

URBAN GEO-SPATIAL INFORMATION UPDATING TECHNOLOGY

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ABSTRACT:

The present situation is a life of basic geographic information. Only when basic geographic information has to renew continuously can it reflect truly the present situation of the nature and cultural features. On the base of deep studying, this paper provides the practical solution of the urban geo-spatial information updating quickly facing the rapid development of our country city building.

The present situation is a life of basic geographic information. Only when basic geographic information has to renew continuously can it reflect truly the present situation of the nature and cultural features. As everyone knows, urbanism is the inevitable result of social development. For the sake of well coming true the strategy target of making country strong with science-education and sustainable development, our country has put forward several significant strategic steps, such as "Small town, Great strategy" and the "Migrating to set up city" etc. Therefore, the step of our country's urbanism will speed up further. All of these bring forward the direct and urgent need of the urban geo-spatial information's acquiring and updating quickly.

Geographic information is the basic part of national information source. The high-speed development of social economy greatly enhance the real need of geographic information, meanwhile, it accelerates the change of all kinds of geographic information. Now, geographic information industry confronts with new chances and challenges. At present, geographic information industry is trying all effort to achieve the goal of digitalization, automation and intellectualization. This tendency reflects clearly in the integrating of remote sensing technique (RS), global positioning system (GPS) and geographic information system (GIS) in geographic information industry's technology system. While the best approach for acquiring and updating of urban geo-spatial information is to accomplish the integration of 3S techniques in the geographic information.

1. THE TECHNOLOGY OF URBAN SPATIAL INFORMATION ACQUIRING AND UPDATING QUICKLY

1.1 The Technology of Urban Change Detection Automatically

Although the time when to update spatial information can be determined on experiences, it is hard to be prompt. Updating period depends mainly on the change degree of geographic information according to the principle. Therefore, it is full possible to detect the change degree automatically from satellite remote sensing imagery. In this way, not only updating geo-spatial data can be prompt, but also that when and where needs to be updated can be ascertained reasonably before time.

Once the time and place that need to be updated is determined, it is necessary to make plans for acquiring image. Usually, the renewed areas are not large, and the different renewal areas are dispersed. To update the spatial data, there's only one way to achieve "prompt", which is the mechanism of spatial data updating based on orthophotos. As far as geo-spatial data updating, there is only one approach to achieve "prompt", that is the mechanism of spatial information updating on the basis of orthophoto maps. The exterior elements of updated images can be solved directly according to the original orthophotos. In this way, it neither needs control points, nor aerial triangulation; therefore, the work efficiency can be improved greatly. And then, the data are collected on the basis of image registration. Considering that most cities of our country haven't build orthophoto images database, however, the necessary method of updating data must include the situation without orthophoto database.

1.2 The Technology of Acquiring Information

The technology of ground observation with high resolution is one of the key technologies to realize city's changing spatial information. With the rapid development of geomatics, the technology of ground observation will be multi-phasic, multi-angled, and has high resolution. America is speeding up its plan to launch business satellites with the resolution of one meter, which means houses and cars in the city can be seen clearly in the image. And it is important for city's changing information with large scale and high resolution.

In the technology of obtaining information with ground observation, use CCD sensor to replace traditional film so that system can obtain digital image directly in the course of flying, which makes it possible to realize the real-time transmission of observe data. At the same time, CCD sensor enhances system's ground observation ability, shortens the period of processing information, and improves the currency of ground observation.

At present, there are two different CCD sensors. One is based on areal array sensor, and the other is based on linear array sensor. Compared with CCD areal array chip, the technology of linear array chip has faster development, and CCD-line sensor has successful application in aerial sensor of our country. However, if we want apply CCD-line sensor in aerial platform, it needs the technology of gyro-stabilized platform with high accuracy to match, so this kind of technology is limited.

