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A Hybrid Tone Reservation (Tr) For Reduction Of Papr In Ofdm Systems

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ABSTRACT

Two procedures of the most known ones for crest to normal power proportion (PAPR) lessening of orthogonal recurrence division multiplexing (OFDM) are chosen mapping (SLM) and fractional transmit succession (PTS). The two plans were proposed as mutilation less PAPR diminishment calculations. One of the primary downsides of orthogonal recurrence division multiplex adjustment is its high crest to-normal power proportion (PAPR) which can initiate poor power effectiveness at high power intensifier. To conquer this issue, number of various methods has been acquainted with diminish the impact of PAPR. In this paper, we dissect the execution of joining Selective Mapping (SLM) and Partial Transmit Sequence (PTS) in correlation with the Tone Reservation strategies (TR). TR is the most well-known PAPR moderation strategy that uses an arrangement of saved tones to configuration crest wiping out flag for PAPR decrease. Finding a viable pinnacle scratching off for PAPR lessening in the time space by utilizing just few saved tones isn't clear. In this manner, we are directed to demonstrate an exchange off between aggregate conveyance work (CDF) and PAPR diminishment. Exploratory outcomes can legitimize that our proposed strategy can give proficient outcomes than conventional techniques. Without a doubt, Orthogonal Frequency Division Multiplexing (OFDM) is being favored by numerous correspondence frameworks because of it attractive highlights. OFDM is multi bearer framework that gives strength in blurring channel and high unearthly effectiveness. In any case, OFDM experiences testing deformities, for example, PAPR. To beat this issue, number of various methods has been acquainted with diminish the impact of PAPR. In this paper, we investigate the execution of joining Selective Mapping (SLM) and Partial Transmit Sequence (PTS) in correlation with the ordinary Tone Reservation systems.

KEYWORDS

Orthogonal frequency division multiplexing (OFDM), peak-to-average power ratio (PAPR), selected mapping (SLM), and partial transmit sequences (PTS), Tone Reservation.

INTRODUCTION

From past few years, research community has started considering orthogonal frequency division multiplexing (OFDM) as one of the core technologies for various communication systems and therefore it has been adopted as a standard for various wireless communication systems such as wireless LAN, wireless MAN and digital audio/video broadcasting [1]. It is an efficient technique for achieving high data rate in wireless communication systems and performs better with frequency selective fading channels [2]. Despite its advantages, an OFDM signal experience high peak-to-average power ratio (PAPR) at the transmitter, which causes signal distortion due to the nonlinearity of the high power amplifier (HPA) and causes higher bit error rate (BER) [3]. The large PAPR also increase the complexity of analog-to-digital converter (ADC) and digital-to analog converter (DAC). Thus, PAPR reduction for OFDM systems has become a topic of research to the academicians and researchers these days.

Many schemes have been proposed by researchers for reducing the PAPR of OFDM signals, which can be broadly put into two categories [4]–[11]. First, the PAPR schemes can be classified as multiplicative or additive schemes, where PAPR reduction is carried out in the OFDM modulator. Selected mapping (SLM) and partial transmit sequence (PTS) are multiplicative schemes because the phase sequences are multiplied with input symbol sequences or OFDM signal sequences [4-6], [8]. Whereas, tone reservation (TR) and clipping are additive schemes because the reference signals are added [7], [9], and [10]. In a second category, the PAPR schemes can be classified as deterministic and probabilistic scheme. Deterministic schemes includes clipping [11], limit the PAPR of the OFDM signals below a given threshold level. Probabilistic schemes modify the characteristics of the PAPR distribution statistically for OFDM signals without signal deformation [12]. SLM and PTS are

probabilistic in nature in which multiple signals are generated and the one with the minimum PAPR is chosen for transmission. The computational complexity of SLM is larger than that of PTS still it outperforms over PTS if the amount of side information is limited.

In this paper, a novel hybrid scheme has been proposed to reduce PAPR value significantly by combining partial transmit scheme with selected mapping scheme. The simulated results are presented to strengthen the idea of proposed scheme over other conventional scheme of PAPR reduction.

