Reduction of PAPR by Hybridization of the Methodologies First by Applying SLM Technique and Then Clipping and Filtering on the Signal

Obair Bashir Bhat, Birinderjit Singh

Abstract— Communication is one of the important facet of life. With the growth in age and its growing demands, there has been accelerated advancement in the field of communications. Signals, at the beginning were sent in the analog domain, are being mailed supplementary in the digital domain these days. For better transmission, even single – carrier waves are being replaced by multi – carriers. Multi – carrier systems like CDMA and OFDM are now – a – days being appliances regularly. In the OFDM system, installed equilaterally, sub – carriers are used to carry the data from the transmitter end to the receiver end. Subsistence of guard band in this system accords with the problem of ISI and noise is minimized by larger number of sub – carriers. But the large Peak – to – Average Power Ratio of these signal have some undesirable effects on the system. in this thesis we have concentrated more on learning the basics of an OFDM System and have undertaken various methods to reduce the PAPR in the system so that this system can be used more commonly and effectively.

Keywords: CDMA, OFDM, PAPR, Carriers, ISI.

I. INTRODUCTION

OFDM is one of the many multicarrier modulation techniques, which grants steep spectral effectiveness, slighter vulnerability, small implementation complexity, to echoes and non – linear distortion. Due to these dominance of the OFDM system, it is enormously worn in several communication systems. But the main dispute one faces while implementing this system is the high peak – to – average power ratio of this system. A immense PAPR boosts the complexity of the analog – to – digital and digital – to – analog converter and reduces the efficiency of the radio – frequency (RF) power amplifier [3,6]. 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 interception of spectral growth and the transmitter power amplifier is no longer confined to linear region in which it should compel. This has a crippling reflex on the battery lifetime. Thus in communication system, it is distinguish that all the potential benefits of multi carrier transmission can be out - weighed by a high PAPR value [3]. 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, estimating complexity gets elaborated, and so on [3].

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A. Peak-To-Average Power Ratio

Presence of large number of independently modulated sub-carriers in an OFDM system the peak value of the system can be very high as compared to the average of the aggregate system. This ratio of the peak to average power value is subtitled as Peak-to-Average Power Ratio. Comprehensible accession of N signals of same phase produces a peak which is N times the average signal. The considerable disadvantages of a immense PAPR are-

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

B. PAPR Of Multi Carrier Signal

Let the data block of length N be represented by a vector. Duration of any symbol in the set $\boldsymbol{X}$ is T and represents one of the sub – carriers set. As the N sub – carriers chosen to transmit the signal are orthogonal to each other, so we can have where and NT is the duration of the OFDM data block $\boldsymbol{X}$. The complicated information frames for the OFDM signal to be transmitted is given by The PAPR of the transmitted signal is defined as Reducing the $max|x(t)|$ is the principle goal of PARP reduction techniques. Considering that discrete- time signals are negotiated with in most systems, frequent PAPR techniques are implemented to accord with amplitudes of various samples of $x(t)$. Due to symbol spaced 25 output in the first equation we find some of the peaks missing which can be compensated by oversampling the equation by some factor to give the true PAPR value.

C. Cumulative Distribution Fucntion

The Cumulative Distribution Function (CDF) is one of the most regularly used parameters, which is worn to pitch the efficiency of any PAPR technique. Normally, the Complementary CDF (CCDF) is used alternative of CDF, which avail 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 multi – carrier signal with a large number of sub-carriers, the actual and imaginary bit of the time – domain signals have a mean of zero and a variance of 0.5 and follow a Gaussian distribution. Usually Rayleigh distribution is proceeded for the amplitude of the multi – carrier signals, where as an intermediate chi-square distribution with two degrees of freedom is followed for the power distribution of the system.

The CDF of the amplitude of a signal unit is given by The CCDF of the PAPR of the information frame is desiderate in our case to compare outputs of various reduction techniques.

