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SUPER-RESOLUTION USING EDGE MODIFICATION THROUGH SWT ON COLOUR IMAGES

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ABSTRACT

Improvement of super-resolution is one of the major aspects in image processing applications. Super-resolution (SR) imaging is a process, to reconstruct a high-resolution (HR) image of a scene from one or more low-resolution images of the scene. In most cases noise is accumulated in edges. Hence edge preserving is an essential task in image super-resolution. In this paper, stationary wavelet transform (SWT) based super-resolution is introduced. In SWT, initially the image is split into 4 subbands and then each subband is modified by multiplying with a boost value and finally applies inverse stationary wavelet transform (ISWT) to produce the required high-resolution image. The proposed method gives better performance compare with other conventional super-resolution techniques in terms of PSNR, Cross-Correlation. All these experiments are carried out using MATLAB software.

KEYWORDS: super-resolution (SR), Stationary Wavelet Transform (SWT), peak signal to noise ratio (PSNR)

INTRODUCTION

Image super-resolution produces a high-resolution (HR) image using one or more low-resolution (LR) images. This area has become a popular research area due to fact that HR images are to be filled with more data which does not directly exist in the LR images. HR image can be obtained using different techniques that can be categorized into three types: Interpolation based, reconstruction based and learning based techniques.

Interpolation based techniques [1, 2, 3, 4,5 ,7 ,8 , 9, 10 and 11,12]matches the LR images pixels with the HR image pixels. The traditional techniques for resolution enhancement like linear and bi-cubic interpolation produce HR image along with blurring, a visual undesirable artifacts, though these algorithms produce good quantitative results [12].

Reconstruction based techniques [6] uses the pair relationship between LR image and HR image, using which linear equations are developed that connect the pixel values of HR and LR images.

In this paper, we are proposing a technique that uses the conventional bi-cubic interpolation technique along with stationary wavelet transform (SWT) to produce a HR image. Bi-cubic interpolation alone produces blurred image, so to reduce the blurring effect the SWT is used to enhance the edge of a HR image produced by bi-cubic interpolation. SWT decomposes an image into four sub-bands, one low frequency sub-band and three high frequency sub-bands. The three high-frequency sub-bands are modified by multiplying a boost value with the sub-bands. Then the inverse SWT (ISWT) is done on these sub-bands to produce the final HR image.

Rest of the paper in a manner that section 2 states the proposed algorithm in detail which is the combination of two techniques: bi cubic interpolation and wavelet transform. Section 3 states the qualitative and quantitative results of the proposed algorithm and section 4 concludes the proposed technique.

PROPOSED TECHNIQUE FOR IMAGE SUPERRESOLUTION

In interpolation based up-scaling, the main loss is across edges i.e. high frequency components. In order to enhance the quality of the interpolated image, processing must be done to preserve edges. The proposed

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algorithm is diagrammatically shown in figure.1. The algorithm can be classified into two fundamental steps: first is the up-scaling of LR image using bi-cubic interpolation and second step is the edge modification using SWT.

Image Splitting

Initially take the color image and it is splitted into Red plane, Green plane, Blue plane, and each plane is up-scaled by using bi-cubic interpolation

Interpolation Technique

This is a simple up-scaling step using bi-cubic interpolation to achieve a HR image. The resultant HR image is blurred that must be processed to reduce the blur effect

Edge Modification using SWT

This is the core step for modifying the HR image edges. Using one level SWT, image is decomposed into four bands: 1 low frequency band (LL) and 3 high frequency band (LH, HL and HH) that represents three edges (horizontal, vertical and diagonal). The reason for using SWT over DWT (discrete wavelet transform) is that the size of the image is retained in SWT whereas in DWT down-sampling of sub-bands causes information loss.

The sub-bands are modified by multiplying with a appropriate boost value. Boost value is a number greater than 1 and less than 3. These boost values are obtained by analyzing different boost values on different images belonging to various image categories. Less than 1 value will further blur the image and value greater than 3 will truncate pixel values. After modifying the sub-bands, the inverse SWT (ISWT) will produce the final HR image. That has much sharper edges as compared to the bi-cubic interpolation alone.

