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REDUCTION OF PEAK POWER AVERAGE RATIO IN OFDM SYSTEM USING CLIPPING TECHNIQUE

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Abstract

High PAPR (Peak Average Power Ratio) is major Obstacle in OFDM (Orthogonal Frequency Division Multiplexing) System. Many methods's is used to reduce the PAPR of the OFDM system. In this paper we analyze clipping and filtering method. It is easy to implement and reduces the amount of PAPR by clipping and Filtering the peak of the maximum power signal. Simulation results show that the clipping and Filtering method is reduced PAPR significantly which decreases as the number of clip and filtering level is increased.

KEYWORDS: OFDM, PAPR, CCDF, MCM

Introduction

Multicarrier communications is a technique that has recently seen rising popularity in wireless and wire line applications. Orthogonal frequency division multiplexing (OFDM) is one of the multicarrier modulation (MCM) techniques that transmit signals through multiple carriers. The advantage of such schemes is that unlimited transmission rates are theoretically possible in highly time dispersive channels. Also, by introducing a guard-period and using differential encoding, reliable transmission over spectrally shaped channels is possible without any equalization. The disadvantage is that multicarrier signals exhibit a high peak-to-average power ratio (PAPR). If nonlinearities are overloaded by large signal peaks, inter modulation among subcarriers and undesired out-of-band radiation is caused.

2. PROBLEM WITH PEAK AVERAGE POWER RATIO IN OFDM SYSTEM

High Peak-to-Average Power Ratio has been recognized as one of the major practical problem involving OFDM modulation. High PAPR results from the nature of the modulation itself where multiple subcarriers are added together to form the signal to be transmitted. When N sinusoids add, the peak magnitude would have a value of N, where the average might be quite low due to the destructive interference between the sinusoids. High PAPR signals are usually undesirable for it usually strains the analog circuitry. High PAPR signals would require a large range of dynamic linearity from the analog circuits which usually results in expensive devices and high power consumption with lower efficiency (for e.g. power amplifier has to operate with larger back-off to maintain linearity).

In OFDM system, some input sequences would result in higher PAPR than others. For example, an input sequence that requires all such carriers to transmit their maximum amplitudes would certainly result in a high output PAPR. Thus by limiting the possible input sequences to a smallest sub set, it should be possible to obtain output signals with a guaranteed low output PAPR. The PAPR of the transmit signal x (t) is the ratio of the maximum instantaneous power and the average power.

If a signal is a sum of N signals each of maximum amplitude equal to 1 Volt, then it is conceivable that we could get maximum amplitude of N Volts, that is, all N signals add at a moment at these maximum points.

The crest factor is widely used in the literature as well, which is defined as the square root of the PAPR.

Crest Factor, C.F. = PAPR

High PAPR / crest factor could cause problems when the signal is applied to a transmitter which contains non-linear components such as High Power amplifier (HPA) in the Transmitter chain. The PAPR has the worst case value PAPRWC which depends on the no. of subscribers N. The non-linear effects on the transmitted OFDM symbols are spectral spreading, inter-modulation and changing the signal constellation. In other words, the nonlinear distortion causes both in-band and out-of-band interference to signals. The in band interference increases the Bit error Rate (BER) of the received signal, while the out-off-band interference causes adjacent

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channel interference through spectral spreading. A better solution is to prevent the occurrence of such nonlinear distortion by reducing PAPR of the transmitted signal with some manipulation of the OFDM signal itself.

3. PROPOSED TECHNIQUES FOR REDUCTION OF PAPR IN OFDM SYSTEM

In this paper mainly proposed the improvement of one technique, which are Clipping and filtering.

Clipping & Filtering techniques is mostly effective techniques to reduce the high PAPR in OFDM system. Here clipping is the nonlinear processes which increase the band noise distortion, also increase in the bit error rate also decrease the spectral efficiency. Here using with filtering this techniques will give better performance. Filtering after clipping will reduce out of band radiation. This technique will reduce the PAPR without spectrum expansion. Here if the OFDM signal is over sampled then the scheme of correction is suitable with the clipping so that each subcarrier generated with the interference. So for proposed this scheme each signal must be oversampled by factor of four. This scheme is more compatible with the PSK modulation scheme.

Clipping and Filtering is one of the easiest techniques which may be under taken for PAPR reduction for an OFDM system. A threshold value of the amplitude is fixed in this case to limit the peak envelope of the input signal. The clipping ratio (CR) is defined as,

$$CR = \frac{A}{\sigma}$$

Where, A is the amplitude and σ is the root mean squared value of the unclipped OFDM signal. The clipping function is performed in digital time domain, before the D/A conversion and the process is described by the following expression,

$$x_k^c = \begin{cases} x_k & |x_k| \le A \\ Ae^{j\emptyset(x_k)} & |x_k| > A \end{cases} \qquad 0 \le K \le N-1$$

Where, x_k^c is the clipped signal, x_k is the transmitted signal, A is the amplitude and $\emptyset(x_k)$ is the phase of the transmitted signal x_k.

4. RESULT AND DISCUSSION

The work also carried by different researcher across the globe, but in this work author improve the PAPR without the increasing the complexity of OFDM system. The fig-1 shows the result of Reference paper using Clipping and Filtering technique.

