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Wavelet Based Sharp Feature Multi-Focus Image Fusion In Dct Domain

[1]Kirandeep Kaur, Amandeep Singh Bhandari[2]
[1]*Student, Department of Electronics and Communication Engg., Punjabi University, Patiala*
[2]*Assistant Professor, Department of Electronics and Communication Engg., Punjabi University, Patiala*

ABSTRACT:- Multi focus Image fusion is process of combining information of two or more images of a scene and as significance has "all-in-focus" image. When one section covers objects in different distance, the camera can b1(Student, Department of Electronics and Communication Engg., Punjabi University, Patiala 2(Assistant Professor, Department of Electronics and Communication Engg., Punjabi University, Patialae focused on each object one afterward the other, generating a set of pictures. Now, by image fusion technique, an image with better focus sideways all zone can be produced. There are many multi focus image fusion approaches, today. One of them is Experiential Mode Decay shaped multi focus image fusion. The object of the image fusion is to retain the most desirable characteristics of each image. A multi-focus image fusion approach using a new sharpness criterion that depends on statistics of image's gradient information is proposed in this dissertation. The proposed approach exploits a Discrete Cosine Wavelet criterion to adaptively perform image fusion by selecting most informative (sharp) information from the input images.

Keywords:- Image processing, Image fusion, Wavelet, DWT, DCT.

I. INTRODUCTION

Image processing is a technique to transform an image into digital form and perform some actions on it, in order to acquire an enhanced image or to extract some valuable information from it. It is quickly growing technologies today, with its applications in many aspects of a business. Image processing procedures core investigation zone inside engineering and computer science disciplines too.

The word digital image processing generally denotes to processing of a two-dimensional picture by a digital computer [3, 4]. A digital image is an array of actual numbers signified by a finite number of bits.

Multi focus Image Fusion

Multi focus Image fusion is process of combining information of two or more images of a scene and as significance has "all-in-focus" image. With the availability of multi sensor data in many fields, image fusion has been getting increasing attention in the studies for a wide spectrum of submissions. There are some submissions of image fusion process which are described underneath.

Multi-sensor fusion refers to the synergistic mixture of dissimilar sources of sensory information into one representational set-up. The information to be fused may come from multiple sensors monitored over a common period of time or from a single sensor monitored over an extended time period. Many sensors produce images.

A simple image fusion technique is to take the average of the source images pixel by pixel. However, along with simplicity, several undesired side effects including condensed contrast also generated. In recent years, many researchers recognized that multiscale alters are very useful for examining the information content of images for the purpose of fusion.

Types of Wavelet Transforms

There are two types of Wavelet transforms, with the help of these transforms we can do the image fusion process, these are given below.

1. Discrete Wavelet Transforms
2. Discrete Cosine Transforms

Discrete Wavelet Transform

Resolution has been normally referred as an important feature of an image. Images are being managed in order to obtain more improved resolution. One of the generally used methods for image resolution improvement is Interpolation. Interpolation has been broadly used in many image processing applications such as facial rebuilding, various description coding [8], and fabulous resolution [9]. Discrete wavelet transform (DWT) is one of the recent wavelet transforms used in image processing.

The CWT (Continuous Wavelet Transform) performs multi resolution exploration by reduction and dilatation of the wavelet functions. The discrete wavelet transform uses filter banks for the building of the multi resolution time-frequency plane. Filter banks will be [11] presented below. The DWT uses multi resolution filter banks and distinctive wavelet filters for the examination and reconstruction of signals.

1(Student, Department of Electronics and Communication Engg., Punjabi University, Patiala 2(Assistant Professor, Department of Electronics and Communication Engg., Punjabi University, Patiala

The Discrete Cosine Transform

Like other alters, the Discrete Cosine Transform (DCT) attempts to decorrelate the image data. After decorrelation each transform coefficient can be encoded individually without losing compression efficiency.

This section describes the DCT and some of its important properties [15].

As deliberated previously, the principle advantage of image transformation is the removal of redundancy between neighboring pixels. This leads to uncorrelated transform coefficients which can be encoded independently [18].

