Resolution Enhancement of High Noise Satellite Images Using DT-DWT Based Fusion Algorithm

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***Abstract*—satellite images have many applications in meteorology, oceanography, fishing, agriculture, biodiversity conservation, forestry, landscape, geology, cartography, regional planning, education, intelligence and warfare. Images can be in visible colors and in other spectra. There are also elevation maps, usually made by radar images. Interpretation and analysis of satellite imagery is conducted using specialized remote sensing applications. Low resolution is the major drawback in these kinds of images. The resolution of satellite images varies depending on the instrument used and the altitude of the satellite's orbit. In order to exploit the information and to analyze the image the resolution of the image has to be enhanced. Various image processing techniques exist for resolution enhancement. The latest being application of wavelet techniques for resolution enhancement. In this paper a comparison of two main wavelet techniques i.e. DWT & SWT are studied based on the image quality metrics and a new image quality enhancement technique is proposed based on wavelet fusion algorithm. The computation results of the image enhancement and image quality metrics of the proposed technique is compared with existing techniques. It is proved that the proposed technique have higher resolution enhancement capability than existing techniques.**

***Keywords*—Satellite image resolution enhancement, discrete wavelet transform (DWT), interpolation, inverse discrete wavelet transform (IDWT), stationary wavelet transform (SWT), image fusion algorithm, dual tree wavelet transform**

I. INTRODUCTION

There are so many applications are used in satellite images. In the images resolution is the most important. Resolution is one of the important characteristics of an image. Images are transformed in order to high resolution and low resolution. One of the most common image resolution techniques is image interpolation. Interpolation is widely used while enhancing the resolution of the image. Three different interpolation techniques are there. Nearest neighbor interpolation, bilinear interpolation and bicubic interpolation are three different techniques. Image resolution enhancement is using wavelet domain is different concept. In this domain there are many algorithms are there. In the image resolution enhancement techniques wavelet plays important role.Here,two transforms based on image resolution enhancement techniques.the first technique is discrete wavelet transform and second one is discrete wavelet transform and stationary wavelet transform.These both techniques are compared using in different satellite images. New satellite image resolution enhancement techniques based on the interpolation of the high frequency sub bands obtained by discrete wavelet transform and the input image is proposed. Discrete wavelet transform is used to decomposition of images needed into different sub bands in this resolution enhancement technique. Next level of low resolution image and all the high frequency sub bands have been interpolated. Then, we applied all images in IDWT achieved high resolution image. Intermediate stage is proposed in order to achieve sharper image generate high resolution image IDWT is applied on all theseimages. Intermediate stage is proposed in order to achieve a sharper image. This technique is tested on satellite benchmark images.

Draw back dwt based on resolution enhancement is the down sampling nature of the decomposition of the image in the DWT method. In a single image may decomposed into four sub bands after applying DWT with decimation factor 2.these sub bands are the size of half of original images because of decimation factor. In these reason we have propose new algorithm which is DWT-SWT and fusion method.

II. DIFFERENT TRANSFORMS USED IN IMAGE RESOLUTION

A. Discrete wavelet transform

These wavelet transformations is sampled version of series of DWT and its computation it may consumes some amount of time ad resources, depending on the resolution required. The discrete wavelet transform(DWT),which is based on sub-band coding, is developing on fast computation of wavelet transform. Here, it transform implement is easy and reduces the computation time and resources required. In speech signal coding also do same work may be done which name was sub band coding. Then develop these sub band coding is named was pyramidal coding. Then these coding schemes we develop many improvements, which resulted in multi-resolution analysis schemes. These CWT, the signals are analyzed using some set of basic functions relates each other by simple scaling and translation. When the DWT, timing-scaling properties representation of digital signal is obtained using digital filtering techniques. Then these digital signals pass though the filters in different cutoff frequencies at different scales.

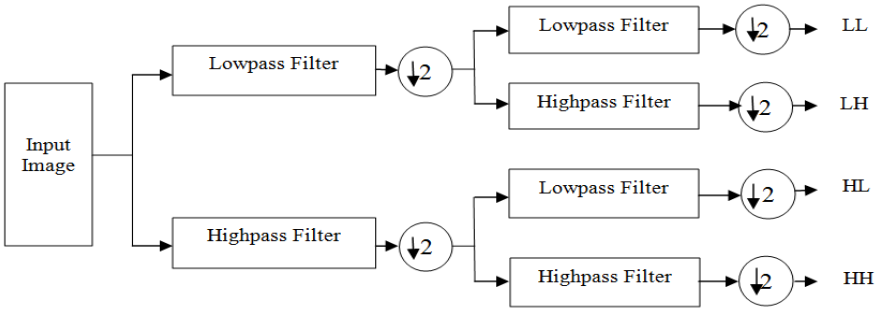

Fig.1 Discrete wavelet transform

B. Interpolation

One of the commonly used techniques for image is interpolation.interpolation interpolation. Interpolation has been widely used in many image processing applications such as facial reconstruction, multiple description coding, and super resolution. There are there well known interpolation techniques, namely nearest neighbor interpolation, bilinear interpolation and bicubic interpolation. Interpolation is the process of using known data values. various interpolation techniques are often used in the atmospheric sciences.