D. Papr Reduction Technique

There are some techniques which are mainly used in reduction and optimization of PAPR.
Amplitude clipping and filtering
Selective mapping
Partial transmit sequence

II. AMPLITUDE CLIPPING AND FILTERING

Amplitude clipping is considered as the simplest technique which may be under taken for PAPR reduction in an OFDM system. A threshold value of the amplitude is certain in this case to limit the peak envelope of the input signal. Signal having values eminent than this pre-determined value are clipped and the rest are allowed to pass through un-disturbed [3]. where,

***B(x)* = the amplitude value after clipping.**

***x* = the initial signal value.**

***A* = the threshold set by the user for clipping the signal.**

The problem in this case is that due to amplitude clipping distortion is examined in the system which can be viewed as another source of noise. This distortion falls in both in – band and out – of – band. Filtering cannot be implemented to reduce the in – band distortion and an error performance degradation is observed here. On the contrary spectral efficiency is hampered by out – of – band radiation. Out – of – band radiation can be reduced by filtering after clipping but this may result in some peak re – growth. A repeated filtering and clipping operation can be implemented to solve this problem. The desired amplitude level is only achieved after several iteration of this process.

III. SELECTIVE MAPPING

The main objective of this technique is to generate a set of data blocks at the transmitter end which represent the original information and then to choose the most favorable block among them for transmission. Let us examine an OFDM system with N orthogonal sub – carriers. A data block is a vector composed of N complex symbols, each of them representing modulation symbol transmitted over a sub – carrier. X is multiplied element by element with U vector composed of N complex numbers, defined so that, where |.| denotes the modulus operator. Each resulting vector, where, produces after IDFT, a corresponding OFDM signal given by where *T* is the OFDM signal duration and is the sub – carrier spacing[5,6]. Among the modified data blocks, the one with the lowest PAPR is selected for transmission. The quantum of PAPR optimization for SLM depends on the number of phase sequences *U* and the design of the phase sequences.

IV. PARTIAL TRASNMIT SEQUENCE

In the PTS technique, input data block **X** is partitioned in *M* disjoint sub – blocks, such that and the sub – blocks are combined to minimize the PAPR in the time domain. The *L* times oversampled time domain signal is obtained by taking the IDFT of length *NL* on concatenated with $(L – 1)N$ zeros. These are called the partial transmit sequences. Complex phase factors are introduced to conjoins the PTSs. The set of phase factors expresses a vector. The time domain signal thereafter conjoining is given by wherethe objective is to find the set of phase factors that attenuate the PAPR. Minimization of PAPR is correspondent to the minimization of maximization

V. PROBLEM FORMULATION

For wireless communication we often use OFDM technique as a digital multi carrier modulation method. A comprehensive number of firmly spaced orthogonal sub carrier signals are used to carry information. it also provide high spectral efficiency ,low noise and non – linear distortion OFDM also provide large data rates with sufficient robustness. Beside such advantages it has some limitations also one of major problem in OFDM is peak – to – average power ratio (PARP).an uniform signal is sent but because of PAPR effect the signal received at output is non –uniform and spiky power spectrum . An OFDM signal generate high PAPR effect due to which there is increased in complexity of the analogtodigital anddigital to analog converter. Secondly due to high PAPR there is reduction in efficiencyof RF amplifiers. Many Techniques had been proposed for removing this PAPR from OFDM system, as per literature recently an clipping algorithm along with filtration was proposed, the PAPR was reduced up to an extent but as clipping is not that much efficient as it cut the signal and also effect theinformation of the signal so there is need to update the methodology by using other techniques.

VI. PROPOSED WORK

As the PAPR is the major problem in OFDM we need to reduce its effectthe problem caused by PAPR is increased complexity inthe analogtodigital anddigital to analog converter.Reduction isefficiency of RF amplifiersso we need to reduce the effect of PAPR in OFDM signal .the PAPR decrease strategies differ as per the needs of the system and depend on different elements. PAPR reducing capacity, increment in power in transmit signal, loss in information rate, unpredictability of processing and increment in the bit-error rate at the receiver end are different variables which are considered before adopting a PAPR decrease strategy of the system. As we need to update the clipping based PAPR reduction methodology so in this thesis an new approach is proposed which is having an advancement over the clipping and the filtering methodology. In our thesis we have worked on hybridization of the methodologies. We have used many techniques like PTS, SLM.We have find that SLM is best out of all. In our thesis we have apply SLM technique and then clipping and filtering on the signal is done .in this way we have reduce the effect of PAPR in OFDM.
The Proposed work can be summed up in the following points:-

