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A Novel Method for PAPR Control NIN SFBC MIMO-OFDM Without Using Side Information

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Abstract: A novel peak-to-average power ratio (PAPR) reduction scheme designated as extended selected mapping (eSLM) is proposed for space-frequency block coding (SFBC) multi-input multi-output orthogonal frequency division multiplexing systems. In the eSLM method, extension matrices comprising amplitude extensions and phase rotations are constructed to indicate the selected signal index without the need for side information and to minimize the PAPR, respectively. To reduce the computational complexity incurred by the inverse discrete Fourier transform operation in generating the candidate signals, a low-complexity eSLM scheme (LC-eSLM) is developed by constructing equivalent candidate signals in the time domain. Notably, the extension matrices in both schemes preserve the orthogonality of the SFBC code, thereby facilitating low-complexity decoding. The simulation results show that the proposed eSLM scheme not only outperforms existing blind SLM-based methods. Compared with the costly ordinary SLM scheme, the eSLM scheme has a lower computational complexity with a performance loss of less than 0.3 dB and requires no side information. Furthermore, the computational complexity of the LC-eSLM scheme is around 40%–50% lower than that of the eSLM scheme with only a marginal degradation in the PAPR reduction performance.

Keywords: Block-Chain, Voting, Decentralization.

I. INTRODUCTION

As of late, the interest for multimedia information administrations has developed definitely which drive us in the period of fourth generation remote communication system. This prerequisite of multimedia information administration where client are in huge numbers and with limited range, present day computerized remote communication system received advances which are bandwidth effective and hearty to multipath channel condition known as multicarrier communication system. The advanced computerized multicarrier remote communication system give rapid information rate at least expense for some clients just as with high unwavering quality. In single carrier system, single carrier possesses the whole communication bandwidth however in multicarrier system the accessible communication bandwidth is partitioned by many sub-carriers. With the goal that each sub-carrier has littler bandwidth as contrast with the bandwidth of the single carrier system. These enormous highlights of multicarrier procedure pull in us to contemplate Orthogonal Frequency Division Multiplexing (OFDM). OFDM frames reason for all 4G remote communication systems because of its enormous limit as far as number of subcarriers, high information rate more than 100 Mbps and ubiquitous inclusion with high portability . The presentation section comprises of following parts: Overview, Historical Development of OFDM, rule of orthogonality, points of interest and hindrances of OFDM strategy, and the uses of OFDM procedure. The need of high information rate draws the incredible consideration in multi-carrier system. It ought to be skilled to work easily in condition of high carrier frequency, high information transmission rate and portability. The contemplated has demonstrated that OFDM satisfy the multicarrier system necessities.

OFDM is a multi-carrier tweak (MCM) procedure in which complex information images (i.e, BPSK, QPSK, QAM, MPSK and so forth.) are transmitted in parallel in the wake of balancing them over orthogonal sub-carrier. In single carrier (SC) system, one complex information is transmitted utilizing one carrier and in this parallel transmission, complex information is transmitted over sub-carrier. Here the powerful information rate of the system is same as of SC system. The parallel transmission expands the timespan of image and the similar measure of separation in time brought about by multipath defer diminishes. In OFDM system, the orthogonality among sub-carriers is kept up by utilizing opposite Fast Fourier Transform (IFFT) as appeared in figure (2.1). A watchman band is embedded between progressive OFDM images. Inclusion of watchman band in OFDM images should be possible by three techniques cyclic prefix, cyclic addition and zero cushioning. By including watchman band in OFDM images, OFDM convert wideband frequency particular channel into accumulation of parallel narrowband level blurring channel, one channel over each subcarrier. In this manner it evacuates Inter-Symbol Interference (ISI). Because of highlights like high invulnerable to multipath blurring, high information transmission rate and necessity of less intricate equalizer, OFDM has been misused by numerous high information rate broadband remote communication systems of present generation [1], [2].

