Development of Feature-based Classification Software for High Resolution Satellite Imager

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Abstract: In this paper, we investigated a method for feature-based classification to develop software which is suitable to the classification of high resolution satellite imagery. So, we developed related algorithm and designed user interfaces of convenience, considering various elements require for the feature-based classification. The software was tested with eCognition software which is unique commercial software for feature-based classification.
Keywords: Feature-based classification, High resolution satellite imagery.

1. Introduction

Unlike the low/mid resolution satellite imagery, high resolution satellite imagery gives us more details of Earth surface. However, the satellite image processing methods should be changed, according as the resolution is enhanced. Especially in classification processing, it is unlikely that the conventional pixel-based classification method for low/mid resolution satellite imagery is suitable for new high resolution satellite imagery. For example, roads are represented as line types with similar brightness or color in low/mid resolution satellite imagery. But, in high resolution satellite imagery, roads consists of complex features such as center lines, crosswalks, shadows of building, vehicles, trees, etc. So, feature-based classification method will be more suitable for high resolution satellite imagery and this topic is investigated by many people recently.

In this paper, we also investigated feature-based classification method to develop software for the new method. So, we developed related algorithm and designed user interfaces of convenience, considering various elements require for the new classification method.

2. System Configuration

Feature-based classification method is on-going research topic now and there is only one commercial product has been released now. The "eCognition" is the unique commercial software that supports the feature-based classification in current. At first, we analyzed the e-Cognition program in the point of user interface, but processing algorithm. And we designed our program flow which is presented in Fig. 1.

The flow is divided two steps; first step is for image segmentation and second step is for classification based on the segmented image using Fuzzy membership function. Indeed, this concept is derived from eCognition. However, all algorithms related to each flow have been developed independent of the eCognition.

Fig 2. also shows the Configuration of our system.

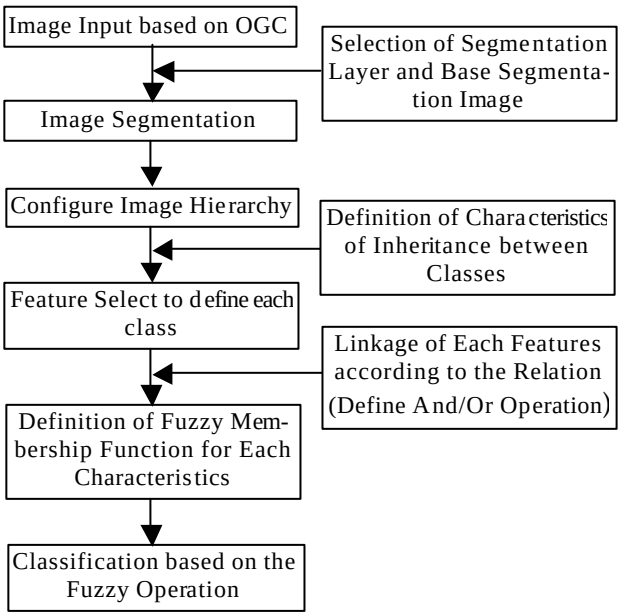

Fig. 1. System flow chart

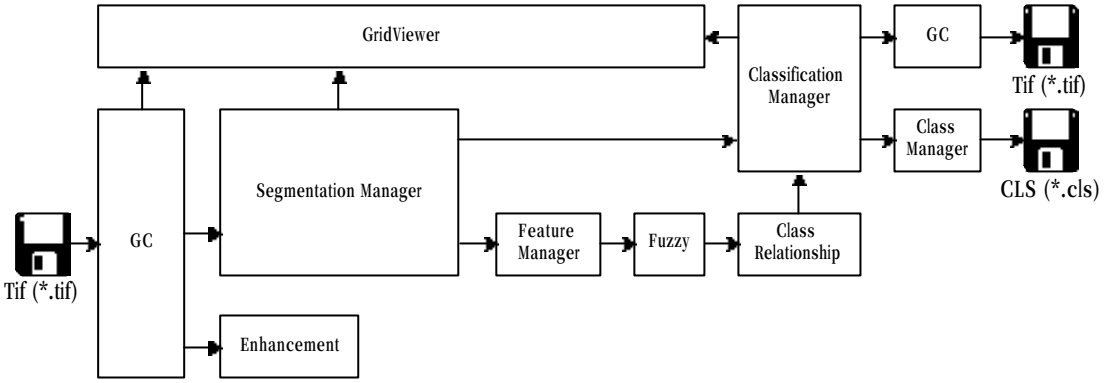

Fig. 2. System configuration

3. System Development

1) Input Part

The input part of the system has been developed based on the Grid Coverage specification of Open GIS Consortium. Therefore, various images can be input with unification and system can be easily extended. Large sized satellite images can be effectively managed with our component conforming Grid Coverage Specification.

2) Selection of bands and Base Segmentation Image

In case of multi-band satellite images, object can be characterized in specific band. Selecting suitable bands in which features of interest can be well characterized, optimum segmentation images for classification can be achieved. It is possible in our system to select bands to make optimum segmentation image.

