Improvement of Satellite Image Resolution Using Discrete Wavelet Transform

Engineering

R.Srithulasiraman	Assistant professor/ECE, Karpagam college of engineering, (Autonomous)
M.Gobinath	IV Year B.E (ECE), Karpagam college of engineering, (Autonomous)

ABSTRACT
Satellite images are being now-a-days used in all fields. The major problem of these color images are their poor perception. A new method to enhance the satellite image which using the concept of wavelets and threshold decomposition is discussed here. The existing enhancement technique uses DWT (Discrete Wavelet Transform) to decomposed input image into different sub bands. Threshold decomposition is a powerful theoretical tool, which is used in nonlinear image analysis. Detecting the positions of the edges through threshold decomposition and these edges are sharpened by using morphological filters. This method will give better qualitative and quantitative results. These quantitative (peak signal-to-noise ratio and root mean square error). The visual results show the superiority of the proposed technique.

1.Introduction

Image enhancement is the technique which is most widely required in the field of image processing to improve the visualization of the features. Satellite images are useful in many applications for instance finding of the spectral signature of different objects such as the vegetation index, land cover, classification, and crop pattern. The remote sensing image is vital in the areas of unfortunate natural disasters to provide humanitarian aid and damage assessment as well as to device new protection strategies.

One of the most common problem, occurs in satellite images while capturing image with a huge amount of distance, is the dark light and contrast of image. Contrast is determined by the difference in the color and brightness of the object with other objects in the same field of view. Basically contrast is developed due to difference in luminance which is reflected from two surfaces. If an image has been taken in very dark or a very bright situation, the information may be lost in those areas which are excessively and uniformly dark or bright.

The problem is how the contrast of an image can be improved from the input satellite image which has complete information but is not visible. There have been several technique reported in literature for the contrast analysis of satellite image such as General Histogram Equalization (GHE), Gamma correction and local histogram equalization (LHE). These techniques are very simple and effective Indies for the contrast enhancement. But these techniques are not efficient as the information laid on the histogram of the image which is totally lost.

During the last decade, the Wavelet Transform, more particularly Discrete Wavelet Transform has emerged as powerful and robust tool for analyzing and extracting information from non-stationary signal such as speech signals due to the time varying nature of these signals. Discrete wavelet transform is also widely useful in many fields like removing of noise, compression, enhancement and remote sensing.

Recently, many techniques have been developed based on wavelet or wavelet packets for analysis of satellite images. In this paper, a novel technique based on the Singular Value Decomposition (SVD) and Discrete Wavelet Transform (DWT) has been proposed for enhancement of low-contrast satellite images.

SVD technique is based on a theorem from linear algebra which says that a rectangular matrix A, that can be broken down into the product of three matrices, as follows:

An orthogonal matrix UA, A diagonal matrix ΣA and (iii) the transpose of an orthogonal matrix VA. The Singular Value- based image equalization (SVE) technique is based on equalizing the singular value matrix obtained by singular value decomposition (SVD).

SVD of an image, which can be:

interpreted as a matrix, is written as follows $T A = UA \Sigma AVA$

The singular value matrix represents the intensity information of image and any alteration on the singular values change the intensity of the input image. The main advantage of using DWT for image equalization comes from the fact that ΣA contains the intensity information of the image; here multiband satellite image has been taken for better the analysis.

2. Related Work

Traditional filters and Haar transform technique have some problems, especially enhancing the noisy image.

• Enhanced Images are unclear because of blur. So the proposed system uses 2D Level DWT with different types.
• Morphological Filter for better resolution result.

The proposed technique has the advantages of superior resolution, sharper image and smoother edges. The PSNR (Peak Signal to Noise Ratio) improvement of the proposed technique is up to 7.19dB.

Resolution Enhancement technique is based on the Interpolation of the high-frequency sub-bands obtained by Discrete Wavelet Transforms (DWT).

3. Image

An image is a two-dimensional picture, which has a similar appearance to some subject usually a physical object or a person. An image is a rectangular grid of pixels. It has a definite height and a definite width counted in pixels. Each pixel is square and has a fixed size on a given display.

However different computer monitors may use different sized pixels.

The pixels that constitute an image are ordered as a grid (columns and rows); each pixel consists of numbers representing magnitudes of brightness and color. Each pixel has a color. The color is a 32-bit integer. The first eight bits determine the redness of the pixel, the next eight bits the greenness, the next eight bits the blueness, and the remaining eight bits the transparency of the pixel.

