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Progressive Image Transmission over OFDM System with Minimum Peak to Average Power Ratio (PAPR)

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ABSTRACT: The main aim of this project is reduce the PAPR of transmitted OFDM signals, improve the transmitted image quality & The SPIHT coder is chosen as the source coding technique due to its flexibility of code rate and simplicity of designing optimal system. 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. 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 transform

I. INTRODUCTION

OFDM modulation has been adopted by several wireless multimedia transmission standards, such as Digital Audio Broadcasting (DAB) and Digital Video Broadcasting (DVB-T), because it provides a high degree of immunity to multipath fading and impulsive noise, Orthogonal Frequency Division Multiplexing (OFDM) is a special form of multicarrier modulation scheme, which divides the entire frequency selective fading channel into many orthogonal narrow band flat fading sub channels. In OFDM system high-bit-rate data stream is transmitted in parallel over a number of lowers data rate subcarriers and do not undergo ISI due to the long symbol duration. It can significantly improve the channel transmission performance without employing complex equalization schemes. It also has broad application prospect in wireless image and video communications. There are still some challenging issues, which remain unresolved in the design of OFDM systems. One of the major problems is high PAPR of transmitted OFDM signals. Therefore, the OFDM receiver detection efficiency is very sensitive to the nonlinear devices used in its signal processing loop, such as Digital-to-Analog Converter (DAC) and High Power Amplifier (HPA), which may severely impair system performance due to induced spectral regrowth and detection efficiency degradation.

Major advantages of OFDM systems are

1. High spectral efficiency due to nearly rectangular frequency spectrum for high
Numbers of sub-carriers
2. Simple digital realization by using the FFT operation.
3. Less complex receivers due to the avoidance of ISI with a sufficiently long cyclic
Prefix.
4. Different modulation schemes can be used on individual sub-carriers which are
Adapted to the transmission conditions on each sub-carrier

II. MOTIVATION

There are still some challenging issues, which remain unresolved in the design of OFDM systems. One of the major problems is high PAPR of transmitted OFDM signals. Therefore, the OFDM receiver detection efficiency is very sensitive to the nonlinear devices used in its signal processing loop, such as Digital to Analog Converter (DAC) and High Power Amplifier (HPA), which may severely impair system performance due to induced spectral regrowth and detection efficiency degradation. All fading and Inter-Symbol Interference (ISI) result in severe losses of transmitted

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image quality The aim of this project is reduce the PAPR of transmitted OFDM signals, improve the transmitted image quality & The SPIHT coder is chosen as the source coding technique due to its flexibility of code rate and simplicity of designing optimal system.

III. THE SPIHT ALGORITHM

The SPHIT 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 in to a tree rooted in the lowest frequency (coarsest scale) subband with offspring in several generations along the same spatial orientation in the higher frequency subband. Fig.1 shows a spatial orientation tree and the parent children dependency defied by the SPHIT algorithm across subband in the wavelet image. The tree is defied in such a way that each node has either no offspring (the leaves) or four offspring at the same spatial location in the next fmersubband 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. SPIRT describes this collocation with one to four parent-children relationships,

$$\text{Parent} = (i,j)$$

$$\text{Children} = [(2i,2j),(2i+1,2j),(2i,2j+1),(2i+1,2j+1)]$$

The SPHIT 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 SPIRT 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 SPHIT 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 SPHIT 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, SPHIT does a refmement 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 refmement stages are continued until a predefined bit-budget is exhausted.

