NOVEL PAPR REDUCTION TECHNIQUE BY COMBINING SLM WITH CLIPPING AND FILTERING TECHNIQUE FOR MIMO-OFDM SYSTEM

Kavita Singh[1], Kapil Gupta[2]

[1]*Department of ECE, MMU University, Mullana-Ambala, Haryana*
[2]*Department of ECE, MMU University, Mullana-Ambala, Haryana*

ABSTRACT

Increased demand of multimedia system applications leads to high speed transmission speed that may be gratified by OFDM (orthogonal frequency division multiplexing). In wireless transmissions, OFDM is extremely smashing technology as it provides flexibility and high speed.One of the major drawbacks in the MIMO-OFDM is high peak-to-average power ratio (PAPR).Clipping & Filtering, Selected mapping (SLM), Partial transmit sequence (PTS) are some of the techniques which minimizes the PAPR. Many schemes have been proposed by scholars for decreasing the PAPR of OFDM signals, which can be categorized put into two categories. PAPR schemes can be classified as multiplicative or additive schemes, where PAPR reduction is carried out in the OFDM modulator.SLM is multiplicative scheme because the phase sequences are multiplied with input symbol sequences or OFDM signal sequences whereas clipping are additive schemes because the reference signals are added. In this paper, a hybrid approach for reducing Peak to Average Power Ratio in OFDM is presented. The method is based on SLM approach with clipping and filtering technique. Performance of the proposed method is evaluated and compared with the existing techniques.

***Keywords*— Orthogonal Division Multiplexing Division (OFDM), Multiple-Input-Multiple-Output (MIMO), Peak-to-Average Power Ratio (PAPR), Selected Mapping (SLM), Clipping and Filtering, Conventional Hybrid (CH).**

INTRODUCTION

For 4G and 5G wireless communications broadband the Multiple-input-Multiple-output orthogonal frequency-division multiplexing (MIMO-OFDM) is that the dominant air interface. MIMO technology is joined to produce a lot of reliable communications at rapid speed that divides a radio channel into an outsized range of closely spaced sub channels. During the mid-1990s the analysis conducted that whereas MIMO may be used with alternative common air interfaces, for instance, code-division multiple access (CDMA) and time-division multiple access (TDMA), at higher information rates the mixture of OFDM and MIMO is sensible [1]. For the mobile broadband network and most advanced wireless local area network (WLAN) the MIMO-OFDM is the establishment since it conveys the most elevated limit and information throughput and accomplishes the best spectral potency. Utilizing OFDM modulation at higher speed the MIMO would be most sensible, because rapid information channel is changing over through the OFDM into various parallel lower-speed channels. The presence of the multiple transmit antennas (multiple input) and multiple receive antennas (multiple output) is indicated by the term "MIMO", in modern usage . Whereas

beam-forming the various transmit reception antennas can be utilized and for diversity the multiple receive antennas can be utilized, the simultaneous transmission of multiple signals (spatial multiplexing) to duplicate unearthly effectiveness (limit) is referred by "MIMO" [2-5]. Because of its potential in accomplishing high information rate, spatial multiplexing and reliable performance the MIMO-OFDM system have drawn noteworthy interests [6-7].Since for the 4G mobile communications bandwidth resources are as yet constrained. More refined plan and data transmission structure is requiring in the up and coming era of mobile communication system. Because of the superior performance of MIMO-OFDM they need been adopted. When MIMO-OFDM is combined they can provide industry evolution from the 3G to 4G system. The output is superposition of multiple sub-carriers in MIMO-OFDM system. For this situation, prompt power yields increments and may request higher forces than the mean energy of the framework since the periods of these carriers are same. In MIMO-OFDM the high PAPR is one of the most serious problems. With the PAPR to transmit signals, with very high power scope it requires power amplifiers. These types of amplifiers have low efficiency-cost factor and very expensive. In performance degradation this gives rise to non-linear distortion which changes the superposition of the signal spectrum. In PAPR to increase combat, one natural arrangement is to adopt amplifiers to have bigger exchange off range [8]. In the II section related work is discussed, in III section methodology and algorithm for PAPR reduction are explained. In the IV section the results and discussions are made and V section conclusion is discussed.

