COOPERATIVE INTERPRETATION OF LAND USE

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ABSTRACT:

As the improvement of the theory of remote sensing imagery interpretation, the method of it goes from manual interpretation to semi-automatic and then to the intelligent interpretation. The land use updated survey which based on remote sensing images need to do the image interpretation, so that it can identify the various types of land. Although the intelligent interpretation has been used for the recognition of the land-use of the information, but the accuracy of the land use classification is limited. people are still needed to participate in the work of interpretation. And we should make full use of land-use database support the interpretation. Then a collaborative interpretation, of land-use is formed. It can improve the accuracy of land use classification. In this paper, SPOT images and land-use the information of Nanhu in Wuhan City at 2005 are used for the Cooperative Interpretation of Land Use. The results show that Cooperative Interpretation of Land Use can get a higher accuracy of remote sensing images than the intelligent interpretation.

1. INTRODUCTION

Since the 1970s, as the first terrestrial satellite was successfully launched, people have started to use computers to do the interpretation of satellite remote sensing images. HCI was first used to obtain the land information from remote sensing images. The essence of this method is visual interpretation of remote sensing images, it depends on the experience level of the people who do the interpretation work of image interpretation. It has no breakthroughs in the method of interpretation of remote sensing image.

In the 1980s, the method of statistical pattern recognition was mainly used in the remote sensing image interpretation by computer. For example, Strahler (1980) used the method of maximum likelihood to do the classification of remote sensing image data, Goldber (1983) used the spectral characteristics to get the class of multi-band satellite image, so that the information of the forest resources can be got. Wang F (1990) expounded the difference in principle of classification between the fuzzy classification and the traditional statistical classification, and made the method of fuzzy supervised classification, which, to a certain extent, improved the accuracy of the classification. All the methods above have just make use of the spectral characteristics during the interpretation of remote sensing images. In fact, there is a phenomenon called "foreign body in the same spectrum, with the different spectrum" exist in the features on the Earth's surface. It often makes the faults and miss in the classification, so that it has a low accuracy of interpretation. This situation brought people
looking for other ways to improve the accuracy of interpretation.

In the late of 1980s, D. Goodenough (1988) and M. Ehlers (1989) made the integration of remote sensing and geographic information systems, which help to promote the combination between the geographic information system and automatically interpret of remote sensing imaging. In 1994, Li Deren firstly proposed the concept that found knowledge from the GIS database at the International Conference on GIS in Ottawa Canada. In this way, the knowledge found in GIS and in remote sensing images are combined to do the automatically interpreted by computer.

In the 1990s, people do the research on the acquisition, expression, search strategies and reasoning mechanism of the interpretation knowledge of the remote sensing. And the research work that using the expert systems in the interpretation of the remote sensing image has greater development, such as that Middlekoop, Hans.L (1991) Made use of the feature's knowledge in the classification of remote sensing image; Qin Ming (1991) made a system to achieve the goal of automatic interpretation of satellite images based on expert knowledge. This knowledge-based expert system for interpretation, to a certain extent, can improve the accuracy of computer interpretation, but it is still far from meeting the practical stage level.

For a long time, the visual interpretation is the main method in getting certain information from remote sensing images. It has been widely used in the application with high accuracy, especially in the use of high-resolution remote sensing images. Visual interpretation generally receives a higher accuracy of classification than the computer does. Martin and Hoarth reported that when doing the land classification, the accuracy of using computer would drop 21% than using the method of visual interpretation; to the dynamic monitoring, the accuracy would drop 24.6%. However, with the resolution of the spatial remote sensing data keeping improving and the volume of data keeping growing, the large-scale high-speed real-time interpretation work almost beyond the limits of visual

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interpretation. More and more interpretation work dependents on the computer. But for the large and complex task of interpretation of remote sensing of land resources, the traditional visual interpretation and the analysis of remote sensing image only using computer, both are hard to meet the requirement. Therefore, the combining of the two, which can make full use of their advantages, will be more conducive to the extraction of information from the remote sensing imagery.
Cooperative interpretation is such a method in which people and computer work together to do the remote sensing imagery interpretation. This method not only can make use of the experience of the remote sensing imagery readers, but also give full play to the advantages of computer processing. It is an effective way of interpretation to obtain the required information from remote sensing imagery.

