Registration of Optical and SAR Image

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***Abstract*—*Automatic image registration is a vital but challenging task, particularly for remote sensing image, because of the inconsistency of the radiometric and geometric properties. Image registration can be broadly classified into two categories: Intensity based methods and Feature based methods .Feature-based methods have proven to be effective; common features are difficult to extract and match, Though feature-based methods have been successfully developed for the registration of optical images, the registration of synthetic aperture radar (SAR) and Optical images is still a challenging problem in remote sensing. In this paper, an improved version of the scale-invariant feature transform (SIFT) is first introduced to obtain initial matching features of two images i.e. optical and SAR images. Then, the initial matching features will be refined by showing their spatial relationship. The refined feature matches are finally used for estimating registration parametric order*

Keywords--- Optical and SAR image registration, remote sensing, spatial consistent matching (SCM), synthetic aperture radar (SAR),Scale-Invarient feature transform(SIFT).

I.INTRODUCTION

IMAGE registration is a vital process which determines the most precise match between two images of the same scene, which may have been acquired at the same or different sensors, from the same or different viewpoint and by the same or different time [1]. This process geometrically aligns the two images—the reference and sensed images. There are many fields such as computer vision, pattern matching, medical image analysis, and remote sensing image processing. All these fields required image registration techniques. The difficulties involved in the image registration include both geometric deformations such as translation effect, rotation and scale distortion, occlusion, and viewpoint difference and radiometric discrepancies such as illumination change and sensor and spectral content difference[5].Therefore, further research studies are required in order to improve the performance of the existing registration methods.

There are two types of image registration methods, namely, intensity- and feature-based methods [1], [7]. Feature-based methods firstly extract salient features and then comparing them using similarity measures to establish the geometric relation between two images. One of the main advantages of these approaches is that they are fast and robust to noise. Even though, they have significant radiometric distortion and complex geometric distortion, they perform well on the condition that is suitable for features are extracted and matching by reliable algorithms. The commonly used features include edge, points, region, size, color, text, contour, and region, and the well-known feature matching methods include spatial relation, invariant descriptors and relaxation methods [1]

A. Automatic registration of optical-to-SAR images is challenging because of the following reasons:

- Different geometric properties. The Distance mode of a SAR sensor and side locking would cause a series of geometrical distortions known as layover, foreshortening and shadow, which do not exist in the corresponding optical image.
- Different radiometric characteristics. Optical instruments are passive system in the field of visible and near infrared whereas SAR instruments are active remote sensing system in the field of microwaves. Due to imaging condition, the brightness values may change significantly.
- Strong speckle noises by SAR sensors. Sensors and environmental noises such as sprinkler noise make the feature extraction difficult in SAR images and hinder the effort of identifying common features between optical and SAR images.

B. Basic Methodology:

- The core idea consists of following aspects:
- Find the database of Optical and SAR image registration.
- Extract their geometric features by using SIFT algorithms

- Use Initial feature matching by KNN
- Estimate registration parameters using RANSAC and record the number of inliers
- Registered image obtain

Fig.1 Above figure shows Optical and Tarrasa-X staring spotlight image of Oslo

II. LITERATURE REVIEW

Image registration is the method of extracting information from two or more images of the same scene taken from different viewpoints, from different times and/or by different sensors. It geometrically aligns two images—the reference and sensed images. In all image analysis tasks, image registration is a crucial step in which the final information is obtain from the combination of various data sources like a change detection, image fusion and multichannel image restoration.

A. Image registration have the following steps:

- Feature detection: Feature detection can be obtained by salient and distinctive objects features in both reference and sensed images.
- Feature matching Phenomenon: The similarity and difference between reference and sense image established.
- Estimation of Transformed model: The type and parameters of the so-called mapping functions, aligning the sensed image with the reference image, are estimated.
- Transformation and resampling of images: The sensed image is transformed by means of the mapping functions.

The implementation of each stage in image registration of images has its own typical problems. First, we have to decide what kind of features is suitable for the given task. The images which is to be used in the image registration should be distinctive enough, and their features should be detected easily[10]. Usually, the physical interpretability of the features is need. The sets of the detected images in the reference and sensed images must have enough common elements, even in the situations when the images do not cover exactly the same scene or when there are object occlusions. The detection methods should not be sensitive to the assumed image deformation but have good localization accuracy[11]. In an ideal case, algorithm which is used for obtaining all the features in images from all possible projections should be able to detect same features which will be extracted by particular image deformation.

