Open access Journal International Journal of Emerging Trends in Science and Technology

A Hybrid PAPR Reduction Scheme Using Selective Mapping and Amplitude Clipping

Authors
Akshay Gupta[1], Dr. Sarita Singh Bhadauria[2]
[1]Department of Electronics Engineering, Madhav Institute of Technology & Sciences, Gwalior, India
Email: *akshaygupta005@gmail.com*
[2]Department of Electronics Engineering, Madhav Institute of Technology & Sciences, Gwalior, India
Email: *saritamits61@yahoo.com*

Abstract
High information rate is the major requirement of modern communication systems. As there is the scarcity of spectrum OFDM proves itself very useful. In OFDM the subcarriers are made adjacent and orthogonal to each other so as to avoid interference. To increase the data rate number of subcarrier has to be increased which results in the noteworthy issue of high PAPR. The main reason for high PAPR is high peak values of subcarriers than the average value. The Hybrid scheme is introduced for PAPR lessening in this paper.
Keywords: *OFDM, PAPR, SLM, CLIPPING, CCDF.*

1. INTRODUCTION

OFDM (Orthogonal Frequency Division Multi-plexing) is a Multi Carriers Modulation plan which can be viewed as either a modulation innovation or multiplexing innovation.. OFDM is better plan for high information rate for modern wireless communication. OFDM has various superiority like durability in multipath smudging, high spectral productiveness, ability to counteract impulse interference. OFDM has been picked for hoisted information rate communications and has been broadly utilized as a part of mordern wireless communication standards such as Digital Video Broadcasting (DVB) and mobile worldwide interoperability for microwave access (mobile WiMAX) based on OFDM access technology[2]. There are some concerns which are noteworthy in OFDM framework. One of them is Peak Average To Power Ratio (PAPR).

The OFDM receiver used for detection is very sensitive to the nonlinear devices used in its signal processing loop, such as Digital-to-Analog Converter (DAC) and High Power Amplifier (HPA), which might extremely impede system performance due to induced spectral regrowth and detection efficiency degradation. Frequency Offset produces other major problem of Inter Carrier Interference (ICI)[1][3].

Keeping in mind the end goal to diminish the PAPR of OFDM signals, numerous arrangements have been proposed. These techniques can be portrayed by different parameters like nonlinearity, measure of transforming at transmitter's side individually at recipient's side and size of side data expected to be sent to the reciever Some of the remarkable methods are selective mapping (SLM) [1][14], partial transmit sequence (PTS) [2], and tone reservation (TR) [13].Clipping is one of the extraordinary nonlinear PAPR lessening procedures, where the magnitude of the signal is restricted to a given edge. Keeping in mind the end goal to diminish the sign deformation, several frequency domain filtering methods have been advocated [9].

2. OFDM SYSTEM

By and large OFDM framework contain a heap of N baseband signals and they are orthogonal to one another. The N subcarriers have a bandwidth of B_w Hz and are separated by a gap of $\Delta f = B_w/N$.

The numerical representation of OFDM in continous time space is as:

$$x(t) = \frac{1}{\sqrt{N}} \sum_{K=0}^{N-1} X[k] e^{\frac{j2\pi\Delta fkt}{T}} \quad (1)$$

Where T is symbol duration.

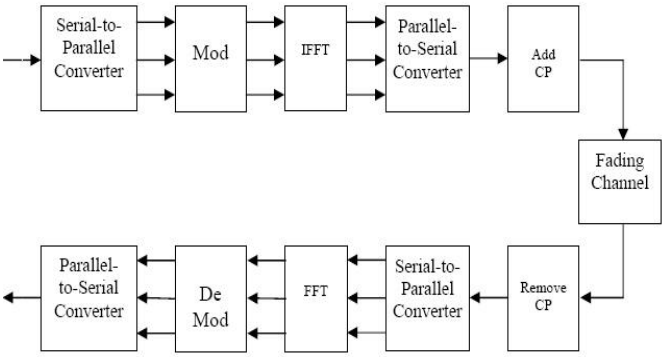

Figure 1. Block diagram of OFDM system

In cases, the OFDM-based wireless systems use multipath channels. The fading produced by these channels causes the inter symbol interference (ISI).To keep away from this issue, every period T of the signal is stretched out with a copied part comparing to a guard interval.

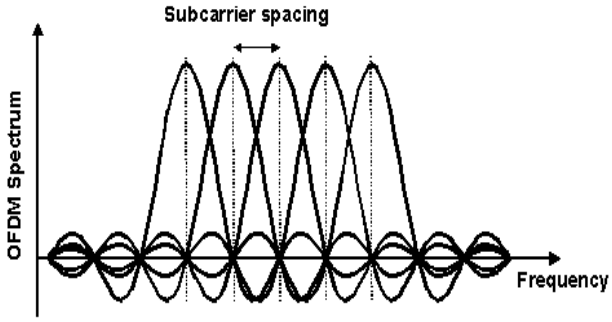

Figure 2. Spectra of OFDM symbol

3. PEAK TO AVERAGE POWER RATIO

PAPR is introduced in the system due to addition of many sinusoid of different frequency. High peaks are formed at particular instant which increases the peak power at that instant which result in high PAPR.

