Available Online at http://www.journalajst.com

ISSN: 0976-3376

ASIAN JOURNAL OF SCIENCE AND TECHNOLOGY

Asian Journal of Science and Technology
Vol. 09, Issue, 05, pp.8095-8098, May, 2018

RESEARCH ARTICLE

PAPR REDUCTION FOR OFDM BASED MASSIVE MIMO SYSTEMS USING SELECTED MAPPING TECHNIQUE

[1], *Kolamala Jhansi Rani, [2]Moramreddy Radha and [3]Radhika, K.

[1, 2]B Tech IVth Year, ECE, GIST, Nellore, India
[2]Associate Professor in ECE Dept., GIST, Nellore, India

ARTICLE INFO

Article History:
Received 22nd February, 2018
Received in revised form
19th March, 2018
Accepted 06th April, 2018
Published online 30th May, 2018

Key words:
PAPR, OFDM,
SLM,
AWGN Channels.

ABSTRACT

In orthogonal frequency-division multiplexing (OFDM) based massive multiple-input multiple-output (MIMO) downlink system, the problem of peak-to-average power ratio proportion (PAPR) decrease is examined. OFDM consist of more number of unconventional subcarriers, due to the amplitude of that such subcarriers can have high peak values. The transmitted signalling has the high peak-to-average power ratio which is one of the complicated issue in OFDM system of rules .It is difficult to understand which techniques can reduce the effect of PAPR performance in OFDM. In this paper we proposed a Selected-Mapping technique .The briny strategy behind implementing this Selected-Mapping (SLM) technique is to reduce peak to average power in orthogonal frequency division multiplexing system. SLM is a distortion less technique which can reduce PAPR efficiently without incrementing power. Simulation results for the Selected-Mapping demonstrates that the system can achieve significant reduction in PAPR and satisfactory bit error rate performance over the AWGN channel.

INTRODUCTION

Multiple-input Multiple-output (MIMO) is a method used to multiply the capacity of the radio transmission link with the use of multiple antennas at transmitter side and multiple antennas at receiver side to exploit multipath propagation. MIMO is fundamentally different from smart antenna techniques developed to enhance the functioning of a single information signaling, such as beam forming and diversity. Massive MIMO systems (Alamouti, 1998) are those that are equipped with a large number of antennas at the base station simultaneously serving as much smaller number of single-antenna users sharing the same time frequency bandwidth. In addition to higher throughput, massive MIMO systems also have the potential to improve the energy efficiency and enable the use of inexpensive, low-power components. Hence, it forecast that massive MIMO will lead to changes in wireless communication.Inpractice, broadband wireless communication theory may suffer from frequency selective fading. Orthogonal frequency division multiplexing (OFDM) is a method of encryption digital data on multiple carrier frequencies. OFDM is a multicarrier modulation technique which is used in broadband wireless communication system like Wi -Max, DVB-T and future 4G because of its various features multipath delay spread tolerance spectral bandwidth efficiency, immunity to frequency selective fading channels (Won Young *et al.,* 2010).

***Corresponding author:* Kolamala Jhansi Rani,**
BTech IVth Year, ECE, GIST, Nellore.

OFDM signal contains more number of modulated sub channel signals that may shows a high signal peak with respect to the average level of the signal. An OFDM signal consists of a number of independently modulated subcarrier , which can gsive a large peak to average power ratio and these subcarriers are mutually orthogonal that's why its name occur as orthogonal frequency division multiplexing (Wu *et al.,* 1995). OFDM is a combination of modulation and multiplexing. It transforms a signal from frequency domain to time domain. The time domain OFDM signal is constituted by the sum of complex exponential functions, whose amplitudes and phases are determined by the data symbols transmitted over the different carriers. OFDM is a multicarrier system which uses Discrete Fourier Transform (DFT) or Fast Fourier Transform (FFT).The basic principle behind OFDM technique is that high rate data stream is splitting into a number of lower rate data stream and transmit them simultaneously over multiple number of carriers. In OFDM the cyclic prefix is used for lower multi-path distortion. The linear power amplifiers are being used in the transmitter so the Q-spot must be in the linear region. Due to the high PAPR the Q-spot moves to the saturation region hence the signal clips which generates in-band and out-of-band distortion. So to keep the Q-point in the linear region the dynamic range of the major power amplifier should be increased which again reduces its efficiency and enhances the monetary value. Hence a trade-off exists between nonlinearity and efficiency (Jiang, 2007). And also with the increasing of this dynamic range the cost of power amplifier increased. As a communication engineer our objective should be to reduce this PAPR.

