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Energy Saving Of Images During Transmission Using Spiht Algorithm Combined With Huffman Encoding Over OFDM Channel

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Abstract

In this paper, Energy saving of images during transmission using SPIHT algorithm combined with Huffman encoding over OFDM channel has been proposed. In the past decade, DWT has produced more system energy and less received image quality in terms of mean square error (MSE).In this paper, first decompose the image in to different level, The compressed coefficients are arranged in descending order of priority and mapped over the channels . The coefficients with lower importance level, which are likely mapped over the bad channels, are discarded at the transmitter to save power without significant loss of reception quality. Secondly, apply the embedded encoder (SPIHT) algorithm and Huffman encoder .Third is the to decode the Huffman and SPIHT decoding of embedded encoder. In this technique reduce the number of encoding bits and reduce the system power consumptions.

Index terms:- Huffman encoding, Huffman decoding, SPIHT algorithm,PSNR,energy saving, DWT-OFDM.

I.INTRODUCTION

OFDM is a multi-carrier modulation scheme having excellent performance which allows overlapping in frequency domain. In **OFDM,** individual sub channels are affected by flat fading, so for a period of time, condition of the sub channels may be good, or they might be deeply faded. The packets which are transmitted through these faded sub channels are highly prone to be lost at the receiver due to non-acceptable errors. **OFDM** system provides an opportunity to exploit the diversity in frequency domain by providing a number of subcarriers, which can work as multiple channels for applications having multiple bit streams.

In recent years, for still image transmission, most common way is progressive (or layered) encoding technique. State-of-the-art image or video compression techniques, such as JPEG2000 [1] (which uses Discrete Wavelet Transform **DWT**), layered coding is performed. In this technique has loss-less transmission system, in the event of errors reconstruction of image can be stalled due to retransmission of lost coefficients, which is not acceptable in real time content delivery applications. The wavelet transform [2] as a branch of mathematics developed rapidly, which has a good localization property [3] in the time domain and frequency domain, can analyze the details of any scale and frequency. so, it superior to Fourier and **DCT**. It has been widely applied and developed in image processing and compression. **EZW** stands for 'Embedded Zero tree Wavelet', which is abbreviated from the title of Jerome Shapiro's 1993 article[4],"Embedded Image Coding Using Zero trees of Wavelet Coefficients". **EZW** is a simple and effective image compression algorithm, its output bit-stream ordered by importance. Encoding was able to end at any location, so it allowed achieving accurate rate or distortion. This algorithm does not need to train and require pre-stored codebook. In a word, it does not require any prior knowledge of original image. More improvements over **EZW** are achieved by **SPIHT**, by Amir Said and William Pearlman, in 1996 article, "Set Partitioning in Hierarchical Trees" [5]. In this method, more (wide-sense) zero trees are efficiently found and represented by separating the tree root from the tree, so, making compression more efficient. Experiments are shown that the image through the wavelet transform, the wavelet coefficients' value in high frequency region are generally small [6], so it will appear seriate "0" situation in quantify. **SPIHT** does not adopt a special method to treat with it, but direct output. In this paper, focus on this point, propose a simple and effective method combined with Huffman encode for further compression. A large number of experimental results are shown that this method saves a lot of bits in transmission, further enhanced the compression performance.

In this paper is organized as follows. Explain proposed method in section II. The simulation results in Section III. Concluding remarks are made in Section IV.

II. PROPOSED METHOD

It is simple and effective method to saves a lot of bits in transmission ,reduce the system energy consumption and better image quality at the receiver's he block diagram of proposed method as shown fig (1).

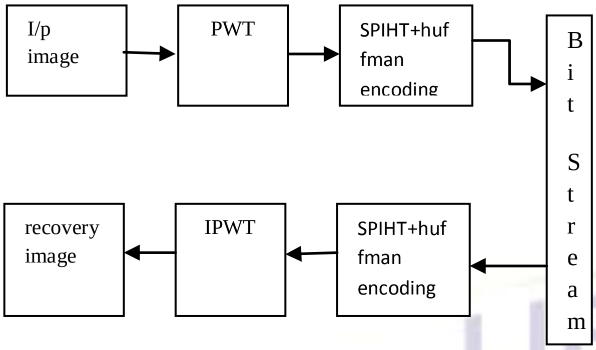

Fig.1. Block diagram of proposed method

The algorithm of proposed method as shown below

1) decompose the image in to four sub band coefficients using **PWT**

2) Apply the **SPIHT** algorithm Huffman encoding of all decomposed images and convert to bit stream as shown in fig.3.

