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To Study the Different Techniques to Reduce the PAPR in OFDM System

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Abstract

Orthogonal Frequency Division Multiplexing(OFDM) is a method in which modulation of signal is done. Orthogonal Frequency Division Multiplexing has become popular technique for transporting large amount of data in both wired and wireless communication. It is a digital modulation technique in which signal is transmitted in parallel mode. As compared to single carrier system OFDM is more unaffected to frequency selective fading. Large peak to average power ratio(PAPR) is One of the major drawback of the OFDM system. This paper present different techniques which are used to minimize or reduce PAPR in OFDM system.

Keywords: Orthogonal Frequency Division Multiplexing(OFDM), Inter symbol interference(ISI), Peak To Average Power Ratio(PAPR), Bit Error Rate(BER).

1. INTRODUCTION

Today, OFDM has grown to be the most [1] current announcement system in high-speed infrastructures. OFDM is becoming the chosen modulation technique [2] for wireless transportations. OFDM can offer large data rates with [3] sufficient robustness to radio channel impairments. As the most promising technique, OFDM is used in various field of communication like digital video broadcasting (DVB), wireless local area network(WLAN) and digital audio broadcasting(DAB).[5] It is a multi-carrier modulation technique. Because of its simplicity, it is much easier to use single carrier transmission scheme but the major problem of single carrier modulation is inter symbol

interference. Orthogonal frequency division multiplexing(OFDM) came into existence to remove the shortage of single carrier transmission in case of having high data rate. OFDM is good for high speed digital communication. OFDM modulation technique is used in 4G mobile system. One of the major drawback of OFDM system is high peak to average power ratio(PAPR) in time domain and form large amplitude wave form. High PAPR push the power amplifier into non-linear area result in in-band and out-of-band distortion. This PAPR should be least for powerful transmission. Number of techniques are used to overcome the Peak to average power ratio in OFDM system. In this paper we present different techniques that can be used to minimize high PAPR problem in OFDM system.
This paper contain overview of all the techniques.

2. OVERVIEW OF PAPR.

The peak to average power ratio(PAPR) is the major drawback of OFDM system which decrease the performance of the transmitted signal. The large peak to average power ratio(PAPR) push the power amplifier to work in nonlinear area which result in band and out of band distortion. When subcarriers with large number are out of phase, a significant PAPR can cause the transmitter's power amplifier to run within a non-linear operating region. This cause significant signal distortion at the output of the power amplifier. In addition, the high PAPR can cause saturation at the digital to analog converter, leading to saturation of the power amplifier. PAPR also causes inter-modulation distortion between the sub-carriers and distorts the transmit signal constellation. Therefore, the power amplifier must operate with a large power back-off, approximate to that of PAPR which lead to insufficient operation. Therefore it is necessary to overcome the PAPR of the transmit signal in MIMO-OFDM systems.[5]

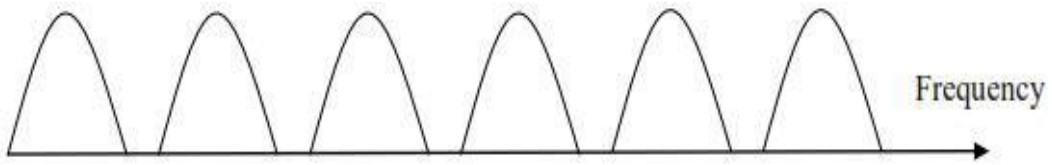

Fig 2.1 Spectrum of traditional FDM scheme

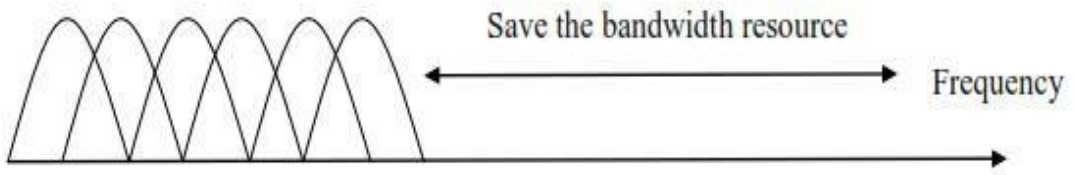

Fig 2.2 Spectrum of OFDM

For continuous time signal x[t] the expression for PAPR is given below.

$$\text{PAPR(x[t])} = \frac{max[x(t)]^2}{E[x(t)]^2}$$

For discreate time version x[n], the expression for PAPR is given below.

$$\text{PAPR(x[n])} = \frac{max[x(n)]^2}{E[x(n)]^2}$$

Where E[.] is the expection operator.

