Aircraft Video Recognition using Template Matching in Satellite Images

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Abstract: The project proposes to recognize an aircraft in satellite image using template matching for accurate detection and tracking. Aircraft recognition is an important issue of target recognition in satellite images and has many important applications in practice. High resolution multispectral satellite images with multi-angular look capability have tremendous potential applications. However, automatic aircraft recognition is not a simple problem, as the resolution of satellite images gets higher, more abundant colour, texture, and spatial information are provided. Here the system involves an object tracking algorithm with three-step processing that includes moving object detection, target modeling, and target matching. Object detection - involves objects extracted frame by frame, Target modeling – we find features and obtain target in the images, Target tracking – we track the object in every images. Potentially moving objects are first identified on the time-series images. The target is then modeled by extracting both spectral and spatial features. In the target matching procedure, template will be used as matching model to recognize with each frame by frame for accurate detection. Here, normalized cross correlation and spatial features are used as features model for recognition. This recognition model will be continued for all sequence of satellite images. Final simulated will be demonstrated the capability of object tracking in a complex environment with the help of high resolution multispectral satellite imagery.

Keywords: Aircraft Image; Template Creation; Co-Occurrence Matrix Matching; Tracking Process.

I. INTRODUCTION

Object tracking in a complex environment has long been an interesting and challenging problem. In the remote sensing context, it has often been applied to the use of aerial or satellite imagery to track ground vehicle traffic. Algorithms have been developed to demonstrate vehicle tracking using low-rate video or visible imagery sequences collected by sensors on aircraft. Airborne spectral imagery, as well as spectral combined with Polari-metric imaging, have also been used to demonstrate the capability of remote Sensing platforms to track vehicles. In another application, satellite imagery along with other data sources has been used to track ships in the ocean. Additionally, synthetic aperture radar airborne and satellite sensors have also been shown to have surface object tracking capabilities. Current satellite platforms offer limited utility for surface object tracking primarily due to inherent tradeoffs in resolution and spatial/temporal coverage. High resolution satellites located in low earth orbits with adequate resolution (1 meter) to resolve surface objects offer limited spatial coverage (tens of sq. km.) and long repeat intervals (days). Satellites with short repeat intervals (minutes) are located in geosynchronous orbits and offer poor ground resolution (1 km).

However, as satellite technology matures and more satellites are launched into orbit, it is appropriate to consider the possibilities for tracking surface objects offered by these new systems. In this work, we propose an object tracking (Co-Occurrence Matrix) algorithm for use with multi temporal and multispectral satellite imagery. Multiple objects can be tracked simultaneously with user-initialized starting points. At this point, the tracking algorithm only relies on the intensities of the pixels and does not include any kinematic capability to account for the smooth movement of the objects. The outline of the paper is as follows. In this paper, the proposed object tracking algorithm is introduced. Then in this the proposed algorithm is validated by performing object tracking on a set of Aircraft video multi-sequence images provided by Digital Globe. Discussion and conclusions are presented.

II. DESCRIPTION

A. Aircraft Video

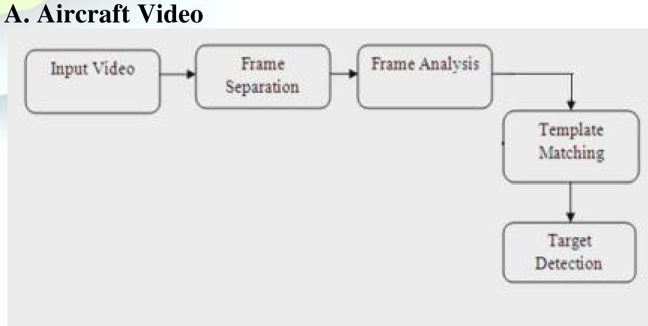


Fig.1.Block Diagram: Aircraft Recognition Using Template Matching.

Stands for Audio Video Interlaced. It is one of the oldest formats. It was created by Microsoft to go with Windows Xp and its “Video for Windows” application. Even though it is widely used due to the number of editing systems and software that uses AVI by default, this format has many restrictions, especially the compatibility with operations systems and other interface boards. Big screen films are not digital and are still highly esteemed as quality images.

However, it is easier to maintain the quality of a digital video. Traditional tapes are subject to wear and tear more so than DVD or hard drive disks. Also, once done, a digital video can be copied over and over without losing its original information.

B. Template Creation

It is a technique in digital image processing for finding small parts of an image which match a template image

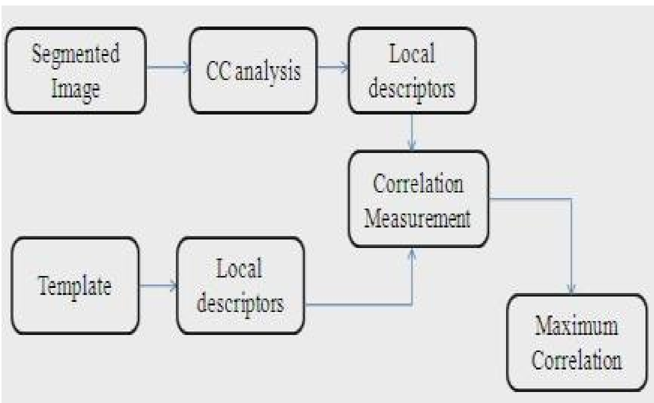


Fig.2. Block Diagram: Template Matching Analysis.

