A Method to Align Images Using Image Segmentation

K.Poornima, R.Kanchana

Abstract—**Most high level interpretation task rely on image alignment process. In this work, a method for automated image alignment through image segmentation is proposed. The image data need to be analyzed, preferably by automatic processing techniques because of the huge amount of data. This new approach mainly consists in combining several segmentations of the pair of images to be registered. It can be applied to a pair of satellite images with simulated translation, and to real remote sensing examples comprising different viewing angles, different acquisition dates and different sensors. This process allows the alignment of pairs of images (multitemporal and multisensor) with differences in rotation and translation, with small differences in the spectral content, leading to the subpixel accuracy.**

Index Terms— **Image alignment, Image segmentation, Wiener filtering.**

I. INTRODUCTION

Image Processing is processing of the image so as to reveal the inner details for further investigation. Image Alignment is the process of overlaying two or more images of the same scene taken at different times, from different viewpoints, and/or by different sensors. Image Alignment is an essential task to jointly exploit, integrate, or compare all these different data.The usual features used for earth image Alignment might not be as reliable for planetary images. In general, features that are uniformly distributed over the entire image are required for image Alignment. Such features can be easily identified in earth images (except for desert or sea regions). On the other hand, it is more difficult to extract strong and uniformly distributed features in planetary images. Additionally, earth data present a combination of natural and well-organized man-made features, e.g., roads, rivers, or buildings.

Planetary images only contain natural non organized features such as craters, rocks, boulders, and ridges. Therefore, although Alignment is the major application of this letter, the purpose of this letter is not to propose a Alignment approach instead, it focuses on robust methods for the extraction of morphological planetary features that can be used for refining the accuracy of planetary image Alignment. Additionally, such methods could be also potentially useful for the automated detection of craters and rocks.

For Alignment, the accurate extracted features can be then matched by any matching approach. In this letter, we use a global optimization technique based on a genetic algorithm but this choice is not restrictive, and any other feature-based alignment technique, could be used in conjunction with the proposed feature extraction method.

Under the scope of remote sensing applications, one of the major problems is related to the radiometric content due to multisensor or multispectral pairs of images. Moreover, scale is frequently known, as most satellite images are provided with sufficiently accurate scale information, being the exception aerial photographs when the aircraft is flying across a region with significant differences in the terrain elevation.

In order to overcome the typical problems of planetary images with limited contrast, poor illumination, and a lack of good features, we propose here a new unsupervised region-based approach to the extraction of different planetary features for Alignment purposes. The reference and unregistered images may differ in translation, rotation, and scale and may present distortions associated to the terrain relief and significantly different spectral content. The proposing segmentation methods are more adequate to images containing sufficiently large and homogeneous objects such as large water bodies, presenting limited performance for other datasets such as satellite images in urban context.

Dare and Dowman [10] proposed an improved model for automatic feature-based image registration, based on multiple feature extraction and feature matching algorithms. With the combination of extraction and matching algorithms, it was possible to identify common features in multisensor situations, from which tie points can be derived. The tie points were initially obtained from matching the centroids, followed by the matching of the pixels of the patch edges. This approach is quite sensitive to differences on the patch delineation, which may often occur when using images from different sensors or even with temporal differences.

Local descriptor is a widely used technique in several image and video-based tasks [11]. One of the main advantages of local descriptors is that they are distinctive, are robust to occlusion, and do not require segmentation. The concept behind it is to detect image regions covariant to a class of transformations, which are then used as support regions to compute invariant descriptors, i.e., the detectors provide the regions which are used to compute the descriptors [11]. A comprehensive review on the comparison of affine region detectors may

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be found in [12].

In this work, a method for automated image Alignment through feature point extraction using image segmentation is proposing, which allows for a more detailed pixel based segmentation, rather than the traditional methods, and consequently to an accurate image Alignment. This approach is able to estimate the rotation and/or translation between two images.

