Foreshore Resources Survey of Shanghai in QuickBird Image

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Abstract By use of RS and GIS, the QuickBird image and geographic map were used for the survey of the foreshore resources of Shanghai. The image was processed and interpreted. The distribution maps of sea dike, foreshore, vegetation, soil, hydraulic structures, landscape, topography, and so on were extracted in manual classification. These data have been integrated into the information management system for the shoreline and foreshore. It plays an important role in the evolvement analysis of the shoreline and foreshore.

Key Words: RS, GIS, QuickBird, Foreshore, Shoreline

1. Introduction

Foreshore is one of the major resources along the coastal area in Shanghai of China. It is a special area of the tideland. There are many important economic values, such as breeding, planting, inning, tour and so on, in this area. The conventional surveying of foreshore resources is a hard work with long time and high charge. On the other side, it is difficult to survey in tideland and to monitor the dynamic change in a large area by use of conventional method.

Because of its advantages of large-scale, high efficiency, real-time and comprehensive information, the remote sensing is developing in quantity, standard and intelligentizing. As the method of real-time survey, it has more advantages than the others. So, it can be adopted as a convenient, important and modern method for the real dynamic survey of foreshore resources.

QuickBird is a commercial remote sensing satellite launched successfully on October 18, 2001 in America with the sensor of high spatial resolution. The resolution of panchromatic image is 0.61 meters and that of multi-spectrum image is 2.44 meters. It has also notable advantages in the imaging breadth and imaging pendulum angle. So it is satisfied for the survey of foreshore resources. However the image will arise distortion in both spectrum and shape because the satellite imaging will be influenced by entironment. In this paper, the primary QuickBird images with different spectrum were merged, the spectrums were enhanced and the geometry shape was rectified .

The distribution maps of foreshore, shoreline, river, road and so on were drawn on the basis of the processed image. Meanwhile the 1:10000 topographic map was adopted as a reference. Comparing the distribution maps with the geographic map, the former have higher accuracy than the latter. The cost for the survey of foreshore resources in remote sensing is much lower than that in traditional method.

2 Image Processing

There are two kinds of TIF format images in the primary QuickBird images, panchromatic image and multi-spectrum image. The former has the high spatial resolution and the latter has the rich spectrum information of different kinds of bands. In order to get an image with high resolution and rich spectrum information, these two images with different spatial resolution should be merged. The traditional mergence methods are: Principle Component Alternation (PCA), IHS Alternation, Ratio Alternation and so on. PCA is a multidimensional linear alternation on the basis of the image's statistical feature. It can reveal the within information of QuickBird image's multi-channel data structure accurately. So it is adopted in this paper. The operation step is that the resolulion of the first main component of the multi-spectrum is transformed by that of the panchromatic image. As far as the re-sampling method for the mergence, the Nearest Neighbor Interpolation, Bilinear Interpolation or Cubic Convolution Interpolation can be adopted according to the real situation. Comparing to the Bilinear Interpolation, the Cubic Convolution Interpolation has higher fitting precision because the 4*4 window is used for calculation. So the Cubic Convolution Interpolation was used in this paper. The mergence was run in the software ERDAS8.6. Clicking the Main —Image Interpreter —Spatial Enhancement —Resolution Merge, the Resolution Merge dialogue frame jumps out on the screen. The following parameters need to be set:

Input the High Resolution File: original panchromatic image of QuickBird;

Input Multi-spectrum File: original multi-spectrum image of QuickBird;

Define Output File: define output file name and the location to deposit the file;

Select mergence method: Principle Component;

Select Re-sampling method: Cubic Convolution;

Output Option: Stretch Unsigned 8 bit

Layer Selection Option: Select Layers 1: 4.

The second step is the spectrum strengthening of the merged image. The method adopted in this paper is the Principal Component Alternation. It can compress the correlative multi-band data to several independent bands. The compressed image can be interpreted easily. It was also run in the software ERDAS8.6. Clicking the Main —Image Interpreter —Spectral Enhancement —Principal Components, the Principal Components dialogue frame jumps out on the screen. The following major parameters need to be set:

Determine input file (Input File): Previous merged image;

Define output file (Output File): Define out file name and the location to deposit the file;

File coordinate type (Coordinate Type): MAP;

The main component data bulk of needs (Number of Components Desired): 3.

