Received: April 1, 2019

International Journal of
Intelligent Engineering & Systems

http://www.inass.org/

Priority Based Scheduling for Energy Efficient Power Allocation in MIMO-NOMA System with Multiple Users

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Abstract: Enhancing the efficiency of power allocation and the achievable sum rate of Multiple Input Multiple Output (MIMO) based multi-user systems are essential as conventional methods are very complex. The traditional methods are not only less efficient but also do not address user fairness. The existing conventional methods use simple user ordering schemes that remain unsuitable for MIMO Non-Orthogonal Multiple Access (NOMA) system. Accordingly, a new elegant propose method using Particle Swarm Optimization (PSO) algorithm based priority scheduling in power allocation (PPPA) prioritizes the users based on the maximum power and QoS constraints. The proposed method offers a capable platform that will also provide energy efficiency in power allocation. The priority-based scheduling based on PSO algorithm that prioritizes the users optimally based on objective function, and it is effective due to faster convergence and adaptive nature of the algorithm. The proposed method for power allocation compared with the existing methods using the number of admitted users in the system. We observed that the energy efficiency and achievable rate is found to be superior by 6.76% and 58.37 Mbits/sec. Thus our proposed method not only provides better energy efficiency but also has a profound improvement in data rate.

Keywords: Multiple input multiple output, Non-orthogonal multiple access, Energy efficiency, Achievable rate, Power allocation, Priority scheduling, Particle swarm optimization.

1. Introduction

The communication system of the fifth generation renders higher network capacity, spectral efficiency, and energy efficiency and Non-Orthogonal Multiple Access (NOMA) becomes the attracted technology in 5G, as they provide greater spectral efficiency through the simultaneous allocation of frequency bandwidth to multi-users. Additionally, the method offers greater user throughput through appropriate power allocation. For using NOMA, a base station (BS) chooses the users for advance pairing with the shared spectrum such that the channel conditions of the paired users are useful to enhance the system sum rate [1, 2]. These requirements are offered using the technologies, like NOMA millimeter (mm) wave, and MIMO [3]. It is significantly noted that NOMA provides better network capacity and serves multiple users simultaneously to attain greater throughput, Spectral Efficiency (SE), and fairness, when compared with the general Orthogonal Multiple Access (OMA) schemes [4, 5].

In addition to SE, Energy Efficiency (EE) is a useful metric in 5G wireless communication systems that meet the more significant energy cost and green environment crisis [6, 7]. Energy efficient power allocation that selected the users with minimum power requirement, and hence, allowed a maximum number of users. Recently, researchers invest their time in integrating MIMO-NOMA for maximizing SE. For MIMO-NOMA systems, users are paired as clusters to minimize the complexity of successive interference cancellation (SIC) at the receiver such that the users of the same cluster share a common beam former [8]. The technical advances highlight that payload power allocation and ideal SIC decoding are the main constraints in NOMA. For single and multiple-antenna systems, the performance gain of NOMA is based on the error propagation of SIC decoding. Thus, practically, the sources of error propagation are Channel Estimation Error (CEE) and erroneous in data detection, respectively [9]. Thus, usage of MIMO along with NOMA (MIMO-NOMA) adds value to the technology and enhances the system performance concerning the throughput efficiency, the spectrum reuse probability, and the power efficiency [2.10]. The method Joint User Pairing and Dynamic Power Allocation (JUPDPA) [11] and attained the maximum achievable rate and modeled NOMA [12] offered poor power consumption, but the performance highly depends on channel realization. The method [13], termed as spectrum and energy efficient millimeter wave (mmWave) transmission scheme that suppressed the inter-beam and intra-beam interferences but was not suitable in the ultra-dense network (UDN). Optimizing the MIMO-NOMA issue is difficult due to the issues associated with Sum-rate maximization, energy consumption and Quality of Service (QoS) requirements of multiple users in NOMA is a big challenge [14, 15] in the presence of a large number of MUs.

The research insists on developing a power allocation method that works effectively in the MIMO-NOMA systems. The conventional methods offered a computational ease scenario of allocation but failed to render an optimal way of scheduling. The optimal scheduling criterion is initiated in this research using PSO algorithm that orders the users in a transmitter based on the QoS and the energy requirements of the user such that the energy efficient and user satisfaction are attained. The significant contribution of the research is the PSO-based priority scheduling in the multiple user environment of NOMA such that the efficiency is assured. The proposed method is the integration of PSO in MIMO-NOMA-based systems that aim at the optimal scheduling of the users.

The rest of the paper is organized as follows. In section 2 the MIMO-NOMA system model and problem formulation are presented. The proposed method of power allocation using the priority based scheduling mechanism is implemented in section 3 and section 4 enumerates the discussion of the proposed method. Finally, the paper is concluded in section 5.