II. LITERATURE SURVEY

N. Stavri et al (2001), [21] presented some results on the use of wavelet algorithms for image fusion. It starts with a brief introduction of image fusion that described three different wavelet transforms and the way they can be employed to fuse 2-D images. These include: the discrete wavelet transform (DWT); the dual-tree complex wavelet transform (DT-CWT); and Mallat's discrete dyadic wavelet transform (DDWT), which can also be used to compute a multiscale edge representation of an image. The experimental comparison clearly shows that DT-CWT fusion systems provide better results than their DWT counterparts.

L. Shutao et al (2008), [22] defined that image fusion is a process of combining complementary information from multiple images of the same scene into an image, so that the resultant image contains a more accurate description of the scene than any of the individual source images. In this work, a new region based multi-focus image fusion method has been proposed. The proposed method was more robust to miss-registration or slight motion of the object than the pixel-based method.

H. A. B. Mohammad et al (2010), [23] describes the objective of image fusion is to combine information from multiple images of the same scene in order to deliver only the useful information. The discrete cosine transform (DCT) based methods of image fusion are more suitable and time-saving in real-time systems using DCT based standards of still image or video. The experimental results on several images showed the efficiency improvement of their method both in quality and complexity reduction in comparison with several recent proposed techniques.

T. Jing et al (2011), [24] their aim of multi-focus image fusion was to combine multiple images with different focuses for enhancing the perception of a scene. The challenge was to how evaluate the local content (sharp) information of the input images. Extensive experimental results were provided to demonstrate that the proposed bilateral sharpness criterion outperforms conventional seven sharpness criterions.

M. Reenu et al (2013), [25] presented a wavelet based perceptive image quality assessment metric (WASH-Wavelet based Sharp features) based on HVS which accounts for the sensitivity of human vision to sharp features of the image, the sharpness and zero-crossings. The highly visible sharp regions gave good quality estimation based on the structural distortion of the image. The WASH algorithm was tested on the publicly available databases and gave best results with the state-of-the-art quality assessment metrics as well as the wavelet based perceptive quality assessment metrics.

III. PROPOSED WORK

The main objective of image fusion is to join the information from multiple out-of-focus images of the same scene in such a way that only the useful information is kept. The discrete cosine transform based methods of image fusion are more suitable and time-saving in real-time systems using DCT based standards of still image or video. In this work, we propose an efficient approach for fusion of multi-focus images based on variance and sharpness index calculation in DCT domain. The research methodology and main objectives of our work are summarized below:-

- Divide the images into 8×8 sub-blocks.
- Calculate DCT coefficients for each sub-block.
- Develop new criteria to calculate image sharpness of each sub-block in DCT domain for activity level measure.
- Use the variance and sharpness based criteria to fuse the sub-blocks efficiently to retain useful information per block.
- Combine all sub-blocks to create the final fused image.

