

# STUDY AND EXPERIMENT ON UPDATING LAND USE STATUS QUO MAPS FROM HIGH-RESOLUTION IMAGES BASED ON DECISION TREE

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## ABSTRACT:

According to the deficiency of the process in Land Use Status quo Maps updating, this paper puts forward to a way to update The Land Use Status quo Maps based on decision tree, utilizing The Land Use Status quo Maps and latest remote images to combine decision tree judging process with land use map updating flow, and has an analysis with SPOT 5 high-resolution images and land use vector map in Fuzhou city of Fujian province in China test site. The test results showed that, through building decision rule, it is feasible to update land use data rapidly based on decision tree, and find a new way to update Land Use Status quo Maps ultimately.

## 1. INTRODUCTION

The Land Use Status quo Maps (LUSM) are basic materials of planning and scientific management for carrying on the reasonable utilization of land resource. The LUSM at county level in China have been established primarily in 1995. The investigation mainly adopts manual operating, which have shortcomings of heavy time span, tedious investigating course, consuming more manpower, easy to introduce error. At present, the land use investigation of some counties has already gone through over ten years. The land use situation has changed enormously, and traditional updating method has not met the demand of updating LUSM quickly already. On the basis of existing LUSM, it needs to design and develop corresponding quick updating technology.

Generally, Utilizing 3S technology can update the LUSM fast. At present, the successful technology way (representative) have already been put forward by professor Zhang ji-xian Utilizing airborne and satellite borne remote sensing images, which is called the whole processing of raster data. Meanwhile, another study by Yang gui-jun is the updating method of raster-vector combination technique based on the image facets of land use situation derived from remote sensing images.

This paper has put forward a method based on decision tree according to the above two kinds of methods, a new thinking about the updating technology of LUSM. It has taken SPOT5 high-resolution image and vector LUSM of Fuzhou, a city of Fujian Province in China, as an example to carry on test analysis, probe into the feasibility of this method. The test result indicates that this method combines the judgment course based on decision tree with the updating process of the LUSM, enriches map update technology, and offers a kind of concise and practical method to update maps.

## 2. THE BASIC PRINCIPLE OF DECISION TREE

The origin of the decision tree may be traced back to the study system set up by Hunt etc. while studying human concept modeling in the sixties of the 20th century. ID3 algorithm put

forward by Quinlan was one of the earliest decision tree algorithms at the end of the seventies of the 20th century.

What is called decision tree is to say if each decision or the incident (namely natural state) may elicit two or a lot of incidents, and result in different effect. When drawing the decision branches, it looks like one branch of tree very much, so that forms the decision tree. So the decision tree is a tree-like structure, and, its each tree node can be a node of leaves, corresponding to one type, and a partition too. To some concrete categorized questions or the rule study problem, the establishing process of the decision tree is from top to bottom, divide and conquer. Namely beginning from the root joint, through testing the data sample, dividing the data sample into different data sample subsets according to different results, each data sample subset will form one subset joint. Then, divide each subset joint again, and produce the new subset joint. Repeat it until reach the specific ultimate rules. The method of extracting the classification rules from a decision tree is as follows: To every leaf node, figure out the route from root-node to it firstly. All nodal division conditions on this route are combined to form a categorized rule. And so, N nodes will be against n rules.

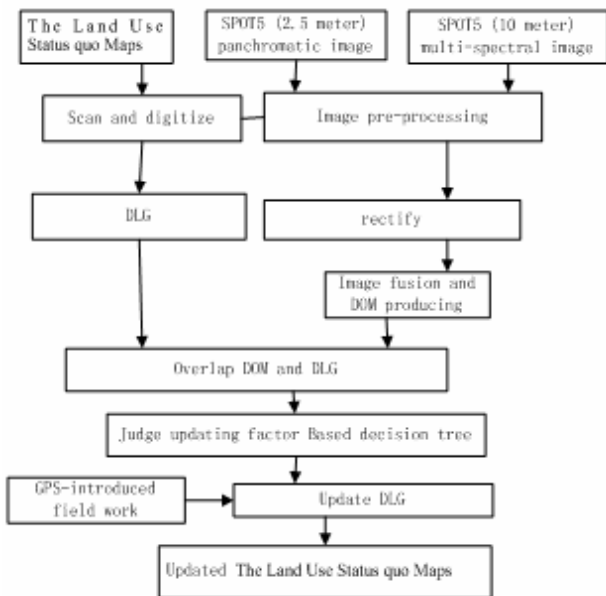
The theory of the decision tree has gone through decades of development, it already be applied in the fields of classifying extensively, predicting, drawing rules. At present, its advantage lies in that it is intelligible. Namely, not only are the classification and predicting course very easy to be understood, but also is categorized rule extracted from decision tree strong intelligible.