2. System model

This section deliberates the system model and the existing issues of the conventional power allocation methods. The conventional methods concentrate on the ordering based power allocation methods that are optimally tuned in the proposed method. The system model of the MIMO-NOMA [8] comprising of multiple users and illustrates the block diagram of [2x2] MIMO-NOMA using the DCO-OFDM modulation [16]. Let us consider two input signals $y_1(t)$ and $y_2(t)$ that are the inputs of transmitter 1 and transmitter 2, respectively. Once the modulation using the DCO-OFDM is completed, the superposition of the power domain and the addition of DC bias is performed such that the input signal of the k^{th} user is represented as,

$$y_k(i) = \sum_{i=1}^{U} \sqrt{\beta_{k,l}(i)}\ H_{k,l} + J_{dc} \tag{1}$$

Where $H_{k,l}$ symbolizes the intended signal corresponding to the l^{th} user in the k^{th} transmitter. The power of the l^{th} user in the k^{th} transmitter is $\beta_{k,l}$ and J_{dc} is the DC bias for the individual transmitter. The power of the user in the transmitter is and is the DC bias for the individual transmitter. For assuring an overall power ρ_e for the individual transmitter, the power constraint is formulated as

$$\sum_{l=1}^{U} \beta_{k,l} = \rho_e \tag{2}$$

The value of the power is assumed to be unity free from generality loss. The vector of the received a signal at l^{th} user after the free space propagation is given as,

$$Y_l = \chi \rho_{opt} \delta G_l y + q \tag{3}$$

Where χ denotes the responsivity of the transmitter and ρ_{opt} specifies the optimal power of the transmitter. The modulation index and the channel matrix are denoted as δ and G_l. G_l is the [2x2] matrix of the channel belonging to the l^{th} user. The transmitted signal vector is denoted as that is the transpose function. The additive noise is denoted as the transpose function, $y=[y1\ y2]^T$. The additive noise is denoted as q_l. It is considered that the individual transmitter uses a Lambertian radiation pattern and the Line of Sight (LOS) is assumed such that the channel gain of the LOS between the k^{th} transmitter and l^{th} receiver belonging to the user is measured.

$$M_{jkl} = \frac{(n+1)D_{trans}}{2\pi\kappa^2} \mu\vartheta cos^n(\psi) co\,s(\theta) \tag{4}$$

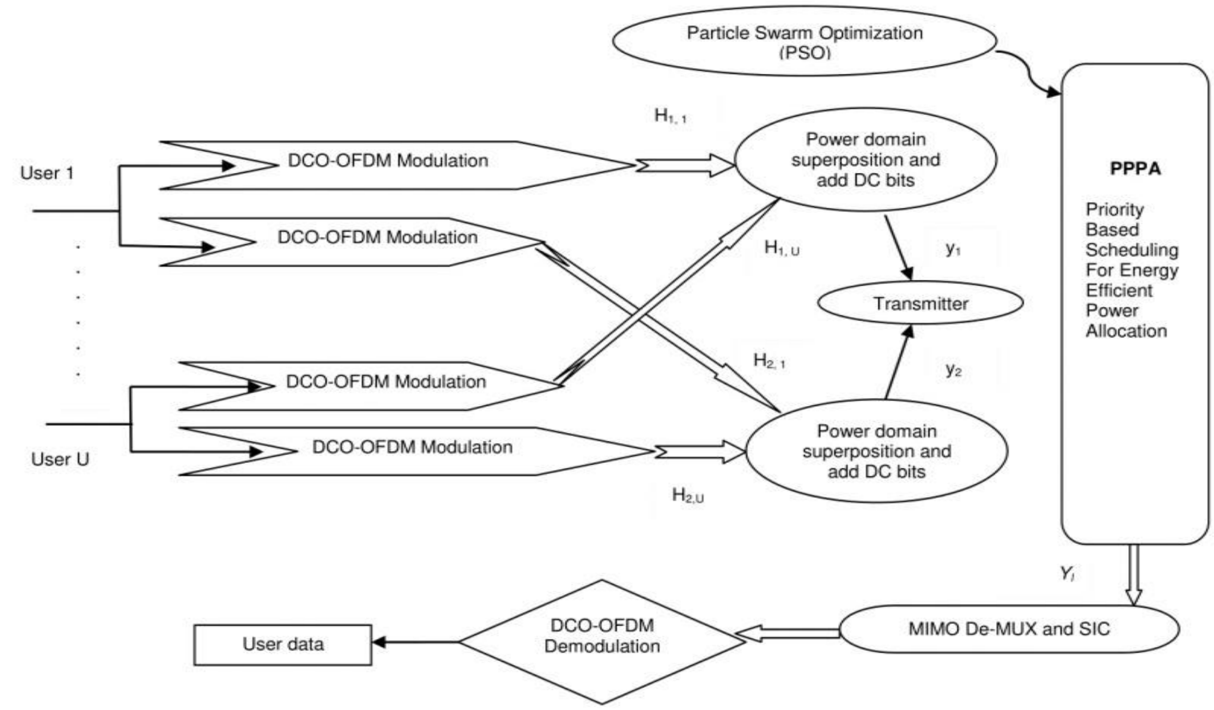

Figure.1 Block diagram of the proposed priority based scheduling in MIMO-NOMA based systems

