Analysis of Different Colour Image Enhancement Techniques Using Interpolation and Super Resolution Methods

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Abstract- The objective of image processing is to get better resolution for further processing. Several enhancement techniques are proposed for colour image enhancement among these interpolation methods and wavelets are most popularly used. In this paper different colour images are enhanced by using different methods. The Proposed method is compared with existing methods like Bicubic interpolation method, Wavelet zero padding method with respect to PSNR and it has shown that the proposed technique method gives better performance than the existing methods.

Index Terms- Bicubic interpolation method, Wavelet zero padding method and Super Resolution method.

I. INTRODUCTION

Resolution is one of the important properties of an image. One of the commonly used techniques for image resolution enhancement is Interpolation. Interpolation has been widely used in several image processing applications such as facial reconstruction, multiple description coding, and super resolution

Interpolation method increases the number of pixels in a digital image. Interpolation-based super resolution has been used for a long time, and many interpolation techniques have been developed to increase the quality of this image. There are three well-known interpolation techniques; namely, nearest neighbor interpolation, bilinear interpolation, and bicubic interpolation. Bicubic interpolation is more sophisticated than the other two techniques but produces smoother edges than bilinear interpolation.

In image resolution enhancement wavelet domain is a relatively new research and recently, many new algorithms have been proposed. In wavelet domain, its, unknown coefficients are estimated in order to improve sharpness of reconstructed images. Their estimation was carried out by investigating the evolution of wavelet transform extreme among the same type of subbands [1]. Edges identified by an edge detection algorithm in lower frequency subbands were used to prepare a model for estimating edges in higher-frequency subbands, and only the coefficients with significant values were estimated as the evolution of the wavelet coefficients. These significant coefficients correspond to salient image discontinuities, and consequently, only the portrayal of those can be targeted with this approach.

Discrete wavelet transform (DWT) [2] is one of the recent wavelet transforms used in image processing. DWT decomposes an image into different sub band images, namely low-low (LL), low- high (LH), high-low (HL), and high-high (HH). Another recent wavelet transform which has been used in several image processing applications is stationary wavelet transform (SWT). In short, SWT is similar to DWT but it does not use down-sampling, hence the sub bands will have the same size as the input image. One of the commonly used techniques for image resolution enhancement is Interpolation, but the main loss of it is high frequency components (edges) in the image

The high frequency subbands obtained by SWT of the input image are corrected by the interpolated high frequency subbands of DWT to obtain the estimated coefficients. In parallel, the input image is also interpolated separately. Finally applying inverse DWT (IDWT) to the estimated coefficients and interpolated a high resolution image is obtained.

In this work, we have proposed a new resolution enhancement technique by wavelet transforms these wavelet transforms decompose a low- resolution image into different sub band images. Then the high-frequency sub band images are interpolated using bicubic interpolation. In parallel, the input image is also interpolated separately. Finally, the estimated coefficients of the image and interpolated input image are combined by using inverse DWT (IDWT) to achieve a high-resolution output image.

The conventional techniques used are:

- Interpolation techniques namely,
  - nearest interpolation
  - bilinear interpolation and
  - bicubic interpolation
- Wavelet zero padding (WZP).

II. BICUBIC INTERPOLATION:

In mathematics, bicubic interpolation is an extension of cubic interpolation for interpolating data points on a two dimensional regular grid. The interpolated surface is smoother than corresponding surfaces obtained by bilinear interpolation or nearest-neighbor interpolation. Bicubic interpolation can be accomplished using Lagrange polynomials, cubic splines, or cubic convolution algorithm.

In image processing, bicubic interpolation is often chosen over bilinear interpolation or nearest neighbor in image resampling, when speed is not an issue. Images resampled with bicubic interpolation are smoother and have fewer interpolation artifacts.

III. WAVELET ZERO PADDING METHOD:

It is one of the easiest image resolution enhancement method. In this low resolution images are considered and zero matrices are formed for edges. These matrices embedded into transformed image. Inverse wavelets are applied to transform to get original high resolution image. The following steps are followed to get high resolution image.

