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STUDY OF IMAGE COMPRESSION TECHNIQUE BASED ON THE SPIHT ALGORITHEM

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ABSTRACT

In this paper, we study the compression technique. That is, Set Partitioning in Hierarchical Trees (SPIHT). This compression technique is based on the wavelet transform .A wavelet is a small wave which has its energy concentrated in time. It gives a tool for the analysis of non-stationary signal. Wavelet transform which decompose a signal into a set of basis function .This basic function is called the Wavelet. Here we see that SPIHT compression technique can preserve better visual characteristics of an original Image in the sense of PSNR (peak signal to noise ratio).

KEYWORDS: Wavelet analysis; image compression; SPIHT; PSNR.

INTRODUCTION

In the recent years, there is a large amount of information present in the form of Digital image data. At present, there is a huge demand for the image size and resolution. It is the outcome of the expansion of best and less exclusive image acquits icon devices. This thing is firm to carry on because digital imaging can only restore other technology. However, the digital images require more storage space/bandwidth, there is always a proficient algorithm is added to the overall system performance. In the literature, a number of algorithms were introduced. For high compression ratio at low bit, the coefficient formed by a wavelet transform will be zero, or very close to zero. This happens because "real world" images contain low frequency which contains the maximum information. As a tree in the root contain the lowest frequency and the children of each tree. The Nodes of tree are being spatially connected co-efficient have higher frequency sub bands, there is a huge chance that one or more sub tree will consist completely of coefficients which are zero or nearly zero, such sub tree are called zero tree. In the zero tree based image, compression schemes are Embedded Zero tree Wavelet Coding [1] and Set Partitioning into hierarchical trees [2], the intent is to use the properties (i.e. Mean, Deviation, contrast, entropy etc.) of the tree in order to competence code the location of significant coefficient. Since almost co-efficient will be zero so the spatial location of the significant co-efficient makes, size of a typical compressed image [3].

SPIHT ALGORITHM

Figure 1 shows the wavelet tree structure of SPIHT algorithm. We use the following function to indicate the significance of a set of coordinates and use the following sets of coordinates as defined in the SPIHT[5]:

$$S_n(X) = \begin{cases} 1, & \max_{(i,j)\in X} \{|c_{i,j}|\} \geq 2^n \\ 0, & others \end{cases} \quad (1)$$

