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PAPR reduction in OFDM using PTS and DCT technique

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***Abstract*:**

PAPR is considered as the fundamental problem in OFDM. The increase in PAPR signal can result into a non-uniform output even though the input is uniform, so it degrades the quality of the signal. Moreover, the large peaks cause saturation in the power amplifiers, thus it is desirable to reduce the PAPR in the signal. Therefore, the paper focused on proposing a new technique that is using PTS and Clipping technique altogether. The proposed work considered double threshold value in order to clip upper and lower data simultaneously. Furthermore, traditional PTS technique is combined with the DCT to improve the quality of the signal. The experimental analysis has performed using different techniques which concludes that the proposed technique outperforms the other and is capable of reducing the PAPR in the signal.

Keywords—*OFDM, PAPR, PTS, DCT, Clipping, Lower threshold, Upper threshold.*

I. INTRODUCTION

OFDM is one of the many multicarrier modulation techniques, which provides high spectral efficiency, low implementation complexity, less vulnerability to echoes and non linear distortion. Due to these advantages of the OFDM system, it is vastly used in various communication systems [1]. But the major problem one faces while implementing this system is the high peak – to – average power ratio of this system. A large PAPR increases the complexity of the analog – to – digital and digital – to – analog converter and reduces the efficiency of the radio frequency (RF) power amplifier . Regulatory and application constraints can be implemented to reduce the peak transmitted power which in turn reduces the range of multi carrier transmission. This leads to the prevention of spectral growth and the transmitter power amplifier is no longer confined to linear region in which it should operate [2][3]. This has a harmful effect on the battery lifetime. Thus in communication system, it is observed that all the potential benefits of multi carrier transmission can be outweighed by a high PAPR value .Implementing this system is the high peak – to – average power ratio of this system. A large PAPR increases the complexity of digital to analog converter (DAC) and reduces the efficiency of the radio frequency (RF) power amplifier. OFDM signal exhibits a very high PAPR, which is due to the summation of sin waves and non-constant envelope. Therefore, RF power amplifiers have to be operated in a very large linear region. Otherwise, the signal peaks get into non-linear region causing signal distortion [4]. This signal distortion introduces inter modulation among the subcarriers and out-of-band radiation. PAPR is a very important situation in the communication system because it has big effects on the transmitted signal. Low PAPR makes the transmit power amplifier works efficiently, on the other hand, the high PAPR makes the signal peaks move into the non-linear region of the RF power amplifier which reduces the efficiency of the RF power amplifier.

In addition, high PAPR requires a high-resolution DAC at the transmitter, high-resolution analog to digital converter (ADC) at the receiver. Any non-linearity in the signal will cause distortion such as inter-carrier Interference (ICI) and inter symbol interference (ISI) [5]. The Cumulative Distribution Function (CDF) is used to measure the efficiency of any PAPR reduction technique. Normally, the Complementary CDF (CCDF) is used instead of CDF, which helps us to measure the probability that the PAPR of a certain data block exceeds the given threshold. By implementing the Central Limit Theorem for a multicarrier signal with a large number of sub-carriers, the real and imaginary part of the time domain signals have a mean of zero and a variance of 0.5 and thus follow a Gaussian distribution. So Rayleigh distribution is followed for the amplitude of the multicarrier signal, where as a central chi-square distribution with two degrees of freedom is followed for the power distribution of the system [6].
The Peak to Average Power Ratio (PAPR) is currently viewed as an important implementation issue in communication systems. Specifically, for wireless cellular systems the price of the mobile unit is required to remain low. This means that a limited PAPR can be supported. Orthogonal Frequency Division Multiplexing

(OFDM) and Single Carrier (SC) are the prominent candidates for the next generation of wireless communications physical layer standards [7]. PAPR was considered extensively for OFDM and much attention was given to the issue by academy and industry. PAPR as a function of bandwidth efficiency for OFDM and SC modulation techniques is considered. It is shown that high PAPR for both types of modulation technique appears as a result of high bandwidth efficiency demand, regardless of the modulation technique used. This property is not unique to OFDM [8].

There are a number of techniques to deal with the problem of PAPR. Some of them are "amplitude clipping", "clipping and filtering", "coding", "partial transmit sequence (PTS)", "selected mapping (SLM)" and "interleaving". These techniques achieve PAPR reduction at the expense of transmit signal power increase, bit error rate (BER) increase, data rate loss, computational complexity increase, and so on [9].