2. APPROACHES

In the land use updating surveying, cooperative interpretation is a method which can get a high accuracy result of remote sensing image interpretation. This method, under corresponding hardware and software environment, bases on the digital remote sensing imagery, combined with land-use database, gets the stack of the vector data and the grid data, and carries out the necessary remote sensing image data integration and enhanced. Then the computer automatic interpretation can be done to get some kinds of the land, which have the high accuracy through the automatic interpretation of remote sensing images. After that the visual interpretation can be done to get the subdivision of the land-use types, which might be done under the help of the land terrain information that extracted from the land use database. The process of human-computer cooperative interpretation of land use is as follows:

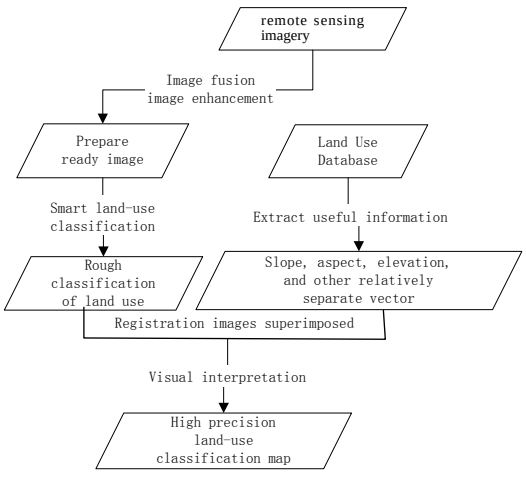

Figure 1 processes of interpretation

Cooperative interpretation is a cooperative work of man and computer, which involves the question of work division between human and computer. First, automatic interpretation would be done to get a rough classification of land-use, which makes full use of the high speed of the computer operating and the strong ability to deal with the data-processing. According to various types of paper about the results and the accuracy of the classification, to the standard of classification of the second land use investigation, and to the field studies of the study area, the paper has defined the types of the land-use in the automatic part of the cooperative interpretation as below: farmland, grass, water, transport land, construction land and other land, a total of six categories of land use types.

Using the extracting information from the land-use databases, such as a slope of the terrain, slope and elevation relative and other information, it can reduce the uncertainty in the interpretation. In general, the assisted information plays an important role in the interpreted as following:
(1) to do the radiation correction to the remote sensing images, eliminate or reduce the difference in the impact of terrain;
(2) as a direct evidence of interpretation, to increase the amount of information of remote sensing images;
(3) as an assisted evidence supporting the interpretation, to reduce the uncertainty in the interpretation;
(4) as the test data of the results of the interpretation, to reduce misjudgment rate.

3. THE INTERPRETATION AND THE EVALUATION OF ITS ACCURACY

3.1 Experiment

SPOT image of South Lake in Wuhan City in 2005 is select as the Experimental zones. The image's resolution is 2.5 m for it had been integrated. Experimental areas is located at: longitude 114 ° 18'11 .18 "-- 114 ° 19'26 .39 ", latitude: 30 ° 29'41 .79 "-- 30 ° 30'46 .55". This region is at the southwest of Wuhan city, the location of it is remoteness from urban centre. According to the latest land-use classification standards and its own interpretation characteristics of remote sensing image, the type of land in this area can be divided into: (1) farmland (including paddy and vegetables) (2) water (including lakes, ponds and ditches) (3) transport land (including road and airport sites) (4) construction land (including to use, mining warehouse space, land for residential development, public administration and public services Space) (5) grass (6) other land (here mainly refers to idle and bare land). The original imag as Figure 2.

Figure 2 original image.

