A Method for Automatic accurate Image Registration Through Histogram-Based Image Segmentation and Translation (delineation)

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Abstract
Automatic image registration is still present challenge in several fields like computer vision and remote sensing applications. Image registration is the process of transforming different sets of data into one coordinate system. In this paper, we propose a method for Automatic accurate Image Registration through Histogram-Based Image Segmentation and translation (delineation) using Wiener filtering which allows for a more detailed histogram-based segmentation, rather than the traditional methods, and consequently to an accurate image registration. Proposed system is able to estimate the rotation and/or translation between two images— which may be multitemporal or multisensor—with small differences in the spectral content. The first dataset consists in a photograph and a rotated and shifted version of the same photograph, with different levels of added noise. This allows for the registration of pairs of images with differences in rotation and translation. Various applications of image registration are target recognition, monitoring global land usage using satellite images, matching stereo images to recover shape for navigation, and aligning images from different medical modalities for diagnosis.

Keywords
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I. Introduction

Image registration is establishment of correspondence between images of the same scene. Image registration is a process of aligning two images acquired by same/different sensors, at different times or from different viewpoint. To register images, we need to determine geometric transformation that aligns images with respect to the reference image.

The Automatic Image Registration (AIR) is still a present challenge regarding image processing related applications mainly remote sensing applications. The problem of registering remote sensing images can roughly be locally seen as the determination of translations and a small rotation. Under the scope of computer vision applications, the rigid-body transformation may seem a simple problem to solve with many existing methods.

An image processor does the functions of image acquisition, storage, preprocessing, segmentation, representation, recognition and interpretation and finally displays or records the resulting image. The first step in the process is image acquisition by an imaging sensor in conjunction with a digitizer to digitize the image. The next step is the preprocessing step where the image is improved being fed as an input to the other processes. Preprocessing typically deals with enhancing, removing noise, isolating regions, etc. Segmentation partitions an image into its constituent parts or objects.

Image segmentation comprises a wide variety of methods either for monochrome or color images it can be employed to image or video applications, in the latter to each frame individually. Most image segmentation methods can be classified according to their nature: histogram thresholding, feature. The histogram thresholding, several methods have been reported. Typically, histogram-based image segmentation comprises three stages: recognizing the modes of the histogram, finding the valleys between the identified modes and finally apply thresholds to the image based upon the valleys. Some works published in this field cover the peaks detection on the histogram curve based upon homogeneity criteria, propose recursive thresholding techniques based upon discriminant analysis, maximum correlation criterion for bi level thresholding, entropy-based, using fuzzy sets, among several others.

The output of segmentation is usually raw pixel data, which consists of either the boundary of the region or the pixels in the region themselves. Representation is the process of transforming the raw pixel data into a form useful for subsequent processing by the computer. Description deals with extracting features that are basic in differentiating one class of objects from another. Recognition assigns a label to an object based on the information provided by its descriptors. Interpretation involves assigning meaning to an ensemble of recognized objects. The knowledge about a problem domain is incorporated into the knowledge base. The knowledge base guides the operation of each processing module and also controls the interaction between the modules.

In this paper, a method for automatic image registration through histogram-based image segmentation and translation (delineation) using Wiener filtering is proposed which allows for a more detailed histogram based segmentation, rather than the traditional methods, and consequently to an accurate image registration. Proposed system is able to estimate the rotation and/or translation between two images. This method is very advantageous to generate accurate rotation and shift of a base image with respect to unregistered image, register base image with unregistered image.

II. Realted Work

A. Wavelet-based Image Registration

The wavelet transform generates a multi-resolution representation of image data. Using such multi-resolution data, the size of the search data can be reduced by initially searching at lowest resolution images (smallest data size) and then proceeding to higher resolution images where the search results are only refined. Wavelet-based multi-resolution preserves most of the important features of the original data even at a low resolution. It also eliminates weak features in higher resolution while highlighting strong image features. LeMoigne et al. presented a cross-comparison of automated registration algorithms for multiple source remote sensing data. A Multi-Resolution Wavelet-based (MRW) image registration was used. The algorithm requires no a priori knowledge in order to perform automatic registration. The similarity measure is based on the normalized cross-correlation.

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B. Genetic Algorithm-based Image Registration

Image registration involves a search to find the transform that yields the highest similarity between the input and the reference images. While most of the registration techniques employ linear search over the sampling of search scope, some researchers have attempted to apply Genetic Algorithms (GAs) to help search over the complex search scope in image registration. Genetic Algorithms are based on an adaptive stochastic random search. GAs mimic the natural evolutionary process by representing the potential solutions with a set of chromosomes in the population. Fitzpatrick et al. investigated the applicability of the GAs search to determine the transformation of the moving object between two images. They indicated that the primary application of their work is in X-ray, gamma ray, and nuclear magnetic resonance imaging (NMR). The transformations used included translation, rotation, and elastic motion. Experiments were carried out using simulated data, however. Neither accuracy nor computing performance was quantified.