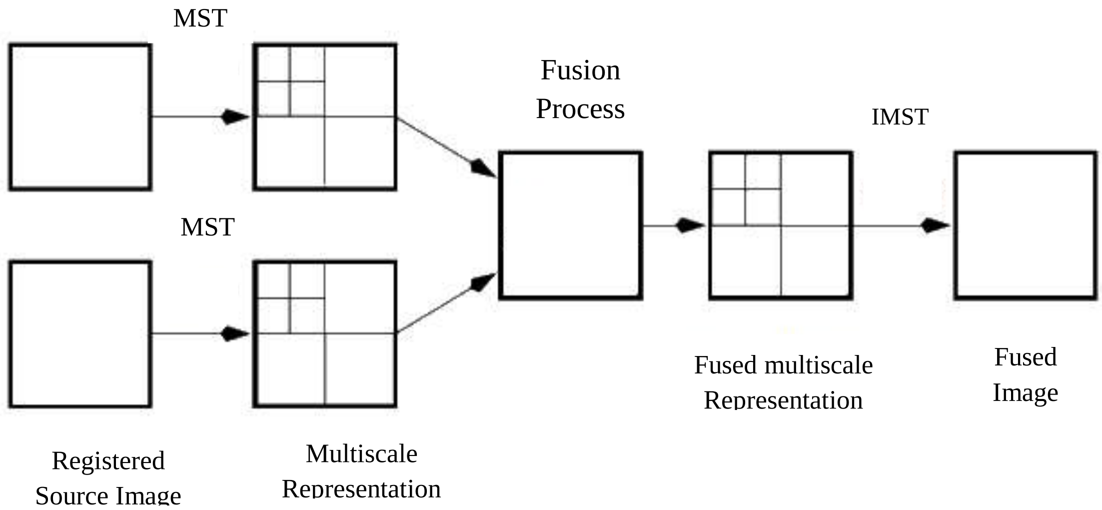

Figure 1: Block diagram of a generic image fusion scheme

Sharpness criterions

In view of that the determination of the weighting scheme is the key issue of designing multi-focus image fusion techniques, a review on the existing sharpness criterions is provided in this section. Since the degree of de-focus varies inversely with the amount of high spatial frequency energy present in the spatial frequency spectrum, the amount of high-frequency information (corresponding to edge information in images) is usually used as the basis to measure the degree of image's blur [14]. More specifically, the well-focused image has sharper edges and is expected to have higher frequency content than those that are blurred. In the following analysis, denote $I(r,c)$ be the intensity value at the position (r,c) of the image I.

Variance for a $M \times N$ block of the image can be defined as [12]

$$S_{VAR} = \frac{1}{M \times N} = \sum_{r}\sum_{c}(I(r,c) - \mu)^2$$

Proposed DCT

Decorrelation

The principle advantage of image transformation is the removal of redundancy between neighboring pixels. This leads to uncorrelated transform coefficients which can be encoded independently.

Separability

The DCT transform equation below can be expressed as,

$$C(u,v) = \alpha(u)\alpha(v)\sum_{x=0}^{N-1}\cos\left[\frac{\pi(2x+1)u}{2N}\right]\sum_{y=0}^{N-1}\mathrm{f(x,y)}\cos\left[\frac{\pi(2y+1)v}{2N}\right]$$

For $u, v = 0,1,2,\dots,N-1$.

This property, known as separability, has the principle advantage that $C(u, v)$ can be computed in two steps by successive 2-D operations on rows and columns of an image.

Symmetry

Another look at the row and column operations in Equation below reveals that these operations are functionally identical. Such a transformation is called a symmetric transformation. A separable and symmetric transform can be expressed in the form

$$T = AfA,$$

IV. RESULTS

Experiments are conducted to compare the performance of the proposed bilateral sharpness criterion with other using a bilateral gradient-based sharpness criterion, by individually incorporating them as the weighting scheme to perform image fusion. The parameters of the proposed criterion are experimentally set as α=1 and β=0.5. Also, the size of the neighborhood is set to be 5×5. The above parameter settings are experimentally selected. Our setting might not be globally optimal, but this setting yields fairly good performance in our simulations. The first experiment is to conduct image fusion using three sets of images with different focus levels: 256×256 Clock, 256×256 Bottle, and 256×256 Book, as shown in Fig. 5.1-5.9.