3. RELATED WORK

Zeynab Mohammadi et.al,2015[1] described a new multicarrier system , in which filter bank and unique word OFDM methods are combined together, called filter bank-UW-OFDM system. Because complex symbols were used in the filter bank-UW-OFDM system, the space time coding scheme can be employed.

Marko Beko et.al,2014[2] addressed the peak-to-average power ratio decrease in orthogonal frequencydivision multiplexing systems. This problematic, which is known to be NP hard, is shown to be approached by a second-order cone programming difficult using a sequential convex programming attitude, making it much calmer to handle.

M. Hasan et al. [3] proposed that OFDM as an attractive signaling scheme for communication systems and adopted in many wireless standards. The main drawback of OFDM was its high Peak-to- Average Power Ratio (PAPR) which limits its applications in communication systems. In fact, PAPR could cause power degradation and spectral spreading. The performances of different PAPR reduction techniques in OFDM systems, depends on Complementary Cumulative Distribution Function (CCDF), computational complexity, bandwidth expansion, in-band signal distortion and out-of-band radiation. Extensive computer simulations show that up to 8.4 dB reduction in PAPR can be achieved by different techniques.

X.Zhong et.al.[4] proposed that using clipping and filtering algorithm reduces PAPR of the system and BER performance was improved . It was analyzed that clipping and filtering method was more efficient than direct clipping because clipping and filtering algorithm reduces more PAPR than direct clipping algorithm. Clipping and filtering method use filter to remove in band distortion and it reduces peak re growth.

Z. Ibraheem et.al.[5] proposed that OFDM as most promising technique for transmitting of high stream data. The main disadvantage of OFDM was PAPR.Partial transmit sequence was the effective technique for PAPR reduction It involves

partitioning of data into frames into disjoint sub blocks .It was observed that when size of partitions was increased, the performance was improved.

S. Bhavi et al. [6] proposed that OFDM was multi carrier modulation scheme. OFDM used orthogonal subcarrier and also used available bandwidth efficiency. To achieve high speed transmission OFDM was generally used. As the no of subcarrier in OFDM increases the Peak to average power ratio increases. To minimize the effect of PAPR no of promising techniques had been proposed. Clipping and filtering technique gives improvement in PAPR reduction with slight increase in BER.

D.Narendra et.al.[7] proposed that for high data transmission OFDM was generally used. OFDM provided high band width efficiency because the carrier was orthogonal to each other and multiple carriers share the existing data. The main drawback of OFDM system was high peak to average power ratio of the transmitted signal. In order to reduce complexity and to achieve better PAPR reduction by PTS scheme was proposed. PTS was more efficient, practical, and attractive and there was low data loss.

M.M.Kamruzzaman et.al.2011[8] shows that a Turbo coded OFDM wireless link is appraised in the occurrence of Rayleigh vanishing for SISO, SIMO, MISO and MIMO scheme. Data is determined using turbo encoder then modulated by QPSK or 16 QAM or 64 QAM and additional encoded by STBC, and the programmed data are split into n streams which are modulated by OFDM and concurrently transmitted using N transmit antennas.

Sumita Shankar Manure et.al.2011[9] A software orientation model for Orthogonal Frequency Division Multiplexing is advanced and confirmed for its functionality that can be adopt for wireless message requests. BER and functionality of the advanced OFDM model is analysed for Fourier based and Wavelet based OFDM systems for A WGN Channel and consequences are associated. Discreate wavelet transform-OFDM is realised using zero padding and vector transposing for spreading the OFDM signal and similarly the zeroes are discarded at the receiver.

S. Verma et al. [10] proposed that OFDM is attractive transmission technique for high bit rate transmission .One main disadvantage of OFDM was high peak to average power ratio of transmitter's of side information and can reduce the peak to average power ratio in turbo coded frequency division multiplexing system was proposed.

Fabio da Costa Pinto et.al,2011[11] presented low computational difficulty versions of orthogonal frequency division multiplexing modulation scheme for the operation of clustered-OFDM systems for data programme in the pass band frequency. Among the future schemes, which are named Hermit Ian symmetric OFDM I and High speed-OFDM II, the HS-OFDM II can offer computational difficulty reduction in contrast with the single side-band OFDM, OFDM, and HS-OFDM systems when the length of the OFDM symbol increases.

