PAPR Reduction of OFDM by Hybridization of PTS and SLM with Dynamic Optimization

Yuvraj Pant[1], Sanjeev kashyap[2]
[1]*Research Scholar, Green hills enginerring college, kumarhattisolan, himachalpradesh, India*
[2]*Assistant Professor, Green hills enginerring college, kumarhattisolan, himachalpradesh, India*

Abstract- A major drawback of orthogonal frequency division multiplexing (OFDM) is the high peak-to-average power ratio (PAPR) of the transmitted signal. Partial transmit sequence (PTS) technique can improve the PAPR statistics of OFDM signals. In the PTS technique, the data block to be transmitted is partitioned into disjoint subblocks and the subblocks are combined using phase factors to minimize PAPR.In this paper hybrid PTS and ALM approach with optimize selection of blocks for reduction the BER.

Keywords- PTS, SLM, Blocks, Optimization

I. INTRODUCTION

Orthogonal frequency division multiplexing (OFDM) is an effective technique to mitigate ISI(Inter Symbol Interference). OFDM is a frequency division multiplexing (FDM) scheme utilized as a digital multi-carrier modulation method. In other words OFDM is frequency division multiplexing of multi-carriers, which are orthogonal to each other i.e. they are placed exactly at the nulls in the modulation spectra of each other. This makes OFDM spectrally more efficient. In OFDM data is divided into several parallel data streams or sub-channels, one for each sub carrier which are orthogonal to each other although they overlap spectrally Each sub-carrier is modulated with a conventional modulation scheme(such as QAM or PSK) at a low symbol rate maintaining total data rates similar to conventional single-carrier modulation schemes in the same bandwidth. In today's scenario MIMO is very useful with the combination of OFDM system. Exploiting the flexibility of MIMO systems in order to have high data rates is an especially attractive research topic for future scheduling scheme designs and their applications. Multiple-input multiple-output (MIMO) systems offer much larger channel capacity over traditional single-input single-output (SISO) system.

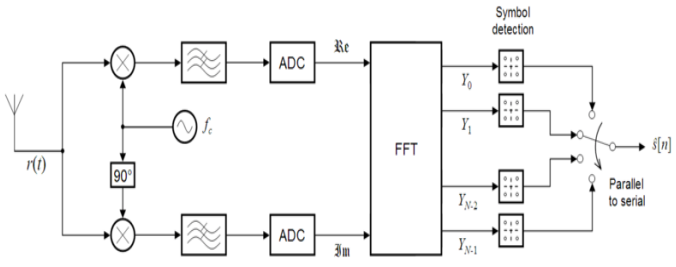

Fig.1: OFDM Block Diagram

II. RELATED STUDY

Joo, Hyun-Seung, et al. worked upon partial transmit schemes without side information to reduce the peak-to-average power ratio of OFDM. The proposed method does not transmit the side information for identifying a rotating vector. Maximum likelihood detector is used to extract the side information from received signal and recover the data sequence. The maximum likelihood method is used to calculate the distance between the signal constellations and rotated by phase offset [1].Kumar, Arun et al. designed MIMO-OFDM by using 4: 8 antenna and OSTBS encoder which combines the different techniques and used to control the inter-symbol interference. Performance evaluation of the proposed system is done by using Bite error rate, signal to noise ratio, constellation plot and MSE [2]. Zheng, Beixiong, et al. Investigates the MIMO-OFDM with index modulation method which provides the flexible trade-off between spectral efficiency and error performance in 5G wireless communication. In this work author detects the interchannel interference which is a challenging task. It is done by using low complexity detectors which is based on Monte carlo theory. These detectors work on the sub-blocks level and sub-carriers level to reduce the complexity [3].

Basar, Ertugrul. et al. investigates the MIMO-OFDM with index modulation method which provides the flexible trade-off between spectral efficiency and error performance in 5G wireless communication. In this work minimum means square error detector and maximum likelihood detector are proposed for performance investigation [4]. Pachori, et al. proposed a combination approach called active partial sequence to reduce the PAPR in OFDM under fading environment. In this approach approximate gradient is combined with partial transmit sequence approach. This approach provides the same data without disturbing the performance of the BER and provides the effective quality of service in wireless communication [5].

