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PTS and C-PTS based OFDM with Companding using Different Modulation Techniques

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ABSTRACT

PTS based OFDM with companding is fast growing new wireless broadband technology which has capability of high data rate transmission, reduced PAPR and advantages like inter carrier interference (ICI) reduction; high reliability; and better performance in multi-path fading. The major effect to be considered at receiver is PAPR effects which must be reduced at transmitter and receiver using different modulation technique. In this paper we presented the PAPR performance of the OFDM system with different modulation technique. Proposed OFDM system is presented using various modulation techniques that is BPSK, QPSK, 16-QAM and 64-QAM.

Keywords:— *OFDM, PTS, BER, PAPR, CCDF*

I. INTRODUCTION

In wireless communication technology the main objective is to provide high quality of data. Orthogonal frequency division multiplexing (OFDM) has become a more popular technique for transmission of signals over wireless channels. In OFDM, signals are transmitted in sub channel of different frequency in parallel. The frequency of sub-channel are so selected that these frequencies are orthogonal to each other and therefore do not interfere with each other. This phenomenon makes it possible to transmit the data in overlapping frequency and hence reduces the bandwidth requirement considerably. OFDM is beneficial in many aspects such as high spectral efficiency, robustness, low computational complexity, frequency selective fading, and easy to implementation using IFFT/FFT [1]. In wireless communication systems the data bits are transmitted in radio space, channels are typically multipath fading channels, which causes inter symbol interference (ISI) in the received signal.

Due to orthogonal carriers, OFDM signal has high PAPR which lowers efficiency of HPA. The high PAPR is mitigated by many techniques [2] like clipping, peak windowing, peak cancellation, companding, tone reservation, tone injection or by distorting the signal or by scrambling and spreading the signal like selected mapping (SLM), partial transmit sequence (PTS) [3][4], interleaving, precoding by using liable sequences. The hardware complexity is less in PTS technique but computational complexity increases as the number of IFFT's increases. The computational complexity is reduced by many reduced PTS techniques [5]-[8]. One technique is by applying Cost Function Qn to OFDM symbols [8]. To reduced complexity PTS summation, the A-law or µ-law compander is fixed to further improve HPA efficiency without hardware complexity.

II. PROPOSED WORK

In this paper, PTS based OFDM system with an interleaved coded transmission is proposed with different modulation schemes. To demonstrate a OFDM system is considered with 64 data subcarriers and 16-QAM constellation. Further we also demonstrated system with 128 data subcarriers. To simulate OFDM system Matrix interleaves are used, the cyclic prefix code of length is said to the channel maximum delay, it will prove channel capacity. The spectrum signal required to get acceptable result of simulation is first chosen based on the input data and the modulation scheme used (such as Differential BPSK, QPSK or 16-QAM). Amplitudes and phases of the carrier signals is calculated based on the chosen scheme of modulation. The Transmitting data before transmission is first assigned to each carrier that is to be produced and further it is modulated. The BER performance evaluation of various modulation system such as DPSK, PSK and 16-QAM modulation schemes for BCH and convolutionally coded system over AWGN channel is demonstrated in this paper. The performance of different modulation techniques is analyzed in terms of PAPR and CCDF.

To achieve error free communication and multiplexing data, guard interval is inserted in the time domain using cyclic prefix since the ISI gets mitigated between OFDM symbols. The OFDM guard interval can be inserted by the cyclic extensions of the OFDM symbol with cyclic prefix (CP) or cyclic suffix (CS) [9]. In this demonstration we used 16-bit cyclic prefix code. System to be practical, we added AWGN noise to channel. AWGN is a noise that affects the transmitted signal when it passes through the communication channel. It contains a uniform continuous frequency spectrum over a particular frequency band. Here BCH and Convolutional coding are opted as one knows [7]-[8], This section defines PTS-OFDM system model as summarized in figure 1, which represents the communication procedure in MIMO-OFDM. In the PTS approach, shown in figure 1, the input data block is partitioned into disjoint subblocks or clusters which are combined to minimize the PAPR. First, define the data block as a vector, X = [X0, X1, ...XN-1]T. Then, partition X into M disjoint sets, represented by the vectors {Xm, m=1,2, . . . M}. Here, we assume that the clusters consist of a contiguous set of subcarriers and are of equal size. In proposed design to promote the lowest PAPR a µ- law and A- law companding is used without amplifying the complexity.

