Lateral Evidence Moderation per novel Chapter Structure aimed at Mixture PTS Order

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Abstract: This paper focus on presenting a new phase sequence based hybrid PTS approach for OFDM systems to mitigate the problem of PAPR without use of side information. The modified phase vectors are then multiplied to the original phase vectors so as to obtain a modified version of phase vectors that includes an offset. Experimental results shows that the PAPR is reduced about 04~0.8 db when compared against the traditional PTS scheme deployed for Hybrid systems.

Keywords: OFDM, PAPR, Hybrid PTS, Side information, Rotating phase vectors.

1. INTRODUCTION

Various wireless communication standards adopted OFDM (orthogonal frequency division multiplexing) as it can transmit the data at higher rate [1] [2]. Despite of many advantages the OFDM suffers from high PAPR (peak to average power ratio) due to the superposition of sub carriers. In order to reduce this problem many researchers have proposed different mitigation algorithms such as clipping [3], coding techniques [4], selective mapping techniques [5], partial transmit sequence [6] [7], tone reservation [8], active constellation [9].

Among these algorithms and approaches PTS (partial transmit sequence) is well known probabilistic approach without causing the signal distortion, in which the candidate signal is selected which has minimum PAPR value among 'U' alternative signals generated by summing the multiplied phase factors for V disjoint sub blocks. To recover the input symbol sequences the selected signal index termed as side information should be transmitted to the receiver. If the index is not detected properly at the receiver then the BER of the system is degraded, hence there is a great need to represent these index signals properly or to propose a approach which doesn't require the side information.

In this paper, a new phase factor sequence is presented which enable to minimize the PAPR without the knowledge of side information at the cost of traditional PTS schemes. The entire work of this paper concentrates on Hybrid PTS schemes [10].

The paper is organized as follows, section 1 presents the introduction to the research work and the need of it, section 2 presents a brief literature survey of the earlier methods which are related to this work and section 3 presents the background related concepts like traditional PTs scheme and hybrid PTS scheme. Section 4 presents the proposed modified phase vector analysis and section 5 presents the experimental results obtained with the proposed approach ending with conclusions.

OFDM PAPR Descriptions

With the linear property of the N narrowband subcarriers, the discrete-time OFDM signals can be written as

$$x(n) = \sum_{K=0}^{N-1} X(k) e^{2\pi kn/N} \qquad (1)$$

For simplicity, we can have x = IFFT {X}, where X = [X(0), ..., X(N − 1)]T and x = [x(0), ..., x(N − 1)]T . Because of the statistical independency of the transmitted subcarriers, the time domain OFDM samples x(n) are approximate Gaussian distribution. In the literature, the complementary cumulative distribution function (CCDF) of the PAPR is one of the most frequently used performance measures for PAPR reduction techniques. CCDF(PAPRo) = P r(PAPR > PAPRo)

2. RELATED WORK

In recent years a lot of research is done on presenting innovative and low complex approaches for the reduction of PAPR in OFDM systems, the concepts and approaches that are related to the current work is presented in this section.

In [11] Y. Zhang et al proposed a method not only to reduce PAPR but also to detect the transmission errors. This method is mainly based on sub coding, and its extension where the redundant bit location is classified as optimized sub block and combination optimized sub- blocking.

In [12] Bauml.et.al proposed SLM approach. Where the parallel data is multiplied by predetermined set of phase vectors and generates alternate signal which are orthogonal to one another. From these alternate orthogonal signals, the one which has least PAPR is selected for transmission. The multiplied signal can be sent as side information in order to recover exact signal at the receiver. This method suffers from greater limitation that as number of phase increases complexity of the system increases.

In [13] K. D. Choe et al. proposed a scrambling approach involving data reversal positions that can reduce the PAPR value. In this analysis the PAPR is detected using correlator and before IFFT processing the symbols are arranged by inversing the data bits so as to reduce the PAPR value. This method proved to be very simpler and low complex and attaining a reasonable PAPR and also the number of IFFT's used in this analysis is very much lower than any PTS scheme

In [14] Muller et.al presented partial Transmit sequence (PTS) which is based on phase rotation and shifting. Initially the data is converted into different non overlapping sub blocks and the data in each sub block is multiplied with some phase vector. The sub block with low PAPR is chosen to construct a candidate signal for transmission. This method is a modified version of SLM approach with more flexibility. However it is more applicable practically since it doesn't require any side information as in the case of SLM approach.

