Enhancement in Quality of Satellite Images Using Traditional Techniques and Discrete Wavelet Transform: A Review

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Abstract- Due to the low- frequency nature of the satellite image, it's going to seem as a blurred image. Image resolution techniques are used to improve the frequency of those pictures, that are utilized in a good variety of applications like remote sensing, medical imaging with vital challenges like aliasing reduction, ringing, distortion, blurring, artifacts, etc. Enhancing the resolution of a picture includes up the amount of pixels out there to represent the small print of image. Here, we have a tendency to compare all DWT based mostly sweetening strategies, within which satellite image is rotten it into four sub-bands by DWT, then the high frequency sub bands and low frequency sub bands are targeted for sweetening of sharpness, distinction and determination of image, finally parts are later combined using IDWT, once minor alterations to the input image done.

Keywords- Remote sensing Image, Image enhancement, Discrete Wavelet Transform, Inverse Discrete Wavelet Transform

I. INTRODUCTION

Enhancing the Resolution of a picture is most significant within the field of image process. a typical Resolution enhancement (RE) technique is to vary the scale of dots like pixels. Image resolution is that the detail a picture holds. Higher resolution implies that additional image detail. Image enhancement is one among the preprocessing techniques. DWT has been used so as to preserve the high frequency elements of the image. The redundancy and shift unchangingness of the DWT mean that DWT coefficients are inherently interpolated. One level DWT is employed to decompose an input image into totally different subbands [2]. Interpolation in image process may be a well-known methodology to extend the resolution of digital image. It will increase the amount of pixels during a digital image. comparatively new analysis addition, and recently, several new algorithms and others have computable at the unknown details of wavelet coefficients in a shot to boost the sharpness of reconstructed pictures [3].The 1- D DWT are often extended to 2-D transform using isolatable wavelet filters. With separable filters, applying a 1-D rework to all or any the rows of the input then repetition on all of the columns will reason the 2-D rework. once one-level 2-D DWT is applied to a picture, four rework constant sets are created. The four sets are LL, HL, LH, and HH, wherever the primary letter corresponds to applying either a low pass or high pass filter to the rows, and also the second letter refers to the filter applied to the columns as shown in Fig.1.

II. LITERATURE REVIEW

Pavithra C, Dr. S. Bhargavi [1] Author uses a method where two different images which are having same resolution are combined using discrete wavelet transform to increase the resolution of fused image to perform this task they first applying two dimensional discrete wavelet transform on both the images then high level component will be used to generate high resolution image finally inverse discrete wavelet transform is applied to get the original image. This generated image contains more information and greater resolution then original images.

For the pictures interpolation Hasan Demirel and Gholamreza Anbarjafari [4] proposed a DWT technique. Anyway as likened to different systems, the pictures obtained from DWT and IDWT strategy have low PSNR and are not sharp. Hasan and Gholamreza [4] encased the Discrete and stationary wavelet deterioration strategy dependent on insertion of high recurrence sub band pictures coming about because of DWT .In this system, Stationary wavelet change are used for upgrade of the high recurrence picture segments. Similarly extraordinary outcomes are created by this procedure. Satellite pictures are should have been redesigned both in terms of goals and edges with the goal that the nature of enhanced picture looks improved than unique picture. In picture handling Complex Wavelet Transform (CWT)is used which gives two complex-esteemed sub-band pictures of low recurrence and six complex esteemed sub-band imagesofhighfrequencyoforiginalimage.MSE and PSNR of the too settled picture additionally moved forward. Picture enhancement techniques are connected for the change of band powers and reducing the clamor which cover significant data, about complexity based element extraction from satellite

pictures of high goals. Wavelet change, Fourier disintegration, and discrete cosine change are elective methodologies that have a place with the recurrence space strategies, [6][7]. Complex dissemination techniques like standardized stun channel for the enhancement of picture and an incline keeping up de-noising process were used [8].

