

Different Techniques to Reduce the PAPR in OFDM System

*Malhar Chauhan, **Saurabh patel, ***Hardik patel

*(Department of Electronics & Communication, RGPV, Bhopal)

** (Department of Electronics & Communication, NSIT, Jetalpur)

*** (Department of Electronics & Communication, NSIT, Jetalpur)

ABSTRACT

Orthogonal Frequency Division Multiplexing (OFDM) is well known Technique for transmitting large data Over Radio waves. Its main disadvantage is PAPR (Peak to average power ratio) nothing but several sinusoidal leads. This paper presents Reduction PAPR using all proposed techniques . This Proposed techniques shows better performance for reduction in PAPR any technique can be used according to performance.

Keywords: - Orthogonal Frequency Division Multiplexing (OFDM), Peak to Average Power Ratio, Problems & Solutions.

INTRODUCTION

OFDM is multicarrier multiplexing access Technique for Transmitting Large data over Radio waves. Next mobile Generation system is expected to provide high data rate to meet the requirement for future multimedia applicaton. Minimum data rate required for the 4G System is 10-20Mbps & at least 2Mbps in moving vehicles. And modulation technique adopted by 4G mobile system is OFDM. One of the major problems observed in OFDM system is PAPR (Peak to Average Power Ratio). This PAPR must be Reduce for efficient transmission. Different techniques can be used for reduce PAPR in OFDM system. In this Paper We describe all techniques which can be used to reduce PAPR in OFDM system. All the techniques performs best in reduction. this paper contains an overview of all techniques to reduce PAPR in OFDM system.

I. OFDM

OFDM is generally used for the Digital Television Broad casting (DTB), Digital Audio Broadcasting (DAB) & Digital Video Broad casting (DVB) like this..OFDM is the technique which divide available spectrum in many carriers and each carrier will modulate by low data rate stream. OFDM uses the spectrum much more efficiently by spacing the Channels more closely together. This can be done by making all the carriers orthogonal to one another, preventing interference between the closely.

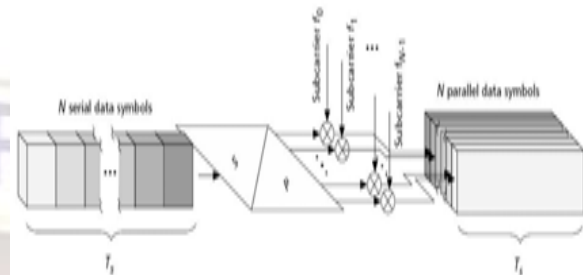


FIG.1. MULTICARRIER TRANSMISSION TECHNIQUE

II. PAPR PROBLEM & REQUIREMENT OF REDUCTION

In previous paragraph basics of OFDM (Orthogonal frequency division multiplexing) has been discussed .actually OFDM system is very efficient & marvelous technique in its manner, but when there is a merits demerits also available. So here we discuss one of the major drawbacks of the OFDM system. Drawback is high PAPR (Peak-to-Average Power ratio). PAPR means randomly sinusoidal leads occurred during transmission of the OFDM signal. So in this chapter we discuss basics of PAPR, why it is created & what the proposed solution are for reduce it.

So as per the introduction of PAPR we can judge that to reduce the PAPR is most important point in the OFDM system. Because of when we are talking about the high speed data communication in real life like video calling, high speed internet access, and also main point is that high speed data access up to 2mbps while moving on the vehicle at 100km/h, digital video broadcasting (DVB), Microwave terrestrial television, Digital audio broadcasting (DAB), 4G system, hyper LAN. So this most type of communication systems required high data rate. But problem occurs like PAPR in OFDM system prevent these types of facilities in the real life. So to reduce it is most important.

Now here is the explanation of PAPR in Mathematical equation form. PAPR is defined as the maximum power occurring in the OFDM transmission to the average power of the OFDM transmission. Mathematical representation has been given below.

$$PAPR = \frac{P_{\text{peak}}}{P_{\text{average}}} = \frac{\max [|x_n|^2]}{E [|x_n|^2]}$$

Where, P_{peak} = Peak power of the OFDM system

P_{average} = average power of the OFDM system.

$E[\cdot]$ is the expectation operator

The PAPR of an oversampled version of $x(t)$ calculated as per the above equation (1). Here in this equation our main goal is to minimize the $\max [|X_n|^2]$.

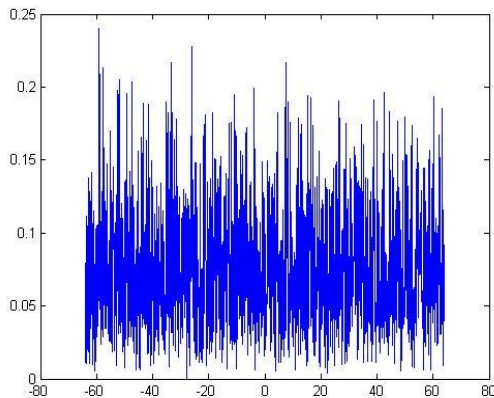


Fig.2 OFDM signal containing sinusoidal high peaks

Now in Fig. 2 as per explained above high sinusoidal peak is shown clearly. So we can understand by seeing it what is it. Signal is transmitted with the $sdata = 64$ data symbol per frame to IFFT. This is the simulation of OFDM system to observe PAPR in it. So this is the basic explanation about PAPR and why it is reduce in OFDM system. Now there are different techniques has been proposed for the reducing PAPR in OFDM system.