Where $n=\frac{ln\,2}{\ln(cos\phi)}$ denotes the Lambertian emission order and ϕ specifies the semi-angle at half power of the transmitter. D_{trans} is the active area belonging to the transmitter and κ specifies the distance between the k^{th} transmitter and j^{th} receiver. The transmitter gain constants are denoted as μ and ϑ, respectively. The emission angle and the incident angle are denoted as, ψ and θ. The channel gain attains a value of zero if and only if the incident angle lies outside the Field of View (FOV) of the receiver. For recovering the transmitted data, MIMO De-multiplexing and Zero-Forcing (ZF) are employed that lowers the complexity. In the end, the estimated signal vector of the l^{th} user is computed as,

$$\widetilde{y}_l = y + \frac{1}{\chi \rho_{opt}\delta} G_l^{-1} + q \tag{5}$$

Where G_l^{-1} refers to the inverse of G_l and *SIC* is computed for individual transmitters and for computing *SIC*, it is essential for ordering the users for the individual transmitters. Unlike the single NOMA, there is a need for a new method for ordering the users of a particular transmitter. Thus, the users of a transmitter are ordered based on the channel gains and the ordering is based on the proposed priority-based scheduling with the usage of the PSO algorithm. The proposed method of ordering is based on the QoS and power requirement of the user in a channel.

2.1 Problem formulation

The subsection presents the problem formulation of the power allocation method [16,17]. The power consumed by the user is based on two factors, such as fixed circuit power consumption ρ_c and the flexible transmit power that is given as,

$$\rho_i = \rho_{max} \sum_{f=1}^{N} \sum_{k=1}^{K} \Upsilon_{f,h} \tag{6}$$

The maximum energy efficiency (Max-EE) of the system is given as,

$$\eta = \frac{v^{mean}}{\rho_c + \rho_i} \tag{7}$$

where $v^{mean} = \sum_{f=1}^{N} \sum_{k=1}^{K} \varepsilon_{f,h}$ is referred to as the achievable sum-rate. The objective function of the system relies on maximizing the energy efficiency η of the system such that the individual user possesses the minimum rate. The objective function is derived a $\underset{\Upsilon_{f,h}}{max}\,\eta$ such that

$$\varepsilon_{f,h} \geq \varepsilon_{f,h}^{min}\ ,\ \text{f=\{1,...N\}, h=\{1,...K\}} \tag{8}$$

$$\sum_{f=1}^{N} \sum_{h=1}^{K} \Upsilon_{f,h} \leq 1 \tag{9}$$

where, $\varepsilon_{f,h}$ is achieved data rate at the user *(f,h)*, Eq. (8) and (9) are the minimum rate requirements of the users and minimum transmit power.

3. Proposed method for energy efficiency: Particle swarm optimization algorithm based priority scheduling in power allocation (PPPA)

The main aim of the research is to model a method that performs the energy-efficient power allocation in MIMO-NOMA using priority-based scheduling. The MIMO-NOMA system consists of multiple users and multiple receivers and the objective function to follow the optimal power allocation is based on the energy maximization in addition to the QoS constraint. Thus, the optimal power allocation strategy is developed using the user admission protocol that is based on the Priority-based scheduling. The proposed method of scheduling overcomes the existing method that undergoes the one by one arrangement in the ascending order strategy as in [8]. The Priority-based scheduling is progressed using the optimization algorithm, PSO that prioritizes the users of a transmitter with respect to the power and the QoS requirement of the user. The proposed user admission protocol is the integration of PSO in the MIMO-NOMA system in order to progress the efficient power allocation to ensure energy efficiency. Fig. 1 shows the proposed model of the power admission protocol.

Power allocation plays a prominent role in the NOMA system that is one of the major challenges faced by MIMO-NOMA systems. The existing method in [8] uses two methods for evaluating the required sum rate of the MIMO-NOMA based systems in such a way that the complexity associated with power allocation is minimized. In addition to offering the QoS and energy efficient power allocation, the proposed method is employed. The proposed method offers an effective power allocation through the prioritization of the users in a transmitter that assure the required QoS and power requirement. The user admission protocol is developed using the proposed priority-based scheduling protocol based on the PSO algorithm.