In [15] wang et.al proposed a method that uses oversampling factor of 4 for the discrete OFDM signal to approximate the peaks in the signal. Oversampling with a factor of 4 increases complexity however the complexity is reduced by searching of the peak components in the original signal with reference to 4 times oversamples signals. It is also observed to combine this approach with traditional SLM approach doing so will decrease the performance slightly but it can be implemented at very low complexity

In [16] Zhou et al , proposed Multi- point-square mapping (MPSM) based PTS scheme . In this analysis the conventional QPSK constellation scheme is extended to 16-QAM constellation to provide disjoint points for mapping. This approach provides promising results as that of conventional PTS scheme but it doesn't require any side information. This makes it possible for better bandwidth efficiency and BER performance when compared with conventional PTS scheme.

In [17] Wu .et.al proposed an approach by interleaving the partitioned partial transmit sequence approach. This is very attractive approach but its performance is inferior to adjacent partitioning scheme of PTS because the candidate signal generated with this approach is not independent. This approach completely analyzes the independence of candidates and finds appropriate effective   phase vectors. Simulation results provides an conclusion that the proposed conjugate PTS scheme is providing better results than the traditional PTS scheme with optimal complexity.

In [10] a hybrid scheme was introduced in which the side information is the sum of SLM and PTS parts and the computational complexity also less than the conventional PTS scheme. In [18], proposed a hybrid scheme integrating

it with dummy signal insertion and achieved a considerable decrease in PAPR with low complexity.

3. BACKGROUND

a) Conventional PTS (C-PTS)

The below diagram depicts the functionality of the conventional PTS scheme for OFDM systems
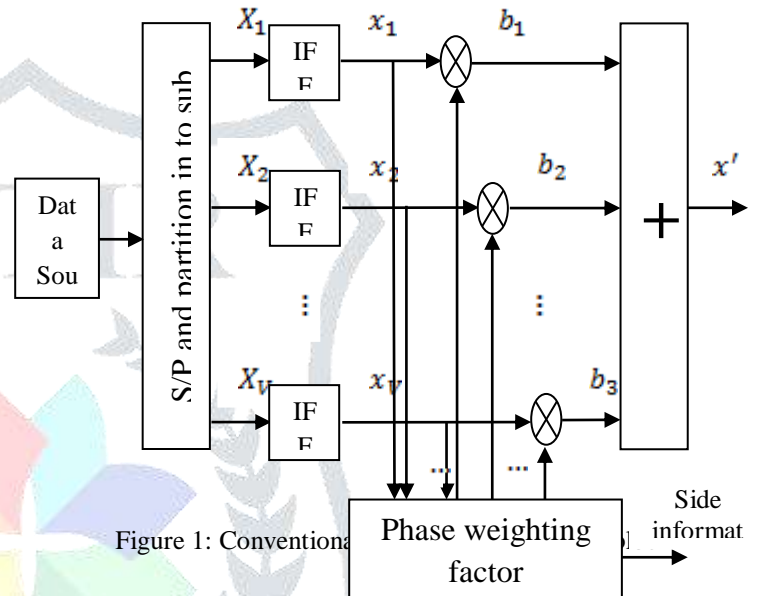

Figure 1: Conventional ... Phase weighting factor ... Side informat

The Partial transmit sequence (PTS) is intended to apply on the input data block for performing the partition process on input block to number of disjoint sub-blocks and each partitioned sub block are padded with zeros and weighted by that individual disjoint sub block phase factor.