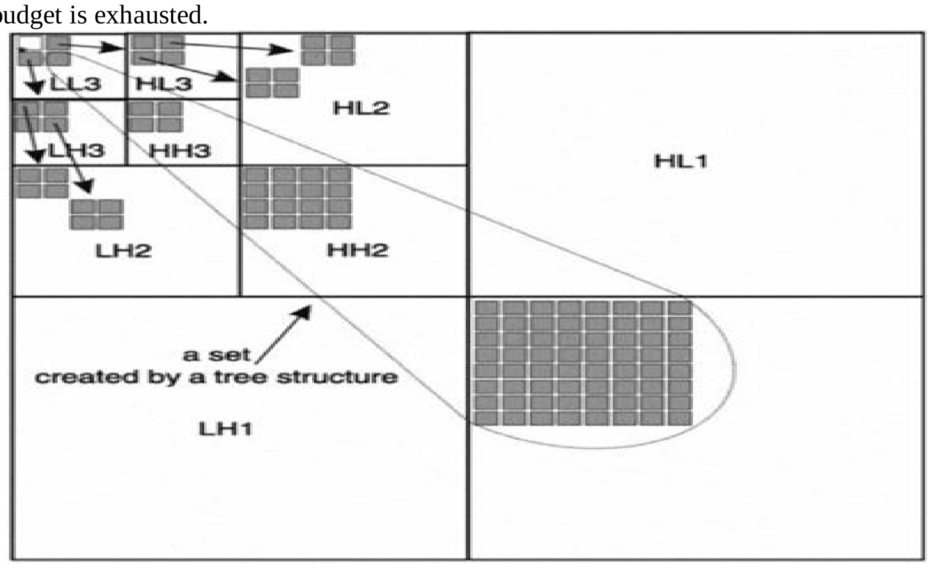

Fig. 1: Parent-children dependency and spatial orientation trees across wavelet subbands in SPIHT.

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IV. PAPR

The PAPR of OFDM signals x(t) is defined as the ratio between the maximum Instantaneous power and its average power.

$$PAPR[x(t)] = \frac{P_{PEAK}}{P_{AVERAGE}} = 10\log_{10}\frac{\max[|X(n)|^2]}{E[|x_n|^2]}$$

Where PPEAK represents peak output power, PAVERAGE means average output power. E[·] denotes the expected value, xn represents the transmitted OFDM signals which are obtained by taking IFFT operation on modulated input symbols

A) PAPR REDUCTION TECHNIQUES--

Many techniques have been used to reduce the PAPR in OFDM system. Now as per the below table we can see how many techniques can be used.

Several PAPR reduction techniques have been proposed in the literature. These techniques are divided into two groups - signal scrambling techniques and signal distortion techniques which are given below:

I) Signal Scrambling Techniques

- Block Coding Techniques
- Block Coding Scheme with Error Correction
- Selected Mapping (SLM)
- Partial Transmit Sequence (PTS)
- Interleaving Technique
- Tone Reservation (TR)
- Tone Injection (TI)

II) Signal Distortion Techniques

- Peak Windowing
- Envelope Scaling
- Peak Reduction Carrier
- Clipping and Filtering

V. SIMULATION

The wavelet decomposition depth is an important criterion that really matters. This simulation revealed a fact that SPIHT is most efficient.

Fig 2: Original Image For Wavelet Transform.

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The input image is 8 bits per pixel, grayscale test image, 'Cameraman' from MATLAB toolbox is utilized in the simulation has a resolution 256x256 pixels

