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A Hybrid Papr Reduction Technique For Mimo OFDM System With Qpsk

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ABSTACT:- This work present hybrid Peak to average power ratio mitigation technique based on PTS and modified clipping technique in MIMO-OFDM system. Firstly we applied signal to PTS and then we applied Modified clipping technique. This hybrid technique gives betterment in PAPR reduction capacity of the system. The simulation demonstrates that proposed hybrid technique better than the PTS and Original MIMO-OFDM system. This technique results in improve BER as contrast to without any technique. It shows that 18.88% improvement as compared to original scheme and 7.95% improvement contrast to PTS scheme.

KEYWORDS:- AWGN, OFDM, MIMO, PAPR,

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I. INTRODUCTION

MIMO OFDM is broadly used as a demanding technique for next-generation broadband wireless applications due to its potential in achieving high data rate and providing reliable performance of diversity and special multiplexing [1]. As A OFDM systems, a key challenge of MIMO-OFDM transmission systems is the problem of high peak-to-average power ratio (PAPR), which leads to server distortion at the output of power amplifier. To mitigate this problem, a variety of PAPR reduction techniques for OFDM systems have been presented in the literature, including companding [2], clipping [3], selected mapping (SLM) [4], and partial transmit sequences (PTS) [5] etc. Among these techniques, Partial Transmit Sequence is attractive due to efficiently minimize the PAPR without distorting OFDM signals. At the receiver end, PTS needs transmitting side information for signal recovery. Higher PAPR reduction can be achieved by using Clipping method but it alters the signal that root for the in out band distortion and band distortion.

Numerous PTS-based techniques have been extended to the context of MIMO-OFDM systems in order to mitigate PAPR. In this paper hybrid method of PTS and Clipping is used for better PAPR reduction and maintain bit error rate.

II. PAPR & MIMO OFDM SYSTEM

An OFDM data block with N subcarriers, Xk=(X0,X1,...XN-1), is formed with each symbol modulating the corresponding subcarrier from a set of subcarriers., The N subcarriers are chosen to be orthogonal in an MIMO-OFDM system, over the period $0 \le t \le T$ where, T is the original data symbol period, and f0=1/T is the frequency spacing between adjacent subcarriers.

The complex baseband OFDM signal for N subcarriers can be written as

$$x(t)=\frac{1}{\sqrt{N}}\sum_{k=0}^{N-1} X_k\, e^{j2\pi k f_0 t}\ ,\ 0 \le t \le T$$

Replacing $t=nT_b$, where $T_b = T/N$, presents the discrete time version denoted by

$$x(t)=\frac{1}{\sqrt{N}}\sum_{k=0}^{N-1} Xk\, e^{j2\pi kn/LN}\ ,\ n=0,1,......NL-1$$

Where, L is the oversampling factor. The symbol-spaced sampling occasionally misses few signal peaks and outcomes in optimistic results for the PAPR. Inverse fast Fourier transform (IFFT) can be done on sampling signal.

The PAPR OFDM signal, $x(t)$, is termed as the ratio between the maximum instantaneous power and the average power, defined by

$$PAPR=\frac{max_{\,0\le t\le T}\ l x(t) l^2}{E[l x(t) l^2]}$$

where E [.] is the expectation operator.

The PAPR of the continuous-time OFDM signal cannot be correctly computed in the Nyquist sampling rate, which relates to N samples per OFDM symbol. In this case, signal peaks may be skipped and PAPR estimates are not correct. So, oversampling is necessary.

The PAPR reduction performance is estimated by using the complementary cumulative distribution function (CCDF) of the PAPR of signals. CCDF express the probability of exceeding a given threshold PAPR0 and is represented [6] as

$$\text{CCDF}\ (\text{PAPR}(x(n)))=P_r(\text{PAPR}(x(n)))>\text{PAPR}_0)$$

Due to the independence of the N samples, the CCDF of the PAPR of single input single output (SISO) OFDM as a data block with Nyquist rate sampling is given by

$$P= P_r(\text{PAPR}(x(n))>\text{PAPR}_0)=1- (1- e^{-PAPR\circ})^N$$

The independent statement in equation is not correct for oversampling case [6]-[8]. The expression for the PAPR can be modified for N subcarriers and oversampling by the distribution for LN. Hence, the CCDF of PAPR calculated for the oversampled signal can be redefined as

