## PAPR Reduction in OFDM Using Clipping And Filtering Scheme

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#### ABSTRACT

Orthogonal frequency division multiplexing provide high data rate services where a single data stream is transmitted over a number of low rate subcarrier. It is a multicarrier modulation technique widely used in almost all applications. It provide several advantages over other multiplexing techniques includes reduced inter carrier interference, inter symbol interference, immunity to multi path fading etc. OFDM signal is a sum of number of sinusoidal which results in high peak to average power ratio(PAPR) that lead to a challenging issue. This increase in signal envelope causes performance degradation and power inefficiency. Therefore the use of appropriate PAPR reduction techniques is very beneficial when considering an OFDM system. Here the basic technique used to reduce the signal amplitude is clipping where further reduce the signal distortion by filtering the clipped signal for efficient PAPR reduction. All the results are simulated on MATLAB platform to analyse PAPR reduction performances. The proposed scheme provides reduced computational complexity and improved PAPR reduction.

Keywords: Clipping threshold, ISI, Orthogonal frequency division multiplexing, Peak to average power ratio, (PA)

#### **I.INTRODUCTION**

OFDM is one of the multi-carrier modulation technique that can support high data rate transmission over wireless channels and employ the available spectrum efficiently. It is the basic need of the physical layer for many commercial systems and wireless standards such as the Wireless Local Area Network (WLAN), Worldwide Interoperability for Microwave Access (WiMAX), Digital Audio Broadcasting (DAB), Digital Video Broadcasting (DVB) and Digital Subscriber Line (DSL)[1]. The OFDM system multiplexed multiple carriers using multiple data symbols simultaneously that increases the data symbol duration and consequently reducing its spectrum range. OFDM offer high spectral efficiency, immune to multipath fading, low inter symbol interference(ISI) and high power efficiency. But main drawback of OFDM is high peak to average power ratio that degrades the system performance by driving the power amplifier in saturation region. The

demand of high datarate leads us to OFDM system which transmit the large data over low modulation rate. Each carriers are orthogonal to eachother ,due to which inter carrier spacing between carriers is removed and carriers are closely spaced without overlapping. Different modulation techniques are used by different number of users. The high power amplifiers drives in non-linear region which increase the signal envelope, so need to reduce the amplitude level of signal.

In literature survey various techniques are introduced to reduced the PAPR which includes clipping [2],peak windowing[3],signal companding[4],Selected mapping [5],partial transmit sequence [6],tone injection ,tone reservation[7] and block coding schemes[8].Each technique has its own advantage and disadvantage. These techniques improve the PAPR performance by effecting the system parameters like signal to noise ratio ,bit error rate and power efficiency.

The rest of the paper is organized as follows: In section II discuss the basic of PAPR in OFDM and its effect on system performance.SectionIII describes the PAPR approach and simulation result done in MATLAB are shown in section IV.Finally, the conclusion of paper.

#### **II. PEAK TO AVERAGE POWER RATIO**

Peak to average power ratio is one of the drawback of OFDM system which limit the demand of high data rate services. This cause occurs due to number of subcarriers when transmitted in channel. The same phase exist between the subcarriers while transmitting and lead to increase in signal envelope. Due to which, the signal amplitude increases and distortion is introduced in system which drives the power amplifier in non linear region. The peak to average power ratio is defined as ratio of maximum transmitted power to average power of signal. The large PAPR increases the implementation complexity of the digital to analog and analog to digital converter. So it is important to reduce the peak powers of signal.





Various parameters to be considered while selecting the scheme for PAPR mitigation are low average power, no bandwidth expansion, no BER performance degradation, implementation complexity. Some techniques that has been proposed are:

1. SLM: In this technique, the data block is divided into number of sub data block and each block is multiplied by phase contant.Then the signal with minimum PAPR is selected for transmission.At receiver,the side information is required to decode the original signal which reduces the bandwidth efficiency.

2. Companding: A compander and expander is used in this scheme for peak power reduction. A compander is used at transmitter which compresses the signal according to the threshold level and signal within the level remains same. The compressed signal is retrieved at receiver by using expander. The implementation complexity of the system increases.

3. Tone reservation: In this scheme, a reserved tone is used to mitigate the signal peak power. The reduction in peak power depends on number of reserved tones ,location of tones ,allowed power of tones and how much reduction is required using tones. The signal can be easily decoded at receiver without any complexity.

4. Block coding: This method is introduced for reduction in peak to average power ratio by coding all probable symbols. This method select the codewords with minimum power among all symbols. No side information is required at receiver side to decode the signal.

5. Interleaving: An interleaver is used in system according to the need of reduction in signal peak power .this scheme introduces the implementation complexity.

#### **III. PAPR REDUCTION APPROACHES**

The basic approach toward mitigation of peak to average power ratio is clipping the amplitude of signal. The input signal is divided into number of subcarriers and inverse fast fourier transform is applied. Different modulation scheme is used according to need of user ,QAM modulation is used. The threshold level of clippers are set as per reduction process. The non-linearity nature of amplifier introduce the frequency component and cause interference between carriers. This introduced interference is known as in band distortion and out of band distortion. After passing through clipper circuit, signal is passed through filtering process which removes the distortion and improves the system performance.





#### **IV. SIMULATION RESULTS**

MATLAB results shows the dynamic behaviour of system. The number of transmitted symbols are 256 and clipper threshold is 1.5 unit. The PAPR of normal OFDM system is 22.473dB. When signal passed through clipper circuit ,this PAPR reduced to 10.0078dB. This scheme provide efficiency in system performance by 60%.



Fig 3:A normal and clipped OFDM signal



Fig 4: Clipped and filtered OFDM signal of system

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Fig 5: Different modulation techniques with their BER performance

#### V. CONCLUSION

The demands of high data requirement is increasing drastically as new innovations are introduced and this OFDM system is one of best multicarrier modulation technique for these purposes. OFDM offer high datarate with immunity to multipath fading but limit us due to high peak to average power ratio. The signals same phase and peaks added at receiver side drives the power amplifier in non-linear region which degrade the system performance. A technique is used to mitigate the PAPR without distortion at receiver side. The scheme used for mitigation varies from application to application, but clipping is one basic scheme. This will improve the system performance for transmitting the large data in various forms of applications like WLAN, DAB, DVB, LTE. This scheme uses the 256 number of subcarriers with QAM modulation technique and improve the system performance by 60% without implementation complexity.

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