International Journal of Engineering Science Invention
ISSN (Online): 2319 – 6734, ISSN (Print): 2319 – 6726
www.ijesi.org ||Volume 4 Issue 1 || January 2015 || PP.50-52

Automatic Image Registration Using 2D-DWT

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ABSTRACT : *Image registration is an important and fundamental task in image processing used to match two different images. Image registration estimates the parameters of the geometrical transformation model that maps the sensed images back to its reference image. A Feature-Based Approach to automated image-to-image registration is presented. In this paper, various methods are used in different Phases of Image registration. The characteristics of this approach is it combines scale interaction of Discrete wavelets for feature extraction, Scale Invariant Feature Transform (SIFT) for feature matching. Scale-invariant feature transform (or SIFT) is an algorithm in computer vision to detect and describe local features in images. SIFT feature descriptor is invariant to uniform scaling, orientation, and partially invariant to affine distortion and illumination changes.*

KEY WORDS: *Image Registration, Discrete Wavelet Transform, Scale Invariant Feature Transform*

I. INTRODUCTION

In this paper, we propose and implement a novel image registration method to register image with large rotation, scaling and translation. In all types of image registration, Robustness of the algorithm is the main and required goal. However, due to diversification of images acquired their contents and purpose of their alignment, it is almost impossible to design universal method for image registration that fulfill all requirements and suits all types of applications. Many of the image registration techniques have been proposed and reviewed. Image registration techniques can be generally classified in two categories. Intensity based and feature based. The first category utilizes image intensity to estimate the parameters of a transformation between two images using an approach involving all pixels of the image. In second category a set of feature points extracted from an image and utilizes only these extracted feature points instead of all whole image pixels to obtain the transformation parameters. In this paper, a new algorithm for feature based image registration is proposed. The proposed algorithm is based on three main steps, feature point extraction, correspondence between extracted feature points and transformation parameter estimation.

II. IMAGE REGISTRATION BLOCK DIAGRAM

Image registration typically consists of the following steps:

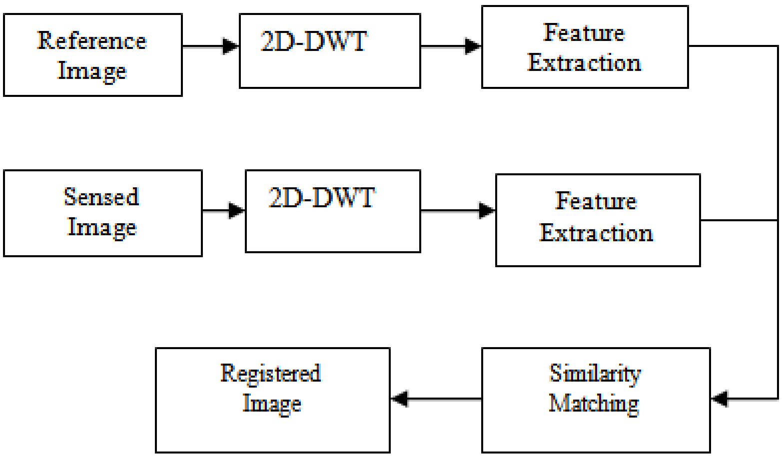

Fig 1 Block Diagram of Image Registration

III. DISCRETE WAVELET TRANSFORM

The Discrete Wavelet Transform (DWT), which is based on sub-band coding, is found to yield a fast computation of Wavelet Transform. It is easy to implement and reduces the computation time and resources required. The two-dimensional DWT of an image function $s(n_1, n_2)$ of size N_1 x N_2 may be expressed as

$$W_{\varphi}(j_0, k_1, k_2) = \frac{1}{\sqrt{N_1 N_2}} \sum_{n_1=0}^{N_1-1} \sum_{n_2=0}^{N_2-1} s(n_1, n_2) \varphi_{j_0, k_1, k_2}(n_1, n_2)$$

$$W_{\psi}^{i}(j_0, k_1, k_2) = \frac{1}{\sqrt{N_1 N_2}} \sum_{n_1=0}^{N_1-1} \sum_{n_2=0}^{N_2-1} s(n_1, n_2) \psi^{i}_{j_0, k_1, k_2}(n_1, n_2)$$

Where i = {H, V, D} indicate the direction index of the wavelet function. As in one-dimensional case j_0 represents any starting scale, which may be treated as $j_0=0$. Given the above two equations are two-dimensional DWT.