$$P= P_r(\text{PAPR}(x(n))>\text{PAPR}_0)=1- (1- e^{-PAPR\circ})^{LN}$$

Investigation of the PAPR performance is the analogous to the SISO for each transmitting antenna in a MIMO-OFDM system. The PAPR of MIMO-OFDM system is defined as the highest of PAPRs along with all transmit antennas [9], i.e.,

$$PAPR_{MIMO-OFDM} = \max_{1\leq i\leq Mt} PAPRi$$

where, PAPRi denotes i^{th} transmit antenna PAPR value. Specifically, CCDF of the PAPR in Mt transmit antenna for MIMO-OFDM system can be rewrite as

$$P_r(PAPR_{MIMO-OFDM}>\text{PAPR}_0)=1- (1- e^{-PAPR\circ})^{Mt\ LN}$$

Comparing equation, it is marked that MIMO-OFDM outcomes in even poorer PAPR than SISO-OFDM.

1) Previous Method

A. PTS TECHNIQUE

PTS is extensively used to diminish the PAPR in MIMO-OFDM signals. Whole sequence is firstly divides the frequency signal vector into a small number of blocks [10]. In MIMO-OFDM signals, the phase transformation is done before applying frequency separation [11], [12]. The block diagram of the PTS technique is shown in figure 2. In PTS, block separation is done to split the input frequencies into a number of blocks. IFFT of each block is taken separately. Finally, from the group of phase vectors the suitable phase vector is selected [13], [14]. The input symbol sequence is partitioned into V disjoint sub-blocks as follows:

$X = [X^1X^2.....X^v]$

where, X^i = represents the sub-blocks (i = 1,2,…,V).

Sub-carriers divide into a sub-block and multiplied by a different phase factor as follows

$b^v = e^{j\phi v}$ *for* $v = 1, 2,\dots, V$

IFFT of each sub-block is taken and finally time domain signal is calculated as below:

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

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

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

X^v represents the partial transmit sequence. Minimum PAPR choose for transmission according to corresponding phase vector is defined by,

$$\bar{b}^1, \bar{b}^2, \dots, \bar{b}^V = \underset{[b^1,\ b^2,\ \dots,\ b^V]}{\arg\min} \left(\max_{n=0,\ 1,\dots,\ N-1} \left| \sum_{v=1}^{V} b^v X^v\ (n) \right| \right)$$

Above equation recognized the minimum PAPR set of phase vector. Minimum PAPR for each phase in time domain is defined by,

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

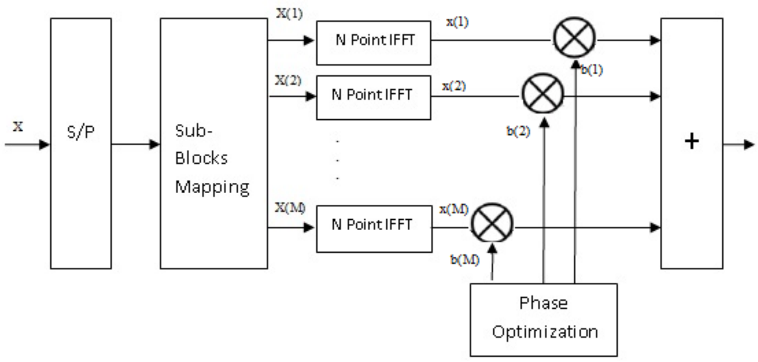

Figure 1 PTS schemes

B. CLIPPING TECHNIQUE

This is simple technique utilized for PAPR reduction of OFDM signal. A Clip is also called as non linear saturation which is employed about the peaks to reduce the peaks before high power amplifier to lessen PAPR and so is called Clipping Technique. This is simple method but it commences In Band Distortion and Out Of Band Radiation in OFDM Signal. Joint filtering and clipping technique reduce the OOB radiation but IB distortion are still there since this method degrades OFDM system performance *e.g.* spectral efficiency and BER. Envelop scaling is used for PAPR reduction due to equality envelop properties of all subcarriers input [15]. Clipping means set predefined threshold, if amplitude of signal value above the threshold amplitude of the signal is clipped. This limit the input signals under a threshold value. Clipping formula is as follows.

$$\mathrm{Zc[n]} = \left\{ \begin{array}{cc} -A & [n] \le -A \\ [n] & \mathrm{Mod}([n]) |< A| \\ A & [n] \ge A \end{array} \right\}$$

Clipping is simplest but yet it has a small amount shortcoming. Clipping enhance bit-error-rate performance because of signal distortion.