II. PROPOSED APPROACH

The aim here is to propose a technique for the extraction of different structures on a considered planetary surface for the Alignment of optical planetary images. The proposed approach is based on image analysis techniques and is potentially useful for the detection of feature points. Finding the relationship between two coordinate systems using pairs of measurements of the coordinates of a number of points in both systems is a classic photogrammetric task [2]. Different types of features are present in the planetary images, and their sizes, shapes, and positions are estimated by applying different methods. The extracted features used for Alignment purposes.

Segmentation is the process of partitioning an image into multiple regions, for instance, in order to distinguish objects from the background. A frequent approach to segmentation introduces a set of characteristic points that are related to the objects to be detected, automatically selected and used as "feature points" (FPs) to segment the images. Many segmentation approaches have been explored in the literature. Here, the SIFT has been chosen, a method which is automatic, robust, and fast. The flowchart of the proposed technique for feature extraction is shown in Fig. 2.

A large number of segmentation methods can be found in the literature, but there is no single method which can be considered good for all images, nor are all methods equally good for a particular type of image. The existing image segmentation methods include gray-level thresholding, iterative pixel classification, surface-based segmentation, edge detection, and methods based on fuzzy set theory. Thresholding based methods can be classified according to global or local thresholding and also as either bilevel thresholding or multithresholding. For the aforementioned facts, we decided to consider the nonparametric and unsupervised Otsu's thresholding method.

The Otsu's thresholding method may be recommended as the simplest and standard method for automatic threshold selection, which can be applied to various practical problems Although the Otsu's thresholding method is usually applied to images with a bimodal histogram, it may also provide a meaningful result for unimodal or multimodal histograms where a precise delineation of the objects present on the scene is not a requirement. Some examples are illustrated in where the histogram shape is nearly unimodal and a meaningful segmentation is obtained. The key concept behind this method is to obtain an optimal threshold that maximizes a function of the threshold level. The optimal threshold is selected by a discriminant criterion, in order to maximize the separability of the resultant classes in gray levels. The procedure utilizes only the zeroth- and the first-order cumulative moments of the graylevel histogram.

PREPROCESSING:

Too much detail on the pixel domain may lead to undesirable segmentation results. Therefore, it is advisable an image enhancement step prior further processing. By image enhancement (which is itself a largely subjective process), it is intended to obtain an image with less detail than the original version, nearest to the "object" identification which is performed by the human eye. Although typically more mathematical and complex, restoration algorithms may provide the exploitation of the detailed characteristics of an image and its degradation.

The Wiener filter [5] is one of the most used filters under the scope of image restoration methods [4]. However, it may also be used for image enhancement, with the aim of reducing the detail on an image, since it is typically a low pass filter and consequently induces a significant blurring effect.

