Energy Optimization of Wireless Sensor Network OFDM System by Reduction of PAPR using FFT

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***Abstract*— In a communication system, operation of the transmitter power amplifier is limited to linear range. Input signal with an amplitude more than the transmitter power amplifier linear range results in signal distortion. Hence, the input signal to the transmitter should be with low peak to average power ratio. This paper presents a new method of reducing the peak to average power ratio in OFDM system for energy optimization in wireless sensor network. The proposed method is based on DCT aided successive addition and subtraction of OFDM symbols inside the single OFDM frame. Performance of the proposed method is evaluated and found to be superior to PTS, SLM techniques. High Peak to Average Power Ratio (PAPR) is still almost important challenge in Orthogonal Frequency Division Multiplexing (OFDM) system. We use Discrete Cosine Transform (DCT) preceding based SLM technique for PAPR reduction in OFDM systems. This technique is based on pre-coding the constellation symbols with DCT pre-coder after the multiplication of phase rotation factor and before the Inverse Fast Fourier Transform (IFFT) in SLM-OFDM System.**

Keywords—Energy Optimization, PAPR, OFDM, Wireless Sensor Networks.

I. INTRODUCTION

This Orthogonal Frequency Division Multiplexing (OFDM) is an orthogonal multicarrier communication system. Bandwidth efficiency, high data rate and immune to fading makes the OFDM systems preferred choice for modern communication system and are being implemented in many modern communication systems like Digital Audio Broadcasting (DAB), Digital Video Broadcasting (DVB), Wireless Local Area Network (WLAN) and Long Term Evolution (LTE). In a multicarrier communication system, like OFDM, independent phases of subcarriers may have constructive or destructive effect. In addition the sub-carriers in an OFDM system are overlapping to maximize spectral efficiency.Ordinarily, overlapping adjacent channels can interfere with one another. However, sub-carriers in an OFDM system are precisely orthogonal to one another.OFDM systems are able to maximize spectral efficiency without causing adjacent channel interference.OFDM is a subset of frequency division multiplexing in which a single channel utilizes multiple Subcarriers on adjacent frequencies When all subcarriers have same phase then the constructive effect gives high peak amplitude and produces high peak to average power ratio (PAPR). If amplitude of the OFDM signal is greater than linear range of transmitter amplifier, the amplifier may operate in saturation region which leads to nonlinear distortion. To mitigate this high PAPR many methods have been used. The method to overcome high PAPR is coding technique where,specific code words are used to minimize the PAPR. Coding technique has no distortion effect and no out-of-bound radiation.

Scrambling is another technique to reduce PAPR. This method is a probabilistic approach. In this method, the input data block of the OFDM symbols are scrambled (i.e multiplied with different phase) and the resulting OFDM symbols with minimum PAPR is chosen to transmit. It does not suffer from out of bound radiation but the spectral efficiency decreases. Again, computational complexity increases with increase in the number of subcarrier. Few of technique based on this includes partial transmit sequence (PTS) selective mapping (SLM) technique tone injection (TI) technique and tone reservation (TR) technique.

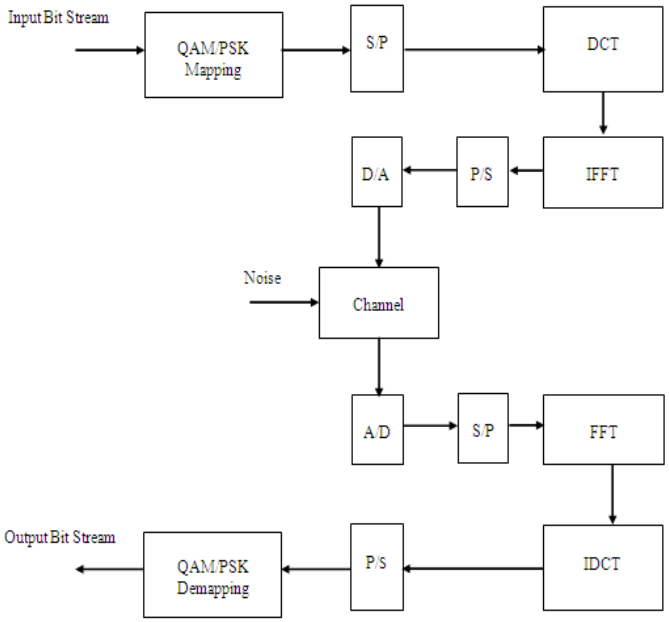
Discrete Fourier Transform (DFT) spreading technique is also a method of minimizing the PAPR. This technique is specifically useful for mobile terminals and they are used in uplink transmission. In this method, the input signal is spread with DFT that can be subsequently taken by IFFT. This technique reduces the PAPR of the OFDM signal up to single carrier transmission.