PAPR for signal s(t) is defines as:

$$PAPR = \frac{\max |s(t)|^2, 0 \le t \le T}{1/T \int_0^T |s(t)|^2 dt} \quad (2)$$

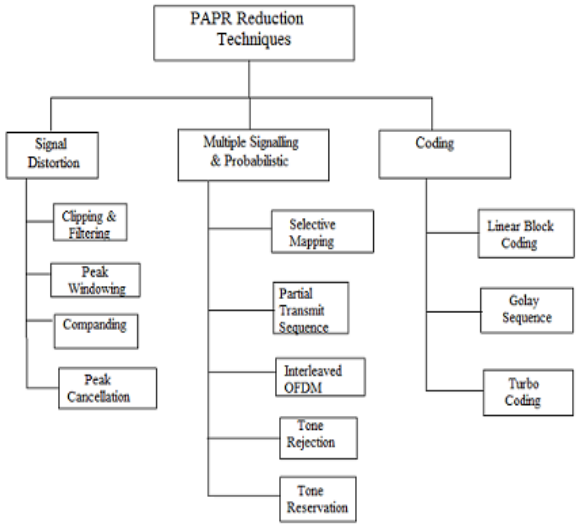

Figure 3. Classification of PAPR reduction technique

3.1 Selective Mapping

In the SLM technique, the transmitter generates a set of sufficiently different candidate data blocks, all representing the same information as the original data block, and selects the most favorable for transmission [15].A block diagram of the SLM technique is shown in Fig. 4. Each data block is multiplied by *U* different phase sequences, each of length *N*,

B(*u*) = [*bu*,0, *bu*,1, …, *bu*,*N*–1]*T*, *u* = 1, 2, …, *U*, resulting in *U* modified data blocks. To include the unmodified data block in the set of modified data blocks, we set **B**(1) as the all-one vector of length *N*. Let us denote the modified data block for the *u*th phase sequence

$$\mathbf{X}(u) = [X0bu,0, X1bu,1, \ldots, XN{-}1bu,N{-}1]^T, \quad u = 1, 2, \ldots, U.$$

After applying SLM to **X**, the multicarrier signal becomes:

$$x^{(u)}(t) = \frac{1}{\sqrt{N}} \sum_{n=0}^{N-1} X_n b_{u,n} . e^{j2\pi n\Delta ft}, 0 \le t < NT, u = 1,2,.U \quad (3)$$

Among the modified data blocks **X**(*u*), *u* = 1, 2, …, *U*, the one with the lowest PAPR is selected for transmission. Information about the selected phase sequence should be transmitted to the receiver as

side information. At the receiver, the reverse operation is performed to recover the original data block. For implementation, the

SLM technique needs *U* IFFT operations. This approach is applicable with all types of modulation and any number of subcarriers. The amount of PAPR reduction for SLM depends on the number of phase sequences *U* and the design of the phase sequences.

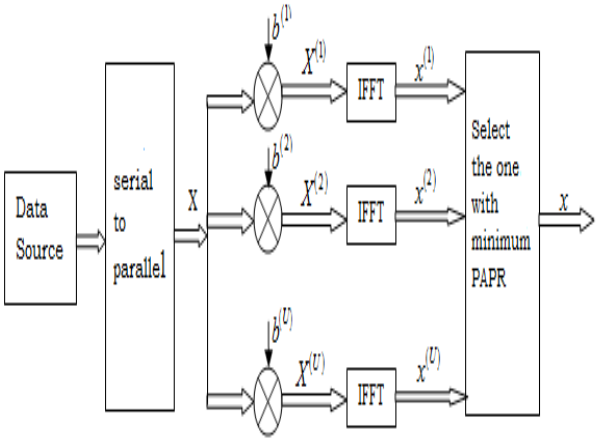

Figure 4. Block diagram of SLM Technique

3.2 Amplitude Clipping

The simplest technique for PAPR reduction is amplitude clipping which restrains the peak envelope of the input signal to a predetermined value or passes it through unperturbed. The noise caused by it falls both in-band and out of- band. In-band distortion cannot be reduced by filtering resulting an error performance degradation, while out-of-band radiation reduces spectral efficiency[4]. Filtering after clipping can reduce out-of-band radiation though cause some peak regrowth[3]. To reduce overall peak regrowth, repeated clipping-and-filtering can be used. Repeated clipping-and-filtering takes many iterations to reach a required amplitude level. A technique to iteratively reproduce has premise on the way that the impact of clipping noise is attenuated by making decisions in the frequency domain. When the decisions reconverted to the time domain, the signal recovered from the harmful clipping effects. An alternate approach to invalidate the execution debasement is to recreate the clipped specimens in view of alternate samples in the oversampled signals.