A sliding window over other image sequences is used to indicate the possible presence of the reference target. A regional feature matching operator is applied to find the similarity between the target model and the pixels within the window. The labeled component from segmentation module will be applied to extract the region features to describe its characteristics. Here correlation coefficient will be used to measure the similarity between two different objects for target detection and tracking.

C. Correlation Measurements

Correlation Coefficient: It is used to find the similarity between two different objects with their region features. It will be described by,

$$Cor\_coef = [sum(sum(u1.*u2))] / [sqrt(sum(sum(u1.*u1))*sum(sum(u2.*u2)))] \quad (1)$$

Where,

u1 = F1 – mean of F1, u2 = F2 – mean of F2 F1 – Feature set1 and F2 – Features set2.

After this measurement, maximum correlated values are searched to recognize the location of desired object and tracking it through rectangular box with bounding parameters.

D. Local region descriptors

After the segmentation, connected component analysis is performed for the segmented local regions to group the similar property objects. Each object region will be described by measuring the following characteristics,

Area
Equivalent diameter
Perimeter and Eccentricity
Width and Height
Orientation

These features are measured all presence of objects and target region will be identified and tracked with help of templates

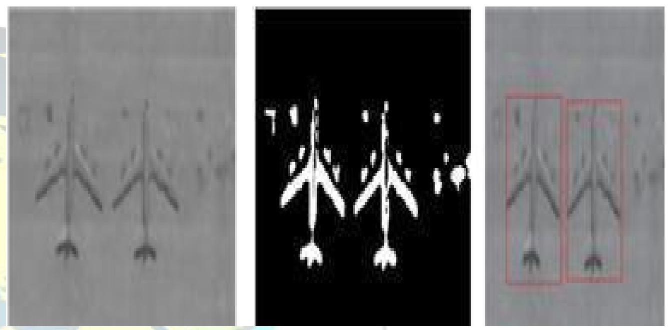


Fig.3. Object tracking Using Otsu method Segmentation

E. Video Based Satellite Image Tracking

The proposing method has three steps, object detection, target modeling, target tracking. Object detection involves objects extracted frame by frame. Target modeling, we find features and obtain target in the images. Target tracking, we track the object in every images

III. RESULT AND DISCUSSION

A threshold could be applied to filter out the pixels with low similarities. Regional maxima can then be found based on the values.

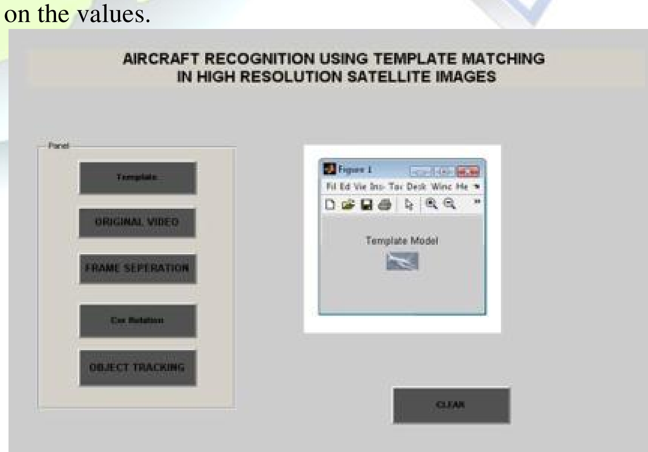


Fig.4. Template Selection.

Regional maxima are defined as the connected pixels with a constant value, and their boundary pixels all have lower values. A binary image can then be generated to identify the

which may occupy only a few pixels, it is quite possible that the edges of the background also will present high similarities in pixel count. An opening morphological filter is therefore optional to eliminate this edge effect in the binary image. The opening morphological filter is the erosion followed by the dilation. The definition of the erosion and dilation operators can be found

$$\phi(\mathbf{y}) = \left\{w_1 \cdot \left[1 - \hat{d}_B(\mathbf{y})\right] + w_2 \cdot \hat{d}_I(\mathbf{y})\right\} \cdot \mathrm{RMAX}(\mathbf{y}) \quad (2)$$

Where and are normalized Bhattacharyya distance and histogram intersection whose original values are divided by their maxima, and are weighting coefficients. In this paper and are selected equally as 0.5. A high value indicates a good matching with the target model. The harbor area was first selected for algorithm testing. The RGB image of the first frame is shown in.

