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# Hybrid Approach using SLM and PTS Techniques to Reduce PAPR

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**Abstract:** ***For 4rth age group wireless communication Orthogonal Frequency Division Multiplexing (OFDM) is a striking & hopeful method. The major drawback of the OFDM transmitted signal method is High Peak-to-Average Power Ratio (PAPR). To decrease the high Peak-to-Average Power Ratio (PAPR) of Orthogonal Frequency Division Multiplexing (OFDM) signals a latest customized method found on SLM & PTS scheme is projected in this paper. We have compared the proposed technique with the SLM, PTS, Iterative flipping and Original schemes.***

**Keywords:** Peak to Average Power Ratio (PAPR), Analog to Digital converters, Digital to Analog converters, Orthogonal Frequency Division Multiplexing (OFDM), Partial Transmit Sequence (PTS) and Selected mapping (SLM)

## 1. Introduction

There are many advantages of Orthogonal Frequency Division Multiplexing (OFDM) & it is vigor beside the frequency-selective fading channel. That's why this method has been extensively used in numerous wireless communication systems, like DAB (Digital Audio Broadcasting) & the IEEE 802.11a standard for WLAN & the IEEE 802.16a standard for WMAN [1].

At the point when in time areas all the N subcarriers are integrated usefully & create crest control that is N times more prominent than the normal force of the signal, which called the PAPR. OFDM signals have a high PAPR, which needs the costly radio transmitters having HPA (High Power Amplifiers) working more than an extensive direct range.

OFDM signal comprises of part of autonomous adjusted sub-bearers, which are made the issue of Peak Average Power Ratio. It is difficult to launch elevated crest sufficiency signal to the transmitter with no decreasing crests. Therefore we need to decrease elevated crest sufficiency of the signal prior to transmitting. For this PAPR problem there are numbers of techniques have been developed. Like TI (tone injection), TR (tone reservation), AC (amplitude clipping) ACE (Active Constellation Extension), filtering & clipping, Selective Mapping (SLM), PTS (partial transmit sequence).

In the Partial Transmit Sequence method, an inventive input numbers mass of N characters is separated into a number of disjoint sub-blocks. The subcarriers in every sub block are weighted by a stage component, to produce distinctive signals instead of the similar data so as to in inventive signal. The phase aspects are chosen so as to the PAPR of the joined signal is lessened that is defined as the optimum phase aspect. The PAPR exclusive of signal alteration can be decreased by the PTS method. It needs an complete explore above every grouping of permitted phase aspects, therefore the investigate complication boosts exponentially through the no. of sub-blocks. The Partial Transmit Sequence method has lofty computational complication for larger sub-blocks [1].

Iterative flipping is somehow same as the PTS scheme, but the computation complication diminished to be linear with the no. of sub-blocks in iterative flipping. It is the easiest method [10]. PAPR lessening in OFDM signal the Selected mapping (SLM) method used. In this method the PAPR lessening is attained by reproducing autonomous phase chains to the inventive enter information & influential the PAPR of all phase series & put in information grouping. The mishmash among the lowly PAPR is broadcasted [11]. We are presenting a latest method in this paper which is based on PTS & SLM technique which is developed to lessening the PAPR of the OFDM signal. I n suggested method the PTS&SLM technique are mixed & present good PAPR lessening presentation.

In Section II, we discussed the PAPR difficulty. In Section III give the brief description of PTS scheme. Section IV contains the SLM brief description. The projected method is enlightened in Section V. The results discussed in the Section VI. And Conclusion is given in the last Section VII.

## 2. PAPR

The PAPR is the connection among the greatest force of an example in a specified OFDM transmits representation isolated through the normal force of that OFDM symbol. PAPR happens when in a multicarrier system the diverse sub-carriers are out of phase with one another. At every moment they are diverse regarding one another at distinctive phase values. At the point when all the focuses accomplish the most extreme esteem at the same time; this will result in the output envelope to abruptly shoot up which causes a "peak" in the output envelope. Because of vicinity of huge number of autonomously regulated subcarriers in an OFDM system, the peak estimation of the system can be elevated when contrasted with the normal of the entire system. This proportion of the top to normal force worth is termed as Peak to Normal Power Ratio.

$$\text{PAPR}=\frac{\max|x(t)|^2}{E\left[|x(t)|^2\right]}$$

Where *E* [.] denotes the expectation operator.

