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Image Enhancement Using Dual Tree Complex Wavelet Transform based Image Fusion Method -A Literature Survey

Alokranjan Yadav[1], Prof. S.P. Bhosale[2]

M.E Student, Department of Electronic Engineering, AISSMS COE, Pune (MS), India[1]

Associate Professor, Department of Electronics Engineering, AISSMS COE, Pune (MS), India[2]

ABSTRACT: Image Fusion in image processing means combining of the multiple input images to get superior image.To increase the quality of the input images Image Fusion Techniques are used. The input images must be the images of the same picture with different quality measures. The quality of the output image will be better than any of the input images. The main methods of the image fusion involve simple image fusion, pyramid based image fusion and wavelet based image fusion. Image fusion methods can be used in areas of medical imaging, remote sensing, entertainment etc. This paper focuses on the different image fusion wavelet based methods evolved so far and their comparison based on the quality of the output image. It also discuss about the different quality metrics that can be used to assess the quality of the output image.

KEYWORDS: Image Fusion, Wavelet based technique, Dual tree complex wavelet transform, shift invariance, multiresolution analysis.

I.INTRODUCTION

An Image is combination of multiple pixels. This pixel value decides concentration of the particular color in overall image. Image processing is a technique in which different calculations are done on the numerical value of pixel. Image processing is having great importance in the field of remote sensing, medical imaging, entertainment etc. Image Fusion is one of the important technique in image processing. In image fusion technique multiple input images are combined together to create output image of superior quality. An image can be represented both in s partial domain and in spectral domain. Image Fusion [1] is the process of fusing perfectly registered input images which can represent both spatial and spectral information. It retains important information and produces an image which is better for human and computer perception for further processing Since spatial representation is simple, spatial fusion methods are also simple. Spectral representation can clearly define the edgefeatures of the image. So the spectral based image fusion methods produce better quality output image rather than spatial methods. Simple Image Fusion methods come under the category of spatial methods whereas Pyramid as well as Wavelet transform methods come under spectral methods.

In medical imaging, we can have a positron emission tomography and a magnetic resonance images from the brain of the same patient [2]. The first is a functional image displaying the brain activity, but without anatomical information. On the contrary, the second provides anatomical information but without functional activity. Moreover, although the two images come exactly from the same brain area, the positron emission tomography has less pixels than the magnetic resonance, i.e. we say that the first has less spatial resolution than the second. In general, the problem that image fusion tries to solve is to combine information from several images (sensors) taken from the same scene in order to achieve a new fused image, which contains the best information coming from the original images. Hence, the fused image has better quality than any of the original images [2].

The wavelet transform having great importance in image compression. For image compression applications, wavelet transform consider as a most suitable technique compared to the Fourier transform. Fourier transform is not practical for computing spectral information because it requires all previous and future information about the signal

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over the entire time domain and it cannot observe frequencies varying with time because the resulting function after Fourier transform is a function independent of time [1]. On the other hand, wavelet transforms are based on wavelets which are varying frequency in limited duration [1].

The complex wavelet transform (CWT) is a complex-valued extension to the standard discrete wavelet transform (DWT). It is a two-dimensional wavelet transform which provides multiresolution, sparse representation, and useful characterization of the structure of an image.The Dual-tree complex wavelet transform (DTCWT)[3] calculates the complex transform of a signal using two separate DWT decompositions (tree a and tree b). If the filters used in one are specifically designed different from those in the other it is possible for one DWT to produce the real coefficients and the other the imaginary. Dual Tree wavelet transform can be clearly shown in Fig1.