B. Approaches to image registration:

There are many approaches to extract images:

- Fourier analysis transformation
- Warping Techniques
- Voronoi integrated transform
- Cross correlation approach using Fourier Analysis
- SIFT Transform

C. In SIFT Techniques, there are number of methods:

Some of them are as follows:

- A Vector SIFT Detector for Interest Point Detection in Hyperspectral Imagery
- Multilevel SIFT Matching for Large-Size Very High Scale Image Registration
- BFSIFT Method: Bilateral Filter Scale Invariant Feature Transform
- SAR-SIFT: synthetic aperture radar Scale invariant feature transform

Lots of work is done on SIFT Techniques and its still going.

III. PROPOSED WORK AND RESULT

The framework of proposed method is shown in Fig. First, the improved SIFT features are extracted from the SAR and optical images, respectively. Second, a set of matching features is obtained by K nearest neighbor (NN) (KNN) matching. Finally, to obtain a set of spatial consistent matches for estimating

transformation parameters set each of the top n-matching features as a seed and outputting the estimated parameters with the largest number of inliers, the outputted transformation parameters are used to produce the registered images

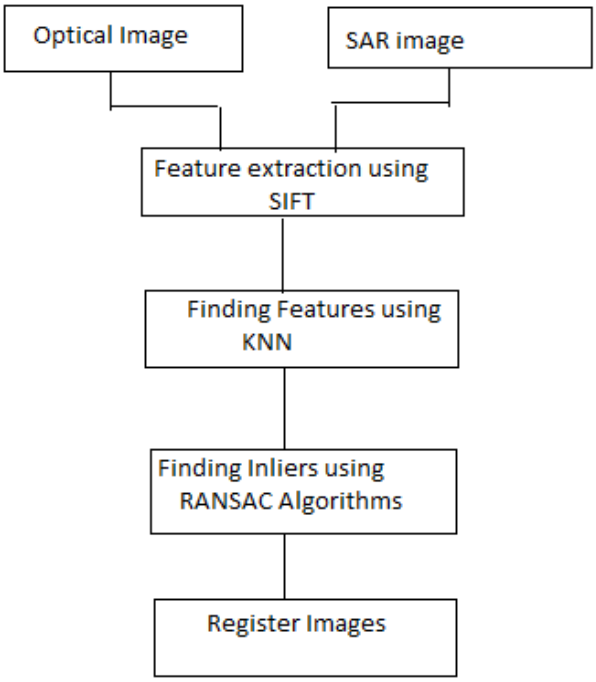

Fig.2 System Architecture of Proposed Method

For image registration, Optical image registration methods have been successfully developed over the past decades, still the registration of synthetic aperture radar (SAR) and optical images is a challenging problem in remote sensing. Feature-based methods are supposed to be more effective for multi-source image registration. Probably all of these methods depends on the feature extraction algorithms. In this article, take two images, one is Optical and second is SAR images from database. Optical and SAR images contains some kinds of impurities, like speckles noise. If this noise is present, then feature extraction could not be accurate. So, for this purpose

, noise should be removed .After removal of noise, registration can be possible.

A set of reference images are used to extract the SIFT key points of an object and store it in the database. By individually comparing each feature from a new image to the database where number of similar images are stored and using Euclidean distance method for finding candidate matching features. For getting good matches by comparing with database images, various parameters need to be checked. This parameters are its location, scale, orientations, color, size and shape. By using an efficient hash table, the determination of consistent clusters is performed rapidly. Each cluster of 3 or more features that agree on an object and its pose is then subject to further detailed model verification and subsequently outliers are discarded.

Given a desired number of clusters k, and a data set of workload samples, and a set of k initial starting points, for finds the desired number of distinct clusters and their centroids, use k-mean clustering algorithms when all the co-ordinates i.e. feature points are used to calculate the average of the point. The co-ordinate of that point are called as Centroid.

A. Formally, the algorithm for k-mean clustering is as follows:

1. Take a number of desired clusters, k.

2. Take k as a starting point. It is used as initial estimates of the cluster centroids. These are the initial starting values.

3. Verify each point (i.e., job) in the workload data set and assign it to the cluster whose centroid is nearest to it

. 4. Recalculate the new k centroids, when each point is assigned to a cluster.

