ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Website: www.ijareeie.com

Vol. 7, Issue 5, May 2018

A Review on Different PAPR Reduction Techniques Performance in OFDM

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ABSTRACT: With the advent of new high data rate wireless applications, demand of the spectrum is rapidly increasing. Communications governmental and regulatory agencies impose regulations on spectrum usage, such as control of allocations and priorities, as well as its features. At this time, most of the prime spectrum has been assigned and it is difficult to find spectrum for the new wireless applications. OFDM signal consists of a number of independent modulated subcarriers that leads to the problem of PAPR. If all subcarriers come with same phase, the peak power is N times the average power of the signal where N is the total number of symbols in an OFDM signal. Thus, it is not possible to send this high peak amplitude signals to the transmitter without reducing peaks. Because power amplifier used for the transmission has non-linear nature which causing inter-modulation and out-of-band radiation. The high peak of OFDM signal can be reduced in several ways. The proposed system exhibits high PAPR reduction for non-contiguous bands spectrum of OFDM.

KEYWORDS: PAPR , OFDM, MATLAB

I. INTRODUCTION

Orthogonal Frequency Division Multiplexing (OFDM) is a multicarrier modulation technique that divides the available spectrum into subcarriers, with each subcarrier containing a low rate data stream. The subcarriers have proper spacing and pass-band filter shape to satisfy orthogonality as shown in Figure 2.1. OFDM will play an important role in realizing Cognitive Radio (CR) concept by providing a proven, scalable, adaptive technology for wireless communications [10]. Inter-symbol interference (ISI) is reduced completely by using a guard band in every OFDM symbol. In OFDM, using guard band is cyclically extended in order to avoid inter-carrier interference (ICI). The advantage of OFDM system is robustness to channel fading in wireless communication environment. Frequency selective fading is reduced by increasing the number of subcarriers. By choosing the coherence bandwidth is greater than the subcarrier spacing of the channel, each subcarrier is going to be affected by a flat channel and thus no or simple channel equalizer is needed.OFDM is used in many wireless applications today. Already it is used in different WLAN standards (e.g. HIPERLAN-2, IEEE 802.11a), Wireless Metropolitan Area Networks (WMAN), Digital Video Broadcasting (DVB), 3GPP-LTE, Asymmetric Digital Subscriber Line (ADSL) and power line communications.

Why PAPR reduction in OFDM system

The OFDM technique divides the total bandwidth into many narrow sub-channels and sends data in parallel. It has various advantages, such as high spectral efficiency, immunity to impulse interference and, frequency selective fading without having powerful channel equalizer.

But one of the major drawbacks of the OFDM system is high PAPR. OFDM signal consists of lot of independent modulated subcarriers, which are created the problem of PAPR. It is impossible to send this high peak amplitude signals to the transmitter without reducing peaks. So we have to reduce high peak amplitude of the signals before transmitting.

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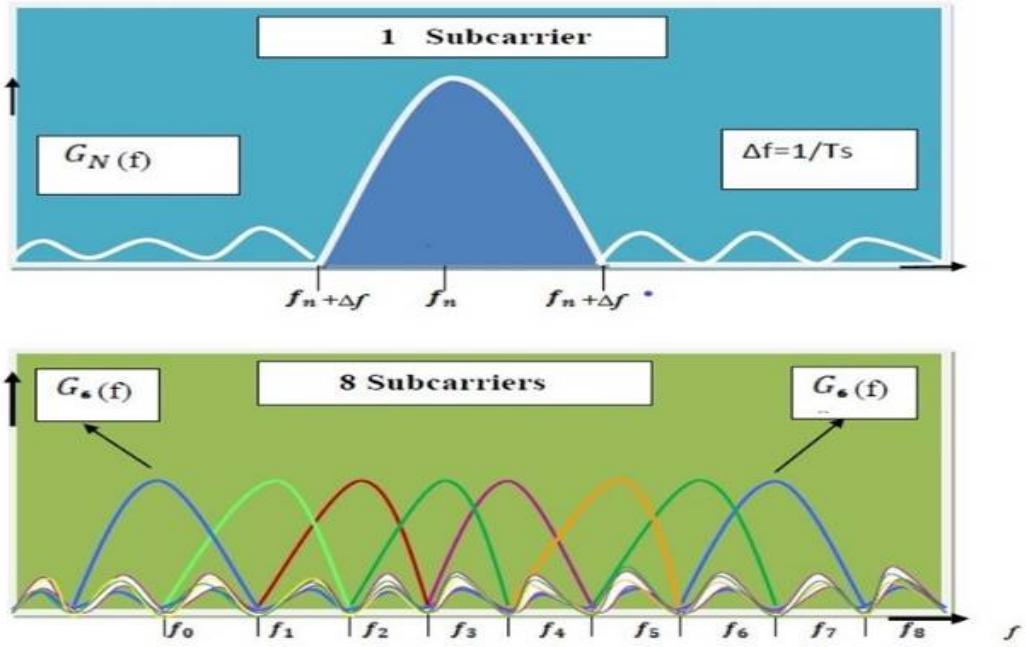

