 ISSN: 2321-8169
35 – 38

Comparing Wavelet and Shearlet Transform for MR Image and CT Image Fusion

Miss.Bhagyashri G. Pardhi
Electronics and Telecommunication Engineering
MGICOET, Shegaon
Maharashtra, India
pardhibhagyashri@gmail.com

Prof. Rahul R. Ambalkar
Electronics and TelecommunicationEngineering
MGICOET, Shegaon
Maharashtra, India
ambalkar.rahul@gmail.com

Dr. C.M. Jadhao
Electronics and Telecommunication Engineering
MGICOET, Shegaon
Maharashtra, India
cmjadhao@gmail.com

Abstract—Image fusion is the process of combining multiple images into a single image. The resulting image will be more informative than the input images. Image fusion improves the quality of image and reduces randomness and redundancy. Image fusion is used in intelligent robots, medical imaging, electronic circuit design etc. The image fusion is classified in two types: spatial domain fusion and frequency domain fusion. Wavelet transform based technique is very helpful in image fusion. Discrete wavelet transform used for better clarity of image fusion. This paper present various image fusion techniques and comparison of wavelet and shearlet transform for MRI image and CT image fusion.

Keywords-Image fusion, MRI, CT, wavelet transform, shearlet transform

*****

I. INTRODUCTION

Fusion of the image will provide more information than any of the input images. In medical field image fusion is done in case of Magnetic Resonance Image (MRI), Computed Tomography (CT), PET etc. In this paper we are using the fusion of MR Images and CT Images. CT image used for ascertain difference in tissue. MRI images used for diagnosing. Fused images will be beneficial for diagnosing and treating cancer [4].

Image fusion is divided in two types : Spatial domain and frequency domain. Spatial domain fusion is classified in simple average, maximum, minimum, max-min, simple block, brovey etc. Frequency domain is classified in DCT, wavelet transform, stationary wavelet transform etc. All spatial domain method is used as simple image fusion methods. In simple average method the fused image is obtained by averaging the pixel from the input images. In minimum or maximum pixel value method, select minimum or maximum pixel value from the input image to generate a fused image. In max-min method, fused image is obtained by averaging largest and smallest value of pixel from the input images. In simple block technique, one pixel is added to its neighboring pixel and a block average is calculated. Brovey transform is used to produce high contrast RGB image.
In Discrete Fourier Transform firstly separate the RGB Plaines if input images are colored. Then apply the various transform, calculate average of pixel to obtain fused transform. Now apply inverse transform and combine separate RGB plaines. In Discrete cosine transform, we have to divide the input image into non-overlapping block. Then compute the DCT coefficient for each block, apply fusion rules and apply IDCT on the fused coefficients. DCT is very simple and basic fusion technique and used for real time application.

II. MRI

MRI stands for Magnetic Resonance Imagining. MRI uses strong magnetic field and radio wave to produce images of the body. MRI contains powerful magnets.

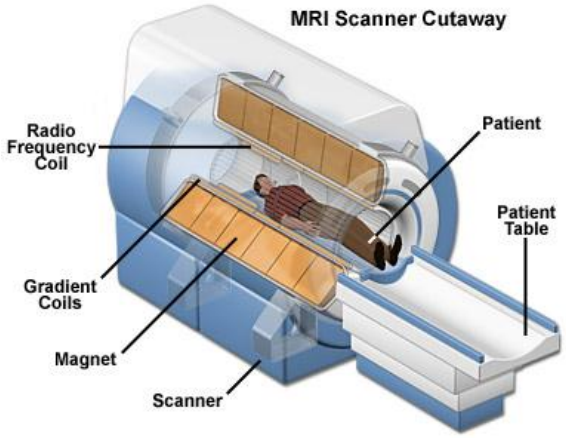


Figure 1: MRI

MRI is a medical imaging technique which helps to find the anatomy of the body. MRI does not provide any radiation like CT scan. Hence, MRI is more sensitive than CT. MRI is good for imaging without radiation, showing difference between normal and abnormal, imaging organs, soft tissue an internal structures.

III. CT SCAN

CT stands for Computerized Tomography. CT uses X-ray to form picture of the inside of body. Computed Tomography is 5-20 minute painless exam process.CT combine the power of X-rays with computers to produce 360 degree view of the body. CT able to scan image bone, soft tissue and blood vessels all at the same time.

