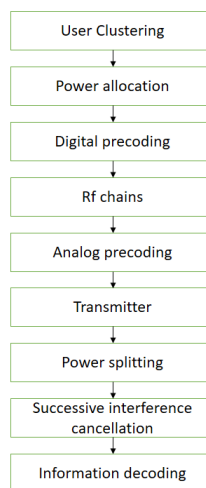


Fig 4.1 Flow chart of NOMA in mMIMO with SWIPT

V. EXPECTED RESULTS

The expected results show that the proposed method has higher spectrum efficiency and energy efficiency when compared to that of conventional zero forcing (ZF) method.

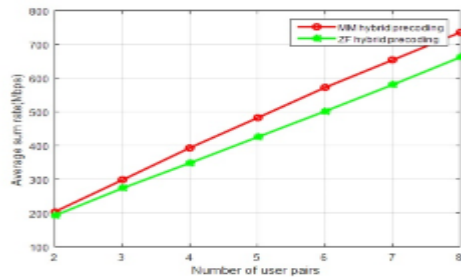


Fig 5.1 Average sum rate of all clustered users with HP

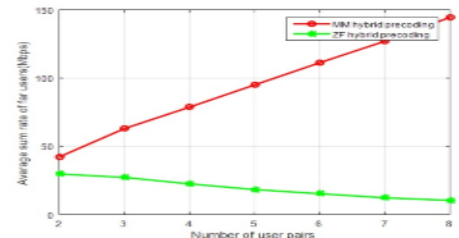


Fig 5.2 Average sum rate of users with HP precoding HP precoding

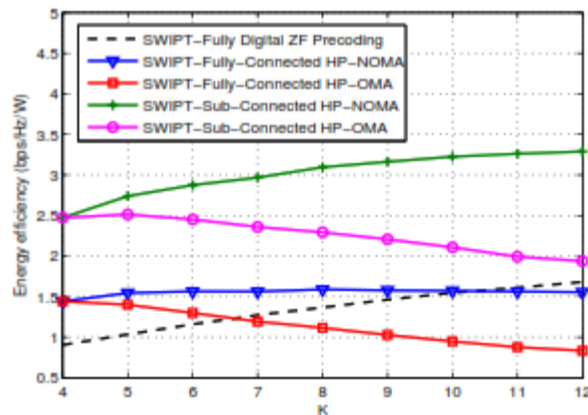


Fig.3. Energy efficiency against number of users

VI. CONCLUSION

NOMA in mMIMO can be used to increase the spectral efficiency. Further on implementing the concept of SWIPT, the RF energy can be harvested and it proves to increase the energy efficiency. Thus, it is possible to increase both energy and spectral efficiency by applying SWIPT in NOMA mMIMO communication.

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