Analysis Of Object Statistics In Remote Sensing Images

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ABSTRACT
Remote sensing refers to the activities of recording, observing, and perceiving (sensing) objects or events in far-away (remote) places. In remote sensing, the sensors are not in direct contact with the objects or events being observed. Electromagnetic radiation normally is used as the information carrier in remote sensing. The output of a remote sensing system is usually an image representing the scene being observed. A further step of image analysis and interpretation is required to extract useful information from the image. In this paper, we will analyze the remote sensing image which can have different types of objects (depends upon the application area). We will identify the object in the given image by using active contour method and after that we will calculate the object's statistics. Object statistics deals with different features like area, region, boundary, texture and threshold etc.

Keywords - Remote Sensing Images, Active Contour Method, Hough Transform

I. INTRODUCTION
Remote sensing image processing is a mature research area allowing real-life applications with clear benefits for the Society. Applications of remote sensing are (1) monitoring and modelling the processes on the Earth's surface and their interaction with the atmosphere; (2)measuring and estimating geographical, biological and physical variables; and (3) identifying materials on the land cover and analyzing the spectral signatures acquired by satellite or airborne sensors. Achievement of these objectives is possible because materials in a scene reflect, absorb, and emit electromagnetic radiation in a different way depending on their molecular composition and shape. Remote sensing exploits this physical fact and deals with the acquisition of information about a scene (or specific object) at a short, medium or long distance.

As the advance of remote sensing technology, high quantity remote sensing images become widely available. With the increasing volume of image data, it is desirable to develop the technique for remote sensing image analysis and understanding. However, the overwhelming amount of image data impose heavy computation constraints.

1.1 ACTIVE CONTOUR METHOD

Contour Method Besides challenges due to imaging noise and partial volume effects, the similarity in intensity and texture between neighboring structures complicates the task of identifying distinct boundaries between the structures. So the active contour method was introduced which developed the concept of shape contours .When evolving shape contours, the interaction consists of modeling the "forces" of attraction, repulsion, and competition by taking into account the relationship between object contours and their shape estimates.[5]
An active contour is an ordered collection of 'n' points in the image plane:

$$v \square \{v_i ,............v_n \}$$

---(1)

$$v_i \quad \square \ (x_i , y_i)_i , i \ \square \ (1_i ,...., n)$$

The points in the contour iteratively approach the boundary of an object through the solution of an energy minimization problem. For each point in the neighborhood of 'Vi', an energy term is computed:

$$E_i \quad \square \ \square E_{\text{int}} (v_i) \square \ \square E_{ext} (v_i) \qquad ....(1)$$

Where $E_{\text{int}} (v_i)$ is an energy function dependent on the shape of the contour and $E_{ext} (v_i)$

is an energy function dependent on the image properties, such as the gradient, near point v_i .□, □ and are constants providing the relative weighting the energy terms.

E_i , E_{int} and E_{ext} are matrices. The value at the center of each matrix corresponds to the contour energy at point v_i . Other values in the matrices correspond (spatially) to the energy at each point in the neighborhood of v_i .

Each point, v_i is moved to the point v_i' , corresponding to the location of the minimum value in E_i . corresponding to the location of the minimum value in E_i . This process is illustrated in Figure 1.1. If the energy functions are chosen correctly, the contour, v , should approach, and stop at, the object boundary.

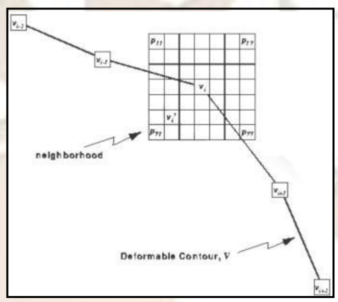

Figure 1: energy function

1.2 INTERNAL ENERGY

The internal energy function is intended to enforce a shape on the deformable contour and to maintain a constant distance between the points in the contour. Additional terms can be added to influence the motion of the contour.

The internal energy function used herein is defined as follows:

$$E_{int}(v_i) = cE_{con}(v_i) + bE_{bal}(v_i) \quad \text{……….(2)}$$

Where $E_{con}(v_i)$ is the continuity energy that enforces the shape of the contour and $E_{bal}(v_i)$ is a balloon force that causes the contour to grow (balloon) or shrink. ‘c’ and ‘b’ provide the relative weighting of the energy terms.

1.3 EXTERNAL ENERGY

The external energy function attracts the deformable contour to interesting features, such as object boundaries, in an image. Any energy expression that accomplishes this attraction can be considered for use.
Image gradient and intensity are obvious (and easy) characteristics to look at (another could be object size or shape). Therefore, the following external energy function is investigated:

$$E_{ext}(v_i) = mE_{mag}(v_i) + gE_{grd}(v_i) \quad \text{……….(3)}$$

Where $E_{mag}(v_i)$ is an expression that attracts the contour to high or low intensity regions and $E_{grd}(v_i)$ is an energy term that moves the contour towards edges. Again, the constants, m,g are provided to adjust the relative weights of the terms.