The input data block taken is $X = \left[X_0, X_1, X_2, \ldots X_{N-1}\right]^T$ and the partition process is applied on taken input data block is to divide it in V disjoint sets $\{x_v, \quad v = 1,2, \ldots v\}$. Subcarriers taken in each group is same and it is maintained same in all groups and the representation of alternative frequency domain signal is given as follow notation

$$X^{'} = \sum_{v=1}^{v} X_v\, b_v \qquad (1)$$

The variables used in above notation is meant for phase factors $X^{'} = e^{j\emptyset_v}$ and $\emptyset_v = \frac{2\pi i}{W}$, i= 0, 1 … W-1. Partial transmit sequence is represented as X_v (IFFT) and

the phase factor selected for such phase factor is minimal for PAPR candidate signal. The possible candidate's navigation from V sub-blocks and W phase weights and possible candidates are represented as WV-1 and the phase factor block is chosen as 1 and V-1 additions and multiplications are carried out for calculation of each candidate.

b) Hybrid PTS scheme

This scheme uses the advantages of both SLM and PTS schemes, this was initially proposed Pushkarev et.al in [10] . The scheme is illustrated in figure 2, in this the original OFDM symbols are multiplied with 'U' phase rotation sequences and then each of the OFDM symbols is partitioned in to V disjoint sub blocks. These sub blocks are selected based on optimization with PTS scheme. This can be written as

$$\left\{ b_1^{\overline{(u)}}, b_2^{(u)} \right\} = argmin \left\{ \sum_{v=1}^{2} b_v^{(u)} X_v^{(u)} \right\} \quad (2)$$

Where $1 \leq u \leq U$ and V=2, Obtain the block which has retained a lower PAPR by using PTS optimization. Lower PAPR from PTS block is statistically independent with each other.
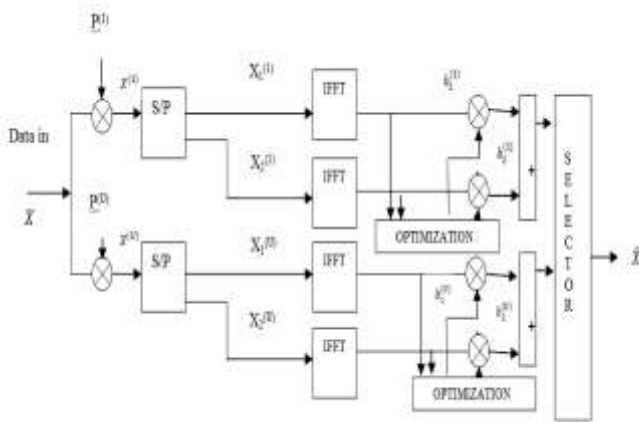

Figure 2: Hybrid approach of PTS scheme

4. PROPOSED APPROACH

To mitigate the transmission of side information a method to embed the SI into phase rotating vectors is presented. Let us consider a V-tuple phase vector is defined as

$$S^u = [S_0^u \ S_1^u \ \dots S_{V-1}^u] \quad (3)$$

Where $S_V^u \in \{0,1,\dots Z\}$ and $0 \leq v \leq V - 1$ and $0 \leq u \leq U - 1$, for instance $S_V^u = 0$ implies phase offset of 0, in order to embed side information into u^{th} rotating vector b^u , then each rotating factor is multiplied by $e^{j\theta s_v^u}$ where θs_v^u is the phase offset $0 \leq \theta s_v^u < 2\pi$,

then the modified phase rotating vector can be represented as

$$\overline{b^u} = \left[\overline{b_0^u} \ \overline{b_1^u} \dots \overline{b_{V-1}^u} \right]$$

$$= \left[b_0^u e^{j\theta s_0^u} \ b_1^u e^{j\theta s_1^u} \ \dots\dots \ b_{V-1}^u e^{j\theta s_{v-1}^u} \right] \quad (4)$$

The modified alternative signal modifies the equation (1) and can be represented as

$$X^u = \sum_{v=1}^{v} X_v \ \overline{b^u}_v$$

In this scheme, X^u with minimum PAPR is selected as the candidate signal. The modified phase vectors for U=8 is tabulated in table 1

