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Review Article

Improve the Quality of Remote Sensing Geographical Images Using ConventionalMethods and Discrete Wavelet Transform: A Survey

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Abstract *- Image enhancement is one of the most striking fields of image processing. Most of the researchers are very interested in different image enhancement techniques because using this technique, and we can get a good quality image. Remote Sensing Images are mostly corrupted by noise and small dust particles during transmission, so for such types of images, lots of traditional methods have been applied for enhancement purposes like histogram equalization contrast setting, increasing resolution that is super-resolution technique, edge sharpness techniques, etc., but in recent few years, lots of researchers found discrete wavelet transform as a new and most powerful technique for enhancement of Remote sensing geographical images. In this paper, we will discuss some traditional methods as well as discrete cosine transform and discrete wavelet transform methods used for enhancement purposes. through this paper, we want to contribute to the research to find out the correct and husband method for their problem*

Keywords *- geographical images, discrete wavelet transform, edge enhancement, sharpening, smoothening.*

I. INTRODUCTION

Enhancing the resolution of an image is most important in the sphere of image method. A typical Resolution sweetening technique is to vary the size of dots like pixels. Image resolution is the detail an image holds. Higher resolution implies extra image detail. Image sweetening is one of the preprocessing techniques. Therefore, distinct wave rework has been used to preserve the high-frequency components of the image. The redundancy and shift in international organization changings of the distinct wave rework mean that distinct wave rework coefficients are inherently interpolated. One level of distinct wave rework is used to decompose an associate degree input image into altogether different subbands [2]. Interpolation in image method is also a well-known methodology to increase the resolution of digital images. It'll increase the number of pixels throughout a digital image. Relatively new analysis addition, and recently, many new algorithms et al. have estimable the unknown details of wave coefficients during a shot to spice up the sharpness of reconstructed footage [3]. The 1- D Discrete Wavelet Transformer is often extended to a 2-D transform using isolatable wavelet filters. With separable filters, applying a 1-D rework to all or any of the input rows and then repetition on all of the columns will reason the 2-D rework. Four rework constant sets are created once one-level 2-D Discrete Wavelet Transformers are applied to a picture. The four sets are LL, HL, LH, and HH, wherever the primary letter applies either a low pass or high pass filter to the rows, and also the second letter also refers to the filter applied to the columns, as shown in fig.1.

II. LITERATURE REVIEW

Satellite pictures play an important role in fashionable computer-aided applications like geographical data systems. High-resolution satellite picture square measure is nonheritable with synthetic Aperture microwave radar (SAR) imaging. It is widely used in numerous analysis disciplines of remote sensing, ecology, oceanography, geology, and interferometry. However, the economical use of those satellite pictures is feasible. The captured images square measure of prime quality with high-resolution pixels and are free from external factors like noise, the default of capturing devices, discrete sources of radiation, etc. [1]. At the same time, discussing the subparts of the most composed work, like resolution and distinction of a picture, these 2factors square measure invariably vital problems in several image process applications, like satellite image resolution sweetening, feature extraction, and video resolution sweetening. Due to the interpolation of a picture, the number of pixels in digital images increases, and its applications square measures wide employed in several image processing applications, like image resolution enhancement, multiple description cryptography, and facial reconstruction. Several techniques are developed to increase the resolution of image sweetening by interpolation [2]. For the picture interpolation, Hasan Demirel and Gholamreza Anbarjafari [4] proposed a **Discrete Wavelet Transform** technique. As likened to different systems, the pictures obtained from **Discrete Wavelet Transform** and Inverse **Discrete Wavelet Transform**strategy have low PSNR and are not sharp. Hasan and Gholamreza [4] encased the Discrete and stationary wavelet deterioration strategy dependent on the insertion of high recurrence sub-band pictures coming about because of the **Discrete Wavelet Transform**. In this system, Stationary wavelet changes are used to upgrade the high recurrence picture segments. Similarly, extraordinary outcomes are created by this procedure. Satellite pictures should have been redesigned both in terms of goals and edges with the goal that the nature of an enhanced picture looks improved than a unique picture. Jinshan Tang Eli Peli et al. (2003) recommended a world bar chart exploit that adjusts the intensity histogram to approximate uniform distribution.[5]Oskam Chae et al. (2007) recommended the dynamic bar chart exploit (DHE) technique takes management over the impact of the ancient bar chart exploit so that it performs the sweetening of a picture while not losing details in it.[6]Tarun Mahashwari et al. (2013) recommended a fuzzy technique to enhance the standard of a picture, i.e., enhancing an image. several quite fuzzy image sweetening ways are planned, like fuzzy distinction adjustments, fuzzy image segmentation, and fuzzy edge detection. [7]. In picture handling, Complex Wavelet Transform (CWT) gives two complex-esteemed sub-band pictures of low recurrence and six complex esteemed sub-band images of the high frequency of the original image. MSE and PSNR of the too-settled picture additionally moved forward. Picture enhancement techniques are connected to the change of band powers and reducing the clamor, which covers 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 to enhance the picture and an incline keeping up de-noising process were used [8].