Presence of large number of independently modulated sub-carriers in an OFDM system due to which the peak value of the system can be very high as compared to the average of the whole system. This ratio of the peak to average power value is termed as Peak-to-Average Power Ratio. Coherent addition of N signals of same phase produces a peak which is N times the average signal.

The major disadvantages of a high PAPR are-

1. Increased complexity in the analog to digital and digital to analog converter.
2. Reduction is efficiency of RF amplifiers.

II. BACKGROUND

In OFDM modulation, the high peak-to-average power ratio (PAPR) of transmitted signal because of the superposition of many subcarriers is one of the major problems. Due to the rise of PAPR in the signal the quality of the signal is degraded, also the complexity is increased in the analog to digital and digital to analog converter. So there is a need to reduce the effect of PAPR.Many techniques have been suggested for PAPR reduction, with different levels of success and complexity.Techniques like filtration, PTS etc were proposed but these techniques achieve PAPR reduction at the expense of transmit signal power increase, bit error rate (BER) increase, data rate loss, computational complexity increase, and so on. So there is need to proposed some other techniques that can reduce PAPR to a great extent, by studying previous PAPR reduction techniques, a new technique is proposed in this paper.

From the literature survey, it has studied that use of PTS in the traditional methods for reduction of PAPR does not provide better and recommended results. Due to which it should be replaced with the quality oriented technique to improve the results. In the conventional methods, single threshold value is used on which basis data clipping has done. But it suffers from the problem of upper part clipping as only single threshold value is used. Consequently, in order to remove these issues from the conventional methods, new methods are proposed.

III. PROPOSED WORK

As in the problem formulation, it concludes that single threshold value cannot clip upper and lower data simultaneously. Due to which double threshold value is used in the proposed work to clip both parts of the data. Secondly, PTS individually cannot degrade the PAPR value of the data so it has combined with the DCT technique as it has found a better after analysis the literature survey. As a result, proposed method can resolve the issues found in the conventional methods.

IV. METHODOLOGY

PAPR is the major problem in OFDM technique,so there is need to reduce the PAPR in order to get better quality signal.Many techniques have been applied earlier to reduce its effect and steps of one technique are given below, in order to minimize the effect of PAPR.

1. Firstly generate a signal that carries information, which is to be sent to the receiver without any distortion.
2. After the generation of the information signal, apply the modulation technique, so that the signal is transmitted with less distortion.
3. Convert the serial signal into a parallel signal and forwards it to further block.
4. Perform Inverse Fast Fourier Transform on the parallel signal.
5. Now evaluate the lower and upper threshold value of the signal in order to perform clipping further.
6. Once the valuation of the lower and upper threshold has done, perform clipping to reduce the effect of PAPR over the signal.
7. Perform PTS reduction technique over the clipped signal.
8. Finally the calculation of the PAPR is done. The signal with lessen PAPR is obtained.

The methodology for the proposed work has shown in the below block diagram. The block diagram illustrates the steps which are stated above and implemented in a order. After producing step by step methodology, results are acquired shown in next section.