Figure 2: Reference clock Image 1

Figure 3: Reference clock Image 2

Figure 4: Final clock Image After Fusion

Figure 5: Reference Bottle Image 1

Figure 6: Reference Bottle Image 2

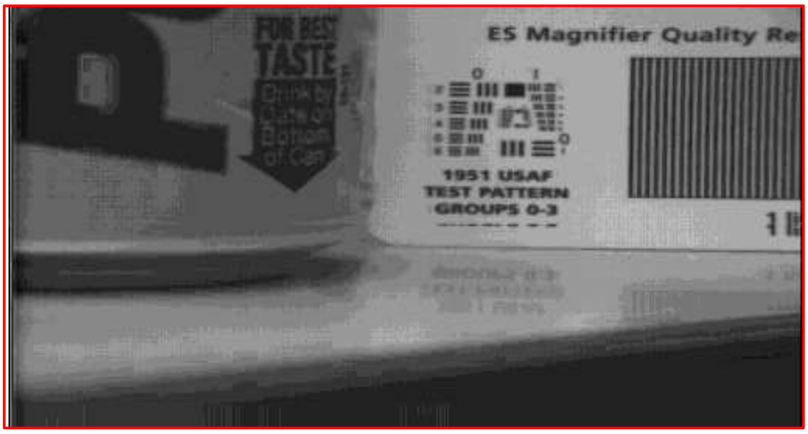

Figure 7: Final Bottle Image After Fusion

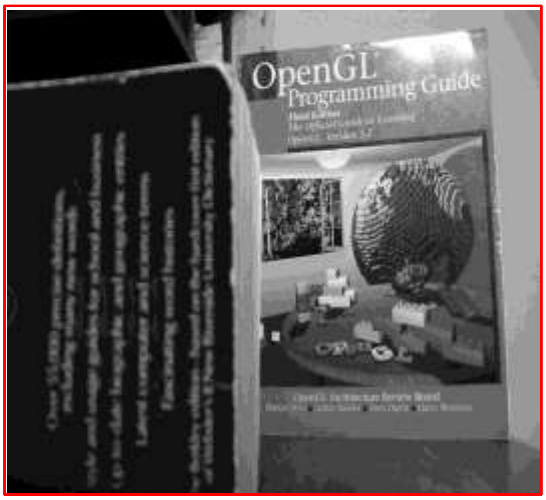

Figure 8: Reference Book Image 1

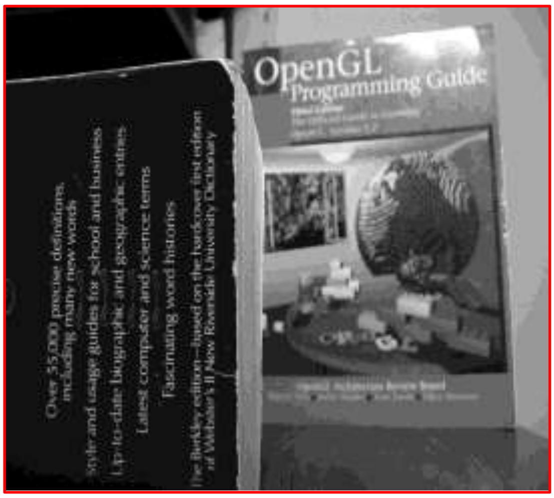

Figure 9: Reference Book Image 2

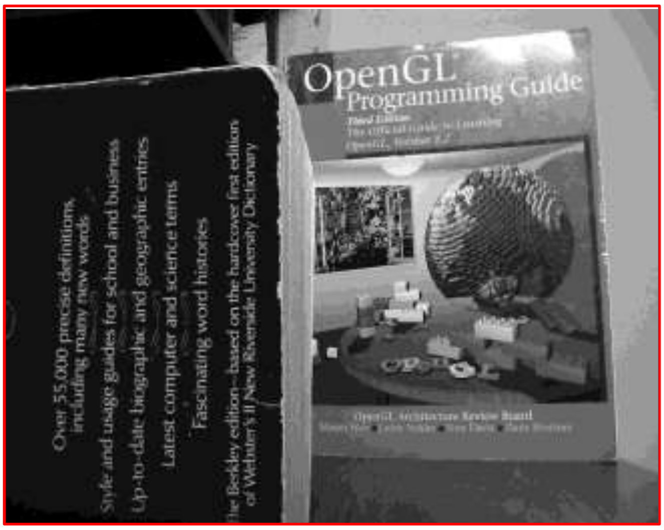

Figure 10: Final Book Image After Fusion

Table 1: Comparison of Mutual Information with bilateral gradient-based sharpness criterion

Test Image	Using a bilateral gradient-based sharpness criterion	Using Discreate Cosine Wavelet sharpness criterion
Clock	8.52	15.9909
Bottle	8.54	16.0835
Book	9.36	20.8909

V. CONCLUSION

A multi-focus image fusion approach using a new sharpness criterion that depends on statistics of image's gradient information is proposed in this dissertation. The proposed approach exploits a Discrete Cosine Wavelet criterion to adaptively perform image fusion by selecting most informative (sharp) information from the input images. The proposed Discrete Cosine Wavelet sharpness criterion outperforms over Bacterial conventional sharpness criterions, as verified in our extensive experiments using four sets of test images under two objective metrics, and the comparison takes places in the table and shows that resultant image is better quality than the previous method.

