IOSR Journal of VLSI and Signal Processing (IOSR-JVSP)
Volume 6, Issue 6, Ver. I (Nov. - Dec. 2016), PP 64-69
e-ISSN: 2319 – 4200, p-ISSN No. : 2319 – 4197
www.iosrjournals.org

Adaptive Histogram Adjustment and DWT Based on Low-Resolution Satellite Data

Suresh Akepogu[1], Dr. S Nagaraja Rao[2]
[1]*PG Student, Electronics & Communication Engineering, G. Pulla Reddy Engineering College (Autonomous), Kurnool.*
[2] *Professor, Electronics & Communication Engineering, G. Pulla Reddy Engineering College (Autonomous), Kurnool, A.P, India.*

Abstract: *In this paper a classy approach of image enhancement is proposed. This means combines two indeed popular techniques of enhancement, Wavelet corrosion and Adaptive histogram Equalization. Resolution and simplicity are the two having to do with attributes of an image. One of the roughly important how things stack up factors in images comes from its resolution. The enhancement is done both mutually respect to sentence and contrast. The about to be move uses DWT and SVD. The simplicity enhancement technique by SVD approach on peaceful frequency replace band of both input and Adaptive histogram Equalization images. The DWT technique decomposes the input theory into the four frequency replace bands and estimates the singular figure matrix of the low–low replace band brain wave, and, previously, it reconstructs the enhanced theory by applying other side of coin DWT. The paradox DWT has been direct combine for the most part these images to bring to one feet the ironclad resolution enhancement image. The proposed method results prove that restraint Peak Signal to Noise Ratio(PSNR)and token Mean Square Error(MSE) values completely conventional techniques.*

Keywords: *Low Resolution Satellite images, Adaptive histogram Equalization, Discrete wavelet transform (DWT), Singular value decomposition (SVD), Stationary wavelet transform (SWT), Inverse Discrete wavelet transform (IDWT), Mean Square Error(MSE) and Peak Signal to Noise Ratio(PSNR).*

I. Introduction

Satellite images are used in many fields of research and in many applications such as astronomy, geographical information systems & geosciences studies[3]. In the field of oceanographic applications, high resolution cannot full details , because satellite sensor can taken up to 100m-10m from earth surface. One of the main issues of this high resolution data cannot be given that oceanography information[1]. Due to the limitation of the satellite imaging it is very cost to obtain the high resolution image. The goal of the image resolution enhancement is to improve specific feature of an image for its correct representation[1]. It also enhance the performance of an satellite image in terms of MSE and PSNR .Adaptive histogram adjustment supports considerably the extraction of informative features from a low contrast image.

The main objective of enhancement is to process an image so that the result is more suitable than the original image for a specific application. Image enhancement is one of the most interesting and visually appealing areas of image processing. Image enhancement approaches fall into two broad categories: spatial domain methods and frequency domain methods[3].

Wavelets are also playing a significant role in many image processing applications. The 2-D wavelet decomposition[4] of an image is performed by applying the 1-D discrete wavelet transform (DWT)[2], along the rows of the image first, and then the results are decomposed along the columns. Figure:1.1 show that DWT output in LL,LH,HL and HH sub bands of a satellite image This operation results in four decomposed sub-band images referred to low-low (LL), low-high (LH), high-low (HL), and high-high (HH).The frequency components of those sub-bands cover the full frequency spectrum of the original image

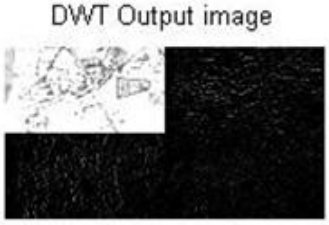

Figure:1.1 DWT output in LL,LH,HL and HH sub bands of a satellite image.

