Overview of techniques used for image resolution enhancement

Mayuri D Patil
Department of Computer Science Engineering
Technocrats Institute of Technology, Rajiv Gandhi Prodyogiki Vishwavidyalay
Bhopal (M.P.), India
mayuri24588@gmail.com,

Prof. Surbhi Khare
Department of Computer Science Engineering
Technocrats Institute of Technology, Rajiv Gandhi Prodyogiki Vishwavidyalay,
Bhopal (M.P.), India
surbhi.khare@gmail.com

***Abstract*—Image resolution enhancement is one of the first steps in image processing. Image resolution enhancement is the process of manipulating an image so that resultant image is more suitable than the original one for specific application. Image enhancement can be done in various domains. For image resolution enhancement there are many methods, out of which image interpolation scheme is one of the most effective method. However, resolution is vital aspect of any image. Good quality image i.e. high resolution image produces better result in image processing applications. An interpolation is the technique to increase the resolution of the image by selecting new pixel from surrounding one. Image interpolation in complex wavelet transform is produces better results for any imaging application. DTCWT technique is used to improve the resolution of any satellite image. The paper focuses on the different techniques that are used to increase resolution of the images and their comparative results.**

***Keywords*- DTCWT**

I. INTRODUCTION

In the recent years there is increased in the demand for better quality images in the various applications such as medical, astronomy, object recognition. Image resolution enhancement is also widely useful for satellite image applications which include building construction, bridge recognition, in GPS technique. For image enhancement process there are two domains has been taken into consideration one is image domain and transform domain. Transform domain determine which transformations used in the enhancement.

Image interpolation is widely used resolution enhancement method for various applications. Image interpolation is the process of using known data to estimate values at unknown locations. Interpolation method select new pixel from surrounding pixels. Mainly there are two types of interpolation algorithms

1. Adaptive algorithms-these algorithms changes depending on what they are interpolating.
2. Non adaptive algorithms- include linear interpolation algorithms.

Linear interpolation includes nearest neighbour, bilinear, Bicubic interpolation. But images obtained by these linear interpolation technique produces many artifacts like blurring, blocking etc. To avoid these problems non linear interpolation algorithms are used for resolution enhancement. Computational problem is increase as interpolating factor is increases. Transform domain determine which transformations used in the enhancement. Transform theory plays a fundamental role in image processing, as working with the transform of an image instead of the image itself may give us more insight into the properties of the image. Two dimensional transforms are applied to image enhancement, restoration, encoding and description**.** Various types of transforms are used for the image enhancement.

DFT (Discrete Fourier Transform) One drawback of DFT is that the transform works badly when the end points are far apart. If the full Fourier transform was applied in this case, many higher Fourier components would be introduced to compensate for this.

DCT (Discrete Cosine Transform) One drawback is that there is no way to use the DCT for lossless compression, since outputs of the transform are not integers.

This problem can be solved by interpolating images in wavelet domain. Instead of applying a block transform, one can attempt with a transform where one block influences many other (surrounding) blocks. This may reduce the so, artifact like blocking may be removed when using subband transforms. To produce better result it

is effective to use wavelet transform. Wavelet transformation, originally a mathematical tool for signal processing, is now popular in the field of image fusion. Recently, many image fusion methods based on wavelet transformation have been published. The wavelets used in image fusion can be categorized into three general classes: Orthogonal, Biorthogonal and Nonorthogonal. Although these wavelets share some common properties, each wavelet leads to unique image decomposition and a reconstruction method which leads to differences among wavelet fusion methods. The wavelet transform has become a useful computational tool for a variety of signal and image processing applications. Wavelet transforms are also useful for `cleaning' signals and images (reducing unwanted noise and blurring). Some algorithms for processing astronomical images, for example, are based on wavelet and wavelet-like transforms. The wavelet transform of the image is first computed, the wavelet representation is then modified appropriately, and then the wavelet transform is reversed (inverted) to obtain a new image. When constructing subband transforms from wavelets, we will construct the transform by first finding a filter bank from the scaling function of the wavelet. Transforms in image processing are two-dimensional, so we need a few comments on how we implement a separable transform. When a two dimensional transform is separable, we can calculate it by applying the corresponding one-dimensional transform to the columns first, and then to the rows. Wavelet transform is used in various images processing application and produces better quality images.

II. IMAGE ENHANCEMENT TECHNIQUES

Previously numbers of techniques are used for increasing the quality of images in various applications. Each technique produces different artifacts and results.

According to Robert G. Keys[1] Cubic convolution interpolation is derived from set of conditions which are applied on interpolation kernel. Interpolation kernels are design to maximize accuracy for given level of computation factor. In terms of storage and computing time cubic convolution is more effective than cubic splines.

