IOSR Journal of Electronics and Communication Engineering (IOSR-JECE)
e-ISSN: 2278-2834,p- ISSN: 2278-8735.Volume 9, Issue 2, Ver. VIII (Mar - Apr. 2014), PP 107-109
www.iosrjournals.org

Implementation of Discrete Wavelet Transform Based Image Fusion

Vadher Jagruti

Abstract: *Image fusion is the process by which two or more images are combined into a single image retaining the important features from each of the original images. Due to imperfections of imaging devices (optical sensors) and instability of the observed scene (object motion), acquired images are often blurred,and may exhibit insufficient resolution.So image fusion can be used to get improved image resolution.There are many methods for image fusion,from which wavelet transform based image fusion has advantage over other spatial domain methods in terms of spatial and spectral resolution.In this paper,discrete wavelet transform based image fusion is implemented.*

Keywords**:** *Image fusion,discrete wavelet transform(DWT),similarity measure.*

I. Introduction

A. **Image fusion**

Image fusion is the process that combines information from multiple images of the same scene. These images may be captured from different sensors, acquired at different times, or having different spatial and spectral characteristics. The object of the image fusion is to retain the most desirable characteristics of each image.[1]

With rapid advancements in technology, it is now possible to obtain information from multi source images to produce a high quality fused image with spatial and spectral information [1] [2]. Important applications of the fusion of images include medical imaging, microscopic imaging, remote sensing, computer vision, and robotics.Fusion techniques include the simplest method of pixel averaging to more complicated methods such as principal component analysis and wavelet transform fusion. Several approaches to image fusion can be distinguished, depending on whether the images are fused in the spatial domain or they are transformed into another domain, and their transforms fused. The actual fusion process can take place at different levels of information representation [3]. A generic categorization is to consider the different levels as, sorted in ascending order of abstraction:pixel, feature and decision level[4]. In pixel level fusion,information is obtained from a set of associated pixels.In feature level fusion,information is obtained from features such as edges,regions having particular characteristic and pixel intensities etc. Decision-level fusion consists of merging information at a higher level of abstraction, combines the results from multiple algorithms to yield a final fused decision.

B. **Objective:**

In image fusion,fusion rule and selection of wavelet plays an important role in deciding quality of fused image when wavelet transform is applied to multifocus image fusion.The main objective of the paper is to determine with which wavelet basis function the proposed DWT based image fusion provides better result.

II. Image Fusion Techniques

Fusion techniques are broadly classified into two groups:spatial domain and transform domain.In spatial domain,operation is performed directly on pixels.

The fusion methods such as averaging, Brovey method, principal component analysis (PCA) and IHS based methods fall under spatial domain approaches. Another important spatial domain fusion method is the high pass filtering based technique. The disadvantage of spatial domain approaches is that they produce spatial distortion in the fused image. Spectral distortion becomes a negative factor while we go for further processing such as classification problem . Spatial distortion can be very well handled by frequency domain approaches on image fusion. The multi resolution analysis has become a very useful tool for analyzing remote sensing images.[1] The discrete wavelet transform has become a very useful tool for fusion. Some other fusion methods are also there such as Laplacian-pyramid based, Curvelet transform based etc. These methods show a better performance in spatial and spectral quality of the fused image compared to other spatial domain methods of fusion.

III. Wavelet Transform Based Image Fusion

Due to the limited focus depth of the optical lens it is often not possible to get an image that contains all relevant objects in focus. To obtain an image with every object in focus a multi-focus image fusion process is required to fuse the images giving a better view for human or machine perception.

A.Preprocessing for image fusion:

The basic steps performed in image fusion given in fig. 1.

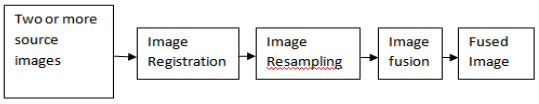

Figure-1.

At the beginning of fusing images, image registration make sure that each pixel at correlated images has the connection between images in order to fix the problem of distortion image[4].After registration, resampling is done to adjust each image that about to fuse to the same dimension. After resampling, each image will be of the same size. Images with the same size will be easy for fusing process. Inverse transfer is necessary if image has been transferred into another domain.

B. **DWT based image fusion**

Wavelet transform is a mathematical tool developed originally in the field of signal processing. It can also be applied to fuse image data following the concept of the multi-resolution analysis (MRA) [5]. The multi-resolution wavelet transform is an intermediate representation between Fourier and spatial representations; it can provide good localization properties in both spatial and Fourier domains.

2-D Discrete Wavelet Transformation (DWT) converts the image from the spatial domain to frequency domainIn DWT,two channel filter bank is used. By applying the 1-D discrete wavelet transform (DWT) along the rows of the image first, and then along the columns to produce 2-D decomposition of image[7], the wavelet transform decomposes the image into low-low,low-high,high-low and high-high frequency components as shown in figure-2..These four components are referred to as approximation,horizontal,vertical and diagonal coefficients respectively because low-low frequency components contains average information whereas the other components contain directional information due to spatial resolution. Higher absolute values of wavelet coefficients in the high bands correspond to salient features such as edges or lines [4][5][6].