II. LITERATURE REVIEW

In 2010, Jung Chien Chen [46] proposed Electromagnetism-like (EM) algorithm for PTS technique, a stochastic improvement approach, to accomplish significant PAPR reduction with low multifaceted nature. EM algorithm primarily works with four methods: (1) instatement, which create irregular examples inside the limit of number of subblocks and iteration, (2) nearby inquiry system is utilized to look through ideal stage factor, (3) figuring of total power strategy is utilized to compute stage factor that join with sub blocks for low PAPR and rejects others, (4) development of the particles methodology is utilized to refresh stage factor from number of sub blocks. In 2010, Sheng. Ju. Ku et al., [7] proposed another diminished intricacy PTS conspire. In this plan, another cost capacity is made which can be characterized as the total of the power tests in the wake of taking IFFT in each sub block. The examples with cost work that are more noteworthy than or equivalent to a fixed limit are selected. As an outcome, the sign with most reduced PAPR for transmission is looked over the selected hopefuls. The proposed plan can accomplish around the equivalent PAPR as of the CPTS conspire with less computational multifaceted nature.

III.PROPOSED TECHNIQUE FOR PAPR REDUCTION

In this paper, a new hybrid technique is proposed to reduce the PAPR. This proposed technique is a combination of pre-coding and PTS methods and it is less complex than PTS method. Furthermore, it reduces the PAPR considerably with only few numbers of sub blocks as compare to PTS technique. This chapter described in detail the system model and PAPR as well as power spectral density (PSD) for this model. Simulation results are done to evaluate the PAPR and PSD performance.

A. Introduction

From the literature survey, it has been found that the frequency domain PAPR reduction technique is better than time domain because of its ability to reduce the PAPR without distorting the transmitted signals and thus not producing any in band distortion and out of band radiation. Among many available techniques of frequency domain, PTS and pre-coding are the best frequency domain methods to reduce PAPR as compare to others. PTS method is distortion less method because it divides frequency vector into some sub-blocks before applying the phase transformation. The main issue of this scheme is increment in complexity due to increased number of sub blocks, number of selection of phase factors and amount of side information to be sent for recovery of original signal. Pre-coding technique reduces the PAPR with less complexity but the number of subcarriers increases with increase in roll off factor. Here, we proposed the combine technique of pre-coding and PTS to reduce the PAPR of OFDM system. This method is mainly focused to reduce PAPR and to minimize the complexity which arises due to number of sub blocks. The complexity associated with PTS regarding the increased number of sub blocks is the requirement of more IFFT operation to be performed for sub blocks. So, this proposed method obtain the considerable reduction in PAPR using few number of sub blocks as comparison to the PAPR obtained by using large number of sub blocks in PTS scheme.

B. System Model

A proposed system based on pre-coding of encoded data applying to PTS OFDM with sub-carriers is shown in figure 4.1. In this system, -ary data encoder converts the input data bits into complex data symbols at the beginning of the system model. Different type of modulation techniques (e.g. BPSK, QPSK, QAM etc.) can be used for data encoder. After that, encoded data with data rate is arranged into blocks of length of symbols each. These symbols are converted from serial to parallel. Each symbols block is pre-coded by pre-coding matrix of size

$$X(k) = \sum_{n=0}^{N-1} p_{k,n} \times X, \;\; k = 0,1,2,\ldots\ldots L-1 \tag{1}$$

where

$$P = \begin{bmatrix} p_{0,0} & p_{0,1} & \cdots & p_{0,N-1} \\ p_{1,0} & p_{1,1} & \cdots & p_{1,N-1} \\ \vdots & & \ddots & \vdots \\ p_{L-1,0} & p_{L-1,1} & \cdots & p_{L-1,N-1} \end{bmatrix}$$

These pre-coded symbols are oversampled by a sampling factor to provide better estimation of PAPR [38], by inserting zeros in the pre-coded symbol. These oversampled pre-coded symbols are partition into disjoint sub blocks.

