SQUEEZING OF COLOR IMAGE USING DUAL TREE COMPLEX WAVELET TRANSFORM BASED PRELIMINARY PLAN

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ABSTRACT

In this paper, we scrutinize the role of dual tree complex wavelet transform. This Dual tree complex wavelet transform (DT-CWT) is slightly short of shift invariant and directionally selective in two or rise up dimensions.The nature of multidimensional DT-CWT is non separable & dependent on the computationally expeditious, separable filter bank(SFB).This paper explains the designing of complex wavelet transform with directional properties and use of this designed form in squeezing of image. If we take the DT-CWT transform, then many of wavelet coefficients are approximately zero and this shows the intra sub-bands dependency. We further access the performance of SPIHT coding preliminary plan for coding of those coefficients. At last, In the results of proposed preliminary plan gives higher rate of squeezing and lower mean square error(MSE) compared to plan of DWT. Dual tree complex wavelet transform-SPIHT preliminary plan outperform DWT based preliminary plan at lower bit rates.

KEYWORDS

Image squeezing, Complex wavelet transform, Texture of image, Dual tree, SPIHT

1. INTRODUCTION

The discrete wavelet transform are used for squeezing the image since 1990.In the 2D-DWT squeezing technique, two one dimension are used for vertical & horizontal direction respectively [1].The image have two types of singularities in which the 2-D discrete wavelet transform (Traditional 2-D DWT) are able to capture point singularities with more effectiveness but at the time of capturing line singularities it becomes failed. It got failed because alignment of horizontal or vertical direction of image and edges & contour in images are not perfect. This imperfectness can be solving by using a new transform by filtering the image in both direction. If the alignment of edges & contour are not perfect with horizontally & vertically then the energy of image is spread across the sub band which is the property of DWT.To solve the problem of energy spreading in sub bands ,the directional transform is required.

There are two categories are defined for adaptive transform which are: - First category is used for analysis the image along the set of direction which is predetermined [8].Second category is used for analysis the direction itself to the orientation feature of image [5],[11][12]. On the other hand, two types of adaptive wavelet transform & lifting structured based transform are proposed because both are suitable for filtering the direction to the orientation of edges & texture[5],[11].To minimize the prediction error, use different types of direction selection method which is given in [12],[15],[16].

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In this paper, we access the result of squeezing preliminary plan based dual tree CWT & DWT with the coding plan of SPIHT (bior 4.4 filter coefficients).After analysis, the result of squeezing of preliminary plan, the proposed preliminary plan outperform than DWT plan at lower bit rate.

There are two scientist named reeves & Kingsbury have already discussed the DT-DWT which gives the result with higher PSNR at same bit per pixel [19].Coding of image with DT-DWT is also reported [17]

2. 2-D DUAL TREE CWT

We know that the DWT is very useful plan for signal processing but the performance of DWT is small in range because of unable to select higher dimension, aliasing problem at the time of signal in down sampled, the energy division at the time of high frequency band. The condition of aliasing can be removed by complex wavelet transform which provides the quadrature wavelets [11].

2.1 1D Dual Tree Wavelet:-

The dual tree CWT preliminary plan gives the exact reconstruction of input signal but this plan use the analytical filter at the place of real filter for removing the deficiency of DWT plan. The dual tree CWT preliminary plan uses two DWT trees of real filter coefficient. The two wavelets ψreal (t) and ψimag (t) are orthogonal to each other which composed as analytical function ψc (t).

On the other hand, there are two scaling function ϕr (t) and ϕi (t).This analytic function & scaling function relationship is written:

$$\psi(t) = \sqrt{2}\sum_n h1(n)\boldsymbol{\phi}(2t-n)$$
$$\boldsymbol{\phi}(t) = \sqrt{2}\sum_n h0(n)\boldsymbol{\phi}(2t-n)$$

Scaling filter – h (0) & g (0) are HT pair

Follow half sample delay condition is given by:-

$$g0(n)=h0(n-0.5)$$

In frequency domain,

Magnitude is given by:

$$\left|G0\left(e^{jw}\right)\right| = \left|I\!I0\left(e^{jw}\right)\right|$$

Phase condition is given by:

$$\angle G0\left(e^{jw}\right) = \angle H0\left(e^{jw}\right)$$

In this preliminary plan, the standard DWT operates in parallel in which first one standard DWT is called real tree(tree-a) and second one standard DWT is called imaginary tree(tree-b).The conjugate filter for standard DWT is represented by ha & gb respectively.

