

INTEGRATING OBJECT-ORIENTED IMAGE ANALYSIS AND DECISION TREE ALGORITHM FOR LAND USE AND LAND COVER CLASSIFICATION USING RADARSAT-2 POLARIMETRIC SAR IMAGERY

Zhixin Qi¹, Anthony Gar-On Yeh¹, Xia Li², Zheng Lin²

¹ Department of Urban Planning and Design, The University of Hong Kong, Pokfulam Road, Hong Kong SAR, P.R. China (qizhixin@hkusua.hku.hk)

² School of Geography and Planning, Sun Yat-sen University, 135 West Xingang Rd., Guangzhou 510275, P.R. China (lixia@mail.sysu.edu.cn; lixia@graduate.hku.hk)

1. INTRODUCTION

Classification of polarimetric SAR (PolSAR) images has become an important research topic since PolSAR images through ENVISAT ASAR, ALOS PALSAR and RADARSAT-2 were available. Classification methods for PolSAR images have been explored by many researchers [1]–[6]. Recently some polarimetric decomposition theorems have been introduced [7]–[11], and classification methods based on the decomposition results were also explored by some researchers [12]–[15]. However, so far most of the classification methods for PolSAR images are pixel-based. The pixel-based classification methods are affected by speckles, and only the tonal information of pixels can be utilized by these methods. Moreover, the results of the pixel-based methods are almost discontinuous raster format maps, which are hardly to use to extract objects of interest and update geographical information system database expediently.

The objective of this study is to explore a new classification method of integrating polarimetric decomposition, object-oriented image analysis and decision tree algorithms for PolSAR imagery. In this method, forty polarimetric descriptors were first calculated by using the H/A/ α polarimetric decomposition and combined with the parameters of the scattering matrix and coherency matrix to form a PolSAR multichannel image. Next, during the object-oriented image analysis, image objects were delineated by implementing a multi-resolution segmentation on the Pauli composition image of RADARSAT-2 PolSAR data. Meanwhile, a total of 1276 features were extracted for each image object. Then, a decision tree algorithm was used to select features and create a decision tree for the classification. Finally, the land use and land cover classification of RADARSAT-2 PolSAR image was carried out by using the constructed decision tree.

2. METHODOLOGY

2.1. Polarimetric target decomposition

The polarimetric decomposition is aimed at providing an interpretation of the physical information extracted from the observed scattering of microwaves by surface and volume structures. The additional information contained in the cross-correlation terms can be exploited by polarimetric decomposition theorems to extract even more characteristic from polarimetric data sets [16]. The H/A/ α decomposition was used in this study to extract polarimetric descriptors from a RADARSAT-2 PolSAR image (Fig. 1). A total of 40 polarimetric descriptors were extracted and combined with the elements of the scattering matrix and coherency matrix to form a PolSAR multichannel image.

2.2. Object-oriented image analysis

In recent years, object-oriented image analysis has been increasingly used for the classification of remote sensing data [17]–[20]. By delineating objects from remote sensing images, the object-oriented image analysis can obtain a variety of additional spatial and textural information, which is important for improving the accuracy of remote sensing classification [21]. Meanwhile, image objects are much easier to manipulate and utilize than pure pixels. In this study, the object-oriented package, Definiens Developer 7.0, was used to implement the multi-resolution segmentation to delineate objects based on shape and color homogeneity [21], [22] from the RADARSAT-2 PolSAR data. A total of 1276 features such as textural, geometric and spatial features were extracted for each image object.

2.3. Decision tree algorithm

The purpose of decision tree algorithm is to determine the class of each image object based on their features. Since a large set of features can be extracted for image objects through object-oriented image analysis, the selection of proper features is very important for classification. Decision trees are commonly used for variable selection to reduce data dimensionality in image analysis [23]. Classification accuracies from decision tree classifiers are often greater compared to using maximum likelihood or linear discriminant function classifiers [24]. In this study, QUEST was used as a decision tree tool for the land use and land cover classification. The QUEST is a binary-split decision tree algorithm for classification and data mining [25].

3. CONCLUSIONS

The comparison between the proposed method and Wishart supervised classification method indicates that the proposed method outperforms the pixel-based classification method and reduces discontinuous phenomenon (Fig. 2). Accuracy evaluation was carried out based on field investigation. An ALOS image of the 10m multispectral bands obtained on 31 November 2008 was used as a reference map to assist the collection of ground true information (Fig. 1). The results show that the overall classification accuracy of the proposed method was 89.34% whereas it was 79.36% in the pixel-based classification. Moreover, the overall kappa accuracy was also increased



Fig. 1. (a) RADARSAT-2 Quad-Pol image of the study area (obtained on 21 March 2009; Pauli Composition), (b) ALOS image of the study area (obtained on 31 November 2008).

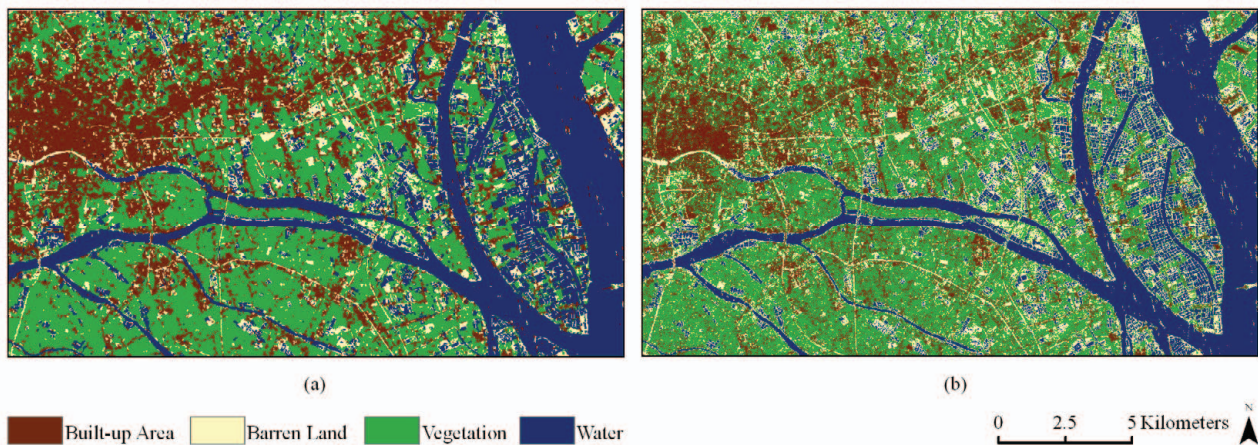


Fig. 2. Land use and land cover classification results (a) Proposed method, (b) Wishart supervised classification.

from 72.41% to 85.76% by using the proposed method. The user's and producer's accuracy for all the classes were also improved by using this integrated method. The experiments have indicated that the proposed method is a better method for land use and land cover classification of polarimetric SAR imagery.

4. REFERENCES

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