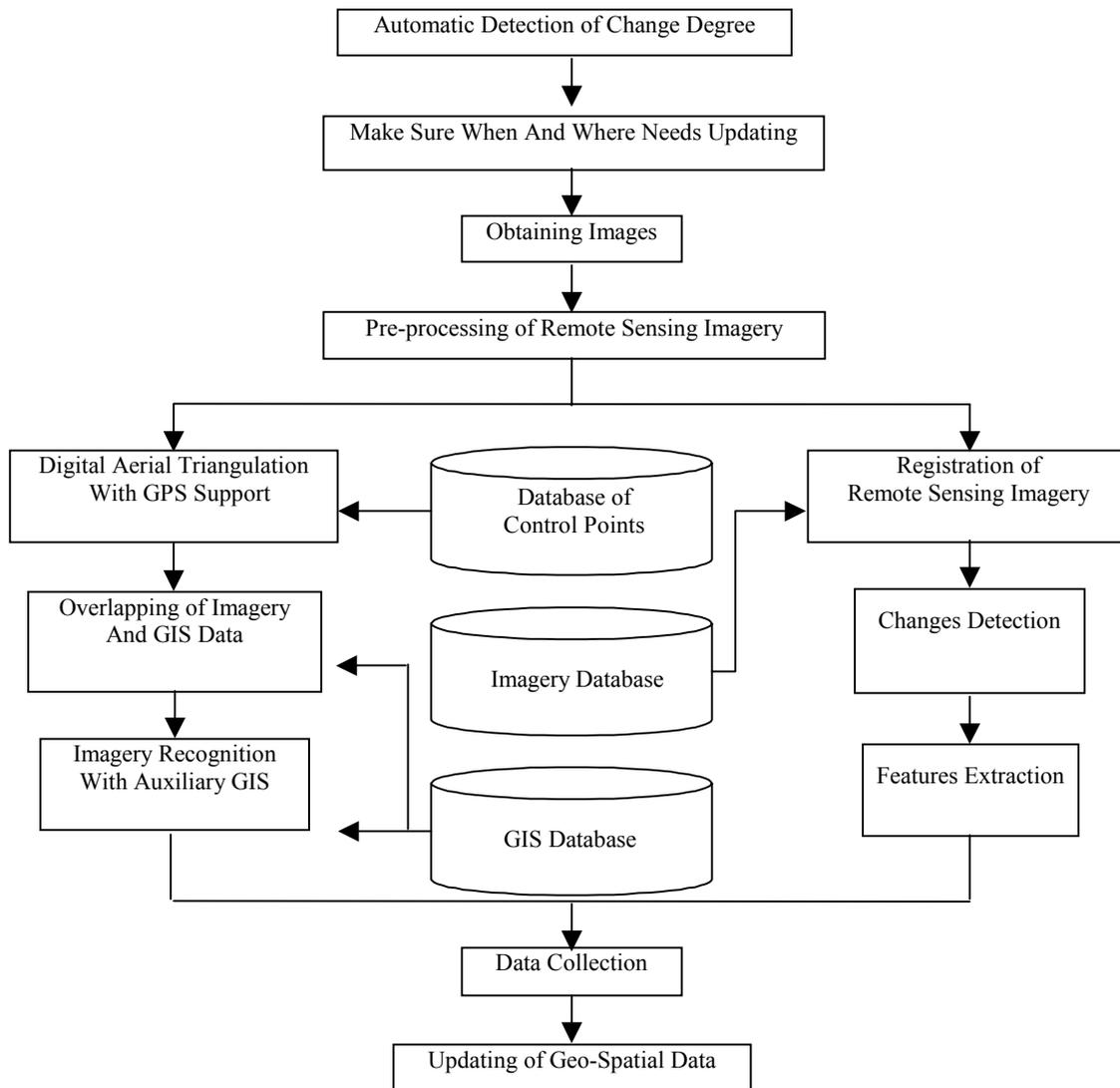


Figure 1. The Workflow of Urban Geo-Spatial Information Updating

Undoubtedly, it is a possible way to realize high accuracy mapping by using big CCD-matrix sensor. For the need of development in the future, digital aerial photogrammetry system that based on 4k×4k CCD chip can't meet the both requirements of high accuracy and work efficiency in mapping large-scale maps. At present, CCD productions and the applied technology in foreign countries develop rapidly, for example, 8k×8k or 9k×9k CCD chip has been produced. They make it possible for the development of digital aerial photogrammetry camera's imaging technology towards higher accuracy and larger scale. But such CCD chip with so large amount of pixels is very expensive.

In order to meet the city's large-scale mapping with low cost, more than one individual small CCD camera can be used with tying together, resulting in a large field of view of the camera. Thus, it is rather an effective means to realize the high-resolution imaging with the rectified images after flying. A post-processing procedure serves to transform the individual images (called sub-images) into one virtual image that can be considered being of a high-resolution and normal central perspective photogrammetric image. This is a key technique to obtain the images that ensure the precision of large-scale surveying.

