[More* *et al.*, 5(8): August, 2016]
IC™ Value: 3.00

ISSN: 2277-9655
Impact Factor: 4.116

IJESRT

INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

IMAGE RESOLUTION ENHANCEMENT USING WAVELET DECOMPOSITION

Miss. Shital G. More*, Prof. L. K. Chouthmol

* Electronics and Telecommunication, Sapkal Knowledge Hub College of Engineering, Nashik,India

DOI: 10.5281/zenodo.59671

ABSTRACT

Satellite images are being used in many fields of research. One of the major issues of these types of images is theirresolution.In this correspondence, I propose an image resolution enhancement technique based on interpolation of the high frequency subband images obtained by discrete wavelet transform (DWT) and the input image. The edges are enhanced by introducing an intermediate stage by using stationary wavelet transform (SWT). DWT is applied in order to decompose an input image into different subbands. Then the high frequency subbands as well as the input image are interpolated. The estimated high frequency subbands are being modified using high frequency subbands obtained through SWT. Then all these subbands are combined to generate a new high resolution image using inverse DWT (IDWT). The quantitative and visual results are showing the superiority of the proposed technique over the conventional and state-of-art image resolution enhancement techniques.

KEYWORDS: Discrete wavelet transform (DWT), Sationary Wavelet transform (SWT), interpolation, satellite image resolution enhancement, wavelet zero padding (WZP).

INTRODUCTION

RESOLUTION of an image has been always an important issue in many image- and video-processing applications, such as video resolution enhancement [2], feature extraction [3], and satellite image resolution enhancement [4]. Interpolation in image processing is a method to increase the number of pixels in a digital image. Interpolation has been widely used in many image processing applications, such as facial reconstruction [5], multiple description coding , and image resolution enhancement . The interpolation-based image resolution enhancement has been used for a long time and many interpolation techniques have been developed to increase the quality of this task. There are three well-known interpolation techniques, namely, nearest neighbor, bilinear, and bicubic. Bicubic interpolation is more sophisticated than the other two techniques and produces smoother edges.

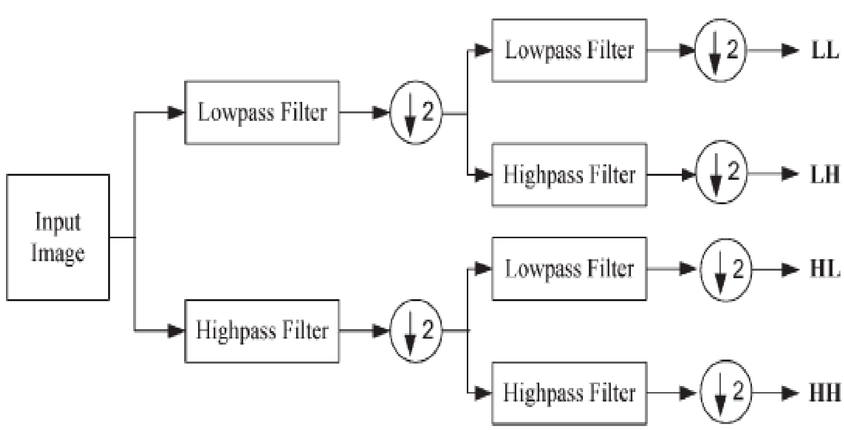


Fig. 1.1. Block diagram of DWT filter banks of level 1.

Fig.1. 2. LL, LH, HL, and HH subbands of a satellite image obtained by using DWT.

Wavelets are also playing a significant role in many imageprocessing applications. The 2-D wavelet decomposition of an image is performed by applying the 1-D discrete wavelettransform (DWT) along the rows of the image first, and the results are decomposed along the columns. This operation results in four decomposed subband images referred to lowlow (LL), low-high (LH), high-low (HL), and high-high (HH). The frequency components of those subbands cover the fullfrequency spectrum of the original image. Theoretically, a filter bank shown in Fig. 1.1 should operate on the image in order to generate different subband frequency images. Fig. 2 shows different subbands of a satellite image where the top left image is the LL subband, and the bottom right image is the HH subband. Image resolution enhancement using wavelets is a relatively new subject and recently many new algorithms have been proposed . Carey *et al.* have attempted to estimate the unknown details of wavelet coefficients in an effort to improve the sharpness of the reconstructed images . Their estimation was carried out by investigating the evolution of wavelet transform extrema among the same type of subbands. Edges identified by an edge detection algorithm in lower frequency subbands were used to prepare a model for estimating edges in higher frequency subbands and only the coefficients with significant values were estimated as the evolution of the wavelet coefficients. In many researches, hidden Markov has been also implemented in order to estimate the coefficients.

