Available online at: http://www.ijmtst.com/vol4issue11.html
International Journal for Modern Trends in Science and Technology
ISSN: 2455-3778 :: Volume: 04, Issue No: 11, November 2018

Multi-focus and Multi-modal image fusion using Segmentation approach

Dr. Keyur Brahmbhatt

IT Department, BVM Engineering College, VV Nagar, Gujarat, India

To Cite this Article
Dr. Keyur Brahmbhatt, "Multi-focus and Multi-modal image fusion using Segmentation approach", *International Journal for Modern Trends in Science and Technology*, Vol. 04, Issue 11, November 2018, pp.-16-20.

Article Info
Received on 21-Oct-2018, Revised on 19-Nov-2018, Accepted on 26-Nov-2018.

ABSTRACT

The complete fusions of one or more images gain from various modalities or gadget is very importance in many applications, such as microscopic imaging, computer vision, medical imaging, remote sensing, and robotics. Various feature of one or more image can combine and generate a new image called fused image and the procedure called image fusion. Perceptual significance is typically used as the criteria for preserving image features within an image fusion. The purpose of this research paper is to construct trustworthy methods that represent the visual information. The information gained from dissimilar imaging cameras, in a single merged image without the loss of data. Here using region consistency check image fusion rule in Ripplet transform, temporary fused image is generated. After that segmentation applied on temporary fused image and using spatial frequency image fusion rule best segment was chosen. Finally modernize the image. The results shows that proposed algorithm gives good result compare to existing algorithms.

KEYWORDS: *Fusion, Ripplet transform, N- cut segmentation, Temporary fused image, Region consistency check*

I. INTRODUCTION

One of the features of cameras with long focal spans is finite depth of field. The object within the depth of field is focused others are blurred. The image with all focused object will get by performing image fusion. The purpose of fusing images is to integrate harmonizing and surplus information from various images to produce a combined image that having better results than any of the individual input images. The process of fusing image is doing important roles in so many fields such as biomedical imaging, remote sensing, robotics, and computer vision and defense system [13]. Fusion procedure can start without registration of image if images have been taken by still cameras. While images are taken by mobile camera, before applying fusion registration of image must required. The method of spatially aligning two or more images of a sight is known as image registration. The procedure brings into association of each pixel in the images [4]. The warping mold selected to line up the images should be a correct illustration of the geometric disparity between images. When the view is almost flat and the depth of the camera to the sight is somewhat bigger than variation in image depth, taken images will be correlated by the affine transformation. Under this corresponding lines in a sight appear similar in an image. If tiny depth but distances of scene is high then images will be correlated by the projective transformation. With this, straight lines will appears straight in the images [1]. In this research paper, all registered images have been taken. Image fusion is also very helpful in medical diagnosis. Two medical images like CT, MRI, and PET etc. have been merged to get more information from a single image. Here Magnetic Resonance Imaging (MRI) images and Computer Tomography (CT) were used to make fusion using fusion rules.MRI images gives soft tissues and CT images gives bone structure.

II. METHODS

Transform domain processing techniques consists of three major parts [7]:

- Decomposition
- configuration of the initial image
- Re-composition.

A. Ripplet Transform

Fourier Transform and Wavelet Transform are Conventional transforms which endure from discontinuities like edges and contours in images. To deal this problem, Jun Xu et al. proposed a new transform known as Ripplet Transform (RT). The RT having higher dimensional simplification of the Curvelet Transform (CVT) which is capable of presenting images or 2D signals at dissimilar levels and dissimilar directions. To achieve anisotropic directionality, CVT utilizes a parabolic scaling law. Here, the anisotropic property of CVT ensures to resolve 2D singularities along C2 curves [12]. While, RT gives a new tight frame with sparse illustration for images without continuity along Cd curves [14].