1. Obtain an intermediate HR image by WZP Method.
2. By using spatial shifting, wavelet transforming and discarding high frequency component no. of images will be obtained.
3. Repeat WZP process for all images to obtain better resolution images.
4. All these images are realigned to get averaged high resolution images.

IV. SUPER RESOLUTION IMAGE ENHANCEMENT TECHNIQUE

The main loss when enhancing the resolution of an image by applying interpolation is its high-frequency components, that is, the edges. This loss occurs because the interpolation smoothen the image. Hence, in order to increase the quality of the super-resolution image, preserving the edges is essential. In this work, discrete wavelet transform (DWT) has been employed in order to preserve the high-frequency components of the image. DWT decomposes an image into different sub band images; namely, low-low (LL), low-high (LH), high-low (HL), and high-high (HH). LH, HL, and HH sub band images contain the high-frequency components of the input image. These three high frequency sub bands (LH, HL and HH) contain the high frequency components of the input image. In the proposed technique, bi-cubic interpolation with enlargement factor of 2 is applied to high frequency sub band images

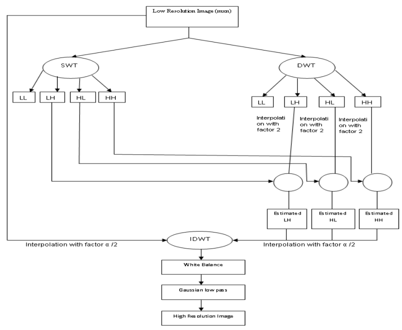

Fig.1 Block diagram of the proposed image resolution Enhancement algorithm

In this work, DWT has been employed in order to preserve the high frequency components of the image. The redundancy and shift invariance of the DWT mean that DWT coefficients are inherently interpolable [3]. Down sampling in each of the DWT sub bands causes information loss in the respective sub bands. That is why SWT is employed to minimize this loss. The interpolated high frequency sub bands and the SWT high frequency sub bands have the same size which means they can be added with each other. The new corrected high frequency sub bands can be interpolated further for higher enlargement. Also it is known that in the wavelet domain, the low resolution image is obtained by low pass filtering of the high resolution image [5].

Using input image instead of low frequency sub band increases the quality of the super resolution image. Fig. 1 illustrates the block diagram of the proposed image resolution enhancement technique. By interpolating input image and estimated high frequency sub bands by $\alpha/2$ (here α is the interpolation factor) at final interpolation stages respectively, and then by applying IDWT, as illustrated in Fig. 1, the output image will contain sharper edges than the high resolution image obtained by interpolation of the input image directly. This is due to the fact that, the interpolation of isolated high frequency components in high frequency sub bands and using the corrections obtained by adding high frequency sub bands of SWT of the input image, will preserve more high frequency components after the interpolation than interpolating input image directly.

After applying the IDWT it is proposed white balance [3] for Enhancement the image. White balance is a technique that is used to remove the colour cast in a particular and unwanted color that is dominating in an image. This is used to simulate the complex color stability that humans have. The purpose of the white balance is to maintain as close as possible the colors in the image. This adjusts automatically the colors of the image by stretching the red, green and blue channels individually. This is achieved by changing the ratio between the three color channels of the image such as red, green and blue. The basic concept of this white balance is refinement of the sharpness of edges due to this reason white balance is widely used in digital cameras. White Balance computes the average amount of each color present in the input image and then applies to ensure that the output image has an equal amount of each color. White balance is the process of removing unrealistic color casts, so that objects which appear white in person are rendered white in the image. This white balance is to average the brightest and darkest pixels on the image. Edges and other sharp intensity transitions such as noise in an image contribute significantly to the high frequency content. Hence smoothing is achieved by high frequency attenuation; that is by low pass filtering. The Gaussian filters are mainly classified in to two types. They are High pass filter (sharpening filter) and Low pass filter (smoothing filter). Edges enhancement is associated with high frequency components. Gaussian filters [4] are a class of linear smoothing filters with the pixels chosen according to the shape of a Gaussian function. Gaussian smoothing filters are effective low-pass filters from the perspective of both the spatial and frequency domains, are efficient to implement, and can be used effectively by engineers in practical vision applications. The amount of smoothing performed by the filter will be the same in all directions. In general, the edges in an image will not be oriented in some particular direction that is known in advance; consequently, there is no reason a priori to smooth more in one direction than in another. The function creates a two- dimensional filter of specified type and returns a correlation kernel, which is the appropriate form to use with imfilter. The default value for the kernel size is [3 3]. The default value for the σ (sigma) is 0.5. As σ increases, more samples must be obtained to represent the Gaussian function accurately. Therefore, σ controls the amount of smoothing. In all steps of the proposed satellite image resolution enhancement technique, Daubechies wavelet transform as mother wavelet function and bicubic interpolation as interpolation technique have been used.