 ISSN: 2321-8169
35 – 38

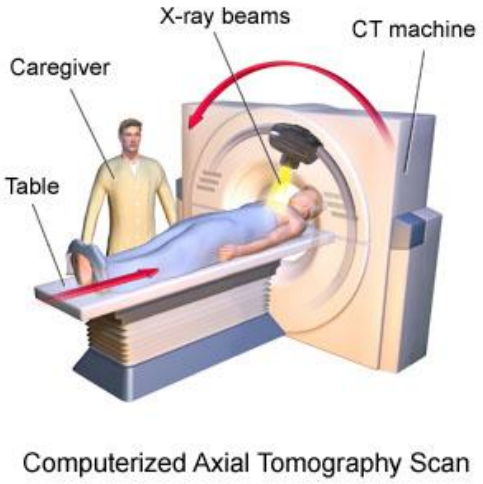


Figure 2: CT Scan

It provides the radiologist with detail of bony structure and detecting cancers. CT is not recommended for pregnant women or children. CT is good for detecting cancer, evaluating lung issues, imaging bone, soft tissue and blood vessels.

IV. WAVELET TRANSFORM

Wavelet transform is a mathematical tool used for data fusion. Image fusion algorithm is based on wavelet transform. Wavelet transform has good time-frequency characteristics. Wavelet transform can be used as multi resolution image fusion. By using wavelet transform fusion technique, fused image is just like a output images. As shown in figure(3)[5]

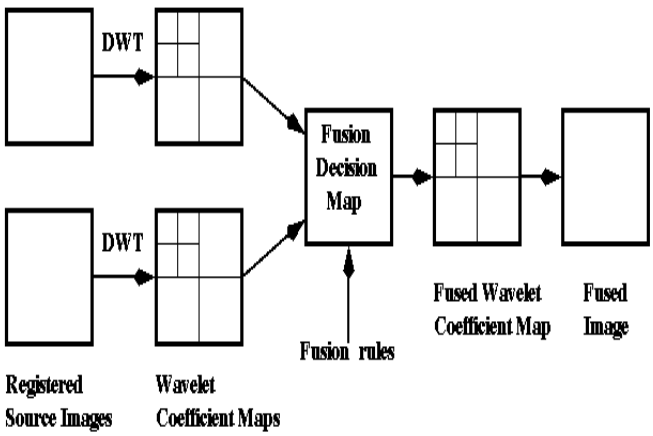


Figure 3. Block diagram of fusion of two image

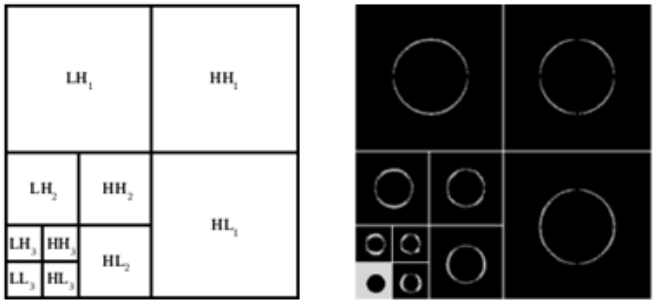


Figure4 . Pixel representation of image fusion

A. *Image fusion based on wavelet Transform*

For image fusion based on wavelet transform, firstly read two source images and resizes them. Now apply mallet algorithm to source image into low pass and high pass. At each level we get four images: low pass and three high pass. Now apply max wavelet coefficient rule for finding fused coefficient [1]. For construction from fused low pass and high pass coefficient apply mallet reconstruction algorithm..Figure 5 shows theFlow chart for image fusion based on wavelet Transform.

