Image Resolution Enhancement using Wavelet Approach: A Review

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Abstract- Comparison of various image super resolution enhancement techniques in wavelet domains is studied. We analyzed various wavelet domain based methods such as wavelet zero padding (WZP), Discrete Wavelet Transform (DWT), Stationary Wavelet Transform (SWT), Cycle-spinning, Dual Tree-Complex Wavelet Transform. The most common feature of these algorithms is that they use the spatial information of low resolution image (image in which sharp edges are absent) as an input image which is then decomposed into different sub bands by using a specific wavelet transform. The high and low frequency components of image are obtained after decomposition of original image. These sub band images as well as input image were interpolated. All these images were added to generate a new resolution enhanced image by using an inverse transform.

Keywords – Wavelet Zero Padding (WZP), Discrete Wavelet Transform (DWT), Stationary Wavelet Transform (SWT), Image super resolution, Cycle-Spinning, Low Resolution (LR), High resolution (HR), De-noising.

I. INTRODUCTION

Resolution has been referred as important aspect of an image. As the resolution goes up, the image becomes more clear. It becomes sharper, and more detailed. Images are being processed in order to obtain more enhanced resolution. Interpolation is most commonly used techniques for image resolution enhancement. In many image processing application Interpolation has been widely used such as facial reconstruction, multiple descriptions coding, and super resolution. In digital image processing interpolation is a process of increasing number of pixel in an image. Several interpolation techniques have been developed to increase image resolution. There are three well known interpolation technique, namely nearest neighbor interpolation, bilinear interpolation and bicubic interpolation [1].

Resolution of image enhancement in the wavelet domain is a relatively new research addition and recently many new algorithms have been proposed [2]-[3]. The unknown details of wavelet coefficients is used to improve the sharpness of the reconstructed images [3]. Their estimation was carried out by investigating the evolution of wavelet transform among the similar type of subbands. Edges identified by an edge detection algorithm in lower frequency subbands were used to develop a model for estimating edges in higher-frequency subbands and evaluated wavelet coefficients. These significant coefficients correspond to salient image discontinuation, and the portrayal of those can be targeted with this approach [4].

II. LITERATURE SURVEY

X. Li and M. T. Orchard, described an edge-directed interpolation algorithm for natural images. The basic idea is to first evaluate local covariance coefficients obtained from a low-resolution image and then use these covariance estimates to adapt the interpolation at a higher resolution which is based on the geometric difference between the high-resolution covariance and low-resolution covariance. The edge-directed property of covariance-based adaptation attributes to its capability of tuning the interpolation coefficients to peer an arbitrarily oriented step edge. To reduce the overall computational complexity a hybrid approach changing between bilinear interpolation and

covariance-based adaptive interpolation is proposed. Two main applications of the new interpolation algorithm are, resolution enhancement of grayscale images and reconstruction of color images from CCD samples. In both applications, new edge-directed interpolation demonstrates significant enhancement over linear interpolation on visual quality of the interpolated images [4].

Alptekin Temizel, Theo Vlachos, described an image resolution enhancement algorithm in a wavelet domain. An initial high-resolution estimation to the original image is obtained by zero-padding in the wavelet domain. This is further processed using the cycle-spinning methodology which minimize ringing. A critical element of the algorithm is the adoption of a simplified edge profile fit for the description of edge degradations such as blurring due to loss of resolution. Finally linear regression with minimal training set of high-resolution original is employed to rectify the degraded edges. Results show that the proposed method performs conventional image interpolation approaches both in objective and subjective terms, also compared favourably with state-of-the-art methods operating in the wavelet domain [5].

Ercelebi, E., proposed method utilizes the multi-scale characteristics of the wavelet transform and local statistics of each subbands. By using this proposed method transformation of an image take place into the wavelet domain using lifting based wavelet filter and then applies a wiener filter in the wavelet domain and finally transform the result into the spatial domain. When the peak signal to noise (PSNR) ratio is low, image is transforming into the lifting based wavelet domain and then applying the wiener filter in the wavelet domain produce better result than directly applying wiener filter in spatial domain [6].