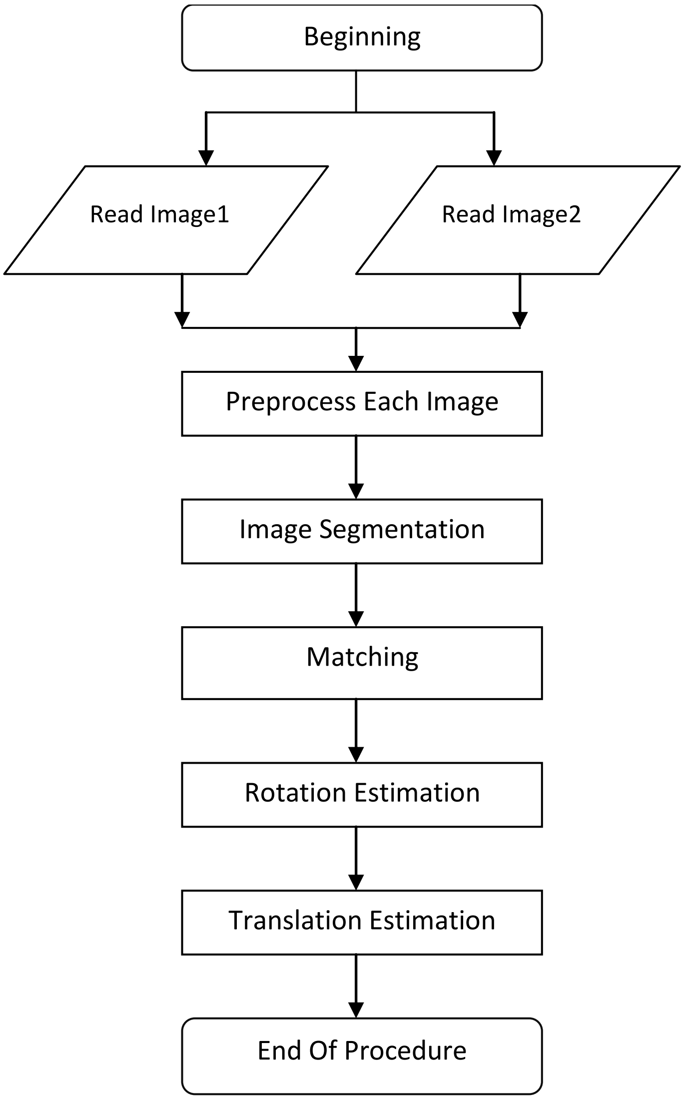


Fig. 1. Flowchart of the Proposed Approach

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. Let P() be a homogeneity predicate defined on groups of connected pixels and J the first principal component (of size m × n pixels) of I, obtained as described in the previous section.

Segmentation is a partitioning of image J into a set of l connected regions such that

$$\bigcup_{i=1}^{l} Si = J \text{ with } Si \cap Sj = \varphi, i \neq j$$

Figure 1. after filter SAR image(left) and SAR image(right)

and the uniformity predicate P(Si) = true for all regions Si and P(Si ∪ Sj) = false when Si is adjacent to Sj . According to this bilevel thresholding, the image J pixels are assigned as 0 or 1. Then, the connected components in the binary image are identified and assigned a number, and objects with size less than 0.1% of the image size are removed in order to reduce the computation effort, without compromising the method performance.

The matching step begins with the evaluation between every possible two-by-two combination of objects obtained by the segmentation of the two images. Under the scope of automatic registration of satellite images, since several distortion effects may be present in an acquired image, it is desirable to have a reference image with as little distortions as possible.

The nearest neighbor is defined as the keypoint with minimum Euclidean distance for the invariant descriptor vector. An effective measure for a matching validation is the ratio between the distance of the closest neighbor and the distance to the second closest neighbor, hereafter assigned as dratio. This procedure of outlier detection is applied to each object of the image in the horizontal axis. Fig. 3 illustrates an example of two regions which have been matched.

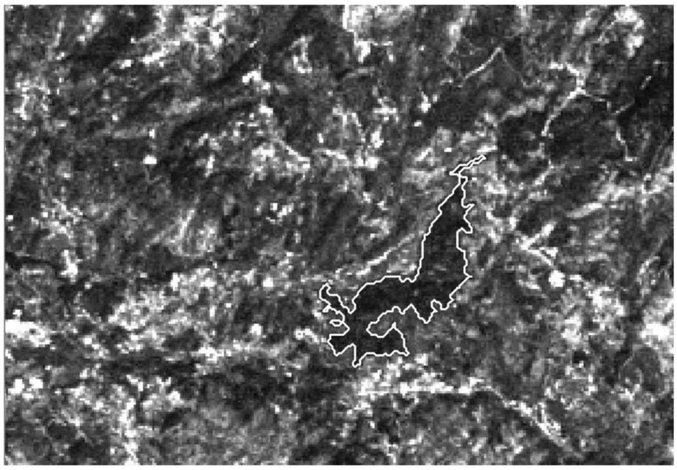
ROTATION ESTIMATION:

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.