B. Segmentation

A procedure of partitioning an image into its ingredient's pieces or objects in the image i.e set of pixels called Image Segmentation. The pixels in an area are similar according to some homogeneity features like texture, color, intensity etc. The features are used to place and recognize boundaries of an image [7]. The aim of isolating an image is to analyze the image to extort all information [2]. There are mainly three techniques namely [6]:

- Threshold based techniques

The threshold based technique is the most spontaneous of them all. It is found of local pixel intensity stages. The existing image is match up to the background of an image and a threshold value.

- Edge based techniques

Edge-based method is found of the general method of finding boundaries of an image and discontinuities in an image. An edge is a collection of tied pixels having same intensity plane, between two adjacent pixels. That can be differentiated by guesstimate the intensity gradient, i.e., variance in contrast.

- Region based techniques

The region-based method divides an image into regions. First, the boundaries of an image and discontinuities in image are looked, i.e., high intensity varies in the pixel values. As be against to an edge, a region is comprehensive concepts and is shaped by a closed path. The pixel values surrounded by the regions are compared to some pre-defined connectivity modal, which must be picked very cautiously since an over rigorous criterion creates splintered regions and a merciful criterion overlook blurred regions. Then, some kind of part mounting is applied which causing slighter regions to combine into bigger regions. This process ends with well divided regions that are created by the intensity plane differences.

III. PROPOSED ALGORITHM

The input images should be registered to ensure that the consequent pixels would be aligned. In this section first spatial frequency fusion rule has been discussed. The procedure of proposed algorithm is shown in figure 1.

A. Fusion Rule

The spatial frequency [10], which is initiated from the human visual system, shows the active plane in an image. The human visual system is multifaceted to understand with current physiological means. But an efficient quality of an image fusion achieved by the utilization of spatial frequency. The spatial frequency of an image is calculated by:

Assume that an image of size K x L, where K = the number of rows and L = the number of columns is taken. The row (RF) and column (CF) frequencies of the image is calculated by

$$RF = \sqrt{\frac{1}{KL}\sum_{k=0}^{K-1}\sum_{l=1}^{L-1}[F(k,l) - F(k,l-1)]^2} \qquad (1)$$

Where F (m, n) is the gray value of pixel at position (m, n) of image F.

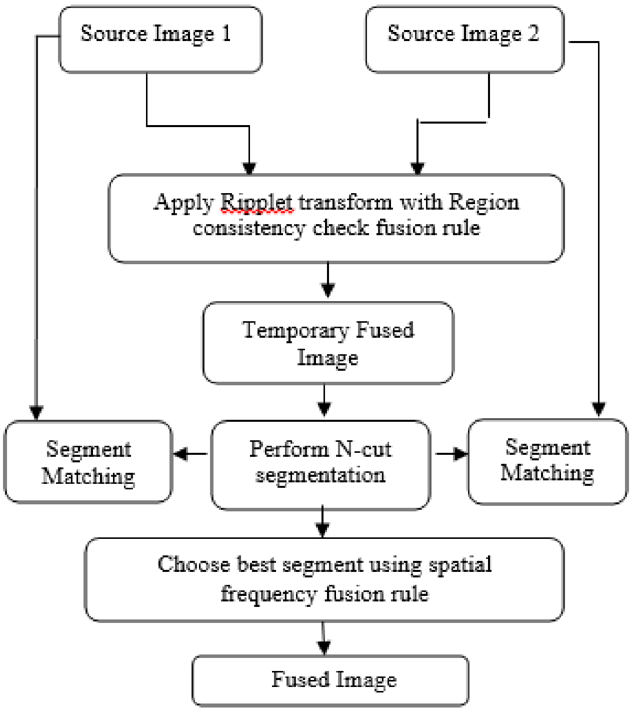
$$CF = \sqrt{\frac{1}{KL}\sum_{k=0}^{K-1}\sum_{l=1}^{L-1}[F(k,l) - F(k-1,l)]^2} \qquad (2)$$

The total spatial frequency of the image is then

$$SF = \sqrt{(RF)^2 + (CF)^2} \qquad (3)$$

B. Proposed algorithm

Proposed algorithm includes image fusion of multi focus and multi-modal images in Ripplet transform using Segmentation. Here temporary fused image generated first and then best segment has been chosen. Finally more informative fused image has been generated.