The high resolution Digital Module Camera configuration is composed of four panchromatic CCD modules and three multi-spectral CCD modules, respectively (see Fig. 2). The four panchromatic are arranged like a 2x2 matrix and have their optical axes looking downwards in a slightly divergent set-up so as to reach a large ground coverage. (The hidden lines is the composite virtual image)

In order to obtain the images that are both high spatial resolution and better chroma and saturation, it is feasible to use four 4k×4k high-resolution panchromatic CCD lens modules and three 2k×2k multi-spectral RGB channels with reduced resolution. In course of flight, the seven CCDs exposed at the same time, and of image post-processing, the RGB channels are first combined by means of color matching. The color image thus produced is then, if necessary, combined together with the panchromatic image to the so-called color composite.

There are several methods to realize the images color fusion with different angle. IHS transform is the most common and basic method. In practical application, there are many models of IHS transform, such as triangle model, double-hex pyramid model, cylinder model and so on. IHS transform is applied

widely in the pixel fusion of several sensors, which transforms the low-resolution data of three channels into the IHS space by using IHS transform. Meanwhile, we should stretch contrast of single high-resolution channel image to make sure that the mean value and variance of its gray level are the same with lightness constituent image in IHS space, and then regard the processed image as new lightness constituent and transform into original space by inverse IHS transform. Therefore, the obtained image not only has high spatial resolution, but also has the hue and saturation of the original image. It is convenient for visual interpretation and computer automatic processing. Because the spatial resolution has been improved, the accuracy of classifying terrain also can be improved.

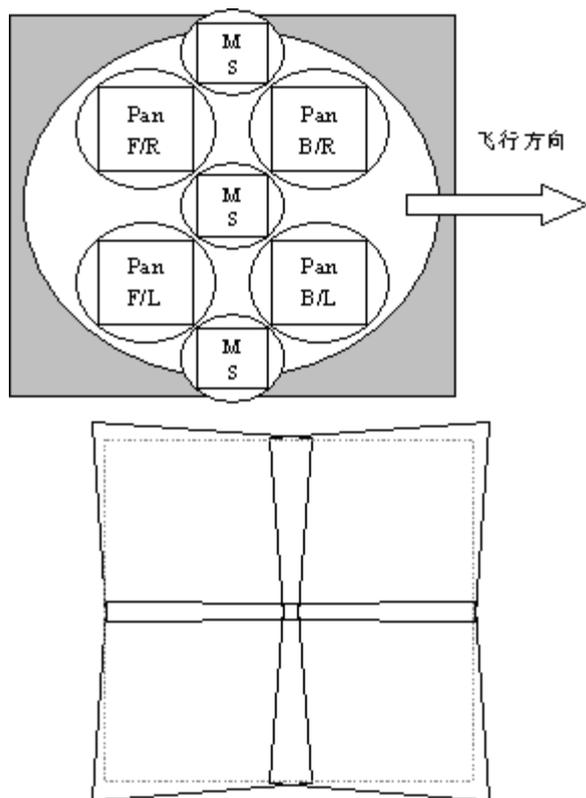


Fig. 2

2. AUTOMATIC AERIAL TRIANGULATION BASED ON MATRIX/LINE SENSOR IMAGERY

Without orthophotos' support, adopting GPS auxiliary data to establish joint-block adjustment in digital aero-triangulation is the valid approach of achieving the image exterior orientation automatically. The digital aero-triangulation technique with GPS supporting not only benefits to the automatic system workflow on the basis of the original control points database but also to achieve the intelligentization of checking and updating the change of spatial information.

The remote sensing technology has many advantages, such as high speed, rich information, authenticity and so on. So, it can provide rich original data for the production of geographic information, and at the same time, the 3S integration makes the appliance of the remote sensing technology and global positioning system much more widely. In recent years, with the development of the digital remote sensing technology and global positioning, the 3S technology is also integrating rapidly.

Based on the principle of real-time GPS orientation, we can realize the exterior orientation of high-resolution digital CCD-line or CCD-matrix images. That's to say, the position and attitude of camera can be computed at the same time of photography, which provide necessary data for the next step to extract geographic information.

At present, digital photogrammetry is developing towards the direction of automation and intelligentization. The main barrier of the automation of digital photogrammetry faces is the automatic recognition of control points during the process of image's exterior orientation. One of the methods to overcome it is to standardize the control points, and thus can automate the process of exterior orientation. But it can increase a lot of work meantime.

Another more effective method is to combine block aerial triangulation with GPS orientation data. It is use the technology of dynamic GPS to obtain the coordinates of camera station when it is on the point of taking photography, which is the so-called GPS auxiliary aerial triangulation. Based on the database of original control points, with GPS auxiliary aerial triangulation, it can cut down the number of control points largely, and even abandon all the control points when realizing the exterior orientation of image.

