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A NEW SLM AND PTS SCHEMES FOR OFDM TO REDUCTION OF PAPR

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ABSTRACT—Orthogonal frequency division multiplexing (OFDM) is a multi carrier modulation technique where the revolution of 4G wireless communication is focused towards OFDM systems. The major drawback of OFDM system is high Peak to average power ratio .Two techniques of the most known ones for peak to average power ratio (PAPR) reduction of orthogonal frequency division multiplexing (OFDM) are selected mapping (SLM) and partial transmit sequence (PTS). Both schemes were proposed as distortion less PAPR reduction algorithms. However, it has been an argument to prove which scheme is the most efficient. In this paper, we propose a new PAPR reduction efficiency parameter which will be applied on the complementary cumulative distribution function (CCDF) of each technique to compare the results. We show as well how the performance of the system reacts when increasing the probability of getting high PAPR values. Using the proposed efficiency formula, we show that PTS system performance improves when increasing the probability, whereas the SLM system performance gets impaired when increasing the probability within the same range.

I.INTRODUCTION: Nowadays the wireless applications are focused towards high data rates. The concept of multi carrier transmission provides high data rates in communication channel. The OFDM is a special kind of multi carrier transmission technique that divides the communication channel into several equally spaced frequency bands. Here the bit streams are divided into many sub streams and send the information over different sub channels. A sub-carrier carrying the user information is transmitted in each band. Each sub carrier is orthogonal with other sub carrier and it is carried out by a modulation scheme. Data's are transmitted simultaneously in super imposed and parallel form. The sub carriers are closely spaced and overlapped to achieve high bandwidth efficiency [2]. The main disadvantage of OFDM is high peak to average power ratio. The peak values of some of the transmitted signals are larger than the typical values [1]. High PAPR of the OFDM transmitted signals results in bit error rate performance degradation, inter modulation effects on the sub carriers, energy spilling into adjacent channels and also causes non linear distortion in the

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power amplifiers. The main work of this paper is to reduce the high peak powers in OFDM systems. Several methods are there to reduce PAPR effectively(15). In this study the concept of selective mapping (SLM)and partial tansmit sequence(PTS) technique is applied to the OFDM symbols to reduce high peak signals[11]. Coding and simulation were carried out for SLM, PTS and their effects on reducing the PAPR were analysed. Also Reduced Complexity approaches for the SLM and PTS techniques were carried out and their performances in reducing the PAPR were performed and analysed[3]. The power signals of all the above work are viewed in complementary cumulative distribution function (CCDF) plot. The results state that the proposed new SLM and PTS method attains a good PAPR reduction and the encoding complexity is reduced by applying the new schemes.

II.SELECTIVEMAPPING TECHNIQUE

(SLM): Many methods are there to reduce the PAPR , but both complexity and redundancy are high and only small gains in PAPR are achieved. When the phases of different sub-carriers add up in phase the possibility of PAPR being high is for sure. Hence one method to reduce the in-phase addition is to change the phase before converting the frequency domain signal into time domain. Hence before taking the N point IDFT each block of input is multiplied by an φ vector of length N. Now there is a possibility that the PAPR may turn low.

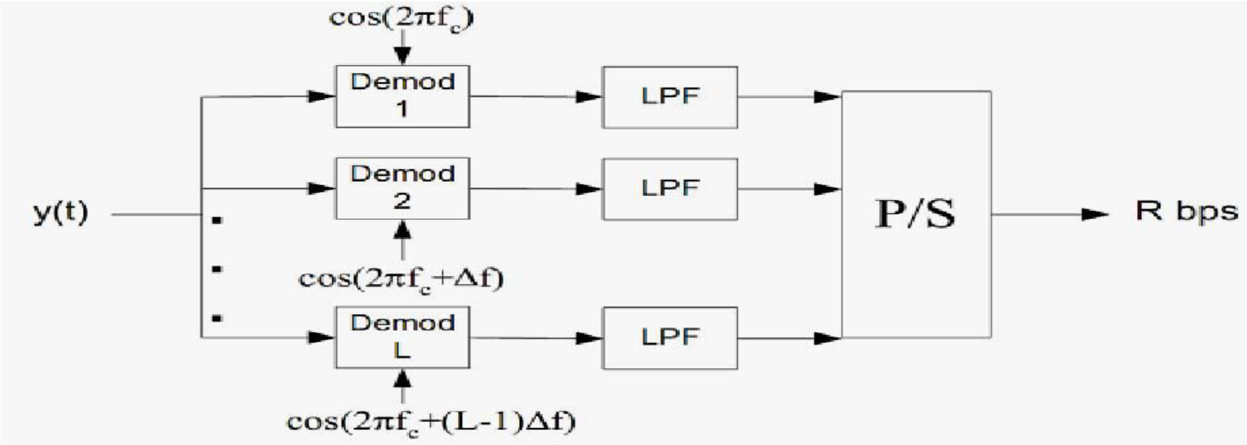

Fig 1 : Scheme of a Modulator with Selective Mapping

III.PARTIAL TRANSMIT SEQUENCES TECHNIQUE (PTS):

