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COMPARATIVE ANALYSIS OF DWT & SWT IN SUPER RESOLUTION

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Abstract — *The motivation is from a human eye which takes in raw images (noisy, blurred and translated) and constructs a super resolution image. An image with improved resolution is desired in almost all of the applications to enhance qualitative features and is reported to be achieved by Super Resolution Image Reconstruction (SRIR). Some low resolution images of same scene which are usually rotated, translated and blurred are taken to form a super resolution image.DWT is applied in order to decompose an input image into different sub bands. Then the high frequency sub bands as well as the input image are interpolated. The estimated high frequency sub bands are being modified by using high frequency sub band obtained through SWT.*

Keywords- *Discrete wavelet transform, Interpolation, stationary wavelet transform, Super resolution*

I. INTRODUCTION

In the recent years there is increased in the demand for better quality images in the various applications such as medical, astronomy, object recognition. Image resolution enhancement is also widely useful for satellite image applications which include building construction, bridge recognition, in GPS techniques. DWT decomposes an image into different sub band images, namely low-low (LL), low high (LH), high-low (HL), and high-high (HH). Another recent wavelet transform which has been used in several image processing applications is stationary wavelet transform (SWT) [9]. In short, SWT is similar to DWT but it does not use down-sampling, hence the sub bands will have the same size as the input image. Resolution is one of the important characteristics of an image. Images are transformed in order to obtain high resolution. One of the most commonly imageresolution enhancement technique is interpolation. Interpolation is widely used while enhancing the resolution of an image. Three different interpolation techniques are present.

II.DISCRETE WAVELET TRANSFORM

The discrete wavelet transform uses filter banks for the construction of the multi-resolution time frequency plan .The DWT uses multi-resolution filter banks and special wavelet filters for the analysis and reconstruction of signals. In many image processing applications wavelets plays an important role. In 2-D wavelet decompositio of an image, the 1D discrete wavelet transform (DWT) is applying along the rows of image and after that result are decomposed along the columns. The result of this operation gives four decomposed sub band images that are low-low (LL), low-high (LH), high-low (HL), and high-high (HH). The complete frequency spectrum of the input image is covered by frequency components of all these sub-bands cover the full frequency spectrum of the original image.

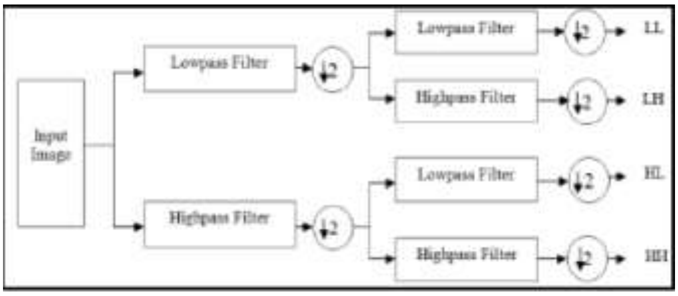

Fig.1. Discrete Wavelet Transform

III.STATIONARY WAVELET TRANSFORM

The stationary wavelet transform is an extension of the standard discrete wavelet transform. Stationary wavelet transform uses high and low pass filters. SWT apply high and low pass filters to the data at each level and at next stage produces two sequences. The two new sequences are having same length as that of the original Sequence. In SWT, instead of decimation we modify the filters at each level by padding them with zeroes. Stationary wavelet transform is computationally more complex.

IV. IMAGE RESOLUTION ENHANCEMENT METHOD USING SWT AND DWT

Discrete wavelet transform have certain properties that makes it better choice for image compression. DWT is especially suitable for images having higher resolution. It possesses the property of Multi-resolution i.e., it represents image on different resolution level simultaneously. The most widely used transform for image fusion at multi scale is Discrete Wavelet Transform (DWT) since it minimizes structural distortions. But, DWT suffers from lack of shift invariance & poor directionality and these disadvantages are overcome by Stationary Wavelet Transform (SWT).

