Improve the Performance of OFDM System by Trigonometric Transformers and PAPR Reduction

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Abstract

In this paper a new scheme is put forward for consideration for progressive image transmission over Orthogonal Frequency Division Multiplexing (OFDM) system with Low Density Parity Check Coding (LDPC).Trigonometric transforms are used in this scheme for improving the performance of the OFDM system and reducing the Peak-to-Average Power Ratio (PAPR) of OFDM signal. OFDM is an efficient method of data transmission for high speed communication systems. The PAPR is a major drawback of multicarrier transmission system such as OFDM. The Set Partitioning In Hierarchical Tress(SPIHT) algorithm is used for source coding of the images to be transmitted.

Keywords: OFDM, PAPR, SPIHT, LDPC, Trigonometric transforms.

I Introduction

1 OFDM

OFDM is a promising solution for high data rate transmission. OFDM is a multicarrier modulation (MCM) technique which to be an attractive candidate for fourth generation (4G) wireless communication systems. OFDM offer high spectral efficiency, immune to the multipath delay, low inter-symbol interference (ISI), immunity to frequency selective fading and high power efficiency. Due to these merits OFDM is select as high data rate communication system such as Digital Video Broadcasting (DVB) and based mobile worldwide interoperability for microwave access.

OFDM divides frequency selective channel into several parallel non frequency selective narrow-band channels, and modulate signal into different frequencies. It can improve the channel transmission performance without employing complex equalization schemes. High peaks of OFDM signals occur when the sinusoidal signals of the subcarriers are added constructively. These high peaks necessitate using larger and expensive linear power amplifiers. So high peak occur irregularly and infrequently, this means that power amplifiers will be operating inefficiently.

Fig 1 shows high sinusoidal peak is clearly. So we can understand by seeing it what is it. Signal is transmitted with the sedate = 64 data symbol per frame to IFFT. This is the sinusoidal of OFDM system to observe PAPR in it.

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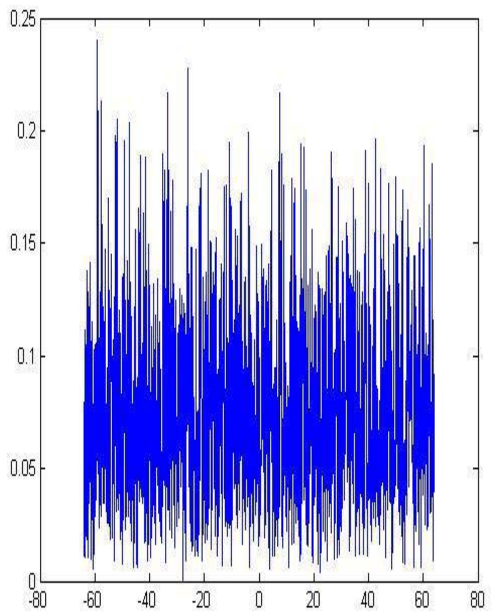

Figure 1.OFDM signal containing sinusoidal high peak

2 PAPR

2.1 What is PAPR?

PAPR means randomly sinusoidal leads occurred during transmission of the OFDM signal. The PAPR of the OFDM signal is defined as

$$\text{PAPR} = \frac{P_{peak}}{P_{average}}$$

Where, P peak = Peak power of the OFDM system
P average = average power of the OFDM system.

$$\text{PAPR}= \frac{\max_{0 \le t < NT} |x(t)|^2}{1/NT \int_0^{NT} |x(t)|^2 dt}$$

X(t)= original signal
N=length

NT= duration of data of OFDM data block X.

In principle, PAPR reduction techniques are concerned with reducing max I x(t) I. Since most system employ discrete-time signals, the amplitude of samples of x (t) is dealt with in many of the PAPR reduction techniques.

2.2 Why PAPR reductions in OFDM system

Reduce the PAPR is most important point in the OFDM system. Because of when we are talking about the high speed data communication in real life like video calling, high speed internet accesses , and also main point is that high speed data access up to 2 mbps while moving on the vehicle at 100km/h, Digital Video Broadcasting (DVB), Microwave terrestrial television , Digital Audio Broadcasting (DAB), 4G system hyper LAN . So this most type of communication systems required high data rate. But problem occurs like PAPR in OFDM system prevent these type of facilities in the real life. So to reduce it is most important.

OFDM signal consists of lot of independent modulated subcarriers, which are created the problem of PAPR. It is impossible to send this high peak amplitude signals to the transmitter without reducing peaks. So we have to reduce high peak amplitude of the signals before transmitting.

2.3 PAPR reduction techniques

PAPR reduction techniques are divided into two groups- signal scrambling techniques and signal distortion techniques which are given below

PAPR réductions techniques

Signal distorsion techniques
i) Signal clipping
ii)Peak windowing
iii)Envelope scaling
iv)Peak reduction carrier

Signal scrambling techniques
i)Block coding
ii)Sub block coding
iii) Interleaving

iv)Partial transmit sequence

v)Selective level mapping

vi) Linear block coding

Vii) Tone reservation

Viii) Tone injection

Figure 2. types of PAPR techniques

3 LDPC

Low-density parity-check (LDPC) codes are a class of linear block codes which provide near capacity performance on a large collection of data transmission and storage channels while simultaneously admitting implementable decoders. LPDC codes were first proposed by Gallager in his 1960 doctoral dissertation. Tanner generalized LDPC codes and introduced a graphical representation of LDPC codes, now called Tanner graphs. The advantages of linear block codes which possess low density parity check matrices.