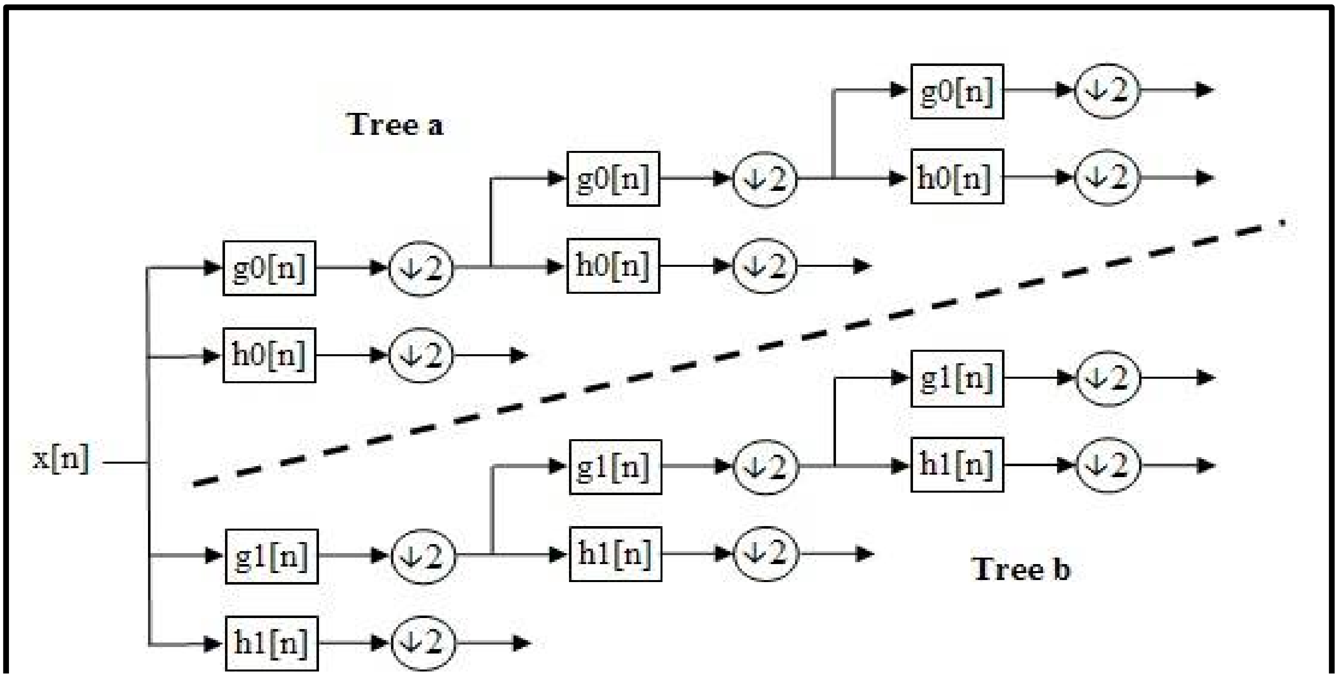

Fig 1: DTCWT Transform

II. RELATED WORK

The concept of Dual Tree Complex Wavelet Transform has been first proposed by Prof. Nick Kingsbury [3]. The key advantages of the dual-tree CWT over the DWT are its shift invariance and directional selectivity. This means that the squared magnitude of a given complex wavelet coefficient provides an accurate measure of spectral energy at a particular location in space, scale, and orientation. It also means that CWT-based algorithms will automatically be almost shift invariant, thus reducing many of the artifacts' of the criticallysampled DWT [3].Prof Nick Kingsbury explained two properties of Dual Tree CWT viz. Near Shift invariance and Directional Selectivity as follows.

a) **Near Shift Invariance**: One way to illustrate the near shift invariance of the dual-tree CWT is to observe how the projection of a signal onto a certain scale varies as the signal translates. The projection of a signal onto scale j can be computed by reconstructing the signal from only the wavelet coefficients in subband j. Fig2 (a) shows a simple pulse signal x(n) and its reconstruction from the wavelet coefficients at the third scale level of the critically sampled DWT and the dual-tree CWT. Fig2(b)shows the same signal translated by three samples and the corresponding reconstructions from level 3. Comparing Fig2 (a), (c), (e) and (b), (d), (f), we see that the DWT-

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reconstructed signal varies significantly with translations of the signal. However, the CWT-reconstructed signal maintains its shape, illustrating the near shift-invariance of the dual-tree CWT. This property of the CWT greatly simplifies wavelet-based modelling, processing, and other applications.

b) Local Hilbert Transform : The envelope of a real signal can be computed using the Hilbert transform to create a complex-valued analytic signal; the magnitude is the sought envelope. A local Hilbert transform can be computed in the complex wavelet domain simply by multiplying the CWT coefficients by j. As a bonus, the CWT-based local Hilbert transform can be efficiently implemented by a continuously running FB.

c) Near Rotation Invariance: The directionality of the 2-D CWT renders it nearly rotation invariant in addition to nearly shift invariant. Fig3 illustrates the image obtained by reconstruction from only one level of the real DWT and dual-tree CWT for a test image with a sharp edge on a hyperbolic trajectory. The ringing and aliasing artifacts in the DWT coefficients that change with the edge orientation are not present in the CWT coefficients.