The existing method uses Gain Ratio Power Allocation (GRPA) and Normalized Gain Difference Power Allocation (NGDPA) that orders the users in ascending order. Generally, GRPA is employed in MIMO-NOMA systems such that the power allocation in the system is based on the optimal channel gain of the individual users. The relation between electrical powers allocated to user l^{th} user and user $l+1^{th}$ is

$$\rho_{i,l} = \left(\frac{h_{1i,l+1}+h_{2i,l+1}}{h_{1i,1}+h_{2i,1}}\right)^{l+1} \rho_{i,l+1} \tag{10}$$

However, the optimal channel gain is replaced by the sum of the optimal channel gain such that the GRPA is employed for the MIMO-NOMA-based systems [17]. On the other hand, the method NGDPA ensures the required sum-rate in the MIMO-NOMA based systems. It differs from GRPA in the computation of the optimal channel gain such that the optimal channel gain in NGDPA is computed as the difference in the channel gain between two users l^{th} and $l+1^{th}$ is given by the following relation

$$\rho_{i,l} = \left(\frac{h_{1i,1}+h_{2i,1}-h_{1i,l+1}-h_{2i,l+1}}{h_{1i,1}+h_{2i,1}}\right)^{l} \rho_{i,l+1} \tag{11}$$

However, the optimal channel gain in GRPA is computed as the absolute value. Therefore, the existing methods are arranged in the ascending order based on the channel gain, but the proposed method prioritizes the users based on the PSO priority-based scheduling. Below are the algorithmic steps involved in the priority-based scheduling for Energy-Efficient Power Allocation. The proposed PSO priority-based scheduling is the integration of PSO [18] with the power allocation method.

3.1 Modulation using DC biased MIMO-OFDM (DCO-OFDM)

The primary step is the modulation using the DCO-OFDM that adds a bias to the signal and clips the negative pulses to zero in such a way to enhance the transmitter power requirements. Let us consider the user signals given as

$$G_l; (1 \leq l \leq U) \tag{12}$$

Where U is the total number of the users and G_l represents the l^{th} user. The power of the users in the transmitter1 and transmitter 2 is given as,

$$H_1 = \{H_{1,1}, H_{1,2}, \dots\dots . . H_{1,U}\} \tag{13}$$

$$H_2 = \{H_{2,1}, H_{2,2}, \dots\dots . . H_{2,U}\} \tag{14}$$

The power is added with the bias in order to meet the power requirements of the user and the output from the modulator is fed to the transmitter and the inputs to the transmitter are y_1 and y_2, respectively. The transmitter transmits the signals y_1 and y_2 to the priority-based scheduling block.

3.2 Priority-based scheduling using PSO algorithm

The input to the priority-based scheduling algorithm is the transmitter output and the scheduling is performed using the PSO algorithm. At the advent of priority-based scheduling, the users are prioritized based on the power and QoS requirements of the user in a transmitter. Let us see a deep insight over the optimization algorithm involved in the prioritization of the users. The advantage of using PSO is that it is capable of searching for the optimal solution in the massive search space through solving the objective function. The particles update the position and the velocity based on the varying environmental conditions to meet the proximity and the quality also, the movement of the particles is not limited as the search is a continuous process. Moreover, the particles are capable of adapting to changing environmental conditions. The steps are:

Step I) Initialization of the swarm population: The population of the particles in the search space is initialized in this step as,

$$w = [w_a]; 1 \leq a \leq m \tag{15}$$

Where refers to the total number of the swarm population. In this paper, the population refers to the transmitters and particles denote the total number of the users corresponding to a transmitter.

Step II) Evaluating the fitness of the particles: The fitness of the particles is evaluated based on the objective function given in Eq. (8) that aims at solving the maximization problem. The constraints are aimed at meeting the maximum power requirements and QoS requirements of the user.

Step III) Compute the optimal position of the individual (personal best): Once the fitness of the particles is evaluated, the individual particle tracks the optimal position of its own and declares the best solution as the personal best solution.

Step IV) Compute the optimal position of the population (global best): Once the personal best is determined, the particles track the optimal position of the swarm that is declared as the global best.

Step V) Update the particle velocity and the particle position: In this step, the position and the velocity of the individual particles are determined using the following formula,

$$z_d(t+1) = z_d(t) + v_d(t+1) \tag{16}$$

$$v_d(t+1) = v_d(t) + C_1 R_1\big(P(t) - z_d(t)\big) + C_2 R_2(O(t) - Z_d(t)) \tag{17}$$

Where $z_d(t+1)$, denotes the position of the d^{th} particle in the next iteration and $z_d(t)$ is the position of the particle in the current iteration. Let us denote the velocity of the d^{th} particle at t^{th} and $(t+1)^{th}$ iteration as, $v_d(t)$ and $v_d(t+1)$, respectively. C_1 and C_2 symbolize the acceleration constants and R_1 and R_2 are the random coefficients in the range [0,1]. $P(t)$ and $Q(t)$ are the personal and the global best solutions of the particles.

