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An Overview of different Methods of Image Analysis and Object Detection

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Abstract—*Information can be extracted in different ways. Remote sensing plays vital role in modern world in the field of satellite imagery. Different types of objects can be tracked and traced using remote sensing image processing method. We have compiled different methods of object extraction to recognize the objects from common features to particular features. Object recognition in these images is a thought-provoking work basically to achieve an image match. To achieve efficiency in robust performance, image processing techniques like de-noising of images, sharpening, binary transformation and edge detection have been used. People essentially want to get information about a particular area from these images which are taken from satellite or aircraft. These are very crucial for disaster surveillance or for other scientific purposes. Various methods based on feature template correlation, object recognition system using multiple invariant moments and detecting objects based on shapes has been discussed.*

Keywords—*Shape Detection,Sonar image, Target recognition, Feature extraction, Multiple Invariant Moments.*

I. INTRODUCTION

With the increasing improvement of resolution of remote sensing image, acquiring maximum information about objects has become the key focus of research. Based on conventional remote sensing image processing technique, we can classify different type of objects like large terrain, such as city and farmland. When the resolution of remote sensing image approaches to 1 meter or even less, we can see most small objects on the ground, such as houses, vehicles, and so on clearly. It is difficult to distinguish those small objects from image background by conventional remote sensing image processing methods. Now there are many studies on manmade object (roads, houses, vehicles) recognition in the high-resolution image. Object recognition algorithm in optical camera image processing are applied to the remote sensing image due to the improvement of the spatial resolution of image. But there are many problems faced in remote sensing image processing and optical camera image processing.

1. The remote sensing images are obtained with different view point angle field and view field
2. The ratio of the number of object pixel and whole image pixel is quite small.
3. The object on the earth are of different variety, from a large city to a small vehicle, and one object itself has different appearance on the remote sensing image because of different view point, view field, view angle and different climatic condition.

Tracking different types of objects using remote sensing image processing method has become challenging. We have compiled different methods of object extraction to recognize the objects from common features to particular features. [1]

II. REMOTE SENSING USING CORRELATION PROCESSING

In remote sensing image, the assumption of a rigid model is not fulfilled but the correlation match based on the distance between profile to shape centre (DPC) is presented for recognizing the object with protruding profile in this paper

1. Definition of DPC of object:When we acquire the profile of the object image, initially the location of shape centre of the profile is computed. Assume that the profile point set is $T(x_i,y_i)$
i=1,2,3….N, where N is the number of points in set T. The shape centre C(x,y) can be computed by equation :

$$X = \sum_{i-1}^{N} X^i/N \qquad \text{Eq (1)}$$

$$y = \sum_{i-1}^{N} y^i/N \qquad \text{Eq (2)}$$

We can get the distant set S of DPC

$$S(i) = \sqrt{(x_i - x)^2 + (y_i - y)^2}$$

Where i=1,2,3
Where (x_i,y_i) = the coordinate of profile points
(x, y) = the coordinate of shape centre

The DPC set reflects the distance change process of the profile related to the shapecentre. So there are two advantages when the DPC set is used as the feature for correlation process:
1) This processing has the characteristic of translation invariant because the shape center is used as a reference points
2) This processing has the characteristic of rotation invariant due to the method for computing the DPC.[1][2]

2.1. Correlation Processing

DPC converts the two dimension edge profile to one dimension feature.It is convenient to choose a correlation method for template matching. The DPC mean square difference (MSD) between the object profile acquired from input image and the template, is proposed as template correlation criterion. A threshold is set to decide whether the object image is similar to template or not.

Assume that S_t (n) is the DPC set of object in input image
S_m (n) is the DPC set of template
n=1, 2, 3…M, if N<M, S_t (n) will be expanded to M by interpolating processing. When N=M, the correlative conjunctions based on MSD can be written as

$$R(n) = \sum_{i-1}^{N}(S_t(\mathrm{i}) - S_m(\mathrm{i}+\mathrm{n}))^2 \qquad \text{Eq (3)}$$

R= m in(R (n /N))

Where R (n) is the correlative conjunctions
R is the correlative degree between object and template

$$\mathrm{R}=\begin{cases} \leq \sigma & accept \\ > \sigma & refuce \end{cases} \qquad \text{Eq(4)}$$

Where σ is the threshold for making decision that the object is similar to template or not [3].

III. SONAR IMAGE RECOGNITION

A sonar image is stored in PCs as a matrix. To hold the feature extraction operation and good recognition to the image pre-processing, some transformation, namely pre-processes are adopted. After pre-processes, a system can get a more clear and easy-operational digital image. Since the information condensed in the raw data is too much and redundant for target image recognition, a series methods about features selection and extraction are introduced. Features selection and extraction is one of the most crucial steps in image recognition, which effects image recognition. Feature extraction is a kind of image transformation, which could transfer high-dimension feature vector to low. The feature extraction process attains dimensional compression, while maintaining the necessary information, which is more representative and essential to the image. Shape description is also an important feature of the target image. It is found that the invariant moment has good effect in classification of the recognition system. Invariant moments is a statistical mathematical character of translated, rotated or scaled image. The steps for the whole process is shown in Figure .1.