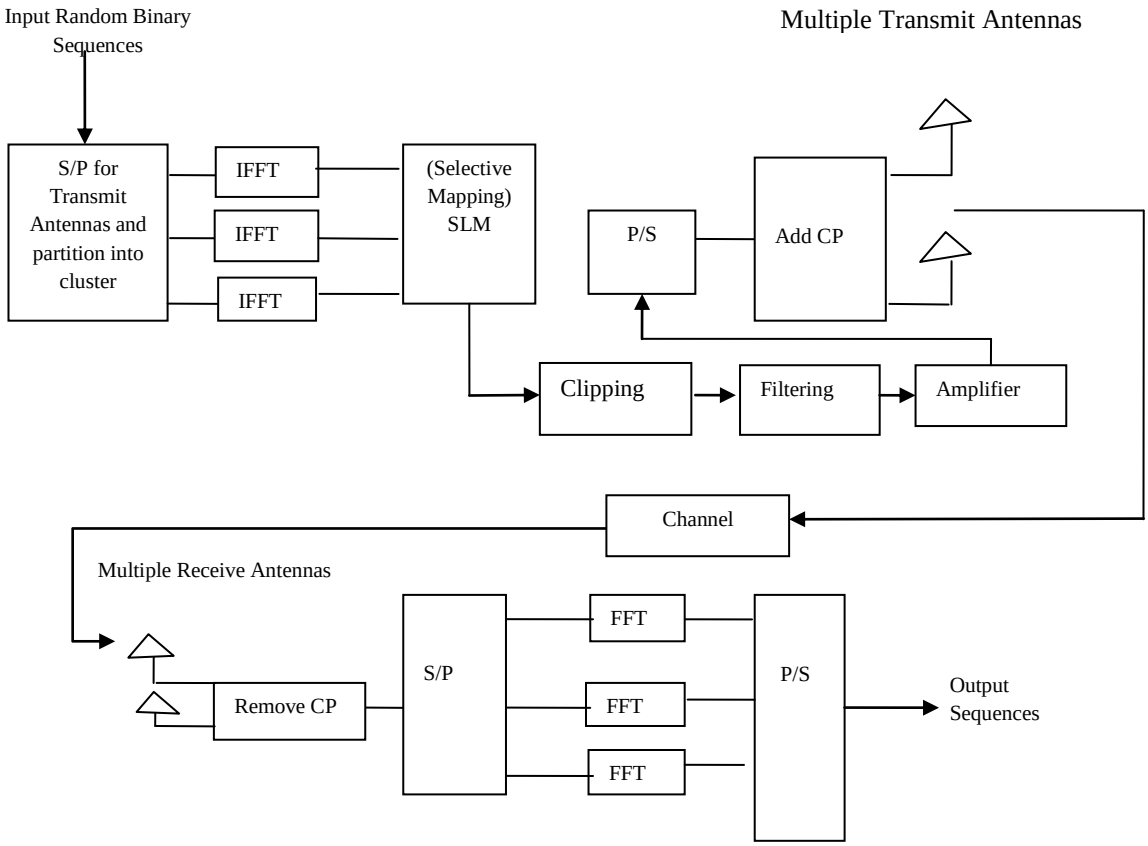

Fig 1: illustration of MIMO-OFDM System with Hybrid SLM modified OFDM and Clipped + Filtering OFDM

RELATED WORK

Ye (Geoffrey) Li et al. [1] proposed the signal detector and minimum Euclidean-distance decoding for enhancing the channel estimation based on successive interference cancellation. According the simulation results shows the four input-output systems where transmitting data at speed 4Mbps over a1.25 MHz channel. MMSE decrease required SNR is about 100 % and 1 % WER by 2.5dB and 1.8 dB .the value of Doppler frequency is 40 Hz so, the MSE of the ECE is about 1.5dB and 1 dB which is better for TU channels and HT channels. Hence MIMO-OFDM can be used for high-data-rate wireless communication systems.

Yung-Lyul Lee et al. [2] described the PAPR performance using SLM approach. The results concluded that, the concurrent SLM-based method selects the transmitted sequence with low PAPR and recovers the side information very accurately; however, suffering a slight degradation of the PAPR performance compared to the individual SLM approach .With the help of the STF diversity, the overall BER show within existence of imprecise side information may be improved.