Harish Kumar Pal, et.al: Harish Kumar pal proposed an Advanced Peak windowing technique to overcome the limitation and drawback of the conventional peak windowing method, where in case of successive peaks emerged in half of window size. The author has proposed APW with the objective of monitoring and detecting instantaneously the high peaks of the signal and suppressing them to a certain threshold level even in case of consecutive peaks. The out of band

radiation is maintained within a certain level by increasing the window size. As a results the proposed method (APW) suppresses effectively high peak to the desired threshold power level even in case when successive peaks occurs within half of the window length the performance of the APW is better when compared with that of conventional Peak windowing.[6]

Aparna P. More, Sunil B. Somani: In this paper, both Iterative Clipping and SLM method is combined to give better PAPR compared to individual methods. The BER for the above method is also improved. The results also prove that the PAPR and BER of combined method i.e. Clipping-SLM method is better than Clipping and SLM method individually. Selective Mapping (SLM) method is another approach which provides good performance for reduction of PAPR, where the actual transmit signal is selected from a set of signals to construct the transmitted signal.[7]

S.S.Ghorpade1, et.al: The main motif of this paper was to show and implement the core of signal processing in OFDM system. A 64 subcarriers OFDM system was designed and simulated using MATLAB and all MATLAB code used was given in this paper , the simulations of transmit spectrum of OFDM, OFDM signal transmitted, Received OFDM signal with Noise and Original message and recovered message simulation was done. The simulated model as the author state in this paper it is the very basic implementation with advantages of less complexity and less time requirement [8].

ChangjianGuo, et.al: In this paper, the authors report a side information free partial transmit sequence (PTS) technique to reduce the peak-to-average power ratio (PAPR) for coherent optical OFDM systems using superimposed training. Simulation results show that this scheme can reduce PAPR effectively, and have a slight BER performance improvement compared with the conventional superimposed training coherent optical OFDM systems. [9]

Bavi et al. The author introduces clipping and filtering as the simplest method of reducing PAPR present in OFDM signal. Where he define clipping as an nonlinear process which clip the high peak of the OFDM signal at a threshold level named CL before the signal pass through HPA. This nonlinear process the author shows that it gives in BER degradation and proposes an oversampling of the signal by taking longer IFFT size. So to ensure that the noise is reduced at a significant level the author propose also filtering after clipping to remove possible out of signal band noise. [10]

III. PROPOSED METHODOLOGY

This section presents the proposed methodology and flow chart of the methodology. In this section SLM approach is explained in detail.

Selective Mapping (SLM) Technique

Lowest PAPR signal in this technique is selected from various signals set represents similar information. The least PAPR signal is selected among similar information sharing signals and its transmission with side information.

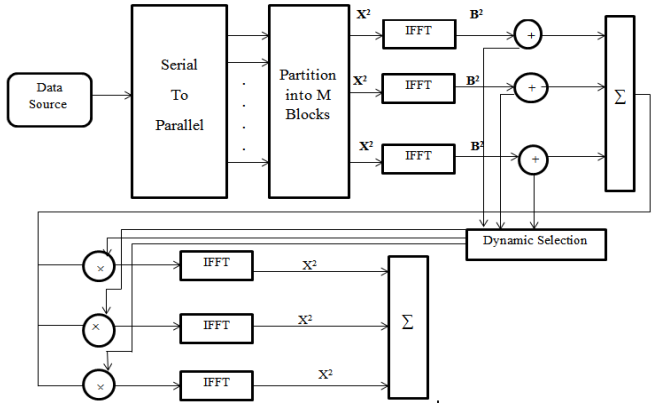

Fig.2: Block diagram of SLM technique

In PAPR reduction, SLM has better performance than PTS for same sub-carriers number and with doing so, there is an increase in computational complexity. The SLM algorithm have following steps:

1. Input signal multiplied with various phase sequence.
2. Generating OFDM signals for each signal.
3. Selecting the lowest PAPR OFDM signal.

IV. RESULTS AND DISCUSSION

Performance Metrics

The following quantitative metrics are used to evaluate the performance

1) **BER**

Bit error rate is defined as no. of error bits per unit time. The no. of error bits referred to received bit number in a stream of data over comm. Channel which are altered due to distortion, noise or interference errors

$$\mathbf{BER}=\frac{1}{2}\,erfc\sqrt{\frac{E_b}{N_0}}$$

2) **SNR**

Signal to noise ratio is the measure utilized in engineering and scientific field which compares the desired signal level to the background noise level.

$$\mathbf{SNR}=\frac{P_S}{P_N}\ \mathbf{or}\ \frac{\sigma_S^2}{\sigma_N^2}\ \mathbf{or}\ \left(\frac{A_S}{A_N}\right)^2$$