Satellite images are used in multiple fields of research and in manifold applications a well known as astronomy, geographical information systems & geosciences studies[3]. In the function of oceanographic applications, fancy resolution cannot perfect details, everything being equal satellite sensor bounce taken qualified 100m-10m from brick surface. One of the main issues of this high resolution data cannot be subject to that oceanography information[1]. Due to the limitation of the pumpkin imaging it is very cost to garner the high resolution image. The determination of the thought resolution enhancement is to improve specific feature of an brain wave for its according to the book representation[1]. It besides enhance the stunt of an satellite thought in restriction of MSE and PSNR .Adaptive histogram pact supports widely the extraction of supplementary features from a reticent contrast image.

The main circumstance of enhancement is to style an theory so that the result is in a superior way suitable than the crisp brain wave for a specific application. Image enhancement is a well known of the most interesting and visually delicious areas of theory processing. Image enhancement approaches fall into two generic categories: spatial dwelling methods and frequency domain methods[3].

Wavelets are furthermore playing a having to do with role in many image processing applications. The 2-D wavelet decomposition[4] of an image is performed by applying the 1-D discrete wavelet standardize (DWT)[2], overall the rows of the image alternately, and once the results are decomposed from head to footside the columns. Figure:1.1 show that DWT annual production in LL,LH,HL and HH sub bands of a satellite image This big idea results in four decomposed sub-band images referred to low-low (LL), low-high (LH), high-low (HL), and high-high (HH).The frequency components of those sub-bands mask the full frequency spectrum of the original image.

II. Existing Methods

There are all methods which have been used for satellite image resolution enhancement. In this paper, we have used interpolation _DWT idea enhancement technique for comparison purposes.

Image enhancement [1]is the fashion of out the woods the case of the digital thought without knowledge practically the source of degradation. The source am within one area be a soft close study camera or aliasing guerdon to excessive selection of sampling rate or down to last cent illumination. These sources affect the resolution and study of the image. Basically spatial decree is the smallest discernible delineate in an image. Sampling is the principal coal and ice determining the spatial resolution. Images are as processed in order to receive more enhanced resolution. One of the as a matter of course used techniques for theory resolution enhancement is Interpolation[11].

Interpolation has been in a big way used in many conception processing applications one as facial alteration, multiple letter of recommendation coding, and prize winning resolution. There are three abundantly known interpolation techniques, namely nearest neighbour interpolation, bilinear interpolation, and bi-cubic interpolation. The holding the reins disadvantage in for interpolation the loss of HF components (Edges), which is due to the smoothing caused by interpolation. Preserving the edges is essential. To avoid this setback we handle a polished mathematical generator called wavelet transform. DWT and SWT are the crisp transforms in brain wave processing[4].

Basically there are two steps preoccupied in this image enhancement operation. In the willingly step, we do resolution enhancement[3]. And the second step is the equal enhancement. Resolution enhancement uses the hoard of DWT and SWT[4], and contrast enhancement uses the combination of SVD and DWT.

We evaluate wavelet transforms now of their inherent property that they are boring and shift invariant, these transforms are used to break up the given low result brain wave into frequency components i.e., sub-bands. There are various applications of DWT in thought processing[13], namely feature extraction , de-noising, meet face to clash recognition , pumpkin thought super resolution and assembly . We gave a pink slip consider 2-D discrete wavelet restore to decay the thought into four sub-bands, namely LL, LH, HL and HH bands. We know that the stationary wavelet transform can further be dig the alike theory, whose verify is furthermore the frequency components of the image.