Figure 1.1-OFDM subcarriers in frequency domain

Mathematical Definition of PAPR

The PAPR of the OFDM signal can be written as:

$$\text{PAPR}\{s(t), \tau\} = \frac{max_{t\epsilon\tau}[s(t)]^2}{E\{[s(t)]^2\}} \quad \textbf{(1.11)}$$

where,

s(t) is the original signal

τ is the time interval

$max_{t\epsilon\tau}[s(t)]^2$ is the peak signal power

$E\{[s(t)]^2\}$ is the average signal power

PAPR Techniques

There have been many new approaches developed during the last few years. Several PAPR reduction techniques have been proposed in the literature. These techniques are divided into two groups. These are signal scrambling techniques and signal distortion techniques. The signal scrambling techniques are:

- Block coding
- Selective Level Mapping (SLM)
- Partial Transmit Sequences (PTS)

Comparison

OFDM is a promising technique for wireless communication systems although it has some drawbacks which are given below:

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- High PAPR
- Frequency offset

High PAPR is one of the major problems of OFDM system. There are several techniques to reduce the PAPR in OFDM transmission system. All PAPR reduction techniques have some advantages and disadvantages. These PAPR reduction techniques should be chosen carefully for getting the desirable minimum PAPR. All PAPR reduction techniques are based on particular situation of system. This section describes and summarizes several techniques of PAPR and proposes repeated clipping and frequency domain filtering technique which is the best solution for PAPR.

Table 1.2 : Performance Comparison between the Techniques

Techniques	Distortion	Power increase	Data rate loss
Clipping and Filtering	Yes	No	No
Coding	No	No	Yes
Partial Transmit Sequence	No	No	Yes
Tone Reservation	No	Yes	Yes
Tone Injection	No	Yes	No
ACE	No	Yes	No
Selected Mapping	No	No	Yes

II. LITERATURE SURVEY

OFDM is a well-established multicarrier modulation approach that helps for high speed data transmission with multipath fading channels. OFDM facilitates multicarrier transmission at high data rates at an end time dispersive channels in mobile applications. High PAPR of the transmitted signal is the major complication in OFDM which affects unfavourable the power amplifier leading to reduced overall performance of the system. This chapter states about the advantages and disadvantages of existing power reduction techniques liable for PAPR reduction in OFDM systems.

PAPR REDUCTION TECHNIQUES IN OFDM

M. Hema Gayathriet.al (2016) Rapid advances in wireless and mobile communication and their convergence are leading to the emergence of new type ofinformation infrastructure that has the potential supporting an array of advanced service for healthcare. The information need to be accessed from the remote database in highly secured and efficient manner. OFDM (Orthogonal frequency division multiplexing) is one of the most promising techniques for wireless communication system. OFDM provides higher spectral efficiency, flexibility and high performance in context of Bit error rate and Peak signal to noise ratio. One of the key problems in OFDM is high peak-to-Average Power Ratio (PAPR) which results in lower mean power level. In this proposed approach, the PAPR is minimized by using ACE

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(Active constellation extension) technique and modulation technique can be implemented by using QPSK (Quadrature phase shift keying) which provides high data rate and reduced computational complexity. However, the proposed method will provide a better transmission quality and higher security when compared to conventional method and it is expected to be suitable for real time medical image transmission. The performance metrics such as BER, MSE, PAPR and PSNR of the image has been analyzed by using MATLAB simulation tool.