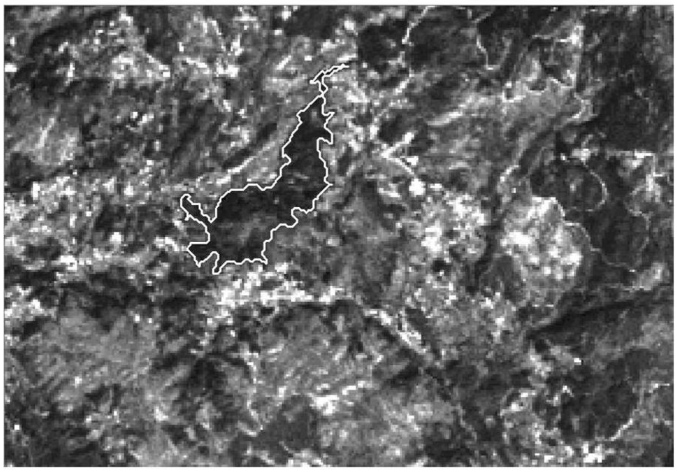
Through considering the frequencies of the rotation candidates, and finding the rotation value which absolute frequency corresponds to the higher outlier, according to the procedure of boxplot outliers detection previously described. This procedure lead to a robust estimation of angle.

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.



(a)



(b)

Fig. 3. Segment of the images where (a) corresponds to band1 and (b) to band 2 with the simulated shift.

In this paper, a method for automated image alignment through Feature Points selection using Image segmentation is proposed, which allows to an accurate image Alignment. This can be able to estimate the rotation and/or translation between two images which may be multitemporal or multisensory with small differences in the spectral content.

III. SIMULATION RESULT

The simulation results for return loss for the frequency The results were obtained on a computer with an Intel Core 2 6400 2.13 GHz processor and 2.0 Gbytes of physical memory, using MATLAB Release 2008b.

Here, detection percentage D, branching factor B, and quality percentage Q were computed as follows:

$D = 100 \cdot TP / (TP + FN)$; $B = FP / TP$;

$Q = 100 \cdot TP / (TP + FP + FN)$; (1)

where true positive TP is the number of detected features that correspond to labeled objects in RM, false positive FP is the number of features detected by the proposed approach, which do not correspond to any object in RM, and false negative FN is the number of objects in RM that have not been detected.

