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Performance Assessment of PAPR Reduction Techniques in OFDM System

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ABSTRACT: To achieve better performance using the multi carrier modulation we should make subcarriers to be orthogonal to each other such as Orthogonal Frequency Division Multiplexing (OFDM) technique. But the great drawback of the OFDM method is its high Peak to Average Power Ratio (PAPR). As we are using the linear power amplifier at the transmitter side so it's operating point will go to the saturation region due to the high PAPR which leads to in-band distortion & out-band radiation. This can be avoided with growing dynamic range of power amplifier which hints to the high cost &the high consumption of power at the base station. It is known that the PAPR reduction arrangements can be generally categorized into two groups, i.e. distortion-less systems like the SLM & PTS & the pre-distortion systems such as clipping & companding. In this Paper, we demonstrate performance of existing algorithms (PTS, SLM and Clipping) which has been compared using the MALAB simulations. The proposed procedure exploited standard PTS, Clipping and SLM methods. We proved that by comparison of these PAPR reduction techniques, the PTS perform much better than other standard methods such as Amplitude clipping, selective mapping projected earlier with respect to CCDF.

KEYWORDS: Orthogonal Frequency Division Multiplexing; multi carrier modulation; Peak to Average Power Ratio; clipping & companding; selected mapping; partial transmit sequence.

I. INTRODUCTION

Orthogonal frequency division multiplexing (OFDM) is an effectual multicarrier transmission method for the wireless communications over frequency selective channels. Using an Inverse Fast Fourier Transform (IFFT) & the Fast Fourier Transform (FFT) for the baseband modulation & demodulation, respectively, shortens the proposal of the transceiver &offers for an effectual hardware execution. A typical OFDM transmission system is shown in Fig. 1. However, time-domain OFDM signal can show a big Peak-to-Average Power Ratio (PAPR). These peaks can cause nonlinear distortion which offerings spectral distribution, intermodulation, &the variations in signal collection. One solution to this difficulty is to employ an exclusive power amplifier with huge linear range. Other methods are based on the signal modification.

So far, numerous methods [16] have been projected increase the PAPR performance in the OFDM systems, comprising direct clipping [17], the Recursive Clipping &Filtering (RCF) [18], companding method [19], the Active Constellation Extension (ACE) [20], coding method [21], the Selective Mapping (SLM) [22], &the Partial Transmit Sequence (PTS) [23-25].

One major drawback of the OFDM is big Peak to Average Power Ratio (PAPR). It is caused nonlinear distortions after amplified by the power amplifier. Several methods to decrease the PAPR have been projected. These methods have been known as amplitude clipping [26]-[27], clipping & filtering [26]-[27], coding [26]-[27], tone reservation (TR) [26]-[27], tone injection (TI) [26]-[27], active constellation extension (ACE)[27], &the multiple signal representation methods, like the selected mapping (SLM) [27], partial transmit sequence (PTS) [27]

The PAPR reduction with a small extent of redundancy [28]–[33]. With selective mapping (SLM) [28]-[30], the multiple sequences are created for original data block & the system with the lowest PAPR is designated for transmission. In Partial Transmit Sequence (PTS) method [30]-[33], disjoint sub blocks of OFDM subcarriers are phase shifted distinctly after IFFT is calculated. If the sub blocks are optimally phase shifted, they show the minimum PAPR &subsequently decrease the PAPR of the compound signal. Amount of the subblocks & their separating system

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determine the PAPR reduction. The examine for optimum sub block phase features is computationally difficulty, but this can be condensed with adaptive PTS [32] or sphere decoding [33]. Usually, the receiver wants side data equivalent to optimal phases in PTS & the transmitted sequences in the SLM. Methods for avoiding explicit side information transmission are accessible in [29], [30].

One of the main drawbacks of the PTS arises from the computation of the multiple IFFTs, causing in a high complexity proportional to number of sub blocks. In an effort to decrease this complexity, intermediate signals within IFFT using decimation in time (DIT) have been used to attain the PTS sub locks.

It is known that PAPR reduction systems can be mainly categorized into two groups, i.e. distortion-less systems like the SLM & PTS & the pre-distortion systems such as clipping &companding. In this paper, we demonstrate the performance of three approaches for the PAPR reduction in OFDM system namely partial transmit sequence method (PTS), Clipping technique and the Selected Mapping Technique (SLM).

In the performance assessment of projected detection algorithm, no oversampling at transmitter is used because oversampling method is useful for appropriately computing the PAPR but has no result on BER unless a HPA is used at the transmitter. To make scheme simple, the HPA is absent from the transmitter. Additionally, only the stationary channel (i.e.,the AWGN Channel) is measured throughout this simulation. Channel estimation is not accomplished here.