Prajapati & Priyanka (2014) identified an effective solution for generating peak cancelation signals requiring only one IFT operation and simple iterative operation for drastic reduction of the computational complexity of conventional tone reservation operations. A small number of tones in the frequency domain can only offer significant PAPR reduction. Communication system such as wireless LAN or WiMax best applies this technique.

Abdul & Werner (2014) proposed a novel PAR reduction algorithm for OFDM based massive MIMO systems in point-to-point scenarios. The massive Degree of Freedom (DoF) of a massive MIMO is exploited using the least-squares iterative approach exploits by reserving the weakest eigen channels. These eigen channels helps for estimating and modelling the peak excursion values that exceed a chosen PAR target value. This model function is then subtracted from the original signal in time domain for PAR reduction. Two different approaches that are equivalent in estimating and modelling the peak values are employed.

Kollar et al (2014) investigated multicarrier modulation technique called Filter Bank Multicarrier (FBMC) that exhibits an extremely low Adjacent Channel Leakage Ratio (ACLR) compared to conventional OFDM technique. The low ACLR of the transmitted FilterBankMultiCarrier (FBMC) signal makes it favourable especiallyin cognitive radio applications thatimpose strict requirements on out-of-band radiation. High PAPR is resulted due to large dynamic range becomes the characteristic of all sorts of multicarrier signals. An overview is presented on transmitter oriented techniques employing baseband clipping for maintaining the system performance with a desired BER.

III. PROBLEM IDENTIFICATION

OFDM is a promising technique for wireless communications. However, PAPR is an important problem faced by OFDM and hence becomes a main disadvantage of multicarrier transmission system leading to power inefficiency in RF section of the transmitter. The other key challenges faced by OFDM includes ISI owing to multipath-use guard interval, large peak to average ratio payable to non-linearities of amplifier phase noise problems of oscillator and frequency offset correction requirement in the receiver. As the transmitter comprises of nonlinear components like Power Amplifiers (PAs), the signal gets distorted by the large PAPR. The nonlinear effects on the transmitted OFDM symbols are spectral spreading, inter-modulation and varying the signal constellation. In other words, both in-band and out-of-band interference to signals are caused by the nonlinear effects. Therefore, a backup approximately equal to the PAPR is required by the PAs for distortion-less transmission. This subsequently decreases the efficiency for amplifiers. The distribution of PAPR based on the characteristics of the OFDM signals was initially investigated in this research followed by the analysis of typical PAPR reduction techniques are analyzed. The present research work thus presented three proposed approaches for PAPR reduction based on the thorough analysis of the existing techniques to overcome the limitations of the existing

IV. PROPOSED METHODOLOGY

PAPR reduction techniques can be categorized into deterministic and probabilistic approaches, as shown in Figure 4.1. Deterministic approaches guarantee that the PAPR of an OFDM signal does not exceed a predefined threshold, whereas the probabilistic approaches minimize the probability that the PAPR of an OFDM signal exceeds a predefined threshold. These categories will be discussed in the following sectionsSignal scrambling techniques are all variations on how to scramble the codes to decrease the PAPR. Coding techniques can be used for signal scrambling. Golay complementary sequences, Shapiro-Rudin sequences, M sequences, Barker codes can be used efficiently to reduce the PAPR. However with the increase in the number of carriers the overhead associated with exhaustive search of the best

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code would increase exponentially. More practical solutions of the signal scrambling techniques are block coding, Selective Level Mapping (SLM) and Partial Transmit Sequences (PTS). Signal scrambling techniques with side information reduces the effective throughput since they introduce redundancy [12]