A nonlinear technique for noisy data improvement is utilized by F. Russo which accepts fuzzy webs for combining contrast enhancement and noise reduction [9]. A method in which three different edge detection approaches based on search, zero-crossing, and fuzzy logic is equated [10].Dr. G. Sudhwani proposed three enhancement techniques namely fuzzy rule based contrast enhancement, contrast enhancement using intensification (INT) operator, and contrast enhancement using fuzzy expected value (FEV) for the low contrast gray scale images [11]. Sudhir M., Nutan Y.Suple. Kharad proposed an improvement of the Fuzzy image based on the gray level mapping function. The aim is to create an image with a higher contrast than the original image by giving the gray levels closer to the mean gray level of the image a greater weight than the mean[12].

In most of the image processing applications, there is a need of expert knowledge to overcome the difficulties (like object recognition, scene analysis). Fuzzy set and fuzzy logic offers a dominant tool to process and represent human knowledge as fuzzy if-then rules. Because of the data uncertainty due to unpredictability, ambiguity and imprecision many difficulties come up in image processing. Fuzzy method can manage ambiguity and vagueness efficiently [13]. Most of the mentioned techniques target the betterment of the visual inspection of the image and commonly involves manual parameter tuning**.**

In [15], satellite images are firstly enhanced by using DWT-SVD method and then segmentation is applied on the enhanced using MRR–MRF Model. 3-level DWT method for image enrichment has been implemented in [16]. Thriveni R. Thriveni R. ET. ET. Oh, al. They propose a fusion based on DWTPCA and a morphological gradient to improve satellite images. The input image is broken down into various sub-bands via DWT. PCA- based fusion is applied to the low- low subband and contrast enhancement input image. IDWT is used to reconstructs the enhanced image. To achieve a sharper boundary discontinuities of image, an intermediate stage estimating the fine detail sub bands is required. This is done by the success of threshold decomposition, morphological gradient based operators are used to detect the locations of the edges and sharpen the detected edges[17].

Jadhav B. D. et. al. roposed an algorithm for satellite image enhancement based on high- frequency subband interpolation obtained by discrete wavelet transform(DWT) and low-resolution input image. This method uses an interpolation of DWT and high- frequency subband images into low-resolution images. The sharpness of image is obtained by the estimation high frequency subband. Inverse DWT is performed to reconstruct the resultant image [18]. Sharma A. et. al. proposed a technique which decomposes the input filtered image into the four frequency sub-bands by using DWT and then the high frequency subband images and input image have been interpolated along with this the technique also estimates the singular value matrix of the low– low sub band of histogram equalized image and input filtered image then normalize both singular value matrices to obtain brightness enhanced image[19]. M. Ekta et. al. compare lots of enhancement techniques for satellite image enhancement [20]. Vasileios Syrris et. al. proposed an unique approach in which a case study is presented where they test a mixture of image enhancement operations like linear and decorrelation stretching and assess the performance through ROC analysis against available building footprints[21].

TABLE 1 PROBLEM IDENTIFICATION

Ref-erence	***Description***	***Problem Identified***	***Proposed Solution***
. [21]	They applied supervised learning techniques to identify the low resolution pixels. Based on testing results histogram of image is adjusted	Focuses only on low resolution images	Other features like boundary, contrast, adaptive histogram equalization may applied with combination of this method
[19]	They work on two features i.e. contrast and resolution. In this paper they used DWT technique to generate 4 different featured images, and then histogram equalization has been applied on LL(low-low) band to enhance the brightness and contrast of image	Worked Only on Gray scale image	Method can be applied to color images

III. ENHANCEMENT OF SATELLITE IMAGES

A. Increase Resolution

There are 5 sorts of resolution once discussing satellite imagery in remote sensing: spatial, spectral, temporal, radiometric and geometric. Campbell (2002) defines these as follows: -

(a) spatial Resolution: Spatial resolution is outlined because the constituent size of a picture representing the dimensions of the extent (i.e. m2) being measured on the bottom, determined by the sensors' fast field of read (IFOV).

(b) Spectral Resolution: spectral resolution is outlined by the wavelength interval size (discreet phase of the magnetic force Spectrum) and range intervals that the detector is measure.