In DWT based image fusion(figure-2),first DWT is applied to source images to obtain wavelet coefficients and appropriate fusion rule is used.Finally, Inverse DWT is applied for reconstruction of final fused image.

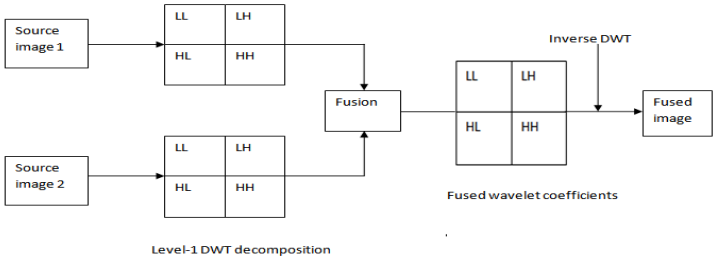

Figure-2.DWT based image fusion

C.Image Fusion Rule Used:

The image fusion techniques mainly perform a very basic operation like pixel selection, addition, subtraction or averaging.

Simple Average: It is a well documented fact that regions of images that are in focus tend to be of higher pixel intensity. Thus this algorithm is a simple way of obtaining an output image with all regions in focus. The value of the pixel of each image is taken and added. This sum is then divided by 2 to obtain the average. The average value is assigned to the corresponding pixel of the output image .This is repeated for all pixel values.

Select Maximum**:**The greater the pixel values the more in focus the image. Thus this rule chooses the in-focus regions from each input image by choosing the greatest value for each pixel, resulting in highly focused output. The value of the pixel of each image is taken and compared to each other. The greatest pixel value is assigned to the corresponding pixel [1] [5].

In proposed DWT based image fusion, average of approximation coefficients of both decomposed images is chosen so that low frequency information i.e. approximate information does not lost and to preserve high frequency information i.e. detail information , corresponding horizontal,vertical and diagonal coefficients of both source images are compared and select maximum rule is applied to get maximum coefficient value that is assigned to corresponding coefficient in fused image.

D..Image fusion evaluation criterion

Similarity Measures (SM) is the correlation of the fused images[8]. These measure provide a quantitative measure of the degree of match between two images, or image patches. Image similarity measures play an important

role in many image fusion algorithms and applications including retrieval, classification, change detection, quality evaluation and registration.

$$SM = \frac{\sum_{i=1}^{M} F(i,j) * R(i,j)}{\sum_{i=1}^{M} [F(i,j)^2 + R(i,j)^2] \sum_{j=1}^{N}}$$

Where, M, N indicate the size of the image is M×N, *F(i,j*), *R*(*i,j)* indicate the gray value of the pixel which is in the row i and in the column j of the image. The more close SM is to 1, the fusion effect is better.

IV. Result And Disscussion:

The DWT image fusion method with fusion rule applying averaging for approximate components and select maximum for other components is implemented with 5 wavelet basic function which are listed in Table are compared.

5 types of wavelet basis functions:
Haar, Daubechies, Biorthogonal, Coiflets, Symlets

Figure 4 shows the result of multifocus fusion of two images with proposed method.

Image 1 Image 2

Figure-4.Result of image fusion

V. Conclusion:

The proposed DWT based image fusion method is implemented in MATLAB and compared for 5 types of wavelet basis functions with the use of Similarity Measure (SM) as an image fusion evaluation criteria, it reflects the image fusion results. Finally we summarized the best wavelet as Haar ,as similarity measure obtained from fused image using proposed image fusion with Harr wavelet and an ideal image is approximately equal to 1.

References:

[1]. Shih-Gu Huang, "Wavelet for Image Fusion"

[2]. Susmitha Vekkot, and Pancham Shukla "A Novel Architecture for Wavelet based Image Fusion". World Academy of Science, Engineering and Technology 57 2009

[3]. Chen Yunhao, Deng Lei, Li Jing, Li Xiaobing and Shi Peijun, ―A new wavelet-based image fusion method for remotely sensed data‖, *International Journal of Remote Sensing* ,Vol. 27, No. 7, 10 April 2006, 1465–1476.

[4]. Deepali A. Godse,Wavlet based Image Fusion Using Pixel Based Maximum Selection Rule, International Journal of Engineering Science and Technology (IJEST).

[5]. Gonzalo Pajares , Jesus Manuel de la Cruz "A wavelet-based image fusion tutorial" 2004 Pattern Recognition Society.

[6]. Stavri Nikolov Paul Hill David Bull Nishan Canagarajah "WAVELETS FOR IMAGE FUSION"

[7]. Hasan. Demirel and Gholamreza. Anbarjafari, ―Discrete Wavelet Transform-Based Satellite Image Resolution Enhancement,‖ *IEEE Geosciences and Remote Sensing Letter*, VOL. 49, NO. 6, JUNE 2011.Brown, L. D., Hua, H., and Gao, C. 2003. A widget framework for augmented interaction in SCAPE

[8]. Hong ZHENG,Dequen ZHENG Yanxianag HU, Sheng Li. Study on the Optimal Parameters of Image Fusion Based on WaveletTransform[J]. *Journal of Computational Information Systems(2010)* 131-137