II. RELATED WORK

Fernando & Foomooljareon (2002) proposed about PAPR difficulty in the OFDM schemes. They presented two algorithms to decrease the PAPR. The first algorithm is passed out by choosing input sequence correctly using the lookup table & the second by scaling the input envelope for subcarriers before they are changed to time domain by the Inverse Fast Fourier Transform (IFFT).

Jung Chieh Chen &Chao-Kai Wen (2010) expresses the PAPR reduction with the TI system as a certain combinatorial optimization difficulty. Following they projected presentation of the cross entropy method to explain the difficulty.

The Partial Transmit Sequence (PTS) technique has established much devotion in decreasing high PAPR of the Orthogonal Frequency Division Multiplexing (OFDM) signals. However, the PTS method requirements an extensive search of all groupings of permissible phase issues & the search complexity increases exponentially with amount of the sub-blocks. The Parametric Minimum Cross Entropy Technique (PMCE) is projected by Yajun wang (2010) to search optimal grouping of phase features. The PMCE algorithm not only decreases PAPR considerably but also decreases the computational difficulty

Most of the current works have concentrated on reducing the PAPR of OFDM signals. However, after connecting this problem with definite features of the High Power Amplifier (HPA), Dong-Hyun Park et al (2007) suggest a novel system based on iterative partial transmit sequence system that uses amount of the OFDM signal where the nonlinear distortion is to be produced by the High Power Amplifier (HPA) as a novelration.

Chin-Liang Wang & Yuan Ouyang (2005) presents the Selected mapping technique (SLM). The SLM technique offers good performance for the PAPR reduction, but it requirements a bank of the Inverse Fast Fourier Transforms (IFFTs) to create a set of candidate transmission signals, & this condition usually consequences in the high computational difficulty.

Stephane Y. Le Goff et al (2009) suggest the novel SLM technique for which no side information desires to be sent. By seeing illustration of the numerous OFDM schemes using either QPSK or 16- QAM modulation, projected technique achieves very well both in the terms of PAPR reduction & bit error rate at the receiver output with the huge amount of sub carriers.

Chusit Pradabpet & Kobchai Dejhan (2008) proposed the novel PAPR reduction technique using the PTS combined with adaptive peak power reduction approaches. In order to decrease the PAPR, the order of input data is rearranged by PTS for the reduction of PAPR & then fed to the adaptive peak power reduction process in proposed system. The comparison among SLM & PTS was projected by Anil Singh Rathore & Neelam Srivastava (2010). They studied thatSLM algorithm is more appropriate if scheme can receive more redundant information.

The investigation of side information difficulty in the SLM method has been protracted by Kasiri & Dehghani (2009). Certain subcarriers have been reserved in OFDM frame which is to be replaced with one of the probable phases according to the amount of phase order blocks in the SLM algorithm.

Houshou Chen &Hsinying Liang (2007) investigated with the BPSK subcarriers by joining SLM &binary cyclic codes. The author decomposes the binary cyclic codes into direct sum of two cyclic sub codes: the correction sub code used for the error correction & the scrambling sub code for PAPR reduction. The communicated OFDM signal is designated that attains minimum PAPR, from set of binary cyclic code words.

Daoud and Alani (2009) improved the performance of the OFDM scheme by using the Low-Density Parity-Check codes as an alternative to the turbo coding in modifying the PAPR difficulty which has been used in the preceding works of authors. Simulation consequences presented that using the LDPC has led to improved performance than the earlier issued turbo encoding in terms of the PAPR reduction proportion.

In a turbo coded OFDM, the low PAPR can be attained by relating SLM. Yung-Chih Tsai & Yeong Ueng (2007) projected to create the multiple applicants used in SLM by employing the tail-biting bits in a tail biting turbo code. In this method, no clear side information is required &no error propagation is detected. The low PAPR can also be attained by distortion-based approaches such as thoughtful clipping.

III. PAPR REDUCTION TECHNIQUES USED FOR COMPARISON

OFDM is multicarrier multiplexing access Method for Transmitting the Large data over Radio waves. Next mobile Generation system is expected to provide the high data rate to meet the requirement for the future multimedia application. Minimum data rate required for 4G System is 10-20Mbps & at least 2Mbps in moving vehicles. And modulation method adopted by 4G mobile system is OFDM. One of the major difficulties observed in the OFDM system is PAPR (Peak to Average Power Ratio). This PAPR must be Decrease for efficient transmission. Different techniques can be used for decrease PAPR in OFDM system.

A large peak-to-average power ratio (PAPR) would source power amplifier used in an OFDM system to be determined in saturation area, thus significant to signal alteration. The traditional remedy for this PAPR difficulty is to use the linear amplifier with a large dynamic range. This answer, however, executes a stringent condition on analog devices in both the transmitter & receiver, & therefore, rises the cost of the system. PAPR reduction technique should be chosen with awareness according to numerous system requirements.