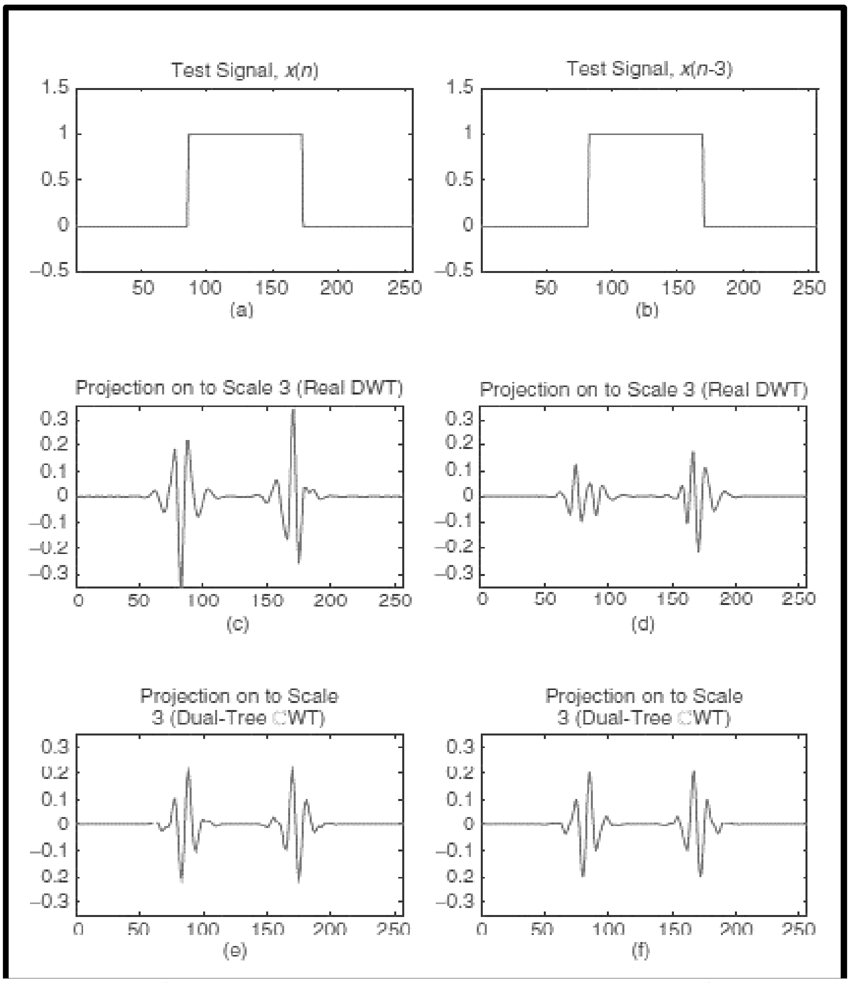

Fig 2:A signal $x(n)$ and its shifted version $x(n-3)$ (a), (b) and its reconstruction from wavelet coefficients at scale level 3 of the real DWT (c), (d) and dual-tree CWT (e), (f). The CWT is more nearly shift-invariant than the DWT.

