Mitigation of Peak to Average Power Ratio with Modified PTS Multiple Signaling Probabilistic Technique in OFDM System

Yamuna.P, Ramassamy.E, Sridevi.V

***Abstract*— As the data rate in OFDM increases, there will be a increase in the subcarriers which in turn leads to high peak to average power ratio. Hence in this paper two techniques such as multiple signaling (Partial Transmit Sequence) and signal distortion (clipping and filtering) techniques are combined to reduced the PAPR. The method proposed is referred as modified PTS. Simulation results shows that the proposed technique can achieve a reduced PAPR when compared with the conventional PTS method. In addition the signals are clipped and filtered with iteration which further shows the better PAPR reduction. The interpolation factor with different IF values are analyzed with the clipping ratio of (CR=4), that is 6 db.**

***Index Term*-- OFDM, PTS, and PAPR reduction techniques**

I. INTRODUCTION

Orthogonal Frequency Division Multiplexing (OFDM) technique separates the channel into equal frequency bands. As the data rate is high it causes the major problem of peak to average power ratio. Because of this problem there occur a non linear distortion in the power amplifier at the receiver side. There are many technique to overcome this major PAPR problem**.** In this paper combining nonlinear and the linear methods, has been proposed, and referred to as clipping and filtering with partial transmit sequence denoted as modified PTS or (PTSCF) Partial Transmit Sequence with Clipping and Filtering method.

OFDM system has been used for high-speed digital communications such as digital audio broadcasting (DAB), digital video broadcasting (DVB), asymmetric digital subscriber line (ADSL) and wireless local area network (WLAN) due to its high bandwidth efficiency, robustness to the narrowband interference and severe multi-path fading. In spite of many advantages, a major drawback of OFDM is a high PAPR problem that causes the nonlinear distortion in HPA and reduces power efficiency. The nonlinear characteristic of HPA is very sensitive to variation in signal amplitudes. So the nonlinear distortion introduced by the

HPA is a well known responsive interference in OFDM system due to the large dynamic range of the modulated signal. The disparaging effects of nonlinear distortions are spectral-spreading of the OFDM signal and inter modulation between subcarriers, which are seriously degrade the system performance.

In Section II, a brief description of PAPR concept in OFDM system is explained. Simulation results of proposed PAPR technique are presented in section III. Performance evaluation and analysis of OFDM system with and without the proposed CRCF_PTS technique are also presented in section III. Finally, concluded in section IV.

II. OFDM SYSTEM WITH PAPER MODEL

When compared with the single carrier, OFDM is multicarrier with more number of subcarriers with the large amount of data symbols. The signal transmitted has a large peak to average power which leads to PAPR problem . In general the PAPR is defined as

$$\text{PAPR(db)} = 10\log_{10}(P_{sat} / P_{avg}) \quad (1)$$

The cumulative distribution function (CCDF) has been used in our simulation to measure the PAPR of OFDM symbols. In general, a complementary formula of CCDF given by

$$P\{PAPR > z\} = 1 - P\{PAPR \leq z\} = 1 - (1 - e^{-z})^{N} \quad (2)$$

Where, z represents threshold power to evaluate the PAPR in OFDM.

A. Clipping And Filtering Technique

One of the simplest distortion less technique the clipping and filtering technique in which the high peaks OFDM signals are clipped with the specified threshold. In OFDM, signal contains high peaks (exceeding a certain threshold) will be applied to clipping and Filtering processes. The clipping ratio, CR, is defined as the ratio of the clipping level value to the root mean square value of the unclipped signal. The clipping is followed by filtering to reduce out-of band power. The filter consists of two FFT operations

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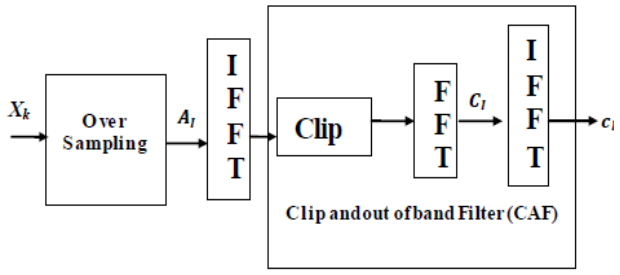

Fig.1. Repeating clipping and filtering technique

From the clipping and filtering block diagram first the over sampling is made after that passed to inverse fast fourier transform block in which it does the computational process and then clipping the signal takes place. The signal clipped with the iterated number and with the varies interpolation factor.