Step VI) Check the stopping criterion: Once the position and velocity of the particles are updated, the feasibility of the solution is verified. The optimal position of the particle is modified with the new position of the particle if and only if the current personal solution is better than the previously existing solution. Otherwise, the previous position is sustained and the process is repeated.

Step VII) Terminate: The process is repeated for the maximum number of iterations until the optimal solution is determined.

The users are ranked based on their priorities in fitness and the order is the output from the optimization algorithm.

The proposed algorithm in Table.1 is implemented by considering the input power of the l^{th} user in the k^{th} transmitter is $\beta_{k,l}$ and the J_{dc} is the DC bias for the individual transmitter. $H_{k,l}$ symbolizes the intended signal corresponding to the l^{th} user in the k^{th} transmitter. The initial position and velocity of particles for the given time t are within the limit (0,1). The achieved data rate of the user (f,h) given by $\varepsilon_{f,h}$ is positive semidefinite signal power at the k^{th} user is calculated as $y_k(i)$. The channel gain of the LOS between the k^{th} transmitter and l^{th} receiver belonging to the user is measured as M_{jkl} repeat this procedure for a multiple number of users. $z_d(t+1)$ denotes the position of the d^{th} particle in the next iteration. In conclusion from Eq. (7), the achievable sum-rate v^{mean} and energy efficiency η of the system is computed.

3.3 Demodulation and generation of data

The output from the priority-based scheduling is given as Y_l that is finally demodulated to form the output data. Thus, the power allocation is performed optimally using the proposed algorithm.

Table 1. Proposed PPPA algorithm

```
Inputs: $\beta_{k,l}, H_{k,l}, J_{dc}$
Outputs: $\eta, v^{mean}$
Initialization : $0 < Z_d(t) < 1, 0 < V_d(t) < 1$
While $\varepsilon_{f,h} - \varepsilon_{f,h}^{min} \geq 0$
    For k=1 to k=2
        For l=1 to U
            Calculate $y_k(i), M_{jkl}$, by $Eq(1)$ and $Eq(4)$
        End For
    End For
    Calculate $Z_d(t+1)$ by $Eq$ (16)
End
Calculate $\eta, v^{mean}$ by $Eq$ (7)
```

4. Results comparative analysis

The section delights the comparative analysis of the power allocation methods and the analysis is progressed based on the performance metrics, such as efficiency and achievable rate. The efficiency is measured as the ratio of the output by input and it is represented in percentage, whereas the achievable rate is expressed in Mbits/sec. The experimentation is performed using MATLAB Simulator and the proposed PPPA method is compared with the existing methods, Maximization Energy Efficiency (Max-EE) [8], Normalized Gain Difference Power Allocation (NGDPA) [16] and Gain Ratio Power Allocation (GRPA) [17].

4.1 Performance analysis based on U=2

The section deliberates the analysis when users, U=2 and Fig. 2 demonstrates the energy efficiency of the methods, like NGDPA, GRPA, Max-EE, and PPPA. The energy efficiency of the methods are analyzed for various values of power and at 5W of power, the methods, NGDPA, GRPA, Max-EE, and PPPA acquired the energy efficiency of 6.46%, 5.34%, 4.52%, and 6.67%, respectively. The graph pictures that the proposed method acquired a higher percentage of energy efficiency. The achievable rate for the transmitter 1 of the methods with respect to the normalized rate is pictured in Fig. 3. At the normalized offset of 0.1, the achievable rate of NGDPA, GRPA, Max-EE, and PPPA attained a value of 56.50, 54.91, 54.99, and 56.89, respectively. The achievable rate decreases with the increase in the normalized offset. In Fig. 4, the achievable rate of transmitter 2 of the methods with respect to the normalized rate is presented. At the normalized offset of 0.1, the achievable rate of NGDPA, GRPA, Max-EE, and PPPA attained a value of 56.50, 53.75, 53.81, and 56.70, respectively. The achievable rate decreases with the increase in the normalized offset.

