Image Registration: A Survey

Jasdeep Kaur¹ Amanpreet Kaur²
¹Research Scholar ²Assistant Professor
¹Information Technology Department ²Computer Science & Engineering
Chandigarh University, Punjab, India

Abstract—In last decades, image registration is widely in use and there is broad range of applications in field of remote sensing, computer science, image compression, face recognition and specially in medical field where it is use to integrate information obtained from different sources. Image registration is a vital part of restoration that uses objective criteria and previous information to enhance image. It is a process of aligning two or more images taken from different viewpoints at different times and using different sensors. A broad methods are available to perform registration like intensity based, feature based and many more. This paper shows a review of various techniques of image registration

Key words: Image registration, intensity based registration, feature based registration.

I. INTRODUCTION

Image registration is a vital part of image restoration that uses objective criteria and previous information to enhance images. Image registration is the method of estimating an optimum transformation between two images. One of the image is referred to as reference image and other image is known as target or sensed image. In many of image processing application, automatic image registration is required where the images of same scene are obtained from different viewpoints, with different sensor and at different times. To perform image registration geometrical transformation is required to be applied to align target or sensed image with reference image. The images are need to be geometrically aligned for better observations.[6,7,13]. In advance, computer science has led to reliable and efficient image processing methods useful in diagnosis, treatment planning and medical research. In medical field camera based diagnostics are widely in use, where data so obtained from different viewpoints using cameras is integrated. Image registration is the most reliable and efficient method of image processing required compensating these movements and vibrations of cameras or other optical systems to get error free results.[19]

A. Area Based Image Registration:

In area based methods a window of pixels of same size is taken for each, the sense and the reference image. Using area matching algorithms these windows are compared with each other. Then centres of windows that are matched with each other are referred as control points. Area based methods can provide better precision and are quite simple but still there is in using this method. This problem may occur when we want to compare image characteristics during multi-sensor registration. As area based methods use gray value of image pixels to perform matching and characteristics of gray levels may different for different sensors. In that case these methods are applicable for multi-sensor image registration.[20]

B. Feature based Methods

In feature based methods the first step is feature extraction. Then geometrical transformation is determined on the basis on those two feature patterns that are best matched with each other. Landmark and control points are two mostly used feature based techniques. Some of the other common features to be used are curves, lines, region etc. Generally gradient based methods are used to detect these features.[16]. If we compare feature based methods with intensity based methods some limitations are determined. As these methods are quite time consuming, because it will take more time in feature extraction. Another difficulty that is faced is while determining required no of features. In feature based methods, to get high accuracy more and more number of features are required to be selected. For this more efforts are required.

C. Intensity Based Methods:

Rather than using feature based image registration, another alternative of performing registration is intensity based image registration where geometrical transformation is determined on the basis of similarity or dissimilarity patterns by observing image intensities directly. This type of registration methods are very popular in many of the application as these are very flexible to use. In most of the cases geometrical transformation are estimated globally by solving minimization of maximization problems.[16]

One of the advantageous factor of using intensity based methods registration can be performed on entire as well as sub images. If the registration is performed on sub images, centers of these images are taken as feature points. But in feature based methods the correspondence so established is between two distinct feature points. In intensity based these feature points help to establish best geometrical transformation which is required to performing mapping between the reference image and the target image. By which a point-to-point correspondence is established between reference and target images. [16, 17]

II. RELATED WORK

Number of researcher has already done their research in the field of unmanned ground vehicles. Some of these are as following:-

In 1998 thevenaz.P, Urs.E. presented a paper entitled as “A Pyramid Approach to Sub-pixel Registration Based on Intensity”. This paper presents a registration algorithm based on automatic sub-pixel that minimizes the mean square intensity difference between a reference and a test can be applicable for both two dimensional and three dimensions. It uses a pyramid approach that is a coarse-to-fine iterative strategy. This algorithm is useful in getting prior knowledge to help to obtain better results [1].