For tree a:-

$$ha = \{h0, h1\}$$

For tree b:-

$$gb = \{g0, g1\}$$

For synthesis, the filter pair are used.

$$\{\widetilde{h0},\ \widetilde{h1}\} \text{ and } \{\widetilde{g0},\ \widetilde{g1}\}$$

The dual tree CWT can be represented by matrix. When the two real DWT are represented by square matrix (Fh & Fg):-

$$F = \begin{pmatrix} Fh \\ Fg \end{pmatrix}$$

For synthesis filter:

$$F^{-1} = \frac{1}{2}[Fh^{-1}\ Fg^{-1}]$$

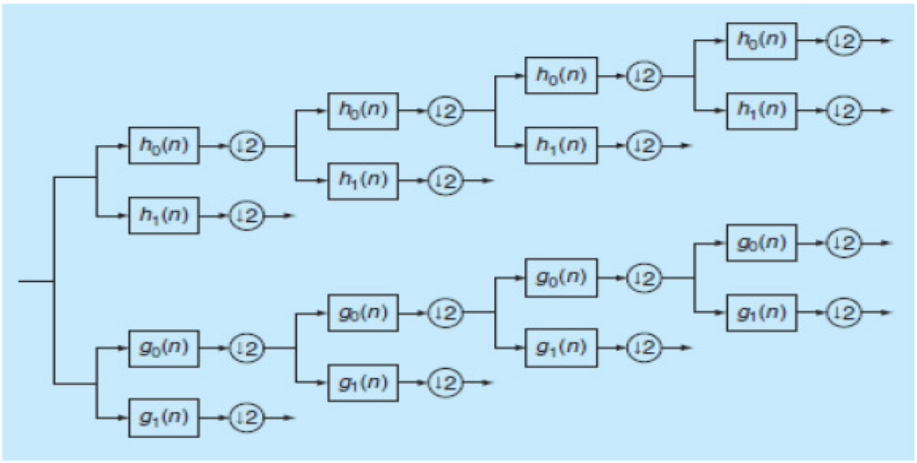

Figure-A: - Filter Bank Analysis for 1-D Dual Tree CWT

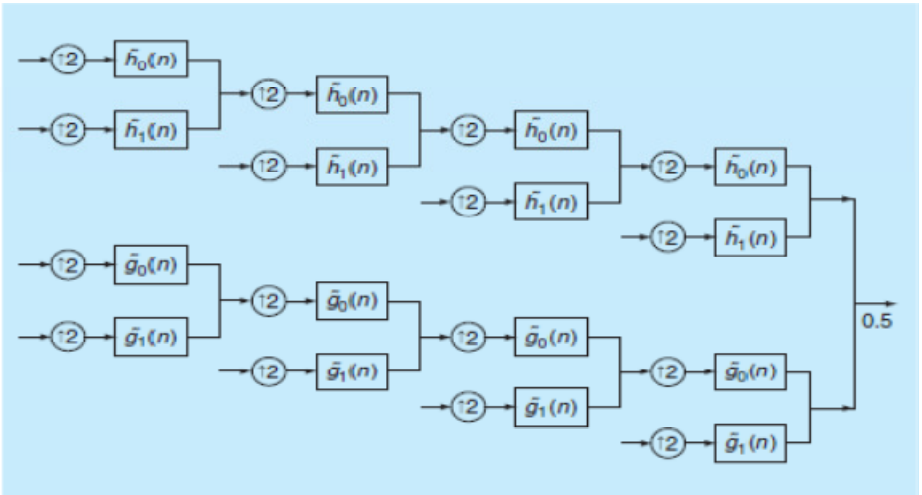

Figure-B: - Filter Bank Synthesis For 1-D Dual Tree CWT

2.2 2D Dual Tree Wavelet

The execution of Dual tree CWT is done without evasion. At the beginning, by using two set of filter, the input image is decomposed and filtered the image horizontally and vertically. This set of filter should satisfy the PR condition and every set contain both low pass filter and high pass filter.

On the other hand, when we joint analytical filter bank and synthesis filter bank then overall transform is similar to analytical.