2. OFDM SYSTEM MODEL

Fig. 1 shows the block diagram of typical OFDM system. A block of input bits (called symbols) are modulated using M-arymodulation scheme and then passed to the serial to parallel converter. Depending upon the system requirements different types of data modulator can be used e.g. MQAM, M-PSK etc.) [45]. The complex parallel data symbols (X) obtained by using modulation techniques are given to N point IFFT block as shown in fig. 1. The baseband transmitted OFDM signal envelope can be written as

$$y(t) = \frac{1}{\sqrt{N}} \sum_{L=0}^{N-1} Y_L \, e^{i2\pi f_L t} \qquad ; 0 \leq t \leq \leq NT \qquad (1)$$

Where, N is the total number of subcarriers, Y, L= 0, 1, 2, N-1 block of N input bits (symbols), f =L f, where Δf=1/ (No), =original symbol period.

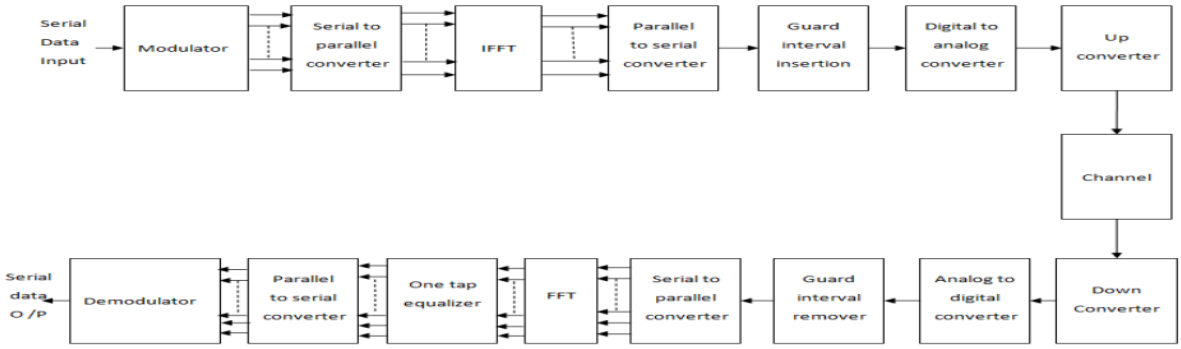


Fig.1: Typical OFDMSystem

$$E[X_k X_l] = \begin{cases} 1 & \forall\, k = l \\ 0 & \forall\, k \neq l \end{cases} \qquad (2)$$

The discrete form of OFDM signal x (n) is given by

$$x(n) = \frac{1}{\sqrt{N}} \sum_{k=0}^{N-1} X_k e^{\frac{j2\pi kn}{N}} \; for n = 0,1,2, \ldots\ldots, N-1 \qquad (3)$$

3)Shows that a signal can be extracted by performing inverse discrete Fourier transform (IDFT) operation on the modulated input bits. Generally, IDFT operation can be performed by using inverse fast Fourier transform (IFFT).

To remove ISI introduced due to delay spread, guard interval is used which is generally interleaved between consecutive OFDM symbols. To remove ISI completely a guard band interval with no signal transmission can be used. However, it may produce ICI due to high frequency components. The guard interval can be introduced in the form of zero padding (ZP) and cyclic extension. Cyclic extension can be extended in two ways-cyclic prefix or cyclic suffix.

