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An Efficient Technique Using Discrete and Stationary Wavelet Transform for Image Resolution Enhancement

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***Abstract* - As the resolution is important factor of the image which holds the details of image. The term resolution is generally used for a pixel count in the imaging. The quality of the image is increased by preserving the edges. Therefore, this work proposes image resolution enhancement technique based on interpolation. Interpolation is widely used in many applications. By the discrete wavelet transform high frequency components are obtained. Interpolation is done with the help of input image. Stationary wavelet transform used to enhance the image whereas, discrete wavelet transform used to decompose an input image into different subbands. After that high frequency subbands and input image are interpolated. Then Inverse discrete wavelet transform gives a new high resolution image. The proposed technique gives better results as compared to conventional technique. Instead of low frequency bands the proposed technique uses input image which increases quality of the super resolved image. Peak signal to noise ratio is used to measure image quality. The original and reconstructed images are indistinguishable by human observations when PSNR is greater than 40dB. The proposed technique will be compared with other enhancement techniques that are bi-linear interpolation and bi-cubic interpolation .Bi-linear interpolation uses the two grid points closest to the selected interpolation location and takes the weighted average to arrive at the interpolated value. In Bi-cubic interpolation, first the position of each pixel in the output map is determined; then the values of 16 surrounding pixels of the input map are used to calculate an interpolated value for each pixel in the output map. The test images used are Lena, Elaine, Baboon and Pepper.**

***KeyWords:* Interpolation,discrete wavelet transform and stationary wavelet transform**

1. INTRODUCTION

Most of the times high frequency components in interpolation are lost. So that discrete wavelet transform is done in order to preserve the high frequency components. Image resolution enhancement is new subject and there are many algorithms have been proposed. The coefficients of DWT are interpolable. Image is decomposed by discrete wavelet transform in three sub-bands. Here the interpolation used is Bi-cubic interpolation.

Sharper images are generated in proposed resolution technique. Discrete wavelet transform [1] is used to decompose a low resolution image into different sub-bands. Then bi-cubic interpolation is done on three high frequency sub-bands which are obtained by Stationary wavelet decomposition. Input image is also interpolated here. Then interpolated high frequency sub-bands and interpolated input image are combined using Inverse Discrete Wavelet De-composition (IDWT). Finally this technique is compared with bi-linear interpolation and bi-cubic interpolation.

Following are the various techniques that can be used for comparison purpose:

-regularly preserving image interpolation [2];
-new edge-directed interpolation [3];
-hidden markov model [4];
-DWT based super resolution [5].

2. IMAGE RESOLUTION ENHANCEMENT

The purpose of image resolution enhancement is to generate sharper high resolution images. There are four sub-bands namely low-low (LL), low-high (LH), high-low (HL), high-high (HH). These sub-bands are decomposed by discrete wavelet transform. The stationary wavelet transform (SWT) is also one of the widely used wavelet transform technique, which is same as discrete wavelet transform but down sampling is not used in SWT. One level DWT is for decomposition. The decomposed sub-bands (LH, HL, and HH) are having high frequency components of input image.

Bi-cubic interpolation is applied on the high frequency sub-bands. SWT gives minimum loss in respective bands. The low frequency sub-bands contains less information than original image, so that for the interpolation original image is used instead of low frequency sub-bands.

The block diagram of image resolution enhancement technique is illustrated in Fig.1. Inverse discrete wavelet transform is used after the interpolation of the input image by the factor $\alpha/2$, the output image will contain sharper edges than direct interpolation of input image.

Using the proposed technique, the resolution of test image Baboon is shown in fig. 2.