II. LITERATURE SURVEY

Literature [1]. In this paper considering the correlation among the phase vector, a novel PTS scheme to reduce computational complexity is proposed, which mainly focuses to simplify in computation for each candidate instead of decreasing the number of candidates signal. The result observed in reduction of PAPR is same as that of conventional PTS but computational complexity is reduced. Literature [2] In this paper a new PTS technique with simple detector is introduced. The candidates are generated by cyclically shifting each sub-block sequence in time domain and then combining them, due to this at the receiver the natural diversity of the phase constellation helps the detector to recover the original signal without side information, the proposed scheme gives good reduction in PAPR and BER performance is same as that

of C-PTS. Literature [3] In this paper, a sub optimal PTS algorithm with harmony search is applied to decrease the search complexity, numerical result show that the proposed approach can achieve excellent performance with lower computational complexity when compared with that of the other PTS approaches. Literature [4] In this paper a modified PTS scheme combine with interleaving technique for PAPR reduction has been presented. The scheme is very effective and avoids the use of any extra inverse Fast Fourier Transformations(IFFT's) as was done in PAPR reduction by ordinary PTS technique dividing the various sub carriers into different sub blocks. Literature[5] In this paper, a new low – complexity SLM scheme is proposed ,which generates alternative signal sequences to an OFDM signal sequences .The proposed scheme considerably reduces the computational complexity without sacrificing BER and PAPR reduction performance only by requiring additional memory to save the additive mapping signal sequences, specially for the OFDM system with quadrature amplitude modulation(QAM) .Similarly ,a low complexity SLM scheme is used for multi-input multi-output (MIMO) OFDM system with space – frequency block code(SFBC).

III. DESCRIPTION



1. QAM (QUADRATURE AMPLITUDE MODULATION): QAM is a method of combing two amplitude modulated signals into a single channel,which doubles the effective bandwidth. In wireless application of digital system QAM is used as pulse amplitude modulation.In QAM signal, there are two carriers each having the same frequency but differ by phase shift of 90 degree.For transmission, the two modulated carriers are combined at the source. The carriers are separated at the destination, the data is extracted from each carrier, after that the data is combined with the original modulating signal/information

2. SERIAL TO PARALLEL CONVERTER: serial to parallel converter converts a stream of data elements received in a time sequence i.e. one at a time into a data stream consisting of multiple data elements transmitted simultaneously.

3. DCT (DISCRETE COSINE TRANSFORM): DCT helps to separate the image into different parts or spectral sub-band The DCT transforms a signal or a image from spatial domain to frequency domain.

4. FFT (FAST FOURIER TRANSFORM): FFT computes the DFT of its sequence, or its inverse**.** Fourier transform converts a signal from its original domain to the frequency domain & vice versa.

5. A-D CONVERTER: Converts analog signal to digital data.

6. CHANNEL: A complex or real input signal adds the white Gaussian noise to AWGN channel block. This block adds real Gaussian noise,when input signal is real and produce a real output signal.This block adds complex, when the input signal is complex.

Gaussian noise produces a complex output signal.Its sample time is inherits from the input signal.

7. D-A CONVERTER: Converts digital data to analog signal.

8. IDCT: Inverse of DCT.

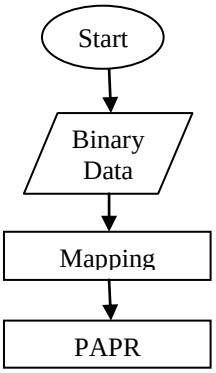
9. IFFT: Inverse of FFT.

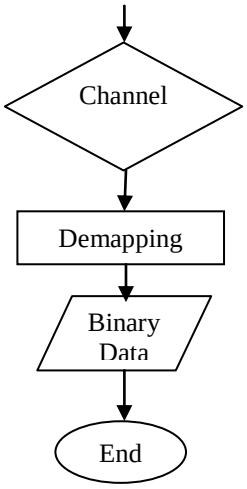
10. PARALLEL TO SERIAL CONVERTER: It converts a stream of multiple data elements, received simultaneously, into a stream of data elements transmitted in time sequence i.e. one at a time.

IV. FLOW CHART AND ALGORITHM

The first input in binary form to begin the calculation process.The binary data is modulated over a carrier to increase the strength of modulation.After modution PAPR is reduced,this reduced PAPR is then given to channel.The modulated binary data over a channel called AWGN(Additive white gaussian noise).The transmission energy is first reduced and then transmitted and the original energy is regained at the receiver side.The signal is then demodulated to the original form and again the binary data is received as originally transmitted.