In this correspondence, one level DWT (with Daubechies 9/7 as wavelet function) is used to decompose an input image into different sub band images. Three high frequency sub bands (LH, HL, and HH) contain the high frequency components of the input image. In the proposed technique, bicubic interpolation with enlargement factor of 2 is applied to high frequency sub band images. Down sampling in each of the DWT sub bands causes information loss in the respective sub bands. That is why SWT is employed to minimize this loss. The interpolated high frequency sub bands and the SWT high frequency sub bands have the same size which means they can be added with each other. The new corrected high frequency sub bands can be interpolated further for higher enlargement. Also it is known that in the wavelet domain, the low resolution image is obtained by low pass filtering of the high resolution image . In other words, low frequency Sub band is the low resolution of the original image. Therefore, instead of using low frequency sub band, which contains less information than the original high resolution image, we are using the input image for the interpolation of low frequency sub band image. Using input image instead of low frequency sub band increases the quality of the super resolved image. Fig. 1 illustrates the block diagram of the proposed Image resolution enhancement technique.

By interpolating input image by α/2, and high frequency sub bands by 2 and α in the intermediate and final interpolation stages respectively, and then by applying IDWT, as illustrated in Fig. 1, the output image will contain sharper edges than the interpolated image obtained by interpolation of the input image directly. This is due to the fact that, the interpolation of isolated high frequency components in high frequency Sub bands and using the corrections obtained by adding high frequency sub bands of SWT of the input image, will preserve more high frequency components after the interpolation than interpolating input image directly.

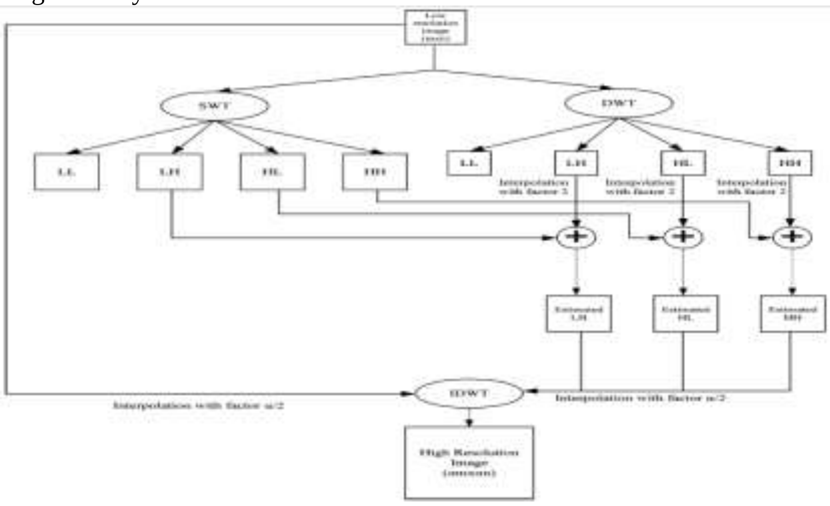

Fig.2 Block Diagram of the DWT and SWT-based Resolution Enhancement Algorithm

V. RESULTS

Satellite Image Resolution Enhancement techniques have beentested on several different satellite images to show the superiority of these techniques

Figure: 3 Low resolution input image

Figure: 4 Output of DWT

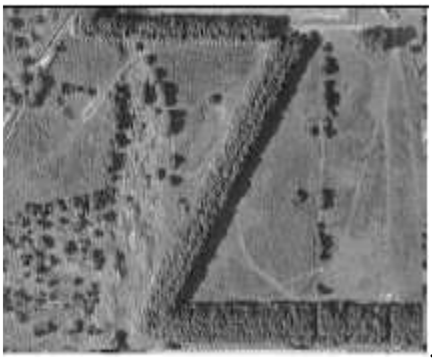

Figure: 5 Output of SWT

CONCLUSION

In this paper comparison of two image resolution enhancement techniques are shown to improve the quality of satellite images. Hence, I got a highly enhanced and sharper image using both these wavelet based image resolution enhancement techniques. From all the visual and quantitative results, it is cleared that the image obtained from image resolution enhancement technique using DWT and SWT having high resolution than image obtain from image resolution enhancement using DWT.

Proposed method involves calculation of DWT sub bands. High frequency sub bands are interpolated to double their size. DWT loses some information in the process of interpolation; it is corrected with the help of SWT

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