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Multi-Carrier Transmission Analysis Based on PAPR Reduction Techniques

First Author Rayes Nazir Bhat [1], Shrishti Khurana Second[2]

[1,2] Rayes Nazir Bhat Department of Electronics and Comunication Engineering & Geeta engineering college, panipat

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Abstract - In this article, we introduce the process of reducing PAPR. Generally two techniques used to minimization of PAPR such as SST and SSD. Here, SST use to minimize the PAPR as partial transmits sequence. The SST includes the block coding technique, active constellation extension, selective level mapping, interleaving, tone reservation, sub block coding technique, partial transmit sequence and many more. On the other hand, in SDT includes the some basic terms clipping, scaling, filtering, peak adjusting and companding. But in these techniques some portion of the signal is distorted during the process of PAPR reduction. Due to this reason signal scrambling techniques are preferred over the signal distortion techniques. This method has many advantages over the other methods discussed. The advantage of this technique the les memory is requiring with less computation time.

Key Words: PAPA reduction, Multi-Carrier Transmission, SDT

1.INTRODUCTION

OFDM is the most efficient bandwidth modulation in which the available spectrum is divided into smaller carriers, which contains low data transfer. OFDM has gained a lot of interest in last decade due to its toughness in the harsh conditions, high performance of a multi path channel with a simple balance, minimum Inter-symbol Interference (ISI), decay. However, the PAPR is a major disruption to any multi-path transmission system (like OFDM) [1]. The dynamic range of the OFDM system is usually larger as compare to the growing number of single-band network that will lead to increased costs, power and even lead to high power outages (PAPR) [2].

The MCM transmission method inspired the notion of OFDM. OFDM is a type of MCM system that uses subdivided carriers with orthogonal subcrriers and dispersed spectrums to achieve remarkably high efficiency. Because of the orthogonality of sub-carriers, band pass filters are not required in OFDM. As a result, the available bandwidth is utilised to its full potential while avoiding Inter-Carrier Interference (ICI). Even if the size of the transit facility varies, it is still feasible to be in charge of it as long as orthogonality is maintained. FFT in the input stream is used to achieve orthogonality. OFDM provides a combined quantity of data with signal duration due to the integration of multiple low-data subcarriers. This minimises or eliminates the danger of the ISI, which is frequent in many station regions with a signal duration, depending on the timing of the channel merger. The addition of CP in the OFDM signal might further minimise the ISI impact [1]-[4], but it also causes SNR and data level losses. They're smooth, but they're also orthogonal. The OFDM objective was already in place as an effective MCM procedure in the 1950s and 1960s. However, due to technological challenges such as the digital installation of FFT and IFFT, the system's deployment was delayed. OFDM proves the combined quantity of data and signal length by combining numerous low-data subcarriers. This minimises or eliminates the danger of ISI, which is prevalent in the context with numerous channels with short signal lengths, depending on the time of channel integration. The inclusion of Cyclic Prefix (CP) in the OFDM signal can further minimise the ISI impact [5]-[6], but it also reduces SNRs and data levels.

Tasadduq et al. [7] , the high PAPR of an OFDM system is one of its primary drawbacks. It is proposed and explored the use of multi-amplitude CPM signals to reduce PAPR. In contrast to modulation systems that use a single channel for high data rate transmission, data is delivered over many parallel low data rate channels in OFDM, ensuring data integrity due to fading. OFDM, on the other hand, has a high PAPR. The PTS approach was utilised by Seung Hee Han et colleagues to enhance the PAPR statistics of OFDM signals in [8]. To discover the phase factors, the suggested approach uses a gradient descent search. The suggested method reduces search complexity significantly while causing minor performance loss. To get the phase factors, the suggested approach uses a gradient-descent search. The PAPR lowers the efficiency of the RF power amplifier in OFDM systems, according to Kwang Don Choe et al in [9]. For the lowering of PAPR value and computations, the suggested technique employs a correlator. The novel approach was compared to a partial transmit sequences (PTS) method by the author. The RF amplifier's efficiency is harmed by this high PAPR value. The following steps make up a suggested prescrambling technique in this paper. The best data reversal points that can lower the PAPR value are first sought. The employment of a correlator predicts the PAPR value of input data based on these outcomes. Also, in [10], Alavi et. al uses PTS as a promising technique for PAPR reduction in OFDM systems. When the amount of computational complexity is restricted, the PTS scheme is recognised to be more beneficial than the SLM system, however the PTS method has more redundancy than the SLM scheme. While the number of subcarriers and modulation orders rise, lowering computational complexity takes precedence above minimising redundancy.