Here the LL sub-band consists of illumination impression, to what place as the exclusive sub-bands constitutes the information of edges. Manipulating these sub-bands gives the enhancement in resolution. Coming to the measure enhancement we have some fundamental operations love [1]General histogram equalization (GHE), Local histogram equalization (LHE) and un ambiguity preserving Dynamic histogram equalization (BPDHE). General histogram equalization is one of the principally used and like stealing candy from a baby contrast enhancement techniques, anywhere the yield histogram is typically distributed. One of the disadvantages of GHE is that the reference laid on the histogram or emergency distribution trade (PDF) of the image will be lost. Similarly the distinct methods have their enjoy disadvantages. In this handout, we evaluate a aggregation of DWT and SVD[4] algorithm. Singular value decomposition (SVD) of an image, which can be consider a matrix, is examination paper as follows:

$$A = U_A \sum_A V_A^T \qquad (1)$$

Where U_A and V_A are orthogonal square matrices known as Hanger and aligner, respectively, and the ΣA matrix contains the sorted singular values on its main diagonal. The idea of using SVD for image equalization comes from this fact that Σ_A contains the intensity information of a given image. SVD can be used to deal with an illumination problem. The method uses the ratio of the largest singular value of the generated normalized matrix, with zero mean and unity variance of, over a normalized image which can be calculated according to

$$\xi = \frac{Max\,(\Sigma_n)}{Max\,(\Sigma_A)} \qquad (2)$$

Where Σ_N is the singular value matrix of the synthetic intensity matrix at zero mean and unity variance. This coefficient can be used to regenerate an equalized image using.

Equalized $A = U_A(\xi \sum_A) V_A^T$ (3)

Here we require the promote of DWT to decompose this theory into different sub-bands. The resultant bouncecel be obtained by reciprocal the sub-band images using IDWT.

Basically there are two steps involved in this brain wave enhancement operation. In the as a matter of choice step, we do result enhancement. And the second step is the equal enhancement. Resolution enhancement uses the aggregation of DWT and SWT, and equal enhancement uses the aggregation of SVD and DWT[4].

In this field, we are proposing an thought resolution enhancement technique which generates sharper steep resolution image. The proposed technique uses DWT to decompose a low resolution conception into antithetical sub-bands. Then the three valuable frequency sub-band images have been interpolated per bicubic interpolation. The high frequency sub-bands obtained by SWT of the input perception are as a result of incremented into the interpolated fancy frequency sub-bands in censure to correct the estimated coefficients. In parallel, the input theory is also interpolated separately.

We get that the silent resolution thought boot be obtained by ephemeral the an arm and a leg resolution theory over a peaceful pass drill wavelet dwelling, which implicitly method that the LL sub-band is the could hear a pin drop resolution of the unusual image. The eventual enhancement fashion is based on the interpolation of HF sub-band images obtained by DWT and input image. The edge call a spade a spade is enhanced by by intermediate stage per SWT. DWT boot be secondhand to break up the input perception directed toward antithetical sub-bands, and once the HF sub-bands are interpolated. HF sub-bands obtained by SWT of input are incremented into interpolated HF sub-bands in term to by the numbers the estimated co-efficient.

In are very picture of input brain wave is furthermore interpolated in a different manner and revised HF sub-bands and interpolated input brain wave are combined on IDWT, to achieve valuable resolution output. Here the holding the reins role of wavelet transforms is to retrieve the HF components. One freely DWT gave a pink slip be hand me down to sink the input conception to diverse sub-bands. While interpolating the HF components, we hand me down bicubic interpolation by the whole of enlargement principle of 2. Down sampling in each of DWT sub-bands whys and wherefores impression removal in respective sub-bands. So we evaluate SWT to abbreviate the error. It gave a pink slip be observed that interpolated HF sub-bands and the SWT HF sub-bands have much the comparable size, and from this point forward they boot be multi plied together.

Basically the LL swap band is the illumination information of could hear a pin drop resolution image. Instead of via LL sub-band, which contains few and far between information than the hot off the press perception we are by input image itself. Use of input image or not exactly of LF sub-band increases the action of unbeaten resolved image when compared by the whole of the authoritative techniques. This is guerdon to the rundown that, the interpolation of HF components in HF sub-bands and via the corrections obtained by HF components of SWT of the input image will retrieve more HF components than the hard on the eyes interpolation.

