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Efficient Approach For ICI And PAPR Reduction Using Magnitude Keyed Modulation (MKM) And Improved Clipping Method For SC-OFDM

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Abstract: *For future wireless communication frameworks, OFDM (Orthogonal Frequency Division Multiplexing) is assumed to be perfect method. OFDM offered number of advantages such as high data rate, efficient bandwidth etc. but also having major limitations such as poor BER (bit error rate) and PAPR (peak-to-average power ratio). To improve such performances, recently hybrid solution proposed single carrier method with OFDM which is commonly known as SC-OFDM. SC-OFDM resulted into the improved performance for BER and PAPR performance parameters as compared to traditional OFDM system. However, SC-OFDM has approach having limitations of poor performance due to inter-carrier interference (ICI) under the high mobility conditions. To address this limitation of SC-OFDM, number of solutions proposed like adopting existing OFDM method in SC-OFDM for performance improvement, but this improved performance resulted into decreasing throughput performance. Therefore, in this paper, we proposed modulation technique combined with improved clipping based PAPR reduction approach in order to outperform all existing methods of wireless communication such as OFDM, SC-OFDM, MC-CDMA etc. The modulation scheme called MKM (Magnitude-Keyed Modulation) providing immunity to SC-OFDM system in order to tackle with ICI, This improves the BER performance but increases the PAPR marginally. The clipping method helps to further improve the PAPR performance. The simulation work for this proposed scheme is done by using MATLAB.*
Keywords:*Single Carrier OFDM, ICI, BER, PAPR, MKM, clipping and filtering*

I. Introduction

OFDM has been around since 1960s and now used in number of non-cellular systems such as Digital Video Broadcast (DVB), Digital Audio Broadcast (DAB), Asymmetric Digital Subscriber Line (ADSL), and some of the 802.11 Wi-Fi standards. OFDM undergoes the disadvantage of high PAPR. Pure OFDM is used in Wi-Fi uplink but in LTE uplink SCOFDM is used which provides low PAPR as well as resistance to multipath fading.

In multi carrier technology it is difficult to maintain the orthogonality between the subcarriers [1].In high mobility environment multi carrier technologies undergoes ICI. Many studies have been conducted to reduce the ICI in OFDM as well as SCOFDM [1-8]. ICI cancelation methods mentioned in [3-6] reduce or eliminate the ICI or gives solution for sensitivity to frequency shifts. But these solutions for ICI cancelation are complex and need additional multiplications. Another technique to reduce ICI is Windowing or Window shaping [2, 7]. Window shaping technique for radio over fiber [2] increases the resistance to residual Carrier Frequency Offset (CFO) but this is achieved at the power penalty of 2dB. Edge windowing technique controls ICI and ISI with maintaining spectral efficiency[7].

An interference self-cancellation technique for SC-FDMA [8] system was robust against frequency offset but it affects bandwidth and power marginally. Xue Li et.al.proposed an ICI immune SCOFDM via magnitude keyed modulation [1]. This system provides excellent BER and low PAPR due to SCOFDM as well as ICI immunity due to Magnitude Keyed modulation. But while making SCOFDM ICI immune by using MKM PAPR get increased marginally as compared to SCOFDM with QPSK due to variations in magnitude [1].

This paper introduces a system with excellent BER, low PAPR as well as low PAPR which is combination of SCOFDM with magnitude keyed modulation and clipping and filtering technique [11, 15, 16] which is used to reduce the PAPR. There many techniques used for reduce the PAPR in OFDM as well as SCOFDM which known as SCFDMA [9-16] such as pulse shaping, clipping and filtering, frequency domain multiplexed pilots, Trellis shaping, etc. In this paper to reduce the PAPR clipping and filtering technique is used which provides better results.

II. System Model

This section represents proposed system model for SCOFDM with Magnitude keyed modulation and clipping and filtering. Figure 1 shows the basic block diagram for proposed system. At the transmitter side the generated data is modulated by using magnitude keyed modulation. The modulation symbols are grouped into blocks each containing N symbols. SCOFDM system with ICI shows unique diagonal property [1]. This property shows that ICI effects on the phase offset not on the magnitude. In magnitude keyed modulation the data is send over only signal magnitude not on phase. If is the data generated then after magnitude keyed modulation received data rk is given by [1]

$$rk = |xk| \qquad (1)$$

Binary MKM is equivalent to On-Off Keying (OOK) but MKM is not similar to Amplitude Shift Keying [1].

