

REMOTE SENSING IMAGE INTERPRETATION STUDY SERVING URBAN PLANNING BASED ON GIS

Qian Wang^{a, b, c}, Jianping Chen^{a, b, c}, Yi Tian^{a, b, c}

^aDepartment of Global science and Resource, CUGB, Xueyuan Road, Beijing - (wangqian12031)@163.com

^bInstitute of Land Resources and High Techniques, CUGB, Xueyuan Road, Beijing - (wangqian12031)@163.com

^cLaboratory of Beijing Land Resources Information Development, CUGB, Xueyuan Road, Beijing - (wangqian12031)@163.com

PS-13, WgS IV/3

KEY WORDS: Remote Sensing, GIS, Visual Interpretation, Supervised Classification, Urban Planning, Present Situation

ABSTRACT:

The level of urbanism is an important parameter to measure a country's civilization degree, so it is important to make a reasonable planning for the city. The primary stage of making an urban planning is the survey of present situation, which needed a lot of people, material and money in the past. But now remote sensing has been used as a new means to get the space information and some attribute information. That's more speedy, accurate and economical. There are mainly two ways to do the remote sensing image classification. One is visual interpretation, and the other is computer automatic interpretation. Computer automatic interpretation is very fast and facile, but it is difficult to make use of people's experience and knowledge. It is inclined to classify a subject in to a wrong class or omit some objects. Meanwhile, city is a very complex geographic synthesis of population, resources, environment and social economy. There are different objects may have same spectral character or the same class of objects have different spectral characters. And the emphasis of making an urban planning is to research city functional cells and the structure rationality. The result of computer automatic classifying can not satisfy the city plan. In contrast, though interactive visual interpretation needs a longer time, it can make full use of people's experience and knowledge. The result is more reasonable and correct. The paper compares the supervised classification with interactive visual interpretation, and indicates that interactive visual interpretation can serve the urban planning better.

1. INTRODUCTION OF URBAN PLANNING THEORY

The urban is a compound system of human and nature. It is also a high-dense geographical synthesis of population, resources, environment, social economic and so on. As one sign of civilization and social progress, the city's effects on national politics, economics and culture become prominent increasingly. In other words, the urbanization's level is a significant parameter to measure a country's extent of civilization, social progress and economic. So it is very important to make reasonable and fit urban planning and management (Fan Wenbing, 2006).

According to the urban development aims, urban planning constitutes the urban character, scale and development direction, makes use of the urban land reasonably. Urban planning relates to politics, economic, society, technology, art and comprehensive domains of human life. It is not only integrated, but also concerned with the policy and practice (Zheng Chaogui, 2004).

The primary phase of urban planning is present situation investigation. In the past, it always consumed a lot of labor force, material and money. The result was not timely and exact. Nowadays, the remote sensing technology can be used to investigate urban terrain, physiognomy, lakes, plants, sights, traffic, land utilization and building distribution quickly. As a main method to obtain and update urban geometric information and some attribute information, the remote sensing technology is quick, exact and economical (Xu Zhenhua, 2005).

2. INTRODUCTION OF REMOTE SENSING IMAGE CLASSIFICATION METHODS

The important content of investigating present situation with remote sensing technology is the remote sensing image classification. The remote sensing image classification has mainly two ways. One is the visual interpretation, the other is computer automatic classification. The visual interpretation is a process of utilizing biology geosciences rules and the check analysis method to carry on generalized analysis and logical deduction according to the operating person's experience and knowledge, the sample's image characteristic and the spatial characteristic (shape, size, shadow, texture, graph, position and layout), together with many kinds of non-remote sensing information. The computer automatic classification uses the pattern recognition technology and the artificial intelligence technology to carry on the analysis and the deduction, understand the remote sensing image, and complete the interpretation of the remote sensing image finally, according to the land object's characteristic in the remote sensing image and the goal land object's interpretation experience and image formation rules in the expert knowledge library, based on the computer system (Liu Renzhao, 2005).

The visual interpretation classification's application mainly has two forms. The first form is carrying on the artificial interpretation and drawing the land utilization chart manually to obtain the land utilization category information with the aerial image, the spatial image and many other kinds of remote sensing images. The second form is mainly the man-machine

interactive visual interpretation method which forms along with the computer technology and the remote sensing image processing technology's development. The image can be zoomed in, zoomed out, moved and enhanced on the software platform. According to the screen interpretation symbol of land objects, the interpretation person outlines the border line directly with the mouse along the image characteristic edge after the image achieves the best visual interpretation effect.