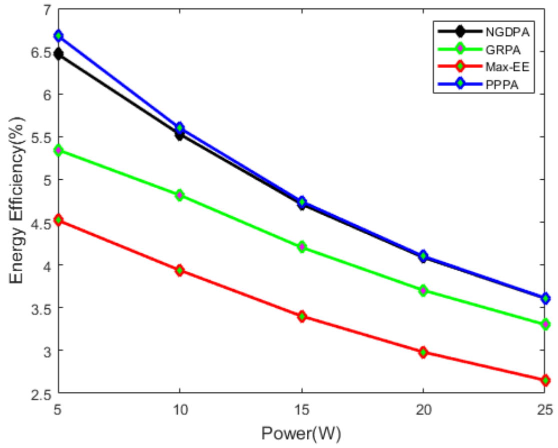

Figure.2 Energy efficiency with respect to power for U=2

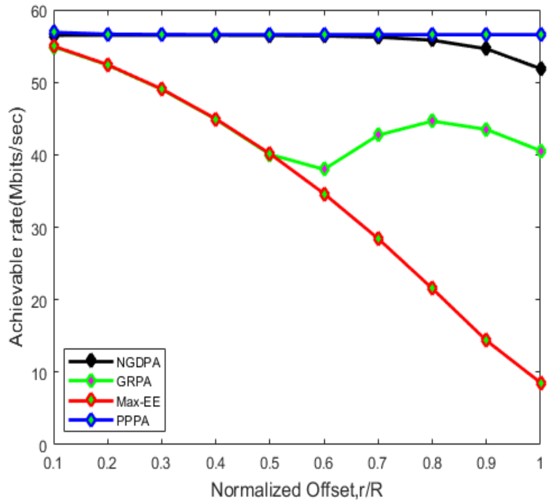

Figure.3 Achievable rate of transmitter 1 with respect to normalized offset for U=2

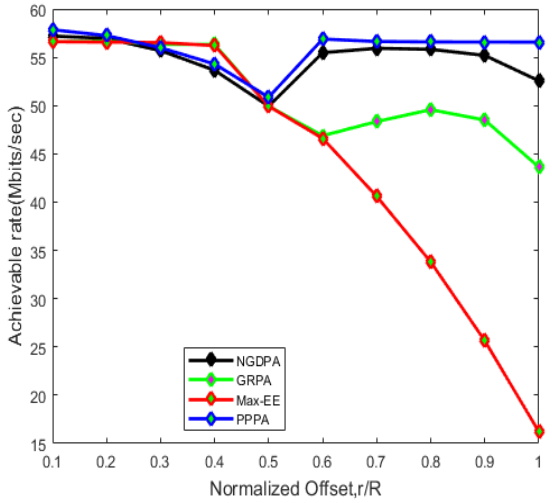

Figure.4 Achievable rate of transmitter 2 with respect to normalized offset for U=2

However, it is clear that the proposed method acquired a better achievable rate when U=2.

4.2 Performance analysis based on U=3

The section deliberates the analysis when Users, U=3 and Fig. 5 demonstrates the energy efficiency of the methods, NGDPA, GRPA, Max-EE, and PPPA. The energy efficiency of the methods are analyzed for various values of power and at 5W of power, NGDPA, GRPA, Max-EE, and PPPA acquired the energy efficiency of 6.30%, 5.29%, 3.29%, and 6.74%, respectively. The graph pictures that the proposed method acquired a greater percentage of energy efficiency. The achievable rate of transmitter 1 of the methods with respect to the normalized rate is pictured in Fig. 6. At the normalized offset of 0.1, the achievable rate of NGDPA, GRPA, Max-EE, and PPPA attained a value of 57.20, 56.66, 56.62, and 57.85 respectively. The achievable rate decreases with the increase in the normalized offset. In Fig. 7, the achievable rate of transmitter 2 of the methods with respect to the normalized rate is presented. At the normalized offset of 0.1, NGDPA, GRPA, Max-EE, and PPPA attained the achievable rate of 57.20, 56.69, 56.59, and 57.59, respectively. The achievable rate decreases with the increase in the normalized offset. However, it is clear that the proposed method acquired a better achievable rate when U=3.

4.3 Performance analysis based on U=4

This section shows the analysis when Users, U=4. Fig. 8 depicts the energy efficiency of the methods, NGDPA, GRPA, Max-EE, and PPPA. The energy efficiency of the methods are analyzed for various values of power and at 5W of power, NGDPA, GRPA, Max-EE, and PPPA acquired the energy efficiency of 6.25%, 5.27%, 2.63%, and 6.76%, respectively. The achievable rate of transmitter 1 of the methods with respect to the normalized rate is shown in Fig. 9. At the normalized offset of 0.1, the achievable rate of NGDPA, GRPA, Max-EE, and PPPA attained a value of 58.19, 52.49, 52.43, and 58.37 respectively. The achievable rate of transmitter 2 of the methods with respect to the normalized rate is presented in Fig. 10. At the normalized offset of 0.1, NGDPA, GRPA, Max-EE, and PPPA attained the achievable rate of 57.25, 56.95, 56.63, and 57.67, respectively. The achievable rate decreases with the increase in the normalized offset. From the figure, it can be shown that the proposed method acquired a better achievable rate when U=4.