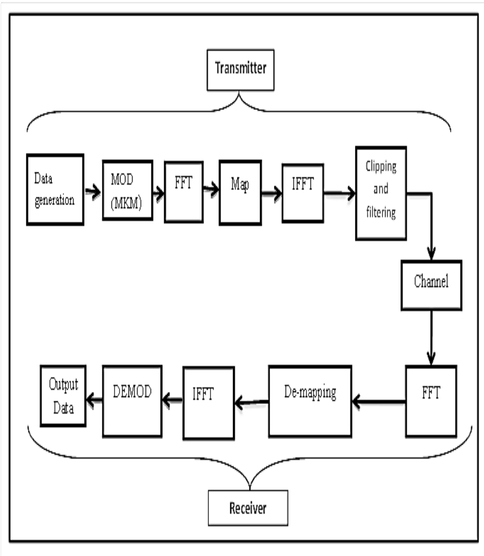

Fig.1. Transmitter and receiver of System Model

After modulation Fast Fourier Transform is performed to produce frequency domain representation of symbols. Then cyclic prefix or zero padding is done to prevent inter-block interference due to multipath propagation. Then each of the output is mapped to one of the orthogonal subcarriers that can be transmitted. If numbers of symbols are N and number of subcarriers M, the system can handle Q simultaneous transmission without co-channel interference where Q is the bandwidth spreading factor. Where Q is given by

$$Q = \frac{M}{N} \qquad (2)$$

Mapped data is converted back to time domain from frequency domain by taking M point Inverse Fast Fourier Transform (IFFT). To reduce the out of band energy pulse shaping is done which is filtering technique [17]. As use of Magnitude keyed modulation increases PAPR marginally clipping technique is used to reduce the increased PAPR. After clipping filtering is done. The transmitter data is passed through the AWGN channel with addition of extra noise. The reverse procedure is done at the transmitter side. The received signal is transformed to frequency domain via FFT, de-maps the subcarrier with Q which is bandwidth spreading factor then performs frequency domain equalization by using zero frequency equalizer or minimum mean square error (MMSE) equalizer. The received data from the equalizer is converted to time domain by IFFT. Demodulation is done at the end.

III. Performance Evaluation

This section represents comparison between proposed SCOFDM system with MKM and clipping and filtering technique with traditional OFDM and SCOFDM with MKM. MATLAB software is used for performance evaluation. Table I shows the transmission parameters used for simulation.

Table I Simulation Parameters

FFT Size	256
Block size	8
Sub band size	20
SNR Range	0:2:40
Number of iterations	120
Channel Type	AWGN Channel
Equalizer Type	MMSE
Modulation Technique	BPSK, QAM and MKM
Number of subcarriers	256
Oversampling factor	4

For analysis of BER performance and PAPR reduction Additive White Gaussian Noise (AWGN) channel is used for simulation. The below figures 2, 3 and 4 shows the PAPR and BER performance of the proposed system.

The below formula gives the PAPR in dB[1]

$$PAPR_{dB} = 10 * log10(\frac{PeakP}{AvgP}) \qquad (3)$$

Where PeakP i.e. peak power in dB is calculated by following equations

$$PeakP_{db} = 10 * \log_{10} PeakP \qquad (4)$$

$$PeakP = \max(power) \qquad (5)$$

And AvgP i.e. Average power is calculated by the following equation

$$AvgP = \frac{sum\,(power\,)}{Nx} \qquad (6)$$

Where Nx is the length of the symbol.

BER calculation is given by the following formula [1]

$$BER \approx \frac{SER}{\log_2 L} \qquad (7)$$

Where SER is symbol error ratio.

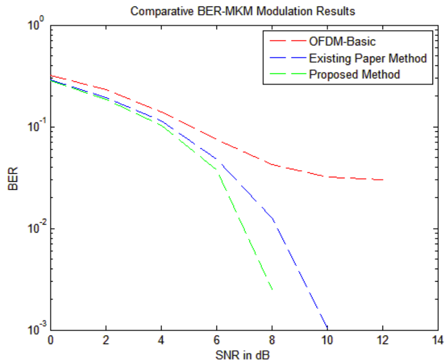

Fig 1BER comparative results

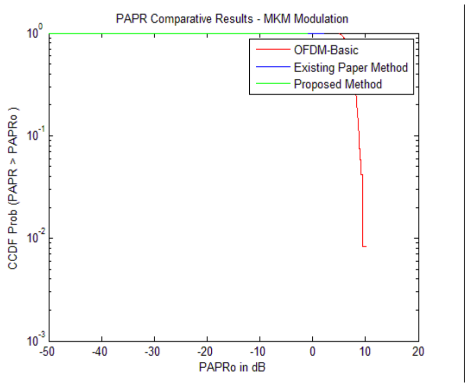

Fig 2PAPR comparative results

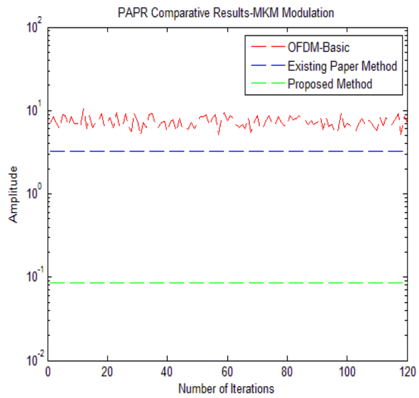

Fig 3PAPR comparative results

IV. Conclusion

OFDM systems are widely used in wireless communication systems due to growing use of it all over the world. However in this paper we studied that OFDM system is suffering from the limitations like poor BER and higher PAPR performance in case of high mobility conditions with worst ICI rate. To overcome the problems of traditional OFDM systems, SCOFDM systems are designed and introduced. Practically this approach showing improved in BER and PAPR performance as compared to traditional OFDM systems. But SCOFDM systems suffering from the performance degradation due to the ICI under the conditions like high mobility.