V. RESULTS

In order to show the effectiveness of the proposed method over the conventional and state-of- art image resolution enhancement techniques, four well-known test images (Lena, Baboon, and Peppers) with different features are used for comparison.

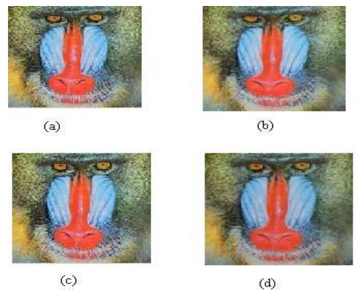

Fig.2 (a) Original low resolution baboon's image
(b) Bicubic interpolated image
(c) Super resolved image using WZP
(d) Proposed technique

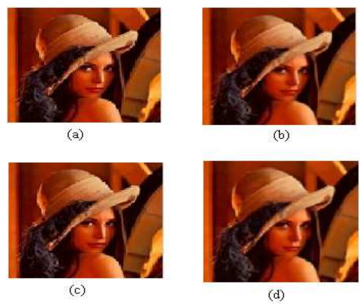

Fig.3 (a) Original low resolution lenas's image
(b) Bicubic interpolated image
(c) Super resolved image using WZP
(d) Proposed technique

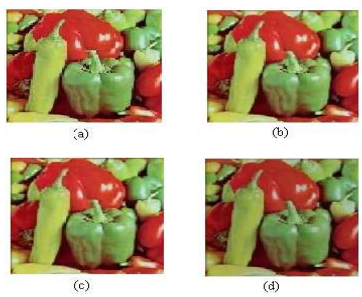

Fig.4 (a) Original low resolution pepper's image
(b) Bicubic interpolated image
(c) Super resolved image using WZP
(d) Proposed technique

Table I compares the PSNR performance of the proposed technique with bicubic interpolation and wavelet zero padding method. The results in Table I indicate that the proposed technique over-performs the aforementioned conventional and state-of-art image resolution enhancement techniques.

VI. CONCLUSION

From the table I it is observed that with respect the PSNR for all the images proposed method gives better performance than existing methods like Bicubic interpolation method and wavelet zero padding method. By observing the PSNR value all most all proposed method superior over all existing methods. There is a 11dB variation between WZP and Proposed technique per Lena images, similarly it is observed 7dB and 8dB variation per Baboon and Pepper images.

TABLE I

PSNR (DB) RESULTS FOR RESOLUTION ENHANCEMENT FROM 128x128 TO 1024x1024 OF THE PROPOSED TECHNIQUE COMPARED WITH THE CONVENTIONAL AND STATE-OF-ART IMAGE RESOLUTION ENHANCEMENT TECHNIQUES

	PSNR(dB)		
Techniques\image	**Lena**	**Baboon**	**Pepper**
Bilinea	49.76	53.24	47.47
Bicubi	50.10	53.88	46.86
WZ	50.36	54.15	44.47
Proposed	**61.97**	**61.64**	**52.21**

VII. REFERENCES

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