Fig 3. shows the segmentation result from our system

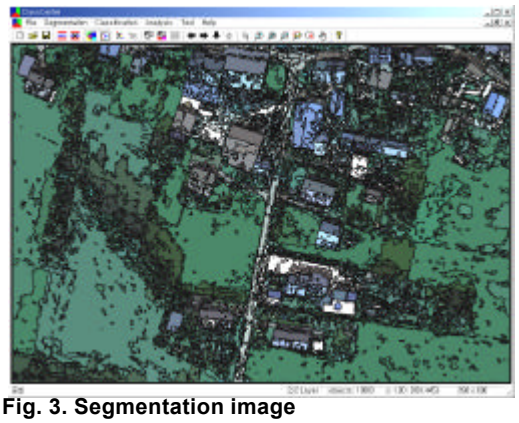

Fig. 3. Segmentation image

3) Definition of Hierarchy and Characteristics of Inheritance

Our system supports the class hierarchy structure. Using the class hierarchy, classes are created by user. Classes can be inherited from other class and the relationship can be set up by tree structure. The attributes in tree structure are set up using nodes which make up the tree. The property of a node and that of higher level node are linked by Fuzzy function.

Fig,. 4. shows the class hierarchy of our system.

Fig. 4. Class hierarchy

4) Feature Selection for Class Description

Classes are fixed using features of segments. There are two types of feature; one is object feature which represent the property of segment itself such as layer value, form, texture and the other is class related feature which represent the relationship among the segments.

At present, we only use mean and standard deviation of each segments but features for class description will be enlarged in near future.

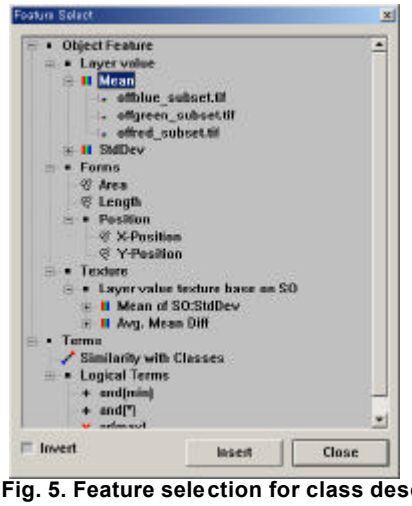

Fig. 5. Feature selection for class description

5) Definition of Feature Relation

A class is defined using combination of several Fuzzy member functions. The classification results are depend on the combination method of Fuzzy member functions. The combination is called as "Feature Relation". We made two relation in our system; And(min) and Or(max). And(min) function returns minimum Fuzzy membership value and Or(max) function is opposite.

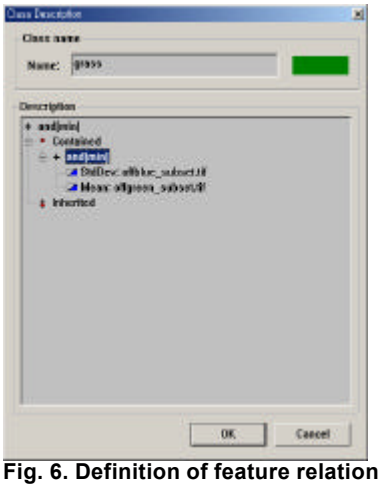

Fig. 6. Definition of feature relation

6) Definition of Fuzzy Member Function

Our system supports 5 kind of basic member function pattern and the pattern can be modified by user. Using these Fuzzy member function, classification process can be more precisely controlled.

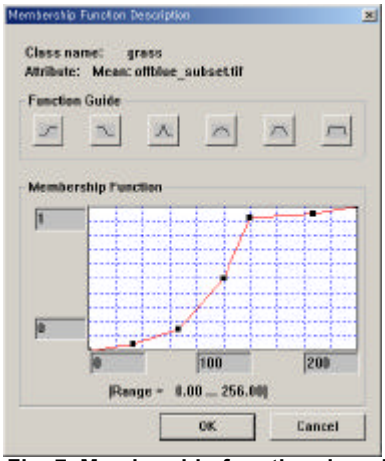

Fig. 7. Membership function description

7) Classification with Fuzzy Operation

After classes are defined through above procedures and the features of classes are set up, we can get the results of classification. The results depend on the suitability of Fuzzy membership functions of classes and the combination of member function.

Fig. 8 shows the result of our system for building class.

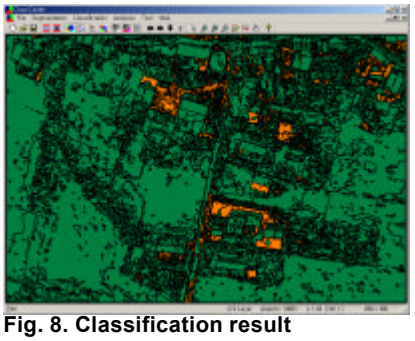

Fig. 8. Classification result

4. System Test

Fig. 9 shows the classification result of same image using eCognition program. Comparing Fig. 8. with Fig. 9. we got to know that results are almost same. System test using ground truth will be executed in near future.

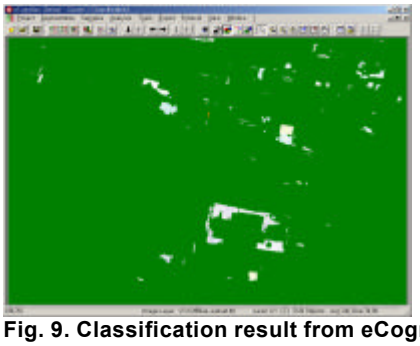

Fig. 9. Classification result from eCognition software

5. Conclusions

In this paper, we have developed software for feature-based classification and tested that with commercialized software eCognition. However, at present, the software has only basic functions for feature-based classification and is similar to proto-type. We found also that the determination of feature of class and the selection of Fuzzy member function are highly expert work. So, it is hard for not-skilled man to work not only with our software but also with eCognition. In future, we will try to overcome the problem.

Acknowledgement

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References

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