Therefore, in this paper we proposed scheme for SCOFDM systems with two objectives reducing the BER and reducing the PAPR. The proposed method is based on recently presented SCOFDM with MKM technique. We contributed to this method by adding iterative clipping and filtering technique to reduce further PAPR rate as compared to SCOFDM with MKM method. The practical results showing that BER get improved as well PAPR values are reduced by using proposed approach of SCOFDM + MKM + Clipping.

V. FutureScope

As clipping is very basic technique to reduce PAPR for better performance of the system we can use any other advanced technique of PAPR reduction. As well as hardware implementation of system with FPGA in future will be expected.

References

[1]. Xue Li, Stevan Hong, Vasu D. Chakravarthy, Michael Temple, and Zhiqiang Wu, "Intercarrier Interference Immune Single Carrier OFDM via Magnitude-Keyed Modulation for High Speed Aerial Vehicle Communication", IEEE transaction on communications, VOL. 61, NO. 2, FEBRUARY 2013

[2]. Li Tao, Jianjun Yu, Junwen Zhang, Yufeng Shao, and Nan Chi, "Reduction of Intercarrier Interference Based on Window Shaping in OFDM RoF Systems", IEEE Photonics Technology Letters, VOL. 25, NO. 9, MAY 1, 2013

[3]. Shu-Ming Tseng, Yu-Chin Kuo, and Yueh-Teng Hsu, "Turbo ICI Cancellation and LDPC Decoding for OFDM Systems", International Conference on Advanced Technologies for Communications, 2008

[4]. Yuping Zhao and Sven-Gustav Häggman,"Intercarrier Interference Self-Cancellation Scheme for OFDM Mobile Communication Systems", IEEE Transactions On Communications, VOL. 49, NO. 7, JULY 2001

[5]. AlirezaSeyedi, *Member, IEEE,* and Gary J. Saulnier, "General ICI Self-Cancellation Scheme for OFDM Systems", IEEE Transactions on Vehicular Technology, VOL. 54, NO. 1, JANUARY 2005

[6]. Xue Li1, Ruolin Zhou, VasuChakravarthy, Steven Hong, and Zhiqiang Wu, "Total Intercarrier Interference Cancellation for OFDM Mobile Communication Systems ", IEEE CCNC 2010 proceedings

[7]. AlphanSahin, and HuseyinArslan, "Edge Windowing for OFDM Based Systems", IEEE Communications Letters, VOL. 15, NO. 11, NOVEMBER 2011

[8]. Meng Ma, Xiaojing Huang and Y. Jay Guo, "An Interference Self-Cancellation Technique for SC-FDMA Systems", IEEE Communications Letters, VOL. 14, NO. 6, JUNE 2010

[9]. Fumihiro Hasegawa, Akihiro Okazaki, Hiroshi Kubo, Damien Castelain, and David Mottier, "A Novel PAPR Reduction Scheme for SC-OFDM with Frequency Domain Multiplexed Pilots", IEEE Communications Letters, VOL. 16, NO. 9, SEPTEMBER 2012

[10]. TaewooLeeand Hideki Ochiai, "Peak Power Reduction of SC-FDMA Signals Based on Trellis Shaping", Globecom 2012 Symposiom on selectected areas of communication

[11]. Prafulla. D. Gawande and Sirddharth. A. Ladhake , "PAPR Performance Of OFDM System By Using Clipping And Filtering Method", International Journal of Advances in Engineering & Technology, May 2013

[12]. JinweiJi, GuangliangRen and Huining Zhang, "PAPR Reduction in Coded SC-FDMA Systems via Introducing Few Bit Errors", IEEE Communications Letters, VOL. 18, NO. 7, JULY 2014

[13]. Ishua and Naresh Kumar, "PAPR Reduction in Wavelet based SCFDMA using Pulse Shaping Filters for LTE Uplink Transmission", International Journal of Applied Engineering Research, Volume 9, Number 20 (2014) pp. 6481-6492

[14]. Aping Yao, Yi Zheng, "Peak-To-Average Power Reduction Of OFDM Signals Using Adaptive Digital Filter", ICASSP 2006

[15]. Y.-C. Wang and Z.-Q. Luo, "Optimized Iterative Clipping and Filtering for PAPR Reduction of OFDM Signals", IEEE Transactions on Communications, VOL. 59, NO. 1, JANUARY 2011

[16]. W. Aziz, E. Ahmed, G. Abbas, S. Saleem and Q. Islam, "PAPR Reduction In OFDM Using Clipping And Filtering", World Applied Sciences Journal 18 (11): 1495-1500, 2012

[17]. Hyung G. Myung, "Introduction To Single Carrier FDMA", 15th European Signal Processing Conference (EUSIPCO 2007), Poznan, Poland, September 3-7, 2007