The last step of image processing is fine geometric rectifying of the strengthened image. The initial projection of the QuickBird image is UTM (the global ink card of transverse axis hold projection) and that of geographic map used in this paper is GK (Gauss - Kriiger projection). So the projection of QuickBird image was transformed to the GK.

The projection transform can be divided into two kinds. One is the direct transform by use of a software, such as ERDAS, ENVI and so on. This method is very convenient. But the enough coordinates accuracy of the initial image is required. Another one is that the image is rectified on the basis of some control points (Tic). The coordinates of these Tics can be extract in some ways, such as known points. The high accuracy of relative coordinates is required only in this way. The initial coordinates of QuickBird image are fixed only to 4 digits after the point. So the second method was adopted to transform the projection of QuickBird image in this paper.

The first step for the rectifying is determining the Tics and extracting their exact coordinates. It is need to be very convenient to find these Tics in the image. So, the measure stakes on the sea dike are selected to be the Tics. The coordinates of these stakes have been measured accurately already. How many Tics are suitable is related to the transform function and the requirement of the precision. In this paper, ERDAS8.6 is adopted and the polynomial alternation is applied in the software. The number of the Tics is related to the power of the polynomial. It can be calculated by $N=((t+1)*(t+2))/2$. The t is the power. The N is the number of the Tics. Totally six Tics (N) are selected because the power (t) adopted is 2 in this paper. It is illustrated that 6 Tics are enough to satisfy the requirement of the precision in the real application.

3 Image Interpretation

When the image have been processed completely, the image can be interpreted to extract the required distribution information of the geography objects, such as the foreshore, river, road, dike, vegetation and so on. The 1:10000 geographic map was adopted as the reference in the interpretation.

As an example, the extracting processes of the dike are as following. Firstly the processed image is opened in ERDAS8.6 Viewer menu. The corresponding relationships between the bands and the colors should be selected in the Raster Option Dialog frame in order to guarantee the image is shown in real color. The third band is corresponded to the red, the second the green, the first the blue. Secondly the vector geographic map is overlaid on the image as a reference. Finally the dikes are drawn by handicraft in lines. The operation steps are clicking Viewer —New —Vector Layer, inputting the attribute Dike Line, selecting the file name, selecting the position to deposit the file, selecting the vector data structure and the type of the layer. The data structure can be selected as SHP. The layer type can be selected as ARC SHAPE because the dikes are draw as line. In succession the dikes, both the top and the foot of the dikes, are drawn carefully one by one by use of the Draw Tool. The dike lines can be integrated into the area shape if necessary. Combining the elevations extracted from the geographic map, the three-dimensional picture of the dikes can be constructed. This kind of picture will be very vivid.

Comparing the distribution maps of the geographic objects extracted from the remote sensing image with that of 1:10000 geographic map, it can be discovered that the former are more detail, richer, more vivid then the latter.

4 Investigation Of Dike And Foreshor Evolvement

The historic distribution maps of the dikes and topographic maps of Shanghai foreshore are available. The dike distributions of the different years show the evolvement of the dikes. The remote sensing image can be used to validate the distributions of the dikes and then make the evolvement analysis more believable. The DEM can be constructed by use of the topographic map of the foreshore. The three-dimensional picture and the two-dimensional picture painted with different colors according to the elevation extracted from DEM can be drawn. Comparing the pictures and the images, the credibility of the topographic map of the foreshore can be validated. The evolvement analysis of the foreshore topography will be more believable. The QuickBird image taken on July 29, 2002 was applied to validate the distribution of the dikes and topography of the foreshore in this paper.

5 Conclution

QuickBird image has many advantages, such as high resolution, rich spectrum information and so on. The remote sensing is an efficient method for the survey of geographic objects and then for the survey of the foreshore resources. When the QuickBird image was applied in the foreshore of Shanghai, the distribution maps of the geographic objects, such as dike, foreshore, river, road and so on, can be extracted with high accuracy. The believability of the evolvement analysis of the dike and foreshore can be validated by use of the image.

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