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Wavelet Transform Based Satellite Image Enhancement

[1]S. Alaudeen Basha and [2]V. Vijayakumar
[1]Department of Information Technology, AMET University, Chennai, India
[2]School of Computer Science and Engineering, VIT University, Chennai, India

Abstract: In this note, Discrete Wavelet Transform (DWT) based image resolution enhancement technique is proposed on high frequency sub-band interpolation images. Input images are decomposed by using DWT in this proposed enhancement technique. DWT decomposes the input image in four dissimilar frequency sub-bands; High-High (HH), High-Low (HL), Low-High (LH) and Low-Low (LL). Edge information is preserved by applying gamma correction to LL sub-band only. New resolution enhanced image is generated by using inverse DWT from high frequency sub-band and low resolution image from input. Entropy, EME and signal to noise ratio performance is measured using this proposed technique.

Key words: Satellite image enhancement, DWT, PSNR, technique, entropy, frequency

INTRODUCTION

Advanced block based DWT technique for contrast enhancement of satellite images is presented by Coumar and Rosario (2016). Flexible radiant transfiguration and preeminent glaze levels are used in this method. Inverse Discrete Wavelet Transform (IDWT) is used to enhance the image finally and DWT based on advanced block is used to improve each block. Inverse DWT is used to fuse the enhanced blocks to obtain emanated image. Picture is decayed into sub-bands using haar wavelet transform. Gamma corrected adaptive knee transformation based on beta wavelet for satellite image enhancement is explained by Singh and Kumar (2016). Input image is decomposed into sub-band images, i.e., Low-Low (LL), Low-High (LH), High-Low (HL) and High-High (HH). Then, input image with LL band coefficients are changed to get enhanced LL-band using adaptive knee transformation.

Fusion and morphological gradient based on DWT-Principal Component Analysis (PCA) for edge preserving satellite image enhancement is described by Thriveni (2015). Input image is decomposed into various sub-bands using DWT. Fusion is applied on the LL sub-band using PCA. Then enhanced image is reconstructed using IDWT. Fine detail sub-bands are required to achieve sharp boundary.

Satellite image enhancement using an effective method is discussed by Jadhav and Patil (2015). DWT with high-frequency sub-bands and lower solution input image is used to obtain sharp image by high frequency sub-band estimation. Resultant image is reconstructed using IDWT. Discrete and stationary wavelet decomposition based image resolution enhancement is discussed by Demirel and Anbarjafari (2011). High frequency sub-band image interpolation based resolution enhancement is obtained by Discrete Wavelet Transform (DWT). Edge is enhanced using the technique of Stationary Wavelet Transform (SWT). Then image is decomposed into sub-bands using DWT scheme. Interpolation is done from input image and expected high frequency sub-bands are changed through SWT using high frequency sub-band obtained. Finally, inverse DWT is used to generate a high resolution image from all these sub-bands.

Plateau histogram equalization based satellite image contrast enhancement algorithm is presented by Aedla (2014). Input image decomposition is done using bi-histogram equalization with plateau and threshold calculation using self-adaptive plateau histogram equalization. Minimum mean brightness error bi-histogram equalization, histogram equalization, dynamic histogram equalization, self-adaptive plateau histogram equalization are compared with existing methods.

Adaptive contrast enhancement of medical X-ray images based on region is discussed by Kanwal *et al*. Adaptive neighborhood technique based contrast enhancement and presented hybrid methodology. Then comparison is done against with existing methods. Singular Value Decomposition (SVD) and DWT based on gamma correction for satellite image enhancement are explained by Sharma and Verma (2014). Intensity transformation based low contrast satellite images are enhanced. There are four various sub-bands are included while decomposes the input image, i.e., LL, LH, HL and HH. Edge information is preserved by applying gamma

Corresponding Author: S. Alaudeen Basha, Department of Information Technology, AMET University, Chennai, India