4. PROPOSED SCHEME

The proposed mixture plan for PAPR diminishment incorporates falling of Selective Mapping and CLIPPING strategies. To expand the general execution we brought together two distinctive signal transforming systems for PAPR lessening. One is the non direct change through constraining the signal to a specific limit level while other is scrambling and probabilistic technique in frequency domain ,

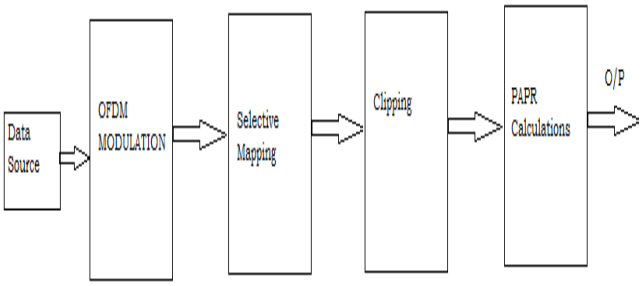

Figure 5. Block diagram of proposed scheme

With the MATLAB simulator study of proposed hybrid PAPR reduction technique can be done.

The OFDM signal which is obtained it is passed through SLM block then the signal is passed through clipping stage. After passing through these blocks PAPR level is calculated using the performance parameter CCDF characteristics .

5. SIMULATION RESULT

We have done significant simulation using MATLAB to evaluate the PAPR performance of the proposed hybrid scheme. the simulation is done by following parameters as shown in the table below:

Modulation	QPSK
Number Of Data Subcarriers (N)	512
Total Number Of Symbols	1000

The below plot figure 6, shows the CCDF of PAPR level of CLIPPING, SLM and HYBRID technique.. The plot shows that there is reduction in PAPR by hybrid technique.

Besides reduction of PAPR there is a drawback that signal distortion and complexity increases .

Peak to Average Power Ratio for normal OFDM signal is approximately 11 dB, by using hybrid method it reduces to around 5 dB. As compare to both clipping and SLM technique HYBRID method is better.

Figure 7. shows the CCDF curve of the hybrid technique with different phase sequence which is multiplied during SLM .

The figure 7. shows selection of phase sequence has effect on PAPR reduction

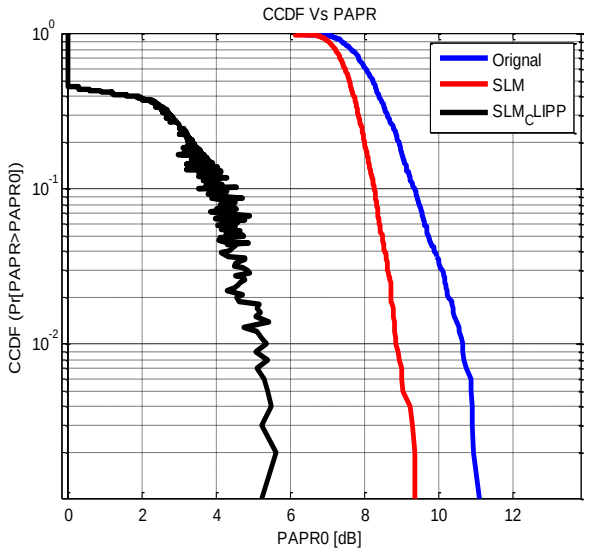

Figure 6.CCDF Vs PAPR plot of Proposed Scheme

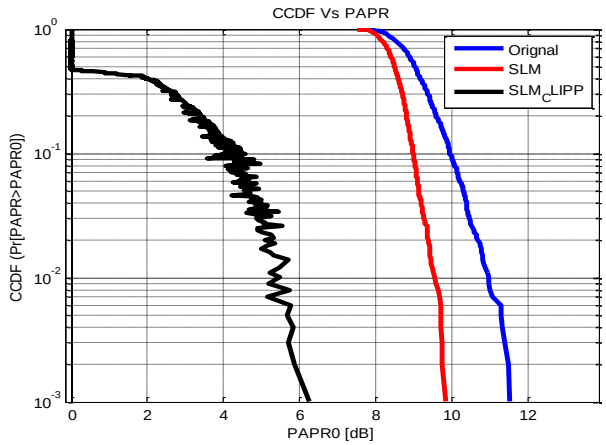

Figure 7. CCDF Vs PAPR plot of Proposed Scheme with different phase sequence

6. CONCLUSION

The subject of PAPR diminishment accept expanded significance because of the way that future remote frameworks are prone to apply OFDM structures with higher number of subcarriers than present ones to attain to higher information rates and mobility. This suggests that the issue of creating PAPR lessening plans for OFDM frameworks that are equipped for alleviating the issue with best execution exchange offs, including least. In this paper we have proposed an optional Peak to Average Power Ratio reduction system in light of serialization of amplitude clipping and SLM routines. The numerical results demonstrate that half breed system have bring higher PAPR diminishment.