Chen et al. offer a PTS approach for improving the PAPR statistics of an OFDM signal in [12]. A unique reduced complexity PTS (RC-PTS) approach is proposed that reduces computational complexity and has been developed to lower the PAPR of an OFDM signal, and its derivation is presented in this work, which takes into account the link between the weighting factors and the transmitted signals. In [13], Houshou Chen et al offer a modified PTS approach for BPSK OFDM by utilising binary Reed-Muller (RM) codes for PAPR reduction. Here, RM codes are examined in both natural and cyclic orderings.

Ghassemi et al. [14] describe a low-complexity PTS approach and in comparison to DIT-PTS, DIF-PTS has a considerably lower multiplicative complexity while achieving equal PAPR reduction. Sheng-Ju Ku et al. offer a low-complexity PTS method to tackle the inherent high PAPR problem of OFDM systems in [15]. Taspinar et al. offer a PTS based on Parallel TS-PTS method to decrease the PAPR of OFDM signals in [16]. For PAPR reduction and search complexity performance, parallel TS- PTS is compared to various PTS methods, which also devised a closed-form method for determining an acceptable threshold, ensuring that proper peak identification in all candidate signals is assured for a given likelihood. To address the disadvantages of C-PTS, Yang et al developed a novel PTS with a simple detector in [17]. The detector at the receiver may effectively retrieve the original signal without side information by using the natural variety of phase constellation for various candidates. The likelihood of side information detection failure indicates that the detector might function with great reliability without any side information. The suggested technique is reliable in estimating the selected shifting number of each sub-block, according to simulation findings. In [18], Seung-Sik Eom et al. give a better peak to PAPR reduction technique for OFDM systems that does not need side information. The suggested method, unlike the SLM or partial transmits sequence (PTS) schemes, works with post IFFT symbols. Raajan et al. presented different techniques to reduce PAPR in the OFDM configuration in [19]. The presence of a guard band in this design reduces the complexity of ISI, while a larger number of subcarriers reduce the influence of noise. PAPR reduction performances vary depending on the arrangement's requirements and are influenced by a number of factors. A number of elements that is included in the report when implementing a PAPR declination system.

2. PROPOSED PTS METHOD

The body of the paper consists of numbered sections that present the main findings. These sections should be organized to best present the material. The basic principle of the OFDM system is to break high data rate transmission into smaller data rate transmissions that are sent out in a series of subcarriers. Each of these signals is modified separately and sent across the channel. The signal will be demodulated and recombined at the receiver to restore the original signal. Each subcarrier is placed orthogonally in the spectrum, as illustrated in the diagram below. When the integral of their product is zero, periodic signals are orthogonal [13]. The block diagram of the OFDM system is shown in Fig.2.