Robert J.Baxley et al. [3] proposed a constrained clipping technique for reducing the PAPR value of the system. The proposed method consists of two different processing units, one is in-band EVM constrained and other is out-of-band spectral constrained .Results show that with the help of in-band algorithm and out-of-band algorithm minimizes 4.5dB PAPR and main advantage of proposed algorithm is that all processing is done at the transmitter side.

Zhefeng Li et al. [4] deal with Chu sequences to the repetition space-time-frequency coding (STFC) in MIMO-OFDM system for better PAPR performance. In this paper the main aims is to repetition across sub-carrier and reduce the PAPR. According to the simulation results shows original repetition and new repetition which have performance of OSTFBC and QOSTFBC in MIMO-OFDM without Clipping where diversity gain is 8 so from this it is clear that QOSTFBC has highest diversity gain and also contain better performance. Performances of OSTFBC and QOSTFBC in MIMO-OFDM with Clipping from this shows that in the original repetition Chu sequences to the repetition across sub-carrier for the phase adjustment help to minimize the PAPR in MIMO-OFDM system.

Heechoon Lee et al. [5] proposed unitary PAPR in multiple transmit antenna without any requirement of side information (SI) .Also proposed on each side of transmitter side applying joint PAPR reduction. Further, there is no increment in Computational complexity. According to the implementation it considered the modulation schemes such as 64 QAM and also used STBC which shows constrained capacity .In this paper assumed non-linear distortion from HPA with 64 QAM for better performance of PAPR reduction which using of 2 x 2 system with Alamoutic STBC . Pair-wise error probability (PWEP) also assumed for better results for BER performance. So results show that for codeword different matrix the PWEP with eigenvalues. It established loss-less PAPR and does not require of side information at the receiver side anymore.

Md. Ibrahim Abdullah et al. [6] described PAPR techniques for improvement in OFDM system and also show the comparison between each technique in OFDM system. According to the simulation results is it observed that SLM techniques show better PAPR performance than the other in OFDM system where M=8 and M=16 is about 0.5dB than the original OFDM signals. By adopting this technique have fewer chances of distortion and less effect to the data rate.

T.Prathap Reddy et al. [7] without any side information combined Novel phase offset SLM scheme in Alamouti MIMO-OFDM systems for PAPR reduction. This technique rises complexity computational and good PAPR performance which is depend on random phase selection. According to simulation and results the proposed scheme evaluate both PAPR reduction and the BER performance, where 104 data blocks are generated with N=1024 and the oversampling factor J=4. QPSK and 16-QAM modulation are used where phase factors are {1, -1} and the saturation point of the solid-state power amplifier (SSPA) is C= 1.0. At the receiver the proposed scheme reduces PAPR which does not need to transmit side information, resulting in the increase of the data rate.

J.P. Panwar et al. [8] introduced the evaluation of Bit Error Rate (BER) and PAPR by operating dissimilar modulation techniques such as BPSK, QPSK, and 16PSK with 256 sub-carriers. According to the simulation results show that with QPSK modulation, the OFDM will be 0.00057 when BER values at SNR 30dB .Simulation of different Modulation schemes such as had carried out and

it is noticed that QPSK and 16PSK modulation schemes show good performance than the BPSK modulation schemes. With QPSK and BPSK, the value of PAPR is 16.8dB and 202.2dB this is the value without using of reduction in techniques.

METHODOLOGY

By using of SLM, an input random binary sequence is partitioned into sub- blocks and using of serial-to-parallel converter is converted into the parallel data stream. To this serial-to- parallel converted data stream OFDM data block is growing components by components with phase. Afterwards data blocks are phase revolved, the revolved OFDM samples characterized same samples which are unmodified OFDM symbols, allocate with familiar phase sequence. At the transmitter side, with the help of IFFT technique the frequency domain of OFDM samples is converted into the time domain of OFDM samples X (t). At the transmitter end, the essential concept in this technique is to choose the signal with minimum PAPR from each independent phase sequences. Clipping and filtering is the simple technique for decreasing PAPR in MIMO-OFDM. This method clipped the OFDM samples which have high peaks earlier going to through amplifier. This may be achieved with the assist of clipper that bound the OFDM samples envelop to the fixed level is termed as clipping level (CL).

