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A HYBRID TECHNIQUE FOR PAPR REDUCTION IN OFDM

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ABSTRACT

The main problem that appears in OFDM systems is that the highest PAPR. The high PAPR of transmitting signals for OFDM systems decreases the system effectiveness and thus will increase the rate of RF power amplifier. There are numerous methods existing for reduction of PAPR such as tone reservation, PTS, clipping, and filtering, interleaving and SLM. The proposed system combines together SLM with PTS in a hybrid manner which decreases the PAPR from 9 to 5 decibels. The proposed work achieves better results that other compared techniques.

Keywords: OFDM, PAPR, PTS, RF, SLM

I. INTRODUCTION

In the present situation, the need for high-speed data transmission has enhanced with accelerated growth in the field of wireless technology. Wireless communication has seen a sudden rise in its development as a huge number of wireless devices are being utilized day by day for efficient transmission [5]. The current digital multicarrier wireless communication system gives a data rate at high speed at less cost for several users and moreover, with high reliability. In a system of the single carrier, which possess the whole bandwidth of communication while in the system of multicarrier [7], the available bandwidth of communication is divided by various subcarriers.

Every subcarrier has the lesser bandwidth as differentiate with the system of single carrier bandwidth. These fantastic options of the technique of multicarrier are Orthogonal Frequency Division Multiplexing. Thus, recent and future generation of wireless communication systems is characterized by a variety of applications starting from low rate voice data to very high rate real-time streaming video data [8]. OFDM is the latest multicarrier modulation technique adopted by the current mobile wireless communications network.

II. ORTHOGONAL FREQUENCY DIVISION MULTIPLEXING

Orthogonal Frequency Division Multiplexing is a multicarrier modulation technique, that makes use of many carriers, among the allotted bandwidth, to convey the data from source to destination. Every carrier makes use of numerous available digital modulation techniques such as QPSK, BPSK, QAM etc.., Orthogonal Frequency Division Multiplexing is very helpful to communicate over channels with frequency selective fading [13]. The necessity of high data rate draws larger concentration in a multicarrier system. It should be capable of operating

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smoothly in an environment of a higher carrier frequency, high data transmission rate, and mobility [10]. In OFDM system, complex data symbols are transmitted in parallel after modulating them over orthogonal subcarrier.

In single carrier system, one complex data are transmitted using one carrier and in this parallel transmission, M complex data are transmitted over M subcarrier. Here the efficient data rate of the system is similar as of the single carrier system. Increases the time period of the symbol of the parallel transmission. Then the relative rate of separation in time caused by multipath delay decreases. In OFDM system, the orthogonality between subcarriers is preserved by using IFFT [14]. A guard band is placed between consecutive OFDM symbols. Insertion of a guard band in OFDM symbols is done by 3 methods: cyclic suffix, cyclic prefix, and zero padding. By adding guard band in OFDM symbols [18], which removes ISI.

III. PAPR IN OFDM

3.1 PAPR Problem

The input symbol stream of the IFFT ought to acquire an identical power spectrum, however, the output of the IFFT may result in a non-uniform power spectrum. A large amount of the transmitted energy would be allotted for majority subcarriers [1]. This problem is measured as the PAPR measurements. It produced several problems in the OFDM system on the transmitting side.

In OFDM system, the input transmits signals are modulated using either QAM or PSK modulation techniques, then performs IFFT operation on the transmitter side. The orthogonal subcarriers are produced at the transmitter end [2]. These transmitted signals can have large peak values in a time domain and these high peak values are known as the High Peak to Average Power Ratio in OFDM System.

3.2 Effect of PAPR

The effect of high PAPR is that it reduces the SQNR of analog to digital converter and digital to analog converter while lowering the performance of power amplifier. As a result, RF power amplifiers need to be performed in the terribly large linear region [3], Elseways the peaks of the signal can get entered into the nonlinear region and will cause distortion.

High PAPR results in a wide range of OFDM signal amplitudes which due to nonlinear characteristics of HPA results in inter-modulation between the different subcarriers and lead to an increase in BER. To achieve a low BER and less signal distortion [9], the high power amplifier has to have a huge dynamic range and operate in the linear amplifier region.

PAPR of a signal is represented by

$$PAPR = \left[\frac{\max[x(n)]^2}{E\{[x(n)]^2\}}\right] \quad (1)$$

Where x (n) represents original signal, the peak signal power is denoted by max $[x(n)]^2$ and $E\{[x(n)]^2\}$ represents the average signal power.