$$X_v = \sum_{m=1}^{V} X_p \tag{2}$$

Here, adjacent partition scheme is used to separate sub blocks. Then the sub blocks are multiplied by complex phase factor , where and taking IFFT of each sub block at the same time.

$$x = \sum_{m=1}^{V} w_v \times IFFT\{X_v\} = \sum_{m=1}^{V} w_v \times x_v \tag{3}$$

is called partial transmit sequence (PTS). After selecting appropriate phase factor the lowest PAPR vector in time domain is given as-

$$\tilde{X} = \sum_{m=1}^{V} \tilde{w_v} \times x_v \tag{4}$$

At the receiver, the received signal is partitioned again into disjoint sub blocks using the same partition scheme of transmitter side. Each partition sub blocks are multiplied by their optimized phase factors , which are calculated in the transmitter side, where is a transpose of . Each time domain sub block is converted to frequency domain by using - point FFT. Frequency domain sub block is multiplied with matrix , where is the hermitan transpose of . After multiplication we get a vector of length

$$\tilde{X} = P^{*} \times Y, \qquad for\, n = 0,1,2,\ldots\ldots N-1.$$

Then obtain result of vector is decoded by using different decoded scheme(e.g., MPSK, MQAM) to recover transmitted symbol.

C. PAPR in OFDM System

In the transmitter side, the PAPR of transmitted signal is defined by-

$$PAPR = \frac{P_{peak}}{P_{avg}} = \max_{0\le t\le T} |x(t)|^2 / E\{|x(t)|^2\} \quad (5)$$

The transmitted OFDM signal can be defined as

$$x(t) = \sum_{n=0}^{N-1} X_p \times X_v \quad (6)$$

where,

$$X_p(t) = \sum_{n=0}^{N-1} X \times P(t), 0 \le t \le T$$

Also, is a set of time limited function used to generate precoding matrix and it is defined by-

$$P(t) = \sum_{k=0}^{L-1} P_{k,n} e^{\frac{j2\pi k}{T}}, 0 \le t \le T \quad (7)$$

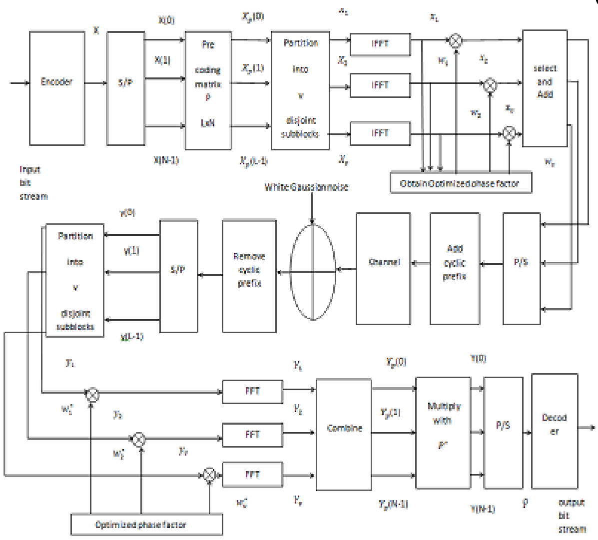

Fig1. Block diagram of Precoding PTS OFDM system with subcarriers.

Here, selection of phase factor should be done in an optimized way to reduce the PAPR as given below

$$[\widetilde{w_1} \dots \widetilde{w_v}] = \frac{\arg\min}{[w_1 \dots . w_v]} \left(\max_{n=0,1,\dots L-1} \sum_{m=1}^{V} |w_v * x_v[n]| \right) \quad (8)$$

The OFDM signal at first depends on the elements of precoding matrix depends on the phase factor. So, the PAPR of can be controlled by proper selection of precoding matrix ( ) as well as proper selection of phase factor. The element of precoding matrix can be determined from the fundamental properties of as mentioned below

$$P_{k,n} = e^{\frac{-j2\Pi kn}{N}} \frac{1}{T} \int_0^T p(t) e^{\frac{-j2\Pi k}{N}} dt \quad (9)$$