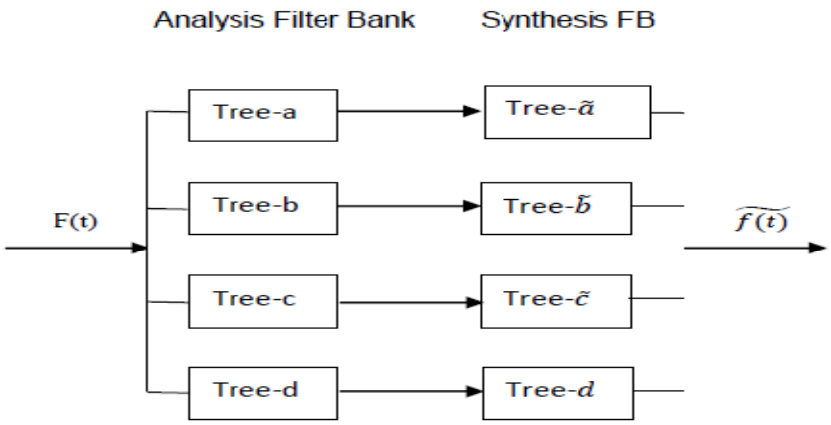

Figure -C:- Filter Bank Sructure For 2-D Dual Tree CWT

At each level of decomposition,two low pass sub band and six high pass sub bands (HLa, LHa, HHa, HLa, LHb & HHb) are generated.

$$LHs = (LHa+LHb)/\sqrt{2},$$
$$LHm = (LHa- LHb)/\sqrt{2},$$
$$HLs = (HLa+HLb)/\sqrt{2},$$
$$HLm = (HLa-HLb)/\sqrt{2},$$
$$HHs = (HHa+HHb)/\sqrt{2},$$
$$HHm = (HHa-HHb)/\sqrt{2}.$$

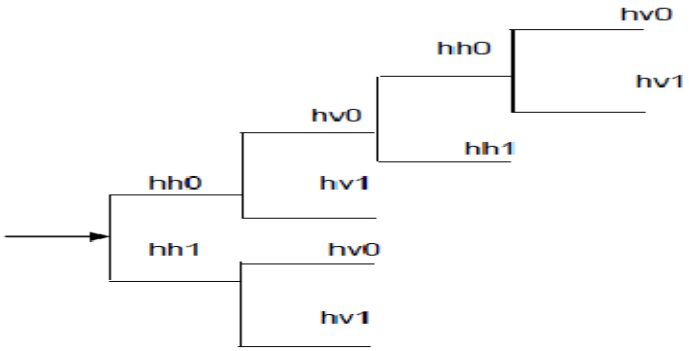

Figure-D:- Structure of Filter Bank of Tree-a

The applied filter on horizontal and vertical dimensions can be written as:-

$$(hh + jgh)(hv + jgv) = (hh.hv - gh.gv) + j(hh.gv + gh.hv)$$

3. SQUEEZING ALGORITHM & CODING OF IMAGE

There are two types of algorithm is necessary for squeezing & de squeezing of image**.**

A) Algorithm for squeezing:-

There are five steps which covers the algorithm for squeezing.

Step 1) In the first step, the image is converted in the form of digital and read by using the MATLAB software.

Step 2) In second step, the format of image in RGB is converted into the format of YCbCr.

Step 3) After that the component of image(y, Cb, Cr) is separated.

Step 4) Use Dual tree CWT preliminary plan for decomposition of each component.

Step 5) At last, by using SPIHT coder, the coefficient of each component is coded

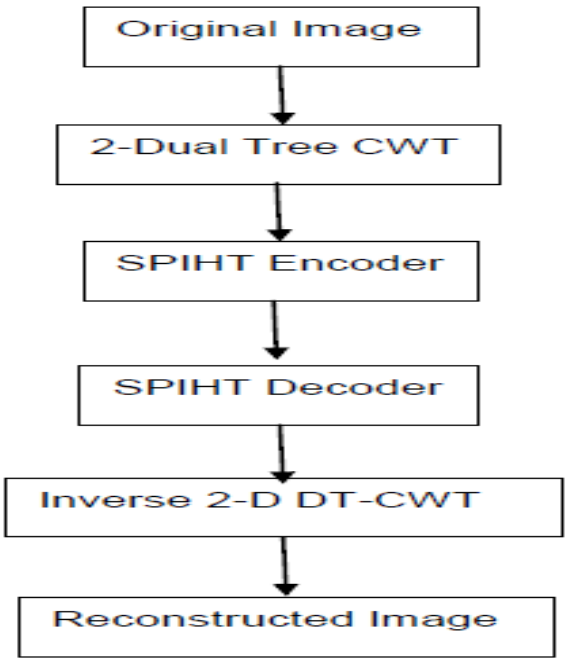

Figure-E: - Algorithm for Image Squeezing

B) Algorithm for De Squeezing:-

There are five steps which covers the algorithm of de squeezing.

