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Evaluation of PAPR in OFDM System by changing the IFFT size for BPSK modulation scheme

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Abstract: OFDM is a broadband multicarrier modulation method that offers superior performance and benefits over older, more traditional single-carrier modulation methods. It is a better fit with today's high-speed data requirements and operation in the UHF and microwave spectrum. Orthogonal frequency division multiplexing (OFDM) is one of the multi-carrier modulation (MCM) techniques that transmit signals through multiple carriers. These carriers (sub carriers) have different frequencies and they are orthogonal to each other. There are various issues related to OFDM such as dispersion (ICI), external interference (crosstalk) and nonlinearities (PAPR). In this paper we discussed the effect of IFFT size on PAPR for BPSK modulation scheme for without any reduction technique, with clipping technique and with comapnding technique."

Keywords – BPSK, COFDM, DMT, DSP, FDM, IFFT, ISSI, OFDM, PAPR, SFN.

I. INTRODUCTION

Orthogonal frequency-division multiplexing (OFDM), essentially identical to coded OFDM (COFDM) and discrete multi-tone modulation (DMT), is a frequency-division multiplexing (FDM) scheme utilized as a digital multi-carrier modulation method. A large number of closely-spaced orthogonal sub-carriers are used to carry data. The data is divided into several parallel data streams or channels, one for each sub-carrier. Each sub-carrier is modulated with a conventional modulation scheme (such as amplitude modulation or phase-shift keying) at a low symbol rate, maintaining total data rates similar to conventional single carrier modulation schemes in the same bandwidth [Macro Breiling].

OFDM has developed into a popular scheme for wideband digital communication, whether wireless or over copper wires, used in applications such as digital television and audio broadcasting, wireless networking and broadband internet access.

The primary advantage of OFDM over single-carrier schemes is its ability to cope with severe channel conditions (for example, attenuation of high frequencies in a long copper wire, narrowband interference and frequency-selective fading due to multipath) without complex equalization filters. Channel equalization is simplified because OFDM may be viewed as using many slowly-modulated narrowband signals rather than one rapidly-modulated wideband signal. The low symbol rate makes the use of a guard interval between symbols affordable, making it possible to handle time-spreading and eliminate intersymbol interference (ISI). This mechanism also facilitates the design of single frequency networks (SFNs), where several adjacent transmitters send the same signal simultaneously at the same frequency, as the signals from multiple distant transmitters may be combined constructively, rather than interfering as would typically occur in a traditional single-carrier system [Cimni L. J.].

In Orthogonal Frequency Division Multiple Access (OFDMA), frequency-division multiple access is achieved by assigning different OFDM sub-channels to different users. OFDMA supports differentiated quality of service by assigning different number of sub-carriers to different users in a similar fashion as in CDMA.

1.1 Block Diagram of OFDM System

Fig. 1.1 shows the basic block diagram of transceiver

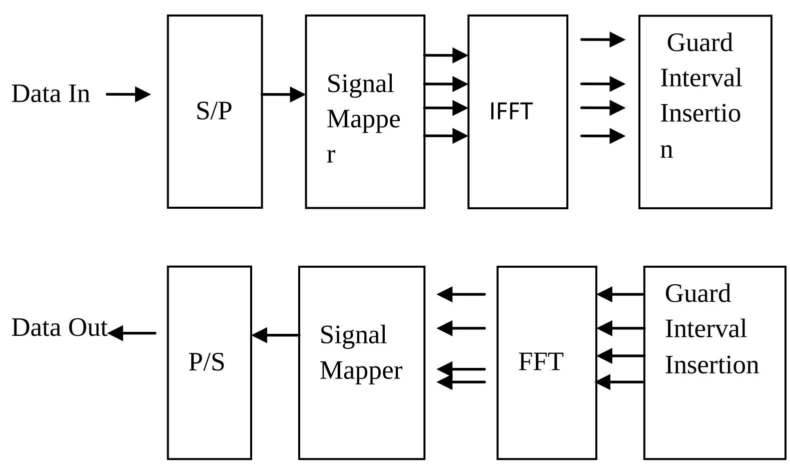

Fig 1: The basic block diagram of OFDM system

II PAPR PROBLEM

The OFDM symbols are obtained by summing up of a number of modulated sub carriers, so the synthesized signal has a relatively large peak power, which will brings high PAPR.