1.4 HOUGH TRANSFORMATION

The Hough transform is a technique which can be used to isolate features of a particular shape within an image. Because it requires that the desired features be specified in some parametric form, the classical Hough transform is most commonly used for the detection of regular curves such as lines, circles, ellipses, etc. A generalized Hough transform can be employed in applications where a simple analytic description of a feature(s) is not possible. Due to the computational complexity of the generalized Hough algorithm, we restrict the main focus of this discussion to the classical Hough transform. Despite its domain restrictions, the classical Hough transform (hereafter referred to without the classical prefix) retains many applications, as most manufactured parts (and many anatomical parts investigated in medical imagery) contain feature boundaries which can be described by regular curves. The main advantage of the Hough transform technique is that it is tolerant of gaps in feature boundary descriptions and is relatively unaffected by image noise.

The Hough transform algorithm uses an array, called an accumulator, to detect the existence of a line y = mx + b. The dimension of the accumulator is equal to the number of unknown parameters of the Hough transform problem. For example, the linear Hough transform problem has two unknown parameters: m and b. The two dimensions of the accumulator array would correspond to quantized values for m and b. For each pixel and its neighborhood, the Hough transform algorithm determines if there is enough evidence of an edge at that pixel. If so, it will calculate the parameters of that line, and then look for the accumulator's bin that the parameters fall into, and increase the value of that bin. By finding the bins with the highest values, typically by looking for local maxima in the accumulator space, the most likely lines can be extracted, and their (approximate) geometric definitions read off. (Shapiro and Stockman, 304) The simplest way of finding these peaks is by applying some form of threshold, but different techniques may yield better results in different circumstances - determining which lines are found as well as how many. Since the lines returned do not contain any length information, it is often next necessary to find which parts of the image match up with which lines. Moreover, due to imperfection errors in the edge detection step, there will usually be errors in the accumulator space, which may make it non-trivial to find the appropriate peaks, and thus the appropriate lines.

II. RELATED WORK

Contour based object detection is fundamental to many image analysis applications, including image segmentation, object recognition and classification. However, highly accurate image contour detection algorithms are also very computationally intensive, which limits their applicability, even for offline batch processing. Lot of research work has been done to detect the objects in remote sensing images. We will just discuss the most recent advancements related to the object detection in remote sensing images.

P.H. Lee, Y.L. Lin, S.C. Chen, C.H. Wu, C.C Tsai, and Y.P. Hung [2] proposed a viewpoint-independent object-detection algorithm that detects objects in videos based on their 2-D and 3-D information. It shows that, by considering 2-D contours and 3-D sizes, one can achieve promising object detection rates. The proposed algorithms were evaluated on both pedestrian and vehicle sequences. It yielded significantly better detection results than the best results reported in PETS 2009, showing that our algorithm outperformed the state-of-the-art pedestrian-detection algorithms.

V.Vaidehi, A. Annis Fathima, S. Ramanathan, Sameer, S. Sagar [3] proposed an efficient scheme for detecting different object classes in an imaging sensor network. The object detection system detects all the instances of objects (for which the classifier was trained) in the given image, regardless of their scales and locations.

S. Chen, C. Cai, E. Li [4] proposed a knowledge modeling, architecture design and detailed implementation of an ontology-based knowledge base for target recognition in remote sensing images. Knowledge base is a critical component of a large ground target recognition system which is a hybrid system that combines knowledge base with remote sensing image processing module. The knowledge base provides necessary knowledge for remote sensing image processing module, and remote sensing image processing module can perform multiple tasks with the support of the knowledge base. The existence of the knowledge base makes the whole recognition system more flexible and more generic than those systems without knowledge base. The effectiveness of the presented knowledge base shows the good prospect of the application of knowledge base in remote sensing image processing domain.

III. PROPOSED METHOD

Remote sensing image may contain different objects but due to different factors like noise, shadow or poor weather conditions, object and its statistics can not be recognize properly. So will follow some steps to remove these factors and after that we will find the objects and calculate their statistics. Following are the steps to be followed:

Process the image in order to remove noise and shadow. A segmentation algorithm often needs a preprocessing step like noise smoothing to reduce the effect of undesired perturbations (artifacts) which might cause over- and under-segmentation.

Using image segmentation process, decompose an image domain into a number of disjoint regions so that the features within each region have visual similarity, strong statistical correlation and reasonably good homogeneity. The preprocessed image works as the input to watershed segmentation algorithm.

After segmentation we can either do binary conversion of image using thresholding or grey scale conversion

The goal of thresholding is to create a binary representation of the image & to discard irrelevant data and keep only the important segments of data which lie above threshold curve. It segments the digital image based on certain characteristics of pixels(for example intensity value)

Grey scale dumps all the color information and leaves with very little information to work with. NTSC standard is used for the conversion to grey scale There exist several methods for segmenting gray-level images[16]. Gray-level thresholding is one of the oldest techniques for image segmentation

Contour extraction, depending on the image quality & structure has two possibilities. The first one is performing image segmentation based on color & texture. If color based segmentation is not possible due to unknown information about objects, then our second way to compute the contour is direct edge detection since we need contours with a thickness of one pixel. Finally we will calculate the threshold, region, boundary, texture and the area of extracted object and its radius will be calculated by using Hough Transformation.