One of the new issues rising in OFDM system is the supposed Peak to Average Power Ratio (PAPR) issue. The input symbol stream of the IFFT ought to have an uniform force range, in any case the output of the IFFT may bring about a non-uniform or spiky force range. The vast majority of transmission vitality would be distributed for a couple rather than the majority subcarriers. This issue can be measured as the PAPR measure. It causes numerous issues in the OFDM system at the transmitting end [2].

## 3. PTS-PAPR reduction method

In the PTS method as demonstrated in figure 1, the input character series is divided into various disjoint character subsequences. IFFT is then connected to every character subsequence & the subsequent signal subsequences are summed in the wake of being duplicated by a set of different pivoting vectors. Next the PAPR is figured for every subsequent grouping & afterward the signal grouping with the least PAPR is transmitted. As the quantity of subcarriers and the request of balance are expanded, lessening the computational unpredictability gets to be more vital than diminishing excess [4].

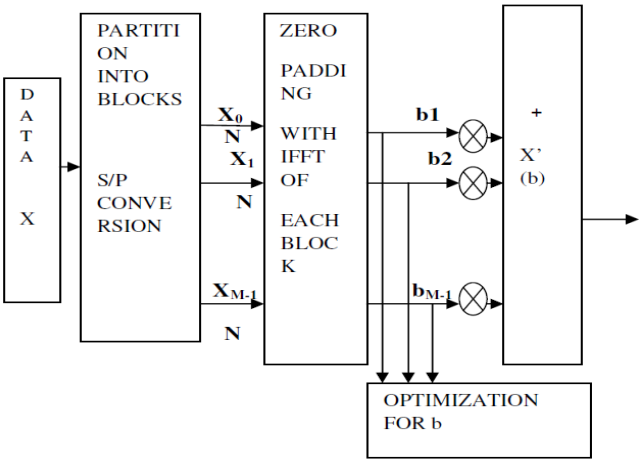


**Figure 1:** PTS-PAPR reduction scheme [5]

**Sub-Block Partition:** Let X = [X (0) X (1) …….X (N0-1)] is OFDM enter character series by extent N0. & X0…..XM-1 by extent N are OFDM symbols later than portioning & the X'0…..X'M-1 by extent N0 later than zero padding, wherever M is the no. of sub-blocks. Consider that the interleaving division technique is used in PTS OFDM method, Xm would be articulated as Xm = $[X(m)X(M+m)……X(NM-M+m)]_{1*N}$ & Xm' would be expressed as Xm'T = $[0…….0X(m)\ 0……..0X(M+m)0……..0X(NM-M+m)0…….0]_{1*N0,}$ wherever 0_m_M-1 and N=N0/M. It is understandable that the nearly all elements of Xm' are zeros, therefore there are lots of pointless multiplications and additions to zeros while applying N0*N0 IFFT would be put back by N*N IFFT [3].

**Adjacent Sub-Block Partition:** In this method, the complication of PTS technique would be lessened with eradicating these multiplications & additions in figure 1. Consider that the adjacent partition process is used in PTS OFDM method, Xm = $[X(mN)X(mN+1)……X(Nm+N-1)]_{1*N}$ & Xm'T = $[0….0X(m)0…..0X(mN+1)0…..0X(Nm+N-1)0….0]_{1*N0,}$ where 0_m_M-1 & N=N0/M.

In figure 1, the intricacy decrease of Partial Transmit Sequence PAPR diminishment method in OFDM systems by lessening the complications of the IFFT architecture are explored in this plan. In the IFFT architecture of PTS OFDM method, there are a part of additions & multiplications by zero, which are clearly pointless. We can productively lessen the computational complications without changing the coming about signal or corrupting the execution of PAPR decrease by taking out the additions & multiplications by zero from the architecture [3].