(c) Temporal Resolution: Temporal resolution is outlined by the quantity of your time (e.g. days) that passes between imagination assortment periods for a given surface location; associate degreed radiometric resolution is outlined because the ability of an imaging system to record several levels of brightness (contrast for example).

(d) Radiometric resolution: Radiometric resolution refers to the effective bit-depth of the detector (number of grayscale levels) and is usually expressed as 8-bit (0-255), 11-bit (0-2047), 12-bit (0-4095) or 16-bit (0-65,535).

(e) Geometric resolution: Geometric resolution refers to the satellite sensor's ability to effectively image some of the surface in a very single constituent and is usually expressed in terms of Ground Sample Distance, or GSD.GSD could be a term containing the optical and general noise sources and is beneficial for comparison however well one detector will "see" an object on the bottom among one constituent. for instance, the GSD of Landsat is ~30m, which implies the littlest unit that maps to one constituent among a picture is ~30m x 30m. the most recent industrial satellite (GeoEye 1) contains a GSD of zero.41 m (effectively 0.5 m due to us Govt restrictions on civilian imaging).

The resolution of satellite pictures varies reckoning on the instrument used and also the altitude of the satellite's orbit. for instance, the Landsat archive offers recurrent imagery at thirty meter resolution for the world, however most of it's not been processed from the data. Landsat seven has a mean come amount of sixteen days. for several smaller areas, pictures with resolution as high as forty one cm may be accessible.

Satellite imagination is typically supplemented with aerial photography, that has higher resolution, however is costlier per area unit. Satellite image may be combined with vector or formation knowledge in a very GIS on condition that the imagery has been spatially corrected in order that it'll properly align with alternative knowledge sets.

B. Histogram Equalization

Histogram exploit [1] could be a common technique for enhancing the looks of pictures. Suppose we've a picture that is preponderantly dark. Then its histogram would be skew towards the lower finish of the gray scale and every one the image detail is compressed into the dark finish of the bar graph. If we have a tendency to might `stretch out' the gray levels at the dark finish to supply a a lot of uniformly distributed bar graph then the image would become a lot of clearer.

C. Contrast Stretching:

Contrast stretching (often known as normalization) could be a easy image improvement technique that tries to boost the contrast in a picture by `stretching' the vary of intensity values it contains to span a desired vary of values, e.g. the the total vary of constituent values that the image kind involved permits. It differs from the a lot of subtle histogram exploit therein it will solely apply a linear scaling operate to the image constituent values. As a result the `enhancement' is a smaller amount harsh. (Most implementations settle for a gray level image as input and manufacture another gray level image as output.)

Before the stretching may be performed it's necessary to specify the higher and lower constituent price limits over that the image is to be normalized. typically these limits can simply be the minimum and most constituent values that the image kind involved permits. for instance for 8-bit gray level pictures the lower and higher limits may be zero and 255. decision the lower and also the higher limits a and b severally.The simplest sort of normalization then scans the image to find the lowest and highest pixel values currently present in the image call these *c* and *d*. Then each pixel *P* is scaled using the following function:

$$Pout = (Pin - C)\left(\frac{b-a}{d-c}\right) + a \qquad \ldots.(1)$$

Here, we set the values 0 whose gray value is 0 or which are actually less than zero and set the value as 255 where the gray value is above 255 or exactly 255. The major problem with this technique is that, if any single pixel has a very low or very high value then that will be selected as c and d. to overcome this problem we can use histogram of image and we can leave 5% pixels from lower side and 5% pixels from upper side in this way always gray values between 5% to 95% when was elected as c and d.

Another technique which is used to identify the values of c and d is, first we plot the histogram of input image then we find out the gray value which is having highest number of pixels in histogram, and this gray value said as cut off grey level .To find out the value of c, we start from zero and start scanning the histogram until we got the greater value then the cut of grey level this value is assumed as value of c. for the value of d we look the histogram download from the highest point and the intensity contains greater value then the cut of gray level will be selected as variable d.