IV. RESULT AND DISCUSSION

Figure 2: Remote Sensing Image

Above figure shows a object in a remote sensing image. We used segmentation to divide t he image domain in to small region and used the active contour method to extract the object as shown in below figures.

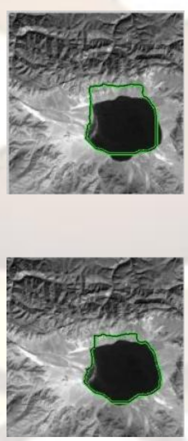

Figure 3: Active Contour (finding a object)

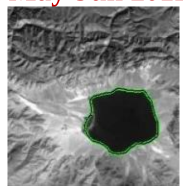

Figure 4: Active Contour (extracting a object)

Figure 5: Object extracted by Active Contour

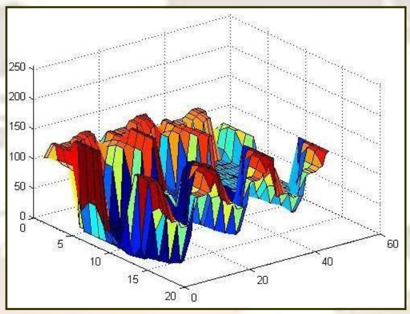

Figure 6: Surface graph of extracted object by Active Contour

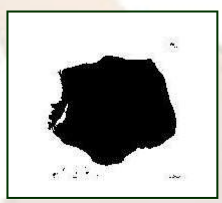

Figure 7: Final output image of object

Now we will calculate the statistics related to the extracted object using Hough transformation as shown in figure below:

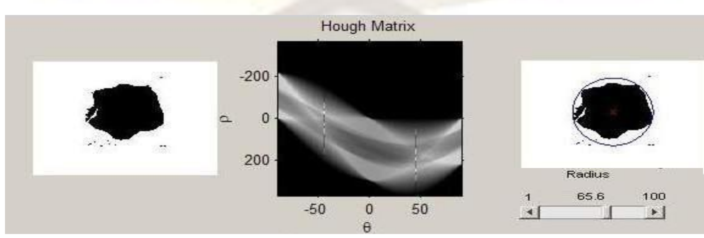

Figure 8: Hough Transformation on extracted object

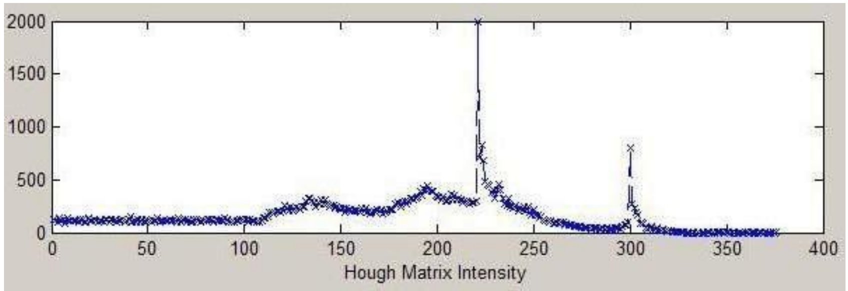

Figure 9: Hough Matrix Intensity

Above figure shows the Hough Intensity Matrix and maximum value for Hough Matrix is 256. Radius of the circle is 65.6 and co-ordinates of centriod are 150 & 100.5. (approx. Values)

Area of the extracted object	8156 units
Threshhold Value	0.3647

Texture	
Contrast	[4.5742e+003 4.0545e+003 3.6669e+003]
Correlation	[-0.2002 -0.1363 -0.0769]
Energy	[1.1944e-004 8.2405e-005 6.9466e-005]
Homogeneity	[0.0485 0.0525 0.0557]

V. CONCLUSION AND FUTURE SCOPE OF WORK

Many solutions have been implemented for the object recognition. Our proposed method can extract the object in given image by using Active Contour method. It is very efficient and consumes less time to find out the object. After finding the the object, we performed different calculations on the extracted object i.e. we calculated the area, region, boundary, texture and threshold etc. All these properties are very important in remote sensing applications. We can also compare the collected data with the previous collected data in order to record the changes occurred in earth surface.

Area of extracted object is 8156 units and threshold value is 0.3647. In case of texture, value of contrast is [4.5742e+003 4.0545e+003 3.6669e+003], value of Correlation is [-0.2002 -0.1363 -0.0769], value of Energy is [1.1944e-004 8.2405e-005 6.9466e-005] and value of Homogeneity is [0.0485 0.0525 0.0557]. Value for Hough Matrix is 256. Radius of the circle is 65.6 and co-ordinates of centriod are X=150 & Y=100.5. (approx. Values).

So, we conclude that this proposed method is very effective and provides better results.

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