One of the challenging drawback for Orthogonal frequency Division Multiplexing scheme is its high Peak-to-average power Ratio. In this paper, it reviews and analysis different OFDM PAPR reduction techniques, based on computational complexness, bandwidth expansion, spectral spillage and performance. They are clipping and filtering, partial transmit sequences.

Clipping and filtering: Clipping is used to remove the signal components that exceeds the some unchanging amplitude level that is called as clip level. However, magazine issue distortion power which called clipping noise and expands the transmitted signal spectrum which causes interfering. Clipping is a nonlinear process and causes in-band noise distortion which causes degradation in the performance of BER and out-of-band noise which decreases the spectral efficiency. However, the iterative signal takes long time and it will increase the computational complexity of an OFDM transmitter. Clipping and filtering technique (Seung Hee Han, 2005) is effective to separate the components of the expanded spectrum. The technique of iterative clipping and filtering deceases the PAPR without spectrum expansion. Although filtering can decrease the spectrum development, filtering after clipping can reduce the out-of-band radiation, but may also cause some peak re-growth, in which the peak signal exceeds the clipping level.

Let x(n) denote the pass band signal and

$x(n)$ denote the clipped version of x(n),which can be expressed as equation (1)

$$x_c[n] = \begin{cases} -A & x[n] \leq -A \\ x[n] & |x[n]| < A \\ A & x[n] \geq A \end{cases} \tag{1}$$

where A is the pre-specified clipping level

Partial transmit sequence: In the Partial transmit sequence technique an input data block of N symbols is partitioned into disjoint sub- blocks. The sub carrier in each sub-block are weighted by a phase factor for that sub-block 'v'. the phase factors are selected such that the PAPR of the combined signal is minimized. Generally the choice of the phase factors is limited to set with a finite numeral of elements to reduce the examiner complexity. So, it is necessary to perform an exhaustive search for (V–1) phase factors. The lookup complexity step-up exponentially with the identification number of sub-blocks V. PTS needs V IFFT functioning for each data block. The amount of PAPR reduction depends on the number of sub-blocks V and the number of allowed phase factors W. There are three kinds of sub-block breakdown schemes: adjacent, interleaved and pseudorandom partitioning. Among them, pseudorandom partitioning has been seems to be the best choice. The PTS technique works with an arbitrary number of sub-carriers and can have any modulation scheme.

The partial transmit sequence is a distortion less method based on compounding signal sub-blocks which are phase angle -shifted by constant phase factors. So many sub-optimal Partial method have been developed. The iterative flipping algorithm for Partial transmit sequence in has the computational complexity linearly proportional to the number of sub-blocks. A vicinity search is proposed in using slope decline hunting . An intelligent genetic algorithm for PAPR diminution is developed. Considering that the usefulness of these techniques is express to multicarrier system with a small number of sub-carriers and the required exhaustive search for a goodness code is intractable, the actual sake of coding for PAPR reduction for practical multicarrier systems are finite. However, for the Original Partial transmit sequence method, the communication system has to hold some bits for the transmission of the phase gyration constituent as Side Information (SI system),resulting in a decrease in the data rate. It is to be noted that SI only represents the information about the phase rotation factors.