After taking Fourier transform and simplifying equation,

$$P(k,n) = (-1)^k e^{-\frac{j2\pi kn}{N}} \frac{1}{T} P\left(\frac{k}{NT_s}\right) \quad (10)$$

Pulse shapes like SQRC, RC, and BTRC functions are used to generate precoding matrix in this thesis. The RC, SQRC and BTRC functions in frequency domain are defined as respectively .

$$P_{RC}(f) = \begin{cases} T_s \sin^2\left(\frac{\pi f Ts}{\beta}\right), & 0 < f \le \frac{\beta}{T_s} \\ T_s, & \frac{\beta}{T_s} < f \le \frac{1}{T_s} \\ T_s \sin^2\left(\frac{\pi(fTs-1)}{2\beta} + \frac{\pi}{2}\right), & \frac{1}{T_s} < f \le \frac{1+\beta}{T_s} \end{cases}$$

$$P_{SQRC}(f) = \begin{cases} T_s \sin\left(\frac{\pi f Ts}{2\beta}\right), & 0 < f \le \frac{\beta}{T_s} \\ T_s, & \frac{\beta}{T_s} < f \le \frac{1}{T_s} \\ T_s \sin\left(\frac{\pi(fTs-1)}{2\beta} + \frac{\pi}{2}\right), & \frac{1}{T_s} < f \le \frac{1+\beta}{T_s} \end{cases}$$

$$P_{BTRC}(f) = \begin{cases} T_s\left(1 - e^{-\frac{2\ln 2}{\beta} f T_s}\right), & 0 < f \le \frac{\beta}{2T_s} \\ T_s\left(-\frac{2\ln 2}{\beta}(\beta - fT_s)\right), & \frac{\beta}{2T_s} < f \le \frac{\beta}{T_s} \\ T_s, & \frac{\beta}{T_s} < f \le \frac{1}{T_s} \\ T_s\left(e^{-\frac{2\ln 2}{\beta}(-1+fT_s)}\right), & \frac{1}{T_s} < f \le \frac{(1+0.5\beta)}{T_s} \\ T_s\left(1 - e^{-\frac{2\ln 2}{\beta}(1+\beta-fT_s)}\right), & \frac{(1+0.5\beta)}{T_s} \end{cases} \quad (11)$$

Where a roll-off factor ranging from 0 to 1. From is a set of allowed phase factor. Here,sets of phase factor have to be verified for solving equation (4.10). So, as the number of subblocks increases, the process of verifying equation (10) also increases. Normally choosing the phase factors * + is restricted to number of subblocks to reduce the search complexity.

IV.RESULTS

A. OFDM Signal with PAPR Reduction

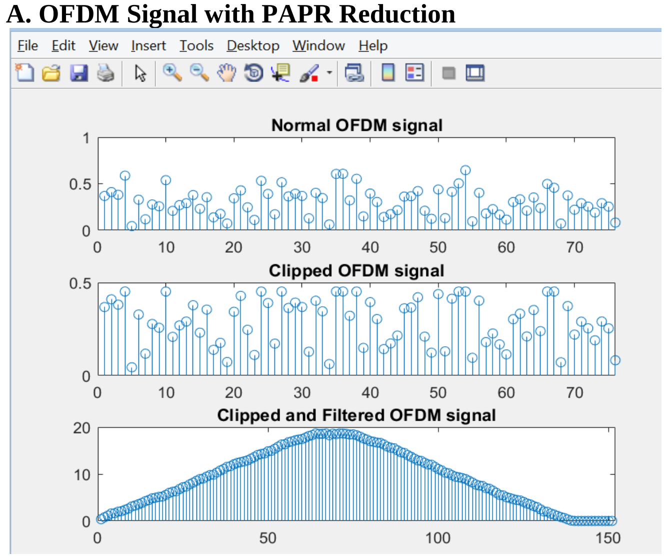

Fig2. PAPR Reduction using Clipping and Filtering Technique.