**Sub-Optimal Sub-Block Partition:** In Sub-Optimal method the following steps are to be taken:

1. Put, $b_m$ = 1, m = 1, 2…M using 2 & 3, we can compute PAPR of OFDM signals by the value of PAPR1, & put index = 1;
2. Put $b_{index}$ = 1, PAPR at this time is calculated by the similar way by the value of PAPR2.
3. If PAPR1 > PAPR2, $b_{index}$ = 1; or else PAPR1 = PAPR2, 1 index $b_{index}$ = -1;
4. index = index + 1;
5. Reiterate from step 2-4 if index < M + 1.

Using Sub-Optimal PTS algorithm we can effectively reduce the amount of computation. The computational expense of PTS is just M IFFT operations as Contrasted with 2M-1 IFFT operations of optimum PTS [6].

## 4. Selective Mapping (SLM) technique

In this method the transmitter creates a set of sufficiently diverse competitor information hinders, all representing to the same data as the original data block & chooses the most good for transmission. Every information block is multiplied by U distinctive phase series, each of length N, B(u)= [bu,0, bu,1,..., bu,N-1]T, u=1,2,...,U, resulting in U modified data block. The amount of PAPR diminishment for SLM relies on the no. of phase sequences U & the outline of the phase sequences. This methodology is pertinent with every type of modulation & any no. of subcarriers.

To minimize the peak to normal transmit power of multicarrier transmission system we used selective mapping technique because this method signals has lowly PAPR is selected from a group of different signals that symbolizes to the similar information [14]. Block diagram of Selective Mapping technique is shown in figure 2.

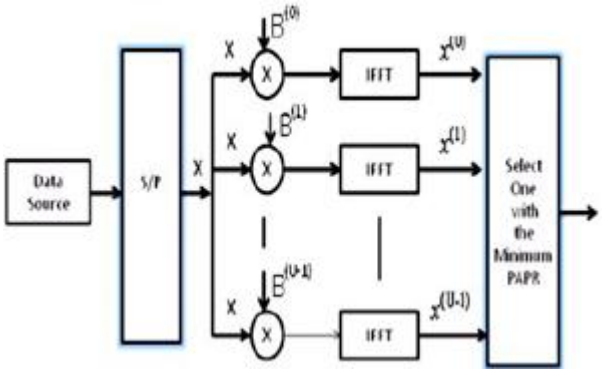


**Figure 2:** Block Diagram of Selective Mapping Method [7]

Figure 2 illustrates the selective mapping method. In short we can say that this method is basically phase rotation method as the phase rotated data which contains the least PAPR will be first-rate to transmit. Now we discuss the diagram. Once S/p alteration as $X=[X_0, X_1..... X_{N-1}]^T$. Now $B^{(u)}$ writes as

$$X^{(u)} = IFFT(X \otimes B^{(u)}) \quad (7)$$

$B^{(u)} = [B_0^{(u)}, B_1^{(u)} \ldots B^{(u)}_{N-1}]^T (u=0, 1...U-1)$

Is the phase weighting order by,

$|B_n^{(u)}|=1(n=0,1,N-1)$

& frequently picked from{±1} to evade the complications for difficult multiplications. The transformed data for the u series

$X^{(u)} = [X_0Bu,_0,X_1Bu,_1,\ldots\ldots X_{N-1}Bu,_{N-1}]^T$

U=0, 1, 2, 3…..U-1. After contrasting the Peak Average Power Ratio with the U data series $x^{(u)}$, the selected mapped one x with the lessen PAPR is picked for broadcast.
Then

$$X= \arg \min_{0\le u\le U}[PAPR(x^{(u)})] \quad (8)$$

U will be better and increased because of PAPR reduction. SLM scheme can efficiently lessen PAPR with no signal alteration [7].