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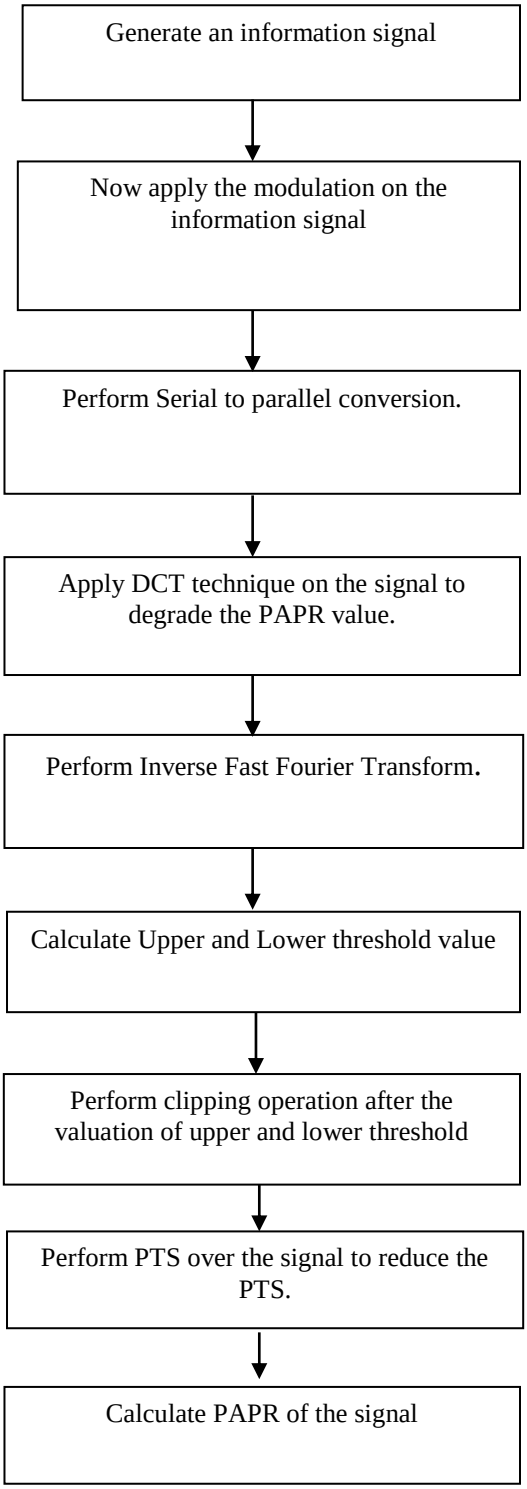

Figure 1. Framework of the proposed work

V. RESULTS AND DISCUSSION

This section explained the results which have acquired after evaluating the proposed technique over the OFDM signal. In the proposed work, clipping technique is used to reduce the PAPR in the signal. For the clipping purpose, two different threshold values has been used that provides appropriate results in comparison with the other techniques.

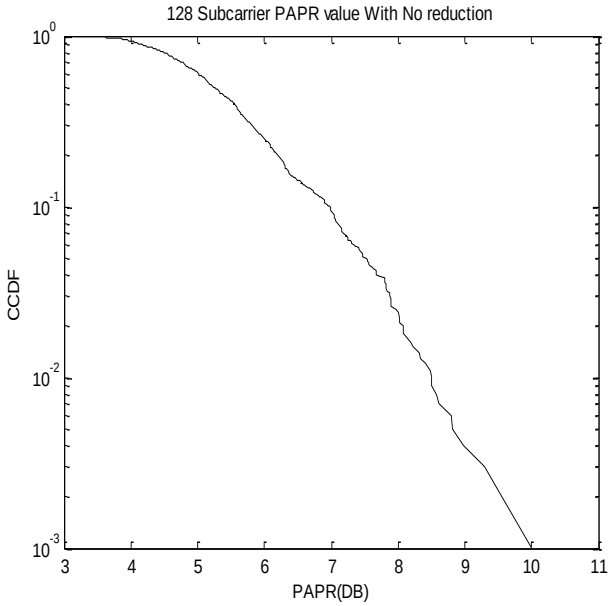

Figure 2. PAPR value with no reduction

The figure 2 shows the value of PAPR without apply any reduction technqiue over the signal. The analysis has performed over the 128 subcarrier. Without any application of reduction technique, PAPR has reduced at 10 with respect to Complementary Cumulative Distribution Function.

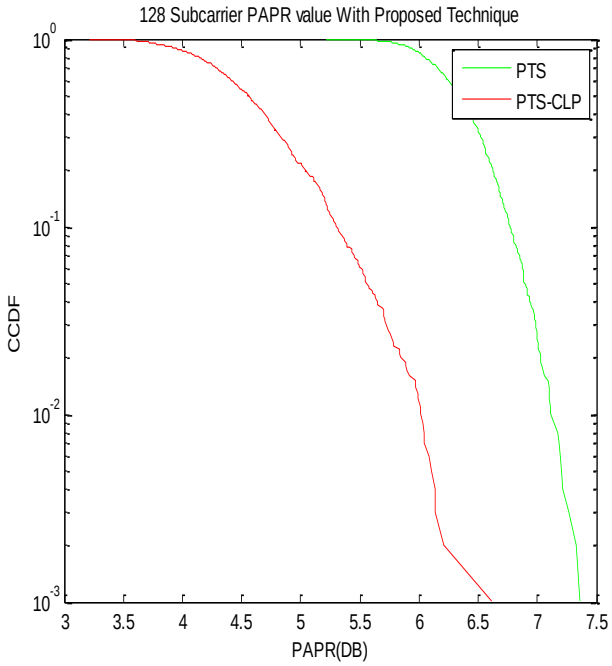

Figure 3. PAPR value with proposed technique

The figure 3 shows the PAPR value of the proposed technique which has reduced at 6.5. The proposed

technique is compared with the PTS existing technique. The reduction of PAPR through the PTS lays at 7.5 whereas using the proposed technique it reduces the PAPR around 6.5.