On contrary to the transmitter, at receiver side, the guard interval of OFDM symbol is removed and then unguarded OFDM

symbol undergoes serial to parallel conversion. After this, FFT operation is performed to converts parallel OFDM data streams into frequency domain. Therefore, the output of FFT block can be expressed as

$$X(n) = F(n).x(n) + w(n) \forall\ 0 \leq n \leq N-1 \quad (4)$$

Where, W (n) is the additive white Gaussian noise (AWGN) component in frequency domain and (.) denotes frequency response of the multipath fading channel at the sub channel

$$F(m) = \frac{1}{\sqrt{N}} \sum_{l=0}^{L-1} h_l\, e^{\frac{-i2\pi mn}{N}} \forall\ m = 0,1, \ldots\ldots, N-1 \quad (5)$$

3. PAPR

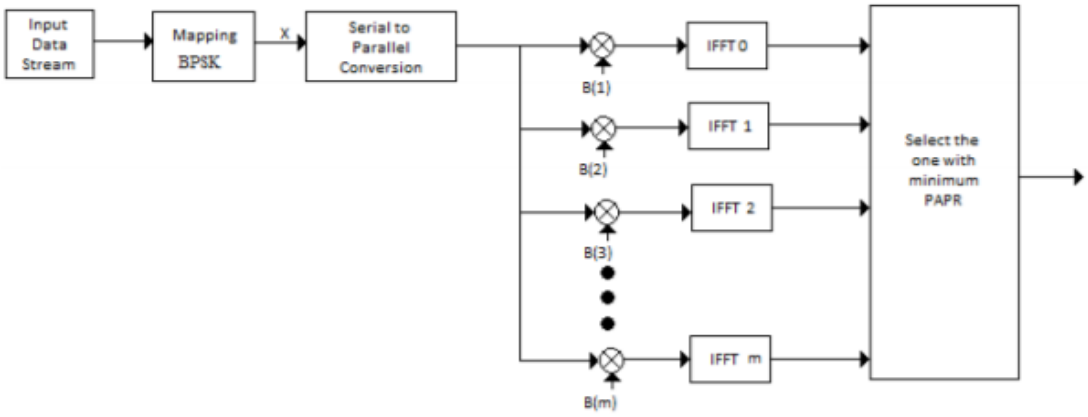
The biggest hurdle to implement OFDM system successfully is its high PAPR value of transmitted signal that severely degrades the system performance. The PAPR of the continuous time OFDM transmitted signal x (t) may be defined as the ratio of the maximum instantaneous power and the average power of OFDM signal.

$$PAPR = \frac{\max[Y(t)]^2}{E\{|Y(t)|^2\}} \forall\ 0 \leq t \leq NT \quad (6)$$

Where, E denotes expectation operator and EV|Yt| X is average power of Y (t) as well as T is an original symbol period. PAPR mainly occurs due to large dynamic range of OFDM symbol waveforms. High PAPR in OFDM fundamentally take place because of IFFT preprocessing (i.e. OFDM signal consists of a multiple independently modulated sub-carriers which can give a large peak when added up with same phases). The discrete time baseband OFDM signals are transformed to continuous time baseband OFDM signals by a low-pass filter called DAC, where the peak power can be increased while maintaining a constant average power. Generally, the PAPR of the continuous time baseband OFDM signals is larger than that of the discrete time baseband OFDM signals by 0.5-1.0 dB [13-14].

4. PROPOSED SCHEME

Many techniques have been proposed by the researchers time to time to overcome PAPR problem associated with OFDM systems. For examples, novel coding schemes, SLM, PTS schemes etc. In this thesis, a hybrid scheme has been proposed by combining SLM technique and different encoding schemes together to reduce PAPR value. The idea is to find the best encoding scheme that helps in reducing PAPR significantly when combined with SLM approach. Fig. 2 is shows the flow diagram of proposed Technique.



PAPR REDUCTION SCHEME

Partial Transmit Sequence (PTS)

As the name suggest, in PTS scheme, signal's high PAPR issue is resolved by dividing the input data block into independent sub blocks which are further processed by converting them into time-domain partial transmit sequences [16]. These partial sequences are thereafter rotated with different phase factors to combine optimally to obtain OFDM signals with lowest PAPR value. To find optimal phase factors is a cumbersome process and requires high computational complexity to the system. Moreover, it requires side information to be transmitted at receiver side for appropriate decoding and demodulation of the transmitted bit sequence [17].