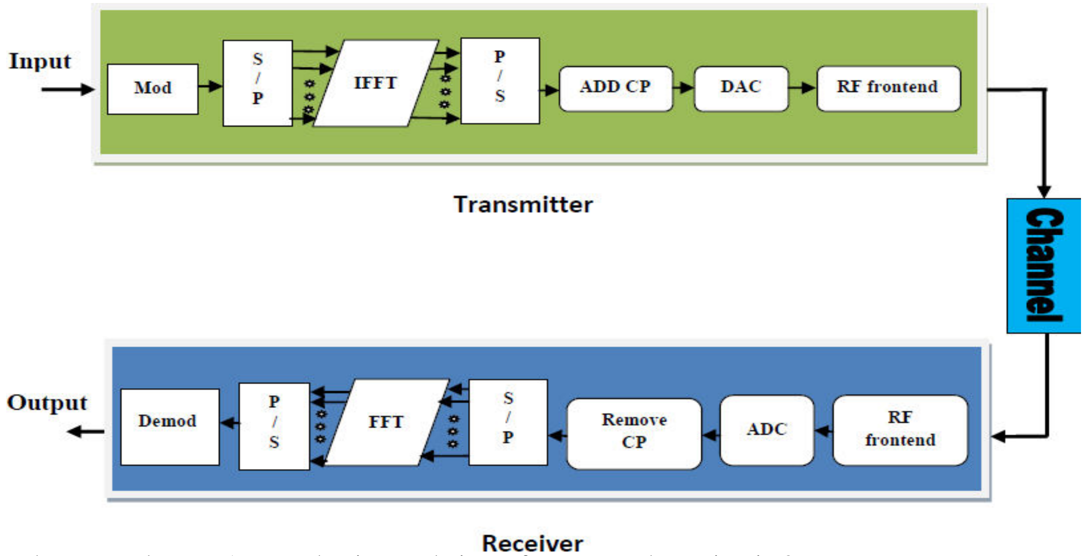

Fig.1. Block Diagram of OFDM

The PTS technique divides the input data block into discrete sub-blocks. The sub-carriers in each sub-block are weighted using phase spins. The phase shifts are based on a PAPR of as little as feasible. Inverse phase shifts are used to obtain the starting data at the receiver. The PTS technique divides a K-symbol input data block into discontinuous sub-blocks. A phase factor specific to each sub-subcarrier block is used to weight each sub-block. The phase factors are set in such a way that the PAPR of the resultant signal is as low as feasible. To implement this technique, the input data block of K symbols is partitioned into M pairwise disjoint chunks Xk, k = 1,..., M. The total number of subcarriers contained in any of these sub-blocks X_k is mostly discretionary, however equal-sized sub-blocks have been proven to be a good option. So that X = M X_k, any subcarrier locations in X_k that are already represented in another sub-block are initialised to zero. Each sub-block is weighted by a set of rotation factors $b_k(u)$, where u = 1.....U, resulting in a modified subcarrier vector X = M $X_k b_k(u)$, which provides the same information as X if the set $b_k(u)$ for each u and k is known. The phase factors are chosen such that the combined signal's PAR is as low as possible (Fig.2).

3. SIMULATION RESULT

The results are obtained by using simulation in MATLAB with parameters (N, M, L) in 64-QAM modulation technique. In 64-QAM Modulation simulations model, following parameter value of the OFDM system is taken: 256 sub-carriers (N) and four over-sampling factor (L). In this work, sub-carriers are categorized in different sub block (M=2, 4, 8, 16, 32, 64). A comparative analysis for CCDF of ideal and PAPR by using PTS technique with different number of sub-block M equal to 2, 4 and M equal to 2, 4, 8 sub blocks with

256 subcarriers is shown in Fig.3(a) and Fig.3(b). Also, a comparative analysis for CCDF of ideal and PAPR by using PTS technique with different number of sub-block M equal to 2, 4, 8, 16 and M equal to 2, 4, 8, 16, 32 sub blocks with 256 subcarriers is shown in Fig.4 (a) and Fig.4(b). Finally, a comparative analysis for CCDF of ideal and PAPR by using PTS technique with different number of sub-block M equal to 2, 4, 8, 16, 32, 63 sub blocks with 256 subcarriers is shown in Fig. 5.