3) Repeat from step 1 for the low-low sub-band image, until it becomes third level.

4) Apply the Huffman decoding of bit stream.

5) Apply **IPWT** to get recover image.
Recovery image is compressed and better image quality.

a) Pyramid structure wavelet transforms (PWT):

The **PWT** is also called as discrete wavelet transforms (**DWT**). The pyramid-structure wavelet transform indicate that it recursively decomposes sub signals in the low frequency channels.

The pyramid-structured wavelet transform is highly sufficient for the images in which most of its information is exist in lower sub-bands [7]. In this work, Haar is the simplest and most widely used, while Daubechies have fractal structures and are vital for current wavelet applications. So Daubechies wavelets are used here.

Using the pyramid-structure wavelet transform, the texture image is decomposed into four sub images, as low-low, low-high, high-low and high-high sub-bands coefficients. Apply each sub band coefficients to **SPIHT** with Huffman encoding as shown in fig (1).

b) SPIHT algorithm:

One of the most efficient algorithms in the area of image compression is the Set Partitioning in Hierarchical Trees (**SPIHT**). It is a simple, fast and completely embedded. In encoder, the resulting LL version of **PWT** is again four-way decomposed, as shown in Figure 2. This process is repeated until the top of the pyramid is reached.

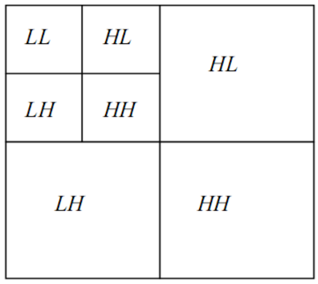

Fig.2. Image decompose using pwt

A wavelet coefficient at location (i,j) in the pyramid representation has four direct descendants (off-springs) at locations:

O(i,j)={(2i,2j),(2i,2j+1),(2i+1,2j),(2i+1,2j+1)} (1)

and each of them recursively maintains a spatial similarity to its corresponding four off-spring. The **SPIHT** algorithm takes advantage of the spatial similarity present in the wavelet space to optimally find the location of the wavelet coefficient that is significant by means of a binary search algorithm.

The **SPIHT** algorithm sends the top coefficients in the pyramid structure using a progressive transmission scheme. In this scheme that allows obtaining a high quality version of the original image from the minimal amount of transmitted data. The PWT coefficients are ordered by magnitude and then the most significant bits are transmitted first, followed by the next bit plane and so on until the lowest bit plane is reached. It can significantly reduce the Mean Square Error (**MSE**) distortion for every bit-plane sent. And increase the PSNR value.

$$PSNR = 10\log_{10}\left(\frac{255^2}{MSE}\right) dB,$$

The SPIHT coder algorithm orders the wavelets coefficient according to the significance test defined as

$$\max_{(i,j)\in\tau_m} |C_{i,j}| \geq 2^n \quad (2)$$

If the significant test is yes, it indicates that a particular wavelet coefficient is significant. If the significant test is no, it indicate that a particular wavelet coefficient is insignificant. If the Wavelets coefficients which are not significant at the nth bit-plane level may be significant at (n-1)th bit-plane or lower. This information is arranged, according to its significance, in three separate lists: list of insignificant sets (LIS), the list of insignificant pixels (LIP) and the list of significant pixels (LSP). In the decoder, the **SPIHT** algorithm replicates the same number of lists.

c) Huffman coding:

It is a statistical coding. It is allocated all significant coefficients with the same space.
For example:
212 coefficient = 1 byte
In encoder, Create binary tree nodes with character and frequency of each character then the Place nodes in a priority queue.
For example:
The lower the occurrence, the higher the priority in the queue.While priority queue contains two or more nodes, follow given procedure

- Create new node
- Dequeue node and make it left sub tree
- Dequeue next node and make it right sub tree
- Frequency of new node equals sum of frequency of left and right children
- Enqueue new node back into queue

After that rescan the significant coefficient and convert to bit stream. In decoder, once receiver has treed it scans incoming bit stream and to saves the lot of bits.
Here a concrete example to analyze the output binary stream of SPIHT encoding. The following is 3 level wavelet decomposition coefficients of SPIHT encoding;

	0	1	2	3	4	5	6	7
0	63	-34	49	10	7	13	-12	7
1	-31	23	14	-13	3	4	6	-1
2	15	14	3	-12	5	-7	3	9
3	-9	-7	-14	8	4	-2	3	2
4	-5	9	-1	47	4	6	-2	2
5	3	0	-3	2	3	-2	0	4
6	2	-3	6	-4	3	6	3	6
7	5	11	5	6	0	3	-4	4

Fig.3.The output bit stream of SPIHT encoding.