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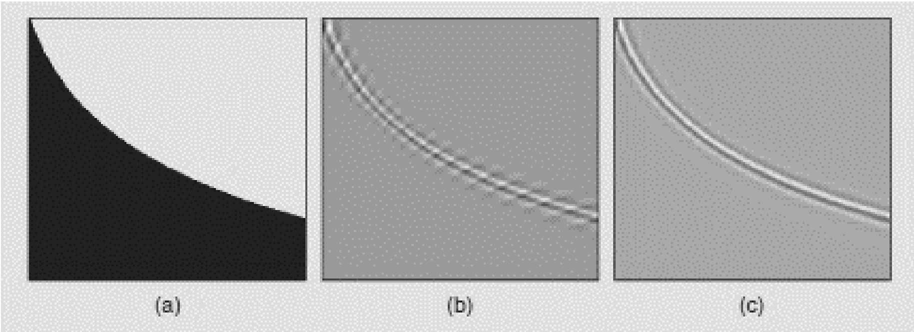

Fig 3 :Near rotation invariance of the CWT. (a) Test image with sharp edge on hyperbolic trajectory. (b) When the test image is reconstructed from one level of the DWT coefficients, ringing and aliasing effects are apparent. (c) The reconstruction of the image from one level of the CWT does not exhibit these phenomena.

CT-DWT given in the above has some disadvantages. This scheme do not having any filtering for noise removal.In the images taken by the camera always contains some noise so due to that noise we will not get correct result. Alexey Lukin, Et. Al [4] given technique for noise removal. Super-resolution algorithm produces even sharper images and the high-frequency component of noise is typically amplified. However the process of regularization helps preventing noise amplification by minimizing the total variation of the resulting image. If the strength of regularization (value of α) is increased, the noise is suppressed, while the sharpness of image contours is preserved.

In the [6] along with CT-DWT another two types of filtering has been used viz. Lanczos Interpolation and Non Mean Filtering (NML) to achieve super resolution.The Non-Local Means Filter[6] is built up on the concept that the image characteristics are likely to appear itself within some neighborhood of the image. The denoising is aimed at removing the noise and preserving the image details. The NL means filter is an extension of the neighborhood filtering algorithm. The NL-means filter computes the denoised pixel by the weighted sum of the surrounding pixels.The commonly used interpolation techniques are based on nearest neighbors (include nearest neighbor, bilinear, bicubic, and Lanczos). Lanczos resampling[6], invented by Cornelius Lanczos, is an interpolation function that is used extensively in the arena of digital signal processing. It is basically a Fourier kernel. Its essentiality is for smoothly interpolating the value of a digital signal between its samples.

Though DTCWT is a complex wavelet transform, but the filters that it uses are all real valued. So, no complex computation is involved in its implementation, making it computationally efficient. In 2-dimension, DTCWT is achieved by applying filters separately along rows and columns. Hence Richa Srivastava et. Al[8] has been proposed "Threshold based Image Fusion in Dual Tree Complex Wavelet Domain" .Wavelet based thresholding is the most popular tool for reducing noise present in the images. In thresholding, they compare the values of wavelet coefficients with the threshold value and preserve them if their absolute values are greater than the predefined threshold. In this work, they have utilized this concept in image fusion. In denoising, they discard the coefficients having lower absolute values than the threshold, because the noise affects the small value wavelet coefficients substantially than the high value wavelet coefficients. In the same way, in image fusion, they are choosing wavelet coefficients having high absolute values. Therefore, they select the wavelet coefficient whose absolute difference from the threshold is higher. The threshold can be defined in two ways. Either it is fixed and constant for the whole processing or it may vary depending on particular parameter(s). Varying threshold is more efficient than the fixed threshold because in multiresolution analysis an image is divided into coefficients of different frequencies and fixed threshold is not able to handle coefficients of different frequencies properly.

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III. Proposed Method

The image super resolution for the input low resolution medical image using the newly introduced DTCWT based image fusion technique using the NLM filtering has been introduced. The DTCWT is used to decompose the input low resolution images into different frequency sub bands which are then process to get super resolution image.