Image file size is expressed as the number of bytes that increases with the number of pixels composing an image, and the color depth of the pixels. The greater the number of rows and columns, the greater the image resolution, and the larger the file.
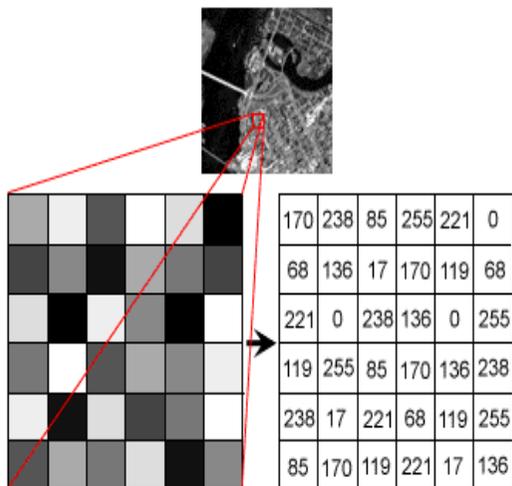
Fig 1: Representation of picture as pixels

4. Method

(a) IMAGE ACQUISITION: Image Acquisition is to acquire a digital image. To do so requires an image sensor and the capability to digitize the signal produced by the sensor. The sensor could be monochrome or color TV camera. Scanner produces a two-dimensional image.

(b) IMAGE ENHANCEMENT: Basically, the idea behind enhancement techniques is to bring out detail that obscured, or simply to highlight certain features of interesting an image. It is important to keep in mind that enhancement is a very subjective area of image processing.

(c) IMAGE RESTORATION: Image restoration is objective, in the sense that restoration techniques tend to be based on mathematical or probabilistic models of image degradation.

(d) SEGMENTATION: Segmentation procedures partition an image into its constituent parts or objects. In general, segmentation is one of the most difficult tasks in digital image processing. A rugged segmentation procedure brings the process a long way toward successful solution of imaging problems that require objects to be identified individually.

(e) IMAGE COMPRESSION:
Digital Image compression addresses the problem of reducing the amount of data required to represent a digital image. The underlying basis of the reduction process is removal of redundant data.

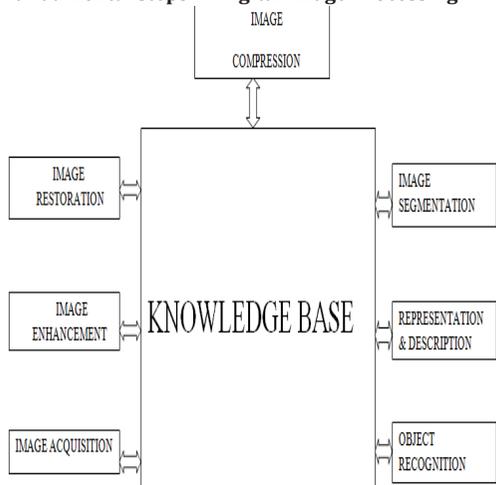**Fundamental steps in Digital Image Processing:**

Fig 2: Basic block diagram of image processing.

5. Discrete Wavelet Transform: Wavelet Transform is a type of signal representation that can give the frequency content of the signal at a particular instant of time or spatial location. The Lifting based wavelet transform decomposes the image into different sub band images, It splits component into numerous frequency bands called sub bands. They are LL, LH, HL, and HH sub bands. A high-frequency sub band contains the edge information of input image and LL sub band contains the clear information about the image.

DWT Sub-band Structure
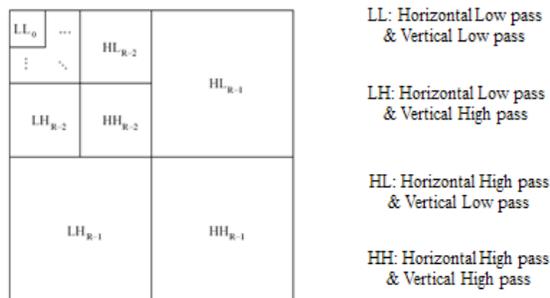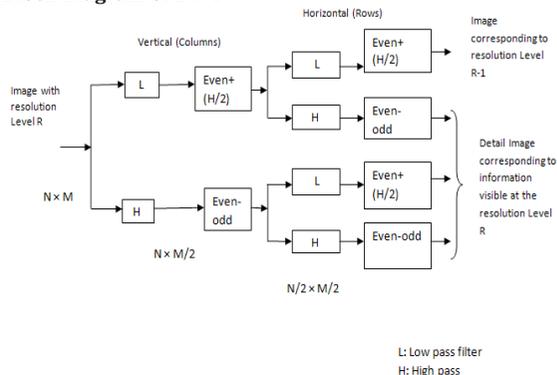

Block Diagram of DWT

Fig 3 & 4 Basic block of DWT

6. Wavelet based Image Resolution Enhancement:

In this paper, we propose a resolution-enhancement technique using interpolated DWT high-frequency sub band images and the input low-resolution image. Inverse DWT (IDWT) has been applied to combine all these images to generate the final resolution-enhanced image. In order to achieve a sharper image, we propose to use an intermediate stage for estimating the high frequency sub bands by utilizing the difference image obtained by subtracting the input image 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=$10\log_{10}(R^2/MSE)$
where R is the maximum fluctuation in the input image MSE is representing the MSE between the given input image Iin and the original image $Iorg$ which can be obtained by the following:

$$MSE = \sum_{i,j} (I_{in}(i,j) - I_{org}(i,j))^2$$

M×N

where M and N are the size of the images.

