A Brief Overview of Satellite Image Resolution Enhancement

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Abstract: ***In this paper, a basic and element wavelet-based algorithm is exhibited for upgrade of the image sharpness or blurring of an Image. Four arrangements of routines are taken after here (De-noising, Decomposition, Sharpness Estimation, and Filtering). To begin with De-noising is done on the input image and afterward it works by at first decomposition the input image through a multi-level divisible DWT. After this, the log-energies of the DWT sub groups are processed. A Scalar Index relating to the information picture's sharpness is registered through the weighted normal of the processed log-energies. A few Satellite imageries are looked into and the Scalar Sharpness Index representing to the picture's general sharpness meant as SSI. This is utilized as a sifting part and the picture is sifted through to give the Sharpened Image. Here alongside the Scalar Sharpness Index, a Block based calculation is exhibited to focus the neighborhood saw sharpness. The Block Based Scalar Sharpness Index is computed by taking the RMS of 0.01 of maximum estimation of the separating parameter which takes the no. of Block Size. This proposed technique is the easiest, quickest and precise contrasting with the presently best-performing procedures for the sharpness estimation.***

Keywords: Blurring, Decomposition, De-noising, DWT, Image Sharpness, Wavelet Decomposition. Cycle Spinning (CS), Discrete Wavelet Transform (DWT), Dual Tree-Complex Wavelet Transforms (DT-CWT), High Resolution (HR), Low Resolution (LR), Un-decimated Wavelet Transform (UWT), Wavelet Zero Padding (WZP)

1. Introduction

Earth perception satellites offer far reaching and consistently upgraded data about our planet. This incorporates data about earth's environment, seas and coasts area, surface and polar areas, among others, that can be viably utilized as a part of catastrophe help, atmosphere research, and ecological and security checking. Exact and auspicious change identification of the world's surface components is critical in these ranges keeping in mind the end goal to help approach making and crisis activity.

Nowadays satellite imagery is being utilized as a part of distinctive fields, so it is important to have high resolution satellite imagery. Satellite imagery are influenced by different factors, for example, scattering, absorption and so on in the space, resolution of these pictures are low. To have better impression of these pictures it is important to have the picture with clear and well defined characterized edges, which gives better noticeable line of edge and so on. Resolution improvement of these imageries has dependably been a noteworthy issue to concentrate more data from them. There are numerous methodologies that can be utilized to improve the resolution of a satellite image. Wavelet domain based methods have substantiated themselves as generally productive method achieving for the required need. In image processing, Interpolation is a surely understood system to increase the resolution of a digital image. To enhance the resolution of image there are numerous interpolation. The three distinct sorts of introduction systems are nearest neighbor, bilinear and bi-cubic interpolation demonstrated in Fig. 1.

Temizel and Vlachos (2005a, b) depicted that in WZP (wavelet zero padding) an introductory rough guess to the obscure HR(high resolution) image is produced utilizing wavelet domain zero padding with the help of given LR image. Temizel and Vlachos (2005a, b) proposed alongside this WZP system, cycle spinning system is utilized to evacuate the ringing defect and enhancing the perceptual quality of picture. Naman and Vijayan (2010) utilized un-decimated wavelet change strategy in which the LR (low resolution) picture is dealt with as the point of interest coefficients is evaluated utilizing the UWT to acquire the obscure HR picture.

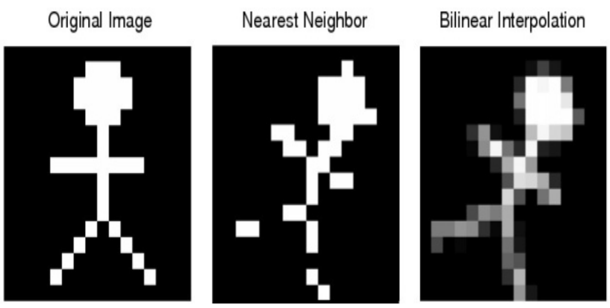

Figure 1: Interpolation methods rough guess block of an obscure wavelet change HR picture.

Demirel and Anbarjafari (2011) exploresd DWT based technique in which interpolation high frequency sub band pictures and the input low resolution picture is utilized and IDWT is connected to join each one of these pictures to produce final resolution improved picture. Demirel and Anbarjafari (2010a, b) proposed DT-CWT based algorithm in which a picture is part into two complex esteemed low frequency sub band image and six complex esteemed high frequency pictures utilizing heading particular channels. At that point acquired images are added trailed by utilizing IDT-CWT to join all pictures to deliver determination upgraded picture. The goal of this study is to analyze and recreate wavelet based system for example, WZP, CS, UWT, DWT and DT-CWT, to discover the execution regarding MSE, PSNR and ENTROPY and to state the best strategy for the resolution improvement of satellite images.

2. Related Work and Method

We have collected some the satellite imagery form Google map for the study purpose and applied all the technique to improve the resolution. For this we have used software MATLAB 13.

Preprocessing: We take the specimen test satellite image also, it is gone through a low pass filter to get a low resolution image. On this low resolution imagery we continue further to confirm the proposed routines consistency.

WZP: Wavelet zero padding is one of the least difficult systems for picture resolution improvement demonstrated in Fig. 2. In this system, wavelet transformed of a LR picture is taken and zero frameworks are inserted into the transformed picture, via tossing high frequency sub bands through the inverse wavelet transform and in this way HR picture is acquired.