PROPOSED ALGORITHM

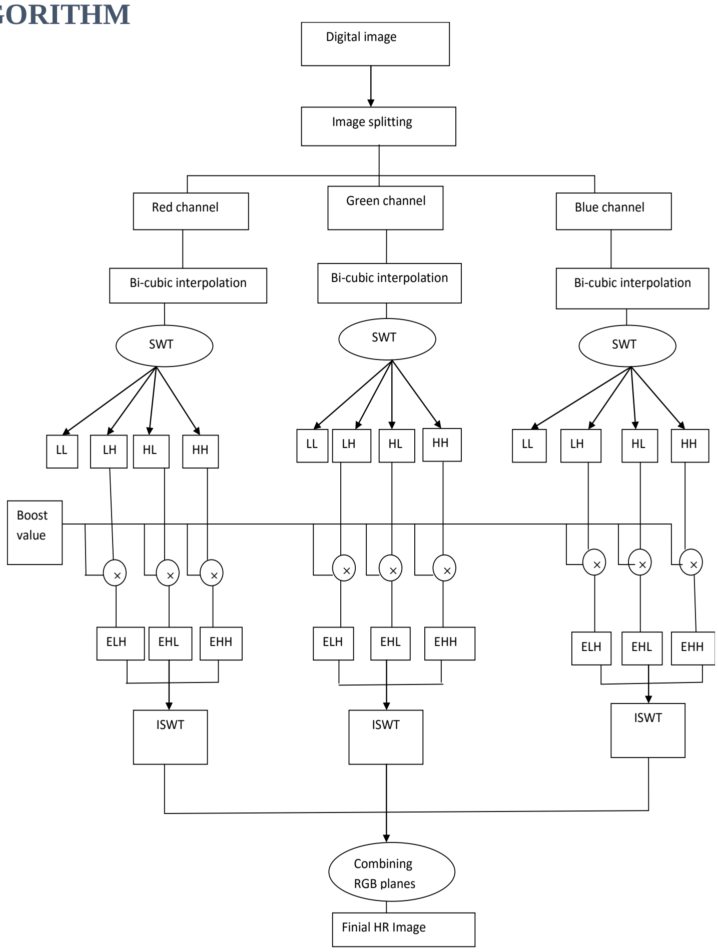

Figure1. Block Diagram of Proposed Algorithm

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PERFORMANCE METRICS

For quantitative analysis, Cross-Correlation (CC) and Peak Signal-to-Noise Ratio (PSNR), values measured in decibel, are used whose formulas are given in equation 1 and 2 respectively.

$$CC = \frac{\sum_m \sum_n (A_{mn}-\bar{A})(B_{mn}-\bar{B})}{\sqrt{(\sum_m \sum_n (A_{mn}-\bar{A})^2)(\sum_m \sum_n (B_{mn}-\bar{B})^2)}} \qquad (1)$$

$$PSNR = 10log_{10}\frac{(2^n-1)^2}{\sqrt{MSE}} \qquad (2)$$

Where is $\bar{A}$ the mean value of A image,

$\bar{B}$ is the mean value of B image,

And MSE is the mean-squared error which is calculated using equation 3.

$$MSE = \frac{1}{MN}\sum_{i=1}^{M}\sum_{j=1}^{N}\left(x(i,j) - y(i,j)\right)^2 \qquad (3)$$

Where i and j are the rows and columns of the image.

RESULTS & DISCRIPTION

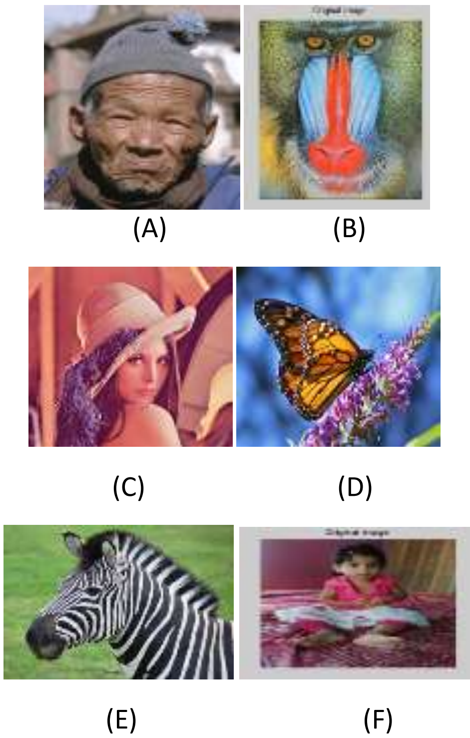

Figure 2 Selected images from the test database.

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Figure (a) Input image

Figure (b) R channel

Figure (c) G channel

Figure (d) B channel

Figure (e) Bi-linear Interpolation

Figure (f) Bi-cubi Interpolation

Figure (g)Wavelet-Zero Padding

Figure (h) Proposed

Figure 3 (a) Input image, (b) R-channel, (c) G-channel, (d)B-channel, (e) Bi-linear interpolation, (f) Bi-cubic interpolation, (g) Wavelet Zero Padding, (h) Proposed.