Some implementations also work with color images. For color images, image are divided into separate channels then histogram is analyzed for each channel separately.

D. Super Resolution

Super-resolution (SR) could be a category of techniques that enhance the resolution of an imaging system. Some SR techniques break the optical phenomenon limit of systems, whereas different SR techniques improve over the resolution of digital imaging device.

There ar each single-frame and multiple-frame variants of SR. Multiple-frame SR uses the sub-pixel shifts between multiple low resolution pictures of an equivalent scene. It creates associate improved resolution image fusing info from all low resolution pictures, and also the created higher resolution pictures ar higher descriptions of the scene. Single frame SR ways arrange to enlarge the image while not introducing blur. These ways use different elements of the low resolution pictures, or different unrelated pictures, to guess what the high resolution image ought to appear as if. Algorithms may also be divided by their domain: frequency or house domain. Originally super-resolution ways worked well solely on grayscale pictures, however researchers have found ways to adapt them to paint camera images[2]. Recently the employment of super-resolution for 3D knowledge has conjointly been shown[3].

E. Discret Wavelet Transform Based Enhencement

2-D discrete wavelet transform (DWT) Wavelets are used pretty ordinarily in image process. pictures is described each in terms of native abstraction and frequency contents exploitation wave transforms. The Fourier rework and DCT provides world frequency characteristics of a picture, however they be unsuccessful to present native frequency characteristics. This downside is overcome in wave transforms. A separate wave transforms (DWT) that the wavelets ar discretely sampled for numerical analysis and useful analysis[15]. this can be overcome by DWT, it captures each frequency and time info. discrete wavelet transform (DWT) decompose signals into sub-bands with smaller bandwidths and slower sample rates specifically Low-Low (LL), Low-High (LH), high-low (HL), and High High (HH). With this, it's obtained four sub-bands from one level of transform – initial low pass sub-band having the coarse approximation of the supply image known as LL sub-band, and 3 high pass sub-bands that exploit image details across completely different directions – hl for horizontal, lh for vertical and HH for diagonal details[17].

The 2-D wave decomposition of a picture is performed by applying 1-D DWT on the rows of the image initial, and, then, the results are decomposed on the columns. The luminance part (V) from HSV is employed here for getting the wavelet transform. The frequency parts of these sub-band pictures cover the frequency parts of the luminosity parts price (V) is as shown in Fig. 2. Hence, discrete wavelet transform (DWT) may be a appropriate tool to be used for coming up with a picture improvement system[19].

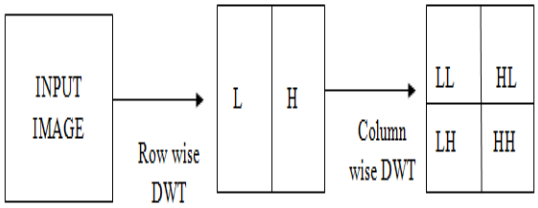

Fig.1: DWT Operation on Image

Here, high level component which contains the edge information of image are extracted using DWT and enhanced using sharpening filter. Finally, using inverse DWT operation enhanced image is generated.

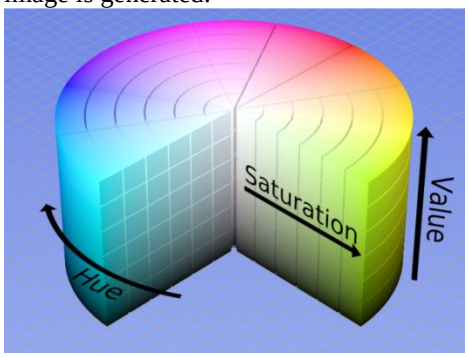

Fig.2: HSV Model

IV. CONCLUSION

We have reviewed lots of satellite image resolution technique is based on Discrete wavelet transform ,contrast enhancement and sharpens enhancement. After review some problems are also identified for future research work. In this survey we found that traditional spatial domain enhancement techniques does not perform well because after enhancement it produces blurred image. So a combination of discrete wavelet transform with fuzzy rule based contrast enhancement may produce good results for satellite image enhancement.

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