An author utilizes a nonlinear technique for noisy data improvement that accepts fuzzy webs for combining contrast enhancement and noise reduction [9]. In [10], two dissimilar strategies are planned to enhance distinction in unhearable B-mode imaging. Their spectral properties were perceived by getting RF knowledge from 2 different phantoms accustomed to kind B-mode images. The formation of the RF envelope from obtained knowledge then provides conversion of the envelope to paint image. Power compression and bar graph leveling techniques found in the literature are accustomed to revamping image properties. From the results created, it's perceived that each algorithm effectively supports the supposed use once they are bid individually. Another author discussed 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 grayscale images [11]. Gonzalez and wood propose some basic enhancement methods in their book [12].

In most image processing applications, expert knowledge is needed to overcome the difficulties (like object recognition and scene analysis). Fuzzy set and fuzzy logic offer a powerful tool to process and represent human knowledge as fuzzy if-then rules. Because of the data uncertainty due to randomness, ambiguity, and vagueness, many difficulties arise in image processing. The 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 involve manual parameter tuning**.**

In [15], remote sensing geographical images are first enhanced using **the Discrete Wavelet Transform-**SVD method, and then segmentation is applied to the enhanced using MRR–MRF Model. 3-level **Discrete Wavelet Transform** method for image enrichment has been implemented in [16]. Thriveni R. Thriveni R. ET. ET. They propose a fusion based on **Discrete Wavelet Transform**PCA and a morphological gradient to improve remote sensing geographical images. The input image is broken down into various sub-bands via **Discrete Wavelet Transform**. PCA- based fusion is applied to the low- low sub-band and contrast enhancement input image. Inverse **Discrete Wavelet Transform**ers are used to reconstruct the enhanced image. An intermediate stage estimating the fine detail subbands is required to achieve sharper boundary discontinuities of the image. The success of threshold decomposition does this; morphological gradient-based operators are used to detect the locations of the edges and sharpen the detected edges [17].

Table1. Problem Identification

S. No	Author	Description	Problem Identified	Proposed Solution
1.	Sharma A. et al. [19]	They concentrate on contrast and resolution enhancement, where DWT is applied to generate LL, HL, LH, and HH components of the image, and then histogram equalization is applied to the LL component for enhancement purpose	Worked Only on Grayscale image	The method can be applied to color images
2.	Vasileios Syrris et.al. [21]	Histogram equalization and super-resolution techniques are used to increase the resolution of the low-resolution image.	Suitable for only bad resolution images,	Other local and global features like sharpness, contrast, etc., may consider for better enhancement.
3.	Brindha S. et al. [22]	They first applied DWT for decomposition purposes then the hidden morkove model was used to enhance the image's contrast.	Only concentrate on the enhancement of contrast.	The visual appearance of the output image is not good enough.

Jadhav B. D. et al. proposed an algorithm for remote sensing geographical image enhancement based on high-frequency subband interpolation obtained by discrete wavelet transform (**Discrete Wavelet Transform**) and the low-resolution input image. This method uses an interpolation of **Discrete Wavelet Transform** and high-frequency subband images into low-resolution images. The high-frequency estimation subband obtains the sharpness of the image. Inverse **Discrete Wavelet Transform**s are performed to reconstruct the resultant image [18]. Sharma A. et al. proposed a technique that decomposes the input filtered image into the four frequency sub-bands using **Discrete Wavelet Transform**. Then, the high-frequency sub-band images and input images were interpolated. 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 many enhancement techniques for remote sensing geographical image enhancement [20]. Vasileios Syrris et al. proposed a unique approach in which a case study is presented. They test a mixture of image enhancement operations like linear and decorrelation stretching and assess ROC analysis against available building footprints [21].

III. ENHANCEMENT OF REMOTE SENSING GEOGRAPHICAL IMAGES:

A. Enhance the Contrast of the image:

Contrast stretching (often known as normalization) could be an easy image improvement technique that tries to boost the contrast in a picture by `stretching' the variety of intensity values it contains to span a desired variety of values, e.g., the total varies of constituent values that the image kind involved permits. It differs from many subtle histograms exploited therein. It will solely apply a linear scaling operation to the constituent image 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 which the image is to be normalized. Typically, these limits can be the minimum and most constituent values that the image kind permits. For instance, for 8-bit gray-level pictures, the lower and higher limits may be zero and 255. the 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, calling these c and d. Then each pixel P is scaled using the following function:

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

Here, we set the value 0, whose gray value is 0 or 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 a histogram of the image, and we can leave 5% pixels from the lower side and 5% pixels from the upper side in this way always gray values between 5% to 95% when was elected as c and d.