TABLE 1: Comparison of PAPR Reduction Techniques

Reduction Technique	**Parameters**			**Operation required at Transmitter (TX)/ Receiver (RX)**
	Decrease distortion	Power raise	Defeat data rate	
Clipping and Filtering	No	No	No	TX: Clipping RX: None
Selective Mapping (SLM)	Yes	No	Yes	TX: M times IDFTs operation RX: Side information extraction, inverse SLM
Block Coding	Yes	No	Yes	TX: Coding or table searching RX: Decoding or table searching
Partial Transmit Sequence(PTS)	Yes	No	Yes	TX: V times IDFTs operation RX: Side information extraction, inverse PTS
Interleaving	Yes	No	Yes	TX: D times IDFTs operation, D-1 times interleaving RX: Side information extraction, de-interleaving
Tone Reservation (TR)	Yes	Yes	Yes	
Tone Injection (TI)	Yes	Yes	No	

A. Partial Transmit Sequence (PTS) for PAPR Reduction

The partial transmit sequence technique is phase optimization technique which can offer an remaining the PAPR reduction with a small amount of redundancy. With this technique, separate subblocks of OFDM subcarriers are phase shifted distinctly after IFFT is calculated. If the subblocks are optimally phase shifted, they display minimum

PAPR &accordingly decrease PAPR of the combined signal. The number of subblocks (V) & the partitioning arrangement define the PAPR reduction. The main difficulty of the PTS ascends from the computation of multiple IFFTs, subsequent in high computational difficulty proportional to the amount of subblocks.

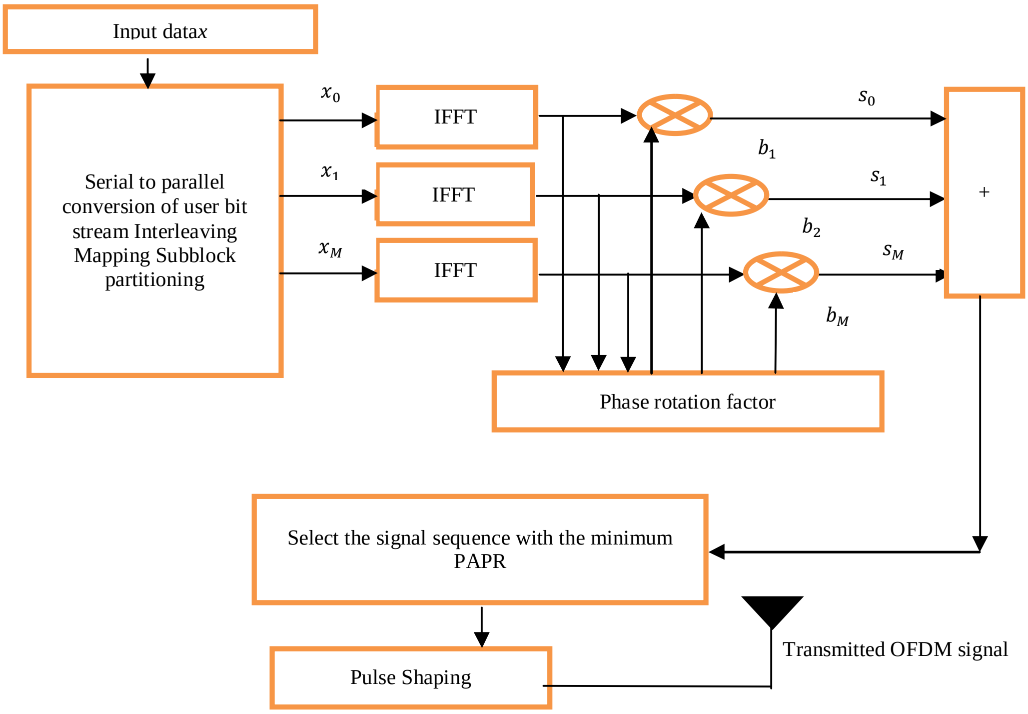

Figure 2: A typical structure of transmitter for PTS combined with interleaved OFDM signal

Sub-block partition for the PTS OFDM is a technique of separation of subbands into the multiple disjoint subblocks. Generally, it can be categorized into 3 groups; interleaved partition, adjacent partition, & pseudo-random partition. For the interleaved method, each subblock signal spread out is allotted at similar subblock. In the adjacent system, consecutive subblocks are allocated into the similar subblock consecutively. And all subblock signal is allocated into any one of the subblocks arbitrarily in pseudo-random arrangement. It can be distinguished that the computational difficulty of interleaved sub-block partitioning arrangement is condensed widely as compared to that of the adjacent & pseudo-random partition system.