Threshold decomposition : The success of threshold decom-

position, gradient-based operators is used to detect the locations of the edges, by detecting the positions of the edges and then applying a class of morphological filtering.

Morphological Filtering : A morphological filter is used to sharpen these detected edges. These detected edges were then sharpened by using some morphological filters. Binary morphological operations of dilation and erosion are used to increase the contrast in the region and direction of the detected edges with the aid of a flat structuring element. The edge detected guided smoothing filters succeeded in enhancing low contrast satellite images. This was done by accurately detecting the positions of the edges through threshold decomposition.

We run our lossy coder with six different quantization parameters and measure the PSNR in relation to the resulting compression ratios. The results ar
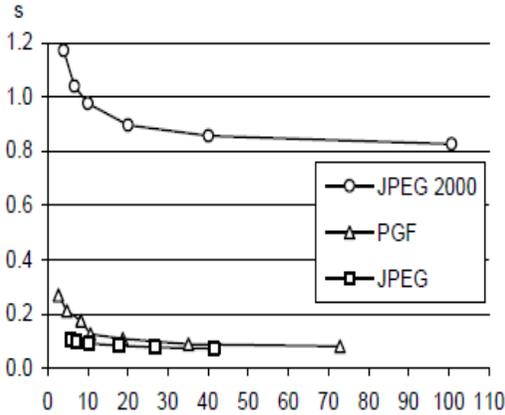

Fig. 5: Decoding time in relation to compression ratio

DWT-Haar Transform

The first DWT was invented by the Hungarian mathematician Alfred Haar. For an input represented by a list of numbers, the Haar waveform transform may be considered to simply pair up input values, storing the difference and passing the sum. The process is repeated recursively, pairing up the sums to provide the next scale: finally resulting in differences and one final sum. The result images can be evaluated with two characteristics, distortion and sharpness. According to the distortion evaluation, adjusting errors are required, by computing the Mean Square Error (MSE). Peak Signal to Noise Ratio (PSNR) adjusts the quality of the image which the higher the PSNR refers to the better quality is the image

7. Performance Evaluation
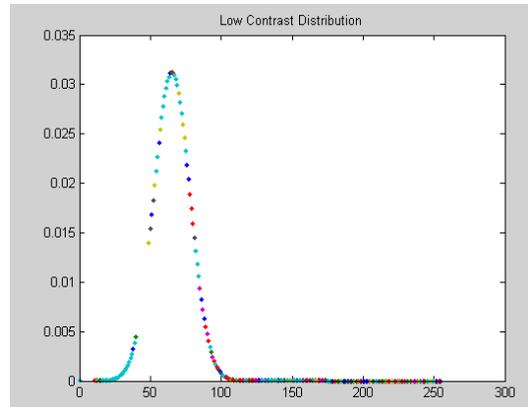## 7.1 Simulation Result

Fig 6: Comparison result

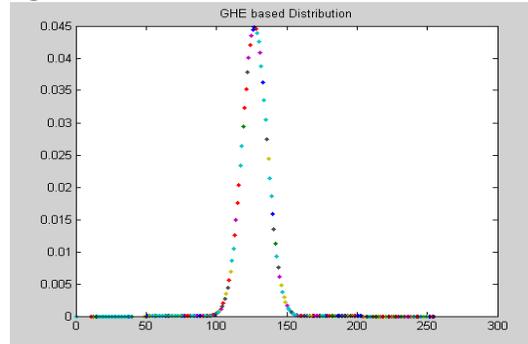**Fig 7: Low contrast distribution**
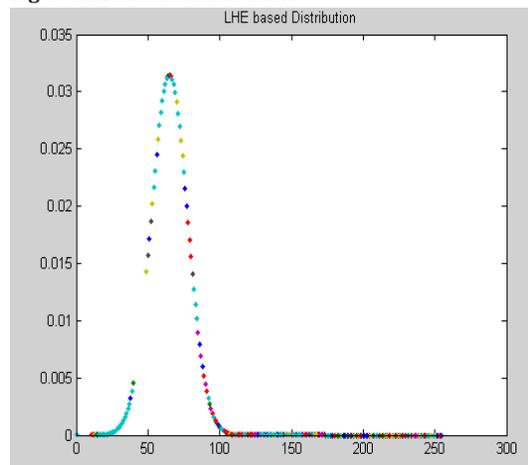