III. PAPR TECHNIQUES

Many techniques have been used to reduce the PAPR in OFDM system. Now as per the below table we can see how many techniques can be used.

3.1 Signal scrambling techniques

3.1.1 Block coding techniques

Main objective of this technique is to reduce PAPR using different block coding & set of code words. This scheme is widely used to reduce the peak to mean envelope power ratio. While selection of the suitable codeword many things must be considered like M-ray phase modulation scheme, any type of coding rate, suitable for encoding –decoding & also main thing is that error correction /error decoding.

3.1.2 Sub block coding techniques

To reduce PAPR more than 3db sub block coding technique is widely used. But this can be achieved at $\frac{3}{4}$ code rate. This techniques based on $\frac{3}{4}$ code rate systematically with added last odd parity checking bit to develop lowest peak envelope power. This coding scheme is termed as systematic odd parity checking coding (SOPC). Large reduction in PAPR can be obtained by the divided large frame into sub block encoded with SOPC.

Table 1 Classification of PAPR techniques

PAPR techniques	
Signal scrambling techniques	Signal distortion techniques
Block coding	Signal clipping
	Peak windowing
Sub block coding	Envelope scaling
Selective level mapping	
Partial transmit sequence	
Interleaving	
Linear block coding	
Tone reservation	
Tone injection	

3.1.3 Selected mapping (SLM)

In particular SLM technique whole set of signal represent the same signal but form it most favorable signal is chosen related to PAPR transmitted. The side information must be transmitted with the chosen signal. This technique is probabilistic based will not remove the peaks but prevent it from frequently generation. This scheme is very reliable but main drawback that is side information must be transmitted along with chosen signal.

3.1.4 Partial transmit sequence (PTS)

Partial transmit sequence is also one of the Probabilistic based. Main idea of this scheme is data block divide into non overlapping sub block with independent rotation factor. This rotation factor generates time domain data with lowest amplitude. This is modified technique of SLM scheme. And gives better performance than SLM. Because of differential modulation no needs to transmit the side information.

3.1.5 Linear block codes

This technique also known as standard array of linear block codes. in this scheme distinct U signal is transmitted along with transmitted sequence. U distinct signal is used constructed using proper select co –set words. Using scrambling codes no needs to transmit side information and received signal can be easily decoded. Main thing is that to select standard array of codes to reduce the PAPR. This technique also modification of the SLM techniques. In this transmitted signal with minimum PAPR using scrambling code. Technique has better performance than SLM technique.

3.1.6 Interleaving

In this technique highly correlated data frame .in this adaptive technique also reduces the complexity. Adaptive interleaving is to establish an early terminating threshold. So the searching process is terminated when the value of PAPR reaches below the threshold value.so, these low threshold force the AIL to search for all interleaving sequence. This technique is less complex than PTS.

3.1.7 Tone Reservation

This technique contains some set of reservation of tones. By using this technique reserved tones can be used to minimize the PAPR. This method is used for multicarrier transmission and also shows the reserving tones to reduce the PAPR. This technique is dependent on amount of complexity. When there is number of tones is small reduction in PAPR may represent non-negligible samples of available bandwidth. Advantage of this tone reservation is very positive that no process is needed at receiver end. And also do not need to transmit the side information along with the transmitted signal. In this data block is added to the time domain signal to reduce the peak leads.

3.1.8 Tone Injection

This method is generally used additive method for PAPR reduction. Using this method data rate loss is very less. This method used the set of active constellation point for an original constellation point to reduce the PAPR. In this each unit all original constellation is mapped on the several equivalent constellation point. & this extra points freedom can be easily used to reduce the PAPR. This method is popularly used as the tone injection method because of the newly applying points into basic constellation for the new points for larger constellation. Main thing is injecting tone of appropriate phase and frequency in OFDM symbol. Main demerits are that transmission of side information is necessary at the receiver side.

3.2 Signal distortion techniques

3.2.1 Clipping & Filtering

Clipping & Filtering techniques is mostly effective techniques to reduce the high PAPR in OFDM system. Here clipping is the nonlinear process 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 with out 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.

3.2.2 Peak windowing

Here peak windowing technique is very similar to the clipping technique but it will give better performance with adding some self interference and increasing in the BER (bit error rate). Due to this out band radiation is also increased. In this method we multiply different windows with large signal peaks like Gaussian shaped window, cosine, Kaiser and Hamming window. OFDM signal is multiplied with several of these windows, the resulting spectrum is a convolution of the original OFDM spectrum with the spectrum of the applied window. Means the windows should be narrow as possible. By using this technique PAPR can be reducing

to 4db of each subcarrier. SNR is limited to .3db due to signal distortion.

3.2.3 Envelope scaling

This technique is related to scaling means before OFDM signals sent to the IFFT all subcarrier is scaled the input envelope. In this technique 256 subcarrier is used so all subcarrier will remain equal. Main idea is that to scheme is that the input envelope in some sub carrier is scaled to achieve the smallest amount of PAPR at the output of the IFFT. Here receiver does not need any side information at the receiver end for decoding. This scheme is suitable for the PSK modulation. When it is applied with the QAM high degradation is occurred in the BER.

IV. CONCLUSION

Basically as per the information about all above described techniques to reduce the PAPR in OFDM system all techniques is different in their way. And using each technique PAPR will be reduced at some what level. To reduce the PAPR any technique can be used.

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