International Journal of Innovative Technology and Exploring Engineering (IJITEE)
ISSN: 2278-3075, Volume-2, Issue-1, December 2012

An Efficient Technique of Multimodality Medical Image Fusion using Improved Contourlet Transformation

Jaspreet Kaur, Chirag Sharma

Abstract*: In medical field to diagnosis the disease an advance technology is used that is multimodality images. To find best diagnosis for a particular disease we perform image fusion. Major issue in multimodality medical image fusion is how to fuse two or more images of different modalities, so that we get more accurate information. To perform efficient fusion contourlet transformation gives the up to mark results. So, In this paper, we propose an improved contourlet transformation, in which we are using multi scale decomposition and considering that DFBs can be modified with Log Gabor Filter in place of low pass and high pass filter. Log Gabor filter localizes an image more accurately and also minimizes the DC Component (noise in image) with which we are improving the quality of fused image. In this paper, we are considering Registered Medical Images. Performance of proposed method is evaluated by five qualities.

Keywords: CNT, DFBs, Log Gabor Filter Multimodalities Medical images fusion.

I. INTRODUCTION

An image fusion can be defined as a process of combining two or more images in one single image without any loss of information. Main objective of image fusion is to merge the complementary and redundant information from different images into one fused images which results in more accurate and clear information. This information can be used for different purposes like human visual and machine perceptions, diagnosis, analysis. Basically there are two image fusion systems. First, Single sensor image fusion system in which we use one sensor that capture multiple images and then fusion them into one image. Imaging sensor has limited capability and does not work in bad environment like clicking an image in fog and rain. Second, Multisensor image fusion system in which we use multiple sensor devices mainly we use infrared cameras which has capability to work in bad environmental conditions. There are three basic levels of image fusion. Pixel level image fusion is at lowest level and contains detailed information. Feature level we simply extract features of different images that are to be fused and then fuse that features to get new image and at last decision level which consist of compact data. Decision level fusion is effective for complicated systems with multiple true or false decisions but not suitable for general applications. All decision and control are decided according to the result of decision level image fusion [1].

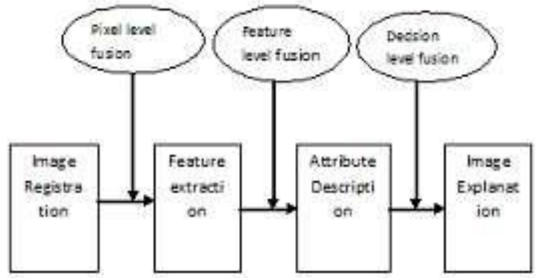

Fig. 1 Basic levels of fusion [1]

A. Multimodality Medical Image Fusion

Medical images are used by doctors to get information about the patient body and to detect any disease. There are several types of diagnostic tools available to capture an image of patient's body. Different types of medical images like X rays which is used to detect broken bones. CT (computer tomography) provide us structure of bones in patient body. These images are used to provide us detail information regarding body parts. MRI is used to get information about soft tissues, organs in human body. It does not use X rays and radiations that harm to our body. Ultrasound is a safe and less harmful image processing, in which high frequency sound waves are used.PET that stands for positron emission tomography. Medical imaging is an important term in field of research, diagnosis and treatment. Multimodality medical image fusion is a process to merge images that are captured by different modalities such as CT, MRI and PET and which results in more useful information for diagnosis or doctors regarding patient's body. Various fusion techniques has attracted more researchers in this domain to assist the physicians in fusing and retrieving information from different modalities such as CT, MRI, PET, SPECT and so on[4].

B. Image Fusion Techniques

Image fusion techniques can be categories into two domains: spatial domain and frequency domain. In spatial domain we covert an image in the form of matrix and then process it. In frequency domain images are represented in form of signal or sub bands. Here in this paper, we are working in transform domain. Further there are three main types which are discussed below:

Laplacian Method

Revised Manuscript Received on December, 2012.

Jaspreet Kaur, Computer Science and Technology, Lovely Professional University, Phagwara, India.
Chirag Sharma, Computer Science and Technology, Lovely Professional University, Phagwara, India.

In this method, input image is decomposed in form of pyramids. Decomposed image is represented into two pyramids: First, Smoothing pyramid contains the average pixel values. Second, Difference pyramid contains the pixel differences that are edges. This pyramid is also known as multi resolution edge representation of the input image [6]. The basic idea behind this is to perform a pyramid decomposition on each source image, then integrate all these decompositions to form a composite representation, and finally reconstruct the fused image by performing an inverse pyramid transform.

Wavelet Transformation

Wavelet transform has been greatly used successfully in many areas, such as texture analysis, data compression, feature detection, and image fusion [5].Wavelet transformation is basically used to decompose an input image into sub bands. We can apply this transformation in both spatial and frequency domain. But it is always preferred to apply wavelet in frequency domain in which images are decomposed into frequency sub bands. Multi resolution analysis is done in wavelet transform.

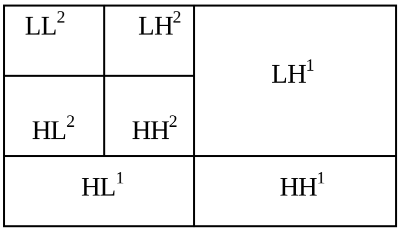

Fig. 2 Wavelet Decomposition

In this given figure, 1,2 denote decomposition levels. H denotes High Frequency Bands. L denotes Low Frequency Bands.

Contourlet Transformation

Contourlet transformation is based on pyramid method. It is recently developed transformations used to decompose an image. This method implemented in two stages, first stage is transformation and second stage sub band Decomposition [4]. Image is decomposed into different scale by laplacian pyramids and then DFBs are applied to each decomposed images. An image gets divided into low pass and high passes sub bands. Filtering of these bands is done by directional filter banks (DFBs).This is a part of a multi-dimensional signal processing theory called as Multi scale Geometric Analysis (MGA) Tools [4].

