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Image Resolution Enhancement Using Discrete Wavelet Transform (DWT)

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Abstract-Images are being used in many fields of research. Resolution is the major issue of the images. The Image Enhancement is the main technique for improving the resolution and visual appearance of the image. A Resolution Enhancement technique is based on the Interpolation of the high-frequency sub bands obtained by Discrete Wavelet Transforms (DWT). Then, the high-frequency sub band images and the input low-resolution image are interpolated .Then all these images are combined and a new resolution image is formed by passing through inverse DWT. DWT preserves the high frequency components which helps to get a more sharper image.
Keywords-Discrete wavelet transform; Image resolution, Enhancement; Interpolation; Inverse discrete wavelet transform (IDWT).

I. INTRODUCTION

In many image processing application and video processing application image resolution enhancement plays a key role [1]. Interpolation is a process of increasing the number of pixel in a digital image. Interpolation is the basic method of image resolution enhancement and has been widely used in many image processing applications, such as facial reconstruction, and image resolution enhancement.

There are three interpolation techniques, namely, nearest neighbor, bilinear, and bicubic. Bicubic interpolation is more distilled than the other two methods and produces smoother edges. Wavelets are also playing a important role in many image processing applications. This operation results in four decomposed sub band images referred to low-low (LL), low-high (LH), high-low (HL), and high-high (HH).

II. LITERATURE REVIEW

There are several methods which have been used for satellite image resolution enhancement. The first one is WZP and CS, and the second one is the CWT-based image resolution enhancement.

2.1 Cycle-Spinning(CS) Based Image Resolution Enhancement

This method adopts the CS methodology in the wavelet domain. And in this methodology unknown coefficients in high-frequency subbands are replaced with zeros, using specific technology such as WZP and cycle-spinning(CS). The algorithm consists of two main steps as follows:

1) An initial approximation to the unknown high resolution image is generated using wavelet domain zero padding (WZP).

2) The cycle-spinning methodology is adopted to operate the following tasks:

- A number of low resolution images are generated from the obtained estimated high resolution image by spatial shifting, wavelet transforming, and discarding the high frequency subbands.
- The WZP processing is applied to all those low resolution images yielding N high resolution images.
- These intermediated high resolution images are realign and averaged to give the final high resolution reconstructed image.

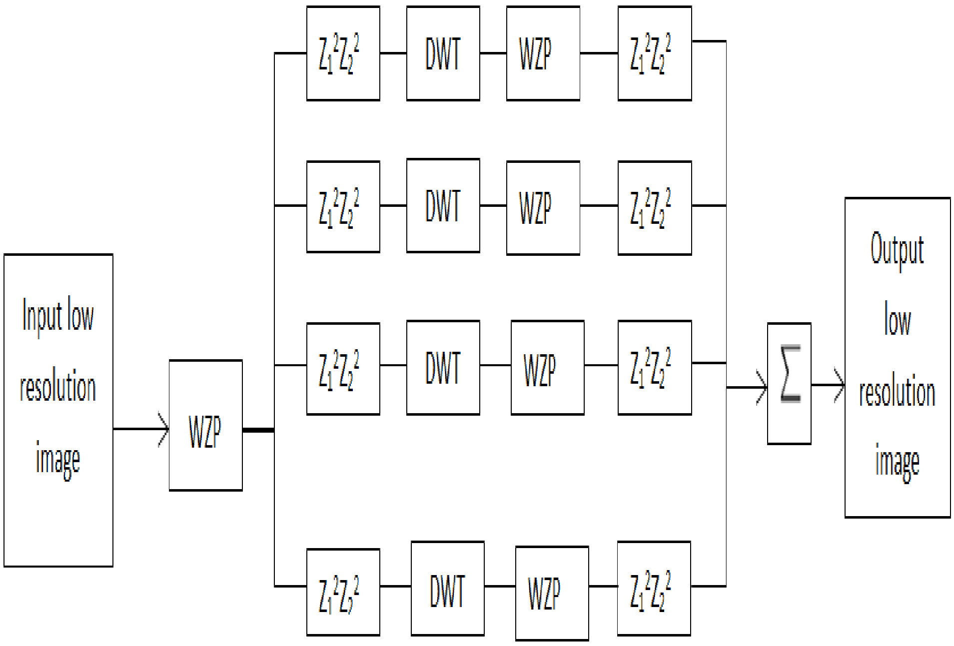

Figure 1 Literature Review

2.2 CWT-Based Image Resolution Enhancement:

In this technique, dual-tree CWT (DT-CWT) is used to decompose an input image into different subband images. DT-CWT is used to decompose an input low resolution image into different subbands. Then, the high-frequency subband images and the input image are interpolated, followed by combining all these images to generate a new high-resolution image by using inverse DT-CWT. The resolution enhancement is achieved by using directional selectivity provided by the CWT, where the high-frequency subbands in six different directions contribute to the sharpness of the high-frequency details, such as edges of this technique are shown in Fig 4 , where the enlargement factor through the resolution enhancement is α.