Selected Mapping (SLM)

Similar to the PTS scheme, in SLM scheme the input data sequences are multiplied by each of the phase sequences to generate alternative input symbol sequences [18]. IFFT operation is performed on each of these alternative input data sequences and then the sequence with the lowest PAPR is transmitted. For the successful implementation of SLM OFDM systems, the SLM technique multiple IFFT operations and side information for each data block [19].

Tone Rejection (TR)

Both, tone rejection (TR) schemes work on the same principle of keeping a subset of tones reserve at the transmitter and receiver side to generating PAPR reduction signals. In TR, the time domain signal is identified to add to the original time domain signal to reduce the PAPR. Similarly, in TI scheme the constellation size is extended by replacing same data point with multiple possible constellation points by duplicating the original constellation into various alternative ones [21- 22].

The TI technique is more challenging than the TR technique since the injected signal occupies the frequency band as the information bearing signals. Moreover, the alternative constellation points in TI technique possess increased energy which results increase in the implementation complexity for the computation the optimal translation vector [23].

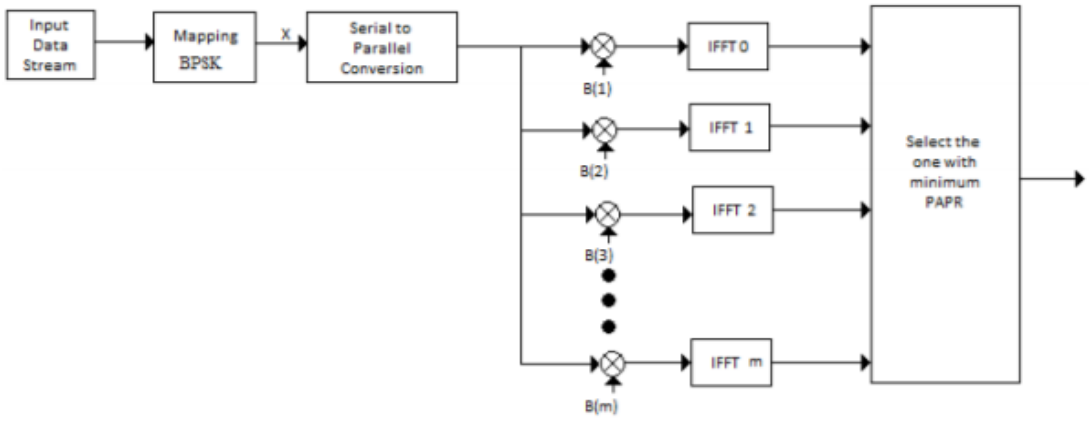


Fig : 2

5. RESULTS & DISCUSSIONS

We have considered an OFDM framework with N = 32 subcarriers and transmission of 1000 OFDM images to assess the general execution of the OFDM framework. Every one of the recreations are done and plots of hypothetical outcomes are assessed in MATLAB condition. We have utilized CCDF, PAPR exhibitions as a measure to check the viability of the proposed conspire.

To assess the CCDF, PAPR exhibitions of ISI plans without PAPR decrease, a QPSK regulated OFDM framework is thought about..

To relieve the impact of multipath proliferation of remote channel, a CP of length 1/32 OFDM image term is utilized and demonstrates the exhibitions of ISI self-cancelation, new ISI self-cancelation and ICI conjugate cancelation plans with and without PAPR diminishment, as an element of standardized recurrence offset(ε). This is relied upon to be the most noticeably bad outcome, however as observed f, the CIR of ICI conjugate cancelation conspire turns out to be more terrible than standard OFDM motion without ICI cancelation for ε > 0.25 .