Following statements are the steps of proposed algorithm:

1. Perform the basic image fusion – Region consistency check[3] in Ripplet Transform on source image 1 and source image 2
2. Apply N-cut segmentation[10] on Fused image
3. Perform segmentation matching on source image 1 and source image 2 using result of step 2.
4. Choose best segment using Fusion rule with spatial frequency
5. Merge all segments and display the final fused image.

IV. Results and Discussion

Fusing process has been applied to achieve useful information. Here the point is to improve the image data by fusing images like left multi-focus image and right multi-focus image in multi-focus image fusion and CT and MRI images in multi-modal image fusion. Experimental results of image fusion methods applied on two input images from multi-focus dataset [15] and multi-modal dataset [11].

Figure 2 shows the input images for multi-focus image fusion and figure 5 shows the input images for multi-modal image fusion.

Figure 3 and figure 6 shows qualitative analysis of simulation. Image fusion algorithms have been measured using 5 standard measuring parameters like RMSE [8], PSNR [5], NCC [5], Standard deviation (SD) [8] [9] and entropy [5].

The implementation has been done in MATLAB 13.

Input image 1 Input image 2

Figure 2: input images for multi-focus image fusion [15]

(a) Result of fusion rule: Averaging (Spatial domain)

(b) Result of fusion Rule: Region consistency check (Frequency domain - Ripplet transform)

Figure 3: Multi-focus image fusion: (a) Result of fusion rule – Averaging in spatial domain (b) Result of fusion rule – region consistency check in frequency domain (Ripplet transform)

Table 1: Quantitative analysis of proposed method and averaging image fusion using segmentation.

Image set	Algorithm	RMSE	PSNR	NCC	SD	Entropy
B1.bmp B2.bmp	Segmentation with averaging fusion rule	.159	6.09	.00	.24	.21
	Segmentation with region consistency check	0.001	61.80	0.99	0.49	7.08
W1.bmp W2.bmp	Segmentation with averaging fusion rule	0.195	54.65	1.00	0.42	5.23

	Segmentation with region consistency check	0.031	55.62	0.99	0.48	7.32
W3.bmp W4.bmp	Segmentation with averaging fusion rule	0.062	0.18	.99	.25	.82
	Segmentation with region consistency check	.001	8.82	.99	.48	.95

Table 1 shows the quantitative analysis of proposed algorithm and averaging image fusion using segmentation. Based on this analysis columnar chart has been generated as shown in figure 4.

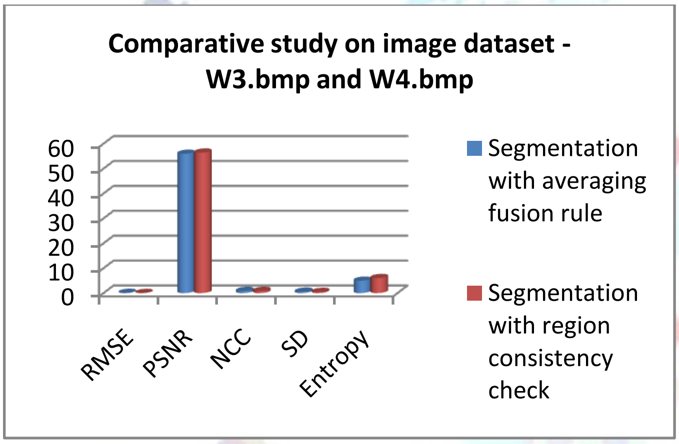
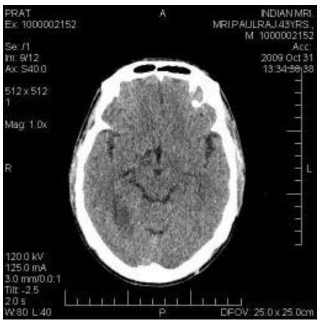
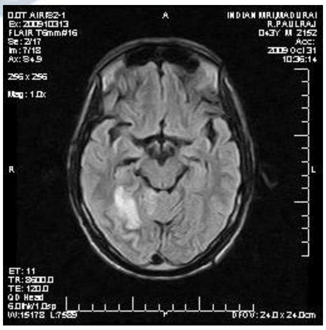


