Vol.4. No. 1, July, 2015
157 - 161,ISSN : 0975-5446

Development of Image De noising Technique using Wavelet Transform for Satellite Images

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Abstract

Satellite images used in many applications like geosciences studies, astronomy, and geographical information system. One of the major issues of satellite images is their resolution. In this paper, we propose a satellite image resolution enhancement technique using discrete wavelet transforms (DWT) to decompose the input image. Apply interpolation on decomposed images. All these images combine and then generate a new high resolution image by using the inverse DWT. The proposed technique has tested with the help of quantitative measure (peak signal-to-noise ratio and root mean square error) and result shows the superior proposed technique.

Key Words : Discrete wavelet transform (DWT), interpolation, satellite image resolution enhancement, PSNR, MSE.

1. Introduction

Satellite images used in many applications like geosciences studies, astronomy, and geographical information systems [1-5]. One of major issue of satellite image is their resolution because of satellite images usually taken from low resolution camera. To increase the resolution of a digital image can be done by using interpolation method. Interpolation used in many image processing application facial recognition, multiple description coding and image resolution enhancement [4].

There are three interpolation techniques, namely, Nearest neighbor interpolation, Bilinear interpolation, Bicubic interpolation. Bicubic interpolation is most sophisticate than the other rest techniques and produces smoother edges [1]. Disadvantage of interpolation method is loss of high frequency component edges, which is due to smoothness. To Preserving the edges is essential. To avoid this problem we use mathematical tool called wavelet transform.

The paper is structured as follows, section 1.1 describe the image decomposition using discrete wavelet transform. Sections 2 describe the methodology. Section 3 describe database related information and discussion about experimental work. Section 4 describe conclusion.

1.1 Discrete Wavelet Transform

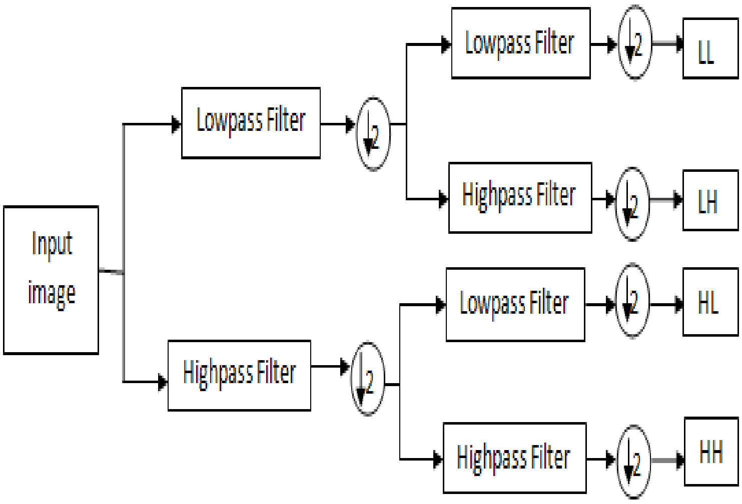

Figure 1. Block diagram of DWT filter bank level one.

Wavelets are also playing an important role in image processing applications. The 2-D wavelet decomposition of an image is performed by applying the 1-D discrete wavelet transform (DWT) along the rows of the image first, and then the results are decomposed along the columns [1][[4].

On low resolution input image we use DWT level – one.DWT adopts two sets of functions called Scaling Function and Wavelet Function which are associated with Lowpass and Highpass filtering. The Down sampling of an image shown in fig.1. To decompose the image in to four parts low-low (LL), low-high (LH), high-low (HL), and high-high (HH).sub bands of a satellite image where the top left image is the LL subband, and the bottom right image is the HH subband. From LL subband we get the approximate component from image or maximum frequency component, in LH image we get the Horizontal component, in HL image we get the vertical component, in HH image we get the Diagonal component.

Fig2. Original image

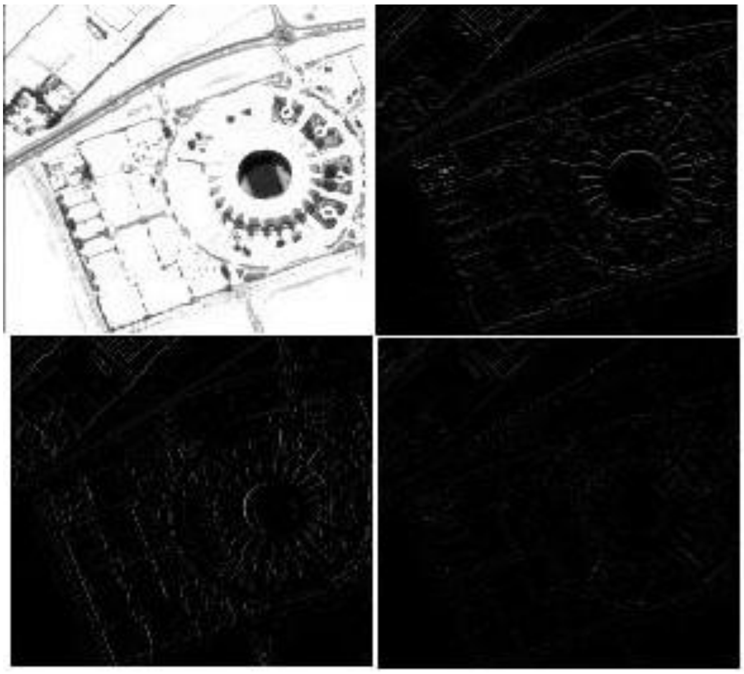

Fig3. Decomposition DWT at level-one using haar.