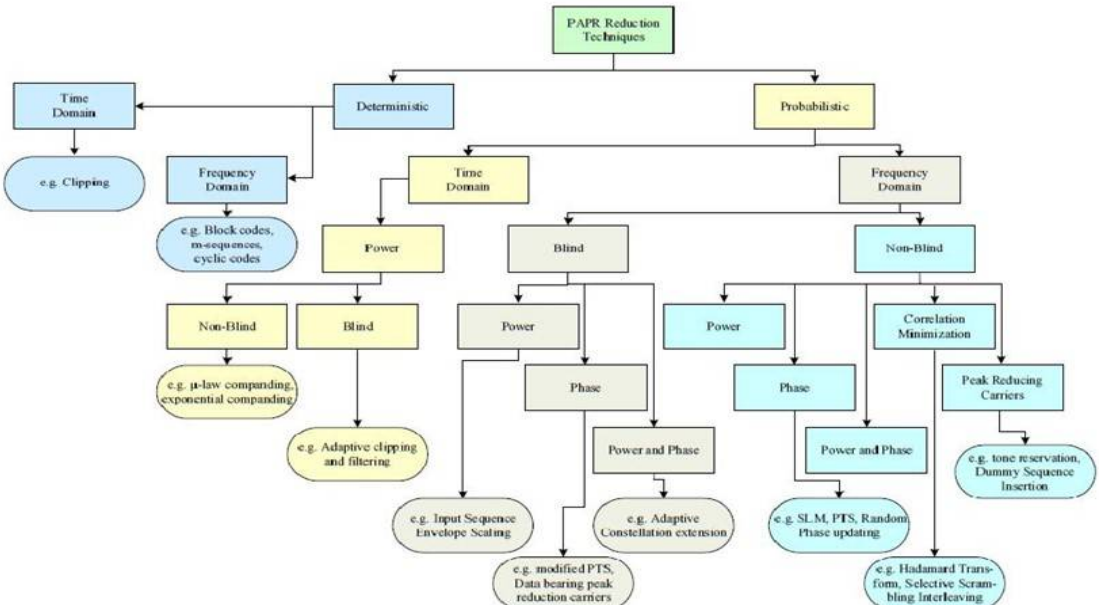

Figure 4.1.the first way taxonomy of PAPR Reduction techniques

V. CONCLUSION

In previous work PAPR reduction technique ACE (Active Consellation Technique is used in which CCDF and BER is calculated. In our work we are going to analyse different type of PAPR reduction technique and their performance. And after that we are going to calculate the BER and PAPR. Then an image is going to be transmitted.

REFERENCES

[1] Seung Hee Han and Jae Hong Lee. An overview of peak-to-average power ratio reduction techniques for multicarrier transmission. IEEE Wireless Communications, 12(2):56 – 65, 2005.
[2] R.W. Bauml, R.F.H. Fischer, and J.B. Huber. Reducing the peak-to-average power ratio of multicarrier modulation by selected mapping. Electronics Letters, 32(22):2056 – 7, 1996/10/24.
[3] S.Y. Le Goff, S.S. Al-Samahi, Boon Kien Khoo, C.C. Tsimenidis, and B.S. Sharif. Selected mapping without side information for papr reduction in ofdm. IEEE Transactions on Wireless Communications, 8(7):3320 – 5, 2009/07/.
[4] B. R. Saltzberg. Performance of an efficient parallel data transmission system. IEEE Trans. Commun., 15(6):80511, Dec 1967.
[5] S.B. Weinstein and P.M. Ebert. Data transmission by frequency-division multiplexing using thediscrete fourier transform. IEEE Transactions on Communication Technology,
[6] Jr. L. J. Cimini. Analysis and simulation of a digital mobile channel using orthogonal frequency division multplexing. IEEE Trans. Commun., 33(7):66575, July 1985.
[7] Won Young Yang Chung-Gu Kang Yong Soo Cho, Jaekwon Kim. MIMO-OFDM Wireless Communications With Matlab. John Wiley & Sons, illustrated edition, 2010.
[8] R. O'Neill and L.B. Lopes. Envelope variations and spectral splatter in clipped multicarrier signals. volume 1, pages 71 – 75, Toronto, Can, 1995.
[9] Xiaodong Li and Jr. Cimini, L.J. Effects of clipping and filtering on the performance of ofdm. IEEE Communications Letters, 2(5):131 – 3, 1998/05/.
[10] A.E. Jones, T.A. Wilkinson, and S.K. Barton. Block coding scheme for reduction of peak tomean envelope power ratio of multicarrier transmission schemes. Electronics Letters, 30(25):2098
[11] S. H. Mller and J. B. Huber. Ofdm with reduced peaktoaverage power ratio by optimum combination of partial transmit sequences. Elect. Lett., 33(5):36869, Feb 1997.
[12] B.S. Krongold and D.L. Jones. Par reduction in ofdm via active constellation extension. volume