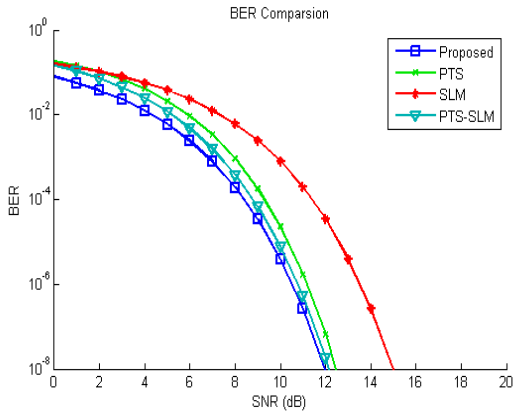

Fig.3: Comparison of BER on PTS, SLM, and PTS_SLM, Proposed

In figure3 depicts the comparison of Bit Error Rate (BER) on different approaches that are proposed approach, PTS, SLM, and PTS_SLM. The values on X-axis denote SNR and values on Y-axis denotes BER on the graph. The Blue line represents proposed approach, Green line represents PTS, Red line represents SLM and Sky blue represents the PTS_SLM approach. The BER is minimum on the proposed approach which shows the less error rate and Red line curve shows the highest error rate in SLM.

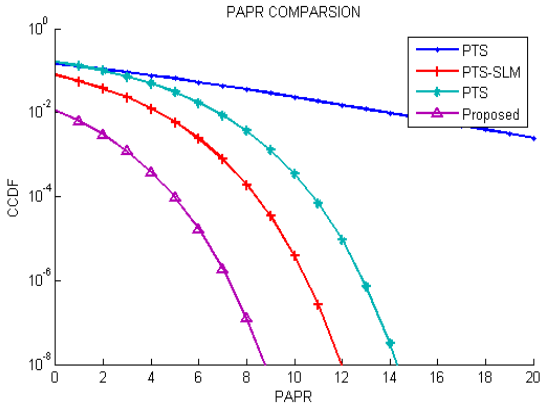

Fig.4: Comparison of PAPR on PTS, SLM, and PTS_SLM, Proposed

In figure 4 depicts the comparison of PAPR on different approaches that are proposed approach, PTS, SLM, and PTS_SLM. The values on X-axis denote PAPR and values on Y-axis denotes CCDF on the graph. The Purple line represents proposed approach, Red line represents PTS_SLM, Sky Blue represents SLM and Blue represents the PTS approach. The PAPR is minimum on the proposed approach which shows the less PAPR and Red Blue line curve shows the highest error rate in PTS.

V. CONCLUSION

In the proposed technique, optimization search is performed to obtain the phase factors. The PAPR statistic of the proposed technique is much better than that of the iterative flipping algorithm and is very close to that of the ordinary PTS technique with significantly reduced search complexity. The proposed technique can be an alternative solution for reducing the complexity of the ordinary PTS technique with little performance degradation.

VI. REFERNCES

[1]. Joo, Hyun-Seung, et al. "New PTS Schemes for PAPR Reduction of OFDM Signals Without Side Information." IEEE Transactions on Broadcasting 63.3 (2017): 562-570.

[2]. Kumar, Arun, and Manisha Gupta. "Design of 4: 8 MIMO OFDM with MSE Equalizer for Different Modulation Techniques." Wireless Personal Communications 95.4 (2017): 4535-4560.

[3]. Zheng, Beixiong, et al. "Multiple-input multiple-output OFDM with index modulation: Low-complexity detector design." IEEE Transactions on Signal Processing 65.11 (2017): 2758-2772.

[4]. Basar, Ertugrul. "On multiple-input multiple-output OFDM with index modulation for next generation wireless networks." IEEE Transactions on Signal Processing 64.15 (2016): 3868-3878.

[5]. 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.

[6]. Pal, Harish Kumar, and Anand Kumar Singh. "PAPR reduction technique using advanced peak windowing method of OFDM system." International Journal of Soft Computing and Engineering 3 (2013): 268-270.

[7]. More, Aparna P., and Sunil B. Somani. "The reduction of PAPR in OFDM systems using clipping and SLM method." Information Communication and Embedded Systems (ICICES), 2013 International Conference on. IEEE, 2013.

[8]. Ghorpade, S. S., and S. V. Sankpal. "Behaviour of OFDM system using MATLAB simulation." International Journal of Advanced Computer Research 3.2 (2013): 67.

[9]. Ghorpade, S. S., and S. V. Sankpal. "Performance Analysis of Multiband OFDM and Pulsed OFDM using Matlab Simulation." IJSR, May (2014).

[10]. Bavi, Shilpa, and SudhirkumarDhotre. "PAPR reduction in OFDM system using clipping and filtering method." International journal of advanced research in computer science and software engineering 5.2 (2015).