RIS Partitioning on Quadrature NOMA UAV assisted Network

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Abstract

RIS assisted UAV aided QNOMA network was proposed in order to enhance coverage and seized the high error rates of conventional NOMA.

Ⅰ. Introduction

Quadrature based signal constellation (QbSC) in term to boost error performance has been done recently in order to fulfil the one aspect from the set of demands of the beyond 5G network (B5G) which are very high spectral performance, enormous bandwidth and very low latency. One of the elegant implementations of QbSC is the quadrature non-orthogonal multiple access (QNOMA) where the main notion is comparable with quadrature spatial modulation (QSM) and partial NOMA [1]. Moreover, in QNOMA the input bits were modulated with M-arry amplitude-shift-keying (MASK) rotated as far as pi/4 and exploiting the principal of Signal Space Diversity (SSD). Additionally, the coordinate interleaver (CI) was utilized, in a rather manner in which the attributes of the transmitted symbol are impacted by potentially distinct fading states inside the channel. Thus, through all of this, the QNOMA provides the same high spectral performance and enormous bandwidth with NOMA system [2] but the complexity is far reduced since successive interference cancellation (SIC) are less than its predecessor.

However, the low complexity multiple access is meaningless if the base station (BS) coverage is limited to blocking objects or extreme terrain. Hence, reconfigurable intelligent surfaces (RIS) were developed recently in order to seize the error rates by the principal of signal diversity and increase coverage where the hardware is comprises of number of elements and capable of steering the incident signal from BS [3][4]. Moreover, for the extreme cases, an unmanned aerial vehicle (UAV) was employed to aid the network, such as UAV relaying, energy harvesting based UAV and integration of RIS in UAV relaying communication [5]. Therefore, as shown in Fig.1 the novel solution of low complexity multiple access and wide cell coverage was proposed where user 1 and user 2 number of elements were separated to diminish inter user interference.

Ⅱ. System Model

In this proposed system model RIS is specifically used for assisting downlink between BS and the receiver as shown in Fig.1. The BS is transmitting in-formation toward every cell user concurrently over a Rayleigh fading channel. It is presumed that the aver-age channel state information of the users is accessible at the BS and that each receiver has its own channel awareness only.

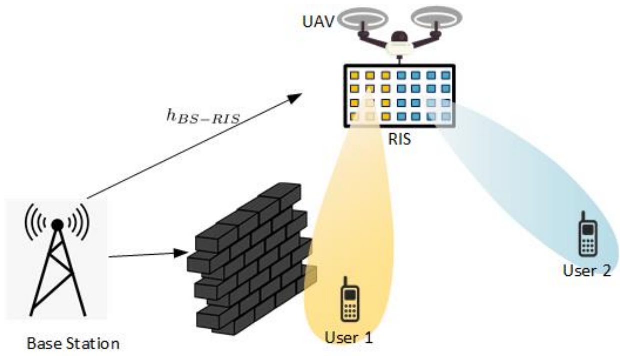

Fig.1. Block Diagram of RIS aided Quadrature NOMA for two users

Refer to the Fig.1, after the signals transmitted by the BS, all the incident signal are reflected through an RIS with N elements to overcome the obstacles. It is assumed that in order to enhances SNR, RIS is capable of independently configured to the appropriate angle to maximize each signal phase. Therefore, the received signal on the receiver side could be written as: $y = \sqrt{\varepsilon k}\left[\sum_{i=1}^{Ck} h_i e^{j\phi_i} g_i\right]x + n$, where $\varepsilon$is the transmitted signal power and i∈[1,2,⋯,N] is an index of the RIS elements. Then n are referring to noise power with the distribution of gaussian as known as additive white gaussian noise (AWGN) and $e^{j\phi i}$ is the adjusted phase from RIS elements with i^{th} index. Therefore, the instantaneous SNR is written as:

$$\gamma_{ins\ k} = \frac{\sqrt{P_k}\left|\sum_{k=1}^{C_k} \alpha_i \beta_{i,k} e^{j(\phi_i-\psi_i-\theta_{i,k})}\right|^2}{N_0\sqrt{L_{A2G}}\sqrt{L_{G2A}}}.$$

In QNOMA system, input is modulated with MASK modulation mapper. Contrary from the conventional MASK, in this term, constellation signal diagram of the MASK was rotated as regards π/4 counter-clockwise. Assuming the users in the BS coverage were $k = [1,2,\cdots,K]$, therefore S_k was the modulated symbols of every k^th user over π/4 MASK modulator. Additionally, it could be expressed that $S_k = S_{kI} + S_{kQ}$ where S_{kI}, S_{kQ} are in-phase ($\Re$.)and quadrature ($\Im$.) element of S_k respectively.

Assuming there are a two users in the cell and the distance among those two are considerably far, hence the modulated symbol for NU and FU were S_1 and S_2 respectively. Afterwards, CI was implemented on both users to obtain $x_1$and $x_2$and it could be written as follow: $x_1 = \sqrt{\alpha P} S_{1,I} + j\sqrt{(1-\alpha)P} S_{2,I}$; $x_2 = \sqrt{\alpha P} S_{1,Q} + j\sqrt{(1-\alpha)P} S_{2,Q}$. In this circumstance, P is the total transmitted power at the BS while α is a power allocation for NU and FU with the value lies in between 0 and 1 ($0< \alpha <1$). The baseband transmitted signal from the BS were denoted by $x = x_{nu} + x_{fu}$.

Ⅲ. Simulation Result

The SER performance result of RIS-QNOMA UAV is presented within this section. In order to prove that in QNOMA are requiring lower number of SIC then the result is presented on different power allocation and different number of elements.

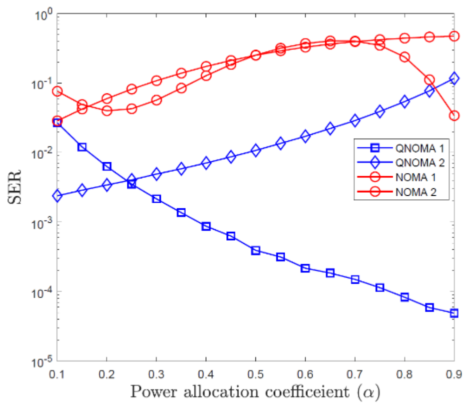

Fig.2. SER result of different power allocation

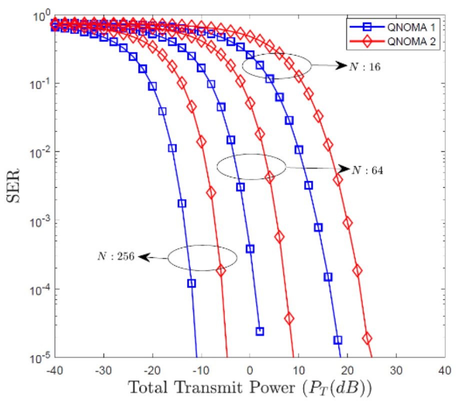

Fig.3. SER result of element number of RIS

IV. Conclusion

The performance of RIS assisted UAV aided QNOMA wireless network is certainly giving a BS massive coverage. Moreover, on the worst channel condition it is possible to obtain low SER with low transmit power with higher number of elements. Furthermore, to increase the network performance even more, the mobile UAV with optimized trajectory is highly feasible in RIS-UAV QNOMA and cooperative UAV RIS QNOMA where more than one drone is carrying RIS to aid the cell user SNR.

ACKNOWLEDGMENT

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