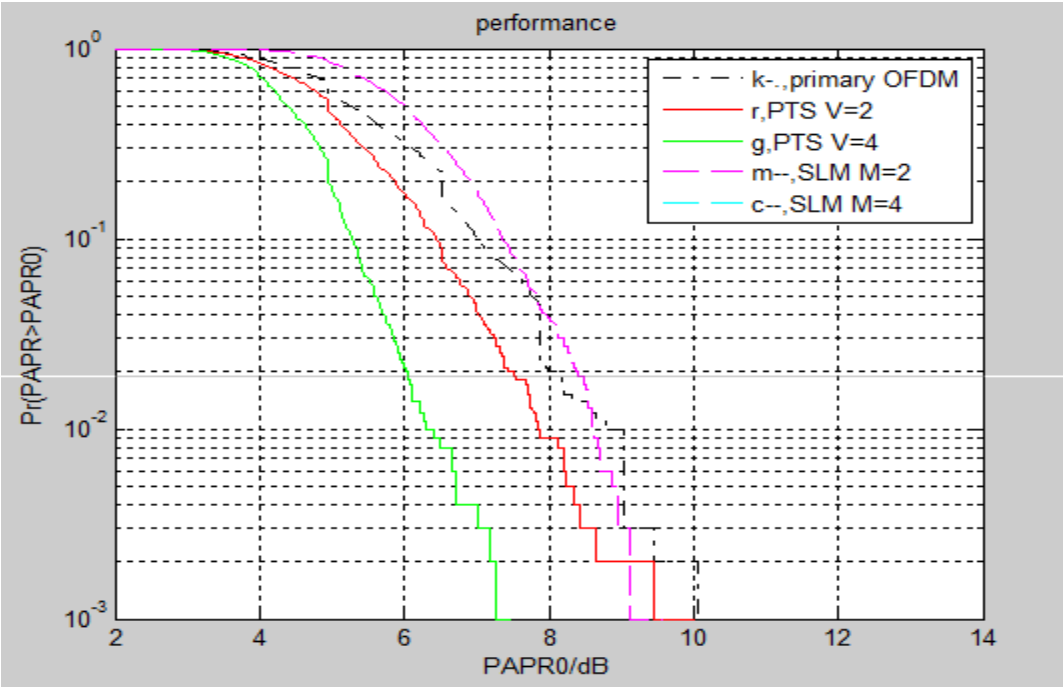


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Fig-3

After applying the proposed values of primary OFDM on both SLM and PTS CCDF's, we have come up with the results shown in Fig**3** .

