Comparison of PAPR Reduction Using ABC-FF Algorithm and OGWO in MIMO-OFDM

K.Aruna Kumari[1], Dr.K.Sri Rama Krishna[2]
Sr.Asst.Professor, ECE Department, Prasad. V. Potluri Siddartha Institute of Technology, Vijayawada,India[1]
Principal, Potti Sriramulu Chalavadi Mallikharjuna Rao College of Engineering and Technology, Vijayawada, India[2]

Abstract:
In the transmitted signal, the high peak-to-average power ratio (PAPR) is the real disadvantage of multiple input, multiple output (MIMO) orthogonal frequency division multiplexing (OFDM) systems. Among different PAPR reduction techniques, selected mapping (SLM) is a famous strategy that accomplishes good PAPR reduction performance without signal distortion. Likewise, Partial transmit sequence (PTS) is additionally solitary of the successful techniques to decrease the PAPR in OFDM. Though, result an optimal segment issue in PTS system is measured to exist a critical concern. To progress the existing PAPR reduction techniques, we have incorporated ideal SLM and PTS based PAPR reduction strategy in parallel. By utilizing, the OGWO algorithm; the transmit succession was chosen with least PAPR above all communication antennas. The proposed PAPR reduction approach is applied independently on each transmitted antenna, and so the PAPR can be extremely reduced. Moreover, the OGWO optimization based PAPR reduction technique will provide better performance and it was been promoted as an uncomplicated way for PAPR reduction. The proposed approach will be analyzed with ABC-FF Algorithm PAPR reduction scheme to show the effectiveness
Keywords: **MIMO**-OFDM, PAPR reduction, SLM, PTS, OGWO based Opposition, ABC, FF**.**
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I. INTRODUCTION

Orthogonal frequency division multiplexing (OFDM) is regularly utilized for high information rate wireless interchanges because of its inherent error robustness in a multipath environment. [1]. Combination of MIMO system with OFDM has a major consideration for the subsequently making broadband utilization suitable to their probable of provide soaring data rate, toughness to desertion channels and consistent communication. MIMO-OFDM has been set up in different remote correspondence standards, for example, IEEE 802.11a/g, remote metropolitan territory systems (WMANs), overall interoperability for microwave get to (WiMAX), and 3GPP Long Term Evolution [2].Power efficiency can be improve by maximizing spatial diversity.By changing a frequency-selective MIMO channel into a set of parallel frequency-flat MIMO channels, OFDM diminishes the complexity of the MIMO receiver. [3].Though, MIMO-OFDM encounters crisis of elevated crest to normal power ratio to outcome in non-linear deformation of the passed on motion at lifted power enhancer [4]. The transmitter has a high PAPR in case of normal power which is basically reduced, with reference to a steady immersion control. In these cutting edge business remote structures, the PAPR issue is huger in uplink [5] in light of the fact that this is the limiting association to the extent extension and range [6], and as the portable terminal is compelled in battery control, the adequacy of the power enhancer is basic.Various strategies have been proposed for lessening in OFDM frameworks of PAPR for example cutting [7] [8], fractional transmit successions (PTS) [8] [9], particular mapping (SLM) [8][10], tone reservation, and so on. Among all these PAPR decrease techniques, cutting is by all accounts the least difficult plan. Be that as it may, it experiences in-band and out-of-band bending that embarrasses the execution of strategy.
The information square is divided into disjoint sub-obstructs in the PTS approach along these lines the sub-bearers in each sub-piece are weighted by stage factor pivots. The stage pivots are picked so that the PAPR is limited [11], [12].Selected Mapping (SLM) strategy is the most skilled diminishment

technique to decrease Peak to Average Power Ratio (PAPR) of Orthogonal Frequency Division Multiplexing (OFDM) system[13] without flag twisting.

Under various engendering, topology or movement conditions this paper plans to build up a methodical approach for PAPR decrease. Here we utilized Parallel PTS and SLM plan to productively diminish the PAPR in MIMO OFDM System. Next area gives an audit on different accessible strategies for diminishment of PAPR in MIMO OFDM System.

