ADJECENT PARTITIONING PTS with TURBO CODING FOR PAPR REDUCTION in OFDM

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***Abstract*— Multicarrier communication (MCM) place a major role in wireless and wired communication. The multicarrier communication have more spectral efficiency and less noise effect compare with single carrier communication. One of the major MCM technique is orthogonal frequency division multiplexing (OFDM). The Main application of OFDM in wireless communication like WCDMA, LTE Digital Video broadcasting, Digital Audio Broadcasting, Wireless broadband communication and ADSL etc. The main disadvantage of OFDM technique is peak to average power ratio (PAPR). The PAPR reduction is one of the major problem in OFDM. To reduce PAPR there are various algorithms are available like SLM, Coding, and PTS etc. In PTS also different type of algorithms are available. The Adjacent portioning PTS is one of the advanced algorithm which is used for reducing PAPR. Adjacent portioning with Partial transmit sequence (AP-(PTS) aim to reduce the PAPR of OFDM signal. The PTS technique is one of the most promising technique to reduce PAPR. In this paper gives an idea to implement adjacent partition PTS with turbo coding for the better performance of the OFDM. Analysis of PAPR with PTS and without PTS is done and the reduction of PAPR is occurred by using this technique. Analysis of the PAPR reduction by using this technique with turbo coding is done by implementing AP-PTS with turbo coding in Simulink. By using AP-PTS with turbo coding almost 3.5dB PAPR reduction can be achieved.**

Keywords: OFDM PAPR adjacent partitioning PTS with turbo coding

I. INTRODUCTION

The demand of Multicarrier communication [8] (MCM) is increasing day by day. One of the important field of MCM is OFDM. OFDM is one of the major wireless modulation technique which have high date rate, high bandwidth efficiency, immune to fading and which give more spectral efficiency. The major application of the OFDM in Mobile communication (WCDMA, LTE etc.), DVB, DAB etc. OFDM is one of the most attractive MCM technology which give high data rate, it is resistive to selective fading[1]. Another important feature of OFDM is the orthogonality of its subcarriers. The subcarriers are orthogonal to each other and it is more effective to selective fading problem. The major application of OFDM system in DVB, WiMAX, DAB, LTE etc. OFDM is mainly used for high data speed MCM it uses multi subcarriers so that it will increase the bandwidth efficiency it is also an efficient communication through ISI because of its orthogonality

The major drawback of OFDM is the PAPR [3]. The time domain signal have many peak values it gives the PAPR become high. If the PAPR of the system was high the linearity of the system loose and the efficiency of the HPA may decrease. It also reduce the spectral efficiency of the system. When the MCM signal passing through nonlinear amplifier the in band and out band distortion of the system may increase so the reduction of PAPR is a must Lot of technique are there for the reduction of PAPR like clipping, SLM, coding, CFR and PTS etc. the most efficient technique is PTS technique.

In PTS lot of algorithms are available in that adjacent partitioning technique is explaining in this paper with coding technique. In PTS we are using phase rotation to the signal and multiply with some constant value likes [1, -1, j, -j] etc. This paper organised as follows OFDM system, PAPR of OFDM, PTS technique using partitioning, and finally conclusion.

II. OFDM

OFDM is the modulation technique which is currently used for the PHY layer of wireless communication [8]. The major advantages of using this technique which give high data rate for the communication low BER. Transmission of multiple input by using multiplexing is the important technique which is capable to transmit multiple signal they are several method currently available for, like TDM, FDM SDM etc. MCM is the efficient technique which give high spectral efficiency, data rate BER etc. OFDM modulation it depends on number of subcarriers and each subcarrier orthogonal to each other. The binary is signal is modulated using IFFT after doing QAM/QPSK [9]. The coding can be used for the reduction of BER. The BER is one of the important factor to consider in OFDM in wireless MCM the BER is more so the BER reduction can be done by using turbo coding. Turbo coding can give better performance in BER.

The equation for IFFT is given by

$$x(t) = \sum_{k=0}^{N-1} X(k) * e^{j2\pi fkt} \quad (1)$$

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For digital transmitter t=nTs where Ts sampling period. Subcarrier frequency Fk=k*fs this is the basic equation for OFDM.