The flow chart of the Discrete wavelet transform sub band coding on the digital image is shown in figure 2, here L refers to low frequency component, H refers to high frequency and the number 1 and 2 refer to the decomposition level of the Discrete wavelet transform. The result of the 2-D Discrete Wavelet Transform from level one to level three is shown in figure 3. The sub image LL is the low frequency component, it is the approximate sub image of the original image; the sub image HL is the component of the low frequency in horizontal direction and the high frequency in vertical direction, it manifests the horizontal edge of the original image; the sub image LH is the component of the high frequency in horizontal direction and the low frequency in vertical direction, it manifests the vertical edge of the original image; the sub image HH is the high frequency component, it manifests the oblique edge of the original image. It is shown that most energy of the original image is contained in the LL2 low frequency region. And the other region in the same size reflect edge feature of the image in different angles. Here we use the 2-D Discrete Haar wavelet transform for the decomposition of the images.

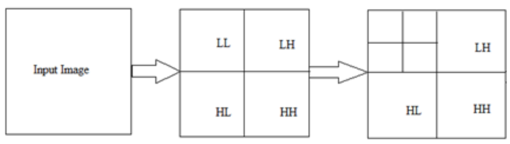

Fig. 2 Flow chart of the DWT sub band coding

IV. FEATURE EXTRACTION

Our proposed algorithm is based on feature based image registration. So first and important task we have to do is feature extraction using Discrete Wavelet Transforms. For the image registration point of view, the extracted feature points must have to fulfill some basic objectives like they should be robust enough to some level of variations in scale and the feature extractor should have the ability to be modified to adapt image structures at different scales and the extracted features should have a well-localized support in the image. Approximated Features from both images are extracted using Discrete Wavelet Transform and Control point correspondence and Feature matching is achieved using Scale-Invariant Feature Transform (SIFT). The scale invariant feature transform (SIFT) algorithm for image features generation which are invariant to image translation, scaling, rotation and partially invariant to illumination changes and affine projection. After extracting the frequency component from the Discrete Wavelet Transform, following steps are applied to detect the features and match the corresponding features from sensed and referenced image. The next process is selecting the control points using the control selection tool that estimates the match of the control points based on the geometric relationship of the previously selected control points.

V. SIMILARITY MATCHING

All the previous steps such as extracting approximated level coefficients, locating and extracting the Interest Points are doing for both reference and sensed Images. Now, we have features of Image 1 and features of Image 2. Next step is to match the features of both images. By using the match Features function, we will get

Index Pairs, containing P pairs of indices. These indices contain features most likely to correspond between the two input feature sets. Next step is to retrieve the locations of corresponding points for each image from the obtained Index Pairs. Our proposed Algorithm uses Nearest Neighbour Ratio method for finding true and false matches. Then the images will be registered automatically.

VI. EXPERIMENT RESULT

The experiment result are shown below fig 2(a) shows the reference image fig 2(b) shows the feature control points fig 2(c) shows the sensed image fig 2(d) shows the control point for sensed images these control points are matched using shift invariance feature transform if it matches the images are registered.

Fig.2. (a) Reference Image, (b) Reference Image Feature points, (c) Sensed Image, (b) Sensed Image Feature points

VII. CONCLUSION

In this paper, a new feature based image registration approach is proposed. This type of approach gives a new dimension to the existing feature based image registration methods. After successful feature extraction using Discrete Wavelet, correspondence between extracted feature points is established using Scale Invariant Method. With this proposed algorithm, we registered images with any degree of rotation and scaling.

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