2. Methodology

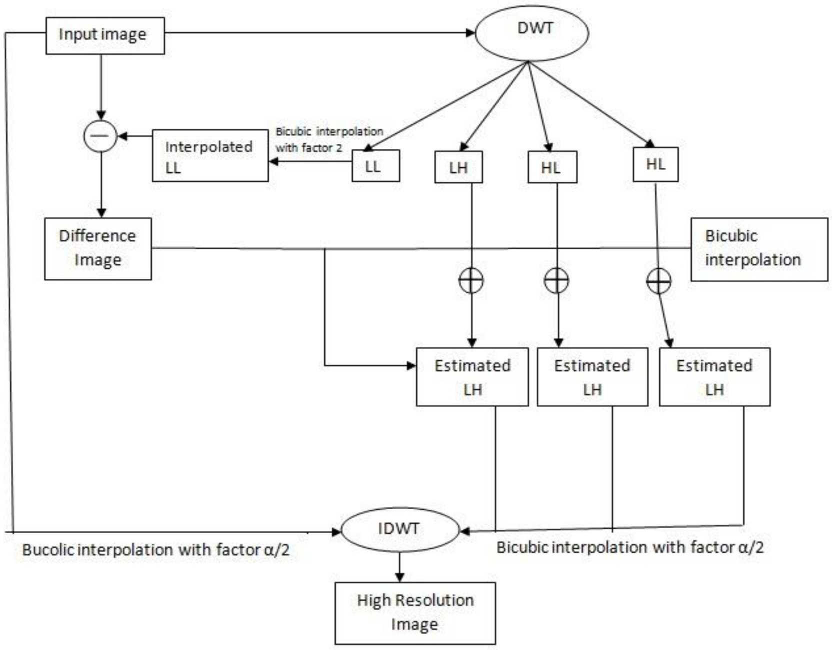

Figure 4. Block diagram of resolution enhancement algorithm**.**

2.1 Proposed Methodology

Now a day's satellite images are using in many applications like feature extraction and reduction of data. This reach paper discuss the noise reduction can be done by using average filter, interpolation and wavelet. The input image which contain some amount of noise by removed by passing it through suitable noise removal filter. The purpose of applying is to improve the edges. After that apply bicubic interpolation on the decomposed subband images. Bicubic interpolation is most sophisticate to produces smoother edges. Finally Inverse DWT is applied and we get the final image enhanced in term of noise, edge and resolution.

3. Experiments and Discussions

3.1 Data Sets

In this research, images taken from The dataset was acquired from Rapid Eye, skysat 2, worldview 1, worldview 2 and worldview 2 from website satimagingcorp's gallery (www.satimagingcorp.com/satellite-sensors/other-satellite.../**rapideye**/).

3.2 Discussions

The proposed technique has been tested by several satellite images. The results are much sharper than the original low-resolution image and interpolated image. Not only visual comparison but also quantitative comparisons are confirming the superiority of the proposed method. Peak signal-to noise ratio (PSNR) and root mean square error (RMSE) have been implemented in order to obtain some quantitative results for comparison. PSNR can be obtained by using the following formula

$$PSNR= 10 \log(R^2 /MSE) \quad (1)$$

where R is the maximum fluctuation in the input image (255 in here as the images are represented by 8 bit, i.e., 8-bit grayscale representation have been used—radiometric resolution is 8 bit) and MSE is representing the MSE between the given input image Iin and the original image Iorg which can be obtained by the following:

$$MSE = \frac{\sum_{i,j} (I_{in}(i,j) - I_{org}(i,j))^2}{M*N} \quad (2)$$

Where, *M* and *N* are the size of the images. Clearly, RMSE is the square root of MSE, hence it can be calculated by the following:

$$RMSE = \sqrt{MSE} \quad (3)$$

Table1. PNSR and MSE

Method/ Image	PSNR		MSE	
	haar	db1	Haar	db1
Img 1	27.49	27.43	116.56	118.34
Img 2	27.45	27.66	117.84	112.14
Img 3	27.02	27.26	130.05	122.97
Img 4	27.15	27.51	126.27	116.06
Img 5	27.68	27.14	111.64	126.57

4. Conclusion

A new resolution enhancement technique based on the interpolation of the high-frequency subband images obtained by DWT and the input image. An original image is interpolated by interpolation with factor two, then all these images have been combined using IDWT to generate a super resolved imaged. The proposed technique has been tested on PSNR and MSE and visual results show the superiority of the proposed technique over the conventional and state-of-art image resolution enhancement techniques.

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