Automatic Extraction Method of Airport Object in Aerial Imagery

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Abstract: Along with the progress of each basic theories in the picture science, the numerical picture processing technique gets the extensive application in each section of national economy, moreover, it has become study hotspot that is automatic identify in panchromatic aerial image. A kind of MF method to extract airport in aerial image was put forward on analysing template match and characteristic extraction. It brought forward a template match method to resolve that because of the information covering to have great capacity in aviation photograph, the hair stabs ordering more, operating great, and so on. It obtained the better result.

Key-Words: Threshold segmentation, Remote sensing image, Panchromatic aerial image, Airport object, Image segmentation, Template match, Characteristic extraction.

1 Introduction

With the development of computer processing technology, especially the pattern recognition, it makes intelligent interpretation of aerial image to be possible. High-resolution remote sensing images should use a computer-controlled intelligent ways and means in order to extract object characteristic and identify the object coordinates automatically, thereby enhancing the image interpretation automation capability [1]. So, it has important meaning to utilize the computer to measure the object out from image and carry on the automatic discernment of the aviation photograph, for improving interpretation efficiency, reduce the judging by accident rate.

Object recognition refers to the characteristic extraction to the importation image of processed, such as taking the image marginal contours and regional segmentation and so on, then classify the images [2] according to these characteristics and then use identification theory such as pattern matching, discriminant function etc. Panchromatic aviation remote sensing image is the main sources of information that objective interpretation; it is the key that how automatically extract the airport contours for remote sensing image.

The airport runway and parking apron and other facilities are the main characteristics of the airport, which is also the key characteristics to identify the airport, the existence of runway and construction around means that the existence of the airport [3, 4]. This paper presents a method that extracts the airport runway automatically in panchromatic aerial image which used to identify the object of airport.

2 Method Extracting Airport Object Automatically Based on MF Algorithm

2.1 Workflow of MF Algorithm

According to characteristic, geometric property, grey level property of the runway in the image and so on, find the airport by detecting the runway, First make pre-treatment including deposing, filtering to the aviation photograph and so on; Then make image segmentation by application template matching method; And then revise imprecise region, eliminate inaccurate region, increase missed region by marginal expansion modes; After the transform of the threshold value, extract the contour of airport runway and the construction around, so gained the airport extraction image. The final output result of this detection method is the area where the airport exists and extracts the characteristic of the airport. The concrete workflow is as shown in Fig.1:

2.2 Introduction of MF Algorithm

MF algorithm includes template matching, threshold transform and characteristic extraction, there into, template matching can rapidly and accurately find matching regions. Marginal expansion can further expand the scope of the airport identified, threshold

transform lay the foundation for the character extraction, contour extraction extract the character of the airport.

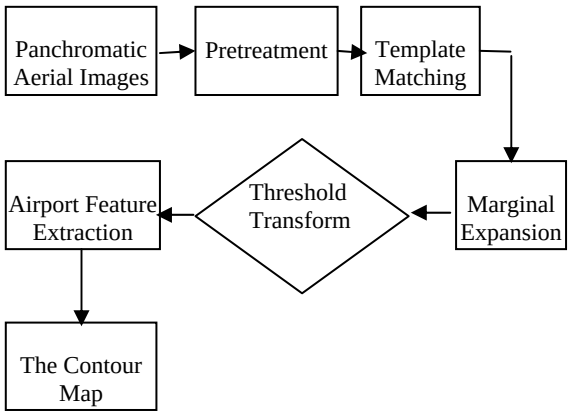

Fig.1 MF algorithm flowchart

2.1.1 Template matching

We have taken an auto-adapted method for the runway model established of the airport extraction:

If the proportion which airport region in the original image is more than 60%, application template matching to find the location of the airport will lose its practical significance[5]. So, we will set the length and width of the runway model auto-adapted to one-third of the original image and one-twentieth. Make use of the template matching between auto-adapted runway model and the original image, so as to find the initial location of the airport runway. At the same time, as the airport in aerial images presents the gray value that is about from 160 to 200, so that each pixel in template is given a different random number from 160 to 200.

A template T was stacked in the search map and was translated, the search map under the cover template is called sub graph $S^{i,j}$, i, j is the coordinates of the upper left point in sub graph which is in image S, called reference point, which can be seen the range of i and j, which is 1 <i, j <N-M +1 in Fig. 3.