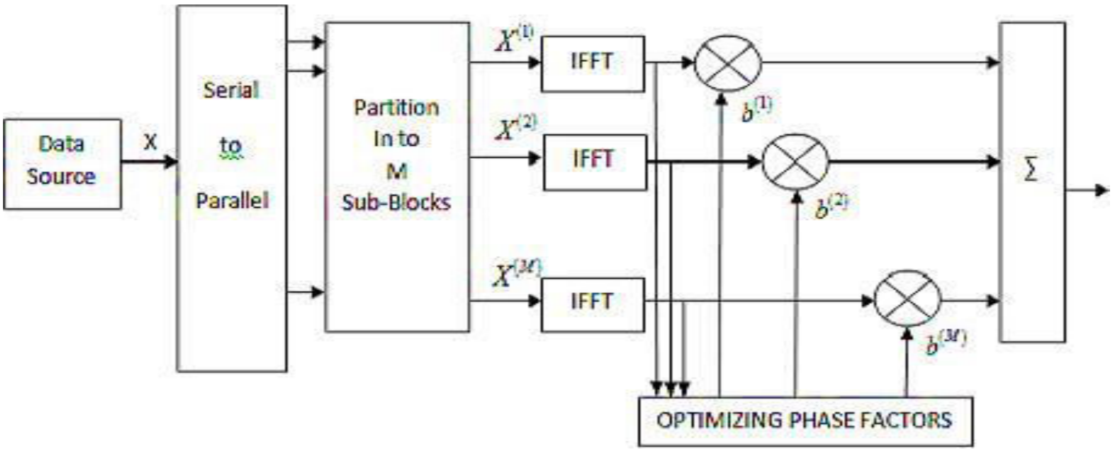

Fig.2 Block diagram of PTS technique

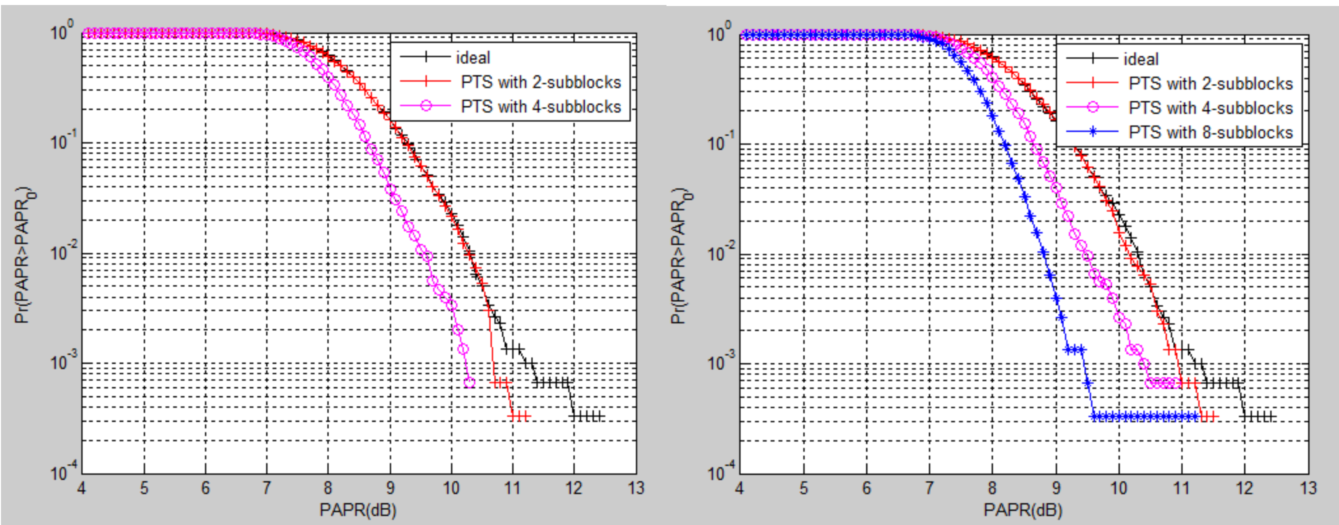

Fig. 3 Comparison analysis for CCDF of idea and PAPR using PTS technique with different number of sub block (a) M=2, 4 (b) M=2, 4, 8 with N=256.

