PAPR Reduction by Using DCT and IDCT Techniques

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Abstract: In OFDM system, the most important issue is peak to average power ratio. Numerous techniques have suggested to lower Peak to average power ratio. The PAPR of the transmitted signal and its PAPR reduction are proposed in this study using a DCT-based modified selective mapping (SLM) technique. PTS (The partial transmit sequence) methodology was among the earliest and almost successful methods devised. In this paper, n innovative method that uses the IDCT combined with introduction of PTS idea, a better PAPR reduction level was achieved. 64 subcarriers, QAM modulation, different kinds of partitions, and recognized phase angles are used in the result. The evaluations of the proposed method against OFDM, PTS, and IDCT Pre-coded OFDM with PTS was used, A results suggest that this method lower the peak to average power ratio more successfully than all three others. A proposed model can also lower maximum OFDM PAPR level to 7dB.

Index Terms— **OFDM (ORTHOGONAL Frequency Division Multiplexing)**, **Peak to Average Power Ratio (PAPR), selective mapping (SLM), DCT**, **IDCT, partial transmit sequence (PTS).**

I. INTRODUCTION

A parallel and multicarrier transmission method is OFDM. These days, Orthogonal Frequency Division Multiplexing widely used at popular standards like Wi-Max, DSL, LTE, 802.11a, and others since it offers a variety of advantages over competing technologies. High data transmission bitrate, robustness against multipath fading, High spectral efficiency, immunity to inter-symbol interference (ISI), are some of the features of OFDM. The OFDM is crucial to how resources are distributed in 4G and 5G technology. The effect of selective fading is minimized by a multiplexing method that combines orthogonal modulation OFDM have an issue of higher peak to average power ratio despite being a great technique for high data transfer bitrate. High PAPR is described as central problem for this method. Despite all the perfect features offered, In OFDM, A higher peak to average power ratio is its primary issue, which raises the complexity, cost, and power consumption of the system. The combination of all subcarrier signals will produce some extremely high peaks in the output signal because of OFDM uses parallelism. The final power amplifier attached to the transmission line is unable to amplify those high peaks linearly, which will cause the OFDM signal to be distorted and cause several problems. To address this problem, even though that it's expensive, a highly sophisticated, intricate power amplifier system which can preserve uniformity is required. PAPR should be decreased in order to decrease the complexity, expense, and inefficiency of OFDM-based systems. An 'N' number of orthogonal subcarriers for transmission are created with the use of the inverse fast Fourier transform (IFFT). Some signals are merged together during the operation of these "N" orthogonal subcarriers as a result of the orthogonality loss. As a result, the peak signals are higher and exceed the HPA's functioning point. Utilizing highly effective HPA or minimizing the peak to average ratio of orthogonal signals can solve this issue. Because an efficient HPA is expensive, lowering the Peak to Average Power Ratio is a best option for the device. A numerous method for reducing PAPR. They are divided into three categories: coding type, signal distortion less type, signal distortion type Clipping and filtering techniques have been used in the type of signal distortion. Prior to amplification, the highest peaking signals are clipped during the clipping process. Secondly, filtering is used to minimize spectral splatter. In coding type Orthogonal modulation and multiplexing are utilized in the PAPR reduction coding system to utilize available code words with lower envelope power

Selective level Mapping (SLM), Partial Transmit Sequence (PTS) are two methods for signal distortion-less type. In SLM, the phase factor is used to scramble each symbol afterwards IFFT is applied to each symbol individually Under the Partial transmit sequence method, multiplies all of the phase factors after dividing the symbols into subsequence equal to the number of phase factors. For transmitting, a signal which has the lowest peak to average power ratio are selected. Some strategies have suggested for decreasing PAPR and have used the discrete cosine transform. We suggest a new, distortion-free method that considerably improves the output of PTS by creatively utilizing discrete cosine transform (DCT). This project introduced a new method that uses the PTS concept and the inverse discrete cosine transform (IDCT) to achieve a higher level of PAPR reduction. Simulations are run with 64 subcarriers, QAM modulation, various numbers of partitioning, admitted angle phases.