B. PAPR Calculation

OFDM signal is the sum of multiple sinusoidal having the frequency separation (1/T) where each sinusoidal gets modulated by independent informationa_k. Mathematically, the transmit signal is

$$x(t) = \sum_0^{k-1} a_k\, e^{\frac{j2\pi kt}{T}} \qquad \dots \textbf{(1)}$$

Due to the large number of sub-carriers in the typical OFDM systems, amplitude of transmitted signal has large dynamic range, leading to in-band distortion and the out-of-band radiation when signal is passed through the nonlinear region of the power amplifier.

Peak Power

$$\mathrm{Max}[x(t)x^*(t)] = Max\left[\sum_0^{k-1} a_k e^{\frac{j2\pi ki}{T}} \sum_0^{k-1} a_k^* e^{\frac{-j2\pi ki}{T}}\right]$$

$$= K^2 \qquad \dots \textbf{(2)}$$

Average Power

$$\mathrm{E}[x(t)x^{*}(t)] = E\left[\sum_{0}^{k-1} a_k e^{\frac{j2\pi ki}{T}} \sum_{0}^{k-1} a_k^{*} e^{\frac{-j2\pi ki}{T}}\right]$$

$= K$ … **(3)**

So, mathematically PAPR is given by,

$PAPR = K^2/K = K$ … **(4)**

TABLE 2: Comparison of the reduction techniques

Technique	Implementation Complexity	Bandwidth Expansion	BER Degradation	Distortion
Clipping	Low	No	Yes	Yes
CODING	Low	Yes	No	Yes
PTS	High	No	No	No

C. Technical Description of PTS Method

The basic idea of partial transmit sequence arrangement is to distribute original OFDM order into several sub sequences & for each sub sequence increased by dissimilar weights until an best value is chosen. For executing the PTS scheme possible phase features or weights are to be created depending on the mapping used. Every subsequence is increased with every weights created& the PAPR is considered each time. The phase issues for which subsequence-weight product signals with the minimum PAPR is acquired is selected as the best values for weight. Thus signals with low PAPR are attained.

Let X is the random input signal in frequency domain with a length of N. X is divided into V disjoint sub blocks.

$X_v = [X_{v,0}, X_{v,1}, \dots, X_{v,N-1}]^T$ … **(5)**

Where $v = 1,2,\dots v$. The dividing of input signal in to sub blocks is such that summation of these sub blocks provides the input signal X, ie.

$\sum_{v=1}^{V} X_v = X$ … **(6)**

Then these sub blocks are common in time domain. Sub block partition is based on interleaving in which computational difficulty is less associated to adjacent & Pseudo-random, however it has the worst PAPR performance between them. Then apply phase rotation factor 'b_v' to the IFFT of each of the sub blocks.

$b_v = e^{j\theta_v}$ … **(7)**

Where $v = 1,2,\dots,V$. The time domain signal after merging is given by:

$x'(b) = \sum_{v=1}^{V} b_v x_v$ … **(8)**

Where $x'(b) = [x'_0(b), x'_1(b), \dots . x'_{NL-1}(b)]^T$ and L is over sampling issue. The optimum signal $x'(b)$ with the lowest PAPR is to be found out.

Both b and x can be shown in matrix form as follows:

$$b = \begin{bmatrix} b_1, b_1, \dots\dots, b_1 \\ \vdots \quad \vdots \quad \vdots \\ b_V, b_V, \dots\dots b_V \end{bmatrix}_{VXN}$$ … **(9)**

$$x = \begin{bmatrix} x_{1,0}, x_{1,1}, \ldots\ldots, x_{1,NL-1} \\ \vdots \quad\quad \vdots \quad\quad \vdots \\ x_{V,0}, x_{V,1}, \ldots\ldots x_{V,NL-1} \end{bmatrix}_{VXNL} \quad \ldots \quad \textbf{(10)}$$

It should be distinguished that all basics of each row of matrix *b* are of the similar values in this method. In direction to have exact the PAPR calculation, at least 4 times over sampling is essential. As over sampling of x, add zeros to the vector, hence the amount of the phase sequence to increase to matrix x will continue the similar.

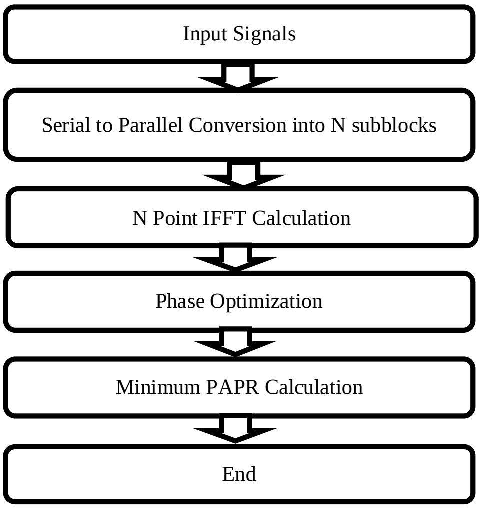

Figure 3: Flowchart for the PTS

The PTS contain of several Inverse Fast Fourier Transform (IFFT) operations & complicated designs to obtain best phase sequence which consequences in growing computational difficulty of PTS.