1.1 Proposed Algorithm

Step 1. For SLM scheme, Initialization of parameters, number of transmitted symbols, alphabet size etc.
Step 2. For each individual sub carriers create OFDM symbols for QAM and setting weights.
Step 3. For SLM approach, originate all feasible join for particular weight factors.
Step 4. Modify OFDM by Selective Mapping Technique and calculate corresponding PAPR of each block
Step 5. Finding the block with minimum PAPR and display
Step 6.Clipping the signals above threshold
Step 7. Filtering the clipped signal
Step 8. Calculating PAPR of Clipped and Filtered signal
Step 9. Display PAPR of normal OFDM, SLM modified OFDM and Clipped + Filtering OFDM

RESULTS AND DISCUSSIONS

To overcome the PAPR in the MIMO-OFDM system, a hybrid technique is proposed. The performance analysis of the hybrid technique has been performed through MATLAB. The performance of PAPR reduction is evaluated.

PAPR of SLM + Clipped + Filtered OFDM

Enter the L factor (1 to 1.5) =1
Enter the number of transmitted symbols (Power of 2) (preferably>32)= 64
Enter the alphabet size (power of 2 and less than number of symbols)(preferably<32)=16
PAPR of normal-OFDM = 23.1622
PAPR of SLM modified-OFDM = 14.1884

PAPR of SLM + Clipping + Filtering Technique=10.8963
Efficiency of SLM Technique in percentage= 38.7434
Efficiency of SLM + Clipping + Filtering Technique in percentage=52.9565
The MIMO-OFDM inserts a guard interval may be in a two dissimilar way**.** The first way is zero padding (ZP), its pads the guard interval with zeros of the OFDM symbols and second way is the cyclic extension of the OFDM symbol for some continuity. CP or ZP is removed at receiver end.