4 Trigonometric transforms

The block diagram of the proposed LDPC-COFDM system is illustrated in Fig1.1 the proposed modifications will be in the transform and replacement block. The SPIHT coder is chosen as the source coding technique due to its flexibility of code rate and simplicity of designing optimal system. The SPIHT divides the image stream into several layers according to the importance of progressive image stream. Then the image stream is converted to a binary format. Afterwards the information bits are LDPC encoded at the LDPC encoder. The OFDM considered in this paper utilizes N frequency tones (number of subcarriers) hence the baseband data is first converted into parallel data of N sub channels so that each bit of a codeword is on different subcarrier.

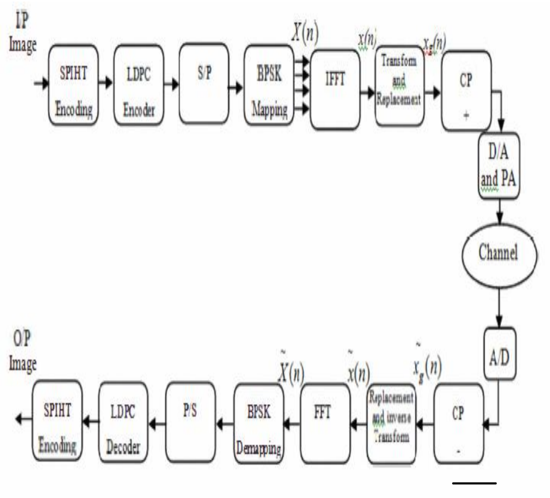

Figure 3. The LDPC COFDM system model with trigonometric transforms

5 SPIHT algorithm

The SPIHT algorithm was developed by Said and Pearlman in 1996. The SPIHT uses the fundamental idea of zero-tree coding from the EZW but is able to obtain a more efficient and better compression performance in most cases without having to use an arithmetic encoder. It uses wavelet sub band decomposition and imposes a quad tree structure across the sub bands in order to exploit the inter-band correlation. SPIHT algorithm uses a special data structure – spatial orientation trees (SOT). This particular structure is not only made full use of different scales the correlation between the wavelet coefficients, but also give full consideration to the correlation of the same scale wavelet coefficients.

The SPIHT algorithm defines and partitions sets in the wavelet decomposed image using a special data structure called a spatial orientation tree. A spatial orientation tree is a group of wavelet coefficients organized into a tree rooted in the lowest frequency (coarsest scale) sub band with offspring in several generations along the same spatial orientation in the higher frequency sub bands. Fig3.1 shows a spatial orientation tree and the parent children dependency defamed by the SPIHT algorithm across sub bands in the wavelet image. The tree is defined in such a way that each node has either no offspring (the leaves) or four offspring at the same spatial location in the next finer sub band level. The pixels in the lowest frequency subband-tree roots are grouped into blocks of 2x2 adjacent pixels, and in each block one of them; marked by star as shown in Fig. 1; has no descendants. SPIHT describes this collocation with one to four parent-children relationships,

Parent = (i,j)

Children = [(2i,2j),(2i + 1,2j),(2i,2j + 1),(2i + 1,2j + 1)]

The SPIHT algorithm consists of three stages: initialization, sorting and refinement. It sorts the wavelet coefficients into three ordered lists: the list of insignificant sets (LIS), the List of Insignificant Pixels (LIP), and the List of Significant Pixels (LSP). At the initialization stage the SPIHT algorithm first defines a start threshold based on the maximum value in the wavelet pyramid, then sets the LSP as an empty list and puts the coordinates of all coefficients in the coarsest level of the wavelet pyramid (Le. the lowest frequency band; LL band) into the LIP and those which have descendants also into the LIS.

In the sorting pass, the algorithm first sorts the elements of the LIP and then the sets with roots in the LIS. For each pixel in the LIP it performs a significance test against the current threshold and outputs the test result to the output bit stream. All test results are encoded as either 0 or 1, depending on the test outcome, so that the SPIHT algorithm directly produces a binary bit stream. If a coefficient is significant, its sign is coded and its coordinate is moved to the LSP. During the sorting pass of LIS, the SPIHT encoder carries out the significance test for each set in the LIS and outputs the significance information. If a set is significant, it is partitioned into its offspring and leaves. Sorting and partitioning are carried out until all significant coefficients have been found and stored in the LSP. After the sorting pass for all elements in the LIP and LIS, SPIHT does a refinement pass with the current threshold for all entries in the LSP, except those which have been moved to the LSP during the last sorting pass. Then the current threshold is divided by two and the sorting and refinement stages are continued until a predefined bit-budget is exhausted.

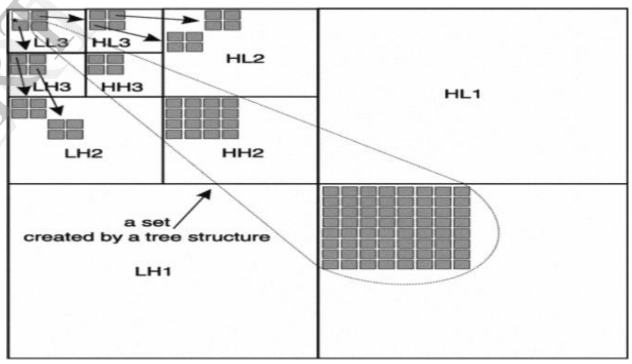

Figure. 4. Parent-children dependency and spatial orientation trees across wavelet sub bands in SPIHT.

6 Conclusions

An efficient LDPC coded OFDM system with trigonometric transforms supporting image transmission using SPIHT compression technique is presented. To archive a reduction in the PAPR without degrading the PSNR performance. It is easy to find in the literature many of the applications being explored for LDPC codes, including application to deep space and satellite communications, wireless communication, magnetic storage, and internet packet transmission.

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