Proposed method

Selected mapping technique (slm): One of effective and distortion technique used to reduce the PAPR in OFDM is selected mapping. The name of this technique itself indicates the one signal has to be selected out of multiple number of signals. According to the concept of discrete time OFDM transmission we should make a data block considering N number of symbols from the constellation plot. Where N is the number of sub- carriers to be used. Then using that data block U number of independent candidate vectors are to be generated with the multiplication of independent phase vectors. Let us consider X is the data block with X (k) as the mapped sub symbol (i.e. the symbol from the constellation). Where k = {0,1,2, N −1}. Let the u^{th} phase vector is denoted as B(u),where u = {1,2, U}.

The u^{th} candidate vector that is generated by the multiplication of data block with the phase vector is denoted as X(u). So we can write the equation (2) to get the k^{th} element of u^{th} candidate vector as

$$X^{(u)}(k) = x(k)B^{(u)}(k) \tag{2}$$

Then by doing IFFT operation to each candidate vector we will obtain U number of alternative OFDM signals, so the n^{th} symbol of u^{th} alternative OFDM signal can be written mathematically as the equation (3)

$$x^{(u)}(n) = \frac{1}{\sqrt{N}} \sum_{k=0}^{N-1} X^{(u)}(k)\, e^{\left(\frac{2\pi nk}{N}\right)} \tag{3}$$

So out of the U number of alternative OFDM signals the signal having minimum PAPR is to be selected for transmission. Let that selected OFDM signal is denoted as $x^{(\tilde{u})}$ (k). This selected mapping (SLM) technique(5) is known as the classical SLM The block diagram for this technique is shown in figure 1

So in this technique for generation of alternative OFDM symbols the independent phase vectors has to generate. We get from the equation 2.6, the k^{th} value of u^{th} phase vector is denoted as $B^{(u)}$ (k) and can be found by the equation (4)

$$^{(u)}(k) = e^{j\varphi^{(u)}}(k) \tag{4}$$

where φ(k) is the random phase value. So from the equation 4 we get that $X^{(u)}$ (k) be a phase rotated version of X (k). From we came to know that two phase vectors $B^{(m)}$ and $B^{(1)}$ is dependent if any joint cumulant between them is nonzero. So the condition of mutual independence between $b^{(m)}$ (n) and $b^{(1)}$ (n) is given as equation (5)