A brief mathematical analysis for PAPR is presented below. The root mean square (RMS) magnitude of the OFDM signal is defined as the "root of the time average of the envelop power ($\sqrt{P}$), where P is defined by equation (1):

$$P = \frac{1}{T}\int_{t=0}^{T} |x(t)|^2 dt \quad = \quad \frac{1}{N}\sum_{n=0}^{N-1} |X(n)|^2 \qquad ...(1)$$

Where, x(t) is the OFDM signal defined by equation (1). The value P in this case corresponds to a single OFDM symbol, and depends on the sequence of information carrying coefficients $\{X_n\}$. The average power of OFDM symbols can be written as $P_{av} = E\{P\}$. Thus, the PAPR of an OFDM signal can be defined as:

$$\zeta = \max |x(t)|^2 / P_{av} \qquad \ldots(2)$$
$$\zeta = \max |x(t)|^2 / E\{|x(t)|^2\} \qquad \ldots(3)$$

III VARIOUS TECHNIQUE FOR REDUCTION OF HIGH PAPR

3.1 CLIPPING

Clipping the signal is the simplest way to reduce the PAPR where the peak amplitude becomes limited to some desired level. In this method the efficiency does not depend on the number of carriers. Clipping causes significant spectral leak into adjacent channels. These out-of-band components must be filtered to prevent adjacent channel interference.

Clipping sounds detrimental but the performance degradation can actually be compensated because it reduces the dynamical range of A/D which reduces the quantization noise. Artificial signals are good at the cost of some extra power needed to transmit these signals. Most of the papers model the nonlinear noise as an additive Gaussian noise, which is reasonable when the clipping level is low enough so that the event of clipping occurs quite frequently. If, on the other hand, the clipping level is high enough so that clipping is a rare event, then this nonlinear noise should be modeled as an impulsive noise instead.

In this method the maximum value of the signal is equal to the value of clipcompress, range of clipcompress is taken from 0.5 to1. As small as the value of clipcompress (means near to 0.5) PAPR is significantly reduced but BER is increase a little bit. So, a trade off is taken while selecting the value of clipcompress.

3.2 COMPANDING

Companding is a signal processing technique used in the digital systems primary in audio such as microphones (more effectively in wireless) to reduce the noise levels in the sound quality mainly owing to low-level radio frequency interference in the frequency channel. Literally, the term "companding" is composed of the words "compressing" and "expanding".

In a wireless system using the companding technique, the audio signal is compressed in the transmitter and expanded in the receiver. The compression process reduces the deviation in the frequency ranges of the audio before it is transmitted and that is restored to the original frequency ranges by the expansion process at the receiver's end.

The objective of the companding process is to preserve the signal-to-noise ratio of the original audio. The companding is also used in the digital systems by compressing the signals before input to an analog-to-digital converter, and then expanding after a digital-to-analog converter. The T-carrier telephone system implements the companding that follows A-law or µ-law. This technique is also used in the digital file formats for better signal-to-noise ratio (SNR) at very low bit rates.

VI RESULT

Evaluation of PAPR by changing the IFFT size for BPSK modulation scheme

In this section a simulation study is carried out to observe the effect of IFFT size on PAPR without any reduction technique, with clipping technique and with companding technique for BPSK modulation technique.

Table 4.1 Values of PAPR for different IFFT size for BPSK

IFFT Size	PAPR (dB)		
	Without any reduction technique	With clipping	With companding
64	20.1	4.42	9.2
128	19.1	5.65	9.1
256	20.0	7.28	8.84
512	18.25	9.46	8.65
1024	19.0	12.3	8.5
2048	18.25	15.2	8.4

These values are plotted in figure 2 for clear understanding.