II. LITERATURE REVIEW

OFDM is successfully used in many wireless digital communication systems over multipath channels. The high PAPR that can cause with OFDM is one of its main drawbacks. Because of their high PAPR, OFDM signals are particularly susceptible to nonlinear effects, which cause power inefficiency in the transmitter's RF. In this project, focused on analysing PAPR reduction by undertaking many techniques to lower the PAPR in the system like normal OFDM, clipping & filtering scheme, convolution scheme, weighted OFDM and modified weighted OFDM system [1]. Modern transmission methods like Orthogonal Division Multiplexing are mostly use in numerous digital communications. It makes use of numerous carriers that are simultaneously modulated. Despite their overlap, they can be demodulated using the proper time windowing at the receiver because of the orthogonality of the sub-carriers. High spectral efficiency is provided by OFDM, which is highly effective against inter-symbol interference and frequency selective fading [7][8].

The primary challenge in OFDM that results in signal distortion and BER performance loss in higher peak to average power ratio. Without reducing weight at receiver portion, a weighted OFDM approach is provided. The weighted OFDM signal's transmission time is the same as its original OFDM signal's transmission time [2][4]. Large number of digital communication systems, including 4G mobile communication, WLANs, digital broadcasting, use the ORTHOGONAL Division Multiplexing (OFDM) technology [3]. Its certain drawbacks, including frequency-offset and PAPR. If Peak to Average Power Ratio problem is ignored, might be quite serious. Inter Carrier Interference (ICI) and Inter Symbol Interference (ISI) both develop as a result of PAPR non-linear distortion, which causes the orthogonality of OFCDM sub-carriers to be lost [5]. The lowering of PAPR has also been suggested using linear techniques similar to partial transmit sequence (PTS) or selective mapping (SLM). The benefits of suggested PAPR reduction strategy are included in the simulation results produced by MATLAB [6]. High Peak to Average Power Ratio is the primary disadvantage of OFDM technology. Peak to average power ratio (PAPR) reduction using the Selective Mapping Technique (SLM) and Partial Transmit Sequence (PTS) approaches is the foundation of the proposed study [9].The Riemann matrix was used to create phase sequences for the SLM technique in the scheme, which it made up of DCT followed by the SLM. Additionally, the phase sequence selection is not randomised with this method, which simplifies receiver decoding. Additionally, since the matrices can be produced at the receiver end to retrieve the data symbol, side information (SI) is not necessary to be transmitted [10].To achieve lowest PAPR in the proposed scheme, we recommend adopting the discrete cosine transform (DCT) in addition to the discrete Fourier transform (DFT) in OFDM system. Additionally, SLM's multiplied phase is modified to lower the PAPR to a tolerable less PAPR level.[11].A DCT based modified selective mapping (SLM) technique is proposed to reduce the PAPR of the transmitted signal and its PAPR reduction performance compared with that of IFFT based modified SLM technique, [12]. A new technique that implements inverse discrete cosine transform (IDCT) along with PTS concept to get an improved PAPR reduction level was introduced. Simulations are performed using QAM modulation, 64 subcarriers and variety number of partitions and admitted angle phases [13].

III. PROPOSED SYSTEM

In this proposed system, in order to achieve a better PAPR reduction level, a novel technique that uses the inverse discrete cosine transform (IDCT) and PTS idea was implemented. 64 subcarriers, QAM modulation, various numbers of partitions, and admitted angle phases are used in the simulations. Before performing the PTS peak value optimization process, the suggested technique uses IDCT as IFFT pro-coding. In this proposed work DCT is applied before the PTS technique which reduces the autocorrelation between every modulated data bit. And comparing both DCT and IDCT techniques

Advantages

Reduces the computation intricacy of the system.

Method gives better performance compared to the conventional techniques.