Figure 4: Columnar chart of comparative study of multi-focus image dataset – W3.bmp and W4.bmp using proposed algorithm and averaging image fusion with segmentation.

The value of RMSE should be low and the value of PSNR, SD, and entropy should be high. The value of NCC must be in the range of 0-1. Nearest to 1 means gives higher robustness. Figure 4 clearly shows that our proposed algorithm gives low RMSE and others parameters gives high values.



Input image 1



Input image 2

Figure 5: input images for multi-focus image fusion [11]

(a) Result of fusion rule: Averaging (Spatial domain)

(b) Result of fusion Rule: Region consistency check (Frequency domain - Ripplet transform)

Figure 6: Multi-focus modal fusion: (a) Result of fusion rule – Averaging in spatial domain (b) Result of fusion rule – region consistency check in frequency domain (Ripplet transform)

Table 2: Quantitative analysis of proposed method and averaging image fusion using segmentation

Image set	Algorithm	RMSE	PSNR	NCC	SD	Entropy
C1.jpg M1.jpg	Segmentation with averaging fusion rule	0.0624	5.9	.836	.53	.9348
	Segmentation with region consistency check	.0222	6.3	.841	.4	.0150
C2.jpg M2.jpg	Segmentation with averaging fusion rule	0.0523	55.9	0.793	0.50	4.9499
	Segmentation with region consistency check	0.0179	56.86	0.800	0.4	5.9022
C7.jpg M7.jpg	Segmentation with averaging fusion rule	0.0624	5.9	0.836	0.53	4.8438
	Segmentation with region consistency check	0.0222	56.39	0.809	0.4	6.0294

Table 2 shows the quantitative analysis of proposed algorithm and averaging image fusion using segmentation. Based on this analysis columnar chart has been generated as shown in figure 7.

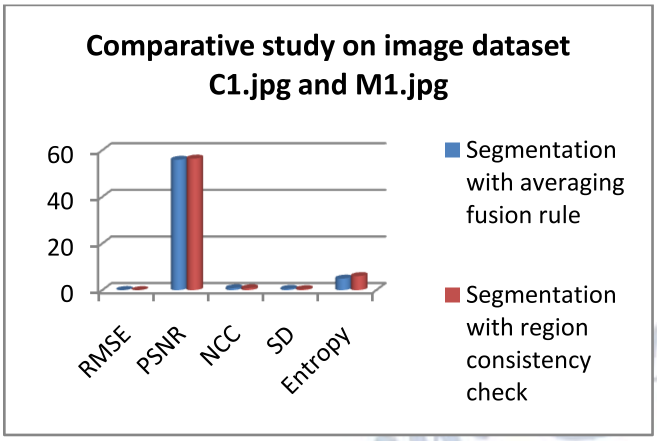


Figure 7: Columnar chart of comparative study of multi-modal image dataset – C1,jpg and M1.jpg using proposed algorithm and averaging image fusion with segmentation.

The value of RMSE should be low and the value of PSNR, SD, and entropy should be high. The value of NCC must be in the range of 0-1. Nearest to 1 means gives higher robustness. Figure 7 clearly shows that our proposed algorithm gives low RMSE and others parameters gives high values.

