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Image Resolution Enhancement using DWT and Edge Extraction

M.Sangeetha
Research Scholar, Computer centre
Alagappa University
Karaikudi

Dr.A.Senthilrajan
Director,Computer Centre
Alagappa University
Karaikudi

Abstract - Image resolution enhancement is a method to improve the quality of an image and it is a preprocess step for various image processing applications. This paper presents a technique to improve the resolution of the low quality images. In the proposed method Discrete wavelet transform (DWT) is used to decompose the input image in to different subbands. To further capture the high frequency details from the high frequency subbandsHaar wavelet transform is used. Edges are extracted from the sub-images to preserve the edge detail effectively. Then the High frequency subbands are interpolated. Finally inverse Haar and inverse DWT is performed to get high resolution image.

Keywords—Discrete wavelet transform (DWT), Edge detection, Haar wavelet transform

I. Introduction

Image resolution reconstruction is an important aspect in digital image processing for variety of applications such as remote sensing, surveillance, pattern recognition etc. It is a process of generating high resolution image from one or more low resolution image. To increase the resolution of an image is to increase the number of pixels per unit area in an image. Due to the limitations in hardware based approaches and the cost of high precision optics and image sensors algorithmicbased approaches are commonly desired.

Image reconstruction algorithms can be classified in to reconstruction based, learning based and interpolation based approaches.[1]Reconstruction based methods usually assume some degraded models and solve the inverse problems to obtain the high resolution (HR) images. But it performs well only under smaller magnification factor. Because of the limited information contained in one single low resolution image (LR), these approaches need to impose strong priors or constraints to regulate the ill posed inverse problem. Learning based methods learn the relationship between LR-HR patch pairs to recover the high frequency (HF) details and well suited for larger magnification factor. But it

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heavily depend on training data set therefore it is only suitable for images whose training data set is available. Interpolation basedmodels such as nearestneighbor and bilinearinterpolationare commonly used. The computation is less but produce jagged edges.Bicubic interpolation is efficient results in sharper images and has fewer artifacts.

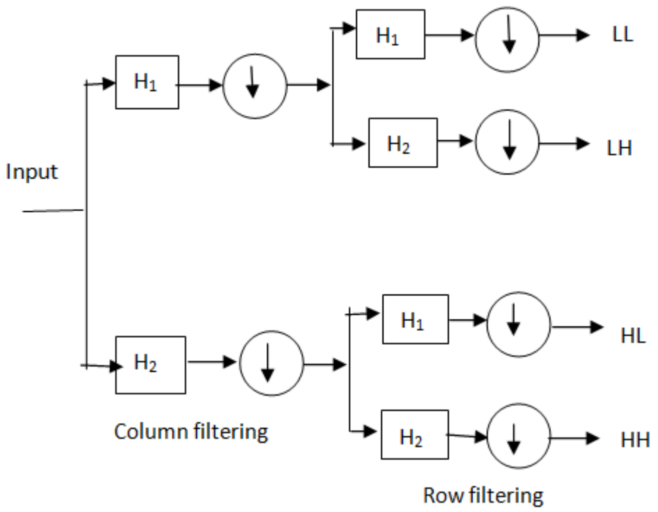
Proposed DWT and SWT [2] based resolution technique. DWT is performed to get the high frequency image details and subsequently SWT is also used to correct the estimated coefficients .The resultant high frequency subbands obtained from SWT is added with the corresponding subbands of DWT.The inverse DWT transform produces the high frequency image.

Proposed a [3] combination of wavelet transform and interpolation based method. It exhibits high PSNR value compared with other popular algorithms.[4] Kim and min proposed DWT and Haar transform to decompose medical images and the edge details are extracted from the input image to enhance the edges of the resultant high resolution image. This method produces satisfactory results. [5] LWT and SWT based resolution enhancement algorithm to get the high frequency images and shows high PSNR value compared to DWT&SWT based and bilinear methods.

In this paper a method to increase the resolution of an image to generate high resolution image is given. The proposed method uses discrete wavelet transform (DWT) to decompose the input image into different subbands. The high frequency (HF) subbands are further decomposed by Haartransform. Finally all the subbands are interpolated.