II. PARTIAL TRANSMIT SEQUENCE (PTS) METHOD

In MIMO-OFDM signals, PTS procedure is for the most part used to lessen the PAPR decrease. This technique at first parts the recurrence vector into few squares. Before applying the stage changes in MIMO-OFDM signals the above recurrence division method is finished.
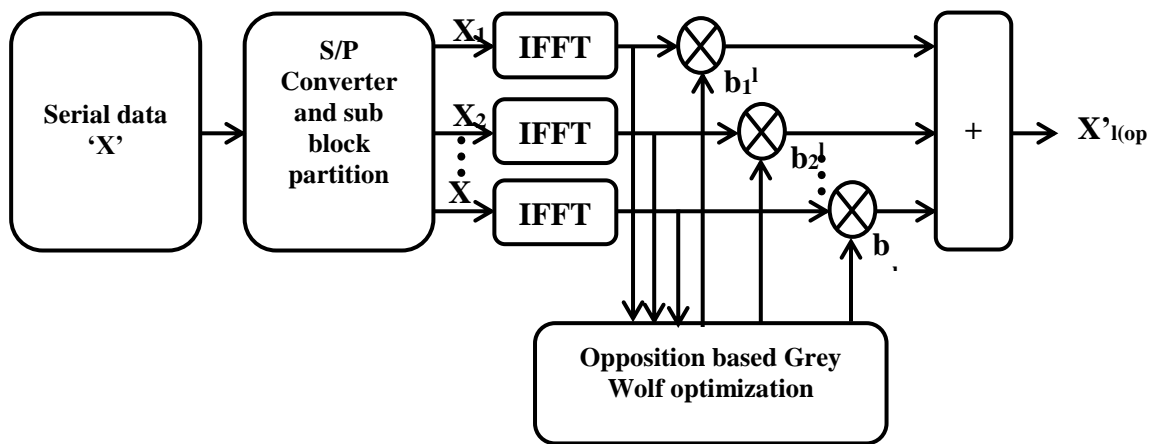

Fig 1: Block diagram of PTS

The practical layout of the PTS method is spoken to in the above figure. 1. Square parcel is used to disconnect the data frequencies into different pieces in PTS system. With the help of IFFT each square is taken care of. At last, the fitting stage vector is browsed the gathering of stage vectors. The enhancement of b square speaks to the duties of picking the ideal stage vectors.

In any case, PTS and SLM based PAPR diminishment methodologies are comprehensively associated in MIMO-OFDM structure.

For the PAPR signal the system of equation is defined.

$$PAPR = \frac{\max_{0 \leq t \leq T} |x(t)|^2}{E\left[|x(t)^2|\right]} \tag{1}$$

Where $E[]$ represents the expectation operator.

That genuine and dream esteems in as far as possible hypothesis condition of is typically disseminated. Therefore, the zero mean and a vacillation of N time the difference in one complex sinusoid. This manage followed in the sufficiency of the OFDM flag. CCDF is used to figure the likelihood of PAPR surpassing a predefined limit esteem. The plan of PAPR condition for CCDF work is described by,

$$CCDF(PAPR(x(n))) = P_r(PAPR(x(n))) > PAPR_0 \tag{2}$$

Nyquist inspecting speed can be unmistakable for each PAPR of a measurements obstruct as takes after

$$P = P_r(PAPR(x(n))) > PAPR_0 = 1 - \left(e^{-PAPR_0}\right)^N \tag{3}$$

Consequently, much emphasis is performed to compute the finest likelihood appropriation of PAPR. The CCDF is characterized by,

$$P_r\left(PAPR > PAPR_0\right) = 1 - \left(e^{-PAPR_0}\right)^N \tag{4}$$

We portray the PAPR of a MIMO-OFDM motion as the most extraordinary of the PAPRs among all the parallel transmit radio wire branches. PAPR at the transmit recieving wire is described as the extent of the pinnacle energy to the normal energy of an OFDM motion in that branch. The MIMO-OFDM PAPR structure can be communicated as;

$$PAPR_{MIMO} = \max PAPR_i, \ i = 1,2,\ldots,N_T \tag{5}$$

Where N_T is the number of transmission antennas.

The info recurrence vector length N can be isolated into V disjoint sub-obstructs as takes after:

$$X = \left[X^1 X^2 \ldots X^V\right] \tag{6}$$

Where X^i represents the sub-block $(i = 1,2,\ldots,V)$. Scrambling technique is utilized as a part of PTS plan to an arrangement of sub-transporter. These sub-transporters plot into a sub-square and increased by a stage factor as takes after:

$$b^v = e^{j\phi_v} \qquad \text{For } v = 1,2,\ldots,V \tag{7}$$

Each sub-square is taken into portrayal to figure the Inverse quick Fourier change (IFFT). At last, time space flag is ascertained as takes after:

$$x = IFFT\left\{\sum_{v=1}^{V} b^v X^v\right\} \tag{8}$$

$$x = \sum_{v=1}^{V} b^v IFFT\left(X^v\right) \tag{9}$$

$$x = \sum_{v=1}^{V} b^v X^v \tag{10}$$

$X^v =$ the partial transmit sequence. Minimum PAPR for the corresponding phase vector is represented by,

$$\tilde{b}^1, \tilde{b}^2, \ldots, \tilde{b}^V = \arg\min\left[b^1, b^2, \ldots, b^V\right]\left(n = 0, \max\left[1,2,\ldots,N-1\right]\right)\left|\sum_{v=1}^{V} b^v X^v(n)\right| \tag{11}$$