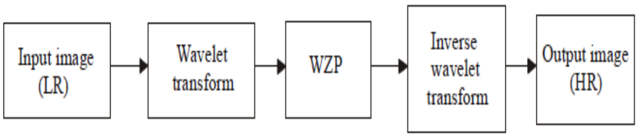

Figure 2: WZP method

Cycle Spinning: In this system, we take after the accompanying steps to get exceedingly resolution images as demonstrated in Fig. 3:

1. First we acquire a transitional HR picture through WZP technique.
2. After that we acquire N number of pictures through spatial shifting, wavelet transforming and decreasing the high frequency component.
3. Again, the WZP procedure is connected to all LR pictures to acquire various HR pictures.
4. These HR pictures are realigned and after taking the average it will give the final HR picture.

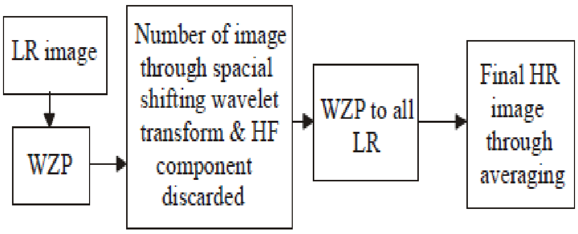

Figure 3: Cycle spinning

UWT: Un-decimated wavelet transform is wavelet transform method which does not utilize decimation after the decomposition of images into distinctive frequency sub bands. In this strategy, first WZP is connected to get an evaluation of HR (high resolution) picture. In the event that the LR (low resolution) picture is signified with Y of size m*n then the evaluated HR (high resolution) picture is given by:

$$x = IDWT\begin{pmatrix} y & b \\ b & y \end{pmatrix}$$

Where, b is the zero lattice of size m*n and IDWT is the inverse discrete wavelet transform.

In next step un-decimated wavelet transform is actualized on the assessed HR picture, as a consequence of which picture is decayed into two groups called assessed subtle elements and close estimation coefficients. The close estimation coefficients are then supplanted by at first evaluated HR picture and opposite UWT is taken to acquire the last HR picture allude to Fig. 4.

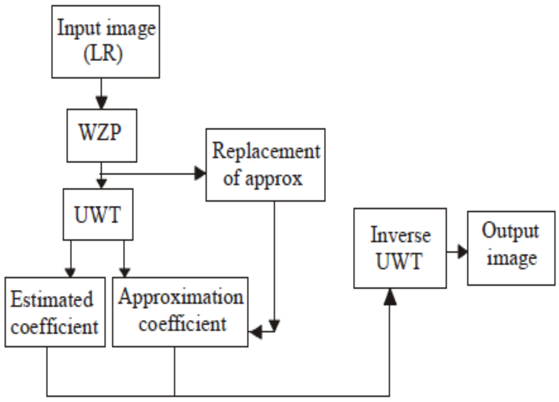

Figure 4: UWT method

DWT: Discrete wavelet change based method is most generally utilized procedure for performing picture interpolation. Here DWT is utilized to decimate a low resolution picture into sub band pictures LL, LH, HL and HH. All the acquired low and high-frequency segments of picture are then added. A distinction picture is received by subtracting the interpolated LL band image from the first LR picture. This distinction picture is then added to the interpolated high frequency segments to get assessed type of HF sub band pictures. At last IDWT is utilized to join these assessed pictures alongside the info picture to acquire high determination pictures.

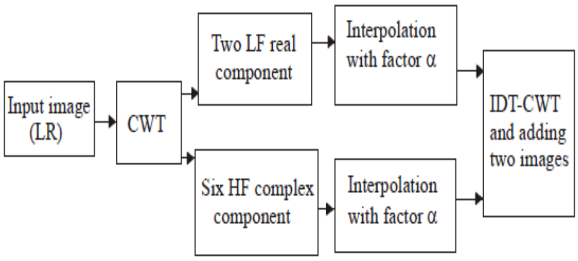

Figure 5: DT-CWT method

DT-CWT: It is additionally an effective method to get a high resolution picture. Block chart for usage of the strategy is demonstrated in the Fig. 5. DT-CWT is connected to break down a data picture into distinctive sub band pictures. In this strategy, heading specific channels are utilized to produce high- frequency sub band pictures, where channels show top size reactions in the vicinity of picture components situated at point +75, +45, +15, -15, -45 and -75 degrees, separately. At that point the six complexvalued pictures are interpolated.The two up scaled pictures are produced by introducing the low determination unique information picture and the moved variant of the data picture in even and vertical bearings. These two genuine esteemed pictures are utilized as the genuine and nonexistent parts of the introduced complex LL picture, separately, for the IDT-CWT operation. At last IDT-CWT is utilized to consolidate every one of these pictures to create determination improved picture.

Post-handling: After the usage of each of the technique, picture got after the opposite wavelet change is changed over to class of sort dim and histogram adjustment is actualized for better view.

Quantitative examination: To assess the execution of every calculation diverse measurements, for example, Mean Square Error (MSE), Peak Signal to Noise Ratio (PSNR), Root Mean Square Error (RMSE) has been ascertained:

Mean Square Error:

MSE= $\frac{1}{mn}[\sum \sum_{j=0}^{n-1}[\mathrm{I}(\mathrm{i,j}) - \mathrm{K}(\mathrm{i,j})]\text{^}2]$

Peak signal to noise ratio:

PSNR=10 log10 $\left(\frac{MAXi\text{^}2}{MSE}\right)$

Entropy:

$$H = -\sum_{i=1}^{n} p(x_i)\log_b(x_i)$$

3. Conclusion

After having the study about various wavelet based methods of satellite image enhancement, it is concluded that till date DTCWT individually has best performance in respect of quantitative analysis like PSNE, MSE, Entropy. Visual quality of image can be improved further by block based enhancement method which is based on log energy calculation of individual block of image.

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