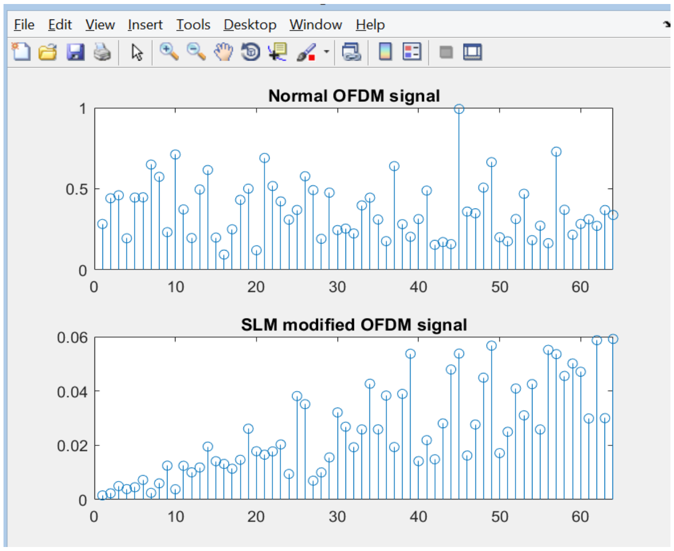

Fig3. PAPR Reduction using SLM Technique.

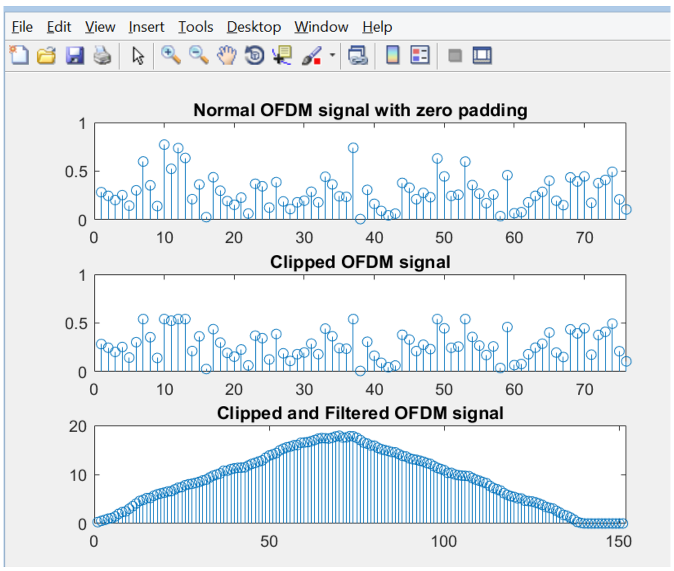

Fig4. PAPR Reduction using Clipping and Filtering Technique and SLM Technique.

V. CONCLUSION AND FUTURE WORK

One of the promising multicarrier communication systems, OFDM, has been adopted by many wireless communication standards due to its several advantageous features in multipath environments. The evolutionary history of OFDM, its advantages and disadvantages including its implementation in different wired and wireless standards are presented in first chapter. The rapid development of OFDM system begins after the implementation of DFT instead of bank of modulators as given by Weinstein and Ebert in 1971. Recently, it is widely exploited by wireless communication standards like IEEE 802.11 a/g/n standards, DAB, DVB, MC-CDMA and WiMAX. Chapter 2 illuminates the theory and mathematics behind OFDM. The role of IFFT and cyclic prefix in OFDM system is mathematically analysed. Furthermore, the simulation results of BER performance over multipath environment including and excluding cyclic prefix using different mapping schemes for different number of subcarriers revealed the inflation of BER at absent of cyclic prefix and at high modulation level as well as insignificant effect of large number sub-carriers on BER performance. Despite of numerous beneficiary features of OFDM system, synchronization and high PAPR are major issues of this system. So, for the complete exploitation these tremendous features of OFDM system these two major problems should be resolved.

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