In the PTS approach, the input data block is partitioned into disjoint sub blocks or clusters which are combined to minimize the PAPR . Define the data block,[Xn,n=0,1……N-1],as a vector ,X=[X0,X1……XN- 1] T . Then, partition X into M disjoint sets, represented by the vectors [Xm,m=1,2……M]. The objective of the PTS approach is to form a weighted combination of the M clusters,

$$X'(b) = \sum_{m=1}^{M} b_m X_m$$

Where [bm , m=1,2……..M] are weighting factors and are assumed to be pure rotations. After transforming to the time domain, the above equation becomes

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$$\mathbf{x}' = \sum_{m=1}^{M} b_m \mathbf{x}_m$$

The vector x_m, called the partial transmit sequence, is the IFFT of X_m. The phase factors are then chosen to minimize the PAPR of x ' . A PTS transmitter is shown in Fig 2.

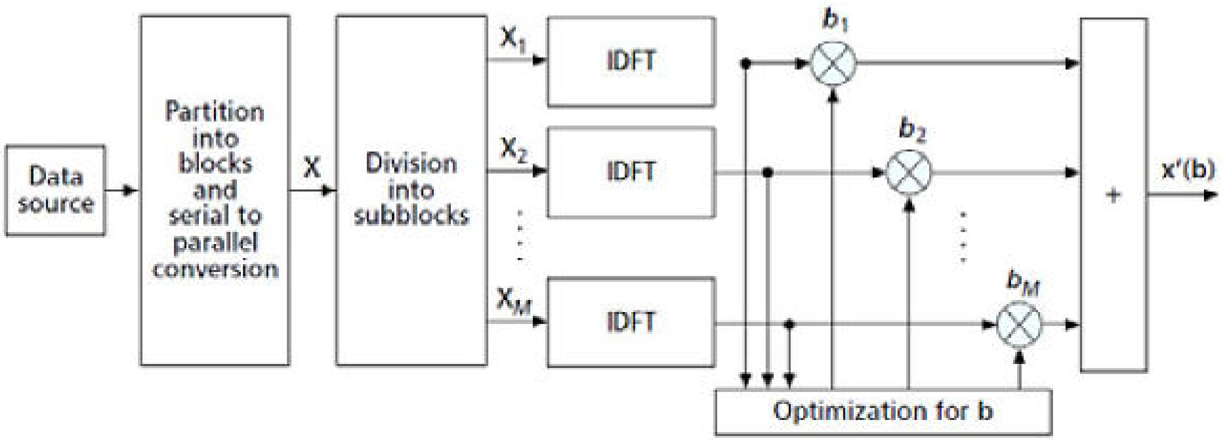

Fig.2. PTS system block diagram

IV.COMPLEXITY REDUCTION FOR SLM AND PTS: Hear we presents a simplified version of partial transmit sequences (PTS) and selected mapping sequences to reduce peak-to-average power ratio (PAPR) of an OFDM signal. Simplification of PTS is achieved by having a set of partitions but optimizing phase values only for alternate partitions. This proves to be a promising solution to reduce complexity of PTS. It is also proposed to choose the selected mapping sequences using a new phase Sequence[4]. In this previous case, although with an increase of the complexity, very high PAPR reduction can be achieved[10]. In the above two methods the complexity factor of the algorithm was quite high. This approach provides a trade-off between complexity and performance in SLM and PTS techniques.

4.1REDUCED COMPLEXITY SLM In the case of reduced complexity SLM the φ vector is changed only of its odd components and the even components are assumed to be 1 for 1000 iterations. The other process remain the same.

4.1.1.ALGORITHM FOR REDUCED COMPLEXITY SLM

Step 1: Get the input vector(X) of length D and let N=integer

Step2: for i=1: N

Step 2.1: Generate φ (i) of length D

Step 2.2: Multiply φ (i) with the input vector and get Z (Freq domain)

Step 2.3: Compute IDFT and get z (Time domain)

Step 2.4: Determine PAPR using the formula

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

Step 2.5: Increment the value of i

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Step 3: Go-to Step 2
Step 4: PAPR of length N is obtained.
Step 5: Select a threshold Y. One with minimum PAPR is used for transmission
Step 6: If min of PAPR>Y then increment a count
Step 7: Perform Steps 1-6 M times
Step 8: Obtain final count
Step 9: Increment the value of N and repeat Steps1-8
Step 10: Plot Graph for various N values where