## 5. Proposed Scheme

The methods which we have discussed in this paper PTS & SLM are offer better PAPR lessening performance. The technique which we proposed in this we first applied the SLM method & then we choose the finest mixture of phase sequence & enter data which provides least amount Peak Average Power Ratio. Currently for more lessening of P APR, we relate this blend of phase series & enter information to Partial Transmit Sequence method which more lessens the Peak Average Power Ratio.

## 6. Simulation results

In this section we show the performance of our proposed method by using simulation tool. For simulation we used MATLAB simulation tool. The parameters which have been taken are shown in following table as follows:

**Table 1:** Parameters

| Parameters | Type/Value |
|---|---|
| No. of (N) subcarriers | 255 |
| No. of (M) sub=blocks | 2, 4, 8, 16 |
| Oversampling(L)factor | 4 |
| Modulation methods | BPSK |
| No. of iterations | 6000 |

Figure 3 to Figure 6 shows the graph for the Complement Cumulative Distribution Function (CCDF) of PAPR.

Figure 3 illustrates the CCDF of PAPR. Here, M=2 sub-blocks in different methods. It achieve the finest PAPR diminution afterward Selective mapping, iterative flipping & partial transmit sequence methods. Though these methods also reduce PAPR, but the performance of SLM & PTS are same at several threshold Peak Average Power Ratio.

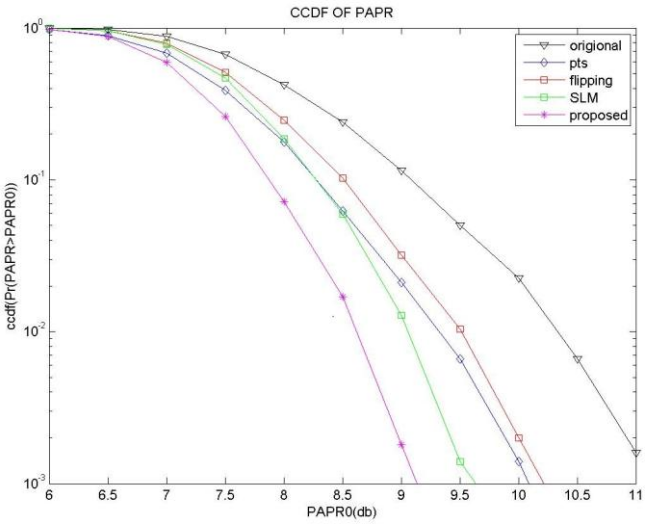


**Figure 3:** CCDFs of PAPR *M*=2 sub-blocks (*N*=255, *L*=4, BPSK modulation).

The presentation of PTS & SLM methods are more better than the previous as shown in figure 4 but iterative flipping performance same as the previous.

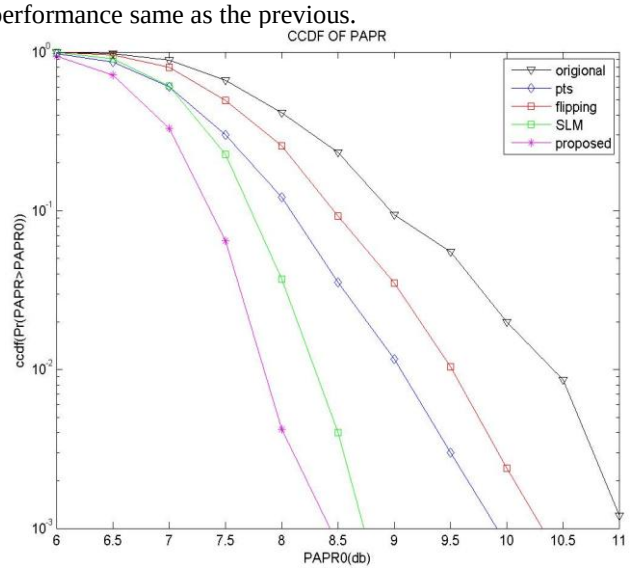


**Figure 4:** CCDFs of PAPR *M*=4 sub-blocks (*N*=255, *L*=4, BPSK modulation).

Figure 5 when *M* = 8 sub-blocks there are some more changes observed as contrasted to the earlier case. It shows the good performance than when M = 2, 4. Figure 3 to 5 illustrate that the increasing the no. sub blocks increasing the performance & SLM methods is boost other than the presentation of the Partial Trasmit Sequence & Iterative techniques similar while the earlier case. This method suggests enhanced PAPR lessening presentation as the no. of sub-blocks raise.