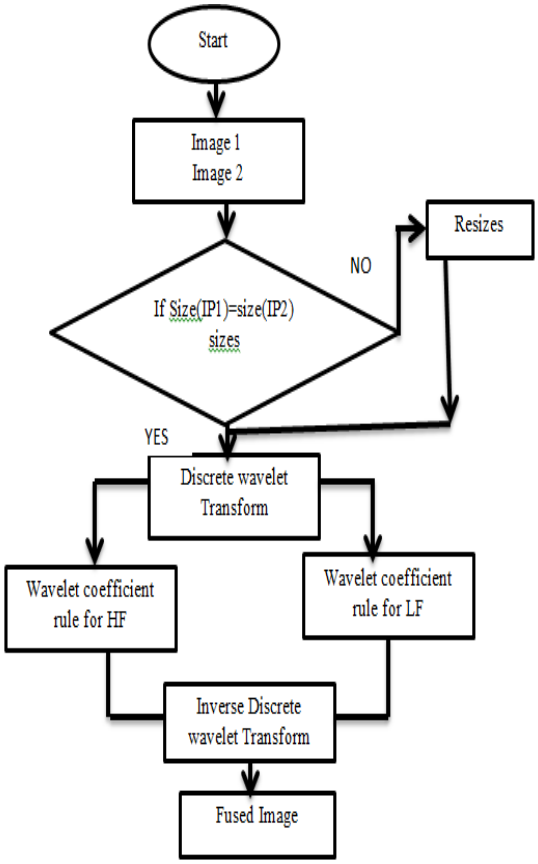


Figure 5: Flow chart for image fusion based onwavelet Transform

 ISSN: 2321-8169
35 – 38

Figure (6) shows the Practical representation of image fusion using DWT.

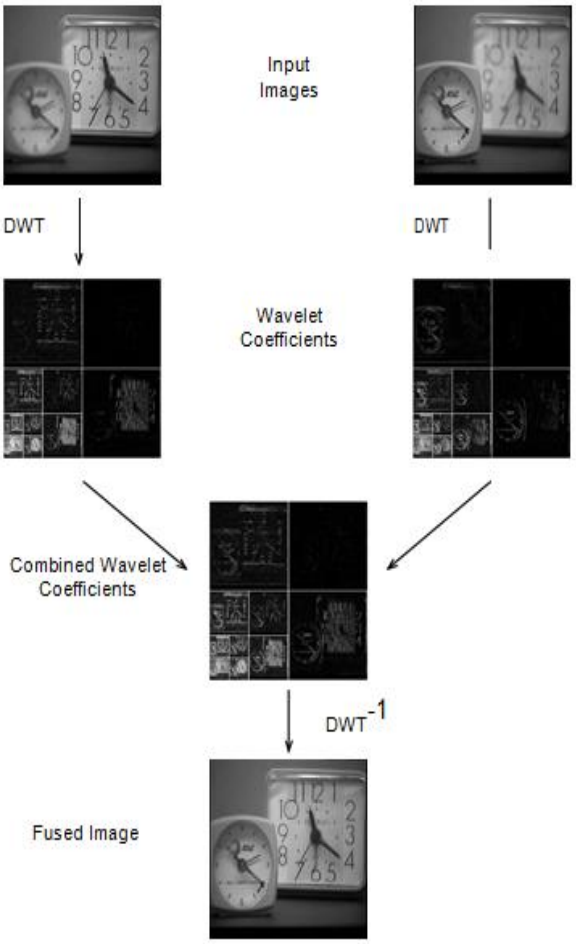
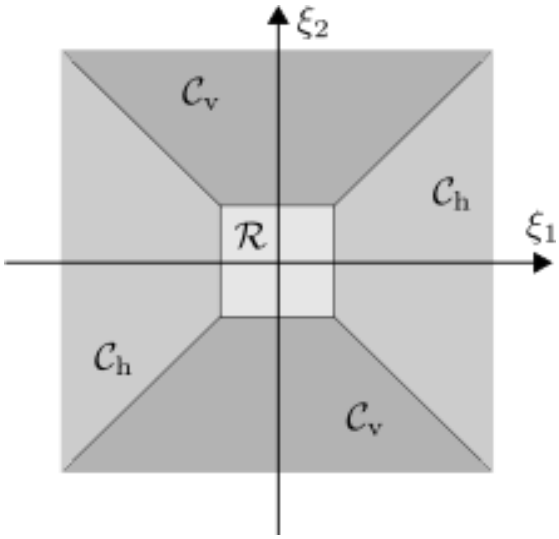


Figure 6: Practical representation of image fusion

V. SHEARLET TRANSFORM

Shearlet transform is a multi-tool. Shearlet has following properties like good localization characteristics, good directional sensitivity, represent rich directional sensitivity, and represent rich direction, parabolic characteristics. Shearlet are multi-scale framework which allows to encode different features in multivariate problem classes. Shearlet introduced for sparse approximation of functions $f \pounds L^2(R^2)$.