No particular PAPR lessening procedure is the best arrangement for all multicarrier transmission frameworks. Rather, the PAPR reduction method ought to be precisely picked as indicated by different framework prerequisites

REFERENCES

1. Yasir Rahmatallah, Seshadri Mohan. “Peak-To-Average Power Ratio Reduction in OFDM Systems: A Survey And Taxonomy”, IEEE communications surveys & tutorials, vol. 15, no. 4, fourth quarter 2013, 1553-877X/13/$31.00 c 2013 IEEE.
2. T. Jiang, W. Xiang, H. H. Chen, and Q. Ni, “Multicast broadcasting services support in OFDMA-based WiMAX systems,” *IEEE Communications Magazine*, vol. 45, no. 8, pp. 78–86, Aug. 2007
3. Ramjee Prasad ,OFDM for wireless multimedia communications. artech house publisher , march 2000
4. Vue Xiao, Xia Lei and Shaoqian Li "Modified Clipping and Filtering Scheme for OFDM Systems" 978-1-4244-4888-3/09/$25.00 ©2009 IEEE
5. Leonard J. Cimini, Nelson R. Sollenberger. “Peak-to-Average Power Ratio Reduction of an OFDM Signal Using Partial Transmit Sequences”, 1089–7798/00$10.00 © 2000 IEEE.
6. Eugen-Victor Cuteanu, Alexandru Isar. “Hybrid PAPR Reduction Scheme with Selective Mapping and Tone Reservation”.
7. Seung Hee Han, Jae Hong Lee " An Overview Of Peak-To-Average Power Ratio Reduction Techniques Formulticarrier

Transmission" IEEE Wireless Communications • April 2005

8. P. Van Eetvelt, G. Wade, and M. Tomlinson, “Peak to Average Power Reduction for OFDM Schemes by Selective Scrambling,” *Elect. Lett.*, vol. 32, no. 21, Oct 1996, pp. 1963–64.
9. Tao Jiang, Yiyan Wu,"An Overview: Peak-To-Average Power Ratio Reduction Techniques For Ofdm Signals"IEEE Transactions On Broadcasting, Vol. 54, No. 2, June 2008
10. Robert J. Baxley and G. Tong Zhou " Comparing Selected Mapping and Partial Transmit Sequence for PAR Reduction" IEEE TRANSACTIONS ON BROADCASTING, VOL. 53, NO. 4, DECEMBER 2007
11. S.H Muller ,J.B Huber "A novel peak power reduction scheme for OFDM" The 8th IEEE International Symposium on Personal, Indoor and Mobile Radio Communications, Feb 1997.
12. Palicot, J. and Lou€et,Y. (Sep. 2005) Power ratio definitions and analysis in single carrier modulations. EUSIPCO,Antalya, Turkey.
13. Y.Z. Jiao, X.J. Liu, and X.A. Wang, "A Novel ToneReservation Scheme with Fast Convergence for PAPR Reduction in OFDM Systems", Consumer Communicationsand Networking Conference, pp. 398-402, January 2008.
14. H. S. Joo, S. J. Heo, H. B. Jeon, J. S. No, and D. J. Shin, “A new blind SLM scheme with low complexity of OFDM signals,” in *Proc. IEEE Vehicular Technology Conference (VTC)*, Alaska, USA,September 2009, pp. 1–5.
15. R. W. Bäuml, R. F. H. Fisher, and J. B. Huber, “Reducingthe Peak-to-Average Power Ratio of Multicarrier Modulation by Selected Mapping,” *Elect. Lett.*, vol. 32,no. 22, Oct. 1996, pp. 2056–57.

AUTHOR PROFILE

Akshay Gupta received the B.E. in Electronics and Communication Engineering from Institute of Technology and Management, RGPV Bhopal and pursuing M.E. from MITS, Gwalior. His area of interests is OFDM Systems.

Dr. Sarita Singh Bhadhauria received the B.E. in Electronics and Communication Engineering from MITS, Gwalior. M.Tech from UOR .She received Ph.d from RGPV Bhopal. She is currently Professor in Electronics Engineering Department MITS, Gwalior. Her area of interests are Digital Image Processing, Communications, Computer Networks and Microprocessors.