PAPR Reduction Using PTS with DCT SLM Technique

[1]Kamlesh Kumar Sen; [2]Vikas sahu

SSTC Bhilai; Chhattisgarh(India)
Email: [1]kamlesh88asl@gmail.com; [2]vikas.lakshya@gmail.com

Abstract- In recent time, the demand for multimedia data services has grown up rapidly. One of the most promising multi-carrier system, Orthogonal Frequency Division Multiplexing (OFDM) forms basis for all 4G wireless communication systems due to its large capacity to allow the number of subcarriers, high data rate and ubiquitous coverage with high mobility. OFDM is significantly affected by peak-to-average-power ratio (PAPR). Unfortunately, the high PAPR inherent to OFDM signal envelopes will occasionally drive high power amplifiers (HPAs) to operate in the nonlinear region of their characteristic curve. The nonlinearity of the HPA exhibits amplitude and phase distortions, which cause loss of orthogonality among the subcarriers, and hence, inter-carrier interference (ICI) is introduced in the transmitted signal. Not only that, high PAPR also leads to in-band distortion and out-of-band radiation.

the PAPR reduction of OFDM system using partial transmits sequence (PTS) and DCT SLM techniques. We proposed a combine technique of PTS and DCT DLS to reduce the PAPR. This hybrid combined technique reduces PAPR effectively and also minimizes the complexity of PTS technique which arises due to number of sub-blocks.

INTRODUCTION

Demand for multimedia data services has grown drastically which drive us in the age of 4th generation wireless communication system. This requirement of multimedia data service where user are in large numbers and with bounded spectrum, modern digital wireless communication system adopted technologies which are bandwidth efficient and robust to multipath channel environment known multi-carrier communication system.

Discrete Fourier Transform (DFT) was applied to generate the orthogonal sub-carriers waveforms. In their proposed model, baseband signals were modulated by the DFT in the transmitter and then demodulated by inverse DFT (IDFT) in the receiver. So, the implementation complexity is reduced by the use of DFT algorithms (i.e. IFFT/FFT).

The OFDM systems have some major problems (like high PAPR, timing and frequency synchronization, Inter-Carrier Interference (ICI) etc.) and lot of work has been reported to solve these problems.

DISTORTION BASED TECHNIQUES

The schemes that introduce spectral re-growth belong to distortion based category. These techniques are the most straightforward PAPR reduction methods. The clipping [14] is one of the simplest distortion based technique to reduce the PAPR of OFDM signal. It reduces the peak of the OFDM signal by clipping the signal to the desired level but it introduces both in-band distortion and out-of-band radiation. To limit out-of-band radiation and PAPR

PAPR REDUCTION METHODS

PAPR reduction methods can be mainly divided into two domain methods: frequency domain method and time domain method [30]. The basic notion of frequency domain method is to increase the cross correlation of the input signal before IDFT and decrease the output of the IDFT peak value or average value.

Broadly PAPR reduction techniques are classified into four sections

1. Signal scrambling (Probabilistic) technique

Signal Scrambling technique scramble each OFDM symbol with different scrambling techniques and select the sequence that gives the smallest PAPR value. It includes methods like Selective Mapping (SLM) and Partial Transmit Sequence (PTS).

2. Signal distortion technique

This technique reduces the PAPR by distorting the OFDM signal non-linearly. The methods like clipping and filtering, peak windowing, and non-linear companding are the example of this technique. These methods are applied after the generation of OFDM signal (after the IFFT).

3. Coding technique

The coding technique employed some error correcting codes for the PAPR reduction. These methods are applied before the generation of OFDM signal (before IFFT). When N signals are added with the same phase, they produce a peak power, which is N times the average power. The basic idea of all coding schemes for the reduction of PAPR is to reduce the occurrence

probability of the same phase of many signals. The coding methods select such code words that minimize or reduce the PAPR. It causes no distortion and creates no out of band radiation, but it suffers from bandwidth efficiency as the code rate is reduced. It also suffered from the complexity to find the best codes and to store large lookup tables for encoding and decoding, especially for a large number of subcarriers. The error correcting codes like block codes, cyclic codes, Golay complementary sequence, Reed-Solomon (RS) code, Reed-Muller (RM) code, Hadamard code and Low Density Parity Check (LDPC) code can be used.

4. Pre-distortion technique

The pre-distortion technique is based on the reorientation or spreading the energy of data symbol before taking IFFT. The pre-distortion scheme includes DFT spreading, pulse shaping or pre-coding and constellation shaping.

The most of the factors mentioned above for selecting the PAPR reduction technique are almost satisfied by frequency domain method (i.e. signal scrambling and pre-distortion methods) because they are distortion le

Comparison of PAPR reduction techniques

Methods	Average Power Increases	Computational Complexy	Bandwidh Expansion	BER Degradation	Side Information	Processing at transmitter and receiver sides
Clipping and filtering	No	Low	No	Yes	No	Tx: Amplitude clipping, filtering Rx: None
Coding	No	Low	Yes	No	No	Tx: Encoding or table search Rx: Decoding or table search
PTS	No	High	Yes	No	Yes	Tx: V IFFTs, W^(V-1)complex vector sums. Rx: Transmission of side information, Inverse PTS
SLM	No	High	Yes	No	Yes	Tx: need more IFFTs than PTS method. Rx: Transmission of side information, Inverse SLM
TR	Yes	High	Yes	No	No	Tx: need IFFTs, find value of peak reduction carriers (PRCs). Rx: Ignore non data bearing subcarriers.
TI	Yes	High	Yes	No	No	Tx: need IFFTs, search for maximum point in time, tones to be modified. Rx: Modulo-D operation.