Table 1: modified Phase vectors with proposed approach

	b_0^u	b_1^u	b_2^u	s_0^u	s_1^u	s_2^u	$\overline{b_0^u}$	$\overline{b_1^u}$	$\overline{b_2^u}$
u=0	1	1	1	0	0	0	1	1	1
u=1	1	1	-1	0	0	1	1	1	$-e^{j\frac{\pi}{6}}$
u=2	1	1	j	0	1	0	1	$e^{j\frac{\pi}{6}}$	j
u=3	1	1	-j	1	0	1	$e^{j\frac{\pi}{6}}$	1	$-e^{j\frac{\pi}{6}}$
u=4	1	-1	1	2	1	0	$e^{j\frac{\pi}{3}}$	$-e^{j\frac{\pi}{6}}$	1
u=5	1	-1	-1	1	1	1	$e^{j\frac{\pi}{6}}$	$-e^{j\frac{\pi}{6}}$	$-e^{j\frac{\pi}{6}}$
u=6	1	-1	j	0	1	2	1	$-e^{j\frac{\pi}{6}}$	$e^{j\frac{\pi}{3}}$
u=7	1	-1	-j	1	2	2	$-e^{j\frac{\pi}{6}}$	$-e^{j\frac{\pi}{3}}$	$-e^{j\frac{\pi}{3}}$
u=8	1	j	1	0	2	0	1	$e^{j\frac{\pi}{3}}$	1

5. EXPERIMENTAL RESULTS

The proposed approach is tested with N=256 sub carriers and 10^4 symbols with 4-QAm modulation. The proposed approach is tested for different 'U' values and the response of it is depicted in the figures below.
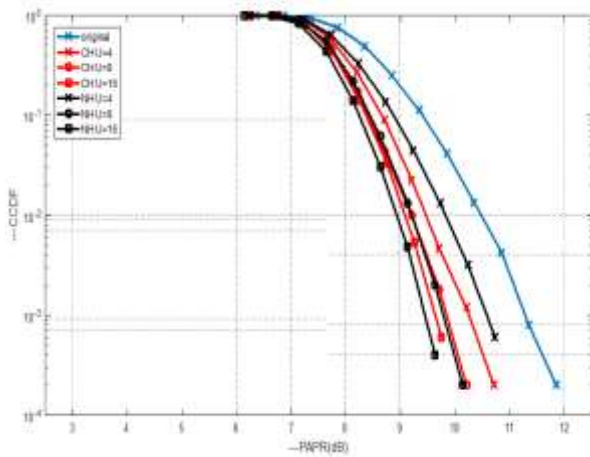
Figure 3: PAPR performance analysis of the proposed and conventional hybrid PTS schemes under U=4, 8, 16

It can be observed from the figure that the approach is attaining higher PAPR for lower U values like 4 which gradually decreases when the value of U is higher. It is also observed that at U=16 a decrement of 04~0.8 db of PAPR is obtained for the proposed approach. From figure 4 it can be observed that the interference is compatibly lower than the C-PTS approach.
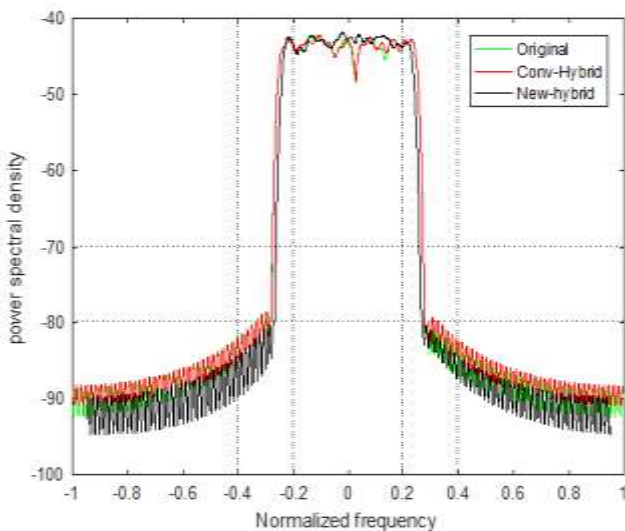

Figure 4: OBI performance of the proposed approach

6 CONCLUSION

A new phase sequence based hybrid PTS scheme for PAPR reduction is proposed in this paper. The sequence of the phase vectors are modified with exponential angle offset which is considered as offset is multiplied with the traditional phase rotating vector . The results obtained with the modified phase rotating vectors shows considerable improvement in the reduction PAPR with cost of minimizing the interference. This work can be further extended with implementation of likelihood detector at the receiver and estimating the BER performance under different channeling environments.

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