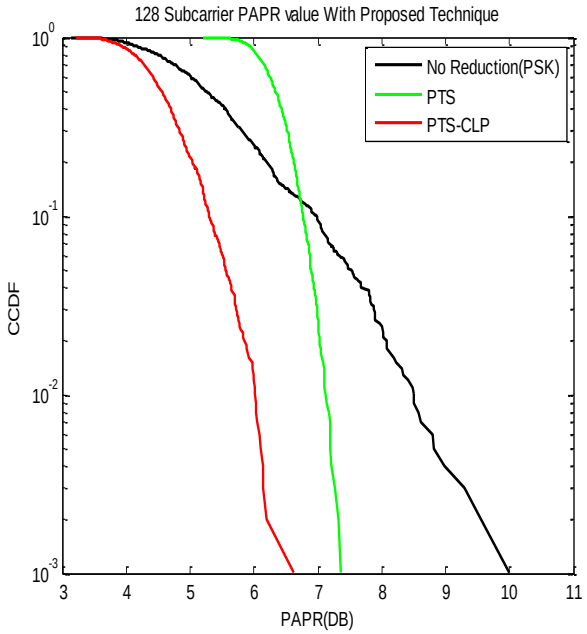

Figure 4. Comparison of different methods in terms of PAPR reduction

The figure 4 depicts the comparison between the PSK, PTS and the proposed technique. In the first PSK, there is no reduction has applied over the signal which resultant into less reduction of PAPR. Comparatively, reduction technique has applied over the PTS and proposed technique. From the results, it has cleared that the proposed technique reduces the high amount of PAPR in the signal.

VI. CONCLUSION AND FUTURE WORK

In the OFDM signal, PAPR is considered as the most common and vital issue. Due to rise in PAPR in the signal the output that is received at the receiving end is in non uniform, though the input is uniform, so it degrades the quality of the signal, also these large peaks cause saturation in the power amplifiers, so it is desirable to reduce the PAPR. Several techniques have been proposed till now to reduce the impact of PAPR in the signal but still facing some problems. In this paper, clipping has used to reduce the impact of the PAPR with the help of lower and upper threshold value. Moreover, the PTS and DCT have combined to reduce the effect of PAPR in the signal effectively as PTS technique alone cannot reduce the PAPR. The experiments have performed over the 128 subcarriers. From the result analysis, it has been declared that before applying any reduction technique, PAPR has not reduced visibly. Whereas the proposed technique i.e. PTS-CLP outperforms the other techniques and reduces the PAPR around 6.5.

The proposed work has done using the PTS-CLP technique to reduce the effect of the PAPR in the signal whereas the existing method can be enhanced in future by updating the proposed PTS-CLP with an optimization algorithm for the improved reduction of PAPR in the signal.

VII. REFERENCES

[1] SuvernaSengar, ParthaPratim Bhattacharya, "Performance Improvement In Ofdm System By Papr Reduction", *International Journal of Emerging Technology and Advanced Engineering*, 2, 12,December 2012, pp. 509-516.

[2] Md. Ibrahim Abdullah, Md. Zulfiker Mahmud, Md. ShamimHossain, Md. Nurul Islam, "Comparative Study of PAPR Reduction Techniques in OFDM", *ARPN Journal of Systems and Software*, 1, 8, November 2011, pp. 263-269.

[3] Zhongpeng Wang "Reduction PAPR of OFDM Signals by Combining SLM with DCT Transform", *International. Journal of Communications, Network and System Sciences*, 3, November 2010, pp. 888-892.

[4] K Srinivasarao, Dr B Prabhakararao, and Dr M V S Sairam, "PEAK-TO-Average Power Reduction In Mimo Ofdm Systems Using Sub-Optimal Algorithm", *International Journal Of Engineering And Computer Science*, 3, 3, May 2013, pp. 261-273.

[5] Maan Singh, Vijay Kumar, "Signal Scrambling Techniques for PAPR Reduction in OFDM Systems", *International Journal Of Engineering And Computer Science*, 2, 1, January 2013, pp. 311-317.