D. Selective Mapping Technique

In the SLM method, from single OFDM sequence D having a length of N, the number of sequences are generated that represent same information using some rotation factors and sequence with the lowest PAPR is transmitted. If the number of generated new sequences is U, called SLM length, then all these sequences are the result of multiplying incoming the original OFDM sequence D by U different rotation factors. These factors are given in vector form as

$$B^{(i)} = [b_0^{(i)}, b_1^{(i)}, \ldots, b_{N-1}^{(i)}] \quad \ldots \textbf{(11)}$$

where $i = 1$ to U and represents the indices of these factors and B is represent the rotation factor in vector form. After multiplying these factors by original OFDM sequence D, we get:

$$X^{(i)} = [d_0 b_0^{(i)}, d_1 b_1^{(i)}, \ldots, d_{N-1} b_{N-1}^{(i)}] \quad \ldots \textbf{(12)}$$

The multiplication factors are phase rotations selected appropriately such that multiplying complex number by these factors results in the rotation of that complex number to additional complex number representing the different point in the constellation. Hence,

$$b_n^i = e^{-j\theta_n^i} \; where \; \theta_n^{(i)} \in [0,2\pi) \quad \ldots \textbf{(13)}$$

Where θ is angle of rotation. The rotation vectors are used as the side information which are transmitted for the signal recovery.

The efficiency of SLM method depends on amount of scrambling done by these rotation factors on original OFDM sequence and the length of SLM *U*. As we increase the number of SLM sequences, the PAPR performance becomes better but at the expense of increase in system complexity.

Although the SLM technique has moderate implementation complexity, this complexity increases as *U* increases. For this reason, numerous researchers devoted their work in this field towards improving complexity computation of the conventional SLM.The complexity of typical SLM technique considering no oversampling (i.e. J = 1) in the terms of complexity additions are:

$$Complexity = UN\log_2 N \qquad \ldots \textbf{(14)}$$

E. Amplitude Clipping Technique

The high PAPR brings drawbacks such as increased complexity of the ADC and DAC and also decreased the efficiency of Radio Frequency power amplifier. One of simple and the effective PAPR reduction approaches is clipping, which abandons signal components that exceed some unchanging amplitude known as clip level. In Clipping, amplitudes of the input signal are clipped to predetermined value. However, clipping yields distortion power, which known as clipping noise, and enlarges the transmitted signal spectrum, which causes interfering. The clipping and the filtering method is effective in eliminating components of expanded spectrum. Although filtering can lessening the spectrum growth, filtering after clipping can decrease out-of-band radiation, but may also reason some peak re-growth, which peak the signal exceeds in the clip level. Technique of the iterative clipping and filtering decreases the PAPR without the spectrum expansion. However, iterative signal takes long time and it will enhance computational complexity of OFDM transmitter.

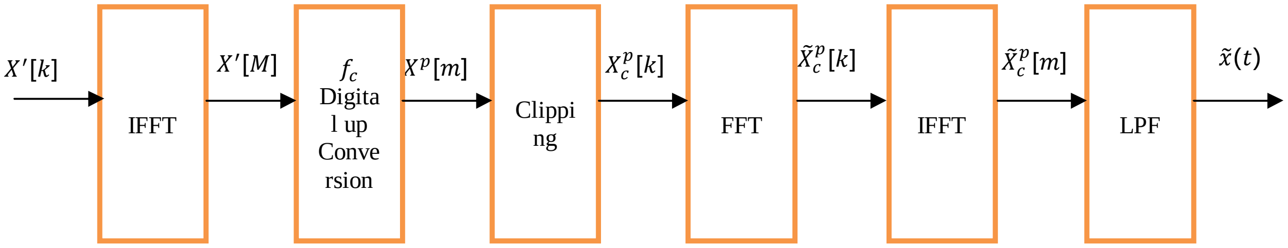

Figure 4: Clipping and Filtering Technique

However, this causes important peak re-growth. So, it can use the iterative clipping and frequency domain filtering to evade peak re-growth. In system used, serial to the parallel converter converts serial input data having the different frequency component which are base band modulated symbols and apply the interpolation to these symbols by zero padding in the middle of input data. Then clipping operation is performed to cut the high peak amplitudes and the frequency domain filtering is used to reduction out of band signal, but caused peak re-growth. This consists of two FFT operations. Forward the FFT transforms the clipped signal back to discrete frequency domain. The in-band discrete components are passed unchanged to inputs of the second IFFT while out of band components are null. Clipping introduces in band distortion and the out of-band signals, which can be controlled by proper filtering.