Propose a resolution-enhancement technique using interpolated DWT high-frequency subband 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,propose to use an intermediate stage for estimating the high frequency subbands by utilizing the difference image obtained by subtracting the input image and its interpolated LL subband. The proposed technique has been compared with standard interpolation techniques, wavelet zero padding (WZP), where the unknown coefficients in high-frequency subbands are replaced with zeros, and state-of-art techniques, such as WZP and cyclespinning (CS) , and previously introduced complex wavelet transform (CWT)-based image resolution enhancement [4]. It is necessary to recall that in this paper the resolution enhancement is used as a process that enlarges the given input in the way that the output is sharper. The performance of the proposed technique over performs all available state-of-art methods for image resolution enhancement. The visual and quantitative results are given in the results and discussions section. In all steps of the proposed satellite image resolution enhancement technique, Daubechies (db.7) wavelet transform as mother wavelet function and bicubic interpolation as interpolation technique have been used.

[More* *et al.*, 5(8): August, 2016] ISSN: 2277-9655
IC™ Value: 3.00 Impact Factor: 4.116

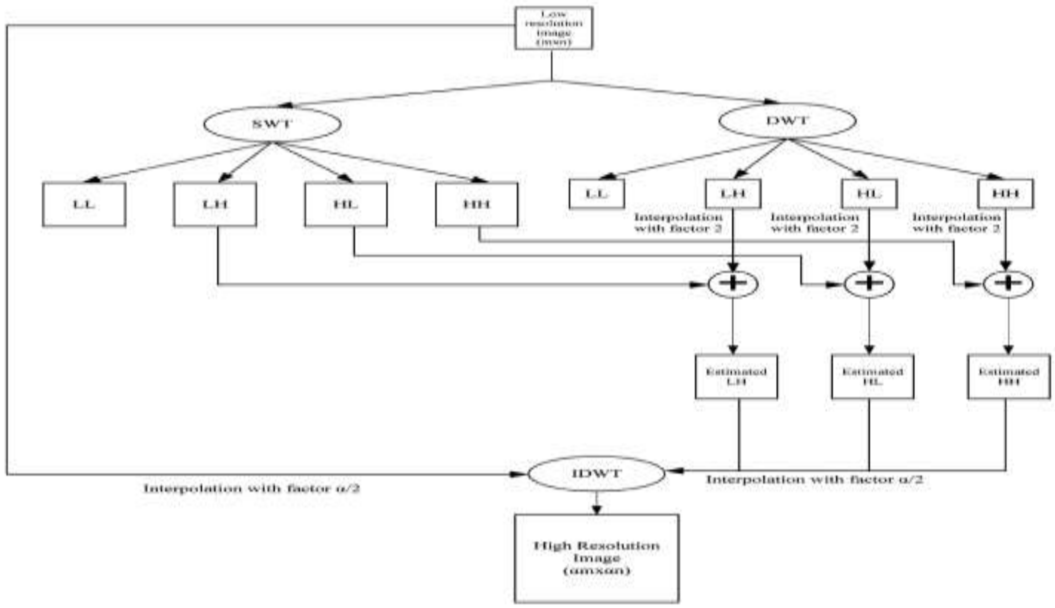


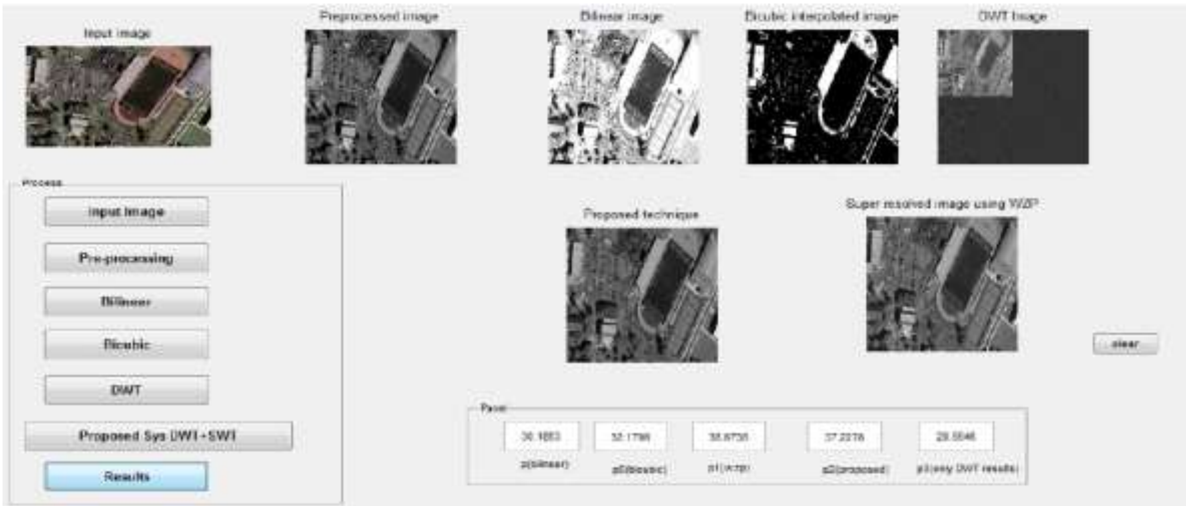
Fig. 2.1. Block diagram of the proposed resolution enhancement algorithm.