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IV. PROPOSED TECHNIQUE

The objectives of the work are learning the numerous PAPR reduction techniques, then combining the SLM and PTS technique. During this hybrid scheme is minimum than the different existing techniques.

4.1 Proposed scheme

This system consists of combining of both partial transmit sequence and selected mapping in a hybrid manner, reduces the PAPR, in addition to this it also reduces the computational complexity when compared with previous techniques. These Hybrid methods are having the skill to decrease the PAPR moreover the performance of BER degrades. Enhances the BER performance further more minimization of PAPR by utilizing SLM with PTS. This hybrid system has the potentials to produce better PAPR reduction performance with lower computational complexity when compared with previous techniques. The construction diagram of Hybrid SLM with PTS system is shown in Fig.1.

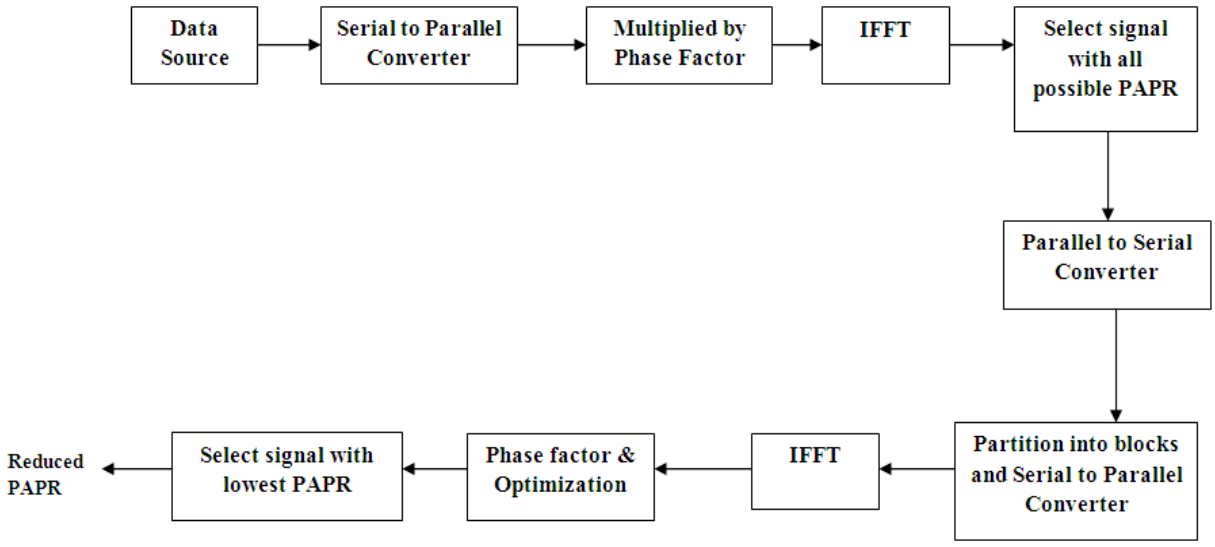

Fig.1. Hybrid SLM and PTS system

In the hybrid system, OFDM symbol is classified into two sections. The primary section is functioning on SLM algorithm and also the second section is functioning on PTS algorithm. Each algorithm is minimizing the PAPR for step by step. Data blocks are multiplied by every phase sequence to get another input symbol sequences. Every other input data sequence is processed further under IFFT operation. It can decrease the PAPR by increasing the phase rotated symbol sequences to the certain level. The phase rotated symbol sequence with the all possible PAPR is selected. Then the select signal with all possible PAPR is converted from parallel to serial. Finally, the signal with the all possible PAPR is applied to the input of Partial transmit sequence technique for further reduction of PAPR. In the PTS technique, input serial data is converted to parallel data and divided into several blocks and also the blocks are multiplied by different phase weights till an optimum value is selected. After that, the signal with lowest PAPR will be transmitted. The data information within the frequency domain is divided into non-overlapping blocks and each block has a similar size. Therefore, every block it contains nonzero elements and set the remainder part to zero. Assume that these blocks have the identical size and no gap between one another.

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V. RESULTS AND DISCUSSIONS

MATLAB simulations are performed for various PAPR reduction methods like clipping method, selected mapping, partial transmit sequences and hybrid SLM and PTS. Transmission of OFDM signal shown in Fig.2. Hybrid Initially, starting with SLM, in this all possible PAPR values are taken from this and feeding to PTS as input. Taking input from SLM this PTS minimizes the PAPR further. Representation of minimizing signal shown in Fig.3.