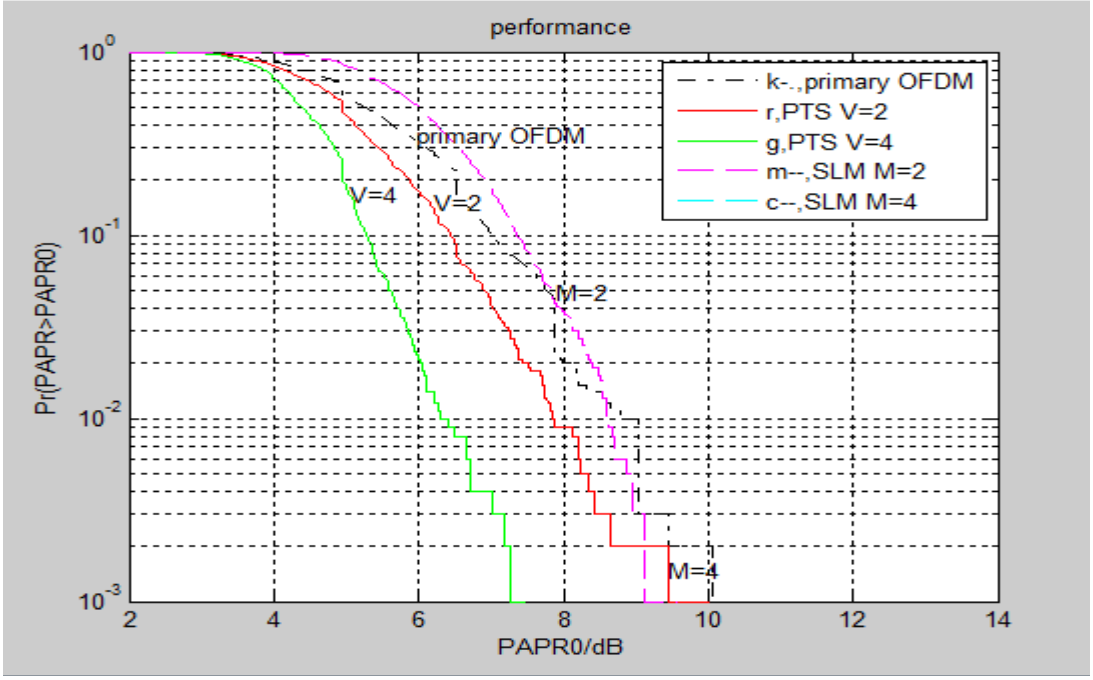

Fig-4

The PAPR reduction efficiency of PTS algorithm improves with having the Probability(PAPR>PAPR$_o$) increased from 10^{-3} to 10^{-0}, while the PAPR reduction efficiency of SLM algorithm gets impaired with having the probability increased within the same range. Both SLM and PTS algorithms were applied to the same OFDM signal and tested for PAPR reduction under the same circumstances.

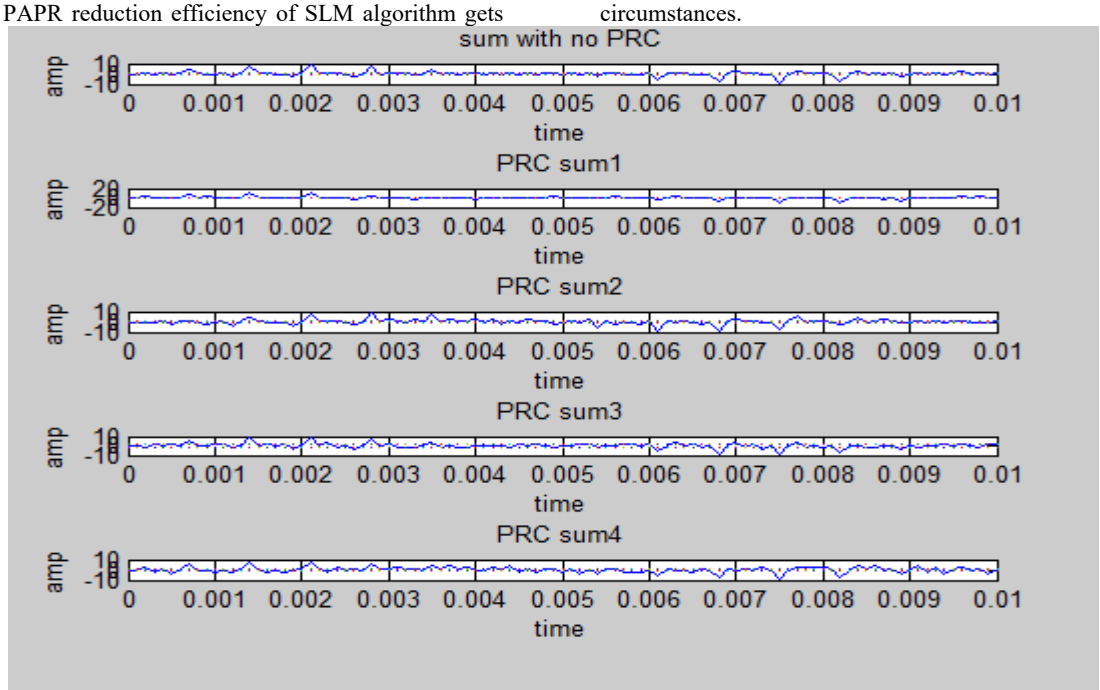

Fig-5 BER performance of the signal after PAPR reduction.