The set of phases based on the computation of minimum PAPR is identified in the above equation. The time domain signal for each phase with minimum PAPR is defined by,

$$\tilde{x} = \sum_{v=1}^{V} b^v X^v \tag{12}$$

III. RESULT AND DISCUSSIONS

This section contains result and discussion about PAPR Reduction using Parallel PTS and SLM scheme with MIMO OFDM. Both the techniques SLM and PTS have been clubbed to attain better performance. The proposed algorithm is executed using MATLAB software and the experimentation is carried out using a system of having 4 GB RAM and 2.10 GHz Intel i-3 processor. This area demonstrates applicable implications of presented technique. Here, we have compared our presented system OGWO with GWO and AABC techniques.

Evaluation Metrics:The assessment metrics are BER and SER. The standard formula of all of them is depicted below.

Bit Error Ratio: The bit error rate (BER) is the amount of bit errors per unit instance. It is also defined as the number of bit errors divided by the total number of relocated bits during a studied time period. Bit error ratio is a unit less performance measure, frequently articulated as a percentage.

$$BER = \frac{Number\ of\ bits\ received\ in\ error}{Total\ number\ of\ bits\ transmitted}$$

Symbol Error Ratio: Symbol error ratio is related with the error occurred with transferred symbols. It is the ratio total number of transferred symbols to the received error free symbols. The symbol error ratio for the proposed and existing techniques has been depicted in figure below

$$SER = \frac{Number\ of\ symbols\ received\ in\ error}{Total\ number\ of\ symbols\ transmitted}$$

Performance analysis

In this section, the performance assessment for PAPR reduction using OGWO algorithm by means of PTS and SLM techniques and the existing algorithms like GWO and AABC is illustrated. The Bit Error Rate (BER), Symbol Error Rate (SER) and PAPR vs. CCDF values of proposed and existing methods are depicted as below in tables. From the comparison table 2, it shows the Bit Error Rate for both the proposed and existing methodologies by evaluated with different number of iterations. For the iteration number 100, the BER of OGWO is 0.42, GWO is 0.53 and for AABC is 0.61375. Likewise, for the iteration 200, OGWO acquires 0.388125, GWO achieves 0.495625 and 0.434375 is for AABC method. Thus the error acquired is minimum for our proposed method than the existing methods. It is clear that the error achieved is less for the proposed methodologies.

Table 1: Comparison of proposed and existing methodologies for BER calculation

Iteration	BER		
	OGWO	GWO	AABC
100	0.42	0.53	0.61375
200	0.388125	0.495625	0.434375
300	0.35875	0.46375	0.415938
400	0.334375	0.43375	0.402188
500	0.3	0.40625	0.39
600	0.17625	0.275	0.380313
700	0.147813	0.245	0.370625
800	0.129063	0.229063	0.360625
900	0.111875	0.212813	0.347188
1000	0.1	0.155313	0.289688

Table 2: Comparison of proposed and existing methodologies for SER calculation

Iteration	SER		
	OGWO	GWO	AABC
100	0.539375	0.541875	0.574375
200	0.50875	0.515	0.555
300	0.491875	0.495	0.54125
400	0.47375	0.476875	0.53125
500	0.458125	0.46	0.52
600	0.444375	0.445625	0.510625
700	0.43	0.4325	0.499375
800	0.41375	0.415	0.484375
900	0.3925	0.3925	0.465
1000	0.280625	0.280625	0.348125

The table2 shows that the comparison between SER with different iteration and evaluated the error rate for both the proposed and existing methodologies. For the iteration level 100, the proposed

method OGWO acquires less error rate 0.539375 comparing to the existing techniques like GWO and AABC with 0.541875 and 0.574375 error rates respectively.

Table 3: Comparison of CCDF vs. PAPR for proposed and existing methodologies

CCDF	PAPR		
	OGWO	GWO	AABC
2	0.001	0	0
2.5	0.03	0.025	0.01
3	0.204	0.171	0.107
3.5	0.54	0.478	0.343
4	0.817	0.758	0.603
4.5	0.942	0.928	0.816
5	0.988	0.982	0.931
5.5	0.996	0.994	0.979
6	0.997	0.995	0.992
6.5	0.999	0.994	0.993
7	0.1	0.999	0.996

Likewise for the iteration 200 the proposed method OGWO obtains the minimum error rate 0.50875 whereas GWO attains 0.515 and AABC with 0.555 error rate. Thus the result obtained for SER with all other iteration have achieved minimum error rate for proposed methodology OGWO as compared to the existing technologies like GWO and AABC.