Mohamed Sufyan Islim et.al,2015[12] presented the concept of the greater Unipolar-OFDM scheme is comprehensive for arbitrary combinations of U-OFDM data streams with various constellation sizes and various power provisions. A closed-form hypothetical bound on the bit error rate performance of the Generalized Enhanced unipolar OFDM was derived and verified by comparison with the results of Monte Carlo simulations. The proposed scheme has an improved power efficiency compared with a spectrally equivalent Direct current biased optical-OFDM. The GREENER-OFDM allows the gap in spectral efficiency between DCO-OFDM and the inherently unipolar optical OFDM schemes to be completely closed.

K.Sumathi et.al, 2012[13] described agreements with how the possessions like bandwidth, power, subcarrier and bit allocations can be done proficiently to improve the spectral efficiency and to achieve the maximum system capacity. Assigning the total accessible power and keeping fairness among users is a difficult task. It is necessary to maintain trade-off between system volume, computational difficulty and fairness. Several optimization systems are used to minimize the overall transmit power of a multiuser OFDM system.

Asanka Nuwanpriya et.al,2012 [14] offered as, due to only the intensity of a signal is second-hand to carry in order, optical wireless systems are controlled to send real and positive values at the optical transmitter. Therefore, the conservative OFDM cannot be directly functional in optical systems. To combat multipath buckle, several customized OFDM systems had been studied, such as DC-biased optical OFDM, asymmetrically clipped optical OFDM, Flip-OFDM and Unipolar OFDM, etc. In order to convey real signal in optical environments, there is a Hermit Ian symmetric restraint with separate Fourier transform, or discrete Hartley transform without the Hermit Ian requirement. In this paper, they proposed a novel OFDM system, namely Situation Modulating OFDM, which utilizes DFT but eradicates the Hermit Ian constraint.

4. PAPR REDUCTION TECHNIQUES

There are number of techniques have been used to overcome the problem of high PAPR in the OFDM system. Various techniques to minimize the PAPR are.

I. SIGNAL SCRAMBLING TECHNIQUES

a) SELECTIVE MAPPING (SLM)

The most promising technique is the selective mapping technique because no distortion is introduced and yet reduce the PAPR. In this technique the signal at the input is divided into many sub-blocks. The signal with least or minimum PAPR is selected from different phase sequence that contain same information at transmitter. The index to be selected is called side information index. The transmitter uses side information so that receiver can make uses of that side information to predict which signal is selected.[4][7]

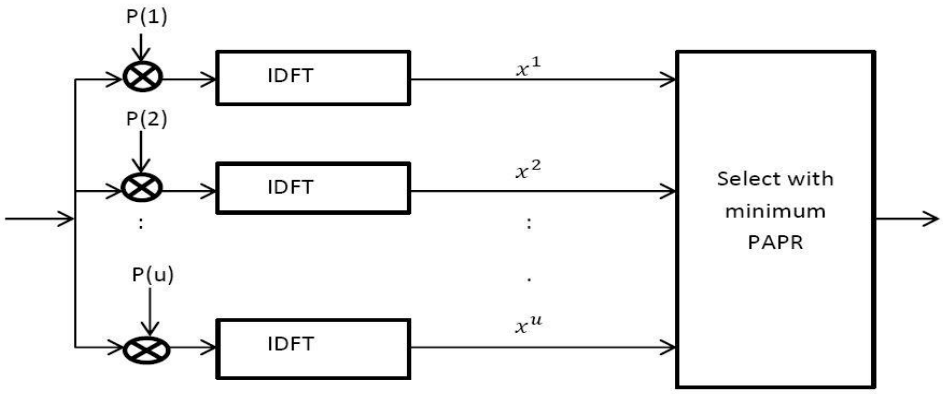

Fig.4.1.1 Block diagram of Selective Mapping.

b) BLOCK CODING TECHNIQUE

It is the easiest method which we used to overcome the peak to average power ratio(PAPR). The basics idea behind this method is to overcome PAPR by applying different blocks code and codewords. This method is applied to reduce the problem of peak to mean envelope power ratio. During the codeword's selection many point should be kept in mind, such as m array phase modulation technique, types of codes rate and also error correction correction and error decoding.[4

c) TONE RESERVATION(TR)

Tone reservation is the simplest way to minimize the PAPR. In this scheme reversing a small fraction of tone lead the large amount of reduction of PAPR with simple operation at the transmitter side. Some set of tones are reserved in this technique. In tone reservation side information and other additional operation are not required, so there is no complexity at the destination end.[8]

d) LINEAR BLOCK CODE(LBC)