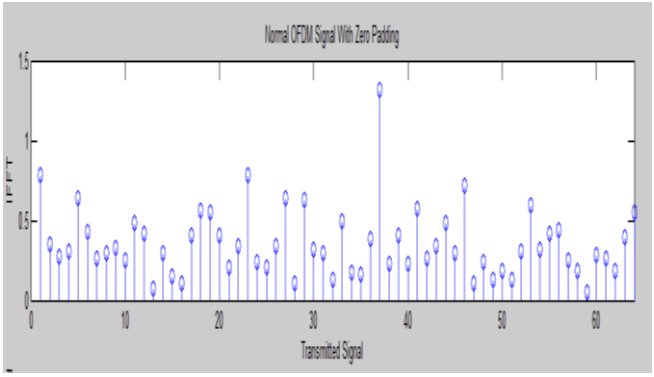

Fig 2: Normal OFDM Signal with Zero Padding

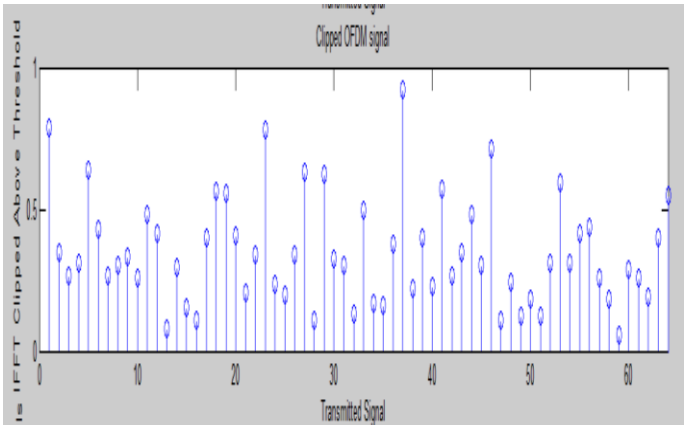

Fig 3: Clipped OFDM Signal

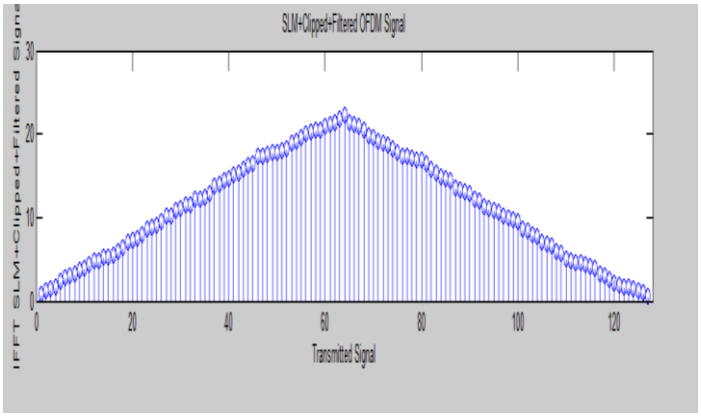

Fig 4: SLM + Clipped + Filtered OFDM Signal

Table 1: PAPR of Normal, SLM Modified and Clipped OFDM

	Normal OFDM	**SLM Modified**	**SLM+ CLIPPING+ FILTERING**
PAPR	23.1622	14.1884	10.8963
Efficiency		38.7434	52.9565

So, SLM + Clipping +Filtering Technique Provides more reduction in PAPR.

Comparison in the PAPR values of different technique i.e. SLM Modified and SLM + Clipping + Filtering, Efficiency and BER performance.

The PAPR comparison of three techniques i.e. Normal OFDM,SLM Modified and SLM + Clipping + Filtering techniques is shown in figure 4.3.1.blue bar shows the PAPR of normal OFDM is 23.1622, red bar shows the PAPR of SLM Modified is 14.1884 and red bar shows the PAPR of SLM + Clipping + Filtering is 10.8963.

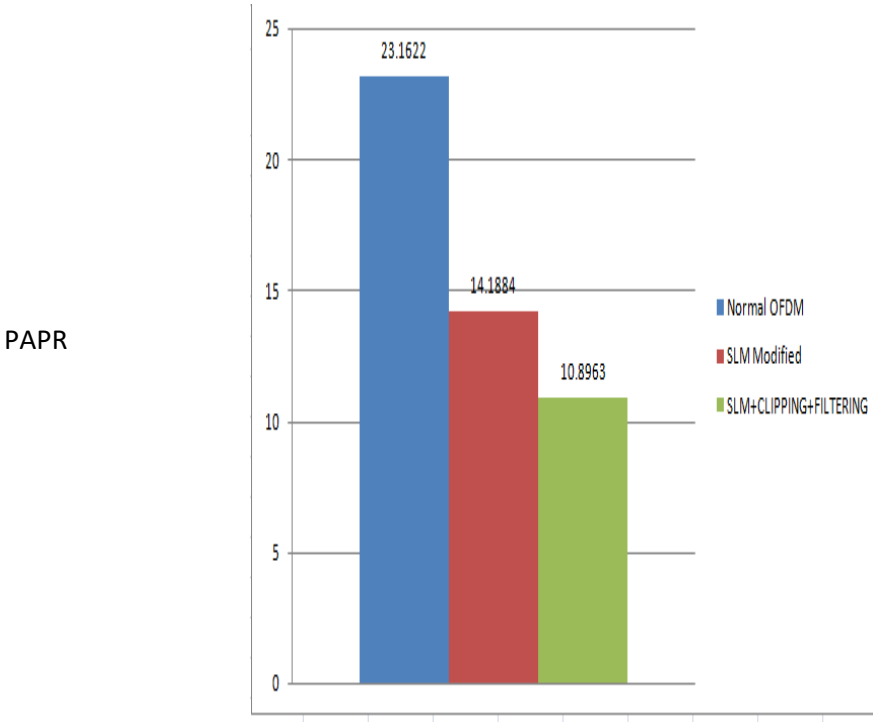

Fig 5: Graph for PAPR Comparison of Normal OFDM , SLM Modified and SLM+CLIPPING+FILTERING

As shown in graph proposed hybrid approach gives better results compared to SLM technique. In case of SLM PAPR are 14.1884 which are reduced to 10.8963.

The efficiency comparison of two techniques i.e. SLM Modified and SLM + Clipping + Filtering techniques is shown in figure 4.3.2.blue bar shows the efficiency of SLM Modified is 38.7434 and red bar shows the efficiency of SLM + Clipping + Filtering is 52.9565.

