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An Approach Based on MIMO and PN Sequence coding for Reduction of Peak to Average Power Ratio (PAPR) in Clipped OFDM

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Abstract

High peak to average power ratio (PAPR) is a very serious drawback in Orthogonal Frequency Division Multiplexing (OFDM). Multiple transmit and receive antennas can be used to form multiple-input multiple-output (MIMO) channels to increase the capacity and data rate. We propose the novel approach which is reduce PAPR and Computational complexity without any distortion based on clipped OFDM. In these technique the phase sequence multiplication before perform FFT operation by using PN sequence generator and second phase sequence multiplication are the invert version of PN sequence generator. The performance of Space-Frequency (SF) block coding for MIMO OFDM along with different equalizers is also analyzed. Bit Error Rate (BER) analysis is presented using different equalizers and then optimum equalization method is suggested .We show the practical aspect of propose scheme in MATLAB environment.

Keywords

OFDM, PAPR, MIMO, SF, BER

1. Introduction

Orthogonal frequency division multiplexing (OFDM) [1] is a multi-carrier modulation technique [2, 3] which has high spectral efficiency and higher data rates. The performance of OFDM system is better than over frequency selective fading channel [4]. To ensure linear amplification of a signal with a large PAPR, the amplifier has to be operated with a large input back off (IBO), which means that the mean power has to be chosen sufficiently low, leading to a very low efficiency of the amplifier. If the IBO is chosen too small, the signal will be distorted.

The main drawback of OFDM is the high peak-to-average power ratio (PAPR)[5]which is reduce the power efficiency of a HPA (High Power Amplifier) [6].OFDM is a special form of multi carrier modulation and painful Inter Symbol Interference (ISI) by multiplexing the data on orthogonal property. OFDM can be combined with MIMO [2, 3] to increase the system capacity and performances many techniques to deal with the PAPR problem [7]. The techniques amplitude clipping, clipping and filtering, coding, tone reservation, tone injection, active constellation extension, partial transmit sequence, selected mapping, and interleaving.

The SLM techniques [8] achieve PAPR reductions but the power increase, bit error rate increase and computational complexity increase. Optimal bit loading and subcarrier allocation problems for multiuser OFDM have been formulated in [9][10], specifically minimization of the overall transmit power under data constraint, and maximization of the data rate under power constraint. These are non linear optimization problems which can be broadly divided into two categories: Margin Adaptive (MA) [11] and Rate Adaptive (RA) optimization [12][13]. It is difficult to solve these problems unless the integer variables are relaxed to allow real numbers. These classical algorithms are computationally intensive due to the nature of non linear optimization.

However, OFDM systems have the undesirable feature of a large Peak to Average Power Ratio (PAPR) of the transmitted signals. Consequently to prevent the spectral growth of the OFDM signal, the transmit amplifier must operate in its linear regions. Therefore, power amplifiers with a large linear region are required for OFDM systems, but such amplifiers will continue to be a major cost component of OFDM systems. Consequently, reducing the PAPR is pivotal to reducing the expense of OFDM systems. However, the increase in bandwidth is an impractical method, and an alternate solution is to adopt some spectral efficient techniques like MIMO systems [14]. The key advantage of employing multiple antennas is to get reliable performance through diversity and the achievable higher data rate through spatial multiplexing.

We provide here an overview of user authentication service by different researchers. The rest of this paper is arranged as follows: Section 2 introduces OFDM and multi carrier system Scheme; Section 3 describes about the peak to average ratio; Section 4 shows the mapping; Section 5 describes the proposed scheme. Section 6 describes Conclusion.

2. OFDM and Multi Carrier System

In multicarrier systems the baseband operations at the transmitter include mapping the data bit stream to

symbols according to a various modulation scheme. The baseband complex symbol are modulates one orthogonal subcarrier and an OFDM signal is formed by summing all the N modulated Independent subcarriers which are equal bandwidth. The mathematical representation of an OFDM time domain signal is given

$$x(t)= \frac{1}{\sqrt{N}} \sum_{k=0}^{N-1} X[k] e^{j 2\pi \Delta f k t / T}, t \in [0, T]$$

Where $T = 1/\Delta f$ is the symbol period and N is Number of sub carriers.

Orthogonal Frequency Division Multiplexing (OFDM) shown in fig.1 is based on a parallel data transmission technique that decreases the effect of selective and multipath fading. Orthogonal Frequency Division Multiplexing (OFDM) is come from the fact that the data is sent using different carriers each of a different frequency and these carriers are orthogonal to each other.