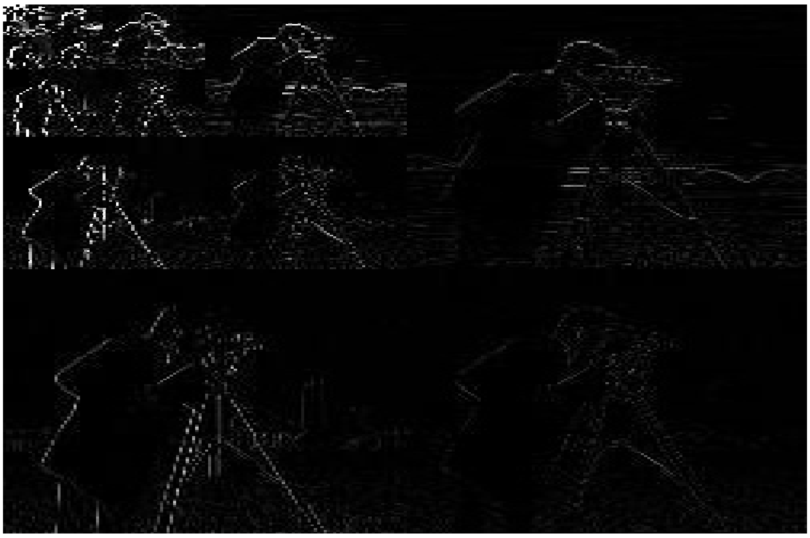

Fig 3: Partition Image Up to 8 Levels.

The parameters used in the simulation are the number of subcarriers of a LDPC coded OFDM system (N) is considered to be 256, Cyclic Prefix is 64, Rate of the SPIHT (r) = 0 to l. LDPC code of R = 1;2 is employed with sum-product decoding, where R denotes the code rate and a (512, 1024) parity check matrix is used. The maximum number of iterations in sum-product decoding is set to 10.Finally, the impact of the of subcarriers on the performance of the three scheme using the SPIHT rate 0.5 & 1.0 at different PAPR value

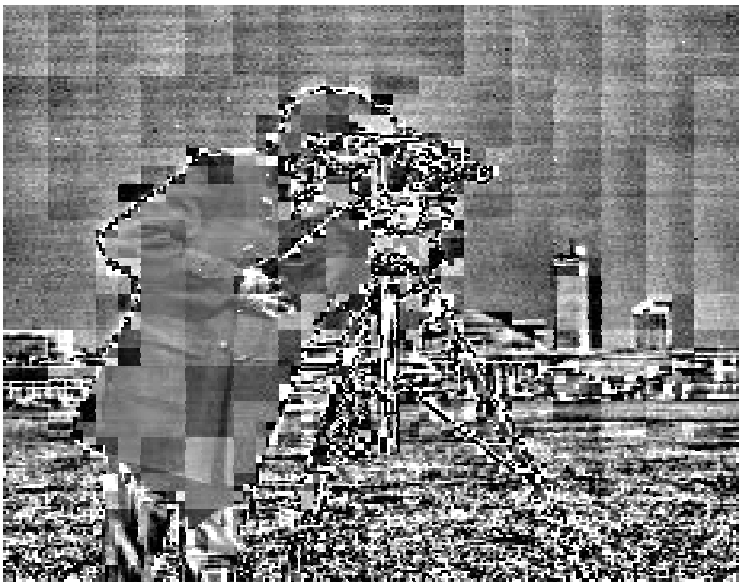

Fig4:256*256 grayscale image

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Fig 5: Received image after encoding and decoding.

VI. CONCLUSION

OFDM is a very attractive technique for wireless communications due to its spectrum efficiency and channel robustness. The combination of the high spectral efficiency OFDM modulation technique and LDPC coding will be a good candidate for high speed broadband wireless applications. The BER performance of the Low Density Parity Check Coding- Coded Orthogonal Frequency Division Multiplexing system (LDPC-COFDM) is influenced by the sub channels which have deep fad due to frequency selective fading. According to this combination, several algorithms were introduced into LDPC-COFDM system to improve the BER by adaptive bit loading and power allocation of each subcarrier.

VII. APPLICATIONS

i) Wireless image and video communication
ii) Handling the increased spatial resolution of today's imaging sensors and evolving broadcast television for better quality of image i.e. for communication purpose.
iii) SPIHT exploits properties that are present in a wide variety of images. It had been successfully tested in natural (portraits, landscape, weddings, etc.) and medical (X-ray, CT, etc.) images.
iv) In multimedia image compression and communication.
v) Video transmission over unreliable network such as Internet or Wireless network suffers from various kinds of adverse condition such as bandwidth fluctuation, burst-error contamination, packet loss, and excessive packet delay due to network congestion.

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