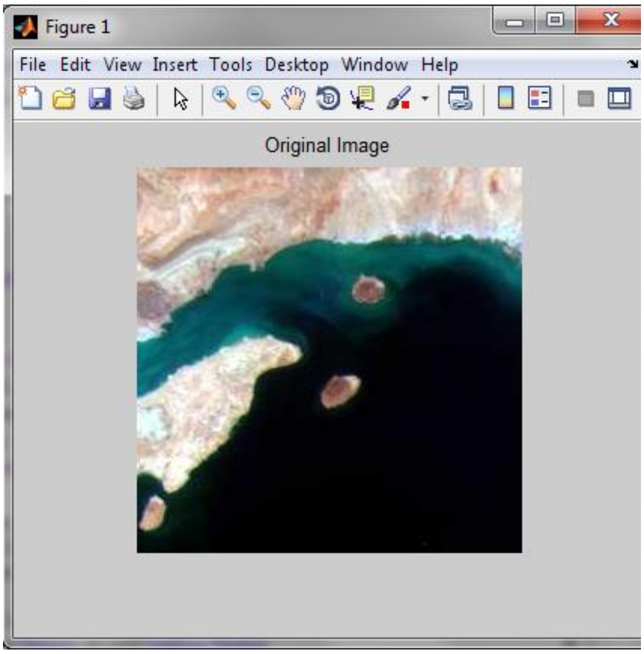


Fig 4 Original Image

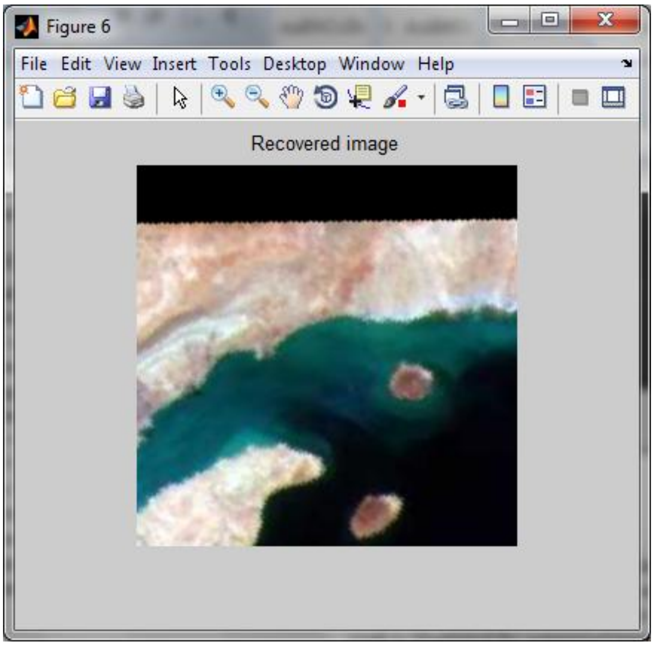


Fig 6 Aligned Image

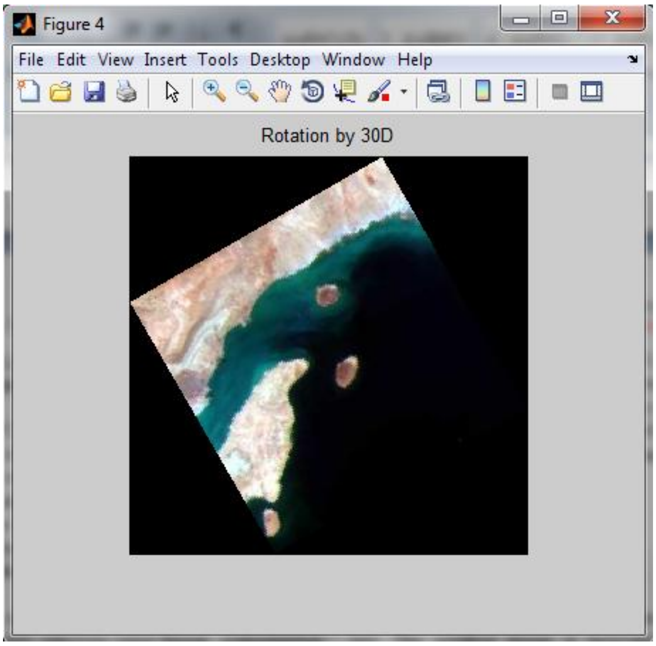


Fig 5 Sensed Image

Figure 4 Original Image is the reference image (image 1) and it is a static image, in which the sensed image is to be registered. The size of the Original Image is 668 x 590 pixels. Figure 5 Sensed Image shows the Original Image with a rotation of 30˚ and scale by value of 0.3.The Sensed Image taken by the same scene with a rotated angle of 30˚ and translated by a scale value of 0.3 is to be aligned with the Original Image. The size of the Sensed Image is 578 x 500 pixels. Figure 6 shows the Aligned Image of Sensed Image with reference to the Original Image.

The two images have pixel variations of about 80 x 90 in size. The resulted image is recovered by a rotation of 29.3699˚ and with recovered scale value of 0.6000 This work is illustrated for automated image alignment of satellite image, with a rotation of 30˚ and scale value of 0.6.

IV. CONCLUSION

The purpose of this work is successfully Simulated. A large variety of Image registration methods can be found in [1] and [3]. In several applications, the registration model only assumes rotation. This work is illustrated for Automated Image alignment of satellite image, which is simulated by a rotation of 30˚, scale value of 0.6 and translation of 80, 90 pixels in horizontal and vertical axis respectively.

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