3.1.1 Image Data Preparation

The SPOT image has been completed to correct geometry, image fusion, and other basic pretreatment work at the time of purchase. So just before the interpretation of image, the enhancement processing is done only. In this experiment, the spectrum enhance has been chosen, and the principal components transform data compression is used to do the

spectrum enhance. This makes it easier to interpret. Spectra enhance image as Figure 3.

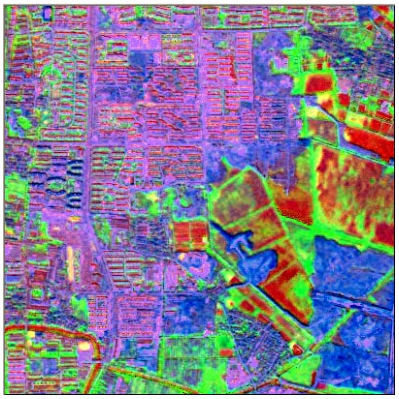

Figure 3 spectrum enhanced Image

3.1.2 Establishment of interpretation signs

The tools of fenestration are used to get the typical image of different land-use type, under the supports of the function of the systems. Then a figure table of interpretation signs, similar to the cut line, needs to be set up. The signs of interpret are establishing as Table 1:

Feature type (code)	Analysis based on interpretation
farmland (01)	Sectors-connecting a block, the texture of internal unity, blue and green mixed region
waters (11)	Red ribbon, red rules quadrilateral distribution, easy to identify
transport land (10)	Purple or pink powder blue ribbon, continuous parallel lines extended
Construction land(05,06,07 ,08)	Purple, dark blue, blue, rectangular shape, or other similar rules polygon
grass(04)	Light green, shape the rules, flaky texture features
Other land(12)	Mixed-green, red green border machines not clear, not shape the rules, regional Flake

Table 1 interpretation signs of South Lake land use types

3.1.3 Extract preliminary information from images

Supervised method is used to get the rough classification of land use. The classification map is as Figure 4.

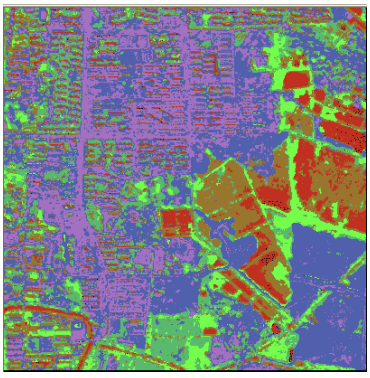

Figure4 rough land classification map

3.1.4 Cooperative Interpretation

The visual interpretation would be done under the support of the supplementary information extracted from the land use database, for example the terrain information, including the slope, aspect and elevation, and so on. During the work of classification, if we find that the area with the slope more than 35° is rarely planted rice, we will be able to consider the area with the slope more than 35° as the non-rice area. However, in some hilly areas, the area with the slope more than 35° is planted rice, so in those area the line of the 35° slope is not applicable. In additional, the height of most hilly terrace is under the 200 meters, so the height information can be used to remove non-rice pixel. As the result, the speed of the image processing and the accuracy of the classification have been improved.

To do the registration between the rough land classification map which is got though the supervised method and the vector data. On the basis of this kick out of spot without regional characteristics, so as to improve the accuracy of interpretation.After doing the cooperative interpretation, the land classification map as Figure 5:

Figure 5 the land classification map by the cooperative interpretation

3.2 Accuracy evaluation and analysis

By comparing the result of the classification of land use which uses the supervised method to do the interpretation of the remote sensing with the land-use statistics of South Lake of Wuhan city in 2005, we can find that the accuracy of land-use classification is 58.6%. After using the method of cooperative interpretation to do the land use classification, the accuracy of land-use classification is 71.3%. Comparing the two accuracy, we can find that the accuracy increase for 12.7%. The result of using cooperative interpretation to do the classification is satisfactory. There are mixed points can be found between the grasslands and the farmlands, also between construction land and transport land. The mixed points of grasslands and the farmlands are mainly concentrated in the urban regions of grass mixed. The mixed points of construction land and transport land are mainly because the spectral and the shape characteristics of the two are very close to each other.