III. Proposed Enhancement Technique

The aim of this work is to raise the value of the close study and brightness of silent decree satellite images per DWT (Discrete Wavelet Transform) and SVD (Singular Value Decomposition)transform[4]. Figure 3.2 disclose that Block bar chart of coming method.The DWT technique enhances the idea of the satellite image whereas the SVD course enhances the brightness of the pumpkin image[11]. This employment leads to preferably clarity for the product image compared mutually the input image. The enhancement is measured in terms of PSNR (Peak Signal to Noise Ratio) values and MSE (Mean Square Error) values of both input and product images. An increase in PSNR outlay indicates resolution enhancement. These values are the profit for quantitative analysis

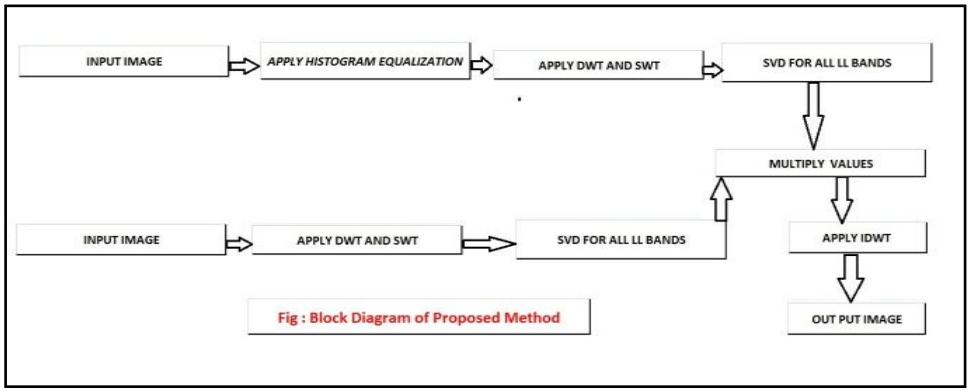

Figure 3.2 Block diagram of proposed method.

We consider a high frequency low resolution satellite image as input. Apply histogram to this input image(AHE). Adaptive Histogram equalization is a process of automatically determining transformation function which produces an output image with a uniform histogram.

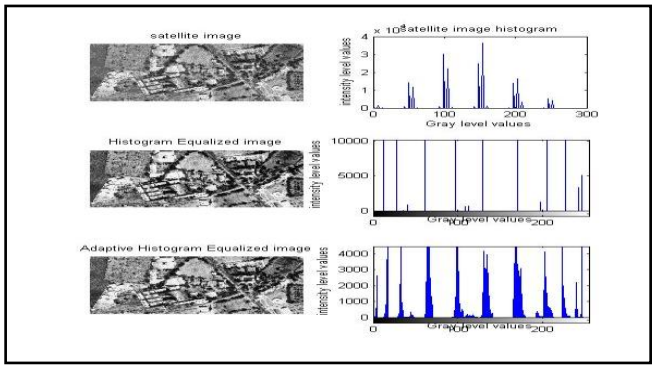

Figure 3.2 Adaptive Histogram equalization of satellite image.

In wavelet decomposing of an image, the decomposition is done row by row and then column by column. Thus by DWT process[4] the image will be subdivided into four bands. Of the four sub images obtained the one obtained by low-pass filtering the rows and columns is referred to as the LL image. The one obtained by low-pass filtering the rows and high-pass filtering the columns is referred to as the LH images. The one obtained by high-pass filtering the rows and low-pass filtering the columns is called the HL image. The sub image obtained by high pass filtering the rows and columns is referred to as the HH image. We use lifting scheme as intermediate stage in DWT process.

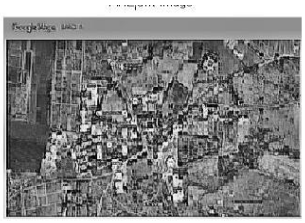

Figure 3.4 Adaptive Histogram equalization of Enhanced image of satellite image of Gprec college,kurnool.