REFERENCES

[1]. KMM, "Design and Fabrication of Color Scanner," Indian Journal of Technology,, vol. 15, 1997.
[2]. R. Jenson, "Digital Image Processing - A Remote Sensing Perspective, Jhon 3rd Edition," 2003.
[3]. A. K. Jain, "Fundamentals Of Digital Image Processing -," in Prentice-Hall, 1989.
[4]. R. C. G. Woods and A. Wesley, "Digital Image Processing," 1992.
[5]. M. Ramanjaneyulu and K. Rao, "A Novel technique to Resample High Resolution Remote Sensing Satellite Images," in Proc. of IGRASS-02.
[6]. K. R. Castleman, "Digital Image Processing," in Prentice-Hall, 1996.
[7]. K. Rao, "Image Processing for Medical Applications,," in Proc. of 14th world conference on NDT, 1996.
[8]. N. Damera-Venkata, T. Kite, W. Geisler, B. Evans and A. Bovik, "Image quality assessment based on a degradation model," Image Processing, IEEE Transactions on, vol. 9, no. 4, pp. 636-650, Apr 2000.
[9]. K. Haris, S. Efstratiadis, N. Maglaveras and A. Katsaggelos, "Hybrid image segmentation using watersheds and fast region merging," Image Processing, IEEE Transactions on, vol. 7, no. 12, pp. 1684-1699, Dec 1998.
[10]. P. C. Teo and D. J. Heeger, "Perceptual image distortion," in in Proc. SPIE, 1994.
[11]. G. Strang and T. Nguyen, Wavelets and Filter Banks, Wellesley College, 1996.
[12]. M. G. E. Schneiders, "Wavelets in control engineering. Master's thesis," 2001.
[13]. B. D. Kraker, "A numerical-experimental approach in structural dynamics," 2000.
[14]. H. B. Barlow, "Possible principles underlying the transformation of sensory messages," in in Sensory Communication, 1961.
[15]. N. Ahmed, T. Natarajan and K. R. Rao, "Discrete cosine transform," Computers, IEEE Transactions on, vol. 100, no. 1, pp. 90-93, 1974.
[16]. R. J. Clarke, "Transform coding of images," Astrophysics, vol. 1, 1985.
[17]. G. Strang, "The discrete cosine transform," SIAM review, vol. 41, no. 1, pp. 135-147, 1999.
[18]. G. Aggarwal and D. D. Gajski, Exploring DCT implementations, Citeseer, 1998.
[19]. W. Huang and Z. L. Jing, "Multi-focus image fusion using pulse coupled neural network," Pattern Recognition Letters, vol. 28, no. 9, pp. 1123-1132.
[20]. G. Pajares and J. M. Cruz, "A wavelet-based image fusion tutorial," Pattern Recognit, vol. 37, no. 9, pp. 1855-1872, 2004.
[21]. S. Nikolov, P. Hill, D. Bull and N. Canagarajah, "Wavelets for image fusion," in Wavelets in signal and image analysis, 2001.
[22]. L. Shutao and B. Yang, "Multifocus image fusion using region segmentation and spatial frequency," Image and Vision Computing, pp. 971-979, 2008.
[23]. H. M. B. Akbari, A. Aghagolzadeh and H. Seyedarabi, "Real-time fusion of multi-focus images for visual sensor networks," in Machine Vision and Image Processing (MVIP), 6th Iranian. IEEE, 2010.
[24]. J. Tian, L. Chen, L. Ma and W. Yu, "Multi-focus image fusion using a bilateral gradient-based sharpness criterion," Optics communications, vol. 284, no. 1, pp. 80-87, 2011.
[25]. M. Reenu, D. David, S. Raj and M. Nair, "Wavelet Based Sharp Features (WASH): An Image Quality Assessment Metric Based on HVS," in Advanced Computing, Networking and Security (ADCONS), 2013 2nd International Conference on, 2013.