4. CONCLUTIONS

Cooperative interpretation of land use improves the accuracy of the interpretation of remote sensing images in a large extent. It

is an effective and good method to do the interpretation of remote sensing image. The method of cooperative interpretation organically combines the automatic interpretation of remote sensing images, the visual interpretation of remote sensing images and the land use databases. Then according to different terrain and other characteristics that different regions have, different land use information can be used to support the interpretation of the remote sensing image. As the result, the accuracy of interpretation of the remote sensing image can be improved.

Mr. Chen Shupeng affirmed the means of visual interpretation. He said that the visual interpretation is not the primary stage of remote sensing applications, or is dispensable, on the contrary, it is irreplaceable in the application of remote sensing, is an integral part of it and it will be a long-term coexistence with the method of land analysis. D. Goodenough (1988) and M. Ehlers (1989) made the integration of remote sensing and geographic information systems. The idea of cooperative interpretation of land use is come from the two ideas above. It is worthy for us to do some further promotion. People can do the bottom development or the secondary development of system of image interpretation, which uses the idea of Cooperative interpretation of land use.

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REFERENCES

Victor Mesev,1998. The use of census data in urban imagine classification. *Photogrammetric Engineering & Remote Sensing* , 64 (5),pp.431 - 438.

Wilson P A.,1997. Rule - Based Classification of Water in Landsat MSSImages Using the Variance Filter]. *Photogrammetric Engineer2ing & Remote Sensing*, 63(5) ,pp.485 - 491.

Moolman D W.,Aldrich C.,1995. The interpretation of flotation froth sur2faces by using digital image analysis and neural networks. *Chemical Engineering Science* , 50 (22), pp.3501 - 3513.

Defries R S, Townshend J R G.,1994. NDVI - Derived Land Cover Clas2sification at a Global Scale. International Journal Remote Sensing, 15 (17),pp.3567 - 3586.

Moller - Jensen L.,1990, Knowledge - Based Classification of an UrbanArea Using Texture and Context Information in Landsat TM Imagery. *Photogrammetric Engineering & Remote Sensing* ,56 (6) ,pp.899 - 904.

Molenaar M.,1993. Object Hierarchies and Uncertainty in GIS or Whyis Standardistation so Difficult. *Geo-Information System* ,6(3),pp.22 - 28.

Qin Qiming,2000.The Problem and Approach in the Auto-interpretation of Remote Sensing Imagery. *Developments in surveying and mapping*, 25(2),pp.21 – 25

Pu Jingjuan,1992. *Principles and Methods of visual interpretation of Remote sensing image*, Beijing Surveying and Mapping Press

Chen Pengshu, Zhao yingshi.,1990. *Land analysis of remote sensing*, Beijing Surveying and Mapping Press

Luo Jian-cheng, Wang Qinmin, Zhou Chenghu.2002. Adaptive Resonance Theory for Classification of Remotely Sensed Image, *Acta Geodaetica Et Cartographic Sinica*, 31(2),pp.145 – 150

Wang Runsheng.,1994, *Image Understanding*, Changsha: National Defense Scientific and Technical University Press

Wang Tao.,1999. Image Interactive Interpretation System for Remote Sensing Supported by GIS. *JOURNAL OF THE GRADUATE SCHOOL ACADEMIA SINICA*, 16(2),pp.161-168.

Zhu Honglei.,1997. Knowledge Based Image Classification Appoach Supported by GIS. *Acta Geodaetica Et Cartographic Sinica*, 26 (4),pp.328 – 336

Yang Sheng tian, Zhu Qi jiang.,2000, Affect of Man computer Interactive Interpretation Method in Soil Erosion Survey of Large Scale by Remote Sensing. *JOURNAL OF SOIL WATER CONSERVATION*, 24(3),pp.88-91