III. SYSTEM ARCHITECTURE

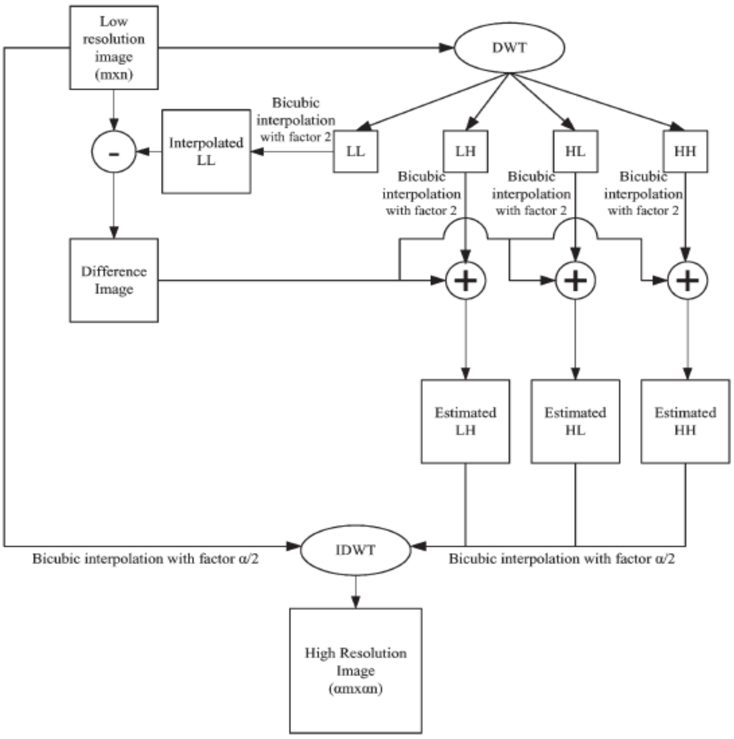

Figure 2 Block diagram of the proposed resolution enhancement algorithm.

To overcome the edge & high frequency losses in above techniques, we have used new resolution enhancement technique which combines DWT, Difference Image, interpolation & Inverse DWT.

The fig 2. Shows block diagram of the resolution enhancement technique. The main blocks present in these techniques are

i) Original low Resolution image
iii) Discrete wavelet transform
iv) Difference Image
v) Interpolation of added sub-bands & input image
vi) Inverse DWT.
vii) High resolution image

IV.METHODOLOGY

In these technique first low resolution image is taken. Low resolution image is passed through discrete wavelet transform DWT. In this technique, DWT [1] has been employed in order to preserve the high-frequency components of the image. DWT is used to decompose an input image into different sub-band images, namely, LL, LH, HL, and HH. [4] Three high frequency sub-bands (LH, HL, and HH) contain the high frequency components of the input image. Bi-cubic interpolation with enlargement factor of 2 is applied to high frequency sub-band images. The low-resolution input satellite image and the interpolated LL image with factor 2 are highly correlated. The difference between the LL subband image and the low-resolution input image are in their high-frequency components. Hence, this difference image can be used in the intermediate process to correct the estimated high-frequency components. The interpolated high frequency sub-bands of DWT and the difference Image they can be added with each other. This estimation is performed by interpolating the high-frequency subbands by factor 2 and then including the difference image (which is high-frequency components on low-resolution input image) into the estimated high-frequency images, followed by another interpolation with factor $\alpha/2$ in order to reach the required size for IDWT process. The intermediate process of adding the difference image, containing high-frequency components, generates significantly sharper and clearer final image. This sharpness is boosted by the fact that, the interpolation of isolated high-frequency components in HH, HL, and LH will preserve more high-frequency components than interpolating the low-resolution image directly.

Algorithm for image resolution enhancement using DWT

The following algorithm used for image resolution enhancement using DWT.

1. Take low resolution image as input.
2. Perform DWT (Refer algorithm for DWT).
3. Take LL subband of output image and perform bicubic interpolation with factor 2 on it.
4. Calculate difference image.
5. On subbands LH, HL, HH calculate interpolated image.
6. Merge all subbands.
7. Perform IDWT on all subbands.
8. Output will be high resolution image.

DWT algorithm:

1. Take input image.
2. For each pixel perform scaling and store it in three arrays named as red ,green and blue
3. For each scaled value perform binary shifting
4. For all shifted value again perform scaling
5. Output image will be DWT image.

VI. RESULT

The proposed technique has been tested on several different images. In order to show the superiority of the proposed method over the conventional and state-of-art techniques from visual point of view Figs. are included. Low-resolution images, the enhanced images by using bicubic interpolation, enhanced images by using WZPand CS-based image resolution enhancement, and also the enhanced images obtained by the proposed technique are shown. It is clear that the resultant image, enhanced by using the proposed technique, is sharper than the other techniques.

CONCLUSION

This paper introduces a resolution enhancement technique based on the interpolation of the high-frequency subband images obtained by DWT and the input image. We presented a model for enhancing the image resolution using DWT .The PSNR and RMSE and visual results shows the superiority of the proposed technique over the conventional and state-of-art image resolution enhancement techniques .The PSNR improvement of the proposed technique is up to7.19 dB compared with the standard bicubic interpolation.

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REFERENCES

[1] H. Demirel and G. Anbarjafari, "Discrete Wavelet Tranform – Based Satellite image resolution Enhancement," In *proc. Of IEEE Transactions on Geosci. And Remote Sensing,* vol. 49, no. 6, pp.234-239,June 2011.

[2] A. Temizel and T. Vlachos, "Image resolution up scaling in the wavelet domain using directional cycle spinning," *J. Electron. Imaging*, vol. 14, no. 4, p. 040501, 2005.

[3] H. Demirel and G. Anbarjafari, "Satellite image resolution enhancement using complex wavelet transform," In *proc. Of IEEE Geosci. Remote Sens. Lett.,*vol. 7, no. 1, pp. 123–126, Jan. 2010.

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

[5] H. 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., pp. 1097–1101,Aug. 2009.