C. *Stationary Wavelet Transform*

The extension stationary wavelet is standard discrete wavelet transform. These stationary wavelet transforms are uses in low and high pass filters only. SWT apply high and low pass filters to the data at each level and at next stage produces two sequences. Then these two sequences produces in same length of sequence compare to original sequence. In, SWT instead of decimation on each stage we modify filters by padding with zeros.stationary wavelet transform more complex one compare to others transforms.

III. EXISTING SYSTEM

A. Image resolution enhancement using dwt&swt:

In images edge is main concept. The main loss is the high frequency components that are edges on using interpolation in the image resolution enhancement, then effected smoothing caused by interpolation. In these technique by applying dwt on the input edge images in order to preserve the high frequency components of the image. The single stage dwt is used to decompose the input image in different subbands.the four sub bands low-low(LL),low-high(LH),high-low(HL),high-high(HH)are produces from DWT decomposition. Bicubic interpolation is applied to high frequency sub bands by interpolation factor 2.then due to down sampling on each sub band some DWT information is loss. Then minimizes these loss we can introduces SWT.these transform also decomposes input images into four sub bands i.e. LL, LH, HL and HH.

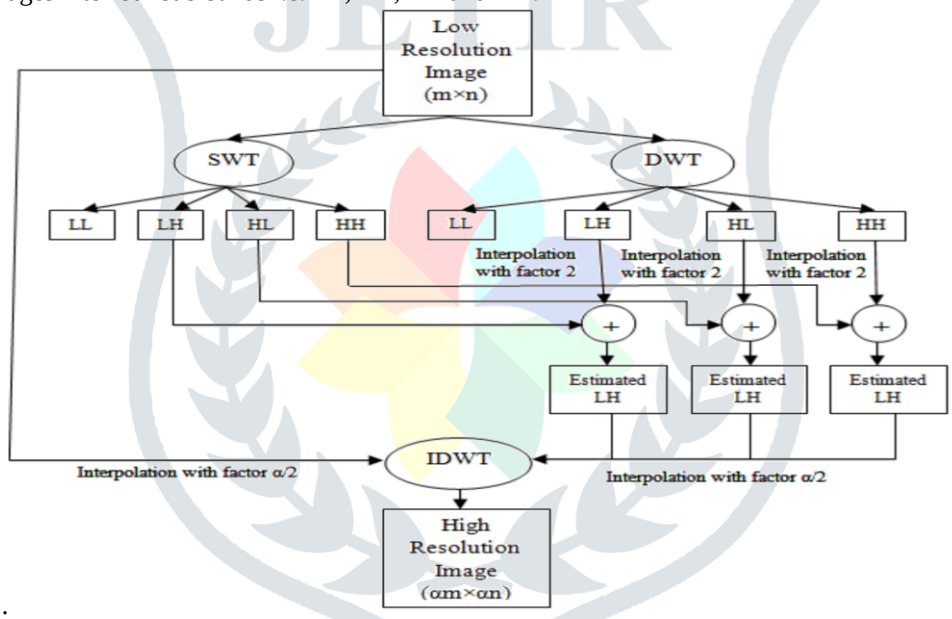

Fig2.Block diagram of the DWT and SWT-based resolution enhancement algorithm

The SWT high frequency sub bands and interpolated high frequencysub bands have these that same size hence that can be added with each other. After the decimation and correlation then new frequency sub bands are obtained. these correlated high frequency sub bands and input image are again interpolated by interpolation factor 2.in these wavelet concept, low resolution image is obtain by low pass filtering of the high resolution image. Hence instead of using low resolution subbands,we are using input image for the interpolation of low frequency sub band of image, thisincreases the quality of image. After interpolation is inverse discrete wavelet transform (IDWT)is applied to all the interpolated subbands.the IDWT output is final output image, which is high resolution image.