X axis: Threshold values

Y axis: Pr[PAPR low>Y]

Step 11: It could be inferred that as the value of N increases PAPR decreases (It is required to inform the phase information controlled for the data sub-carriers to the receiver as side information)

4.2.REDUCED COMPLEXITY PTS : In the case of reduced complexity PTS the „W" vector is changed only of its odd components and the even components are assumed to be 1 for 1000 iterations. The other process

4.2.1ALGORITHM FOR REDUCED COMPLEXITY PTS:

The PTS scenario supported with mathematical expressions is summarized in the following steps:

1. The input data block X is divided and separated into M sub-blocks,

$$X_m = [X_{m,0}, X_{m,1}, \dots, X_{m,L-1}],\ m=1, 2, \dots M \qquad \text{----(1}$$

That means if we recombine these sub-blocks, we would get the original data block X as the following,

$$\sum_{m=1}^{M} X_m = X \qquad \text{--(2)}$$

2. The second step is to convert the sub-blocks to the time domain using inverse fast Fourier transform (IFFT) to form the signal from Xm as the following:

$$x_m = [x_{m,0}, x_{m,1}, \dots, x_{m,L-1}],\ m=1, 2, \dots M \qquad \text{---(3)}$$

3. To the purpose of minimizing PAPR, each sub-block in time domain is rotated by the phase factor

$$b = [b_0, b_1, \dots, b_{M-1}],\ \text{where } b_m = e^{j\emptyset},\ 0 \le \emptyset < 2\pi \qquad \text{---(4)}$$

4. The last step is to add all the sub-blocks up to form the final time domain signal which is

$$X'(b) = \sum_{m=1}^{M} b_m X_m \qquad \text{----(5)}$$

$$\text{Or, } X'(b) = [X_0'(b), X_1'(b), \dots, X_{NL-1}'(b)] \qquad \text{----(6)}$$

V.SIMULATION RESULTS:

After applying the proposed two formulas, 7 and 8 on both SLM and PTS CCDF's, we have come up with the results shown in following figures.

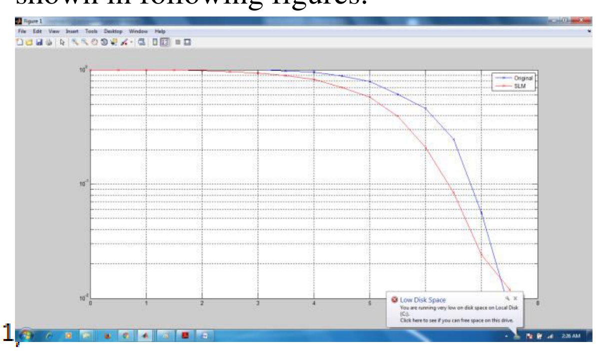

Fig 5.CCDFs of SLM for OFDM PAPR reduction

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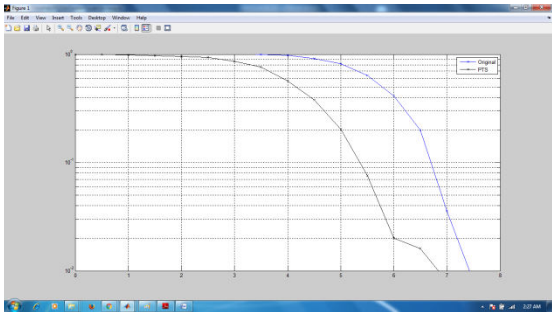

Fig 6.CCDFs of PTS for OFDM PAPR reduction

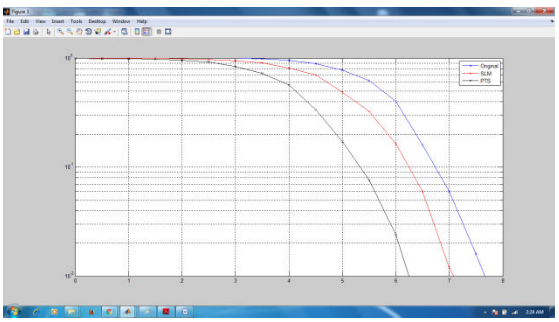

Fig 7.CCDFs of OFDM,SLM ,PTS for OFDM PAPR reduction

CONCLUSION:

It has been always a controversial topic to evaluate SLM and PTS algorithms for OFDM PAPR reduction. Literature publications have shown that PTS PAPR reduction system is more complex than SLM PAPR reduction system is. In this paper, after simulating both PAPR reduction schemes SLM and PTS, a proposed way is implemented to evaluate both SLM and PTS techniques from the angle of the system efficiency when increasing the probability of getting high PAPR values. Results have shown that PTS technique overweighs SLM technique when increasing the probability of having (PAPR>PAPR°).

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