B. Proposed Modified PTS

PTS is a multiple signaling technique in which this technique works with a one or two way such that one way is to generate the multiple permutation and the other way is adding a phase shift by modifying the OFDM signal. The general block diagram of PTS is shown in the below figure

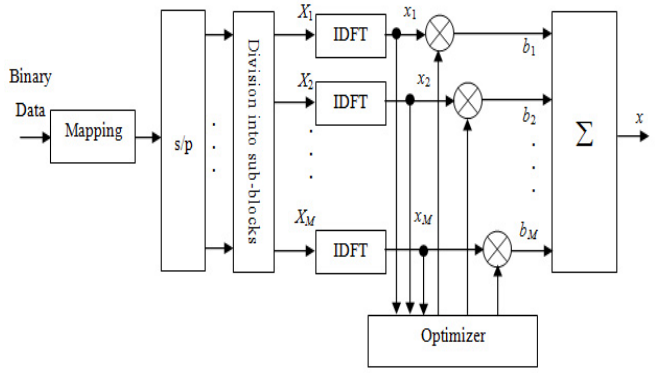

Fig. 2. Block transmitter with PTS diagram of OFDM

In the partial transmit sequence the input blocks are divied into several disjoint sub blocks. The inverse discrete fourier transform of each block is computed for the computational complexity analysis and each one is weighted with the phase factor. The weighted one with the phase factor should be selected in which it should reduce the PAPR. While selecting the phase factor it should noted that the search should be limited in which it reduces the complexity.

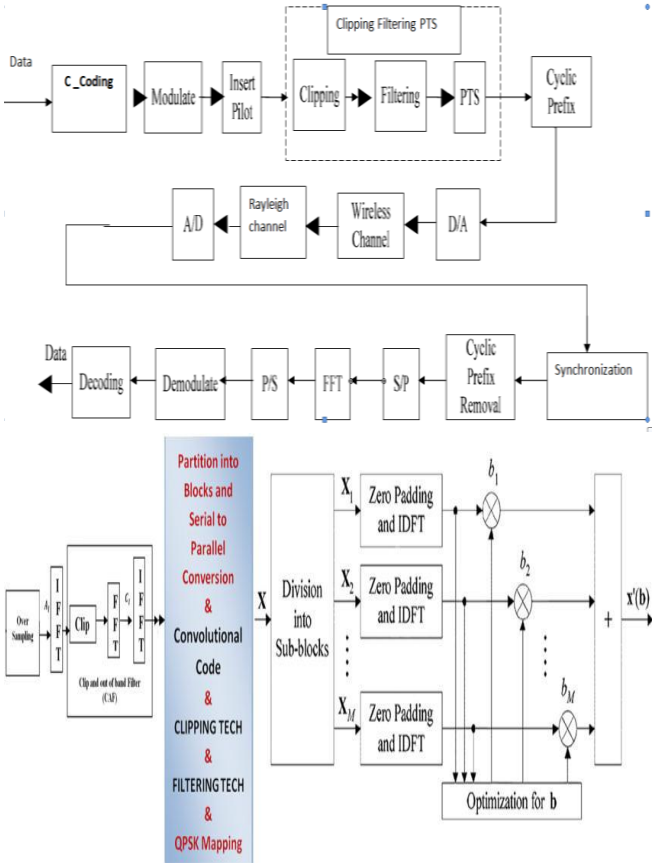

Fig. 3. Proposed PTS Block diagram

In the proposed OFDM system, we have combined the use of convolutional code and RCF (Repeating Clipping and Filtering) as shown in Fig.3. The main idea of the proposed PAPR method (PTSCF) is to use three main signal processing steps to reduce the PAPR value. First is to use the convolution code with the OFDM transmitter. Second, the merit of nonlinear clipping method is used to cut the high power value of these minority symbols. Third, a filter module is added after clipping process to reject the out-of-band signals. Finally, a conventional PTS module is applied to the clipped and filtered symbols. Stages of OFDM transceiver with the proposed (PTSCF) is analyzed.

III. Simulation Results

The simulation parameters of OFDM system have been assumed such as that FFT size k=128, modulation technique is QPSK, and Max symbol(1e-4).

In addition, other parameters including oversampling factor (IF=1 &2), number of iterations (n = 4), clipping ratio (CR= 6dB), and number of PTS groups (V = 4) have been considered in our simulation. The overall performance of OFDM system has been evaluated and investigated with and without the proposed PAPR approach (PTSCF). The simulation results are shown in Fig.4 through Fig.7.

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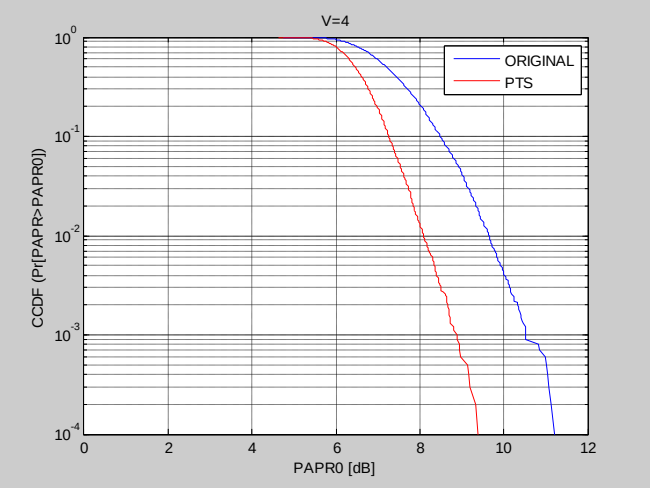