C. Subpixel Image Registration

In general, it is acceptable to achieve a registration result with an error of ±1 pixel. In remote sensing, a distance of one pixel for a Landsat image corresponds to about 80 meters distance on Earth [Tian86]. This means that the pixel-level registration provides a ±40-meter resolution. To achieve a ±4-meter resolution, one must register the images with an accuracy of 0.1pixel. Many other instruments have even coarser resolution. Registration results with an error less than one pixel, i.e. at subpixel accuracy, are essential in applications like change detection, passive navigation, feature location measurements in remote sensing, image sequence analysis, and non destructive evaluation. Subpixel registration, however, introduces substantial extra computational and memory space requirement.

D. Feature Based Methods or Point Mapping Method

Feature based matching techniques do not use the grey values to describe matching entities. It makes use of image features derived by feature extraction algorithm. The purpose of feature extraction is to abstract substantial information from original data input and filter out the redundant information. Features are selected which are likely to be uniquely found in both images and more tolerant of local distortions. Computing of proper transformation depends on these features. Therefore sufficient number of features must be detected to perform calculation. After detecting features in each image, they must be matched. This technique is primary approach to register two images whose type of misalignment is unknown. This occurs if class of transformations cannot be easily categorized as translations or rigid-body movements. In this we can use landmarks and match them using general transformation. The method of point mapping consist of three stages-

- Computing features in the images
- Control points in reference image are corresponded with feature points in data image.
- Spatial mapping.

III. Proposed System

A pair of images in the same scale is taken. Assume that the coordinates of the "static" image and are the pair of the image to be registered. It begins with a preprocessing stage in order to reduce unnecessary detail on the images content, important for the subsequent histogram-based image segmentation phase.

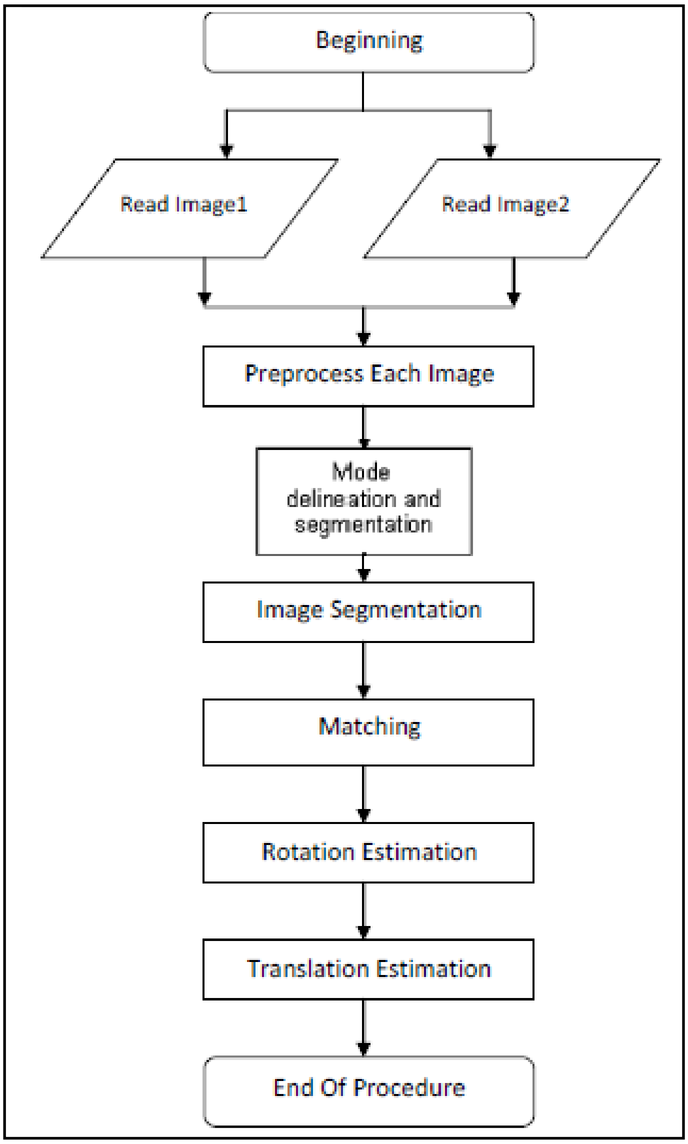

Fig. 1: Flowchart of Proposed System

A. Pre-processing

In this project before we process the images (such as base image and unregistered image) through adaptive wiener filter for removing additive random noise in both images, first we overcome significant differences between the histograms of images to be registered, an histogram equalization of unregistered image using the histogram counts of base image is performed prior to the application of the Wiener filter. In this way, the Wiener filtering on images allows both for the reduction of the image detail, as well as to the smoothing of the histogram, which becomes spiky due to the histogram equalization step. After removal of noise in image by using adaptive wiener filter and regarding images are shown below:

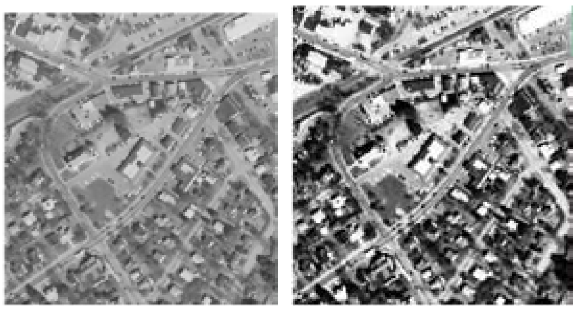

Fig. 2: Original Image and Its Histogram Equalization Image

B. Histogram-Based Segmentation and Delineation

Before going to segment an image, first we are going to analyzing the histogram of the image. The basis of histogram analysis approach is that the regions of interest tend to form modes (a dominating peak that could represent a region) in the corresponding histogram. a typical image segmentation approach based on histogram analysis generally carries out three steps:

- First, recognize the modes of the histogram.
- Second, remove the unwanted peaks (too small compared to the biggest peak) in the histogram.
- Third, find the valley between different two highest modes. Fourth, apply threshold to the image by using deepest valley between two highest peaks.

The method used for mode delineation is based upon the analysis of the consecutive slopes of the histogram. The idea behind this approach is to choose an adequate threshold for considering whether or not one is in the presence of a mode, which is characterized by a significant increase and/or decrease on the slopes sequence. one obvious and functional solution for delineating a mode is to obtain a confidence interval for the slopes sequence, where the presence of a mode is detected by the slopes which are outside the 99% confidence interval. In order to achieve a robust detection through the statistical approach of the confidence interval, a preprocessing of the slopes is required, in order to smooth the slopes sequence irregularity outside the presence of a mode, which may induce the detection of false modes.

C. Image Segmentation

The segmentation of an image allows for its “simplification,” since it significantly reduces the number of different pixel values. Although it is also associated with a loss of information on the image content, the decision of using an original or segmented image will depend on the context of the AIR method. Image segmentation is a process of partitioning an image into nonintersecting regions such that each region is homogeneous and the union of two adjacent regions is not homogeneous.

Fig. 3: Original Image and Its Segmented Image

D. Matching

The matching step begins with the evaluation between every possible two-by-two combination of objects obtained by the segmentation of the two images. For evaluating the images, cost function is used. Here, every possible combination of the alpha values considered for both images. the cost function values are represented in the form of box plots, with the image which led to the lower number of segmented objects corresponding to the horizontal (“categorical”) axis. A valid matching between two objects should lead to the lower values of cost function, sufficiently far from the majority.

E. Rotation Estimation

The rotation and translation are determined on a statistical basis. This allows for the detection of a modal class, restricting the set of possible values for rotation. Through considering the frequencies of the rotation candidates, and finding the rotation value which absolute frequency corresponds to the higher outlier, according to the procedure of box plot outliers detection previously described. This procedure leads to a robust estimation of angle.

F. Translation Estimation

Once angle is obtained, only the initial matching candidates which correspond to the obtained rotation are considered. Then similar procedure as that followed in the rotation estimation is considered for obtaining translation. This statistically based procedure also leads to a robust estimation of translation.

IV. Conclusion

In this paper, a method for automatic image registration through histogram-based image segmentation and translation (delineation) using Wiener filtering is proposed which allows for a more detailed histogram based segmentation, rather than the traditional methods, and consequently to an accurate image registration. Proposed system is able to estimate the rotation and/or translation between two images which may be multitemporal or multisensor—with small differences in the spectral content. This method is very advantageous to generate accurate rotation and shift of a base image with respect to unregistered image, register base image with unregistered image. The proposed methodology of image registration allowed for the obtention of accurate results, even in the presence of a considerable amount of noise. The first dataset consists in a photograph and a rotated and shifted version of the same photograph, with different levels of added noise. This allows for the registration of pairs of images with differences in rotation and translation. Various applications of image registration are target recognition, monitoring global land usage using satellite images, matching stereo images to recover shape for navigation, and aligning images from different medical modalities for diagnosis.

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