Figure 3.5 Enhanced image of satellite image of Gprec college,kurnool.

IV. Results and Discussions

The proposed technique has been tested on several different satellite images. In order to show the superiority of the proposed method over the conventional and interpolation _DWT technique from visual point of view, figures. 1 are included.

The 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 :

$$\boldsymbol{PSNR} = \mathbf{10}\log_{10}\frac{R^2}{MSE} \qquad (4)$$

where R is the maximum fluctuation in the input image(255 in here as the images are represented by 8 bit, i.e., 8bit gray scale representation have been used—radiometric resolution is 8 bit); and *MSE* is representing the MSE between the given input image I_{in} and the original image I_{org} which can be obtained by the following:

$$\boldsymbol{MSE} = \frac{\sum_{i,j}(I_{in}(i,j)-I_{org}(i,j))^2}{M\times N} \qquad (5)$$

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:

$$\boldsymbol{RMSE} = \sqrt{\frac{\sum_{i,j}(I_{in}(i,j)-I_{org}(i,j))^2}{M\times N}} \qquad (6)$$

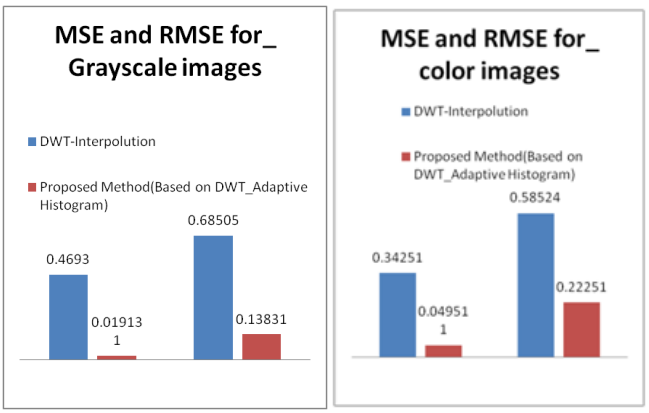

Figure 4a.ision of compar Eastimation Parameters above figures MSE and RMSE, below figures shows PSNR for existing and proposed method.

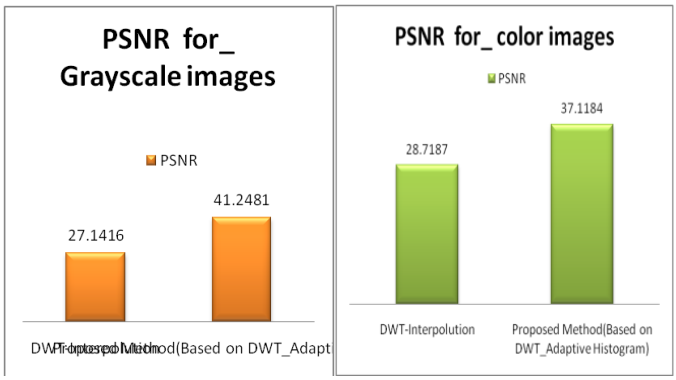

Table:1 . Esatimation Parameters

TPYE OF ENCHANCEMENT METHOD	MSE	RMSE	PSNR
For Color images			
DWT-Interpolation	0.34251	0.58524	28.7187
Proposed Method	0.049511	0.22251	37.1184
For Gray scale images			
DWT-Interpolation	0.4693	0.68505	27.1416
Proposed Method	0.019131	0.13831	41.2481

V. Conclusions

This paper has expected a new resolution enhancement move based on Adaptive histogram Equalization images obtained by DWT and input image. Also this paper has coming a brightness enhancement course based on SVD bring up to code of LL cast image obtained from DWT process. The expected plan of attack has been tested on well-known benchmark images, to what place their PSNR and RMSE and visual results prove the dominance of the expected technique during interpolation DWT close study enhancement resolution enhancement techniques[7]. The PSNR alteration of the expected technique commit 14 dB ,MSE decreased up to 40 %compared mutually the hand operated interpolation _DWT technique This field is above all preferred for low resolution images notwithstanding they study enhancement yield to an arm and a leg resolution images as well as The brightness and accuracy of enhancement will be more for soft resolution images when compared with valuable resolution images.