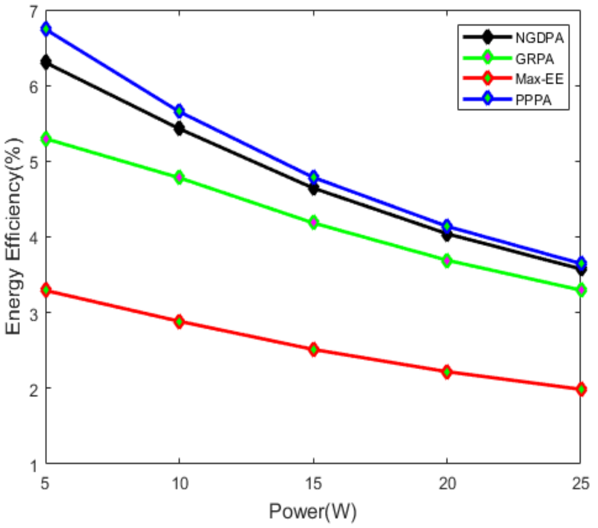

Figure.5 Energy Efficiency with respect to power for U=3

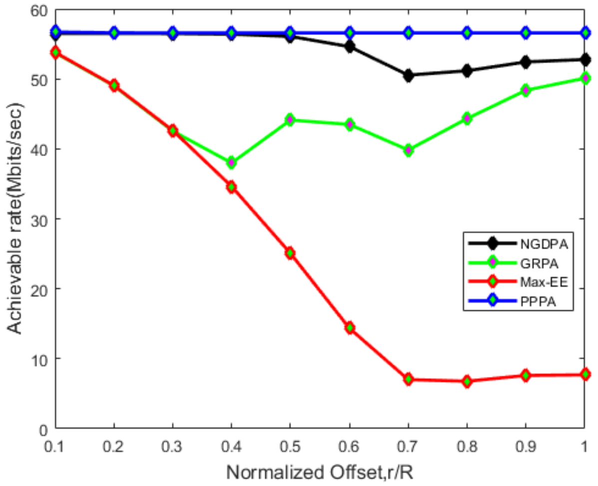

Figure.6 Achievable rate of transmitter 1 with respect to normalized offset for U=3

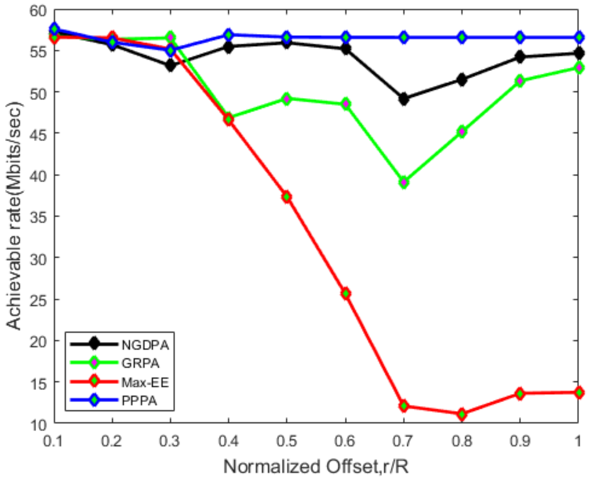

Figure.7 Achievable rate of transmitter 2 with respect to normalized offset for U=3

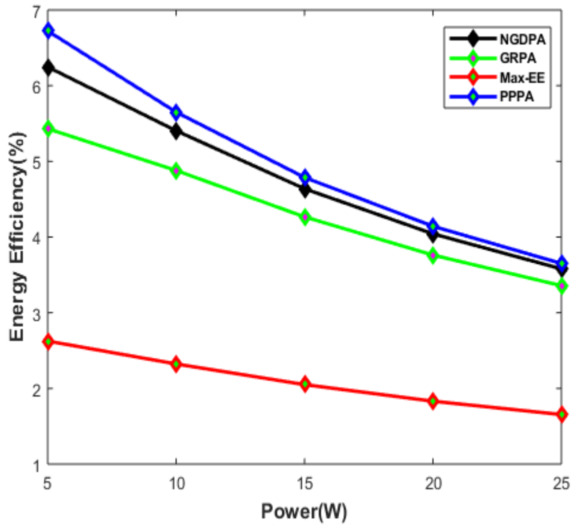

Figure.8 Energy efficiency with respect to power for U=4

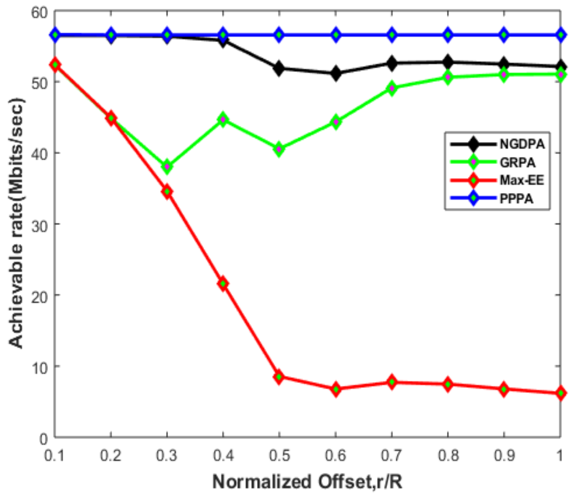

Figure.9 Achievable rate of transmitter 1 with respect to normalized offset for U=4