III. EXPERIMENTAL RESULTS

Fig.4. Original Image

Fig.5. Filter Process

Fig.6.Encoding Process

Fig.7.Reconstructed Image

VALIDATION

1) PSNR = 40.3825 db
2) CR = 3.2867 Sec
3) Enc-time = 13.1871 Sec
4) Dec-time = 12.0013 Sec
5) MSE ≈ **0**

IV ..EXPECTED GRAPH:

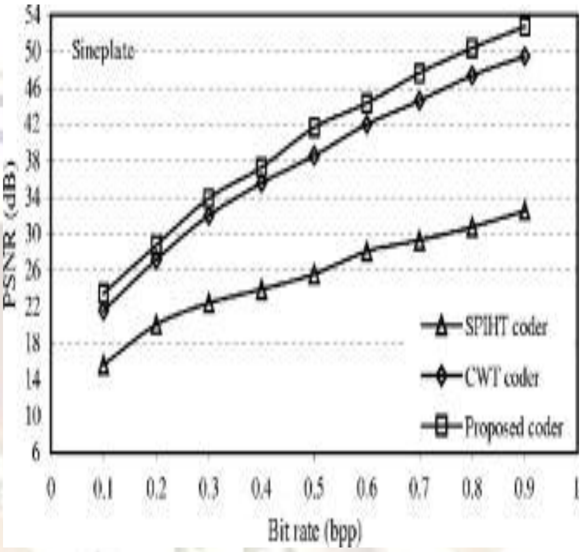

Fig.7.different PSNR values for different Lena images comparison coder

V.CONCLUSION

The **SPIHT** with Huffman coding is simple and effective method for image compression for storage purpose in **OFDM** channels. It saves lot of bits and reduces system power consumption. It observations of image quality in terms of mean square error and energy saving performance are validated by extensive MATLAB.

REFERENCE

[1] C. Christopoulos, A. Skodras, and T. Ebrahimi, "The JPEG2000 still image coding system: An overview," IEEE Trans. Consumer Electron., vol. 46, no. 4, pp. 1103–127, Nov. 2000.

[2] Marc ANTONINI Michel BARLAUD Pierre MATHIEU et al. Image coding using wavelet transform [J]. IEEE Trans. Image Processing 1992 1(2) 205-220.

[3] Cheng Li-chi, Wang Hong-xia, Luo Yong. Wavelet theory and applications. Beijing: Science Press, 2004(Chinese) .

[4] J. M. SHAPIRO. Embedded image coding using zero tree of wavelets coefficients [J]. IEEE Trans. Signal Processing 1993 41(12) 3445-346 2.

[5] Amir SAID William A.PEARLMAN. A new fast and efficient image codec based on set partitioning in hierarchical trees [J].

IEEE Transactions on Circuits and Systems for Video Technology 1996 6(3) 243-250.

[6] FAN Qi-bin. Wavelet analysis. Wuhan: Wuhan University Press, 2008.

[7] M. Banerjee and M. K. Kundu, "Edge based features for content based image retrieval," Pattern Recognition., vol. 36, no. 11, pp. 2649–2661, November 2003.

[8] Y. S. Chan, P. C. Cosman, and L. B. Milstein, "A cross-layer diversity technique for multi-carrier OFDM multimedia networks," *IEEE Trans. Image Proc.*, vol. 15, no. 4, pp. 833–847, Apr. 2006.

[9] R. J. McEliece and W. E. Stark, "Channels with block interference,"*IEEE Trans. info. Theory*, vol. 30, no. 1, pp. 44–53, Jan. 1984.

[10] R. Knopp and P. A. Humblet, "On coding for block fading channels," *IEEE Trans. info. Theory*, vol. 46, no. 1, pp. 189–205, Jan. 2000.