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

Some implementations also work with color images. In this case, all the channels will be stretched using the same offset and scaling to preserve the correct color ratios.

B. Adaptive Histogram Equalization:

Adaptive histogram equalization is employed for up contrast in pictures. It differs from histogram leveling by adaptation technique that computes many histograms, and every histogram is similar to a definite section of a picture. The contrast of an area of a picture won't be sufficiently increased by histogram leveling. AHE improves this by remodeling every picture element with a change derived from a neighboring region. It's wont to overcome some limitations of the world linear min-max windowing technique.

C. SuperResolution Method:

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 the resolution of the digital imaging device.

There are 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 an associate improved resolution image fusing info from all low-resolution pictures, and also, the created higher resolution pictures are higher descriptions of the scene. Single frame SR ways arrange to enlarge the image while not introducing blur. These ways use different elements of low-resolution pictures or unrelated pictures to guess what the high-resolution image ought to appear. 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].

D. Edge Sharpness using Discrete Wavelet Transform:

2-D discrete wavelet transform (**Discrete Wavelet Transform**) Wavelets are usually used in the image process. Pictures are described in terms of native abstraction and frequency contents exploitation wave transforms. The Fourier rework and DCT provide world frequency characteristics of a picture. However, they are unsuccessful in presenting native frequency characteristics. This downside is overcome in wave transforms. A separate wave transforms (**Discrete Wavelet Transform**) that the wavelets are discretely sampled for numerical analysis and useful analysis [15]. This can be overcome by **Discrete Wavelet Transform**, which captures each frequency and time info. Discrete wavelet transforms (DISCRETE WAVELET TRANSFORM) 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 supplied 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 **Discrete Wavelet Transform**ation to the rows of the image initial, and then the results are decomposed on the columns. The luminance part (V) from HSV is employed to get the wavelet transform. The frequency parts of these sub-band pictures cover the frequency parts of the luminosity parts price (V), as shown in Fig. 2. Hence, discrete wavelet transform (**Discrete Wavelet Transform**) may be an appropriate tool for coming up with a picture improvement system [19].

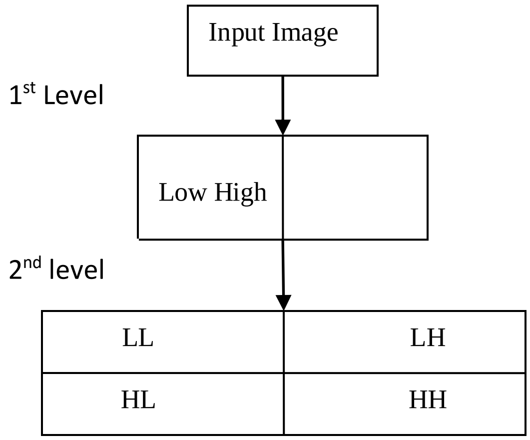

Fig.1 Discrete Wavelet TransformOperation on Image

Here, the high-level component which contains the edge information of the image is extracted using **Discrete Wavelet Transform** and enhanced using a sharpening filter. Finally, using inverse **Discrete Wavelet Transform**operation enhanced image is generated.

E. Increase Resolution:

Hasan et al. (2011) mentioned the resolution improvement exploitationDWT, and SWT uses bicubic interpolation with enlargement issue of 2 of the high-frequency sub-band pictures. At the same time, activity downsampling in each of the DWT sub-bands causes data loss within several sub-bands. Thus to minimize this loss, SWT is utilized. The interpolated high-frequency sub-bands and, therefore, the SWT high-frequency sub-bands have equal sizes, which will be added to one another. The new corrected high-frequency sub-bands are interpolated more for higher improvement. Also, it is well-known that the low-resolution image is obtained by lowpass filtering of the high-resolution image within the rippling rework domain.

IV.CONCLUSION

We have reviewed many remote sensing geographical image resolution techniques based on Discrete wavelet transform, contrast enhancement, and sharp enhancement. After review, some problems are also identified for future research work. In this survey, we found that traditional spatial domain enhancement techniques do not perform well because, after enhancement, it produces a blurred image. So a mixture of the discrete wavelet transform with fuzzy rule-based contrast enhancement may produce good results for remote sensing geographical image enhancement.

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