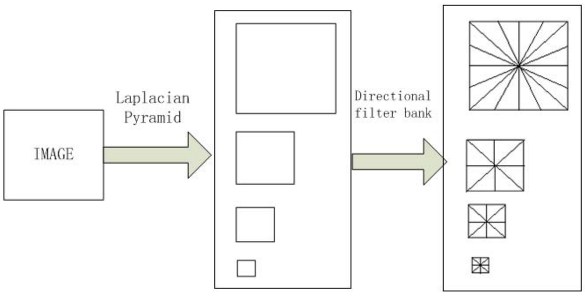

Fig. 3 Flow of Contourlet [1]

In this flow, the image is divided into different scale and different frequency through Laplacian Pyramid. Then, as the output of the Laplacian Pyramid, the sub-bands of image in different scale and frequency are fed into directional filter bank. In this way, directional information can be captured effectively [1].

C. Log Gabor Filter

The "Gabor Filter Bank" is a popular technique used to determine a feature domain for representing an image [3]. The main limitation of Gabor filter is that, it was designed for a bandwidth maximum of 1 octave. So, Field introduced Log Gabor Filter to overcome this limitation. This filter is used for localizing the spatial and frequency information of an image. A Log Gabor Filter has no DC component and can be constructed with any arbitrary bandwidth. Two important characteristics of Log-Gabor filter, First, the Log-Gabor filter function always has zero DC components which not only improve the contrast ridges but also edges of images. Second, the Log Gabor filter function has an extended tail at the high frequency end which allows it to encode images [3].Log Gabor Filter use logarithmic transformation which eliminates the DC component allocated in medium and high pass filters. We use Fourier transformation in log Gabor filter. This transformation decomposes an image into sin and cosine component. Major applications of FT (Fourier transformation) are image compression, image analysis and image filtering.

$$G(\rho,\theta,p,k) = \exp(-1/2(\rho-\rho_k/\sigma_\rho)^2)\exp(-1/2(\theta-\theta_{k,p}/\sigma_\theta)^2)$$

Log Gabor filters consist of complex-filtering arrangement in p oritentations and k scales, whose expression in the Log-polar Fourier domain is given in above equation. In this, (ρ, θ) are the log-polar coordinates and $(\sigma_\rho,\sigma_\theta)$ are the angular and radial bandwidths(common for all the filters).p and k represent the orientation and scale selection respectively.

II. PROPOSED SCHEME

In this paper, to make efficient fusion of two different modality images we are introducing an efficient fusion technique based on contourlet transformation, in which we are using multi scale decomposition and improving the DFBs by replacing low pass and high pass filter with Log Gabor filter, which reduces the DC component in fused image. Resultant image is of better quality as compare to existing method and contain accurate information. Flow chart for this method is given below:

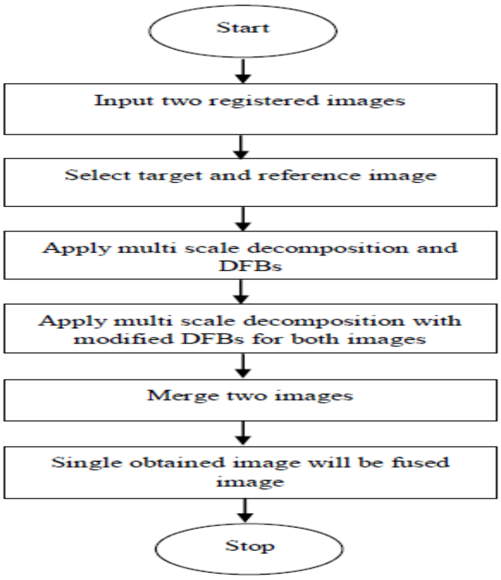

Fig. 4 Flow Chat of Proposed Method.

REFERENCES

1. Mo Tingting, Shi Yuehua, Wei Yipeng, ZhaoFeng, ZhuYongxin,(2009),"Implementing Contourlet Transform for Medical Image Fusion on Heterogenous Platform", IEEE, Pp 115-120.
2. Thanushkodi K., Umaamaheshvari A.,(2010),"Image fusion techniques", IJRRAS 4 (1).
3. R. Redondo, F. Šroubek, S. Fischer, G. Cristóbal, (2008),"Multifocus image fusion using the log-Gabor transform and a Multisize Windows technique"
4. Kavitha S, Rajkumar S, (2009),"Redundany Discrete Wavelet Transform and Contourlet Transform for Multimodality Medical Image Fusion with Quantitative Analysis",IEEE Pp 134-139
5. Fang Zhijun, Huang Shuying, Park Dong Sun, Yang Yong, Wang Zhengyou,(2009),"Wavelet based Approach for Fusing Computed Tomography and Magnetic Resonance Images", Chinese Control and Decision Conference (CCDC 2009) Pp 5770-5774.
6. Singh Nupur , Tanwar Pinky,(2012),"Image fusion using improved Contourlet Transform Technique",International Journal of Recent Technology and Engineering (IJRTE) ISSN: 2277-3878, Volume-1, Issue-2,Pp 131-139.

AUTHORS PROFILE

Jaspreet Kaur is from Jalandhar, she has done her M.Sc. in Computer Science from Guru Nanak Dev University and perusing M.TECH from Lovely Professional University, her research area includes Image Processing.

Chirag Sharma is from Jalandhar, he has done his B. TECH from Punjab Technical University and M.TECH from Lovely Professional University, His research areas includes Image Processing, Software Engineering and Data Mining.