Step 1) Firstly, coded image is read.

Step 2) In this step, SPIHT encoder is used to decode the coded image.

Step 3) After that, this decoded image is passed through the inverse DT-CWT

Step 4) The format of YCbCr is converted into RGB format.

Step 5) At last, measure the mean square error (MSE) and peak signal to noise ratio (PSNR).

4. PERFORMANCE WITH CODING & EXPERIMENTAL RESULTS

The results of coded images are compared between JPEG 2000 Squeezing arrangement & 2D DT-CWT plan that's why the transform having the ability of selection of direction. It outperform the DWT based squeezing plan here SPIHT coding plan is utilized to organize the squeezed bit stream in squeezing preliminary plan.

Squeezing ratio=Set as the input of squeezing system

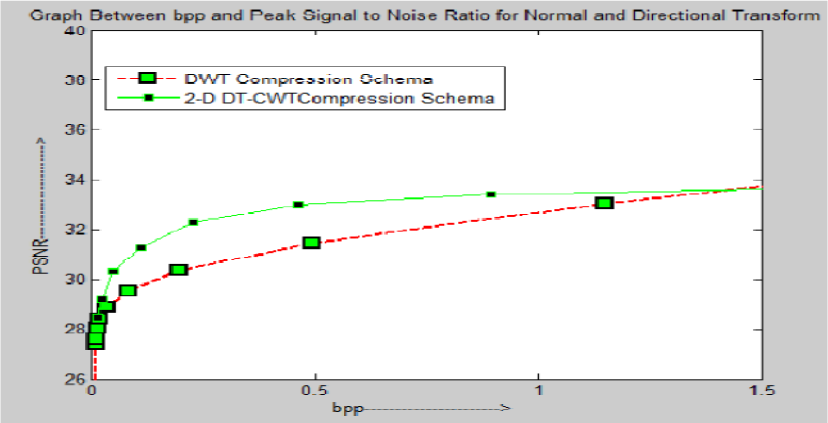

Figure-F:- Analysis of Performance Using JPEG2000 and Proposed Squeezing plan

Thus, for performance checking in image squeezing, the comparison between the JPEG and proposed preliminary plan is shown in table. The unit of performance of image is decimals. By this figure F, we can say that the proposed preliminary plan is better than the old DWT-SPIHT squeezing plan

Image	Size	bpp	JPEG 2000	Proposed schema
Image	256*256	0.1	27.22	27.32
		0.25	30.43	30.49
		0.5	31.04	32.25
		1	31.79	33.24
Lena	256*256	0.1	28.34	28.94
		0.25	33.74	34.30
		0.5	37.01	37.40
		1	40.6	40.77
Baboon	256*256	0.1	21.34	21.46
		0.25	23.06	23.29
		0.5	25.48	25.78
		1	29.01	29.47

Table-1:- Comparison in Performance for Different Image Squeezed by JPEG2000 & Proposed Preliminary Plan

Figure-G:- Original Image

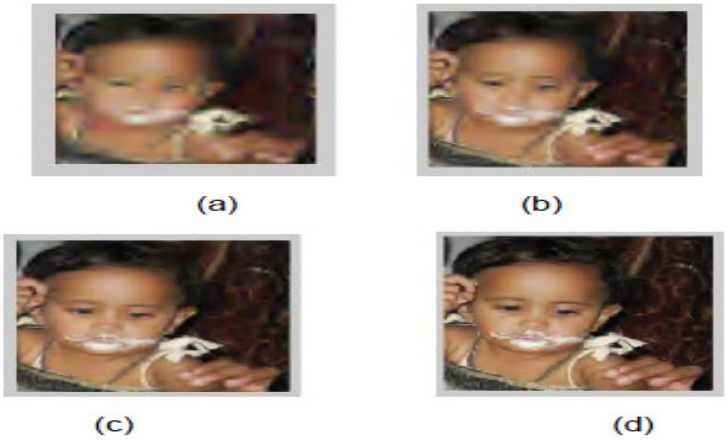

Figure-H: - Reconstructed image at (a) 0.1bpp (b) 0.25bpp (c) 0.5bpp (d) 1bpp

5. CONCLUSION

In this paper, the 2-D Dual tree CWT method is presented. The image squeezing result of this proposed transform is better than JPEG2000 plan at low bit rate. This conclusion results performs on MSE & PSNR.

6. FUTURE WORK

For future work, this arrangement can be used for video coding which is based on wavelet at low computational complexity

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