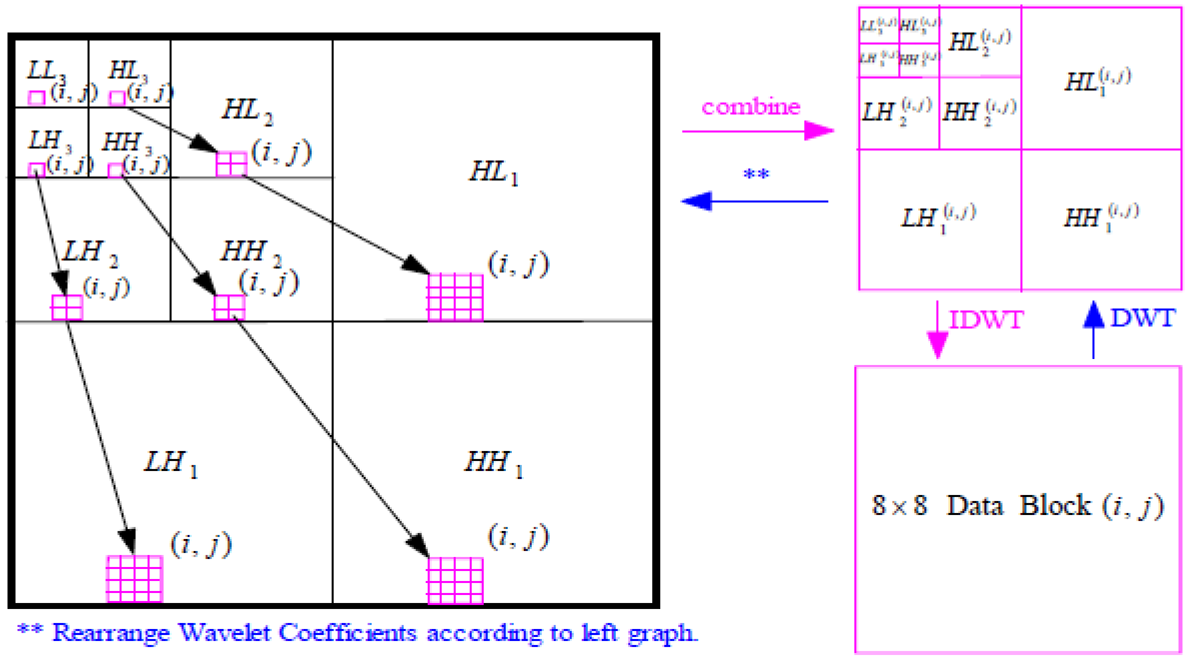

Figure 1. The wavelet tree structure of SPIHT algorithm

The SPIHT algorithm was introduced by said and Pearlman [6] [7]. It is a controlled, well organized and yet computationally easy image compression algorithm. By using this algorithm, greatest PSNR values for a different types of images for a given compression ratio can be obtained. It stands for set partitioned into hierarchical trees. It was developed for transmission and compression. SPIHT uses The Mean squared error (MSE) twist measure [ll]. EZW algorithm is the base version for SPIHT coder [8] [9] and it is a powerful image compression algorithm that produce an embedded bit stream from which the best recreated images in the MSE sense can be extracted at different bit rates, Some of the best results greatest PSNR values and compression ratios for a different types of images have been gained [10] but this algorithm, we can't compress the images dynamically rather we have to change the image manually every time. It is important to have the encoder and decoder test sets for significance in the same way, so the coding algorithm uses three lists called list of significant pixels (LSP), list of insignificant pixels (LIP), and list of insignificant sets (LIS).

SPIHT use the following sets of coordinates:

O (i, j): set of coordinates of all offspring of node *(i, j)*.

D (i, j): set of coordinates of all descendants of node *(i, j)*.

H: set of coordinates of all spatial orientation tree roots (nodes in the highest pyramid level).

LIS: list of the insignificant sets.

LIP: list of the insignificant pixels.

LSP: list of the significant pixels.

L (i, j) = D (i, j) − O (i, j).

A LIS entry is of type A if it represents *D (i, j)*,

Type B if it represents *L (i, j)*.

The steps of the algorithm are as follows:

(1) *Initialization*:

Output *n* = _log 2(max *(i, j)* {|*Ci, j* |}) _;

Set the LSP as an empty list;

Add the coordinates *(i, j)* ∈ *H* to the list LIP, and only those with descendants also to the LIS, as type an entries.

(2) *Sorting pass*:

(2.1) for each entry *(i, j)* in the LIP do:

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(2.1.1) transmit *Sn (i, j)*;
(2.1.2) if *Sn (i, j)* = 1 then move *(i, j)* to the LSP and transmit the sign of *Ci, j;*
(2.2) for each entry *(i, j)* in the LIS do:
(2.2.1) if the entry is of type a then
• transmit *Sn (D (i, j))*;
• If *Sn (D (i, j))* = 1 then
_ for each *(κ, _)* ∈ *O (i, j)* do:
• transmit *Sn (κ, _)*;
• If *Sn (κ, _)* = 1 then add *(κ, _)* to the LSP and output the sign of *Cκ,_*;
• If *Sn (κ, _)* = 0 then add *(κ, _)* to the end of the LIP;
_ If *L (i, j)* _= ∅ then move *(i, j)* to the end of the LIS, as an entry of type B, and go to step (2.2.2);
Otherwise, remove entry *(i, j)* from the LIS;
(2.2.2) if the entry is of type B then
• transmit *Sn (L (i, j))*;
• If *Sn (L (i, j))* = 1 then
_ add each *(κ, _)* ∈ *O (i, j)* to the end of the LIS as an entry of type A;
_ Remove *(i, j)* from the LIS.
(3) *Refinement pass*:
For each entry *(i, j)* in the LSP, except those included in the last sorting pass, output the *n*th most significant bit Of |*Ci, j* |;
(4) *Quantization-step update*:
Decrement *n* by 1 and go to step (2).