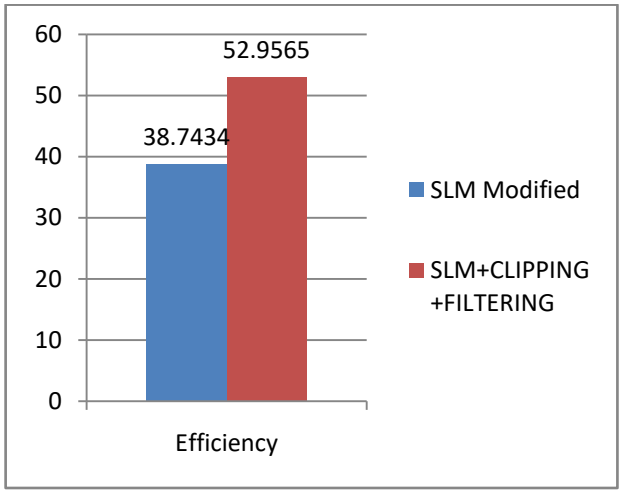

Fig 6: Graph for Efficiency Comparison of Normal OFDM, SLM Modified and SLM + Clipping + Filtering

As shown in graph efficiency of SLM modified is 38.7434 whereas proposed hybrid approach gives 52.9565 efficiency.

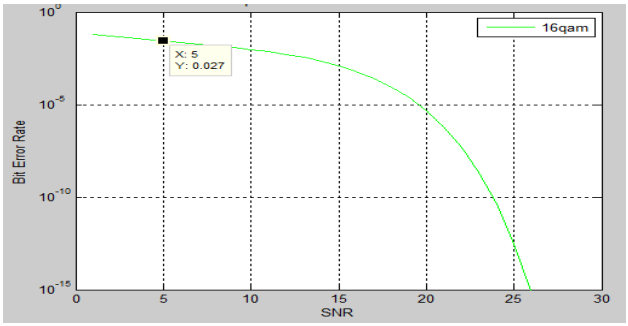

Fig 7: BER performance of OFDM over SNR

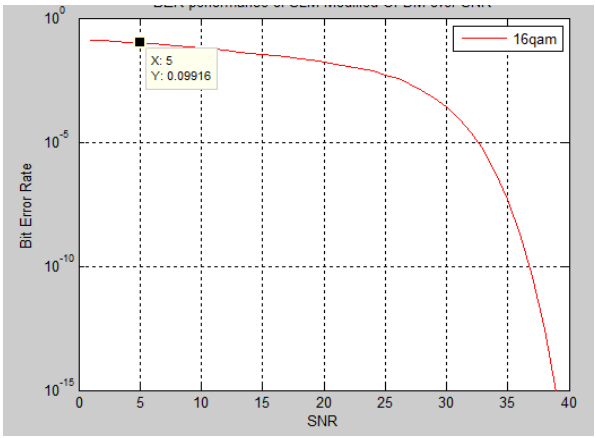

Fig 8: BER performance of SLM Modified + Clipped +Filtering OFDM over SNR

The BER over SNR comparison of two techniques i.e. Normal OFDM, SLM + Clipping + filtering techniques is shown in figure 4.3.3a. And figure 4.3.3b.Combined graph as shown in figure 4.3.3c blue line shows the BER over SNR of SLM Modified + Clipped + Filtering and, red shows the BER over SNR of normal OFDM. Proposed hybrid approach reduces PAPR significantly but at the cost of increasing the BER. By changing and repeating clipping and filtering method, one can attain both low PAPR and low BER.