$$E(e_{j\phi}) = 0 \tag{5}$$

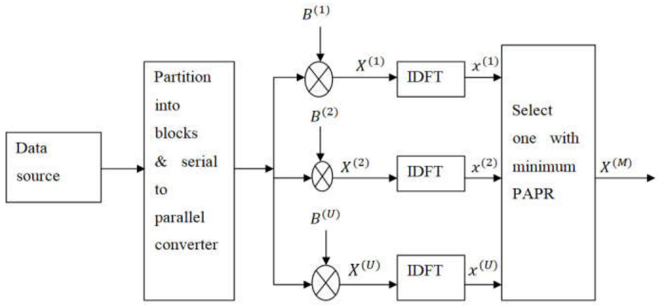

Figure 1. Block diagram of SLM

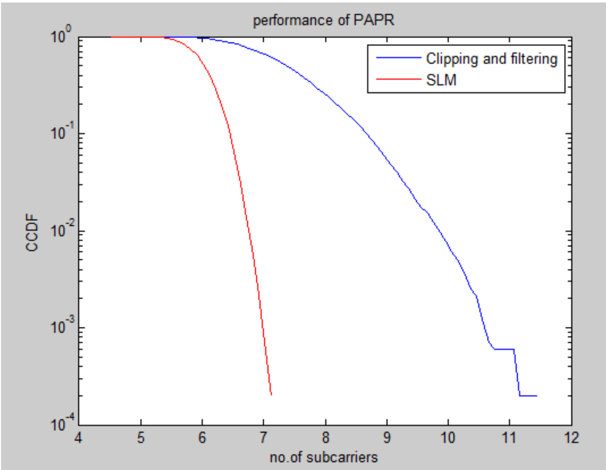

Figure 2. Performance of PAPR

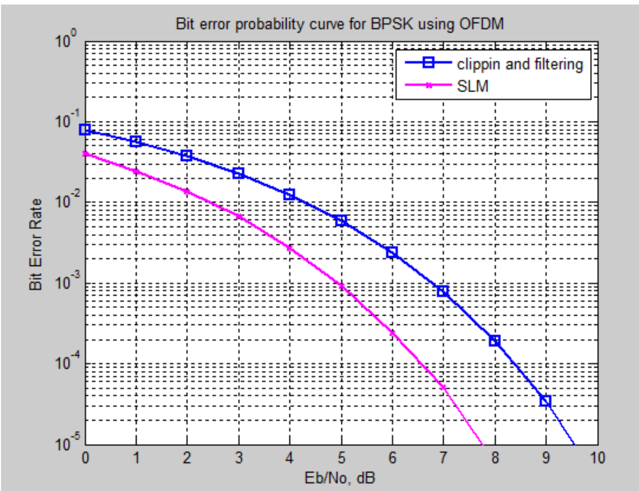

Figure 3. BER curve for BPSK using OFDM

To make satisfy the above condition φ should be uniformly distributed in (0,2π). According to this selection criteria of φ the variation of the PAPR reduction performance will be shown in the next sub section .The figure.1 provides description about the transmitter side of the SLM technique. This selected OFDM signal at transmitter side has to be detected at the pass receiver . So the receiver must have the entropy about the perfect stage transmitter that has been multiplied to generate that selected OFDM; signal. Hence to fulfill the requirement of the receiver some side information (SI) has to be transmitted along with the selected OFDM signal. This SI index is generally transmitted as a set of ⌈log2 U⌉ bits.

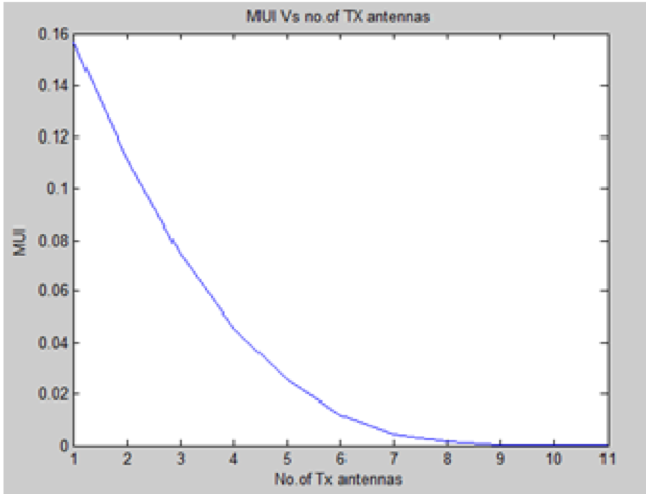

Figure 4. MUI Vs number of transmit antennas

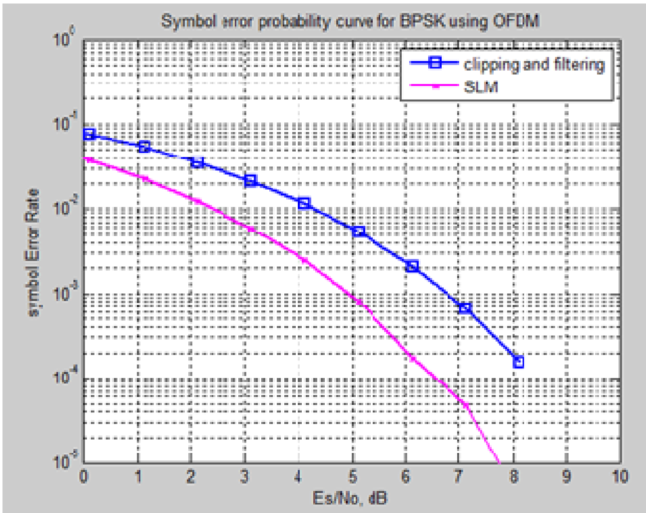

Figure 5. SER curve for BPSK using OFDM

For the efficient transmission of these extra bits channel coding technique should be required. If any SI power cannot be detected perfectly then that total recovered transmitted block will be in error. So we should follow a new SLM technique which avoids the sending of SI index. This technique is discussed briefly in the following sections.