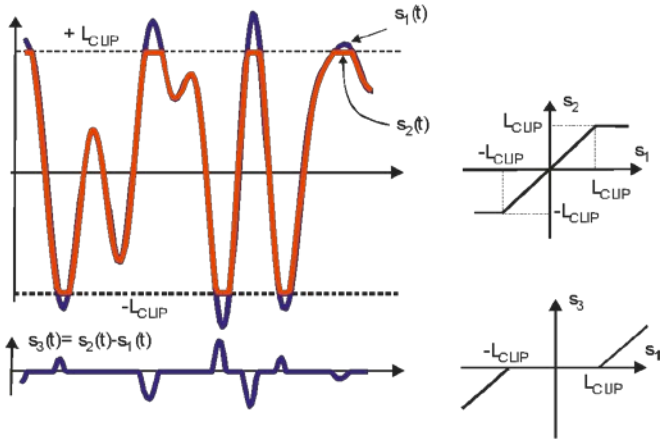

Figure: 1 Clipping Signal Graph

According to figure 1, it shows that the some Signal has been clipped. Clipped Signal s_3 (t) = s_2 (t)- s_1 (t)

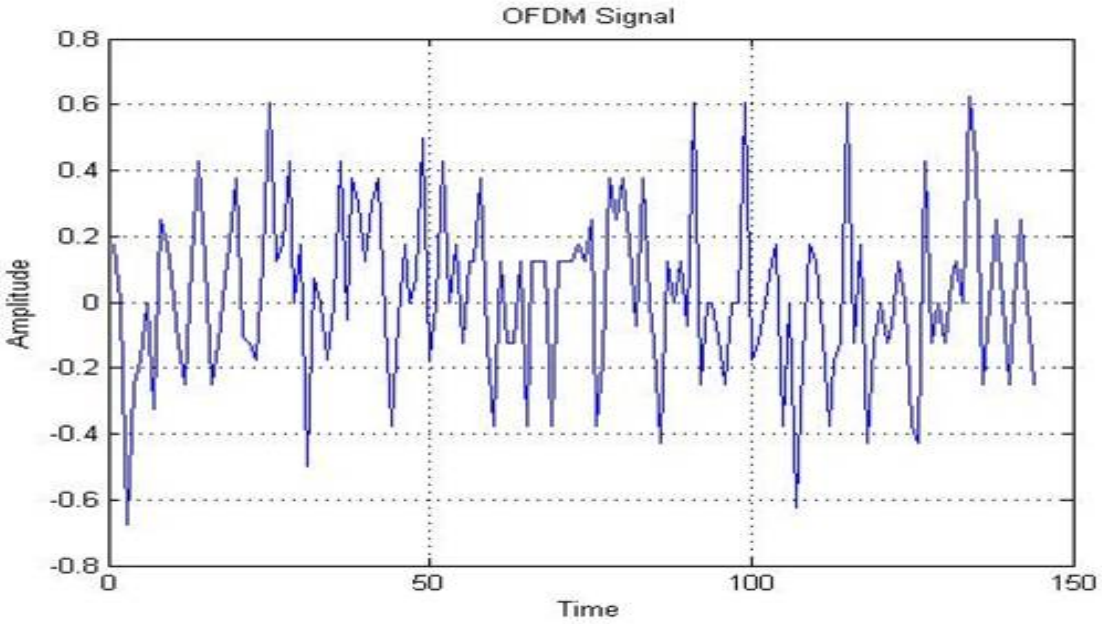

Figure: 2 Signal with high peak value

In the figure 2 showed the OFDM transmitted signal. There are two levels i.e. 0.6 and -0.6.

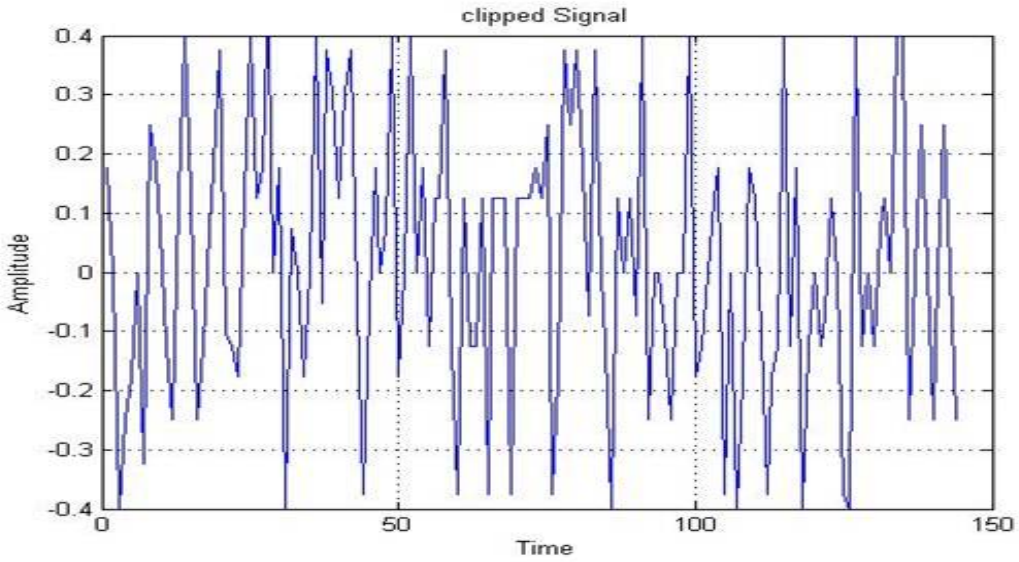

Figure: 3 Signal with clipped peak value

The result of figure 3 based on OFDM Received Signal using Clipping technique which shows the reduction in amplitude in OFDM signal nearby 0.4 dB to -0.4 dB.

5. CONCLUSION

In this paper, performances are compared for two different types of amplitude clipping & filtering based PAPR reduction techniques have been analyzed. We ran the simulation for techniques, i.e: proposed upon QAM. In the new proposed method, QAM provides improved result.

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