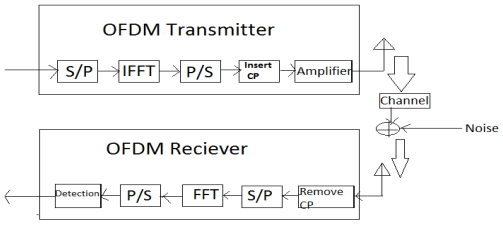

Fig.1 OFDM Technique

3. Peak to Average Ratio

Complementary cumulative distribution function (CCDF) of PAPR is a method of performance estimation used in PAPR reduction techniques. The PAPR is describes the dynamic range of the OFDM time domain signal. The very conventional definition of the PAPR for the OFDM symbol in the time domain is given

$$\text{By PAPR} = \frac{\text{Peak Amplitute of the signal}}{\text{Average value of the signal}}$$

$$\text{PAR}\{x\} = \frac{\max(x)^2}{E\left[(x)^2\right]}$$

The CCDF of the PAR is

$$\Pr[\text{PAR}\{x[n]\} > \gamma] = 1-(1-e^{-\gamma})^N$$

4. Mapping

In a Selected mapping (SLM) shown in fig.3 is a specific scheme for PAPR reduction. SLM takes advantage of the fact that the PAPR of an OFDM signal is very sensitive to phase shifts in the frequency-domain data. PAPR reduction is achieved by multiplying independent phase sequences to the original data and determining the PAPR of each phase sequence combination. The combination with the lowest PAPR is transmitted. In other words, the data sequence X is element-wise phased by *D N*-length phase sequences. PAPR reduction is achieved by multiplying independent phase sequences to the original data and determining the PAPR of each phase sequence combination. The combination with the lowest PAPR is transmitted.

The CCDF of the PAPR in SLM OFDM symbol is

$$\text{Prob}[\text{PAPR}\{x^{(d')}\} > \gamma] = [1-(1-e^{-\gamma})^N]^D$$

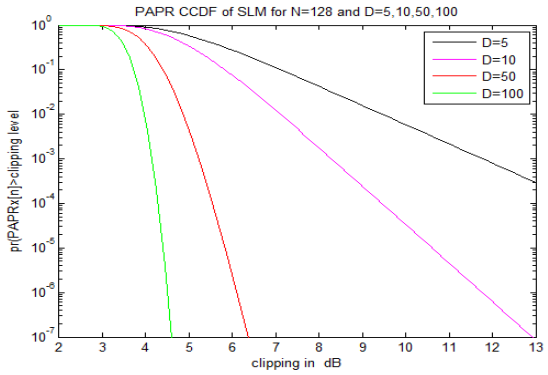

Fig.2 SLM for *N* = 128 and *D* = 5 to 100.

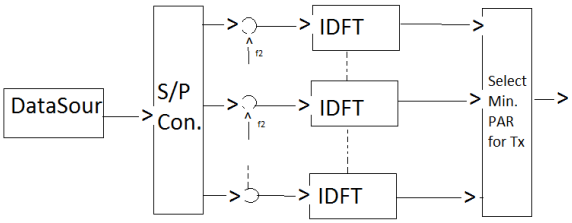

Fig.3 SLM technique

5. Proposed Scheme

We propose the novel approach shown in fig4 which is reduce PAPR and Computational complexity without any increase or decrease the performance. In these technique the phase sequence multiplication before perform IFFT operation by using PN (pseudo random) sequence generator. It generates random sequence of particular length. The second phase sequence generates only use inverter circuit. The phase multiplications are the invert version of PN sequence generator. After perform IFFT operation select minimum PAPR of desire data then transmitted. Which is reduce the PAPR of desire low level and reduce Computational complexity by using only single PN sequence generator in place of two.

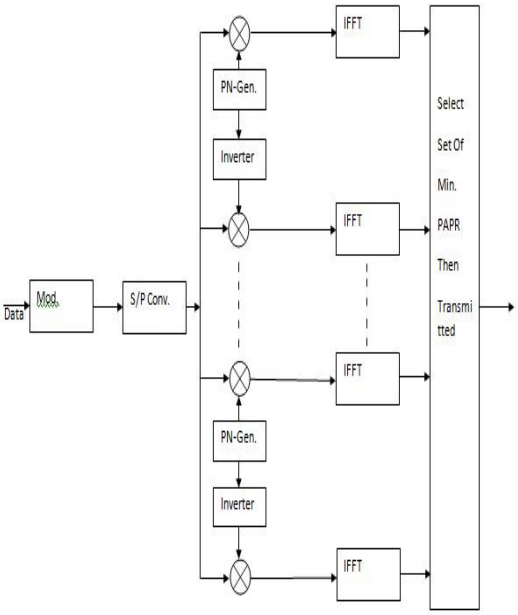

Fig.4 Proposed Schemes

6. Conclusion

The system model for simulation was designed as tunable system so the number of subcarriers used and the length of data source was adjustable. The effect of number of subcarriers used in the system towards BER verses SNR was measured and showed that more number of subcarriers higher bits of error was achieved.