$$x_c^p[m] = \begin{cases} x^p[m] & if\,|x^p[m]| < A \\ \frac{x^p[m]}{|x^p[m]|}.A & Otherwise \end{cases} \qquad \ldots \textbf{(15)}$$

Where, A is pre-specified clipping level. Note that Equation (16) can be applied to both baseband complex-valued signals and the pass band real-valued signals be applied only to the passband signals. Let us define the Clipping Ratio (CR) as the clipping level normalized by RMS values of the OFDM signal, such that

$$CR = \frac{A}{\sigma} \qquad \ldots (16)$$

IV. SIMULATION RESULTS & ANALYSIS

In this section, the practical PAPR performance of proposed scheme has been evaluated. It is known that thePAPR reduction schemes can be mainly classified into two groups, such as distortion-less schemes like the SLM and the PTSand the pre-distortion schemes like clipping and *companding*.

In this sub section, we illustrate performance of the different algorithms which has been compared with existing PAPR reduction approaches using the MALAB simulations. The simulation has been done with an OFDM system which had 1024 symbols and uses the M-QAM constellation modulation scheme on each sub carrier under Gaussian noise. Oversampling rate factor 4 to approximate continuous time peak signal.

The Complementary Cumulative Distribution Function (CCDF) is used to measure of the PAPR reduction in OFDM system. Generally, original OFDM system has the PAPR of 12dB. And it is well known by us that 12dB is the conventional OFDM PAPR without applying any PAPR reduction approaches to the OFDM system. Comparison considers three algorithms: Amplitude Clipping, Selective Mapping, andthe PTS method for different values with their Complimentary Cumulative Distributed Function (CCDF). The auto-correlation function is standard technique to measure the degree of correlation within sequence orthe periodic nature. In the OFDM, high peak happens at the output of IFFT when input data sequence applied at the input of IFFTs is strongly correlated. Therefore, to decrease the auto correlation at input of IFFT, the input data sequences are multiplied with another sequence with the low autocorrelation magnitude.

To make the system simple, HPA isomitted from the transmitter. In addition, only the static channel(such as, Additive White Gaussian Noise (AWGN) Channel) is considered throughout this simulation. The channel estimation is not performed here. Our aim is to just detect the symbols and see the effect of wrong detection on the overall BER and in the terms of results we proved that proposed PAPR reduction perform much better than the standard methods.

The OFDM receiver performance employing Proposed the comparative analysis, partial transmit sequence are (i.e. dividing the OFDM symbols into sub-blocks) are calculated from the OFDM symbol after interleaving and phase shifting is analysed with advantage of the simulation factors listed in Table 2. LS channel estimation is employed to analyses receiver performance in the terms of MSE and BER. The PAPR performance of OFDM system for N=250 and different sub blocks is shown in results. At the CCDF between 0 to 1, reduction in PAPR is about 28.18%, 40.91%, 54.55% and 62.73% for V=2, 4, 8 and 16 when compared to the OFDM system without the PAPR reduction. In this proposed comparison result analysis is based on these parameters:

Simulation parameters	**Type value**
Size of FFT	1024
Symbols per Carrier	50
Number of carriers 'N'	200
Number of sub blocks 'V'	2,4,8 and 16
Phase factors	$+i, -i, +j, -j$
Interleaving factor'S'	4
Pulse shaping filter	Raised cosine
SNR	10

TABLE 3: Lists the simulation parameters used.

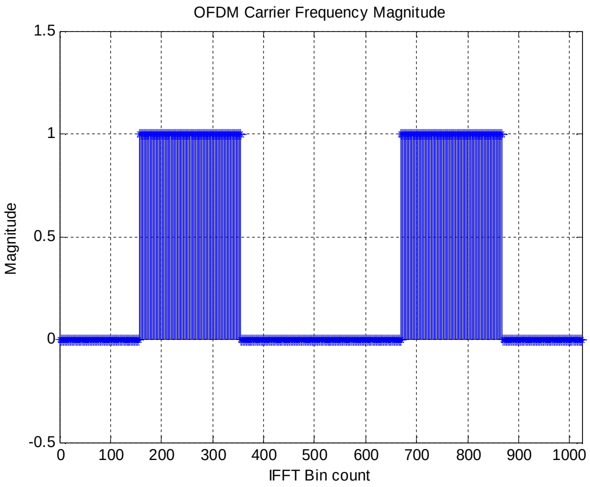

Figure 5: Figure shows the Magnitude of signal with respect to IFFT bin count for transmitted OFDM signal.