Fig 8: GHE based distribution
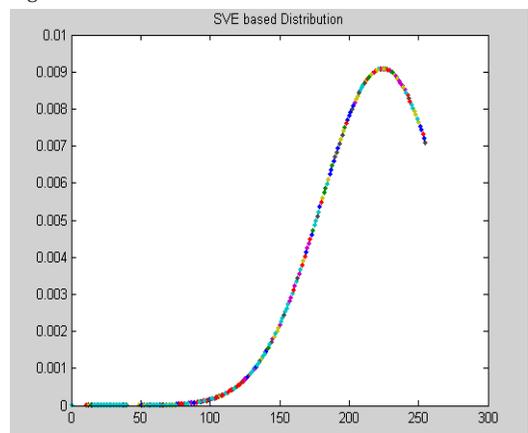

Fig 9: LHE based distribution
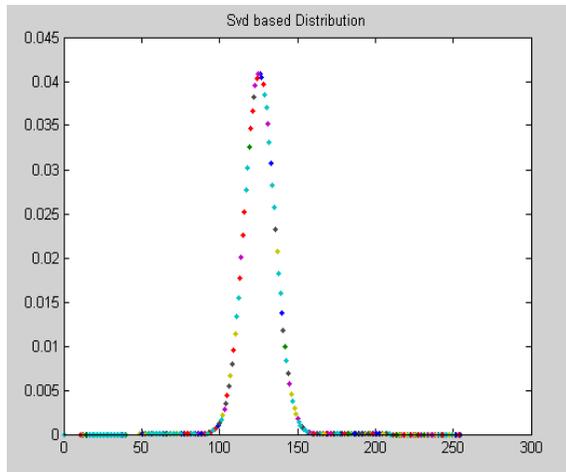

Fig 10: SVE based distribution
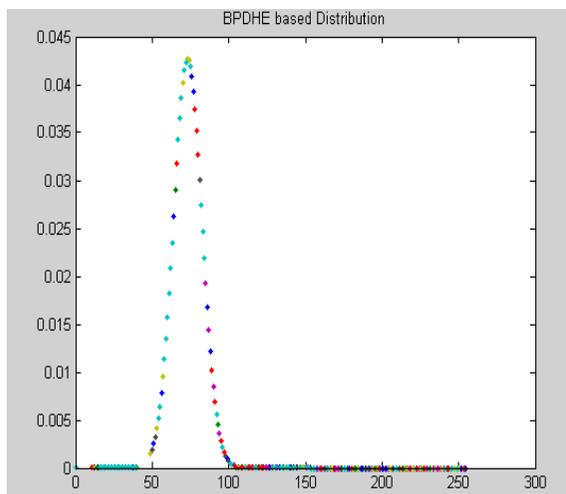
Fig 11: SVD based distribution

Fig 12: BPDHE based distribution

8.Conclusion

While we acknowledge the results shown are for a single data set with a limited number of objects the preliminary results have demonstrated the capability of contrast enhanced images in a complex environment with the help of high resolution multispectral satellite imagery. The technique introduced in this paper also has potential applications implementing the VLSI design based algorithms. The PSNR improvement of the proposed technique is up to 7.19 Db. visual results show the superiority of the proposed technique over the conventional one.

REFERENCE

[1] Hasan Demirel And Gholamreza Anbarjafari "Discrete Wavelet Transform-Based Satellite Image Resolution Enhancement" IEEE transactions on geoscience and remote sensing, vol. 49, no. 6, june 2011. | | [2] Bin Wang D, Rose M and Aly A Farag, "Local Estimation of Gaussian-Based Edge Enhancement Filters Using Fourier Analysis", IEEE Transactions on Acoustics, Speech, and Signal Processing, (1993), Vol. 5, pp. 13-16. | [3] Day-FannShen, Chui-Wen Chiu and Pon-Jay Huang, "Modified Laplacian Filter and Intensity Correction Technique for Image Resolution Enhancement", IEEE International Conference on Multimedia and Expo, (2006), Vol. 7, Nos. 9-12, pp. 457-460. | [4] H. Demirel, C. Ozcinar, and G. Anbarjafari, "Satellite Image Contrast Enhancement Using Discrete Wavelet Transform and Singular Value Decomposition", IEEE Geosciences and Remote Sensing Letters, Vol. 7,No. 2, April 2010, pp. 333-337 |