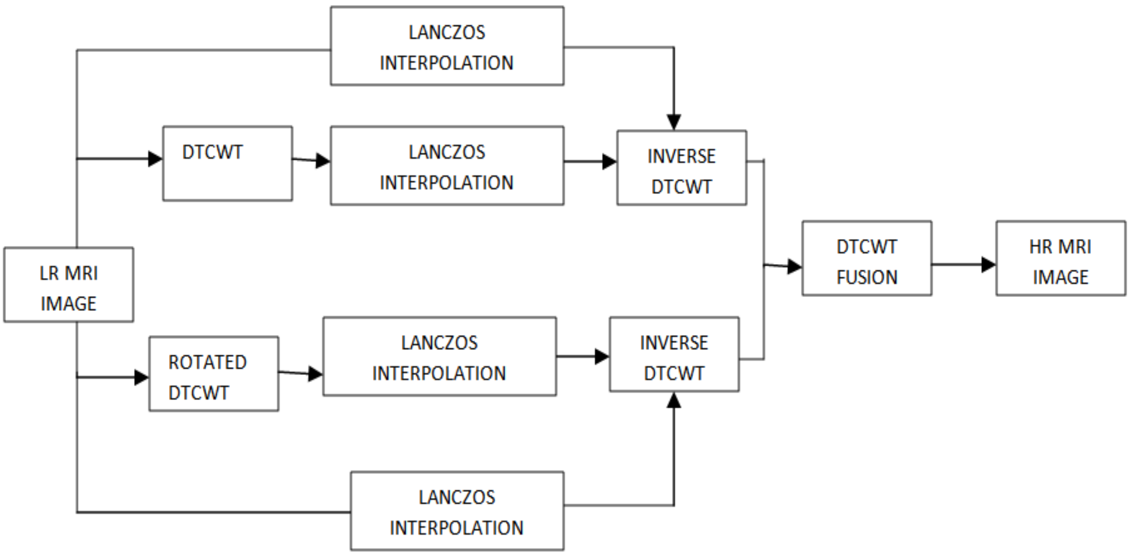

Fig4. Proposed Methodology

In this proposed algorithm, the input low resolution image applied is Medical image (MRI) of different sizes (128 and 256). The DTCWT and Rotational DTCWT are used to decompose the LR image into its different frequency sub bands. For the normal DTCWT, the LR image is decompose into 16 sub bands out of which 12 sub bands are HF sub bands and 4 sub bands are LF sub bands. The 12 sub bands which are having more information contents are used for the proposed application. Similarly for Rotational DTCWT, the 16 sub bands are generated. These sub bands thus produced has the angle of inclination of 45 degree to that of sub bands generated from normal DTCWT.

The 12 HF sub bands are interpolated by using lanczos interpolation. After interpolation process, the processed 12 sub bands and interpolated 4 sub bands from input LR image which are interpolated by β/2 are combined by inverse DTCWT and rotational DTCWT on both sides.

Thus the interpolated outputs from normal and rotational DTCWT are combined by fusion technique using once again DTCWT. The final output of the proposed method is super resolution image.

IV. CONCLUSION

In this paper,we had summarize all Dual Tree Complex Wavelet Transform.we had deeply studied the all techniques available for DT-CWT.In this paper we have figured out different advantges and disadvantages of the DT-CWT techniques.

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REFERENCES

[1] Vineet Naik, Dr. Saylee Gharge, " Satellite Image Resolution Enhancement using DTCWT and DTCWT based Image Fusion" International conference on advance computing, communication and informatics (ICACCI) , September 2016. (*references*)
[2] Gonzalas pajares, " A wavelet based Image Fusion", Pattern recognition, Elsevier computer science, 2004.
[3] Nick Kingsbury, "Dual Tree Complex Wavelet Transform", september 2013.
[4] Alexey Lukin,Andrey s. krylov, "Image Interpolation by super Resolution".
[5] Muhammad Zafar Iqbal, Abdul Gafoor, "Satellite Image Resolution Enhancement using Dual Tree Complex Wavelet Transform and Non-Local Means" IEEE Geoscience AND Remote Sensing Letters, Reading, Vol 10, 2013.
[6] Jino A.R.,Jayaraj, "Satellite Image Enhancement technique based on Lanczos interpolation and NLFMT filtering" unique journal of engineering and advance science, 2014
[7] Y. Padma, Dr. Nagaprakasha," Dual Tree complex wavelet Transform for medical image fusion", IJRET, 2016.
[8] Richa Shrivatsava, Ashish Khare,"Threshold based Image fusion in dual tree complex wavelet transform domain" I.J. Image graphics & signal processing, 2016.