Where,

Cv= vertical cones
Ch= horizontal cones

$$R = F^L = \{(\xi_1, \xi_2) \in \mathbb{R}^2 \mid |\xi_1|, |\xi_2| \leq 1\},$$

$$C^H = \{(\xi_1, \xi_2) \in \mathbb{R}^2 \mid \xi_2/\xi_1| > 1, |\xi_1| > 1\}$$

$$C^V = \{(\xi_1, \xi_2) \in \mathbb{R}^2 \mid \xi_1/\xi_2| > 1, |\xi_2| > 1\}$$

Shearlet transform has two types continuous Shearlet and discrete Shearlet Transform. Continuous shearlet transform work on synthetic wavelet theory which provides an effective technique for geometry multi-scale analysis. The discrete shearlet transform is applied to MRI reconstruction in compressed sensing. Discrete shearlet transform of MRI images into two steps: multi-scale subdivision and localized direction.

A. Image fusion based on Shearlet Transform

For image fusion based on Shearlet transform, firstly read two registered images. Now apply shearlet transform, we get two images(A', B'). Calculate high frequency coefficient and low frequency coefficient. Apply fusion rules to them. We get fused image F'. Now apply inverse shearlet transform to fused image F' and get fused image as an output image.To obtain fused images apply inverse shearlet transform. In inverse shearlet transform the modified fused coefficients are reconstructed.

ISSN: 2321-8169
35 – 38

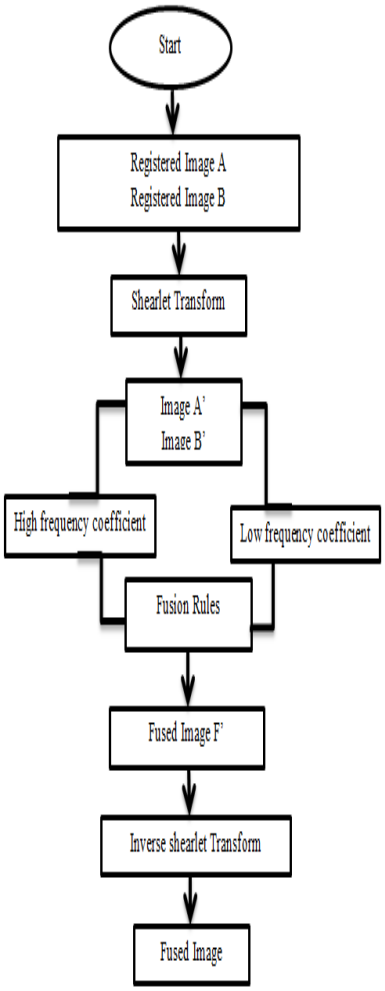


Figure 7: Flow chart for image fusion based onShearlet Transform

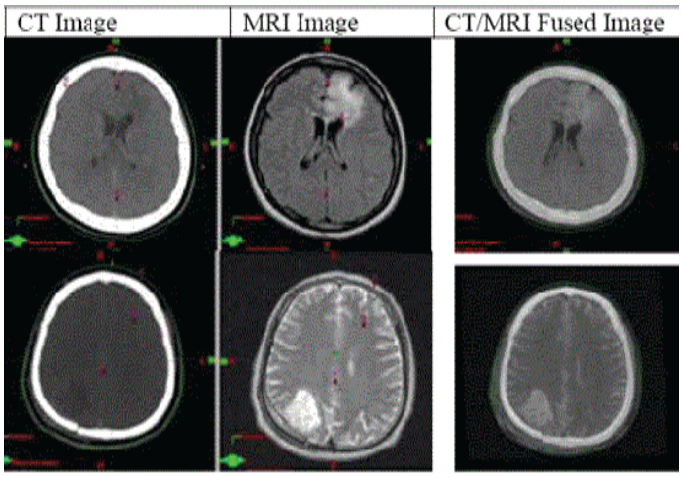


Figure8 : Medical image fusion for CT scan and MRI

REFERENCES

[1] Kanagasabapthy and Vasuki , "Image fusion based on wavelet Transform," International Journal of Biomedical Signal Processing, 2(1), 2011, pp, 15-19. *(references)*

[2] Hari om shanker Mishra and smriti Bhatnagar, "MRI and CT image fusion based on wavelet transform,"International Journal of information and computation Technology, ISSN 0974-2239 Voume 1(2014), pp. 47-52.

[3] Dhirendra Mishra and Bharti Palkar , "Image fusion techniques," Intenational Journal Computer Application(0975-8887) Volume 130 –No 9, November 2015.

[4] Alwin Pinakas, Dr. Sujini paul and Dr. Ponamary Pushpalatha, " A Comparitive study of image fusion in MRI and CT Images" International Journal of Mechanical Engineering and information Technology, Volume 2, Issue November, page no: 875-882, ISSN:2346-196x

[5] Wavelet for image fusion.pdf