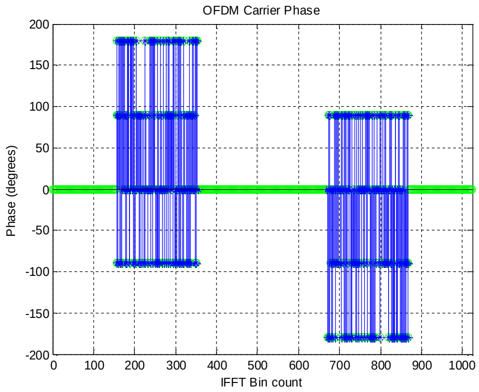

Figure 6: Shows the OFDM carrier phase, in which phase in the degrees of OFDM signal is extracted with respect to IFFT bin count for the transmitted OFDM signal.

To illustrate the performance, an N subcarrier OFDM system with M-QAM modulation is considered. For an correct estimation of the PAPR, the signal is oversampled by factor of 4 (L = 4), and the 1024 random OFDM blocks havebeen generated to obtain numerical results. The results are illustrated using the CCDF, and PAPR is measured with and without proposed PAPR reduction technique.

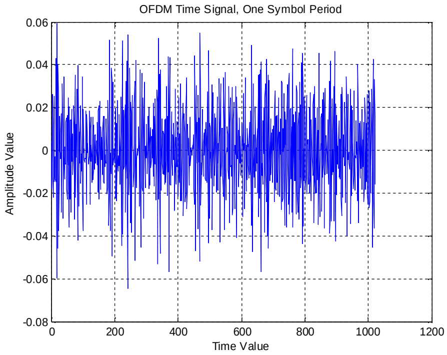

Figure 7: The graph above shows the Amplitude value of signal with respect to time slot (1024) taken for transmitted OFDM signal.

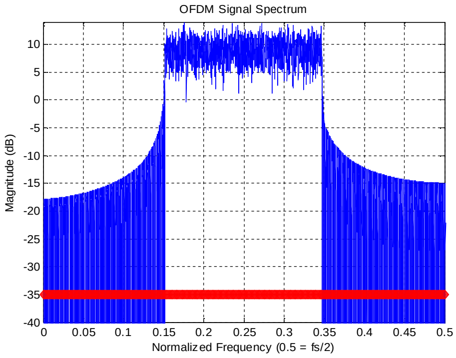

Figure 8: The graph obtained shows a signal spectrum of Proposed OFDM system. X axes shows the normalized frequency defined for the proposed system and Magnitude in dB is shown in Y axes for the transmitted OFDM signal.

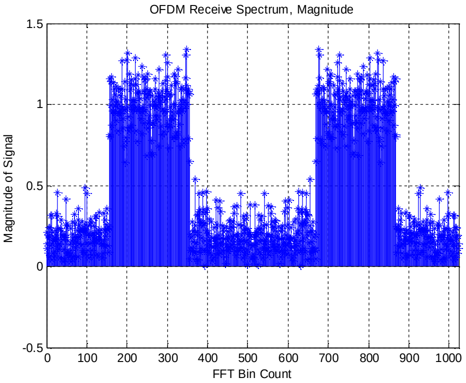

Figure 9: Figure above shows a OFDM received signal spectrum. It shows magnitude of the signal received with respect to FFT bin count for the signal received at Receiver.

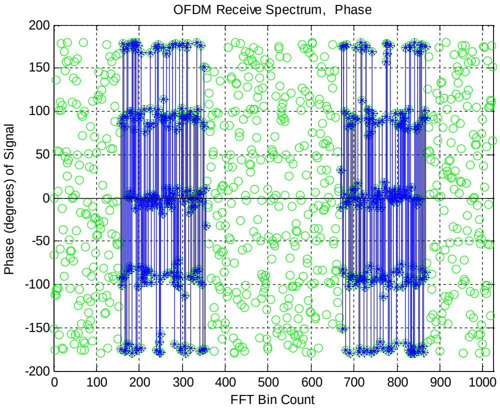

Figure 10: Figure above shows the phase information of received signal spectrum. In figure, phase of received signal is plotted with respect the FFT bin count for signal received at the receiver after adding noise within the channel.

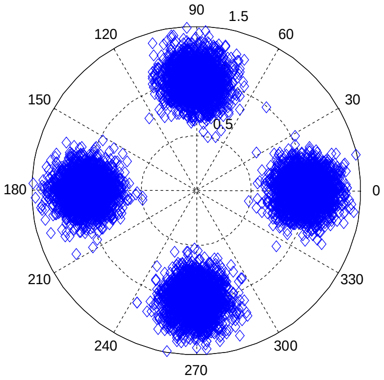

Figure 11: Figure above shows the polar plot of received signal spectrum with respect to the channel information. It shows distribution of the signal spectrum across a polar spectrum.