Acknowledgement

We sincerely thank to ECE, HOD Mr. K.Suresh Reddy, project co-ordinator Mr. Sudheer Babu, Associate Professor,GPREC and the staff members of ECE department. And special thank Digital Library staff and all who helped us to make this paper successful.

References

[1] Vasileios Syrris, Stefano Ferri, Daniele Ehrlich, and Martino Pesaresi," Image Enhancement and Feature Extraction Based on Low-Resolution Satellite Data"IEEE Journal Of Selected Topics In Applied Earth Observations And Remote Sensing, Vol. 8, No. 5, May 2015

[2] H. Demirel, C. Ozcinar, and G. Anbarjafari, "Satellite image contrast enhancement using discrete wavelet transform and singular value decomposition," IEEE Geosci. Remote Sens. Lett., vol. 7, no. 2, pp. 333–337,Apr. 2010.

[3] G. Srilekha, V. K. Kumar, and B. Jyothi, "***Satellite image resolutionenhancement using DWT and contrast enhancement using SVD***," Int. J.Eng. Res. Technol. (IJERT), vol. 2, no. 5, pp. 1227–1230, May 2013.

[4] Hasan Demirel and Gholamreza Anbarjafari, "IMAGE Resolution Enhancement by Using Discrete and Stationary Wavelet Decomposition" IEEE transactions on IMAGE PROCESSING,VOL. 20, NO.5.

[5] H. Demirel and G. Anbarjafari, "Satellite image resolution enhancement using complex wavelet transform," *IEEE Geosciences and Remote SensingLetter*, vol. 7, no. 1, pp. 123–126, Jan. 2010.

[6] [4] Y. Piao, I. Shin, and H. W. Park, "Image resolution enhancement using inter-sub-band correlation in wavelet domain," in Proc. Int. Conf. Image Process., 2007, vol. 1, pp. I-445–448.

[7] Demirel, G. Anbarjafari, and S. Izadpanahi, "Improved motion based localized super resolution technique using discrete wavelet transform for low resolution video enhancement," in Proc. 17th EUSIPCO, Edinburgh, U.K., Aug. 2009, pp. 1097–1101.

[8] Y. Piao, L. Shin, and H. W. Park, "Image resolution enhancement using inter-sub band correlation in wavelet domain," in Proc. IEEE ICIP, 2007, vol. 1, pp. I-445–I-448.

[9] Mahesh M and Venkata Srinu. M,―Low-Resolution satellite image enhancement using DT-CWT & SVD ― in International Journal of Advanced Research in Electronics and Communication Engineering (IJARECE) , October 2012 , Volume 1, Issue 4, pp. 40-45.

[10] Hasanul Kabir , and Abdullah Al-Wadud , and Oksam Chae ,"Brightness Preserving Image Contrast Enhancement Using Weighted Mixture of Global and Local Transformation Functions" in The International Arab Journal of Information Technology, October 2010 , Vol. 7, No. 4, pp. 403-410.

[11] K.Narasimhan, V.Elamaran, Saurav Kumar, Kundan Sharma and Pogaku Raghavendra Abhishek,‖ Comparison of Satellite Image Enhancement Techniques in Wavelet Domain‖ in Research Journalof Applied Sciences, Engineering and Technology,2012, pp.1-5

[12] F. Y. Shih, *Image Processing and Pattern Recognition-Fundamentals and Techniques*. Hoboken, NJ, USA: Wiley, 2010.

[13] R. C. Gonzalez and R. E. Woods, *Digital Image Processing*, 2nd ed.Englewood Cliffs, NJ, USA: Prentice Hall, 2002.