A. Temizel and T. Vlachos[2] Initial approximation to HR image is generating using wavelet domain zero padding. In this method wavelet transform is applied with filters. Image enhancement using cycle spinning reduces ringing and perceptual quality of compressed image is increased. High resolution image is generated using zero padding of high frequency subbands followed by inverse wavelet transform. Low resolution images are followed by wavelet domain resolution enhancement with zero padding i.e. WZP undergoes through spatial shifting to generate output high resolution image.

Yinji Piao, ll-hong Shin, HyunWook Park[3] Intersubband correlation in wavelet domain uses correlation of subband with different sampling phases in DWT. In such enhancement technique sampling phase in DWT is taken into consideration. By analyzing correlation between lower level subband and higher level subbands, interpolation filters are design. First filter are estimated by applying wavelet transform to low resolution image. Estimated filters are used to estimate bands in higher level. And finally inverse wavelet transform is performed to enhance the resolution of input image.

Turgay Celik and Huseyin Kusetogullari[4] The DTCWT technique is used to decompose the original input image into different subband images. Using LR image, initial approximation to unknown HR image is reconstructed using zero padding of high frequency subbands followed by ICWT. Deformations to initial estimation are applied using edge preserving smoothing filtering (EPSF).

Alexander Hildebrand[5] Time multiplexed acquisition produces set of low resolution CFA image undergoes single frame demosaicing algorithm. Then single frames are undergoes through monochromatic super resolution to produce high resolution color images.

Hasan and Gholamreza[7] Discrete and stationary wavelet decomposition technique based on interpolation of high frequency subbands images resulting from DWT. High frequency components of images are enhanced by stationary wavelet transform. This technique produces comparatively greater results.

Hasan Demirel and Gholamreza Anbarjafari [8] DWT technique is for interpolating the images. But the images obtain from DWT and IDWT technique is not sharper compare to previous technique and comparatively low PSNR.

Hasan Demirel and Gholamreza Anbarjafari[6] Complex Wavelet Transform (CWT) is used in image processing. CWT of an image produces two complex-valued low-frequency subband images and six complex-valued high-frequency subband images. DT-CWT decomposes original image into different subband images. Then high frequency subband images and original low frequency image are undergoes the interpolation. These two real-valued images are used as the real and imaginary components of the interpolated complex LL image, respectively, for the IDT-CWT operation. This technique does not interpolate the original image but also interpolates high frequency subband image resulting from DT-CWT. The final output image is high resolution of the original input image. Quality and PSNR of the super resolved image is also improves in this method.

There are some problems with wavelet domain also, it introduces artifacts like aliasing, any wavelet coeffient processing upsets the delicate balance between forward and inverse transform leading to some artifacts in the images. Also produces lack of directional selectivity greatly complicates modeling and processing of geometric image features like ridges and edges. One solution to all these problems in Complex Wavelet Transform (CWT). CWT is only approximately magnitude or phase, shift invariant and free from aliasing.

III. CONCLUSION

In this paper we sight on various image resolution enhancement techniques. All these techniques are invented and implemented by authors are having their own results and artifacts. In image enhancement schemes resolution is one of the main aspects. In order to produce high quality super resolution image all high frequency components of images are required to preserve. To enhance the resolution of the image in wavelet domain produces comparatively better results.

REFERENCES

[1] Robert G. Keys," cubic convolution interpolation for digital image processing", *IEEE transactions on acoustics, speech and signal processing*, vol-29, no.6, December 1981.

[2] A.Temizel and T. Vlachos, "Wavelet Domain Image Resolution Enhancement using Cycle-spinning", Electronics Letters, Vol.41, No.3, Feb. 2005

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

[4] Turgay Celik and Huseyin Kusetogullari, "Self-sampled image resolution enhancement using dual-tree complex wavelet transform" in European Signal Processing Conference, Glasgow, Scotland, 2009.

[5] Alexander Hildebrand, Claas Falldorf, Christoph von Kopylow and Ralf B. Bergmann, "Resolution Enhancement by Time-Multiplexed Acquisition of Sub-Pixel Shifted Images Employing a Spatial Light Modulator" Germany, 2010.

[6] Hasan Demirel and Gholamreza Anbarjafari,"Satellite Image Resolution Enhancement Using Complex Wavelet Transform" IEEE Trans. geoscience and remote sensing letters,vol.7,no.1,January 2010,pp 123- 126.

[7] Hasan Demirel and Gholamreza Anbarjafari,"Image Resolution Enhancement by Using Discrete and Stationary Wavelet Decomposition" IEEE transactions on image processing, vol. 20, no. 5, may 2011.

[8] Hasan Demirel and Gholamreza Anbarjafari,"Discrete Wavelet Transform-Based Satellite Image Resolution Enhancement" IEEE Trans. geoscience and remote sensing letters,vol.49,no.6, June 2011