Proposed Method

In the proposed method we are going to use the video input for the transmission using OFDM transmitter. First we are going to convert the input video into n number of frames. Then we are going to interleave the obtained frames to reduce the PAPR in the communication cannel. In interleave we are going to shuffle the frames of the input video

This will help to reduce the PAPR because of change in the power consumption in shuffle data fames. After interleave the frames this will converted into bytes and the bytes are converted into bits. Now this input video bits are now transfer from OFDM Transmitter and PTS and DCT SLM algorithm are applied on the input bits. Finally the data is obtained in the as the transmitter output. Then AWGN channel (Additive White Gaussian noise) is used to transmit the OFDM transmitter output to the OFDM receiver.

Now in OFDM receiver side input is taken from AWGN channel this input is first converted into bits and then bytes. After that deinterleave is applied on the bytes to get the original sequence of the data and bytes are converted into frames. Now finally frames are converted into video which is the original output of the communication system. In this proposed system we used PTS, DCT and SLM hybrid combination to reduce the PAPR if PAPR is reduced then Noise is reduced and the BER (Bit Error Rate) is also reduced which increase the performance of the communication system.

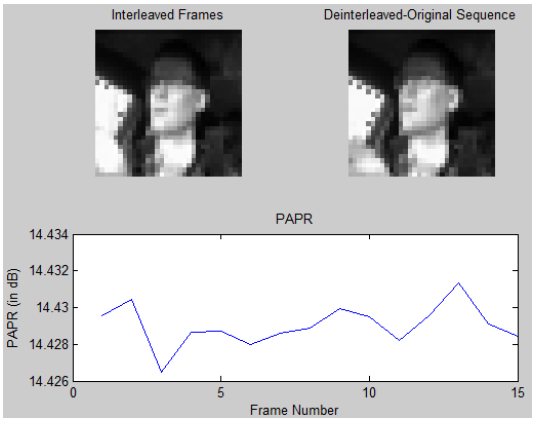
Bit Error Rate

In digital transmission, the number of bit errors is the number of received bits of a data stream over a communication channel that has been altered due to noise, interference, distortion or bit synchronization errors. The bit error rate or bit error ratio (BER) is the number of bit errors divided by the total number of transferred bits during a studied time interval. BER is a unit less performance measure, often expressed as a percentage. The bit error probability pe is the expectation value of the BER. The BER can be considered as an approximate estimate of the bit error probability. This estimate is accurate for a long time interval and a high number of bit errors.

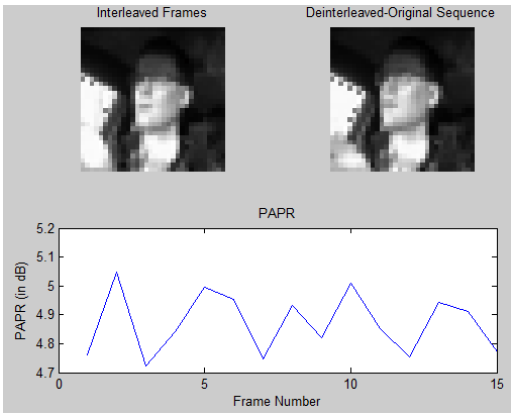
Simulation and Results

Table Comparison table of PAPR for normal and proposed OFDM communication method

Video Size	Normal OFDM PAPR	Proposed OFDM PAPR
100 kb	14 dB	5 dB
500 kb	14.6 dB	5.1 dB
1000kb	13.7 dB	5 dB
2000kb	14.2 dB	4.7 dB



Normal OFDM PAPR



Proposed OFDM PAPR

[1]. A. R. S. Bahai and B. R. Saltzberg, "Multi-Carrier Digital Communications: Theory and Applications of OFDM," Kluwer Academic Publishers, New York, 2000.

[2]. R. Van. Nee and R. Prasad, "OFDM for Wireless Multimedia Communication," Artech house Publisher, London, 2000.

[3]. P. A. Bello, "Selective fading limitations of the KATHRYN," IEEE Transactions on Communication Technology, vol. 13, pp. 320-333 September 1965.

[4] Jiang T., Wu Y., "An Overview: Peak-to-average power ratio reduction techniques for OFDM signals", IEEE Trans. Broadcasting, vol. 54, No. 2, pp. 257–268, Jun. 2008.

[5] Irukulapati, N.V., Chakka V. K., Jain A., "SLM based PAPR reduction of OFDM signal using new phase sequence", Electronics Letters, Vol. 45, No. 24, pp. 1231–1232, Nov. 2009.

[6] Zhou, Y. , Jiang, T., "A Novel Multi-Point Square Mapping Combined with PTS to Reduce PAPR of OFDM Signals without Side Information", IEEE Transaction on Broadcasting, Vol. 55, No. 4, pp. 831–835, Dec. 2009.

[7] Jiang T., Yang Y., Song Y., "Exponential companding transform for PAPR reduction in OFDM systems", IEEE Transaction on Broadcasting, vol. 51, No. 2, pp. 244–248, June 2005.

[8] Huang J. L., Zheng J., Letaief K. B., Gu J., "Companding Transform for Reduction in Peak-to-Average Power Ratio of OFDM Signals", IEEE Transaction on Wireless Communications, Vol. 03, No. 6, pp. 2030-2039, November 2004.

[9] Sulaiman A. A., Ehab F. B., Mohamed Darwish A. E., "Linear Companding Transform for the Reduction of Peak-to-Average Power Ratio of OFDM Signals", IEEE Transaction Broadcasting, Vol. 55, No. 1, pp. 195-200, March 2009.

[10] Wang C. L., Huang Y. C., "Intercarrier interference cancellation using general phase rotated conjugate transmission for OFDM systems", IEEE Transaction on Communications, Vol. 58, No. 3, March 2010.