II. Discrete Wavelet Transform

The imaging applications [4] from a wavelet point of view include imagematching,segmentation, denoising, restoration, enhancement, compression, and other medical image technologies, etc. Wavelets allow complex information such asmusic,speech,images,andpatterns to be decomposed into elementary forms at different positions and scales and subsequently reconstructed with high precision.The DWT has been introduced as a highly efficient and flexible
method for sub band decomposition of signals.[6]The 2-D DWToperates in a straight forward manner by inserting array



Decomposition Analysis

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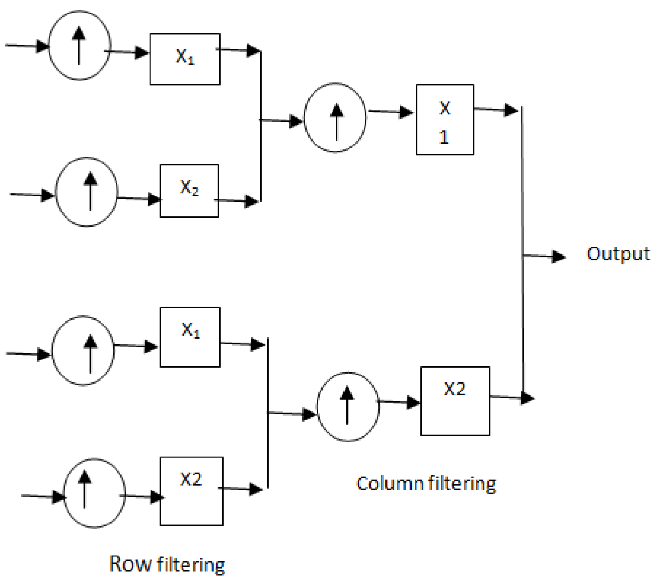

Reconstruction Synthesis

Figure1 Discrete Wavelet transform

transposition between the two 1-D DWT. The rows of the array are processed first with only one level of decomposition. This essentially divides the array into two vertical halves, with the first half storing the average coefficients, while the second vertical half stores the detail coefficients. This process is repeated again with the columns, resulting in four sub-bands within the array defined by filter output. The DWT is shown in fig 1.

I. Proposed Algorithm

In image resolution [2] enhancement by using interpolation the main loss is on its high frequency (HF) 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 the proposed method the input image is decomposed by one level discrete wavelet transform into different frequencysubbands. The wavelet domain provides a way for analyzing waveforms in both frequency and time. The DWT is usedto preserve the HF details of the input image. Moreover the HF subbandsof the DWT transform is further decomposed by Haartransform. An algorithm is proposed to extract the edge information from the HF sub images obtained by haartransform. In order to preserve the edge details, the edges of the HF subbands are extracted. The interpolated image is smoother than the original image. Therefore the edges get blurred. The boundaries of an object generate edge which needs to be captured.The block diagram of the proposedalgorithm is shown in fig 2.

Edges can exist in four directions horizontal, vertical and in diagonal directions. The mask valueis calculated for all the directions. Then the four kernels are applied for all the high frequency sub images.

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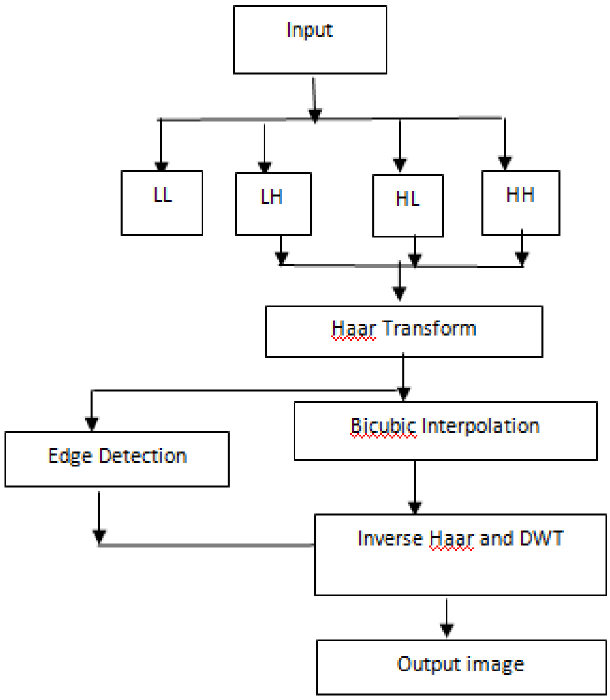

Figure 2 Block diagram of the proposed algorithm

A single fixed threshold value is calculated from observing set of images edge maps to produce suitable edge maps for the given image. The edges are thinned to suppress the thick edges.

Each subband is interpolated via bicubic interpolation. Finally the edge information is fused with the interpolated subbands. The inverse haar and inverse discrete wavelet transform is performed to reconstruct the high resolution image with sharper edges.

II. Conclusion

In this paper image resolution reconstruction method based on discrete wavelet transform and haar transform to obtain high frequency subbands has been proposed. The haar transform to decompose the HF subbandsis to reduce to a small subset of coefficients. The edges are extracted as an intermediate stage to preserve the edge details. The HF subbands are then interpolated. The Edge map is added with the interpolated image. The high resolution is produced through inverse haar and DWT transform.

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