Table 3 gives the resultant data obtained for PAPR vs. CCDF for both the proposed and existing methodologies. By calculating the PAPR vs. CCDF, proposed method OGWO obtains the maximum value when compared with other existing technologies. The bit error ratio of the proposed and existing technique is depicted in figure below.
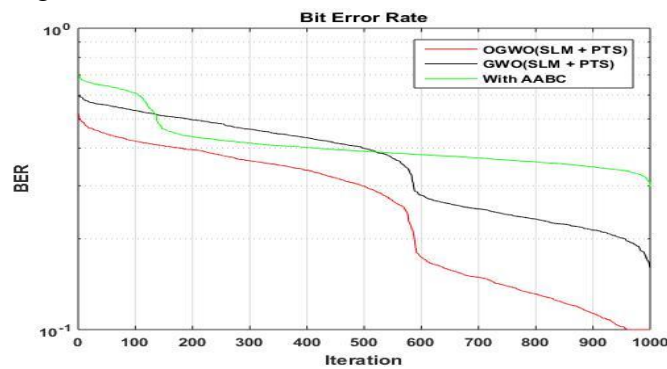

Fig 2: BER for proposed and existing methodologies

It can note from the above graph that the bit error ratio for the proposed technique is considerably lower than existing techniques. Bit error ratio represents the output corrective level, hence the through for proposed technique is better in terms of BER.
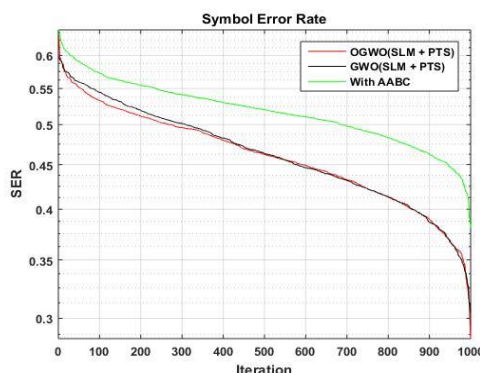

Fig 3: SER for proposed and existing methodologies

It can be observed from above figure that, symbol error ratio for the proposed technique is decreasing considerably faster than existing techniques. Moreover proposed method showed better results than existing technique.

The proposed PAPR vs. CCDF graph for the proposed and the existing techniques is given in figure 4 below.
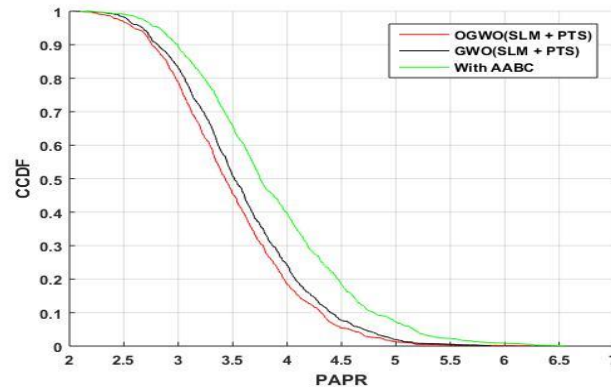

Fig 4: Comparison of PAPR vs. CCDF for proposed and existing methodologies

It can be noted from above figure that PAPR reduction takes place in every technique but for the proposed technique PAPR takes place in short period of time. Moreover, the PAPR has been reduced whereas; it is more in the existing technique. The main motive of the work was to attain less PAPR as much as possible, which proves the efficiency of the technique.

IV. CONCLUSION

In this paper, we have anticipated oddity based Oppositional Gray Wolf Optimizer (OGWO) calculation utilizing SLM and PTS in parallel frame to decrease PAPR in MIMO-OFDM framework. For remote correspondences, OFDM is an exceptionally alluring strategy because of its range productivity and channel vigor. The transmitted flag shows a high PAPR when the information groupings are corresponded is the one of the significant disadvantages in MIMO-OFDM frameworks. In the present work, two divergent PAPR diminishment strategies, i.e., SLM and PTS have been executed on the MIMO-OFDM conspire and the PAPR lessening parameter has been dissected. The result demonstrates that both the SLM plan and PTS plot are more compelling to diminish PAPR in MIMO-OFDM frameworks. With the reproduction ponders, it has been demonstrated that the proposed calculation lessens PAPR prevalent than the current frameworks.

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