PAPR Reduction of OFDM Systems with the Help of DHT–Precoder and M-QAM

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ABSTRACT:
In Present days, High peak to average power ratio is the one of major drawback in orthogonal frequency division multiplexing system, which is used for data transmission over long distances. The high PAPR increases the complexity of analogue to digital and digital to analogue converters and also reduces the efficiency of High power Amplifier(HPA).In this paper, we present the analysis of Discrete Hartley Transform(DHT) pre coded OFDM system using M-QAM(M=8,16,32,64,128,256). Also, we compare the simulation results of DHT pre coded OFDM system with DFT pre coded OFDM system, Walsh Harmand Transform pre coded OFDM system, and selected mapping based OFDM system. Finally, we prove that PAPR of DHT pre coded OFDM system has less PAPR than other and it approaches to Zero.

KEY WORDS:
PAPR,DHT pre coder, M-QAM.

A. INTRODUCTION:
In present days, there is a high demand for the transmission of data without interference and noise and also, to get 100% output at the receiver without Dropping. To improve data rate and to avoid the noise, this project helps the people to avoid the data loss and to gain 100% output by using DHT pre coded OFDM system, which is used to eliminate the complete noise in the transmission system.

In Present days, OFDM system is very efficient system for transmission of data than others. Because, In general FDMA systems, we provide the guard interval between two carriers to avoid the interference between carriers, but, due to this, Half of the Bandwidth of total bandwidth is wasted for Guard interval. so, by using OFDM system we provide 90° phase shift between two adjacent carriers due to these, if two carriers are very adjacent to each other then also they cannot overlap each other because of 90° phase shift between two carriers so because of these we can obtain efficient bandwidth utilization and the is no wastage of bandwidth.

Here, we are using, DHT pre coded OFDM system because of its efficient use of spectrum. By using this cost of the system is also very less because the hardware used for the system is very easy and less hard. And also it is used for conversion of real coefficients into real coefficients so due to these reasons we are using DHT here.

QAM means QUADRATURE Amplitude Modulation which is very efficient modulation technique in communication systems which inbuilt provides QUADRATURE i.e., 90° phase shift between carriers to avoid interference at input level itself. Here, we are using M-QAM i.e., we implement the QAM up to 256 bits i.e, 256 QAM. Finally by observing the results of 256 QAM we conclude that PAPR of 256QAM is approaches to zero

B. DRAWBACKS OF COMMUNICATION SYSTEMS:

PAPR:
It is the ratio of maximum peak amplitude to its RMS value.

\[\text{PAPR} = \frac{\text{maximum peak amplitude}}{\text{RMS value of the peak}}\]

EFFECTS OF PAPR:
- Distortion increases
- Interference increases
- Degradation of output power
- Inefficient use of spectrum

C. PAPR REDUCTION TECHNIQUES:
We have so many techniques for reducing the PAPR, some of the techniques are:

**CLIPPING:**

It is used in WHF pre coded OFDM system, by using this, we can clip the Noise, which is added mostly at peak values, but, due to this there may be a chance of elimination of desired signal also, so, it is not that much of efficient.

**SELECTED MAPPING:**

In this, we multiply all the carriers with certain constant for improvement of peak amplitudes of all carriers based on our selection. Then, the vector with lowest PAPR is selected for Transmission.

**PARTIAL TRANSMIT SEQUENCE:**

Here, we divide the frequency blocks into sub-blocks and we multiply the each block with some constant phase shift. Choosing the appropriate phase shift value reduces the PAPR. The Typical part of this technique to find out the Optimum phase value combination.

**D. DHT PRECODED OFDM SYSTEM:**

Figure shows the block diagram of pre coding based OFDM system. We implemented the pre coding matrix p of dimension N×N before IFFT to reduce the PAPR.