The supervised classification is one of the computer automatic classification methods. Its most basic characteristic is before the classification people have investigated the sample area. With the artificial visual interpretation, people have got the prior knowledge about land objects' category attribute. Then the computer trains the discrimination function to complete the classification according to the knowledge. The classical supervised classification methods are the maximum likelihood method, the minimum distance method, parallelepiped method and so on (Lillesand, 1994; Cshowengerdt, 1983).

The interactive visual interpretation can make full use of the interpretation person's experience and knowledge. It is flexible and good at extracting spatial information, but spends more time and has difference between individuals. Computer automatic classification consumes shorter time, and its repeatability is good. But because it is difficult to use the person's knowledge and extract spatial information, it causes the wrong classification and omitting some land objects easily (Zhang Yin-hui, 2002).

3. REMOTE SENSING IMAGE INTERPRETATION METHODS SERVING URBAN PLANNING

3.1 Supervised Classification

As a result of the urban objects' complexity as well as the urban planning's requirements of the function districts partition, only the computer automatic classification cannot satisfy the needs of the urban present situation investigation. Now take supervised classification as an example to discuss it.

The supervised classification usually carries out the classification of land objects in the image by establishing study samples of typical land objects, such as the building, the water body, the vegetation, the road and so on. Although supervised classification consumes shorter time, but is not suitable to the land objects classification in the urban planning. Firstly, in the way of the remote sensing classification's requirements of the image, because there are too many kinds of the urban land objects, the matter of same kind of objects having different spectrums and the different kinds of objects having same spectrum is very common. It is also impossible to establish the samples of all types. So it is easy to make the wrong classification or there are not enough types. And the buildings are very crowded. The shadow's influence is serious, which reduces the accuracy of classification results. Next, in the way of requirements of urban planning, the key point of urban planning and the management is studying the rationality of the urban function unit and the structure, the scientific nature of urban configuration as well as the appraisal and forecast of urban environment ecosystem and the urban environment pollution (Shen Qi, 2006). The land objects having similar or the same spectral characteristic may belong to the identical category, but their functions in the urban are not always same. For example, the main road and the inferior road belong to the

same road type, but they are actually different in municipal transportation's supporting capacity. A certain urban function unit contains many kinds of land objects mostly. In other words, an urban function unit contains different spectral characteristics. It is impossible to realize the discrimination of urban function units by supervised classification or any other computer automatic classification methods.

3.2 Man-Machine Interactive Visual Interpretation Based On GIS

Compared with the supervised interpretation, the man-machine interactive visual interpretation can use the operating person's experience and the knowledge fully, which is advantageous in associating with other non-remote sensing information, and can distinguish the goals and their nature and function in the image using the contrastive analysis method. Therefore, although visual interpretation consumes more time, but in the way of classification accuracy and the scientific nature, the visual interpretation has more superiorities, and is more suitable for the urban planning, compared with supervised classification and other computer automatic classification methods.

First of all, the remote sensing image used in the urban present situation investigation should be able to display the land objects' geometry characteristics and geographical positions as well as the detail information precisely. The high spatial resolution's aerial image containing the rich spatial information and the clear textural property can satisfy urban information demands well. It has very big superiority in the fine land object extraction and the quantitative investigation, and is helpful in realizing the more environmentally-friendly, more economical, and more accurate planning, which has already become the essential data to establish modernistic city and realize urban sustainable development (Shen Qi, 2006).

In the interpretation process, the urban digital line graphics about road, building, land objects points and so on should be referred to for a clearer understanding about the urban land object's function.

In the GIS platform, the existing urban land object's vector data layer can be added. And the high resolution aerial image can be zoomed in, zoomed out and moved for the man-machine interactive visual interpretation easily. Meanwhile the classification result can be written into the attribute database directly, which is advantageous to the data's management and sharing.

3.3 Case Study

Take 0.2 meter resolution's aerial image and 1:2000 urban digital line graphics (contains road, building and other layers) of some district in Beijing, as well as the ArcGIS platform as an example to explain the man-machine interactive visual interpretation method's superiority in present situation investigation serving the urban planning.

For the first place, register the image based on the existing road layer. Then do the edit on the basis of the road layer according to land objects points distribution and land objects' characteristics reflected from the image, as well as <Urban Land Classification And Planning Construction Classification Standard CBJ137-90>, to get the different urban function units (e.g. Figure 1).

According to <Urban Land Classification And Planning Construction Classification Standard CBJ137-90>, code

different urban function units, add attributes to them, form the attribute list of the land utilization situation (e.g. Figure 2).