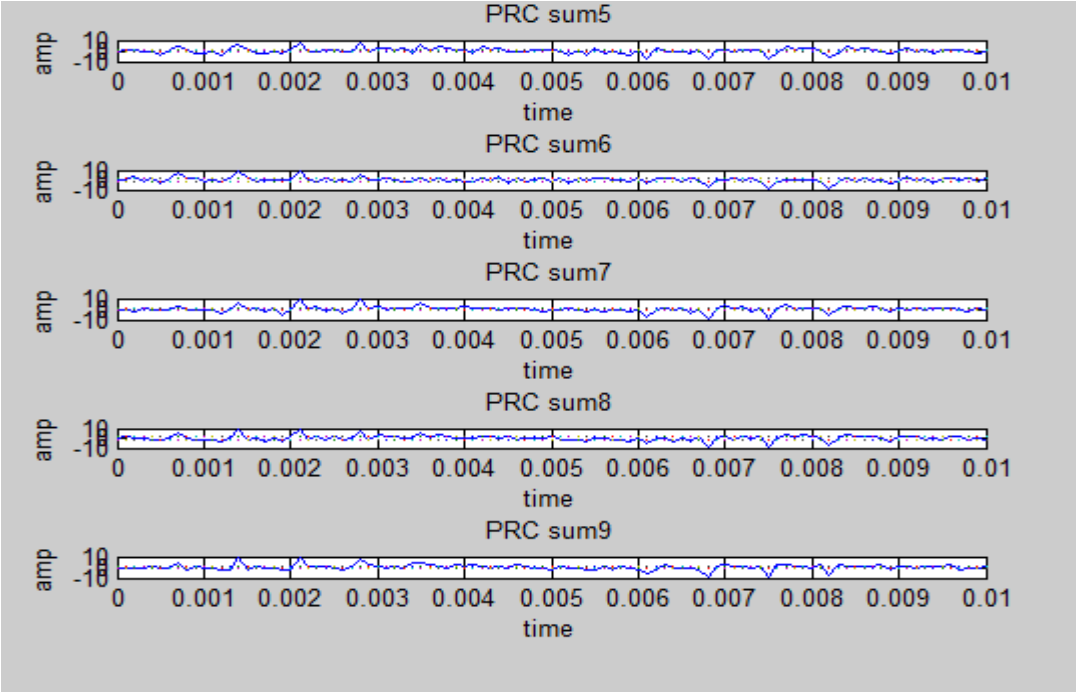

Fig-6 BER performance of the signal after PAPR reduction.

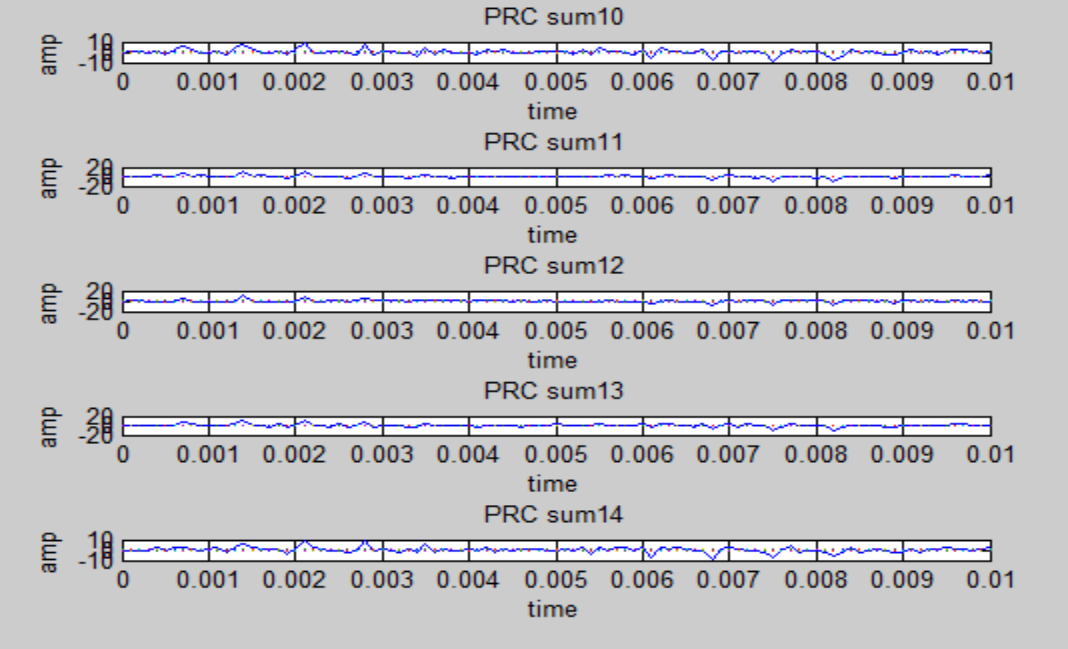

Fig-7 BER performance of the signal after PAPR reduction.