[6] SeungHee Han and Jae Hong Lee, "Modified Selected Mapping Technique for PAPR Reduction of Coded OFDM Signal", *IEEE Transactions on Broadcasting*, 50, 3, September 2004, pp. 335-341.

[7] PeyaliChoudhury, AchalaDeshmukh, "Comparison and analysis of PAPR reduction techniques in OFDM" , *IOSR Journal of Electronics and Communication Engineering*, 4, 5, February 2013, pp. 01-06.

[8] Leman Dewangan, Mangal Singh, Neelam Dewangan, "A Survey of PAPR Reduction Techniques in LTE-OFDM System" , *International Journal of Recent Technology and Engineering*, 2, 6, September 2015, pp. 24-28.

[9] R. Divya Kanti and R.V. Ch. SekharRao, "Systematic Comparison of Different PAPR Reduction Methods in OFDM Systems", *International Journal of Electronics and Communication Engineering*, 7, 1, 2014, pp. 21-30.

[10] Mr.Jobin Raj, Mr.M.Malleswaran,, "DCT Based Modified SLM Technique for PAPR Reduction in OFDM Transmission", *International Journal of Scientific & Engineering Research*, 3, 6, June-2012, pp. 1-6.

[11] Pawan Sharma, SeemaVerma, , "Performance Analysis of Peak-to-Average Power Ratio Reduction Techniques for Wireless Communication Using OFDM Signals" , *Advances in Recent Technologies in Communication and Computing (ARTCom), 2010 International Conference on*, October 2010.

[12] Reshma Elizabeth Regi, Haris P.A , "Performance of PAPR Reduction in OFDM System with Complex Hadamard Sequence using SLM and Clipping", *International Journal of Engineering and Advanced Technology (IJEAT)*, April 2014

[13] KuangXu, Timothy A. Thomas, Douglas L. Jones, "Beam forming MISO-OFDM PAPR Reduction: A Space-User Perspective", 2007 *IEEE International Conference on Acoustics, Speech and Signal Processing - ICASSP '07*, 3, 2007, pp. 377-380.

[14] Guangyue Lu, Ping Wu and Catharina Carlemalm-Logothetis, "PAPR reduction for real baseband OFDM signals", *Signal Processing, 2006 8th International Conference on*, November 2006.

[15] V.B.Malode and B.P.Patil, "Performance of Linear Block Coded OFDM system in BER and PAPR under different channels", *International Journal of Applied Information Systems*, 3, 4, July 2012, pp. 6-12.

[16] Komal Gupta, Monika Kushwaha, AbhayPratap Sharma &Arvind Singh Panwar, "PAPR Reduction of OFDM Using a New Phase Sequence in SLM Technique", *International Journal of Advanced Electrical and Electronics Engineering*, 2, 2, 2013, pp. 125-129.

[17] Tao Jiang, and Yiyan Wu, "An Overview: Peak-to-Average Power Ratio Reduction Techniques for OFDM Signals", *IEEE Transactions on Broadcasting*, 54, 2, June 2008, pp. 257-268.

[18] M.V.R.Vittal,, ''Performance enhancement of OFDM signals using PAPR reduction Techniques and the Comparison of their Performance'', *International Journal of Computer Applications*, 41, 19, March 2012, pp. 30-35.

[19] Md. MahmudulHasan and S S Singh, "An Overview of PAPR Reduction Techniques in OFDM Systems'', *International journal of computer applications* ,60, 15, December 2012, pp. 392-399.

[20] Karuna A Mahajan and Sunil V Mukhare, "Comparison of Signal Scrambling PAPR Reduction Techniques with Signal Distortion Techniques in OFDM Signal", *IJCA Proceedings on International Conference on Recent Trends in Information Technology and Computer Science*, 1, March 2012, pp. 18-22.

[21] PanduranganMukunthan and PerumalDananjayan , ''Modified PTS with Interleaving for PAPR Reduction of OFDM Signal with QPSK Subblocks'', *International Journal of Future Computer and Communication*, 3, 1, February 2014, pp. 22-25.

[22] Gurtej Singh Toor, Harjinder Singh, Amandeep singh Bhandari, "Review Paper On PAPR Reduction Techniques In OFDM System'', *International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering*, 3, 5, May 2014, pp. 9363-9369.