CCDF	Value of PAPR			Original PAPR
	Clipping	**SLM**	**PTS**	
0.8	**9.3582**	**9.4254**	**3.3695**	**10.8653**
0.6	**9.1956**	**9.7881**	**3.1974**	**10.7844**
0.4	**10.1647**	**9.8752**	**3.1526**	**10.9672**
0.2	**20.4691**	**10.7383**	**3.2648**	**11.8564**
0.0	**20.7095**	**21.1958**	**3.9167**	**27.7624**

TABLE 4:PAPR values with respect to CCDF for all the techniques considered in simulation.

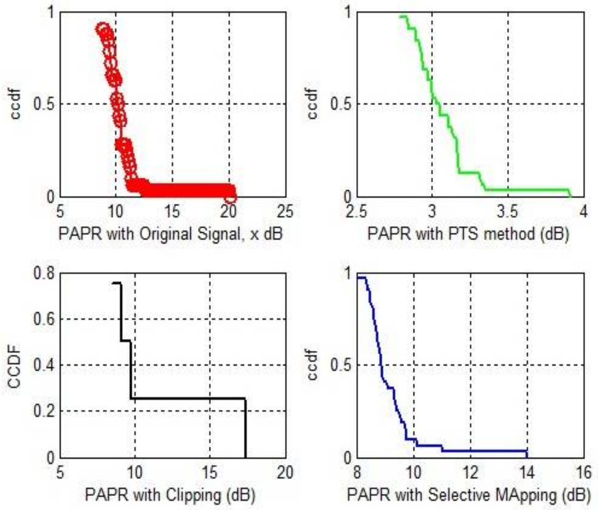

Figure 12: Comparative view of the PAPR values with respect to the CCDF for all the techniques used for the simulation. It is clear from figure that line shown in green forPTS having the lower values of PAPR for all values of the CCDF.

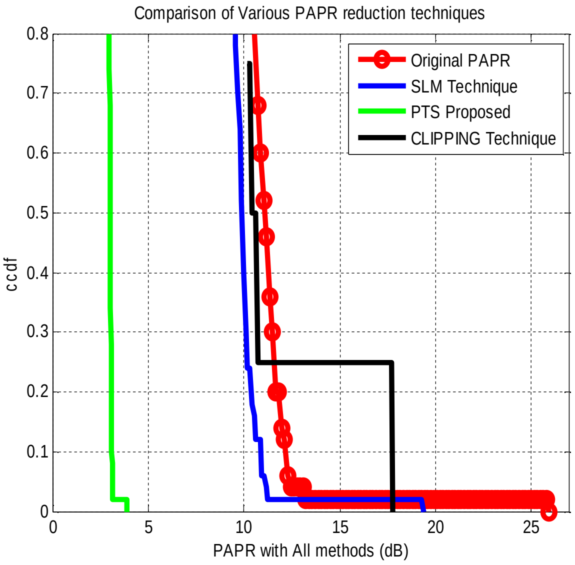

Figure 13: Figure above shows a comparative view of the PAPR with respect to different values of the CCDF for all 3methods

Figure 13 above shows a comparative view of the PAPR with respect to different values of the CCDF for all 3methods used for the simulation. From figure, it is clear that the PTS technique for PAPR reduction technique perform much better than other techniques. We are getting a very lower value of the PAPR of approximately ~4 dB by using standard PTS method.

From figure 12 and figure 13, this section conclude that and also here results shows that, this proposed the PAPR reduction technique successfully extends the stable region to more than ~3dB&the PAPR reduced to less than ~4 dB and outperformed successfully further techniques considered in simulation.

V. CONCLUSION AND FUTURE WORK

Peak value of independently modulated sub-carriers in the OFDM system is actual high compared to average value. Ratio of this value is called the peak-to-average power ratio (PAPR). Though OFDM has numerous benefits like high spectral efficiency, robustness to channel fading, immunity to the impulse interference, capability to handle very robust echoes & the less non-linear distortion it also has drawback of the high PAPR. The Complementary Cumulative Distribution Function (CCDF) is used to measure of the PAPR reduction in OFDM system. Generally, original OFDM system has the PAPR of 12dB. And it is well known by us that the 12dB is conventional OFDM PAPR without applying any PAPR reduction approaches to the OFDM system. Comparison considers three algorithms: Amplitude Clipping, Selective Mapping and the PTS for different values with their Complimentary Cumulative Distributed Function (CCDF). Our aim is to just detect symbols and see the effect of wrong detection on overall BER and in the terms of results we proved that the PTS method PAPR reduction perform much better than standard methods.

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