The automation of aerial triangulation mainly refers to the automation of relative orientation. Compared with the traditional films, the format of CCD camera is smaller; it is necessary to need more images than films when taking photography for a same region. Therefore, the automation of relative orientation can greatly improve the work efficiency of CCD digital aerial triangulation. And it also serves as a link between digital photography and digital mapping; helps to realize the automation of system operating.

3. CHANGE DETECTION TECHNIQUE OF SPATIAL INFORMATION

Spatial information detect technology is also a key step in geo-spatial data updating. On the basis of the satellite remote sensing image and the change detection technique, we can detect automatically the change degree of cities so that the time and place that needs to be updated can be ascertained. Usually before data collection, it is necessary to located the variety parts, — that is a change detection problem should be solved. It includes two aspects here: one is the change detection between images; the other is the change detection between the vector data and grid data.

3.1 Change Detection Technique Between Images

Compare and analyze the data of original image and image taken recently, and based on the registration of the two images, we can use the technology of change detection to locate the change area so as to collect data conveniently. A useful method of detecting image's change is the method of main component transform — it regards all data as a multi-dimensional data set on the basis of the registration of multi-phasic data, and then we can analyze the data set to extract the change information. This method can transform original image into several main component image, and then extract the change information from them. Generally speaking, the first main component reflects unchanged information of old and new image, while the second main component reflects changed information.

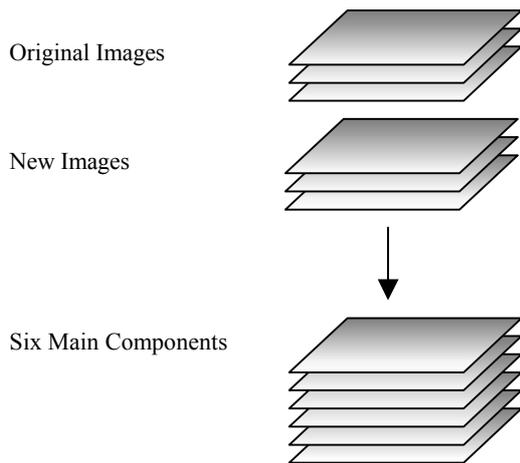


Fig.3

3.2 Change Detection Technique Between The Vector Data And Grid Data

Digital orthophotos come from ground sensor, including aerial photogrammetry, satellite remote sensing photogrammetry and spaceflight remote sensing photogrammetry. The resolution of digital orthophotos varies from sub-meter to kilometer, which construct a pyramid of original ground image. Since the digital orthophotos are in the form of grid, large amount of data is there remarked characteristic. Besides, digital orthophotos contain a variety of information, so the digital orthophotos after geographical registration not only can be used as texture in constructing ground 3-D model, but also have widely application, such as stereo-survey, DTM model, object recognition etc.

The method of using this change detection technique to detect urban change is: first, the digital orthophotos are made from the new acquired data, and then they are overlapped with vector data in the database. Finally, The image processing technology and spatial data analysis technology can be used in order to detect the change of the geo-spatial information and collect data.

4. THE INTELLIGENTIZATION INFORMATION COLLECTED TECHNIQUE OF URBAN

At present, how to recognize and extract information of buildings perfectly from digital image is one of the most research tasks in photogrammetry. Urban large-scale aerial imagery contain rich information of buildings, such as border line of roof, corner points of house, construct and texture information of house, shadows and so on. All of these information offers good condition for the abstraction of buildings. Now there are two ways to analyze and extract terrain surface: single image analysis and overlapped two images analysis.

Therefore, the imaging model must be used in data collection, which demands to study different data collection models according to different projected way. At the same time, it is necessary to fully consider the characteristics of the large-scale images so as to improve the automatic degree as great as

possible with the technology of computer image processing, pattern recognition, computer vision and so on.

The rapidly developing digital photogrammetry system will also become one of the methods to collect large-scale digital city map's data. At present, the photogrammetry system can satisfy the accuracy request of middle-scale, small-scale digital map, and the key technique of large-scale mapping is being solved gradually.

5. THE PERORATION

In summary, city is the center of economy, culture, and transport in a country and district. The city features that change rapidly need the technology of acquiring and updating geographic information urgently. The traditional way of acquiring geographic information can't meet the demands of city's development. To change the present situation, the most urgent work is to establish the mechanism of spatial information updating.