V. Conclusion

In this research paper, a novel region-based multi-focus and multi-modal image fusion algorithm is intended. There are three benefits of region based image fusion: (1) It is a process of regions rather than each pixels, which is useful to defeat of blurring effects, sensitivity to noise and mis-registration; (2) Complexity of algorithm is reduced as well as it improves the quantitative and qualitative results of fused image; (3) The rules of the fusion are found on gathering groups of pixels which form a region of an image. The heart of our proposed algorithm is to do image segmentation with the help of normalized cuts on the intermediate resultant fused image, then the segmented regions are fused using spatial features. The comparison is made on proposed algorithm and spatial method. Implementation results on pairs of images which show that the quite better results are achieved.

Acknowledgment

This research paper is made probable with the help and support from parents, professors, family, friends, and in spirit of, all sentient beings. Especially, please permit me to donate our acknowledgment of thankfulness toward the CHARUSAT University who provides platform for us to do the research on Image Fusion.

References

[1] A. ArdeshirGoshtasby, Fusion of Multifocus Images to Maximize Image Information, Department of Computer Science and Engineering ,Wright State University, Dayton, OH 5435,2006

[2] GurjeetkaurSeerha, Rajneetkaur, Review on Recent Image Segmentation Techniques, International Journal on Computer Science and Engineering (IJCSE), Vol. 5 No. 02, 2013, pp. 1-6.

[3] Miao Qiguang; Wang Baoshu, A Novel Image Fusion Method Using Contourlet Transform,2006 International Conference onCommunications, Circuits and Systems Proceedings , vol.1, no., 25-28 June 2008, pp.548,552

[4] P. E. Anuta, Registration of multispectral video imagery, Society Photo-Optical Instrum. Eng. J., 7:168–175, 1969

[5] Prof. Keyur N. Brahmbhatt, Dr. Ramji M. Makwana, COMPARATIVE STUDY ON IMAGE FUSION METHODS IN SPATIALDOMAIN, International Journal of Advanced Research in Engineering and Technology (IJARET), ISSN 0976 – 6480(Print), ISSN 0976 – 6499(Online) Volume 4, Issue 2, March – April (2013), pp. 1-6.

[6] Rafael C. Gonzalez, Richard E. Woods, " Digital image Processing", Second edition, Prentice Hall

[7] Rajesh Dass, Priyanka, Swapna Devi, "Image Segmentation Techniques", IJECT Vol.3, Issue 1, Jan-March 2012, pp. 1-6

[8] R.J.Sapkal, S.M.Kulkarni, Image Fusion based on Wavelet Transform for Medical Application, International Journal of Engineering Research and Applications (IJERA), ISSN: 2248-9622 ,Vol. 2, Issue 5, September- October 2012, pp.624-627

[9] Shengpeng Liu, Min Wang, and Yong Fang, AContourlet Transform Based Fusion Algorithm for Nighttime Driving Image, L. Wang et al. (Eds.): SKD006, LNAI 4223, 2006, pp. 491-500.

[10] Shutao Li, Bin Yang, Multifocus image fusion using region segmentation and spatial frequency, Elsevier, Image and Vision Computing 2 6 (2008), pp. 971–979.

[11] S Rajkumar,Chandra Prakash, P. V. S. S. R. Chandra Mouli, Medical Image Fusion Based on Redundancy DWT and Mamdani Type Min-sum Mean-of-max Techniques with Quantitative Analysis, International Conference on Recent Advances in Computing and Software Systems (2012), pp. 1-6.

[12] Starck, J. L., E. J. Candes, and D. L. Donoho, \The curvelet transform for image denoising," IEEE Transactions on Image Processing, Vol. 11, No. 6, June 2002, pp. 670-684.

[13] Wei Huang, Zhongliang Jing, Evaluation of focus measures in multi-focus image fusion, Elsevier, Pattern Recognition Letters 28 (2007) , pp. 493–500.

[14] Xu, J., L. Yang, and D. Wu, \Ripplet: A new transform for image processing," Journal of Visual Communication and Image Representation, Vol. 21, No. 7, October 2010, pp.627-639.

[15] Yu Liu, University of Science and Technology of China, Hefei, China.