All rights reserved by www.ijsrd.com
In 2003 Gustavo K., Akram. A. presents a paper entitled as “The Adaptive Bases Algorithm for Intensity-Based Non-rigid Image Registration”. [2] This paper presents an intensity based non rigid registration algorithm that is widely used in medical field. Some of these applications are creation of population averages, geometric correction of functional magnetic resonance imaging (fMRI). To solve these problems many of the methods have been proposed, maximizing mutual Information (MI) is one these methods. But the limitation of this method is its computational complexity. This paper provide a method that is used to reduce the computational complexity and transformation compliance using spatial adaption.

In 2004 Zhiyong Xie and Gerald E. Farin presented a paper “Image Registration Using Hierarchical B-Splines”. In this paper application of Hierarchical B-splines, in the form of free form deformation, provide a natural way for image registration due to its global-to-local influence, coarse-to-fine matching, and computational efficiency. This method can also provide a way to reduce memory overload. When a large data set is used in registration, the data sets at different levels can be divided into some small regions and stored. These data files can be loaded into memory as needed. There is a drawback in this paper regarding validation as, Validation is an important issue in image registration. Unfortunately, there is no standard method to evaluate a system. [3]

In 2009 M. Hub*, M. L. Kessler, and C. P. Karger presented a paper “A Stochastic Approach to Estimate the Uncertainty Involved in B-Spline Image Registration”. This paper proposed a method that is used to distinguish the areas of the same image that is based on the performance of mono model B-spline registration i.e. in which area the B-spline registration performing well and which it is quite less accurate. [4]

In 2010 Myronenko A. presents a paper entitled “Intensity based image registration by minimizing residual complexity” "This paper presents a similarity measure that is based on the assumption of non stationary and complex varying intensity distortion in mono-model setting. To drive this similarity measure, intensity correction field its adaptive regularization is solved analytically to make similarity measure more robust. This similarity measure is referred to as residual complexity. Favoring smooth or piece wise smooth residual are the two basic functions of residual complexity that will help in better alignment of two distorted images due to spatially varying intensity distortions. Moreover this measure is best for complex interactions and provides accurate results for registration for both real world and artificial problems. [19]

In 2009 Bhagalia R., Jeffrey proposed a paper entitled “Accelerated no rigid intensity based image registration using importance sampling” [15]. This paper presents state of art intensity based methods used to detect distortions and abnormal structures in mammographic images. Mammography, it is technique to diagnose and locate tumors of the breasts using X-rays. To find out the abnormalities, images of same breast are compared that are taken at different times. Another method to detect the abnormal structures is bilateral comparison. In this type of comparison images of left breast are compared with the images of the right breasts. Using these methods tumor of breasts can be detected.

In 2013 Andrea M. Michela G. Presents a paper entitled “On the Potential of Information Theoretic Indicators for the Detection of Image Vibrations and for Image Registration on JET”. This paper shows the difficulties occur in camera based diagnostics like vibrations and movements in field of view. It is not easy to measure vibrations directly as the accessibility of the optical systems is strongly limited and too complex to compensate these movements and vibrations of camera and their optics image registration is used. [18].

This paper proposed three registration indicators to enhance the accuracy of registration. These indicators are mutual information, cross correlation and entropy. Here cross correlation is a similarity measure that defines the similarity pattern between two images. Mutual information is used to define mutual dependencies between two random variables. And the last one is entropy used to detect vibrations and provides a maximum success rate i.e. of 86 percent.

III. Conclusion

In this paper we have reviewed various image registration algorithms that are use to register two or more images into one image or map them in single coordinate system. On the basis of this review we have concluded that intensity based registration is better than other registration methods. As we compared feature based registration with intensity based registration, feature based seems to be more complex and time consuming. As it need more and more number of features to get high accuracy. But intensity based methods are based on similarity measures that is less complex less time consuming.

ACKNOWLEDGMENT

I express my sincere gratitude to my Internal Guide Ms. Amanpreet Kaur, who assisting me to write this paper. I thank her for providing me the reinforcement, confidence and most importantly the track for the paper whenever I needed it.

REFERENCES