IV. IMPLEMENTATION

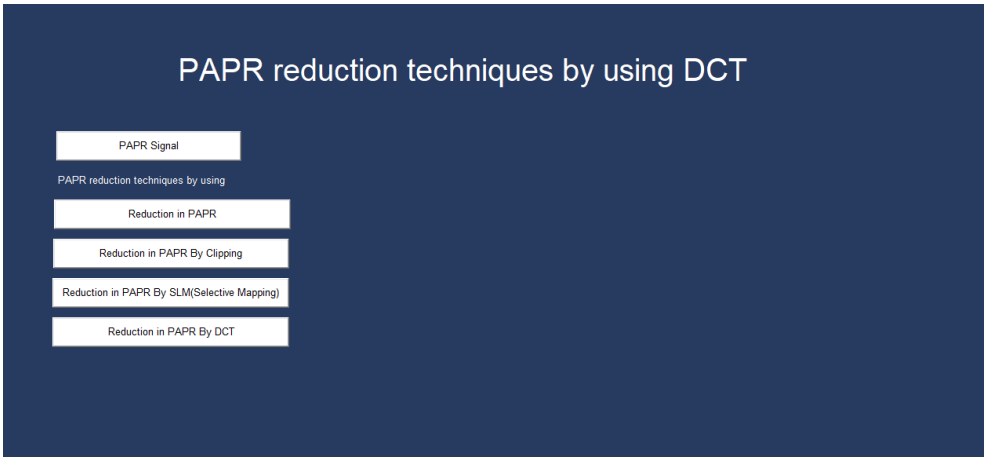

Fig 1: Menu Page

PAPR Menu consists of PAPR Signal, Reduction in PAPR by Clipping, SLM and DCT

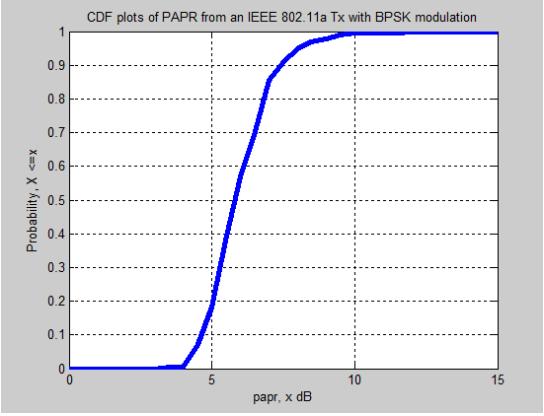

Fig 2: CDF plots of PAPR from an IEEE 802.11a TX with BPSK modulation

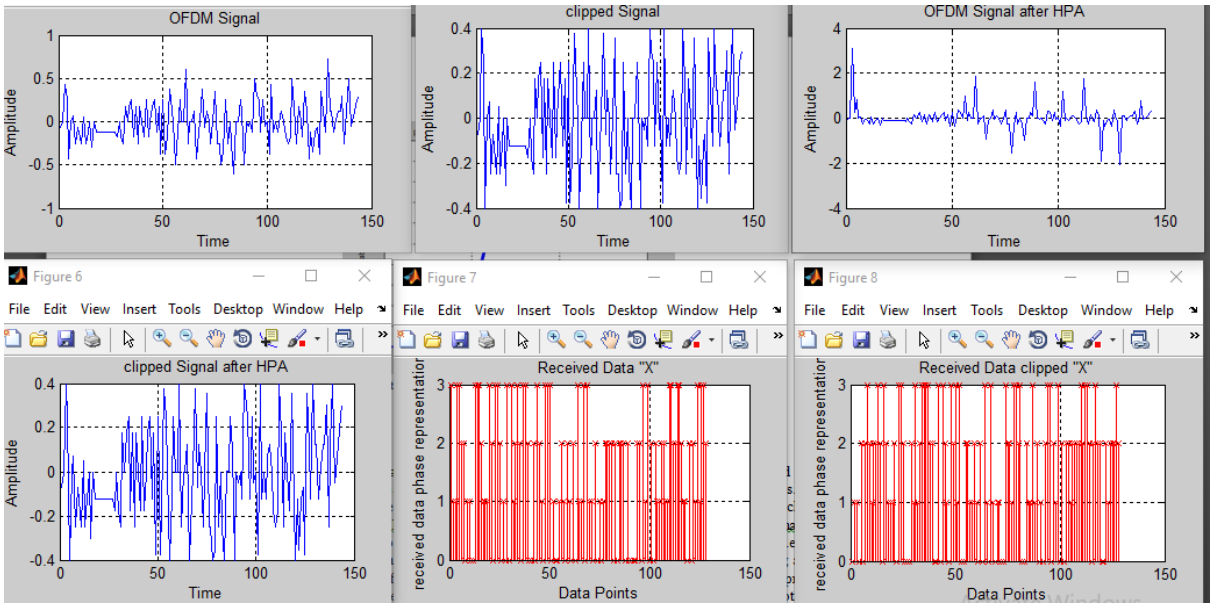

Fig 3: PAPR reduction Using Clipping

The usual OFDM signal peak power is within 0.5 with a normal PAPR of 7.3 before clipping. The peak amplitude of the signal is reduced within the