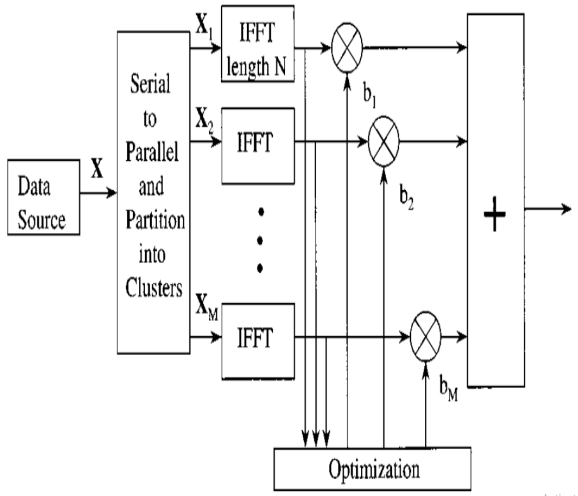

Figure 1: Partial Transmit Sequence System

A-law has non-zero value and it has mid riser at the origin point. Hence it contains non-zero value. The practically used value of "A" is 87.6 As shown in Figure 2 low level inputs the characteristics is linearly segmented and for high level inputs the characteristics is logarithmic segmented [12].

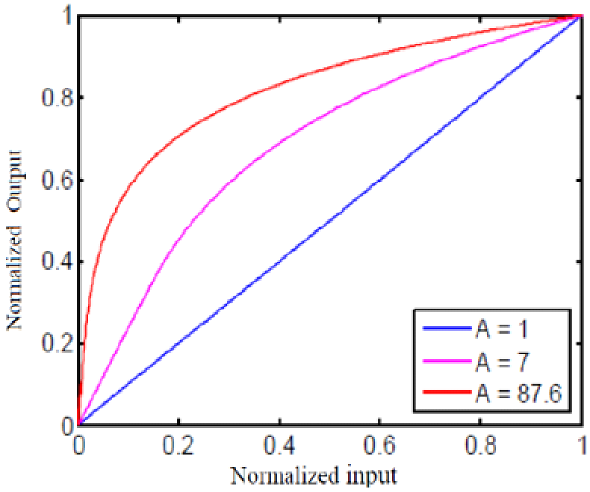

Figure 2: A-Law Companding

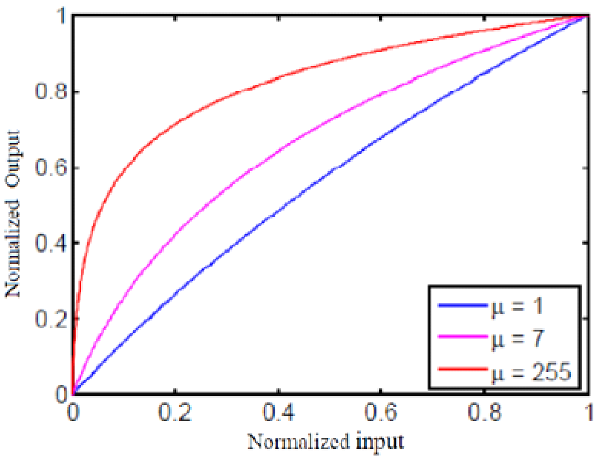

Figure 3: μ–Law Companding

In μ - law companding, as shown in Figure 3 the characteristics is linear when μ=0 (no compression) which is uniform quantization. μ - law has non-zero value and it has mid tread at the origin point. The practically used value of μ is 255[12].

III. RESULT AND DISCUSSION

This paper analyses the BER and PAPR using BPSK, QPSK, 16-QAM, 64-QAM as modulation schemes. The BCH encoder block creates a BCH code with constraint length K=5. Here a coded OFDM system with 64 subcarriers (N=64) and the number of constellations for QAM are 16, 64, 256 i.e. 16-QAM, 64-QAM, 256-QAM is considered. Matrix interleaver is used and cyclic prefix is set at 25 %(16). There are two transmit and receive antennas. The figure 4-7 shows the performance analysis for different modulation schemes. Parameter of proposed system is presented in table 1. OFDM signal with multiple carrier at transmitter by using BPSK modulation is presented in figure 4.

Table 1. Parameters of Proposed System

Parameters	Values
Modulation Techniques	BPSK, QPSK, 16-QAM, 64-QAM, 256-QAM
Coding	Cyclic Prefix
Interleaver	Matrix
Data Subcarriers	128
Cyclic Prefix	16
System	OFDM
IFFT Points	128
No. of Samples	5000

It is even observed from figure 6 that BER keeps improving on using BCH coding for BPSK, QPSK, and 16-QAM respectively. To show the performance of PAPR reduction, the OFDM is combined with Reduced complexity PTS and companding methods which are imitative of the existing methods with number of symbols 500, subcarriers 6,16-QAM and V=2 which are simulated by randomly generated data. A CCDF = Prob{PAPR > PAPRo}, was used to present the range of PAPR in term of a probability of occurrence is presented in figure 5.