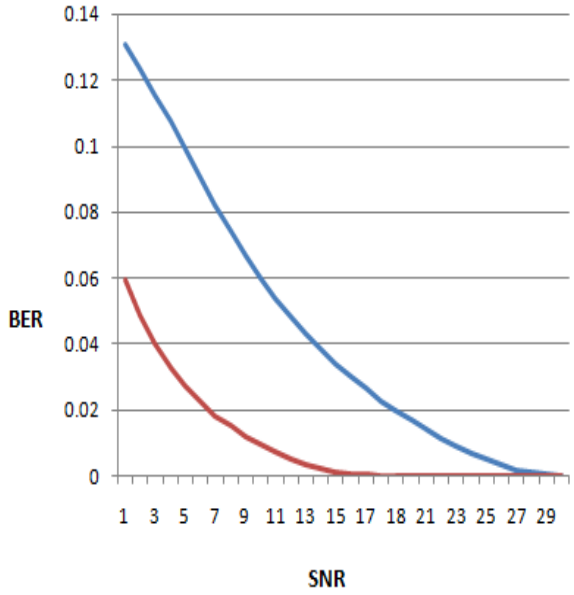

Fig 9: BER Analysis of Normal & SLM Modified + Clipped + Filtering OFDM

1.2 Discussions

The performance of normal OFDM, SLM modified, Clipped is good and improves the PAPR of OFDM signal. The SLM + Clipping + Filtering gives much better than the entire algorithm, it improves the PAPR, efficiency as well as BER performance of the MIMO-OFDM system. These algorithm are best in terms of low PAPR value and high efficiency overall.

CONCLUSION

SLM + Clipped + Filtering are a standout amongst the most usually used methods which minimize the PAPR to a coveted level of signal. Each of alternate OFDM symbol is performed by IFFT operation and then the sequence with the lowermost PAPR is transmitted. It is observed that OFDM signal has higher PAPR without clipping and filtering. These work offerings a hybrid technique to minimize PAPR & evaluation have been finished with conventional techniques as well. MATLAB 7.5 is operated to simulate the results for MIMO-OFDM system. As shown in graph proposed hybrid approach gives better results compared to SLM technique. In case of SLM PAPR are 14.1884 which are reduced to 10.8963. Efficiency of SLM modified is 38.7434 whereas proposed hybrid approach gives 52.9565.

REFERENCES

[1] Ye (Geoffrey) Li, Senior Member, IEEE, Jack H. Winters, Fellow, IEEE, and Nelson R.Sollen berger, Fellow, IEEE "MIMO-OFDM for Wireless Communications, Signal Detection With Enhanced Channel Estimation", IEEE TRANSACTIONS ON COMMUNICATIOS, VOL. 50, NO. 9, SEPTEMBER 1471- 1477.

[2] Yung-Lyul Lee, Young-Hwan You, Won-Gi Jeon, Jong-HO Paik, and Hyoung-Kyu Song. "Peak-to-Average Power Ratio in MIMO-OFDM SystemUsing Selective Mapping" IEEE COMMUNICATIONS LETTERS, VOL.7, NO-12.DECEMBER 2003.

[3] Robert J. Baxley, Chunming Zhao, and G. Tong Zhou. "Constrained Clipping for Crest Factor Reduction in OFDM".IEEE TRANSACTIONS ON BROADCASTING, VOL.52, NO. 4, DECEMBER 2006

[4] Zhefeng Li and Xiang-Gen Xia "Single-Symbol ML Decoding for Orthogonal and Quasi-Orthogonal STBC in Clipped MIMO-OFDM Systems Using a Clipping Noise Model with Gaussian Approximation", IEEE TRANSACTIONS ON COMMUNICATIONS, VOL. 56, NO. 7, JULY 2008 pp 1127- 1136.

[5] Heechoon Lee, Member, IEEE, and Michael P. Fitz, Senior Member, IEEE "Unitary Peak Power Reduction in Multiple Transmit Antennas", IEEE TRANSACTIONS ON COMMUNICATIONS, VOL. 56, NO. 2, FEBRUARY 2008 pp 234- 244.

[6] Md. Ibrahim Abdullah, Md. Zulfiker Mahmud, Md. Shamim Hossain, Md. Nurul Islam "Comparative Study of PAPR Reduction Techniques in OFDM" ARPN Journal of Systems and Software, VOL. 1, NO. 8, November 2011 pp 263-269.

[7] P.Kothai, R.Prabhu "PAPR Reduction in MIMO OFDM Using SLM Scheme". International Journal on Applications in Electrical and Electronics Engineering Volume 1: Issue 4: April 2015, pp 16-20.

[8] Pachori, Khushboo, and Amit Mishra. "PAPR Reduction in MIMO-OFDM by using Active partial sequence." Circuits,Systems, and Signal Processing 34.12 (2015):3999-4010.

[9] Kavita Singh, Kapil Gupta, "PAPR Reduction with Amplitude Clipping & Filtering, SLM & PTS Techniques for MIMO-OFDM System: A Brief Review",International Journal on Recent and Innovation Trends in Computing and Communication ISSN: 2321-8169 Volume: 5 Issue: 5