A. PAPR

One of the major disadvantage of OFDM system is PAPR. The PAPR is the ratio of peak power to average power the equation can be given by

$$PAPR\ x\ n\ = \frac{Max\ \ x\ n}{Avg\ (\ x(n)\ )} \ldots\ldots\ldots(2)$$

There are lot techniques are available for the PAPR reduction like clipping, coding [8], SLM [4], PTS [10], CFR [9] etc. The simplest technique which is used to reduce PAR is clipping [1]. There are several factors to consider in the reduction of PAPR like BER, Spectral regrowth, efficiency, and in band out band distortion etc. In clipping the amplitude of the OFDM signal clipped and after that it is given for the amplification using power amplifier. The disadvantage of clipping is it will increase the in band and out band distortion of the signal due to the nonlinear process

B. Complementary Cumulative Distribution Function (CCDF)

CCDF can be calculated by the value above PAPR0 and it is written by PAPR>PAPR0. It is given by assuming OFDM values are independent to each other

C. PAPR Reduction Techniques

There are several existing technique available for the PAPR reduction but it has its own advantages and disadvantages the major problem with PAPR reduction is the BER may vary due to PAPR reduction [6]. The PAPR reduction technique is using according to system requirements. It mainly depends on transmit power, spectral efficiency' loss in data rate, BER increase etc. PAPR reduction technique divide into two groups signal distortion technique and signal Scrambling technique.

One of the important technique which is used for PAPR reduction is signal distortion technique the peak signal is reduced using adding distorted signal. Clipping, peak windowing and Companding are the signal distortion technique which is used. Another method used is multiple signalling in this method changing the constellation diagram by adding phase shifts or by adding peak reduction carriers.

In signal scrambling technique are mainly classified as block coding technique, SLM, PTS etc. the signal distortion techniques are peak windowing, envelope scaling peak reduction etc. Another important problem with PAPR reduction is complexity of the system will increase.

D. ADJACENT PARTITION PTS

The basic block diagram for adjacent partition PTS [5] is as show below,

In this technique the input is turbo coded and after that it is passing through QAM modulation. After doing QAM the signal is partition into number of parts for example 'x' is partition into 'm' blocks with equal parts and padding zeros for example

X = [X1, X2 . . . . . …Xm] [10]

Before finding IFFT 'X1' is made same length as X like that X2 and upto Xm made same length and padding zeros before and after its position so

X1= IFFT (x1,0 0 . . . . . 0 0 0) [5]
X2= IFFT (0 x2 0 . . . . . 0 0 0 0)

Xm = IFFT (0 0 0 0 0 . . . . 0 xm) after that the phase rotation of the signal can be done the algorithm can be shown

In AP-PTS technique the QAM modulated signal is divided into group M groups and padding zeros after and before for the partitioning. In this paper the 16 QAM signal partitioned into 4 groups and padding zeros according to adjacent partitioning method after that doing IFFT for the signal and multiplying with different phase factors for getting better PAPR reduction. Comparing each PAPR after multiplying the phase factors are checking after that choosing better PAPR reduced signal. The major disadvantage of this technique is number of multiplication and addition will increase. For reducing number of multiplication and addition after finding inverse FFT multiplying with specific phase factor is possible but by using this method the reduction of PAPR is almost 2dB and it may vary with input is coming to IFFT.

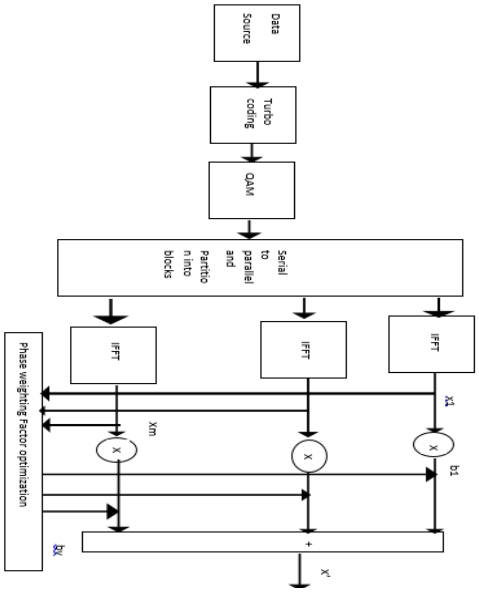

Fig 1: Block Diagram for proposed OFDM

By using the AP-PTS checking with each phase factors it will give almost more than 3dB reduction but the mathematical complexity and calculation time will increase. By using this technique can achieve better spectral efficiency and doing turbo coding we can achieve better BER than AP-PTS alone. After finding IFFT the values multiplying with different phase factors to reduce PAPR and after that the signal is combined together. This is the method we are used in this Let's take B= [1, -1, i,-i] and X= [X1, X2, X3, X4] and check for the minimum PAPR by giving different combination of B. Comparing the different values of output taking the minimum PAPR combination. The flow chart for the AP-PTS is shown in fig 2. Paper the PAPR reduction of the signal shown in the simulation result