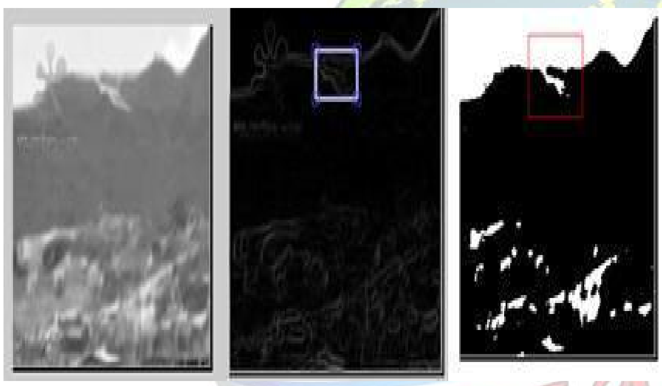


Fig.5. Correlation Measurement in Moving Object in Black and white image.

The target only occupies a few pixels, and exhibits very similar shape and intensity value with a large amount of other objects in the scene. Several other small objects have also been found to be moving in the following images. All these factors introduce significant difficulties for our tracking task. The estimated trajectory of the ship movement based on the proposed object tracking algorithm. The calculated, and values are evaluated based on 50 pixels that are matched.

locations of regional maxima. For a small reference target

The use of both spectral and spatial features ensures better tracking accuracy than using each of them alone as has been observed in the intermediate results of target matching. Our algorithm has been tested using a set of multi-angular sequence images acquired by the WV2 satellite. Three different objects have been successfully tracked at two regions. The tracking performance is analyzed by the calculation of recall, precision, and score of the test. While we acknowledge the results shown are for a single data set with a limited number of objects the preliminary results have demonstrated the capability of tracking objects in a complex environment with the help of high resolution multispectral satellite imagery.

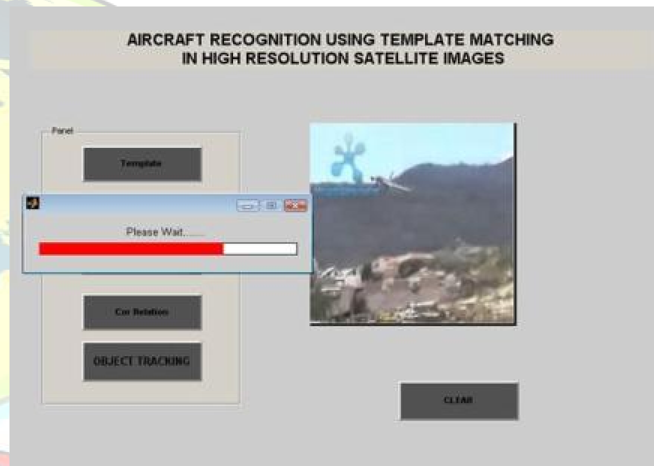
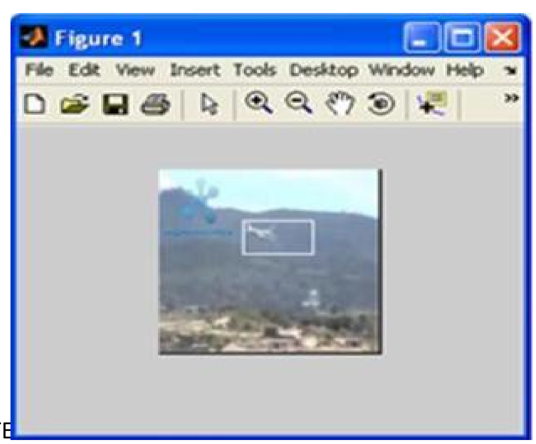


Fig.7. Frame Separation.

The technique introduced in this paper also has potential applications in other research areas, such as object velocity estimation, and traffic control. Based on the spatial resolution of the available data set and also the relatively long time interval between two frames, it is very difficult to visually identify identical objects with small geometric size in the image sequences.



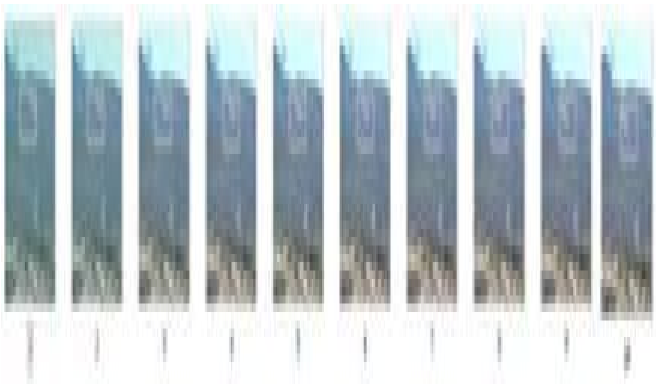


Fig.9. Moving Object track for 10 frames in our video.

IV. CONCLUSION

We have presented an object tracking algorithm applied to a sequence of multispectral satellite images. This unique algorithm is developed for an optical multi-angular data set, and is designed based on moving object estimation, target modelling, and target matching three-step processing. Potentially moving objects are first identified on the time-series images. A reference target is then modelled by extracting spectral and spatial features. In the target matching procedure, the Bhattacharyya distance, histogram intersection, and pixel count similarity are combined in a novel regional operator design. Tracking small objects, such as vehicles, in a denser scene is more challenging, and will be considered in our future work, as will extensions of the algorithm to include a kinematic model to account for the smooth movement of objects.

VII. REFERENCES

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