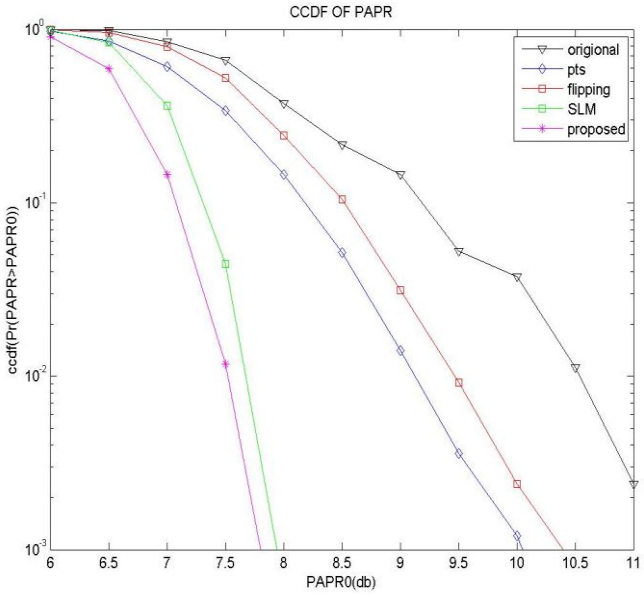


**Figure 5:** CCDFs of PAPR with *M*=8 sub-blocks (*N*=255, *L*=4, BPSK modulation).

When M=16 the proposed methods provide the best results as contrasted to the previous results as shown in Figure 6.

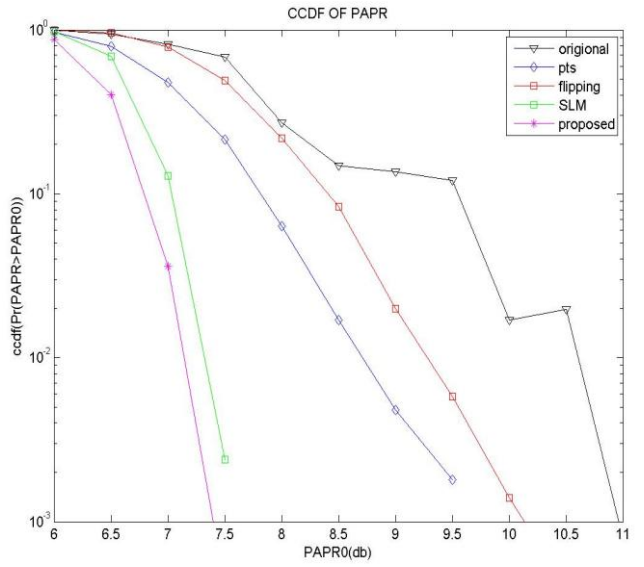


**Figure 6:** CCDFs of PAPR with *M*=16 sub-blocks (*N*=255, *L*=4, BPSK modulation)

The results come after performing simulation shows that our proposed techniques can achieve further Peak Average Power Ratio reduction by increasing the no. of sub-blocks and iterative technique results come same in some cases.

## 7. Conclusion

For Peak Average Power Ratio lessening in OFDM system a new technique is suggested in this paper. The results come after performing simulation shows that by using these methods we can lesser the PAPR. In this technique as we increase the no. sub-blocks the performance get better. Although the projected method suggests superior Peak Average Power Ratio lessening, further research work can be carried out to lessen the computational complication.

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