Satellite images are being used in many fields of research. One of the major issues of these types of images is their resolution. In this work, image resolution technique based on interpolation. In interpolation the bicubic, bilinear and wavelet zero padding techniques used. In this correspondence, Propose an image resolution enhancement technique based on interpolation of the high frequency sub band images obtained by discrete wavelet transform (DWT) and the input image. The edges are enhanced by introducing an intermediate stage by using stationary wavelet transform (SWT). DWT is applied in order to decompose an input image into different sub bands. Then the high frequency sub bands as well as the input image are interpolated. The estimated high frequency sub bands are being modified using high frequency sub bands obtained through SWT. Then all these sub bands are combined to generate a new high resolution image using inverse DWT (IDWT). The quantitative and visual results are showing the superiority of the proposed technique over the conventional and state-of-art image resolution enhancement techniques. Resolution of an image has been always an important issue in many image and video processing applications, such as video resolution enhancement, feature extraction, and satellite image resolution enhancement. Interpolation in image processing is a method to increase the number of pixels in a digital image. Interpolation has been widely used in many image processing applications, such as facial reconstruction. Resolution enhancement is always being associated with the interpolation techniques. Interpolation methods increase the intensity of low frequency components.In image resolution enhancement by using interpolation the main loss is on its high frequency components (i.e., edges), which is due to the smoothing caused by interpolation. In order to increase the quality of the super resolved image, preserving the edges is essential. In this work, DWT has been employed in order to preserve the high frequency components of the image redundancy and shift invariance of the DWT mean that DWT coefficients are inherently interpolable . In this correspondence, one level DWT (with Daubechies 7 as wavelet function) is used to decompose an input image into different subband images. Three high frequency subbands (LH, HL, and HH) contain the high frequency components of the input image. In the proposed technique, bicubic interpolation with enlargement factor of 2 is applied to high frequency subband images. Downsampling in each of the DWT subbands causes information loss in the respective subbands. That is why SWT is employed to minimize this loss. The interpolated high frequency subbands and the SWT high frequency subbands have the same size which means they can be added with each other. The new corrected high frequency subbands can be interpolated further for higher enlargement.

[More* *et al.*, 5(8): August, 2016]
IC™ Value: 3.00

ISSN: 2277-9655
Impact Factor: 4.116

RESULTS AND DISCUSSION



After processing that is preprocessing, bilinear, bicubic, DWT super resolved image and DWT+SWT image display and calculated diferent parameter EN, PSNR and RMSE.

Formulae:

$$EN = -\sum_{i=0}^{n-1} Pilog_{10}Pi \qquad \text{…(1)}$$

$$MSE = \frac{1}{MxN}\sum_{i,j}[Y(i,j) - Y^{'}(i,j)]^2 \qquad \text{…(2)}$$

$$RMSE = \sqrt{\frac{1}{MxN}\sum_{i,j}[Y(i,j) - Y^{'}(i,j)]^2} \qquad \text{…(3)}$$

$$PSNR = 10log10[\frac{255^2}{MSE}] \qquad \text{…(4)}$$

CONCLUSION

Satellite image resolution enhancement technique based on the interpolationof the high-frequency sub band images obtained by DWT and the input image. The proposed technique uses DWT+SWT to decompose an image into diferentsub band images, and then the high-frequency sub band images are interpolated. An original image is interpolated with half of the interpolation factor used for interpolation of the high-frequency sub band images. Afterward, all these images are combined using DWT+SWT to generate a super resolved image. The proposed technique has been tested on several satellite images, where their PSNR and visual results show the superiority of the proposed technique over the conventional andstate-of-the-art image resolution enhancement techniques.