range of 0.4 with varying amplitude levels, still with distortion and peak regrowth, after it has been clipped. The peak power level of the signal is reduced to 2.4 after filtering, and the sampling number is increased without distortion. The PAPR reduction ratio is better when

the power of 2 is fewer than the number of symbols, preferably 32

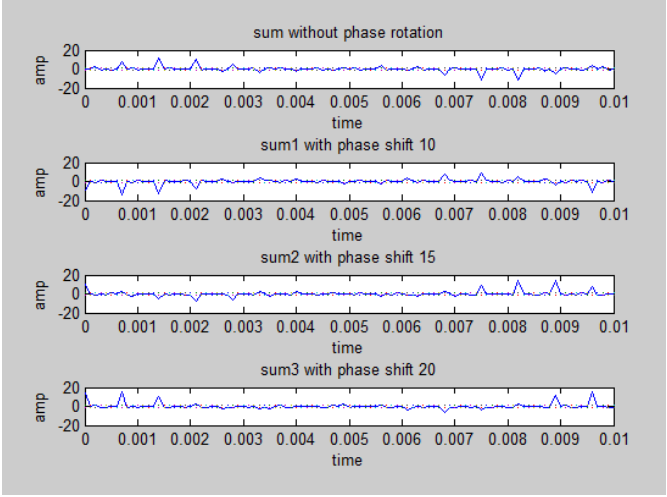

Fig 4: PAPR Reduction Using SLM

The peak power is reduced by using Selective Mapping, resulting in a low PAPR.