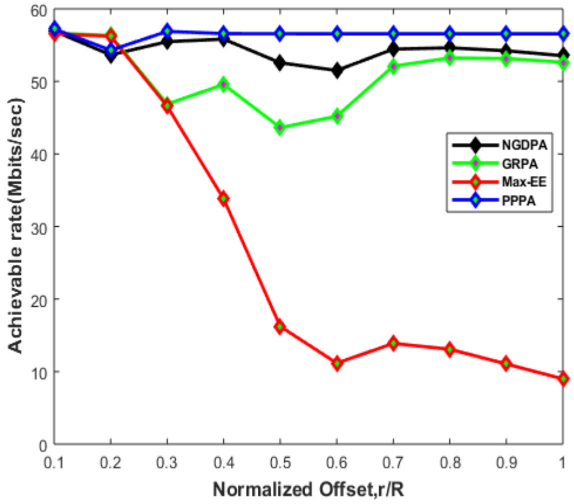

Figure.10 Achievable rate of transmitter 2 with respect to normalized offset for U=4

Table2. Comparison table for Energy Efficiency [%] with respect to Power

Published Literature	**Number of users U=2**		**Number of users U=3**		**Number of user U=4**	
	P=5W	P=25W	P=5W	P=25W	P=5W	P=25W
Max-EE [8]	4.52	2.65	3.29	1.98	2.63	1.65
NGDPA [16]	6.46	3.61	6.30	3.57	6.25	3.53
GRPA [17]	5.34	3.30	5.29	3.29	5.27	3.25
Proposed PPPA	6.67	3.61	6.74	3.64	6.76	3.69

Table 3. Comparison table for Achievable Rate [Mbits/sec] of Transmitter 1 with respect to Normalized Offset [r/R]

Published Literature	**Transmitter 1**					
	Number of users U=2		Number of users U=3		Number of users U=4	
	r/R= 0.1	r/R=1	r/R= 0.1	r/R=1	r/R= 0.1	r/R=1
Max-EE [8]	54.99	08.55	56.62	16.22	52.43	6.17
NGDPA [16]	56.50	51.88	57.20	49.94	58.19	52.31
GRPA [17]	54.91	37.98	56.66	43.63	52.49	51.67
Proposed PPPA	56.89	56.57	57.85	56.34	58.37	58.21

Table 4. Comparison table for Achievable Rate [Mbits/sec] of Transmitter 2 with respect to Normalized Offset [r/R]

Published Literature	**Transmitter 2**					
	Number of users U=2		Number of users U=3		Number of users U=4	
	r/R= 0.1	r/R=1	r/R= 0.1	r/R=1	r/R= 0.1	r/R=1
Max-EE [8]	53.81	06.78	56.59	11.16	56.63	8.87
NGDPA [16]	56.50	50.53	57.20	49.18	57.25	54.32
GRPA [17]	53.75	37.98	56.69	39.13	56.95	53.54
Proposed PPPA	56.70	56.56	57.59	56.85	57.67	57.13

5. Conclusion

The research concentrated on the effective power allocation method aimed at meeting the required QoS and power constraints with low complexity. The proposed method of power allocation is performed for the MIMO-NOMA system that undergoes the priority-based scheduling, in which the users are prioritized at the maximum objective function. The maximum objective function is based on the maximum power and QoS requirements of the user. The priority-based scheduling is based on PSO that follows the swarming behavior of the particles in a population. The proposed method of power allocation assures the users with better QoS and power with better energy efficiency and thereby, offering user satisfaction. The optimization-based scheduling algorithm exhibits a greater converging capability, leading to the optimal selection of the users. The analysis in terms of the energy efficiency and achievable rate proves that the proposed method outperformed the existing methods with a maximum efficiency of 6.76% and achievable rate of 58.37 Mbits/sec. The proposed power allocation method using the PSO-based priority-based scheduling algorithm is capable of allocating the power with the optimal energy and QoS in the MIMO-NOMA-based systems. In future, we will develop a technique with layered transmissions to maximize the sum rate of MIMO-NOMA system.

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