This is an error correcting code. This technique allows more efficient encoding and decoding algorithms as compared to other codes. Linear block codes are basically used in forward error correction and for transmitting symbols or bit on the communication channel. This is also the modification of selective mapping schemes. In this technique transmitted signal with least PAPR used scrambling code. This technique provide better performance than SLM scheme.[9]

Fig.4.1.2. OFDM Transmitter with linear block code

e) PARTIAL TRANSMIT SEQUENCE

It is the most efficient technique to reduce PAPR. In this technique, blocks of data is partitioned into no overlapping sub-blocks. This technique is the modified technique of selective mapping scheme. There are three partitioning methods for PTS scheme: adjacent, interleaved and pseudorandom. Pseudorandom partitioning provide better PAPR performance among all these schemes.[8][9]

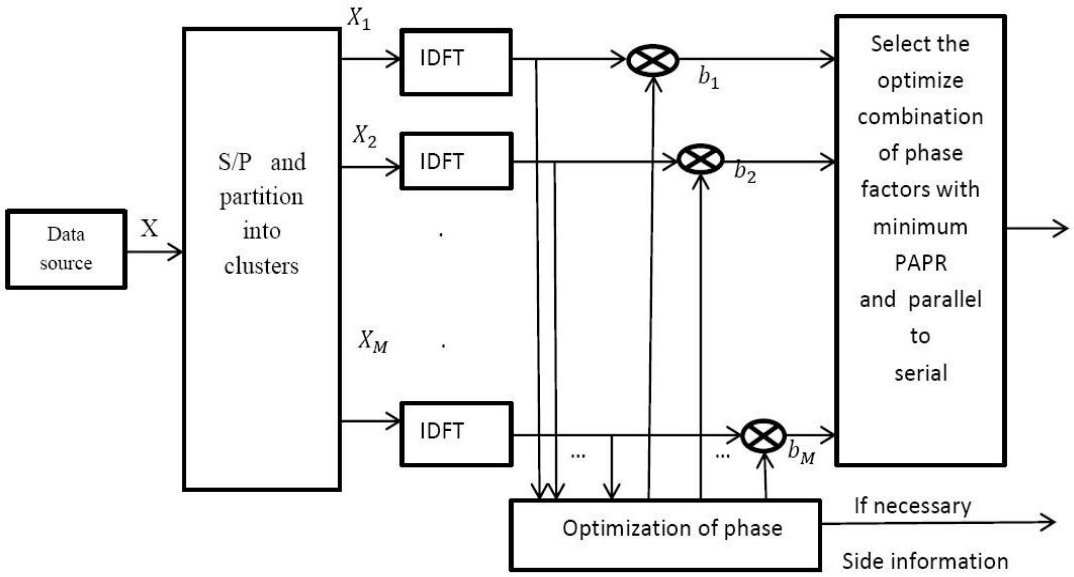

Fig.4.1.3 Block diagram of PTS scheme

f) INTER LEAVING TECHNIQUE

In this technique interleavers are used for the purpose of generation of multiple OFDM signal and same information is transmitted by the signal. It is a device that run on a block of symbol and rearrange them in a specifics way. In this adaptive techniques is also overcome the complexity. Adaptive interleaving is used as an early terminating threshold. As the searching process is terminated the value of PAPR reaches below the threshold value These low threshold force the adaptive interleaver to search for all interleaving sequence. As compared to PTS this technique is less complex.

II. SIGNAL DISTORTION TECHNIQUES

a) CLIPPING AND FILTERING

It is the simplest technique to to minimize the PAPR .In this the high amplitude peaks signal are clipped before passing the signal is passed from the power amplifier. For this clipper is used which limit the signal up to determined level called as clipping level. It is a non-linear process, which result in the formation of in-band and out of band distortion. we can not remove in-band distortion by using filtering, where as out of band distortion can be removed by filtering and improve the performance of BER. By the use of clipping and filtering algorithm, more PAPR can be minimized than that of direct clipping.[9]

b) PEAK WINDOWING

This technique is almost similar to that of clipping technique, but it provides better performance due to the addition of self interference and increased bit error rate(BER). This result in out of band distortion increased. In this technique, different windows are multiplied with large signal peaks such as Gaussian shape window, cosine, Kaiser and hamming window. The size of window should be narrow as possible otherwise it will increase bit error rate(BER).[4]

CONCLUSION

In this paper we present all the techniques which we can use to overcome the PAPR effect in OFDM system as possible for effective transmission of signal. In future we can go for the combination of two or more techniques to minimize the problems more effectively than that of single technique and also improve the performance of the system.

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