C. MODIFIED CLIPPING TECHNIQUE

In conventional clipping, peaks clipping is determined by the CR. Small CR values marks better PAPR reduction but BER degrades severely and large CR values affects badly on PAPR as well as BER. To get better PAPR reduction potential and BER performance of SISO-OFDM systems, an adaptive clipping technique was analyzed [16]. This scheme is extended for the PAPR reduction in MIMO-OFDM systems [17].

In that technique, the PAPR is mitigated by adaptively clipping peaks of OFDM signal. The adaptive clipping technique for MIMO-OFDM signal $x_i(n)$ is as follows

a) Estimating the peak value:

In the first step, they estimated the different successive peak values of MIMO-OFDM signal $x_i(n)$ from different the antennas. Where i=1, 2 correspond to the number of antenna. Consider $p1_i$ be the of maximum peak value of the MIMO OFDM signal $x_i(n)$ i.e.

$p1_i = \max[\mathrm{abs}(x_i(n))] = \max[\mathrm{mod}(x_i(n))]_1$

Once first peak is estimated, the successive peak values of $x_i(n)$ are calculated. Let $p2_i$ be the successive maximum peak in the signal i.e.

$p2_i = \max[\mathrm{abs}(x_i(n))] = \max[\mathrm{mod}(x_i(n))]_2$

and so on, such that:

$\max[(x_i(n))]_1 > \max[(x_i(n))]_2 > \ldots\ldots > \max[(x_i(n))]_n$

Where n = number of peak values estimated.

b) Determining the location of peaks:

In the second step, they find the location of the peaks. Let us indicate these locations as

$p1_i\_loc$, $p2_i\_loc$, $p3_i\_loc$, ... pn_i_loc

Now we have the information of the peaks and locations in signal, clipping is done by taking product of first peak in the signal and a reduction factor (*RF*). *RF* defined as

$$\mathrm{RF} = \frac{\text{lowest peak value of Xi (n)}}{\text{peak of Mod (Xi (n))corresponding to the peak being clipped in Xi (n)}}$$

The modified MIMO-OFDM signal is form & PAPR of signal is estimated. The modified MIMO-OFDM symbol are specified as below for ten values

$\hat{x}_i(p1i\_loc) = x_i(p1i\_loc)*(p10_i)/(p1_i)$

$\hat{x}_i(p2i\_loc) = x_i(p2i\_loc)*(p10_i)/(p2_i)$

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$\hat{x}_i(p9i\_loc) = x_i(p9i\_loc)*(p10_i)/(p9_i)$

In this technique, peaks are clipped by a different amount depending on reduction factor value. The result shows that proposed technique is better than conventional clipping technique in both PAPR reduction and BER performance.

2) Proposed Method

In this scheme, the PTS and the Modified Clipping scheme are collectively used. Figure 2 shows a block diagram of PAPR reduction scheme using the proposed PTS-Modified Clipping algorithm. The main proposal of PTS-Modified Clipping is to apply the advantage of PTS method and also utilize simplest clipping method to slice the high power value of symbols, so system can get better BER performance by introducing proposed technique.