Input

```
Enter the L factor(1 to 1.5)= 2
Enter the number of transmitted symbols(Power of 2)(preferably>32)=36
Enter the alphabet size(Power of 2 and less than number of Symbols)(preferably<32)=16
PAPR of original OFDM
    3.8469

PAPR of DCT OFDM
    2.7338
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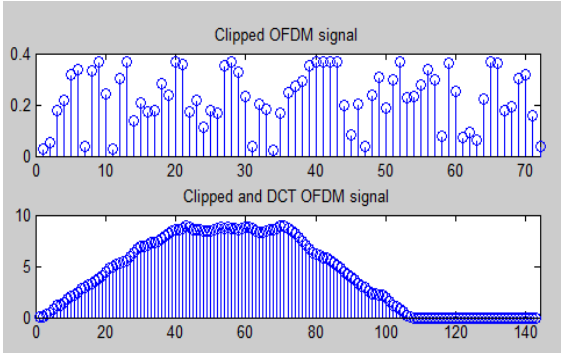

Fig 5: PAPR Reduction using DCT

Discrete Cosine Transform (DCT) precoding based PTS technique for PAPR reduction in OFDM systems

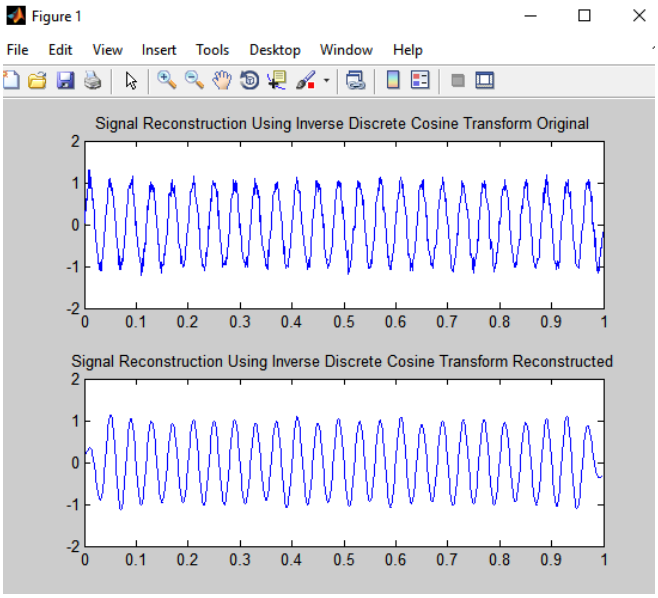

Fig 5.7 IDCT

Signal Reduction using IDCT

Enter the sequence = [2 4 3 1 2]

DCT Sequence =

5.3666 1.1152 0.8279 1.8045 0.1208

Phase = 0 0 3.1416 3.1416 0

IDCT Sequence= 2.0000 4.0000 3.0000 1.0000 2.0000