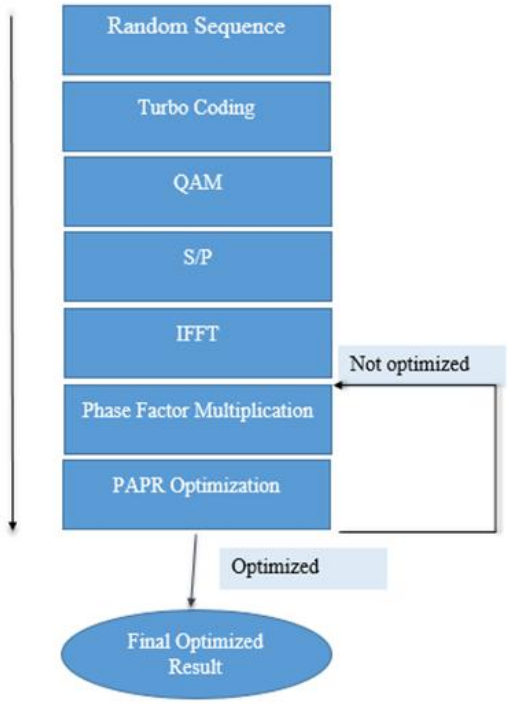

Fig 2 : PAPR optimization algorithm

III. Simulation Result

We examined the simulation for PAPR reduction for turbo coded 16 QAM modulated OFDM system with 64 sub-carriers the AP-PTS is used for the IFFT and the reduced PAPR is obtained by using this technique shown below Fig 3 and Fig 4 shows the PAPR simulation results. The PAPR without OFDM is shown below in fig.3 and OFDM with coding and PTS is shown in fig.4.

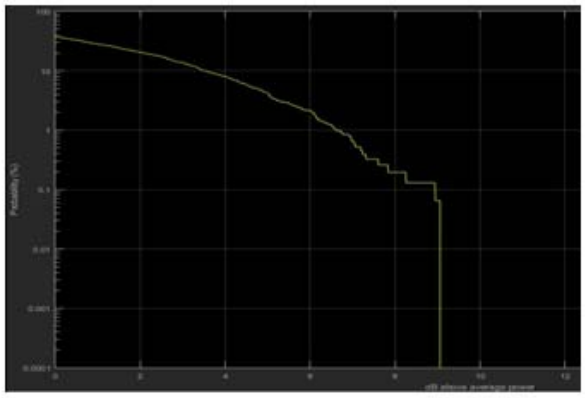

Fig 3:OFDM without PAPR reduction

The simulation result shown below is average power in dB versus probability in percentage (%) of the CCDF. At the Right side of the simulation results measurement details are added.

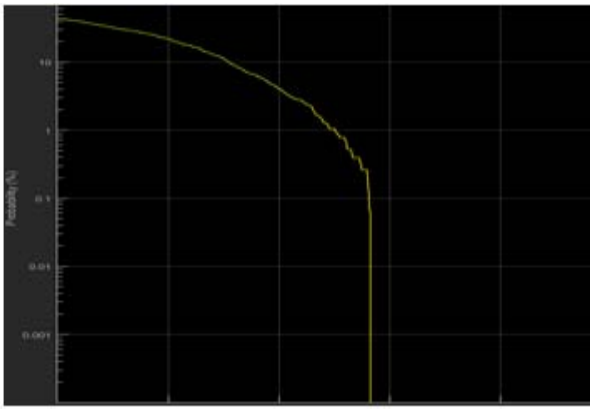

Fig 4: OFDM with coding and PTS

By comparing CCDF of both we come to conclusion that almost 3.5dB reduction in PAPR is occurred PAPR with OFDM.

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