The given figure 3 represents the input color image is splitting into R,G,B channels each channel is applied to interpolation technique it produces the blurred image, interpolation output is applied to wavelet-zero padding, stationary wavelet transform, it gives the better enhancement.

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Table 1 the Peak Signal to Noise Ratio of Different images

PSNR in(dB)				
Images	Bi-linear	Bi-cubic	WZP	Proposed
Zebra	28.3	30	34.4	35.3
Person	28.3	30.3	35.4	36
Lena	27.9	29.3	35.4	35.6
Baboon	29.7	32	34	35.5
Butterfly	28.5	30.4	35.4	36.1

From the Table 1 compares the PSNR values of different images for different techniques. From the table it is clear that the proposed technique gives the better PSNR values compared to bi-linear interpolation, bi-cubic interpolation, WZP techniques

Table 2 Cross-Correlation for Different test images

Cross-Correlation				
Images	Bi-linear	Bi-cubic	WZP	Proposed
Zebra	0.75	0.80	0.85	0.89
Person	0.80	0.82	0.94	0.97
Lena	0.75	0.83	0.90	0.95
Baboon	0.8	0.83	0.88	0.90
Butterfly	0.67	0.72	0.84	0.88

From Table 2 gives the qualitative analysis by using Cross-Correlation Equitation1. It gives the better quality. Compared to bi-linear, bi-cubic, WZP techniques.

CONCLUSION

In this paper, super-resolution technique has been proposed that uses the traditional bi-cubic interpolation. The LR image is first up-scaled using bi-cubic interpolation producing a HR blurred image which is further processed. The edges of the HR image are boosted first in wavelet domain using SWT. The HR image undergoes SWT to produce 3 high frequency sub-bands and 1 low frequency sub-band. The high frequency bands are modified by multiplying an appropriate boost value (whose values lies between 1 and 3). Then using these 3 modified high frequency sub-bands and 1unmodified low frequency band the final HR image is obtained using in ISWT. From the simulation results the Proposed techniques produces HR image which is superior in quality in comparison with other techniques.

REFERENCES

[1] Fahimarif,Tabindasarwar''super-Resolution Using Edge Modification Through Stationary Wavelet Transform'' 2014 18th International Conference on Information Visualisation.
[2] D. Hasan, F. Gholamreza ,"Image Resolution Enhancement by Using Discrete and Stationary Wavelet Decomposition",IEEE Transactions on Image Processing, Vol. 20, No. 5,2011.
[3] Huda Nawaz, Image Zooming Using Wavelet Transform, InternationalConference on System and Simulation in Engineering, Spain, December2006.
[4] S. Udomhunsakul, "Edge Detection in Ultrasonic Image Using Gabor Filters," IEEE Trans. on TENCON, 2004, pp. 175–178.

[5] Jinjun Wang, Yihong Gong, Fast Image Super-Resolution Using Connected-Component Enhancement, IEEE International Conference on Multimedia and Expo, 2008.

[6] Yu-Wing Tai, Shuaicheng Liu, Micheal S. Brown, Stephen Lin, Super Resolution using Edge Prior and Single Image Detail Synthesis, IEEE Conference on Computer Vision and Pattern Recognition, 2010

[7] Huahua Chen, Baolin Jiang, Weiqiang Chen, Image Super-Resolution based on Patches Structure, 4th International Congress on Image and Signal Processing, 2011.

[8] G. Anbarjafari and H. Demirel, "Image super resolution based on interpolation of wavelet domain high frequency subbands and the spatial domain input image," *ETRI J.*, vol. 32, no. 3, pp. 390–394, Jun. 2010.

[9] N. Asuni and A. Giachetti, "Accuracy improvements and artifacts removal in edge based image interpolation," in *Proc. 3rd Int. Conf. Comput. Vis. Theory Appl. (VISAPP)*, 2008, pp. 58–65.

[10] Shreyas Fadnavis*Image Interpolation Techniques in Digital Image Processing: An Overview, ijera, Vol. 4, Issue 10(Part -1), October 2014, pp.70-73.

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

[12] Weizhong Su, Rabab K. Ward, An Edge-based Image Interpolation Approach Using Symmetric Biorthogonal Wavelets Transform, IEEE 8th Workshop on Multimedia Signal Processing, 2006