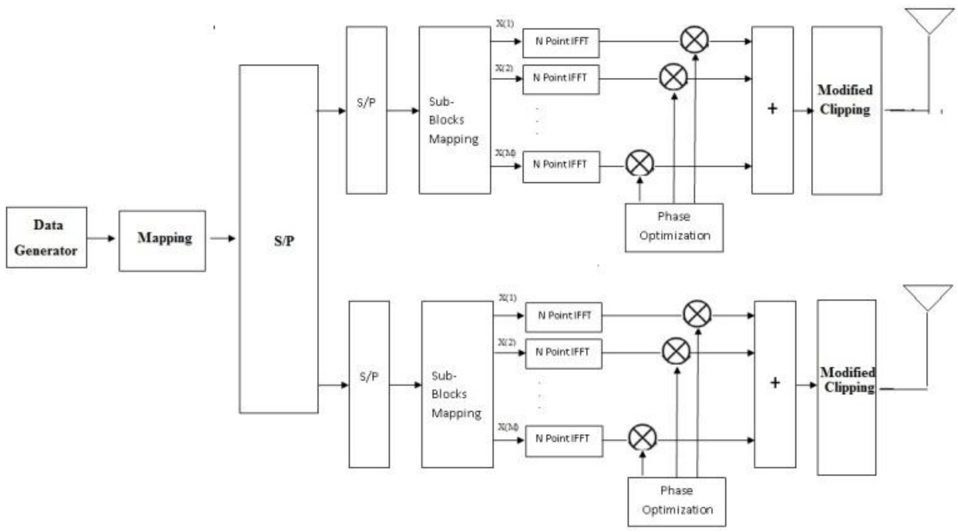

Figure 2 PTS-Modified Clipping schemes transmitter

The random data stream is generated first, and then employs QPSK modulation. Then it is divided into two signals X1 & X2 for each antenna. We add the pilot to each signal previous to convert the sequence from S/P, which will assist us to exactly reproduce the data at the receive section. The modulated sequence passes through PTS block and then modified clipping method block, and then we attach cyclic prefix to elimination of the interference symbol interference. The signal is transmitted through wireless channel. The exactly reversed process is made at the receiver end.

III. SIMULATION RESULT

The analysis of PTS-Modified Clipping scheme has been carried out using MATLAB 10.a version. The 2 X 2 MIMO-OFDM system under consideration, PTS-Modified Clipping scheme based on 52 subcarrier and 4 sub blocks applied to encoded data modulated by QPSK modulation was simulated. The oversampling factor is 4.

Figure 3 demonstrates the PAPR reduction performances that make use of Original, PTS, and PTS-Modified Clipping**.** Now evaluate the PTS-Modified Clipping curves shown in figure 3, PAPR at CCDF 10^{-3} is 9 dB, 7.9 dB and 7.3 dB for Original, PTS and PTS-Modified Clipping scheme respectively. It shows that 18.88% improvement as compared to original scheme and 7.95% improvement as compared to PTS scheme.

Evaluate the PTS-Modified Clipping curves shown in figure 4, we see that the superior BER for PTS-Modified Clipping as compared to Original, PTS. PTS technique has diminished the probability to occur high PAPR values. The proposed system PTS-Modified Clipping technique illustrates better results for MIMO-OFDM symbols to reduce the PAPR.

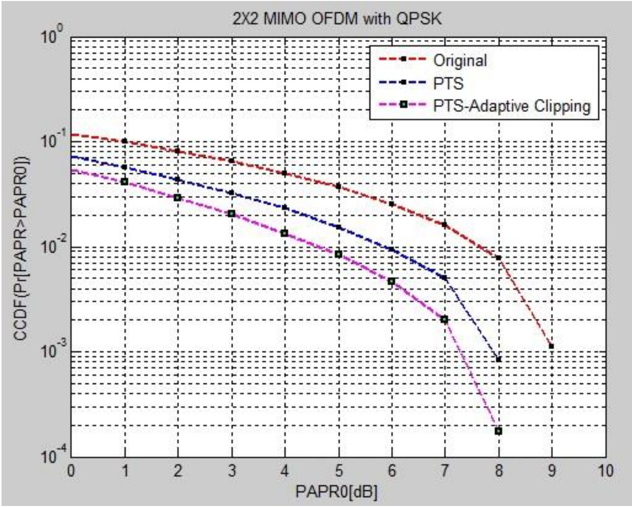

Figure 3 CCDF of PAPR for QPSK and N=52

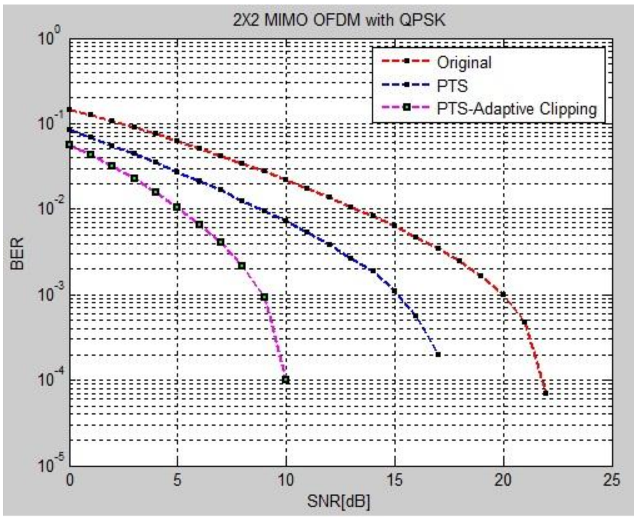

Figure 4 BER comparisons with various schemes

IV. CONCLUSION

In this letter, a hybrid PAPR reduction technique based on PTS-Modified Clipping have been implemented on MIMO-OFDM system. Further the performance analysis of PAPR and the BER using the hybrid technique is perform. PAPR at CCDF 10^{-3} is 9 dB, 7.9 dB and 7.3 dB for Original, PTS and PTS-Modified Clipping scheme respectively. It shows that 18.88% improvement as compared to original scheme and 7.95% improvement contrast to PTS scheme.