Repeat steps 3 and step 4 until no point changes its cluster assignment, or until a maximum number of passes through the data set is performed.

After using matching by KNN, we use RANSAC algorithm. **Random sample consensus** (**RANSAC**) is an iterative method to find out parameters of a mathematical model from a set of observed data which contains outliers. Therefore, it can be interpreted as an outlier detection method. It is a non-deterministic algorithm. It produces a reasonable result only with a certain probability. As iteration increases probability of certainty also increase .RANSAC algorithm solve Location Determination problems.

A basic hypotheses is that the data consists of "inliers" "outliers" do not fit into the model. The outliers can come, e.g., from erroneous measurements or from extreme values of the noise or incorrect assumption about the interpretation of data. RANSAC assumes that, if there is an inliers, there exists a procedure which can predict the parameters of a model that optimally explains or fits data.

That images can be registered.

Figures 3 shown above are the different images of same geographical area. Fig. Is the optical image and Fig's the SAR image.

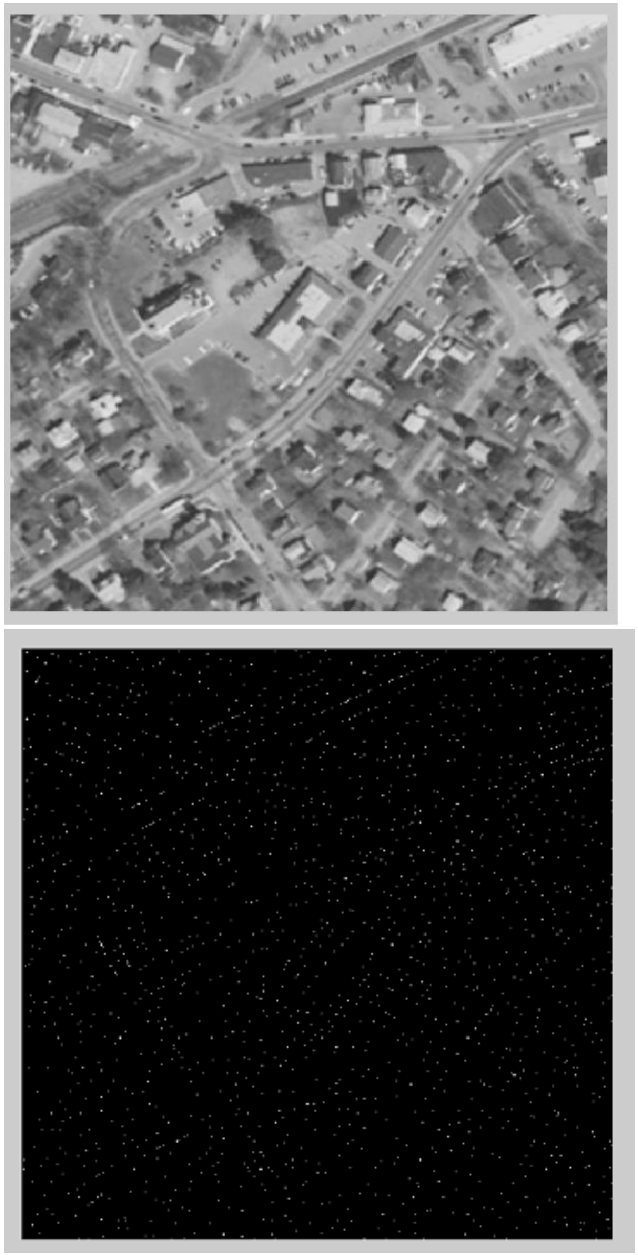

Figure 4 is the SAR image of optical image and Figure is the feature of the SAR Image.

IV.CONCLUSION

Image registration can be very useful in many practical scenarios. It is useful in knowledge extraction, Bio-medical fields, War, Computer Vision, Remote sensing. Image alignment algorithms or image registration can be classified into feature-based and intensity-based. One of the images is referred to as the *reference* image and the others are respectively referred to as the *target* images. Image registration involves spatially registration of the target images to align with the reference images. Correlated matrix method use for

intensity based feature extraction and features based method uses point, size, text, line, region as a matching features. Intensity-based methods uses different shade of intensity while feature-based methods uses different physical parameters.

Thus, take SAR and Optical image. Match them according to Intensity based or Feature based .Then correlate two images and extract information.

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