BUILDING EXTRACTION FROM VHR MULTI-SPECTRAL IMAGES USING RULE-BASED OBJECT-ORIENTED METHOD: A CASE STUDY

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ABSTRACT

Building extraction in urban environments requires high spatial resolution remotely sensed data. However, traditional pixel-based classifiers based on spectral classes are ineffective for high-resolution multi-spectral images due to large within-class spectral variations and between-class spectral confusions that characterize man-made features. Many researchers are exploring the promise of object-oriented analysis to the problem of large-scale detailed urban structure mapping. The successful detection of building rooftops in urban environments from IKONOS imagery with object-oriented analysis has been achieved using ancillary semantic information, such as thematic layers and digital elevation models, or applied for urban scenes with regular building pattern or grid placement.

In this study, a rule-based object-oriented classification method for building extraction is developed from an Ikonos urban scene of variable building morphology, patterning and spectral response without ancillary data. The method includes the following steps: (1) fusion of 1m panchromatic and 4m multispectral bands to produce a pan-sharpened 1m multispectral image; (2) Pan-sharpened images are segmented into visually meaningful segments, or contiguous and homogeneous groups of pixels, that act as image objects. These segments form the basis from which classification can be performed using spatial, textural and contextual information in addition to the spectral values; (3) a supervised spectral-based nearest-neighbour classification was used to separate impervious surfaces from other spectrally dissimilar classes (broad spectral classes); and (4) Spectral, spatial, textural and contextual properties of the image objects are calculated and evaluated for inclusion into object-based fuzzy membership rules. Attributes that provide visual and/or statistical separation between image objects that represent areas of interest and other image objects are candidates for inclusion. Finally, a fuzzy logic classification was

developed to differentiate between rooftop and non-rooftop objects in the impervious surface class using spectral, spatial, textural and contextual information.

The object-oriented fuzzy classifier produces an accurate classification of building rooftops in an urban scene by discriminating between *Roof* and *Non-Roof* classes without the use of ancillary data or the need to infer sub-classes of *Roof* or *Non-Roof* classes by field observation. Accuracy evaluation shows that the rule-based object-oriented classification achieves an overall accuracy of 94%. Post-classification merging of adjacent classified objects in the *Roof* and *Other* classes respectively produces a detailed map of building rooftop boundaries and locations. Further refinement can be performed to simplify the classified building-object polygons into regular shapes.

Fig.**1** Subset of Ikonos panchromatic channel

Fig.**2** Classified roof objects in image subset

Fig.**3** Generalization of roof polygon shapes

Keywords Object-oriented image analysis; Segmentation; Fuzzy logic; Classification

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