The relationship is accomplished between Hybrid method and the original PAPR. The PAPR of the proposed hybrid method is very fewer than existing PAPR. Comparison of reduction techniques shown in Fig.4.

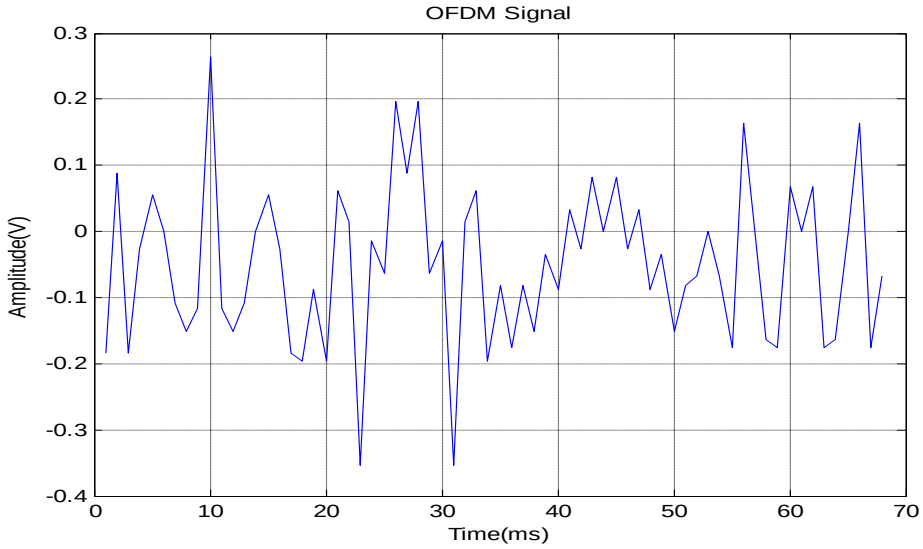

Fig.2. Transmitted OFDM signal

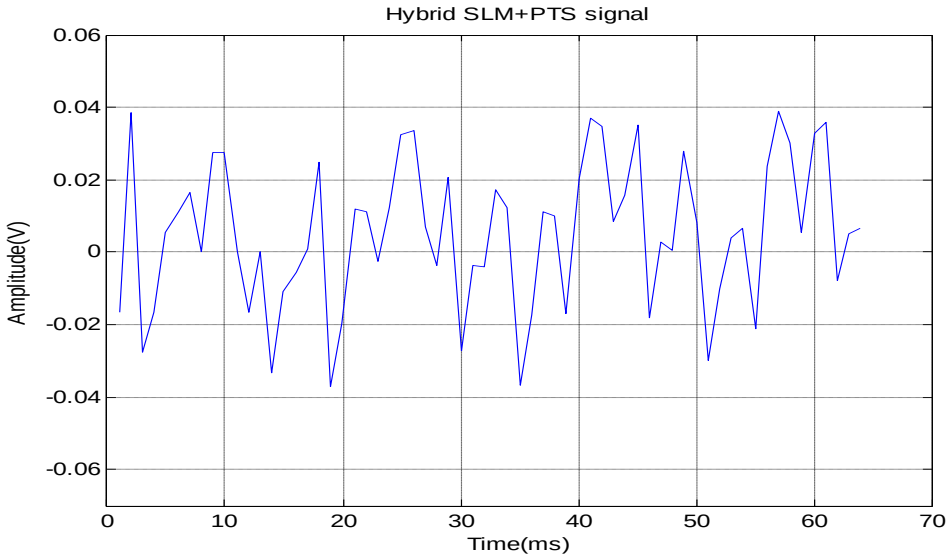

Fig.3. Minimization of hybrid SLM and PTS signal

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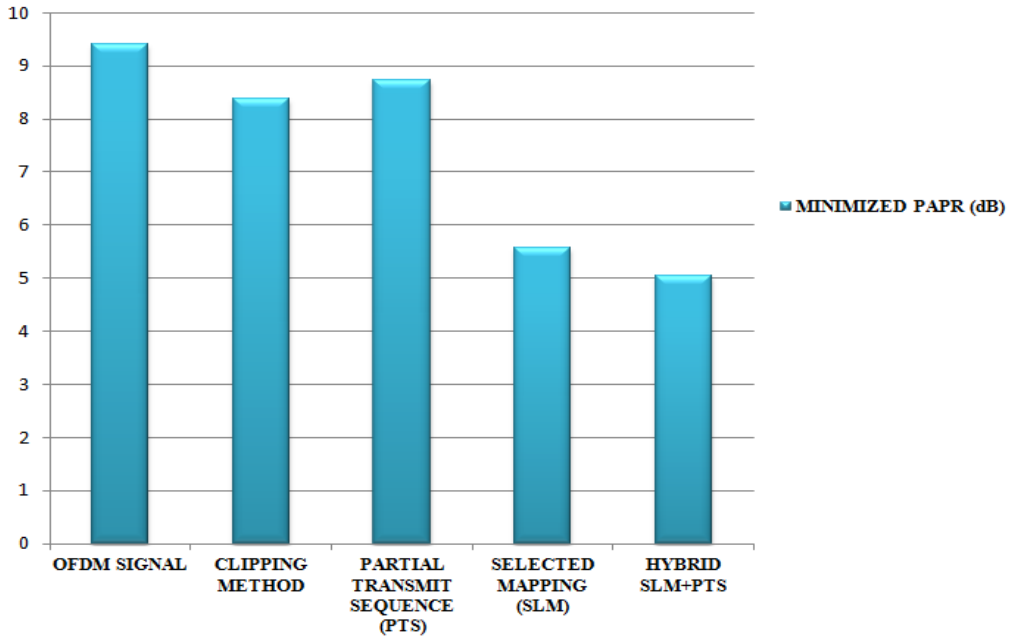

Fig.4. Comparison of reduction techniques

Table 1. shows results obtained from various PAPR reduction techniques. BER versus Eb/No curves for Clipping method, PTS, SLM and proposed method shown in Fig.5.

Table.1. Reduction of PAPR value

S.No	Techniques	Minimized PAPR (dB)
1.	Clipping method	8.3778
2.	Partial transmit sequence (PTS)	8.7289
3.	Selected mapping (SLM)	5.5602
4.	Hybrid SLM+PTS	5.0329

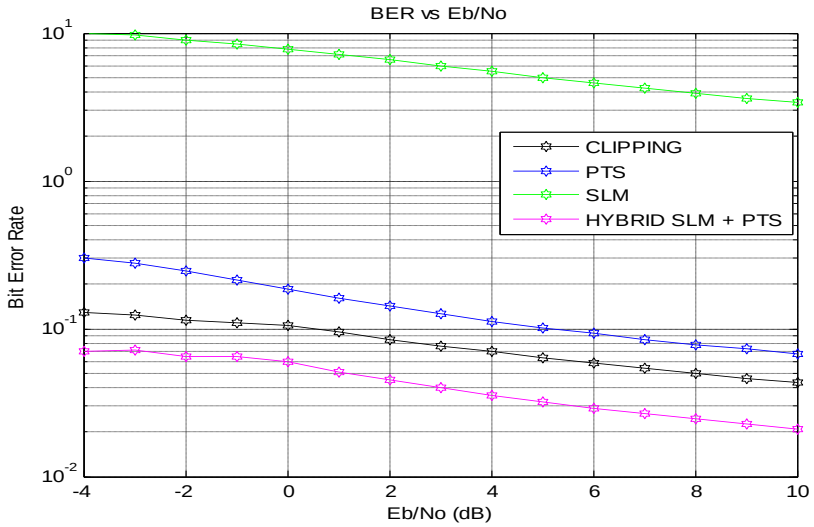

Fig.5. BER curves for clipping, PTS, SLM and Hybrid SLM+PTS

PAPR of OFDM signal is 9.4015dB. By introducing the clipping and filtering method reduces the PAPR value to 8.3778dB. In PTS method, the obtained PAPR value is 8.7289dB. In SLM method, the obtained PAPR value is 5.5602dB. In the proposed hybrid system by combining both the SLM and PTS method results in a PAPR value of 5.0329dB, which results in a minimum PAPR value than the above reduction methods.

VI. CONCLUSION

In this hybrid SLM and PTS are implemented which is compared with clipping method, PTS and SLM method. Then measure the PAPR value of those techniques. For the improvement of performance of PAPR, the methods of clipping are effective and easy, except they are not fit for a huge amount of subcarriers is referred. Since the proposed work can take advantage of both PTS and SLM algorithms, therefore it's the potential to diminish the PAPR than other techniques. BER performance of the Hybrid SLM and PTS is better than others. In the future work, the Modified exponential companding technique will be implemented then compared with previous techniques. Then these techniques are implemented through a Software Defined Radio Hardware kit.

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