Now compare the content between T and $S^{i,j}$ .If they are consistent, the difference between T and $S^{i,j}$ is zero, so you can use one of the two measures to measure the degree of similarity between T and $S^{i,j}$:

$$D(i,j)=\sum_{m=1}^{M}\sum_{n=1}^{M}[S^{i,j}(m,n)-T(m,n)]^2$$

2.1.2 Marginal expansion

Because what we want to realize is that the abstraction of the characteristic of the airport, which is why we need to expand the edge to find out the range of the airport to the preliminary airfield runway confirmed. The airport has been identified as the proportion not more than 60%, so we will match the template in order to get the biggest similarity of the coordinates of the area respectively, upwards, expand left already.

Set original image width as W, the height is H; the image width of the template is w, the height is h; the similar largest regional threshold coordinate is (x, y), the extended coordinates (X, Y).

If x <W / 2, X = x-W / 4; Otherwise, X = x-W / 3.

If y <H/15, Y = y + H/10; Otherwise, Y = Y + H/20.

Thus get the initial coordinates of the area of airport, and then extract the area of airport according to template size and relation under 60% of area of airport received.

2.1.3 Threshold transform

Because the image characteristic extraction needs turn the original image into a binary image, we use an iterative seeking the best image thresholding segmentation algorithm.

This algorithm steps are as follows:

(1) Obtained the minimum gray and maximum gray values of images Z_l and Z_k , make the initial threshold value $T^0=\frac{Z_l+Z_k}{2}$

(2) Threshold value cut image apart into object and background two part, calculated the average gray value Z_O and Z_B of two parts and among them,

$$Z_O=\frac{\sum_{z(i,j)<T^k} z(i,j)\times N(i,j)}{\sum_{z(i,j)<T^k} N(i,j)}$$

$$Z_B=\frac{\sum_{z(i,j)>T^k} z(i,j)\times N(i,j)}{\sum_{z(i,j)>T^k} N(i,j)}$$

In the type $z(i,j)$ is the grey value of the point (i,j) in the image, and it's weight coefficient is $N(i,j)$, generally, $N(i,j)=1.0$.

(3)Ask new threshold value out: $T^{K+1}=\frac{Z_O+Z_B}{2}$

(4)If $T^K=T^{K+1}$, over, otherwise, $K\leftarrow K+1$ transfer to the step (2).

2.1.4 Characteristic Extraction

The purpose of the obtained image binary is to obtain the external contour characteristics of the airport more conveniently, because binary image characteristic extraction algorithm easier to achieve, and it is not easy to noise interference. Contour extraction actually equivalent to a nine-point structure element of the original image corrosion, and then the original image subtract corrosion images.

3 The Experimental Results and Analysis

3.1 The Experimental Results

The core module based on the multi-information airport extraction automatically system is based on the MF algorithm, and its functions covered most of the field of digital image processing.

The airport analysis is the core of the whole system; it implements the automatic identification of the airport characteristics and increases efficiency interpretation. It can detect the projection and difference shadow of the image, and can extract airport from the image. The projection method is an object to give prominence to level or vertical direction of the object, the difference shadow method is to carry on algebraic operations to two images to get the suitable images, the airport extraction is automatically identify the airport contour by using MF algorithm.

3.2 The Results

Fig.2 is a breadth 400 × 556 grey level airport original image which the length and the width ratio reduce to 50% of the image; Fig.3 is the airport characteristics after MF algorithm detection, identification and extracted.

Fig. 2 Original Airport Image

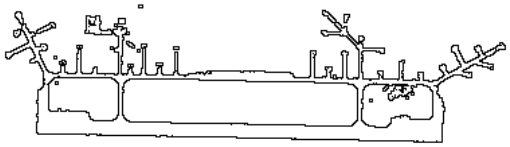

Fig. 3 The airport contour map extracted

Fig.3 is the airport characteristics map after MF algorithm disposal, extraction finally. As can be seen from Figure that the airport marginal contour has been extracted, runway, parking apron, machine nest etc, and other major characteristics have been completely found, no objective omission place basically.

4 Conclusion

Now, the automatic extraction of the airport characteristics in the aviation photograph is still the leading subject in the field of automatic identification on the application, the existing algorithm was unable to meet the requirements of the application because most of the drawbacks. The paper present a new method which automatically extracts the airport characteristics of the aerial images based on the establishment of the airport runway model. Compared with the existing methods, this method has following advantages:

First, identify the regional airport through the establishment of runway model, which reduce the image noise interference and eliminate unnecessary hair stabs ordering.

Second, because of confirming the area of airport after the template is matched, algorithm computation speed has been enhanced.

Third, the combinability of the algorithm is strong, can all extract the ordinary aviation photographs, the practicality have greatly improved more than other algorithms.

The experimental results show that this method is good, with great value and good application prospects.

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