RESULTS

The simulation results are based on MATLAB computer code and it is observed. MATLAB is used as the simulation tool for implementing this project a, it is a high public presentation language for technical computing. It incorporates estimation, visualization, and scheduling in a simple way to use, where difficulty and solvent are expressed in familiar mathematical notation. Typical uses include, math and computation, algorithmic program development, modeling, simulation and prototyping, information analysis, exploration, and visualization. From the below figure 2 it shows that performance of PAPR of both existing and proposed technique. It can be observed that the proposed SLM method displays a better performance of the PAPR than the clipping and filtering technique. The figure 4 represents the multi user interface Vs transmitting antennas.

From this we can say that the even though by the increasing the multiple users, number of antennas decreases. The figure 5 shows the SER performance of the BPSK digital modulation with OFDM technique over AWGN channel. It can be seen that the BER performance of conventional BPSK modulation is almost same with the BPSK using OFDM over an AWGN channel. From the simulation result we can obseve that the ser performance of the clipping & filtering technique and SLM technique using BPSK modulation over AWGN channel are the same. The figure 3 shows that the BER performance of the BPSK digital modulation with OFDM technique over AWGN channel. It can be seen that the BER performance of conventional BPSK modulation is almost same with the BPSK using OFDM over an AWGN channel. From the simulation result we can observe that the clipping and filtering and SLM technique results of BPSK modulation over AWGN channel are the same.

Conclusion

The problem of Peak to average power ratio (PAPR) reduction in OFDM based massive MIMO downlink systems is considered. As compared to traditional single carrier modulation system the multicarrier modulation system offers better transmission. OFDM system suffers from serious problem of high PAPR.PAPR in OFDM occurs when multiple carrier collectively define a larger peak value then the average peak value of a signal. To increase the linearity in the signal and to reduce the error rate , it is required to reduce the PAPR from the signal. Selected mapping technique improves the performance of OFDM system with respective PAPR, it can produce independent multiple frequency OFDM signals. From the simulation results it can be concluded that the PAPR performance of SLM technique is better than other techniques .As number of sub-blocks increases the performance of selected mapping scheme is continuously improved. The obtained results shows the effectively of the work in terms of high PAPR reduction and lesser BER in the system.

REFERENCES

Alamouti. S.M. 1998. A simple transmit diversity technique for wireless communications. IEEE Journal on Selected Areas in Communications, 16(8):1451 – 8/10/.

Won Young Yang Chung-Gu Kang Yong Soo Cho, Jaekwon Kim. MIMO-OFDM Wireless Communications With Matlab. John Wiley & Sons, illustrated edition, 2010.

Wu, Y. and Zou, W. Y. 1995. “Orthogonal frequency division multiplexing: A multi-carrier modulation scheme,” IEEE Trans. *Consumer Electronics*, vol. 41, no. 3, pp. 392-399, Aug.

Jiang, T., Xiang, W., Chen, H. H. and Ni, Q. 2007. “Multicast broadcasting services support in OFDMA-based WiMAX systems,” IEEE Communications Magazine, vol. 45, no. 8, pp. 78-86, Aug.

Seung Hee Han and Jae Hong Lee. 2005. An overview of peak-to-average power ratio reduction techniques for multicarrier transmission. IEEE Wireless Communications, 12(2):56 – 65.

O’Neill, R. and Lopes, L.B. 1995. Envelope variations and spectral splatter in clipped multicarrier signals. volume 1, pages 71 – 75, Toronto, Can.

Mller, S. H. and Huber, J. B. 1997. OFDM with reduced peak to average power ratio by optimum combination of partial transmit sequences. Elect. Lett., 33(5):36869, Feb.

Bauml, R.W., Fischer, R.F.H. and Huber. J.B. 1996. Reducing the peak-to-average power ratio of multicarrier modulation by selected mapping. *Electronics Letters*,32(22):2056–7,0/24.

****