We propose the novel approach which is reduce PAPR and Computational complexity without any distortion based on clipped OFDM. In these technique the phase sequence multiplication before perform FFT operation by using PN sequence generator and second phase sequence multiplication are the invert version of PN sequence generator. The performance of Space-Frequency (SF) block coding for MIMO OFDM along with different equalizers is also analyzed. Bit Error Rate (BER) analysis is presented using different equalizers and then optimum equalization method is suggested. We show the practical aspect of propose scheme in MATLAB environment.

References

[1] Y. Wu, and W.Y. Zou, "Orthogonal frequency division multiplexing a multi-carrier modulation scheme," IEEE Trans. on Consumer Electronics, vol. 41, no. 3, pp. 392-399, Aug. 1995.

[2] R.j Baxley, and T.Zhou, "Power Saving Analysis of Peak-to-Average Power Ratio Reduction in OFDM". IEEE Transactions on Consumer Electronics, VOL.50, NO.3,pp.792-798, August 2004 World Academy of Science, Engineering and Technology 50 2009.

[3] T. K. Helaly, R. Dansereau, and M. El-Tanany, "Improved power amplifier efficiency via Walsh code assignment in synchronous CDMA systems," Proc. Intern. Conf. on Wireless and Mobile Communications (ICWMC'09), pp. 179–184. , Aug. 2009.

[4] X. Wang, T.T. Tjhung, and C.S. Ng, "Reduction of peak-to-average power ratio of OFDM system using a companding technique," IEEE Trans .on Broadcastaing, Sep. 1999.

[5] A. E. Jones, T. A. Wilkinson, and S. Barton, "Block coding scheme for reduction of peak to mean envelope power ratio of multicarrier transmission schemes," IEE Electronics Letters, vol. 30, pp. 2098–2099,Dec. 1994.

[6] Luqing Wang and Chmtha Tellambura" An Overview of Peak-to-Average Power Ratio Reduction Techniques for OFDM Systems" IEEE Trans vol. 39, no. 3, pp -740-754 June 2006.

[7] B. S. Krongold and D. L. Jones, "A study of active constellation extension for PAR reduction in OFDM," Proc. International OFDM Workshop, Germany, pp. 107-111, Sept. 2002.

[8] Seok-Joong Heo, Hyung-Suk Noh "A Modified SLM Scheme With Low Complexity for PAPR Reduction of OFDM Systems" IEEE Trans. Communications, vol. 53, no. 4, pp. 365-369, December 2007.

[9] C.Y.Wong, R.S.Cheng, K.B.Letaief, and R.D.Murch,"Multiuser OFDM with adaptive sub-carrier, bit, and power allocation," IEEE J.Select, Areas Commun., vol. 17, pp.1747-1758, Oct 1999.

[10] W. Rhee and J.M. Cioffi," Increase in capacity of multiuser OFDM system using dynamic sub-channel allocation," in Proc. IEEE Vehicular Technology Conf. (VTC'2000),2000, PP. 1085-1089.

[11] Zukang Shen, Jeffrey G. Andrews and Brian L. vans,"Optimal Power Allocation in Multiuser OFDM Systems",Proc. IEEE Global Commun. Conf., San Francisco, CA,Dec. 2003, pp. 337-341.

[12] Ian C. Wong, Zukang Shen, Brian L. Evans and Jeffrey G. Andrews, "A Low Complexity Algorithm for Proportional Resource Allocation in OFDMA Systems"Proc. IEEE Int.Workshop on Signal Processing Systems,pp. 1-6, Oct.2004.

[13] I. C. Wong and B. L. Evans, "Optimal Downlink OFDMA Resource Allocation with Linear Complexity to Maximize Ergodic Rates", IEEE Transactions on Wireless Communications, vol. 7, no. 3, Mar. 2008, pp. 962-971.

[14] Murch, Ross D., and K. Ben Letaief. "Antenna systems for broadband wireless access." Communications Magazine, IEEE 40, no. 4 (2002): 76-83.