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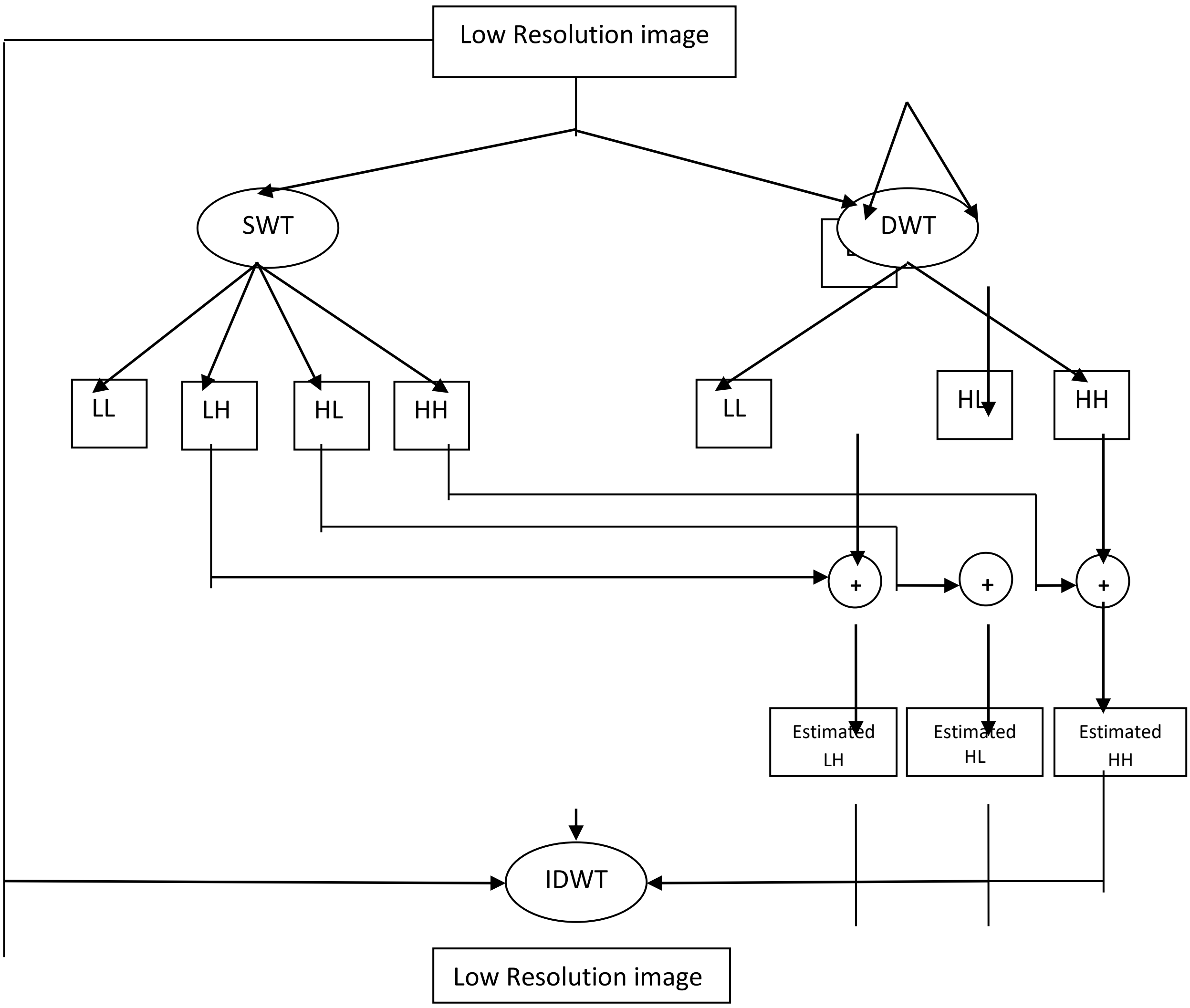

Fig.1. Block diagram of enhancement technique

Fig. 2(d) shows output image which is a super resolved image obtained by proposed technique. The proposed technique is compared by using test images Lena, Baboon, Elaine, and Peppers with the help of comparison parameter Peak Signal to Noise Ratio (PSNR). Basically there are two conventional techniques of interpolation those are Bi-Cubic and Bi-Linear Interpolation.

The other resolution enhancement techniques are Regularity preserving image, New edge directed interpolation, Hidden Markov model, HMM based image super resolution, WZP, CS and edge rectification, DWT based duper resolution, Complex wavelet transform based super resolution.

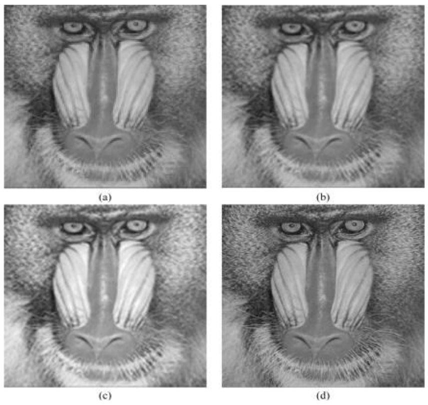

Fig 2. a)Original input image. b) Bi-cubic interpolation c) super resolved image using WZP d) proposed technique

CONCLUSION

In the proposed technique, a low resolution input image is interpolated with the help of high frequency subbands. The discrete wavelet decomposition gives four sub-bands out of that estimation of three high frequency sub-bands is done. Low frequency sub-band is neglected because it is having less information of the input image. Stationary wavelet decomposition is same as discrete wavelet decomposition only difference is that SWT does not gives down sampling. After that low resolution input image and estimated three frequency bands are applied to Inverse discrete wavelet decomposition to get high resolution output image. The proposed technique will be compared with other enhancement techniques that are bi-linear interpolation and bi-cubic interpolation. The proposed technique is compared by using test images Lena, Baboon, Elaine, and Peppers with the help of comparison parameter Peak Signal to Noise Ratio (PSNR). Visual results shows proposed technique gives superior image quality than conventional resolution enhancement techniques.

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