Alptekin Temizle, proposed Hidden Markov Tree (HMT) based methods using Gaussian mixture to produce promising result. However, these methods have one drawback that, as the Gaussian is symmetrical around zero, inherently random signs of this coefficients generated by using this is distribution function are adversely affecting the resulting image quality. They demonstrate that the sign information is an important element affecting the results and proposed a method to estimate signs of these coefficients more accurately [7].

Yi Wan and Dongbin Shi, has described enhanced Histogram equalization in wavelet domain to enhance an image is very important tasks such as image enhancement and normalization. Presented a wavelet-based method that simultaneously achieves the exact specification of histogram and good image enhancement performance. It does so through a carefully designed strict ordering of pixel process, for the image enhancement purpose the wavelet coefficients are fine tuned. Compared to previous work approach like local mean intensity values, local edge information are taken into account. Other merits include good statistical models, fast pixel ordering, and better image enhancement performance [8].

Anush Krishna Moorthy and Alan Conrad Bovik, has proposed the framework for no-reference image quality assessment (NR IQA) algorithms usually assume that the image affected due to distortion are known. This is a limiting assumption for practical applications, since in a many cases the distortions in the image are unknown. For no-reference image quality assessment they have proposed a new two-step framework based on natural scene statistics (NSS). The framework does not require any knowledge of the process which is distorted and the framework is modular in that it can be extended to any number of distortions once it trained. The framework is unique, since it assesses the quality of an image completely blind that is without any knowledge of the source distortion. This is obtained by using distorted image statistics (DIS) which is an extension of natural scene statistics for distorted images. Described DIS and demonstrated that each distortion has a specific unique signature which can be characterized by the use DIS and signature is used to classify images into distortion categories. Also described how distortions aware IQA may be undertaken using DIS. Then they merged distortion classification with the distortion aware IQA to produce a demonstration of the blind image quality index (BIQI) which is of value on its own. On the LIVE image database BIQI was tested and was perform well in terms of correlation with human perception. The BIQI, and NR measure, performed competitively with PSNR, an FR measure, across all distortions and in overall performance [9].

Gholamreza Anbarjafari and Hasan Demirel, has described a new super-resolution technique based on interpolation of the high-frequency subband images which is obtained from discrete wavelet transform (DWT) and the Spatial domain input image. The proposed technique decomposed an image into different subbands by using DWT. Then the high frequency subband images as well as the input low-resolution image have been interpolated. After that all these images are combined to generate a new super-resolved image by using IDWT. The quantitative peak signal-to-

noise ratio (PSNR) and visual results show the superiority of this proposed technique over the conventional and state-of-art resolution of image enhancement techniques [10].

Hasan Demirel and Gholamreza Anbarjafari, described resolution of image enhancement technique based on interpolation of the high frequency subband images obtain from discrete wavelet transform (DWT) and spatial information of input LR image. In order to improve and increase the quality of the super resolved image preservation of edges is very essential. In this work, preservation of high frequency components of the image has been employed by DWT. By using stationary wavelet transform (SWT) the edges are enhanced by introducing an intermediate stage. DWT is applied in order to decompose an input image into different frequency subbands. Then the high frequency subbands and also the input image are interpolated. Then obtained high frequency subbands are being modified by using high frequency subbands which are obtained from SWT. Then all these HF subbands are combined to generate a new high resolution image by using inverse DWT (IDWT). Downsampling in subband of DWT causes information loss in the respective subbands, beacuse of that SWT is employed to minimize this loss. The PSNR and visual results of this technique show the superiority of proposed technique over the conventional and state-of-art resolution of image enhancement techniques [11].

III. SUMMARY

This review paper give a short description of different image resolution enhancement techniques in order to describe various parameter that cause degradation of image and various technique for enhancement of blurred image, setting brightness and contrast, noise removal. Smoothing caused by interpolation because of that loss on high frequency component. Fundamental idea of wavelet transform is that transformation should allow change only in time extension but not in shape. The second generation transform has several advantages over the classical wavelet transform. It can be used to generate multiresolution analysis.

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