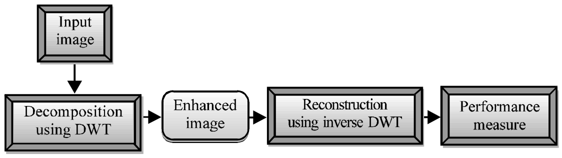


Fig. 1: Block diagram of the proposed system

correction. LL sub-band information of gamma is passed via. SVD and IDWT is applied to reconstruct the enhanced image. Upadhyay *et al*. (2016a) shows the concept of combine technique for classification of IRS P6 LISS-III satellite images. In the research study by Shanthi and Anita (2014) explains about performance analysis of black hole attacks in geographical routing MANET. Land use and land cover classification of LISS-III satellite image using KNN and decision tree is analyzed by Upadhyay *et al*. (2016b). Image super resolution using wavelet transformation based genetic algorithm is discussed for enhancing image compression efficiency (Panda and Jena, 2016).

MATERIALS AND METHODS

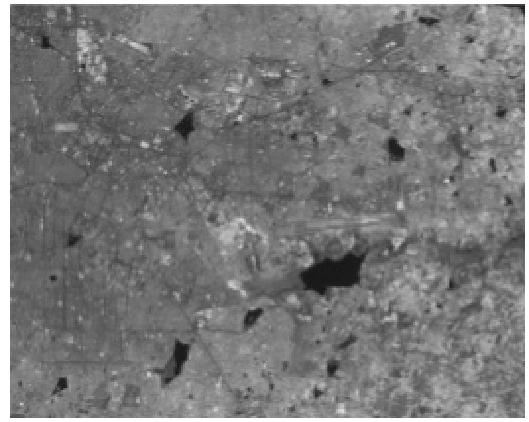
Low-pass filtered signal having some high frequency information because the analysis filter bank has limited filter taps and also some low frequency information is obtained from high pass filtered signal. Same phase has down sampling the both high-pass and low-pass filtered signals but still remains some correlation though there will be correlation at low while down sampling by various phases. Image enhancement is done using DWT technique to obtain a resolution-enhanced image. Results show that the proposed technique performs better than the existing wavelet methods in terms of the PSNR.

Figure 1 shows the block diagram of the proposed satellite image resolution enhancement system. An input image is decomposed by DWT to get high-frequency sub-bands. Both high-frequency sub-bands and the low-resolution input image are interpolated. Two different decompositions are used to calculate the complex transform using DWT. It has two or more high frequency filter banks.

RESULTS AND DISCUSSION

Contrast enhancement in the representation is continued in a number of steps by first decomposing the input image by means of customized DWT. This study tells about the experimental results of the proposed contrast enhancement for satellite images. PSNR, EME and entropy are calculated using both input and enhanced satellite image. Satellite input image and output images are shown in Fig. 2. Our results show that the proposed technique provides reliable improvements by other DWT techniques (Table 1).

(a)



(b)

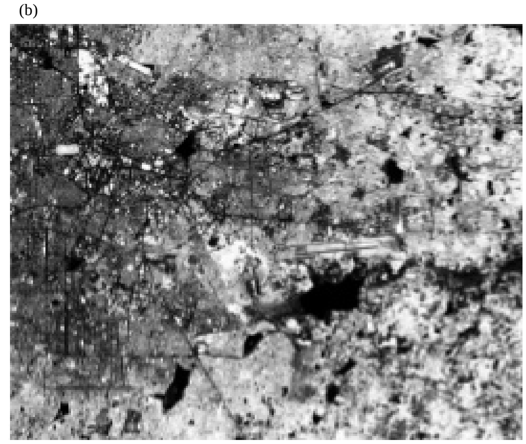


Fig. 2: a) Input image; b) DWT enhanced image

Table 1: Performance measure for the proposed system

Performance	Proposed
PSNR	31.560
Entropy	7.500
EME	0.526

CONCLUSION

DWT domain based image resolution enhancement algorithm is presented in this study. Input images are decomposed using this proposed technique. Then decomposed images are enhanced and finally reconstructed using inverse DWT. The results have shown that the proposed method outperforms conservative image enhancement approaches. The proposed input and resultant images and the performance measure of the proposed method.

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