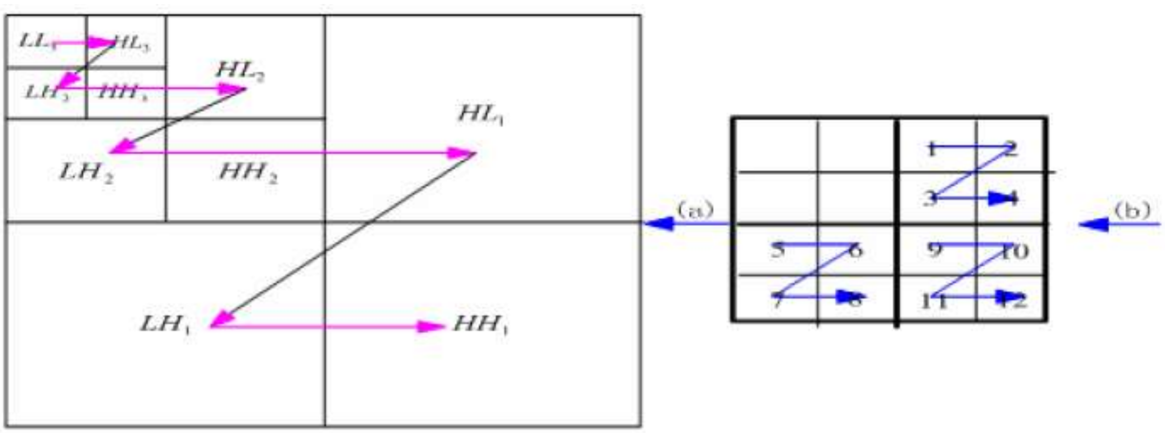

Figure 2. (a) the scanning sort of SPIHT algorithm and wavelet coefficients (b) the scanning sort of SPIHT algorithm in the same frequency band

SIMULATION RESULTS

The distortion between the original and reconstructed signal is measured by Peak Signal-to-Noise Ratio(PSNR.

$$PSNR = 10\lg\left[(M \times N \times f_{\max}^2) \Big/ \left(\sum_{x=0}^{M-1} \sum_{y=0}^{N-1} \left[\hat{f}(x,y) - f(x,y) \right]^2 \right) \right] \qquad (2)$$

Figure 3 shown growing performance of SPIHT coding method compared with the other coder by Increasing block size (8▯8, 16▯16, 32▯32). As we see the SPIHT coding method can preserve

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Better the visual characteristics of an original image. In the sense of PSNR. Figure 4 shown the image compression efficiency in different compression ratio and PSNR.The simulation results have shown that the presented SPIHT algorithm for image compression has excellent performance, and it is very fine for the practical applications.

CONCLUSION

This paper has presented a review on some embedded image codes achieved by set partitioning in the hierarchical trees algorithm (SPIHT). These algorithms use a tree structure or lists to detect and exploit similarities. From the simulation result it's clear that SPIHT compression technique can preserve better visual characteristics of an original Image in the sense of PSNR (peak signal to noise ratio).

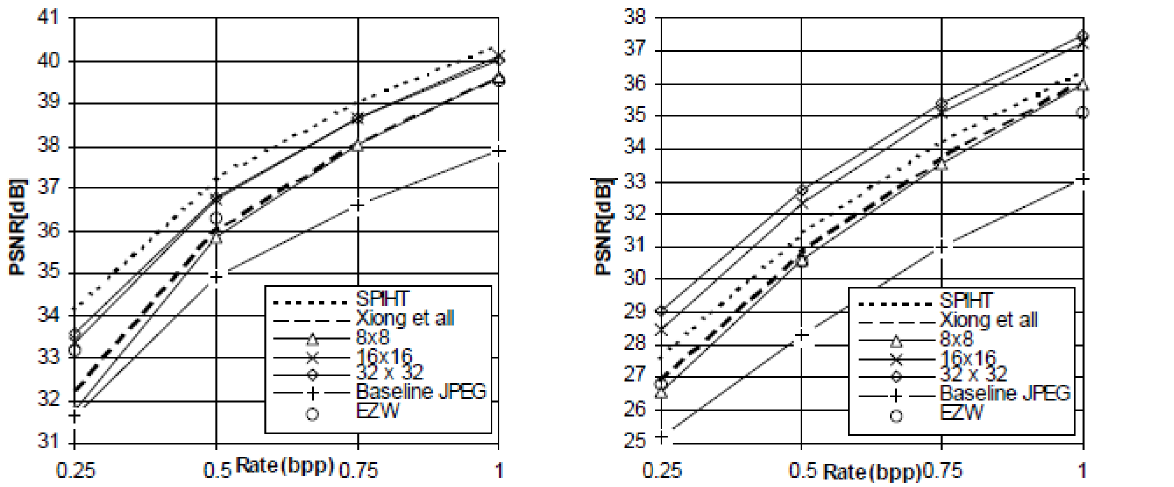

Figure 3. Comparison of rate-distortion performance between SPIHT coding method with different block sizes (8x8, 16x16, 32x32) and other coders

(a) (b) (c)

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(d) (e) (f)

Figure 4. A detail of lena image coded with corresponding PSNR:

a) Original Image b) Image reconstructed, ZWT, 16:1, PSNR=25.2dB c) Image reconstructed, SPIHT, 16:1, PSNR=29.3dB d) Original Image e) Image reconstructed, ZWT, 32:1, PSNR=21.8dB f) Image reconstructed, SPIHT, 32:1, PSNR=25.8dB

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