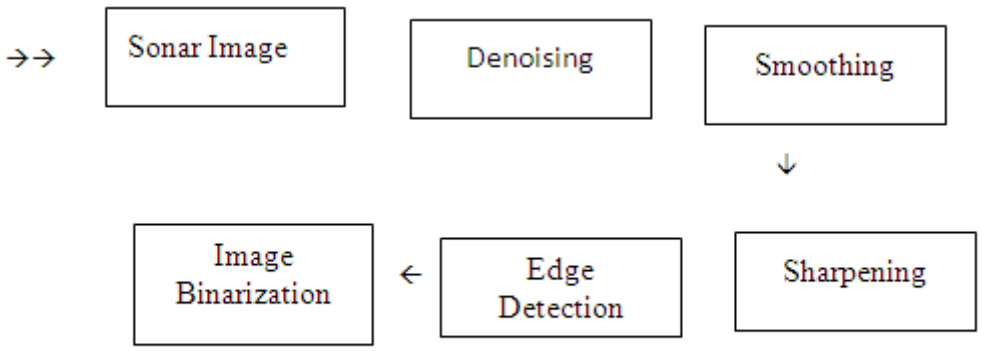

Figure .1. Recognizing Sonar Images

DE-noising of an image is done in many ways. The main properties of a good image DE-noising model is that it will remove noise while preserving edges. Image sharpening is a powerful tool for emphasizing texture and drawing the attention of the viewer. Digital camera sensors and lenses always blur an image to some degree and this requires

correction. Smoothing of images are established by low pass filters. Smoothing is also done using a single value representing the image, such as mean (average) and median (middle) value of an image. Basically edge detection is a set of mathematical methods and these methods identifies points upon which the image brightness changes sharply or having discontinuities in the image. In a binary image, for each pixel there has been only two attainable values. Binary image uses only two colors black and white, although can use any other 2 color as well. One color is used for the foreground of the object while the other one can be used as the background. In the document-scanning industry this is often referred to as "bi-tonal"[3].

3.1. Object Template:

The object template is a representative of object that is built based on the analysis of the properties of object. There are two kinds of object templates used in image processing. One is geometric template of object based on the real gray values of object image and searching the whole input image based on this geometric template. Another more complex method for building the template for object recognition is an abstract feature template based on the description of object feature properties [4]. Following are the features used to describe the object:

1. Spectrum feature
2. Geometric feature
3. Context feature
4. Radiometric feature.

IV. Shape Detection

Morphology is the study of the shape and form of objects. Morphological image analysis can be used to perform the operations like,

i. Object extraction
ii. Image Enhancement -Removal of small objects and noise from the image .
iii. Edge detectors, shape description.

In this Morphological processing first we "Read Image" from data base or appropriate file. Then we perform morphological opening operation to estimate the background illumination.

Shape is the most powerful descriptor of image content. Shape of an object is the most important property about objects and recognizing the shape is the most crucial for object recognition which allows us to predict more fact and features about the objects. In some applications it may be the only feature present, e.g. logo recognition. Shape is not only perceived by visual means but also through tactical sensors .Shape detection and finding exact edges is one of the major problem faced by researchers. To avoid this, edge detection is one of the technique and it is the fundamental for identifying objects. For identifying shape, the point at which brightness changes are ordered as a set of curved lines knows as edges. Different types of edge detection techniques are available. Canny-edge detection and Sobel-edge detection are most common edge detection techniques.

In Sobel edge detector, the task of edge detection is fulfilled by performing a 2D spatial gradient convolution operation on an image. This operator uses two convolution masks G_x and $G_y$as shown below

-1	0	1
-2	0	2
-1	0	1

-1	-2	-1
0	0	0
1	2	1

Here, G_x and G_y are computed as,

$G_x = -1z1+1z3-2z4+2z6-1z7+1z9$

$G_y = 1z1+2z2+1z3-1z7-2z8-1z9$

Where Z_i, i=1, 2….9 are intensity levels of each pixel in the convolution window shown in fig

Z1	Z2	Z3
Z4	Z5	Z6
Z7	Z8	Z9

Sobel operator isvery simple and effective way for finding the edges in an image, mostly for detecting vertical and horizontal edges.

Since canny edge detectors satisfies all three criteria for performance, it is considered as a favourable edge detector. The algorithm is as follows:

1. The first step in this detector is to filter out noise in the image by using a Gaussian smoothing filter.
2. After computing the image gradient, the edge strength is been located in the smoothed image by the edge detector, so that the actual edge can be located.
3. Last step involves reducing the edges by setting any pixels that is not at the maximum to be zero while tracking along with the edge direction known as non-maximum suppression.
4. And finally pixel connectivity is been used for edge detection and linking.

If the magnitude is above the highest threshold,then it is considered as an edge that is called double threshold and it is considered as a non-edge. This edge detector has the advantage that maximum edges get detected by using this edge detector [4]

V. Conclusion

Object recognition in remote sensing is a challenging work. Instead of searching the whole input image with complex features, a method for template correlation based on DPC set is presented in this paper and the experiments show that it is effective for correlation between the profile of the object template and image. The concept of object recognition System for sonar image has also been discussed. Using several processes such as image De-noising, edge detection, binary transformation and image sharpening, robust performance has been achieved.

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