The input baseband signal for OFDM system for N subcarriers is

\[ x(t) = \frac{1}{N} \sum_{k=0}^{N-1} P_{mn} X_k e^{j2\pi kn} \]

\[ 0 \leq n \leq N-1 \]

**Fig:** Block diagram of OFDM system with DHT pre coder and M-QAM.

We can express modulated OFDM vector signal with N subcarriers as

\[ X_N = \text{IFFT} \{ P \cdot X_N \} \]

The PAPR of OFDM signal is

\[ \text{PAPR} = \frac{|x_{\text{peak}}|^2}{x_{\text{rms}}^2} \]

**THE DISCRETE FOURIER TRANSFORM (DFT) PRECODING:**

The DFT of a sequence of length N can be defined as

\[ X(k) = \sum_{n=0}^{N-1} x(n) e^{-j2\pi kn} \]

k= 0, 1 ,.., N-1

IDFT can be written as

\[ x(n) = \frac{1}{N} \sum_{n=0}^{N-1} X(k) e^{j2\pi nk} \]

k= 0, 1 ,.., N-1

Where \( P_{mn} e^{-j2\pi mn/n} \) and N are integers from 0 to N-1 and P is pre coding matrix of size N by N.
M-QAM MAPPER:
Here we are using QUADRATURE AMPLITUDE MODULATION is a digital modulation technique, in QAM it enables DSB-SC modulated signals to occupy the same transmission bandwidth modulated signals to occupy the same transmission bandwidth at the receiver o/p, it is therefore, known as bandwidth conservation scheme, it having the 2 balanced modulators to provide the 90\(^\circ\) phase shift between 2 adjacent sub carriers, so, we get the output of QAM as the combined signals o/p one with normal phase shift and other with 90\(^\circ\) phase shift than before carrier. The o/p of QAM is also digital data, which is applied to serial to parallel converters, Here, we observe up to 256-QAM which is used to reduce the PAPR. So, by using 256-QAM, we reduce the maximum PAPR compared to others, which is very close to Zero with 256 bits.

SERIAL TO PARALLEL CONVERTER:
Here, we are using serial to parallel converters, because, the o/p of QAM is digital, so, to avoid the interference of bits in two adjacent subcarriers .First, we convert this serial data to parallel i.e. one by one bit simulation to avoid the interference between carriers.

DHT-PRECODER:
The o/p of serial to parallel converters is in the bit format is applied to DHT-PRECODER, it converts real-valued functions to real-valued functions and it is a orthogonal separable transform.

\[
H_k = \sum_{n=0}^{N-1} x_n \left[ \cos \left( \frac{2\pi nk}{N} \right) + j \sin \left( \frac{2\pi nk}{N} \right) \right]
\]

\[
= \sum_{n=0}^{N-1} x(n) \cdot \cos \left( \frac{2\pi nk}{N} \right)
\]

Where \( \cos \theta = \cos \theta + \sin \theta \) and \( k = 0, 1 \ldots N-1 \)

\[
p_{mn} = \cos \left( \frac{2\pi mn}{N} \right)
\]

This is the formula for DHT transform for N by N matrix. The pre coding matrix is

\[
P = \begin{bmatrix}
    p_{00} & p_{11} & \cdots & p_{0(N-1)} \\
p_{10} & p_{11} & \cdots & p_{1(N-1)} \\
    \vdots & \vdots & \ddots & \vdots \\
p_{(N-1)0} & p_{(N-1)1} & \cdots & p_{(N-1)(N-1)}
\end{bmatrix}
\]

Where \( p \) is the pre coding matrix of size \( N \) by \( N \). It is used to increase the bandwidth efficiency due to forward and reverse transforms is identical and also complexity is very less. It helps to remove the unwanted peak signal to reduce noise and PAPR.

IFFT:
The o/p of DHT is applied to IFFT to convert frequency to time domain. It is applied to parallel to serial, again converts to serial data.

CHANNEL:
here, we are using Rayleigh channel which is very efficient for long distance transmission and probability of noise is very less. Then, reverse process is done again for gaining Transmitted signal.

E. RESULTS:

FIG: OFDM system for 16-qam with N=8
In this paper, we conclude that the PAPR of DHT pre coded OFDM system has better performance compared to other DFT pre coded OFDM, Walsh hadamard transform OFDM pre coded system and selected mapping pre coded OFDM systems. So, the PAPR of DHT pre coded OFDM system with M-QAM is approaches to zero.

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FIG: OFDM system for 8-QAM with N=8

F. CONCLUSION:

In this paper, we conclude that the PAPR of DHT pre coded OFDM system has better performance compared to other DFT pre coded OFDM, Walsh hadamard transform OFDM pre coded system and selected mapping pre coded OFDM systems. So, the PAPR of DHT pre coded OFDM system with M-QAM is approaches to zero.