REFERENCE

[1]. Soo, Y., Kim, J., Yang, W. Y. and Kang,C.G "*MIMO–OFDM Wireless Communications with Matlab*", 2010.

[2]. Tao Jiang, Guangxi Zhu, "*Nonlinear Companding Transform for Reducing PAPR of OFDM Signals*", *IEEE Transaction on Broadcasting*, vol.50, no. 3, Sept. 2004.

[3]. M. Iwasaki and K. Higuchi, "*Clipping and filtering-based PAPR reduction method for precoded OFDM-MIMO signals*," in Proc. IEEE VTC2010-Spring, Taipei, Taiwan, May 2010.

[4]. Y.L. Lee, Y.H. You, and W.G. Jeon, (2003) "*Peak-to-Average Power Ratio in MIMO-OFDM Systems Using Selective Mapping*", *IEEE Communication Letters*, Vol.7. Number.12, pp-575-577.

[5]. S. H. Han, & J. H. Lee, "*PAPR Reduction of OFDM Signals Using a Reduced Complexity PTS Technique"*, IEE Signal Processing Letters, Volume No.11, November 2004.

[6]. A.D.S. Jayalath, C. Tellambura and H. Wu, "*Reduced complexity PTS and new phase sequences for SLM to reduce PAP of an OFDM signal*," In Proceedings of IEEE 51st *Vehicular Technology Conference*, Tokyo, Japan, 2000, pp. 1914-1917

[7]. J.H. Wen, S.H. Lee, Y.F. huang and H.L. Hung, "*A suboptimal PTS algorithm based on particle swarm optimization technique for PAPR reduction in OFDM systems*," EURASIP *Journal on Wireless Communications and Networking*, vol. 2008, Article ID 601346, pages1-8, doi:10.1155/2008/601346.

[8]. M.Sharif, M.Gharavi-Alkhansari, and B.H. Khalaj, *"On the peak-to-average power of OFDM signals based on oversampling*", *IEEE Transactions on Communications*, vol.51, no.1, pp.72-78, January 2003.

[9]. Harish Reddy and Tolga M.Duman, "*Space-time coded OFDM with low PAPR‖, Proceedings of Global Telecommunications Conference*", San Francisco, USA, 1-5 December 2003, vol. 2, pp. 799-803.

[10]. Vittal MVR, Ramanaidu K, Subhas C (2013), "*PAPR analysis of single carrier FDMA signals with Gaussian pulse shaping".* In: International conference on communications and signal processing (ICCSP). IEEE, pp 776–780.

[11]. Vittal MVR, Naidu KR (2017a) "*A novel reduced complexity optimized PTS technique for PAPR reduction in wireless OFDM systems*". Egyptian Inform J 18(2):123–131.

[12]. Vittal MVR, Naidu KR (2017b) "*Modified alternative-signal technique for sequential optimisation for PAPR reduction in OFDM-OQAM systems*". Defence Sci J 67(3):1–9.

[13]. Wang Y, Chen W, Tellambura C (2010) "*A PAPR reduction method based on artificial bee colony algorithm for OFDM signals*". IEEE Trans Wirel Commun 9(10):2994–2999.

[14]. Yuan JG, Shen Q, Wang JX, Wang Y, Lin JZ, Pang Y (2017) '*A novel improved SLM scheme of the PAPR reduction technology in COOFDM systems*". Optoelectron Lett 13(2):138–142.

[15]. J. Armstrong. *"Peak-to-average power reduction for OFDM by repeated clipping and frequency domain filtering". IEE Electronic Letter* 2002; **38:**246–247.

[16]. S. Singh, A. Kumar, "*A Modified Clipping Algorithm for Reduction of PAPR in OFDM Systems*". Proc. IEEE International Conference on Computational Intelligence and Computing Research (ICCIC) 2015; p. 527-530.

[17]. Sadhana Singh, Arvind Kumar, "*Performance Analysis of Adaptive Clipping Technique for Reduction of PAPR in Alamouti Coded MIMO-OFDM Systems*", 6th International Conference On Advances In Computing & Communications, ICACC 2016, 6-8 September 2016, Cochin, India p. 609 – 616

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