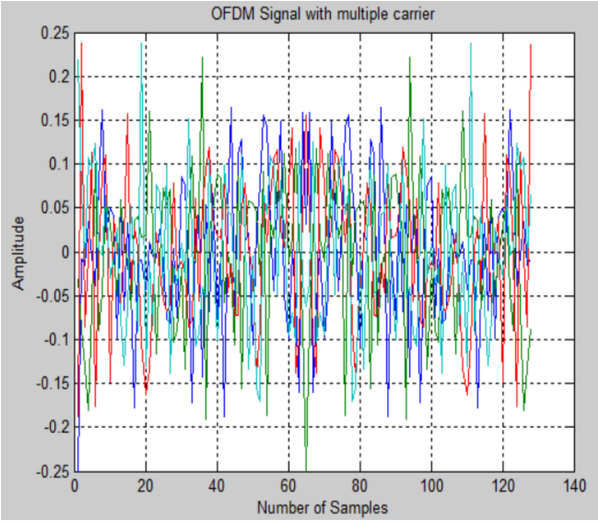

Figure 4: OFDM Signal with multicarrier

The comparison analysis of different OFDM scheme have been analyzed to get reduced PAPR, it is found that µ-law and A -law companding for QAM (as compare to QAM, PSK, FSK) have reduced PAPR as compare to PTS and C-PTS. Further to demonstrate proposed OFDM technique, CCDF is calculated as presented in figure 5 for different OFDM technique.

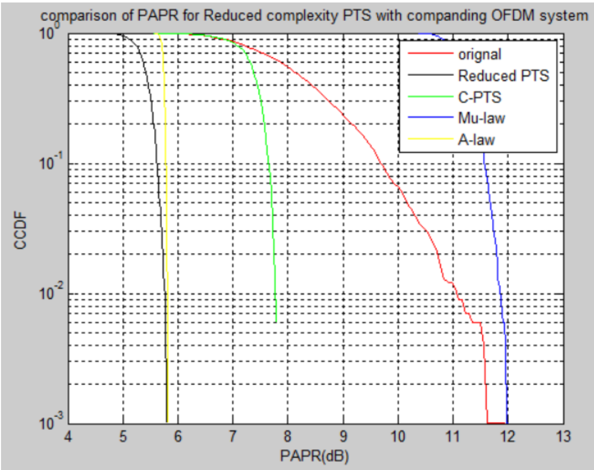

Figure 5: Comparison of PAPR using Different Companding Technique

It is found that QAM is good candidate among all modulation technique to get acceptable return loss, we analyzed for different QAM technique that is 16-QAM, 64-QAM, 256-QAM. Figure 6 presents Bit error rate for different QAM modulation technique.

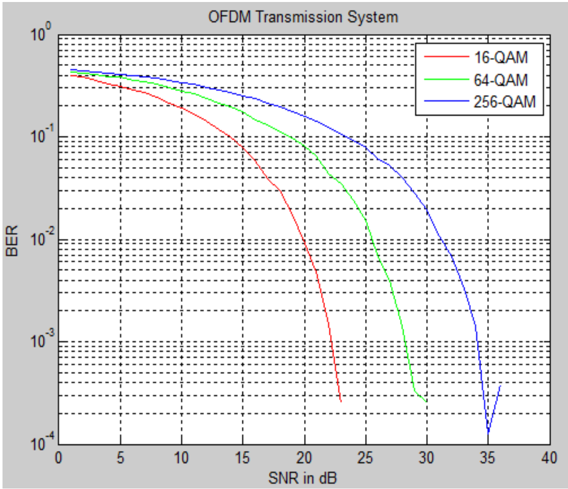

Figure 6: Comparison of BER using different QAM technique

Further we analyzed for different bit error rate of different QAM technique as presented in figure 7, bit error rate probability cure shows that there are very few errors with respect to signal to noise ratio for proposed system.

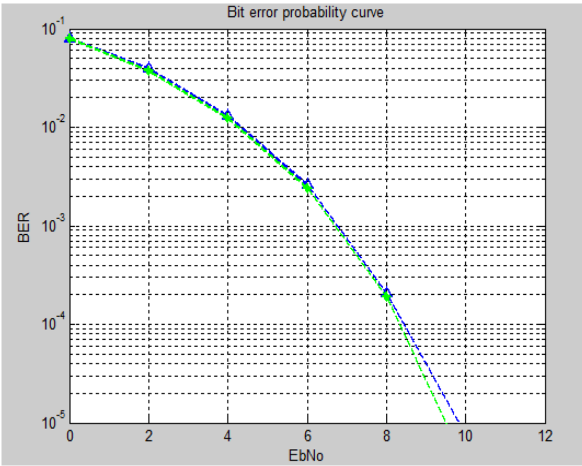

Figure 7: Bit Error Rate Probability Curve

III. Conclusion

In proposed system results show the comparison analysis of PAPR of different OFDM technique is presented figure 5, the reduced PAPR is obtained in companding technique. Further we also analyzed for BER using modulation technique (BPSK, QPSK, 16-QAM, 64-QAM and 256-QAM) over AWGN channel. Based on the simulation results it is concluded that by using 16-QAM scheme better SNR performance for same value of BER is obtained as Compared to the BPSK and QPSK. Through simulation the BER performance of the system and the minimum required SNR to satisfy both high quality and low quality of data services is obtained.

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