## 3. THE LUSM UPDATING FLOW BASED ON DECISION TREE

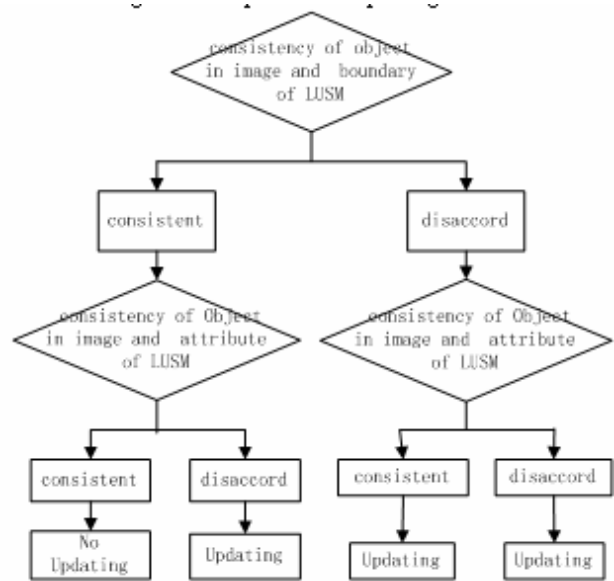
In this paper, the method of decision tree classification mainly applying in extracting remote sensing information, such as residential area, water body, road, and land use classification/cover and so on. But, it is rarely applied in updating The Land Use Status quo Maps (LUSM). The way of

decision tree classification has the characteristic of flexibility, directness, legibility, sturdiness, and high operating efficiency. The advantage of using it for updating LUSM lies in when dividing up digital image data characteristic space, its categorized structure is simple and clear.

SPOT5 satellite is a high-resolution satellite, which launched in France in May of 2002, which has panchromatic and multi-spectrum, two kinds of imaging mode. The resolution of the panchromatic image is 2.5 meters, while the resolution of image of multi-spectrum 10 meters. The fusion image from panchromatic image and multi-spectrum image has already kept the high-resolution of the panchromatic image, possessing the characteristics of abundant the earth's surface of multi-spectrum at the same time. The spectrum characteristic of land use types has diversity. For example, the gray density of the same land use type in each wave band is different, and, different land use types have different performance in the same wave band. Even for the same wave band and land use type, apparent gray density discrepancy can appear in the images of different history period. According that, so long as these differences are analyzed and distinguished, the goal of discerning land use types can be achieved. Boundary range of the land use type (called as space characteristic) can be confirmed according to its figure, position and relations between them. What we can utilize involve the judgment symbols of satellite remote sensing image, such as the figure, size, tone and color, shade, texture, pattern, correlated ground position distribution, relief configuration, river system pattern, plant sign, the sign of mankind activity, and seasonal sign etc. The technique flow of updating LUSM and the flow of judging to update element based on decision tree has been shown in Fig. 1 and Fig. 2 respectively.



Figur1 technique flow of updating LUSM



Figur2 the flow of judging to update element based on decision tree

In flow of utilizing high-resolution remote sensing image updating The Land Use Status quo Maps, the judgment rule is a key. The fact that borders on the satellite image and surface features of The Land Use Status quo Maps keep the same relations is the key to determining whether to update or not, the corresponding updating judgment rules can be expressed as shown in table 1.

Qualification	Relation of satellite image and The Land Use Status quo Maps			
Borderline of object	Consistent	Disaccord	Consistent	Disaccord
Attribute	Consistent	Consistent	Disaccord	Disaccord
Whether to update	No update	Update	Update	Update

Table 1 judgment rules

#### 4. EXPERIMENT AND ANALYSIS

This test based on The Land Use Status quo Maps and SPOT5 image as dataset, orbit number is 295/297, December 14 2003. The LUSM number is G50G048085, and the time of vector data is June 2001.

It takes The Land Use Status quo Maps as reference benchmark to rectify 2.5m SPOT5 panchromatic image, the remain error of selected control points is limited in 3-4 pixels. SPOT5 multi-spectrum data is rectified and matched to SPOT 2.5m panchromatic data, with remain error 2-3 pixels. Image fusion can adopt methods such as HIS transform, Primary Component Analysis (PCA), and multiplication operation. We obtained the result image shown in Fig. 3 after the process of matching, rectifying and cutting of fusion data. Then, the images shown as Fig. 3 and Fig.4, LUSM, are overlapped under ARCVIEW software, so that the updating against the LUSM can be performed according to judgment rules. Observing from a section of SPOT image, most of the test area is in suburb of city, there exists a great deal area being build, many facets in The Land Use Status quo Maps did not accord with image. By

analyzing the consistent between SPOT image and The Land Use Status quo Maps, the correlation between updating element and The Land Use Status quo Maps can be included the next several aspects:



Figure.3 vector map of G50G048085



Figure.4 SPOT 5 fusion image of G50G048085

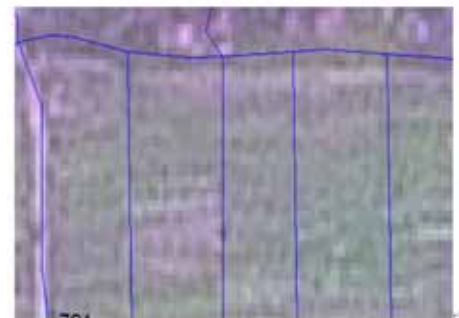
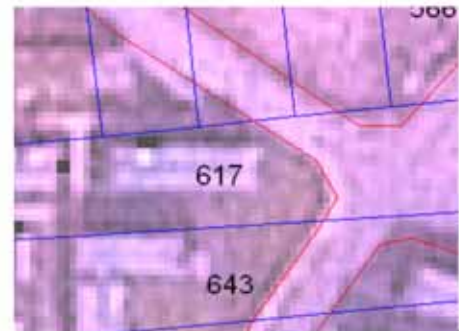


Figure.5 the correlation between updating element and LUSM (L1: Boundary of object is disaccord; R1: Both of them is disaccord; R2: Attribute is disaccord; R3: both of them is consistent)

Where,

- (1) Object boundary is disaccord, the boundary of object had changed, and it needs to be extended.
- (2) Both of them are disaccord. Most of facets are all partly changed, especially in-building road and liner object. In addition, many facets change into one, especially in whole exploitation.
- (3) Attribute is disaccord. Namely land use attribute have changed, mostly show the conversion between cultivated land and other agriculture land, such as cultivated land change into pond.
- (4) Boundary of object and attribute are basic consistent. This status need not be updated

According to the above rule, there are 1936 facets in the quo status map. Among them 394 facets were updated, 20 percent of all of the original ones, further more, many updated ones are derived from multi-facet of original ones. The status is shown as Table 2 as follows. Statistics has shown that the total

changing area exceeded 50%, however, time interval of SPOT image with The Land Use Status quo Maps is only two years, table 2 is the statistics result of former and later changing facets.

20-25 .

2 <sup>nd</sup> classification	Cultivated land			Garden		Forest			Build field				Wasted land			Other land
3 <sup>rd</sup> classification	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1*	20	36	622	267	76	42	9	8	45	345	53	39	28	18	12	98
2*	9	19	197	89	12	15	2	3	0	110	20	11	5	7	2	34
3*(%)	45	52.7	31.6	33.3	15.7	35.7	22.2	37.5	0	31.8	37.7	28.2	17.8	38.9	16.6	34.6

Table 2 statistics of former and later updating facets

**(Annotation:** 1 irrigated field; 2 Non-irrigated field; 3 vegetable plot; 4 orchard; 5 other orchard; 6 woodland; 7 shrub; 8 Sparse woods ; 9 urban and town land; 10 village resident area; 11 independent industrial and mining; 12 Communication land; 13 wasted grass land; 14 Exposed rock; 15 bare ground; 16 river surface and tidal flat .

This statistics based on land classification criterion in china (suit to transition period).

1\* number of facets before updating; 2\* number of facets after updating; 3\* percent of updating area)

## 5. CONCLUSIONS

Through the above test result and analysis, it can be found out that the updating method based on decision tree, for LUSM, make the updating work more direct and concise. This method has already been utilized in succeeding application of monitoring land use dynamically in 2003. But this method has its limitation, which requires the image and map to be matched accurately, or else the precision of the later work could not be guaranteed.

In a word, utilizing the LUSM and new remote sensing image, through setting up the rule of judgment, the method based on decision tree can upgrade the current LUSM fast, and offer a kind of feasible method for the update of land use situation from the current data.

## REFERENCES

Yang Gui-Jun. Research on Integrating Raster with Vector Methods of Updating the Basic Land Use Map Based on 3S Technology [D], [Master Paper], Liao Ning Engineer and Technology University, Dec. 2001.

ZhangJi-Xian, Cheng Ye . J.Feb.2002 Land use updating supported by 3S Science China Land Science 16 (1), pp.

Yang jie, ye chen, zhou,huang xin .J .Nov 2000. Decision tree way by blurring partition[J].Computer Simulation 17(6).pp.19-21.

Zhao Ping, Feng xuezhi, Lin GuangFa J. July ,2003. The Decision Tree Algorithm of Automatically Extracting Residential Information from SPOT Images. Journal of Remote Sensing 7 (4)

Li Shuang ,Ding Shenyang Gian ,Le Xiang. J Feb.2002 The Decision Tree Classification and Its Application Research in Land Cover . Remote sensing technology and application 17 (1)

Song Zhong,Zhang Li Sheng, Lu Yun Xia. J 2002 Photograph Judging and Application Neimenggu Science and Technology.(4).

Du Jin Kang, Huang yongsheng,Feng xue zhi J May 2001..Study on Water Bodies Extraction and Classification from SPOT Image Journal of Remote Sensing 5(3).