Fig. 4. With and without PAPR reduction technique

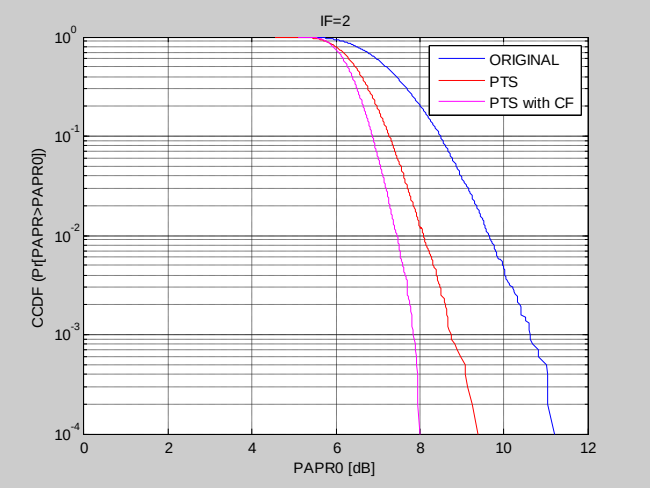

Fig. 5. With and without PAPR reduction technique and PTS combined with clipping and filtering.

This lead to one or two clipping and filtering stages at maximum would be enough. The result presented in Fig.5 shows PAPR level obtained at three cases: without PAPR reduction technique, with traditional PTS, and using PTS with clipping and filtering.

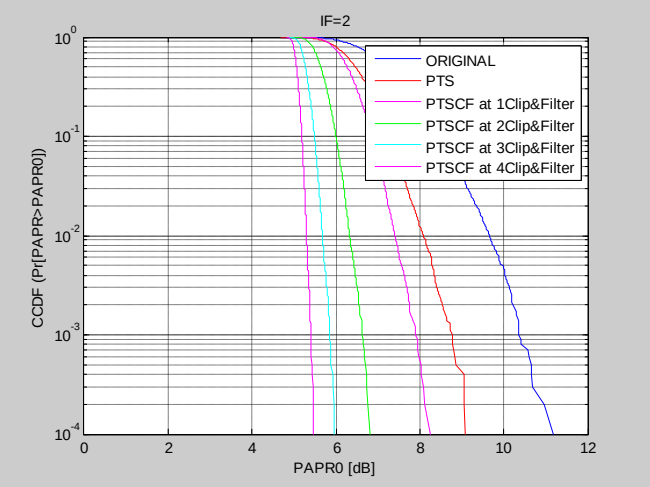

Fig. 6. Effect of filtering and clipping stages number on PAPR level

Next curves shown in fig. 6 illustrate the effect of clipping and filtering number of stages in the proposed PAPR reduction technique denoted by PTSCF. As shown in this fig., PAPR is decreased by increasing number of cascaded clipping and filtering stages following PTS algorithm. From this fig. it is very clear that the lowest PAPR is obtained by applying proposed PAPR reduction technique when compared with the other two techniques

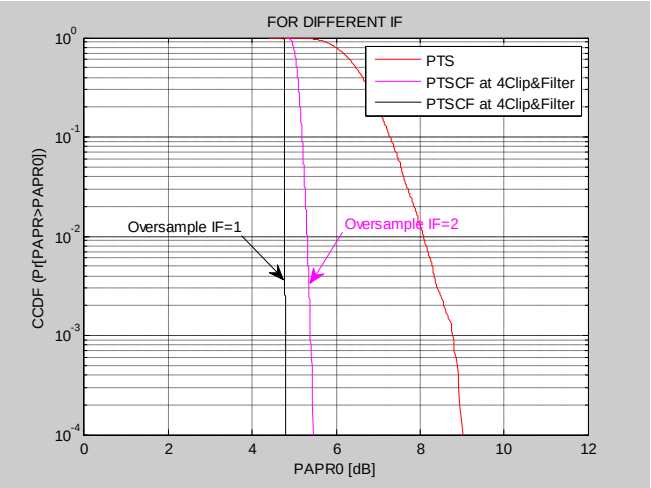

Fig. 7. Fourth stage clip and filter at the different IF values

In the next set of fig. shown in fig. 7, the effect of oversampling order IF on the PAPR level is discussed. As illustrated in this fig. by using IF = 1 obtained PAPR level will be lower than case of applying IF = 2. The reason is because of reduction happen in the average value of OFDM transmitted symbol when the number of zero padding increases.

IV. CONCLUSION

The PAPR reduction scheme based on repeating clipping and filtering, and conventional PTS has been proposed to reduce the peak- to- average power ratio of transmitted OFDM signal. Proposed PAPR reduction technique is denoted by (PTSCF). Performance of PTSCF has been evaluated using different clipping ratio and oversampling factor IF=1 and IF=2. Simulation results showed that the proposed scheme resulted in system performance enhancement in terms of power reduction factor.The presented PAPR technique provided an excellent power reduction with an acceptable additional processing delay for clipping and filtering technique . The presented PAPR method in this paper is strongly enhanced the OFDM system performance with acceptable complexity as well as processing time delay.

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