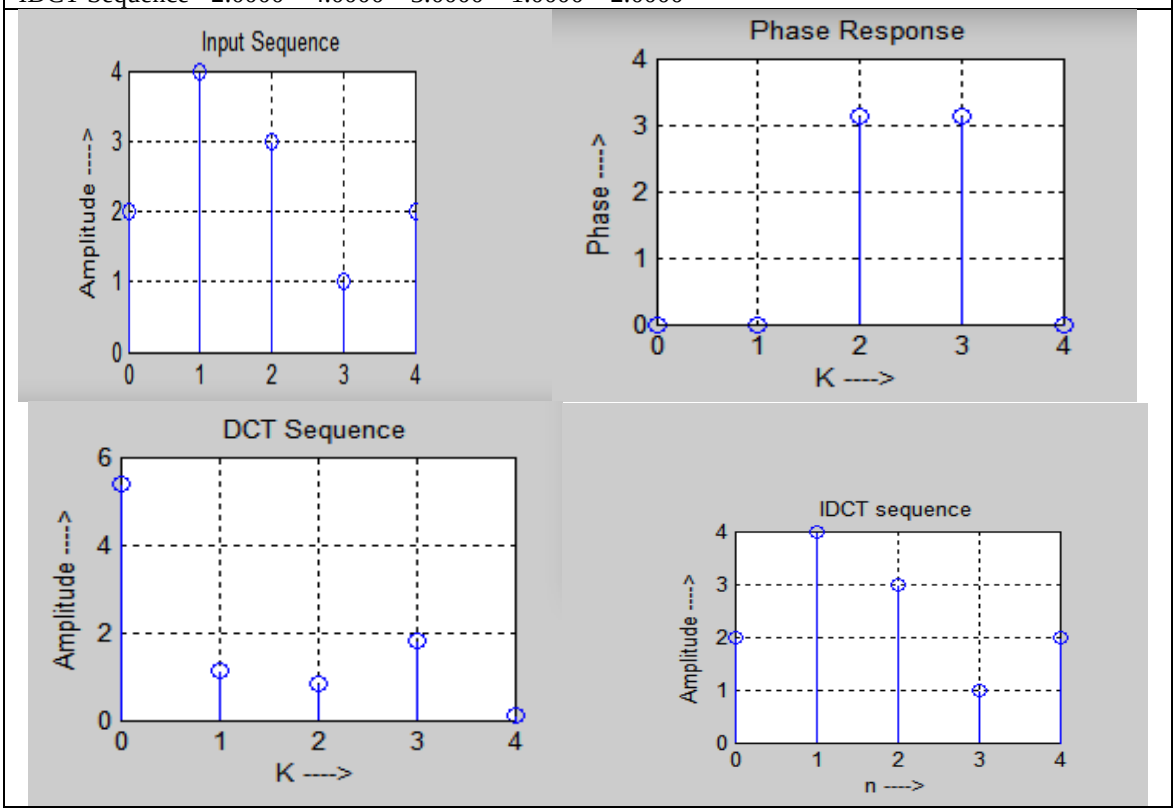

Fig 5.8 IDCT

Comparison of DCT and IDCT

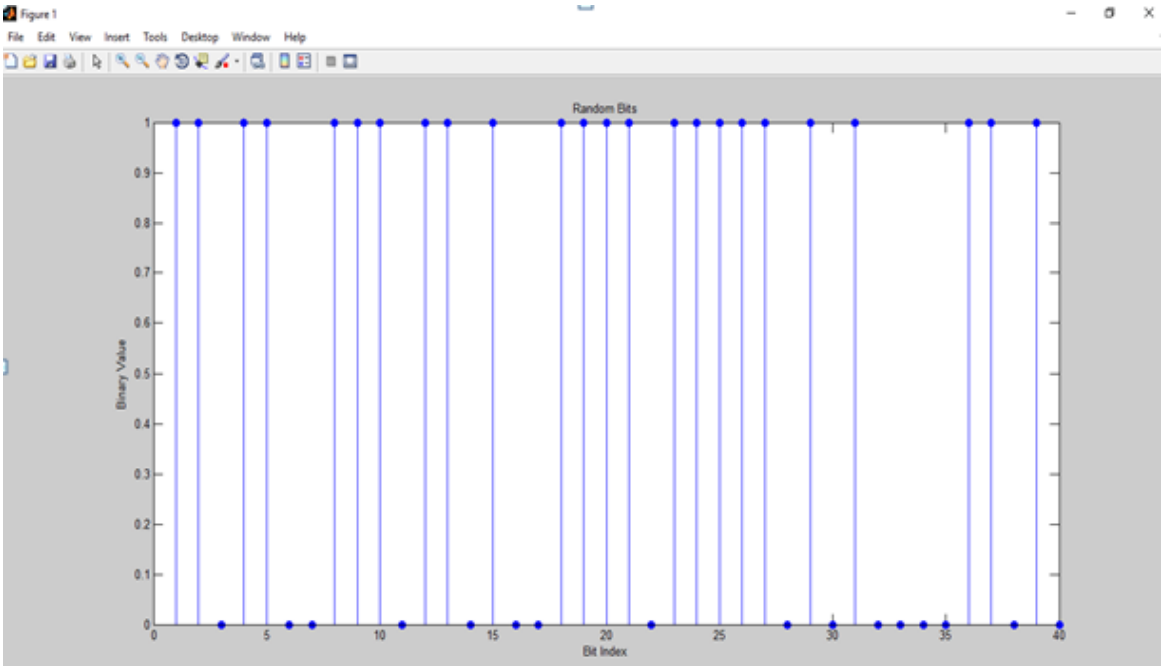

Fig: 5.9 QAM 6

V. CONCLUSION

The PAPR for OFDM has been reduced using a suggested technique. The suggested technique makes use of the partial transmit sequence (PTS) concept of optimal combination and improves its output by precoding Fourier sub-blocks with inverse discrete cosine transform (IDCT). 64 sub-carriers, QAM4, admitted phase angle and varied numbers of partitions, are used to test by the suggested method. As compared to OFDM and traditional PTS, the simulation results indicated a considerable improvement in PAPR reduction.

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