FLOW CHART





ALGORITHM:

FIG.3: Butterfly diagram of an 8-point radix-2 FFT

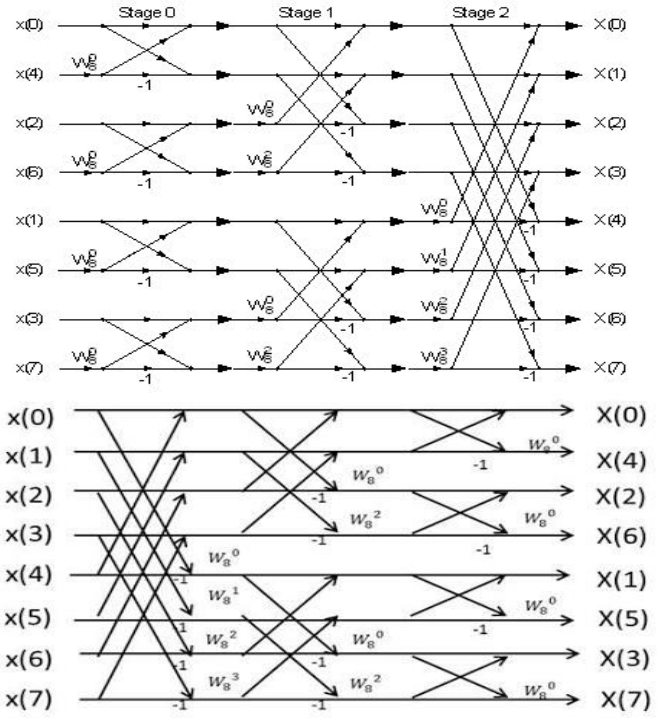


FIG.4:Butterfly diagram of an 8-point radix-2 IFFT

V. SYSTEM MODEL

Partial Transmit Sequence (PTS) is one of the distortionless technique which divides the input sequence into subsequences and chooses the phase optimized minimum PAPR signal for transmission.Partial Transmit Sequence (PTS) algorithm is technique for improving the statistics of a multicarrier signal. The basic idea of Partial Transmit Sequence algorithm is to divide the original OFDM sequence into several subsequences and for each sub-sequences multiplied by different phase factors until an optimum value is chosen. First, consider the data block as vectors,

X=[X1, X2 ……XN-1]T. Then, data vector X are portioned into disjoint sets, represented by the vector {Xm, m=1,2….M}. Here, we assume that the data clusters consist of a contiguous set of subcarriers and are of equal size.The objective is to combine the m number of cluster using the equation and to obtain a optimal solution,

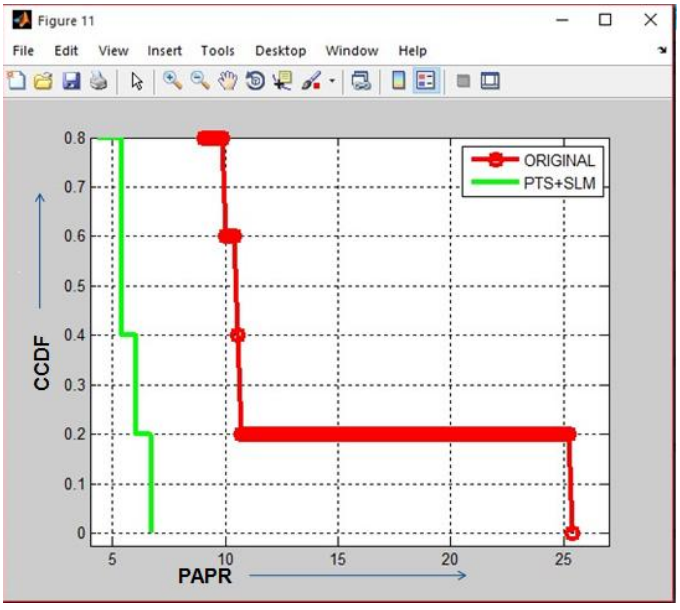
$X'=\sum M_{m=1\ bm\times xm}$

where {m=1,2,….M} are weighting phase factors and are assumed to be rotated using different combinations. Here Xm is the partially transmitted sequence. The increase in the number of phase factor decreases PAPR of the OFDM signal but in turn increases the hardware complexity of the system.

VI. SOFTWARE

Matlab 13.1 is used because it has all necessary packages required to do energy optimization simulations. E.g. FFT and IFFT function, Different modulator/demodulator schemes, AWGN noise channel etc. Matlab has facility to plot all intermediate signals and also can be used for data analysis from command window Matlab signal processing tool box have been used.Signal processing toolbox provides function and apps to generate, measure, transform, filter, and visualize signals.Toolbox includes algorithms for resampling smoothing and synchronizing signals, designing and analyzing filters, estimating power spectra and measuring peak, bandwidth and distortion.It is used to analyze and compare signals in time, frequency and time-frequency domain.

VII. RESULT



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