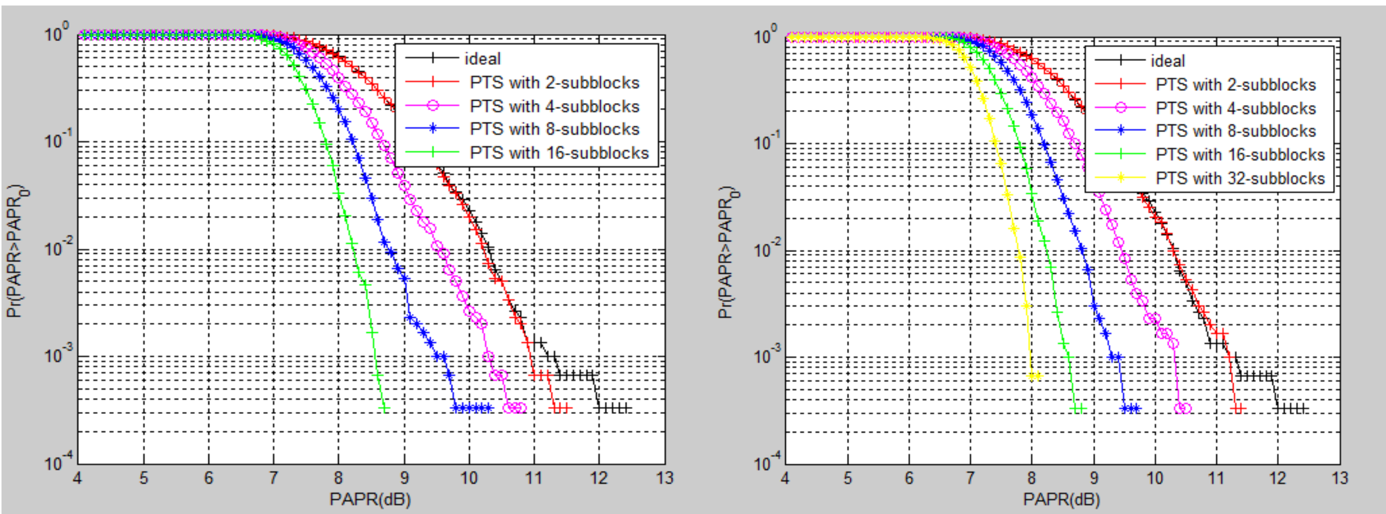

Fig. 4 Comparison analysis for CCDF of idea and PAPR using PTS technique with different number of sub block (a) M=2, 4, 8, 16 (b) M=2, 4, 8, 16, 32 with N=256.

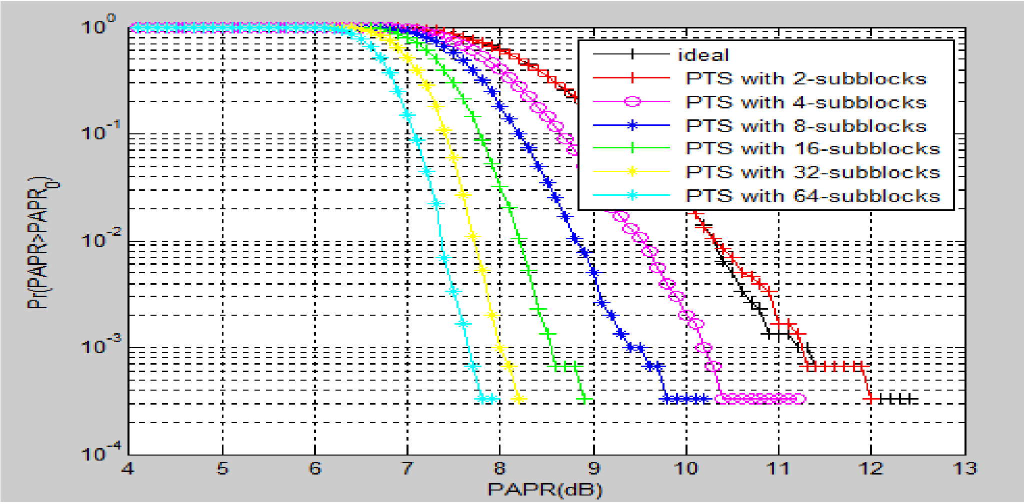

Fig.5 Comparison analysis for CCDF of idea and PAPR using PTS technique with different number of sub block M=2, 4, 8, 16, 32, 64 with N=256.

The obtained simulation result shows the used technique more stable in terms of CCDF. In addition the observed result tell that the performance of the OFDM channel is improved with respect to the increasing number of the sub block. In this work for PAPR observation of OFDM, a 64- QAM modulated signal used which is utilized the wireless communication standard for higher order modulations for larger count of sub-carriers.

3. CONCLUSIONS

This work presented signals scrambling techniques in OFDM signals to minimize the PAPR. Also, we are using the PTS for the PAPR minimization because of reduce in complexity and hardware required due to reduce in multiplication. In this method a more efficient transform (FFT) use to convert the time domain signal to frequency domain. Here, we consider complementary cumulative distribution function (CCDF) as the control parameter for the analysis of PAPR. For PAPR observation of OFDM, a 64-QAM modulated signal is used in this work. In addition the observed result tell that the performance of the OFDM channel is improved with respect to the increasing number of the sub block.

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