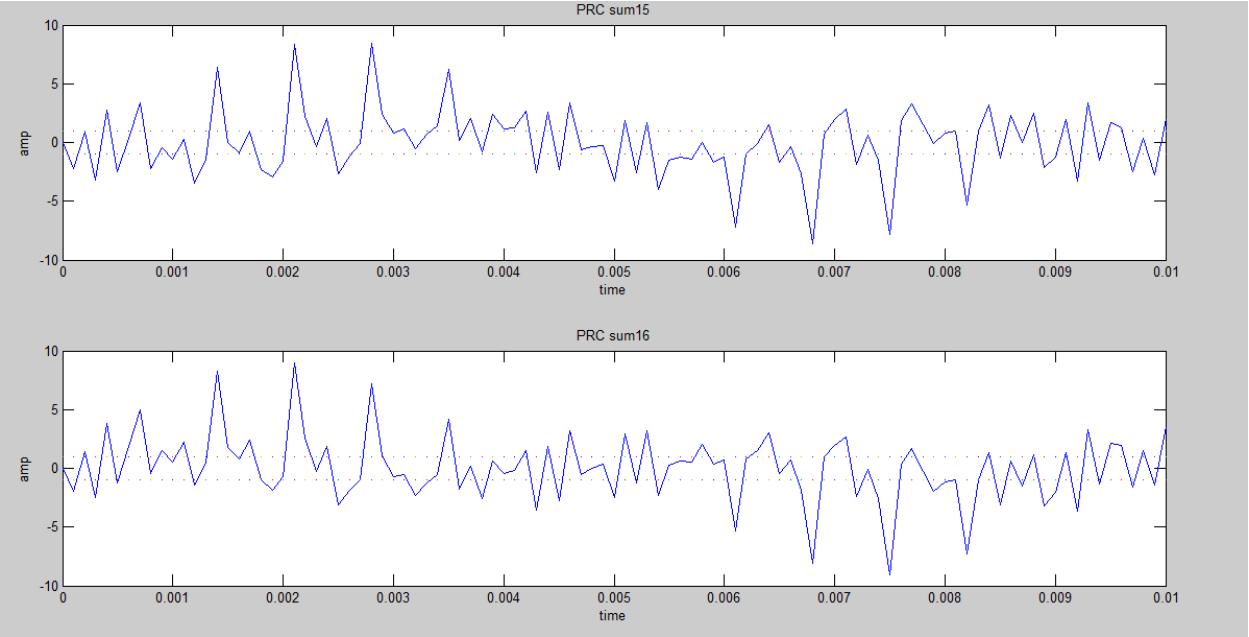

Fig-8 BER performance of the signal after PAPR reduction.

6. CONCLUSION

PTS and SLM are observed to be two well known non-bending PAPR lessening plans. They accomplish PAPR decrease ability at the cost of expanded computational multifaceted nature, and require SI at the less than desirable end to recuperate the first information flag. In these plans, the SI transmission and recuperation have prime significance in light of the fact that any mistake in SI location may prompt serious BER execution debasement. In this paper, in the wake of recreating both PAPR decrease plans SLM and PTS, a proposed way is actualized to assess both SLM and PTS methods from the point of the framework proficiency while expanding the likelihood of getting high PAPR esteems. We present a PAPR diminishment procedure that could be actualized to OFDM correspondence frameworks. The proposed system depends on joining both SLM-PTS with Tone Reservation to give limited PAPR esteem, making it an exceptionally engaging technique particularly for standard OFDM applications.

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