IV. PROPOSED SYSTEM

A. Image resolution enhancement techniques using fusion algorithm:

In these adaptive approach we introduced a new method is satellite image resolution enhancement by using dual tree complex wavelet transform (DT-DWT), which is extension of discrete and stationary wavelet transforms. It can be applied to both real values and imaginary parts i.e., complex values are taken under consideration.So DT-DWT can produces better performance compare to dwt and dwt-swt.theprocess"fusion"is known as improving the visual quality of image by taking two or more real time applications such as satellite,remote sensing,medical imaging etc.

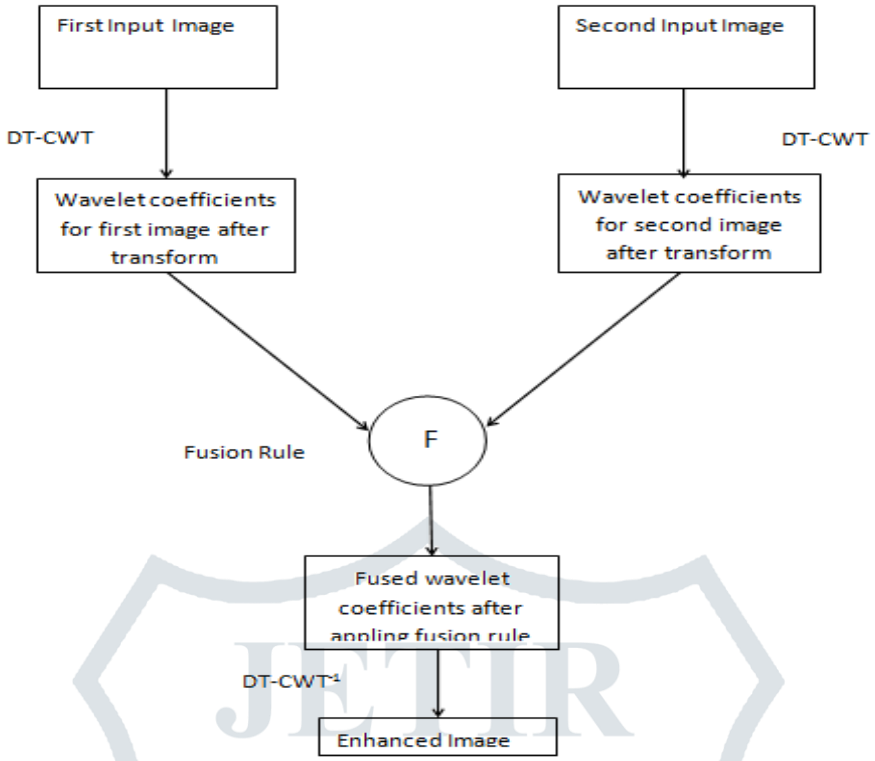

Fig3.The proposed image fusion algorithm.

V. QUALITY ANALYSIS

The quality of the processing images is analyze using peak signal to noise ratio(PSNR).it is defined ratio between the maximum possible powers of image to the power of corrupting noise measure of the peak error. PSNR ratio is measured in decibels between two images. to define PSNR in these following equation

$$PSNR = 10 \log_{10}\left(\frac{R^2}{MSE}\right) \quad (1)$$

Here mean square error(MSE) is the cumulative squared error between the denoised and the original image. in these input image R is maximum fluctuation. To define MSE following equation.

$$MSE = \frac{\sum_{M,N}[I_{1(m,n)} - I_{2(m,n)}]^2}{M * N} \quad (2)$$

Where$I_{1(m,n)}$ denotes original image,$I_{2(m,n)}$ denotes denoised image then here M is number rows of input image, N is number of columns. in these way if MSE in decrease it gives better quality and ii PSNR is increase also better quality of the reconstructed image produced.

VI. EXPERIMENTAL RESULTS

SatelliteImage Resolution Enhancement techniques have been tested on several differentsatellite images to show the superiority of these techniques.Images 1 shown below in that figure (a) original input image, (b) is high resolution image obtain from resolution enhancement using DWT technique and (c) is high resolution image obtain from resolution enhancement using DWT and SWT technique and (d)is high resolution image obtain from resolution enhancement using image fusion algorithm.

Fig 4: Resultant enhanced images using proposed algorithm

TABLE. 1 METHOD TECHNIQUES COMPARISON OF ENHANCED IMAGE QUALITY METRICS USING DWT ,SWT AND FUSION

Method	Quality Metrics	
	MSE	PSNR(dB)
DWT	81.9421262	34.9303302
DWT and SWT	76.4147682	35.2336292
Fusion Algorithm	18.6951792	41.3481062

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