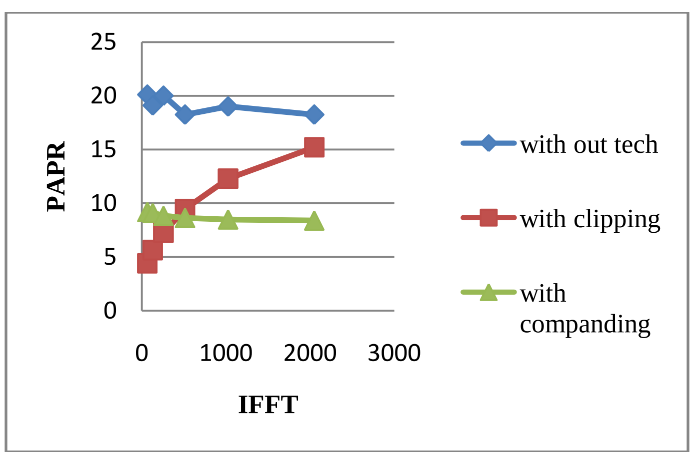

Fig 2 Plot of PAPR Vs IFFT size for BPSK

It is observed in the figure 2, the maximum value of PAPR is 20.1 dB when IFFT size is 64 for BPSK modulation scheme, without any reduction technique. In clipping technique,

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with the increase in the value of IFFT size, PAPR also increases and the range of PAPR size is 4.42 dB to 15.2 dB. On the other hand, in companding technique, with the increase in IFFT size, PAPR decreases and the range of PAPR is 8.4 dB to 9.2 dB. In clipping technique, when IFFT size is 64, then the PAPR value is reduced to 4.42 dB. In companding technique, when IFFT is 2048, then the PAPR value is reduced to 8.4 dB.

V CONCLUSION

Therefore, it is concluded that when the IFFT size (up to 512) is small then the clipping technique is best and for large IFFT size companding technique is best.

REFERENCES

i. *Jianping Wang, Ying Guo, Xianwei Zhou, "PTS-Clipping Method to Reduce the PAPR in ROF-OFDM System", IEEE Transactions on Consumer Electronics, vol. 55, pp. 1193-1197, May 2009.*

ii. *Marco Breiling, Stefan H. Müller-Weinfurtner, and Johannes B. Huber, "SLM Peak-Power Reduction Without ExplicitSide Information", IEEE Trans. On Comm., vol. 8, pp. 2581-2585, Jan. 2001.*

iii. *Cimini L. J., "Analysis and Simulation of a Digital Mobile Channel Using Orthogonal Frequency Division Multiplexing", IEEE Transactions on Communication, vol. 7, pp. 239-241, July 1999.*

iv. *Armstrong J., "Peak-to-Average Power Reduction for OFDM by Repeated Clipping and Frequency Domain Filtering", Electronics Letters, vol. 8, pp. 246-247, Feb. 2002*

v. *Simon Haykin, "Communication Systems", Pearson Education, 4th Edition, 2008.*

vi. *Sanjay Sharma, "Communicatio Systems", Katson Books, 4th Edition 2009.*

vii. *Lin Chen and Xuelong Hu, "Research on Peak to Average Power Ratio Reduction of an OFDM Signal", IEEE Int. Conference of Neural Networks and Signal Processing, vol. 8, pp. 978-982, June 2008.*

viii. *Sakran H., Shokair M., and Abou Elazm A., "Combined Interleaving and Companding for PAPR Reduction in OFDM Systems", Progress In Electromagnetics Research C, vol. 6, pp.67-78, March 2009.*

ix. *Wahaba A. A. A., "An Efficient Technique to Reduce Peak to Average Power Ratio in OFDM", System European Journal of Scientific Research, ISSN, vol. 44, pp. 632-639, Jan. 2010.*

x. *Zhang, Lu Y.H., Gulliver W.-S. , "A Successive Inter-carrier Interference Reduction Algorithm for OFDM Systems", IEEE International Conference on Communications, vol. 9, pp. 2936-2941, June 2007.*