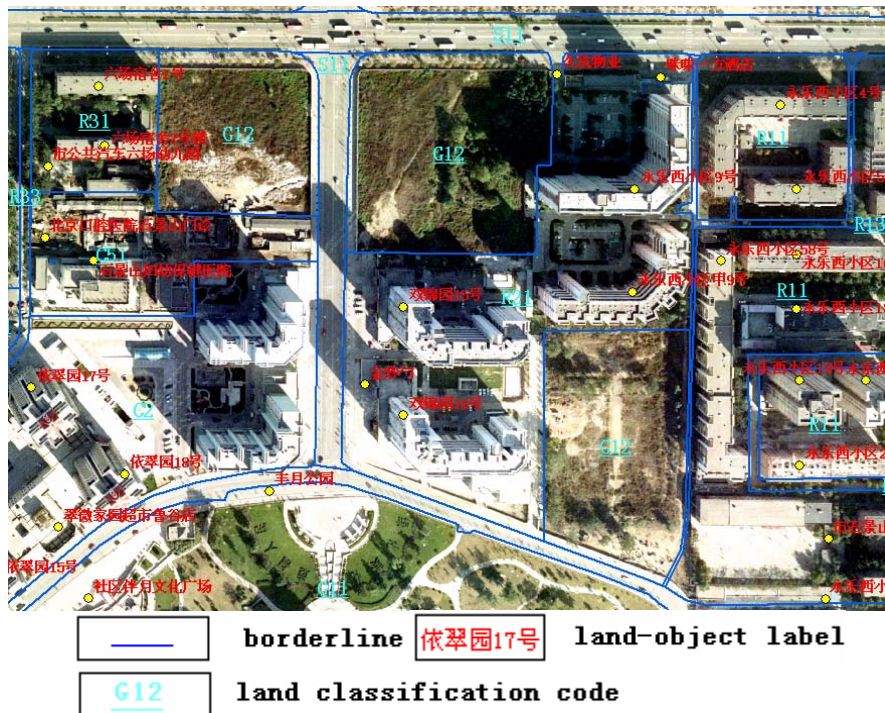


Figure 1. Land-use present situation chart of one district in Beijing

FID	Shape *	Id	Area	Class	大类
40	Polygon M	0	15310.330236	G12	绿地
41	Polygon M	0	8676.835748	T1	对外交通用
42	Polygon M	0	23961.844895	T1	对外交通用
43	Polygon M	0	148886.461731	G21	绿地
44	Polygon M	0	2547.9625	R44	居住用地
45	Polygon M	0	68929.826198	R41	居住用地
46	Polygon M	0	14799.249687	M3	工业用地
47	Polygon M	0	23.176252	S13	道路用地
48	Polygon M	0	5428.500102	R44	居住用地

Figure 2. Land-use present situation attribute chart of one district in Beijing

4. CONCLUSIONS

Although the computer automatic classification has very high automaticity, and needs shorter time, but is not suitable for all classification work. When doing the present situation investigation of the urban land utilization, although the man-machine interactive visual interpretation spends more time, but is also more nimble. Based on the high resolution aerial image and GIS platform, referring to the existing data and the classification standard, the classification result can serve the urban planning better.

REFERENCES

Fan Wenbing, 2006a. Application of "3S" technique to the city planning and building. *Anhui Construction*, (1), pp. 16
 Zheng Chaogui, 2004a. "3S" technology and its application to urban planning *Journal of Chuzhou University*, 6(4), pp. 105
 Xu Zhenhua, Li Ting, 2005a. Newly applying foreground of 3S technologies in urban planning. *Information Technology*, (9), pp. 66
 Liu Renzhao, Liao Wenfeng, 2005a. A review of research on the application of remote sensing image classification. *Geospatial Information*, 3(5), pp.11-12

Thomas M.Lillesand, Ralph W. Kiefer, 1994a. Remote sensing and image interpretation. John Wiley & Sons, INC, pp. 585-618

Robert A. Cshowengerdt, 1983a. Techniques for image processing and classification in remote sensing. Academic Press, INC, pp. 129-195
Zhang Yinhui, Zhao Genxing, 2002a. Classification methods of land use/ cover based on remote sensing technologies. *Journal of China Agricultural Resources and Regional Planning*, 23(3), pp. 21-23

Shen Qi, Ma Jinhui, 2006a. The application of hyperspectral and high resolution remote sensing data to modern urban planning. *Journal of Gansu Sciences*, 18(1), pp. 44-4