1. In SLM and clipping and filtering , data symbols in X are partitioned in to M disjoint sub blocks $X^{(i)}$, where 1 <= i <= M, such that X = SUM($X^{(i)}$) ; 1 <= i <= M
2. The sub blocks $X^{(i)}$ are transformed in to M time-domain partial transmit sequences. $x^{(i)}$ = IFFT ($X^{(i)}$) ; 1 <= i <= M
3. These sequences are independently rotated by some phase factors, bi equal to exp(j*φ_i) ; 1 <= i <= M.
4. These are then conjoined to produce the time domain OFDM signal packet back, x = SUM(bi * $x^{(i)}$; 1 <= i <= M SLM and clipping and filtering algorithm selects a vector bi such that the PAPR of the corresponding transmit sequence x(t) will be minimum. IQ vector of differential wireless standards will have distinct PAPR time domain pattern based on complex modulation schemes used and OFDM/OFDMA structure. Accordingly all the while simulation vivid iterations need to be carried out.

VII. SIMULATION RESULTS

To compare the multi-carrier OFDM system, first we check the PAPR of a single carrier system in base band as well as the pass band. A sinusoid is considered as a message signaland its corresponding PAPR is calculated. It is seen from the figure that PAPR of baseband signal is 0dB and pass band signal is 3dB.As per equation (14), the CCDF is approximated. This approximation approaches actual value as the number of multiple carriers "N" increase. The actual and its approximation for different values of "N" are plotted.PAPR is very sensitive to the choice of modulation in a particular OFDM system. PAPR increases if we deal with the modulations in which amplitude of basic functions changes as in QAM. But same amplitude basis functions correspond to low PAPR. The simplest of its kind, we reduce PAPR by just clipping the excessive peaks. The pass band signal has a PAPR in OFDM, so after clipping considerable PAPR reduction is seen. But this clipping expands the signal and thus ISI occurs. Here the tradeoff is made then by passing the clipped signal through the filter. Now the PAPR is a bit increased but on the brighter side interference isminimized.

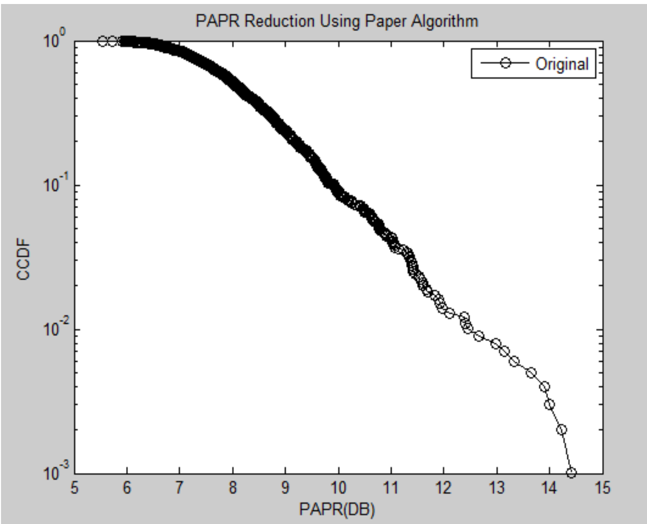

Fig 1. showing PAPR Reduction using Hybrid Technique

REFERENCES

1. H. Taub, D.L. Schilling ,G. saha, taub's principles of communication system McGraw Hill,2008.
2. J .H Lee, "PAPR reduction of OFDM signals using a reduced complexity technique ,2008.
3. S .Mohapatra, S. Das " A new approach for performance improvement of OFDM system by using pulse shapping.2009.
4. JC chen, CP li, tone reservation using near optimal peak for PAPR,2010.
5. P yen, H Minn, CC chong PAPR reduction for bandwidth aggregated OFDM, March 2012.
6. MM rana, M Aslam peak average power ratio for LTE systems, November 2013.
7. J. Wang / Journal of Information & Computational Science 12:1 (2015)