ACKNOWLEDGEMENTS
With all respect and gratitude, I am personally indebted all people who have helped me directly or indirectly for this seminar. I take this opportunity to express my heart-felt gratitude towards my guide Prof. L.K.Chouthmoland Head of Department, Prof. (Dr.) S. B. Bagal , for their constant encouragement, wonderful technical guidance and support throughout the course. I express my sincere gratitude to Principal Prof. (Dr.) Vitthal J. Gond and M.E.Co-ordinator Prof. S. B. Borsefor their continuous support. I would like to great pleasure all teaching and non-teaching sta_ of Electronics and Telecommunication Department for their kind co-operation and guidance for preparing and presenting this seminar work. I would like to give my deepest gratitude towards my parents and friends without them it would have not possible.

REFERENCES
[1] Demirel,G. Anbarjafari and S.Izadpanahi, "Improved motion based localized super resolution technique using deiscrete wavelet transformfor low resolution video enhancement ,"in proc.17thEUSIPCO,Edinburgh ,pp.1097-1101U.K.,Aug.2009.
[2] HasanDemirel and GholamrezaAnbarjafari, "Satellite Image Resolution Enhancement UsingComplex Wavelet Transform,"IEEEGeosci.Remote Sens.Lett.,vol.7,no. 1,pp.123-126,Jan 2010.
[3] W.K. Carey,D.B.Chuang and S.S.Hemami, "Regularity-preserving image interpolation,"IEEE Trans. Image process.,vol.8,no.9,pp.1295-1297,sep 1999.
[4] A.Gambardella and M.Migliaccio, "On the superresoltuion of microwave scanning radiometer measurement,"IEEEGeosci.Remote Sens.Lett.,vol.5,no.4,pp.796-800,oct.2008.
[5] V.A.Tolpekin and a.stein ,"Quantification of the effect of land cover class specralseparabilty on the accuracy of markowrandam field bsedsuperresolutuionmapping,"IEEEtrans.Geosci.Remote Sens., vol 47,no.9,pp.3283-3297,sep.2009.
[6] A.Temizel and T. Vlachos "Wavelet domain image resolution enhancement using cycle-spinning," Electron .Lett., vol.41. no.3, pp.119-121, Feb.3, 2005.
[7] A.Temizel, "Image resolution enhancement using wavelet domain hidden markow tree and coefficient sign estimation", In proc. ICIP, vol.5, pp.V-381-V-3842007.
[8] A. Temizel and T. Vlachos "Image resolution enhancement upscaling in the wavelet domain using directional cycle spinning", J. Electron. Imaging, vol.14, no.4, p.040501, 2005.
[9] Y.piao,L.Shin, and H.W.Park," image resolution enhancement using inter-subband Correlation in wavelet domain,"inproc.IEEE ICIP VOL. 1,PP.I-445-I-448,2007.
[10] Ryan S. Prendergast and Truong Q. Nguyen, "a block-based super-resolution for video sequences",IEEE ICIP PP.1240-1243, 2008
[11] Marco Cagnazzo, WidedMiled, Thomas Maugey, B´eatricePesquet-Popescu,"image interpolation with edge-preserving differential motion",IEEE ICIP PP-361-364,2009.
[12] TurgayCelik and TardiTjahjadi, "Image Resolution Enhancement Using Dual-Tree Complex Wavelet Transform", IEEE geoscience and remote sensing letters, vol. 7, no. 3, july 2010.
[13] S. Zhao, H. Han, and S. Peng, "Wavelet domain HMT-based imagesuper resolution," in Proc. IEEE Int. Conf. Image Process., ,vol. 2, pp. 933–936 Sep. 2003.
[14] K. Kinebuchi, D. D. Muresan, and R. G. Baraniuk, "Waveletbased statistical signal processing using hidden Markov models,"inProc. Int. Conf. Acoust., Speech, Signal Process., , vol. 3, pp. 7–11 2001.
[15] Daubechies, I."The wavelet transform, time-frequency localization and signal analysis",IEEE Transformation and Information Theory 36: 961-1005, 1990.
[16] X. Li and M. T. Orchard, "New edge-directed interpolation," IEEE Trans. Image Process., vol. 10, no. 10, pp. 1521–1527, Oct. 2001.