MAPPING URBAN TREE COVERAGE USING OBJECT-ORIENTED IMAGE ANALYSIS METHOD: A CASE STUDY

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ABSTRACT

Urban tree coverage plays a very important role for living condition and urban planning, environmental protecting, and sustainable development policy making. The existing method of estimating urban tree coverage, which utilizes the buffer operation around tree locations in GIS environment, thus having the same extent of tree crown coverage for every tree, is not effective as expected. The derived result is not accurate enough for the obvious difference among different trees. So, seeking for an effective method for mapping urban tree coverage is an important task for municipal government agencies. High-resolution remote sensing images with a resolution of decimeters can provide such information economically and timely. However, the traditional classifying methods based on pixel analysis are still in poor accuracy for the increased resolution. Object Oriented (OO) approach to image analysis has advantages over pixel-based methods in many aspects. The basic difference to pixel-based procedures is that OO method does not classify single pixels, but rather image objects (image regions). Moreover, the object-oriented method avoids the annoying salt-and-pepper effect of the more or less spatially finely distributed classification results that are typical of pixel-based analysis.

This research proposed an object-oriented method to obtain the distribution of tree coverage in urban environment of London city of Ontario, Canada using 0.6m aerial multi-spectral (4 bands: NIR, Red, Green and Blue band) images. With the support of eCognition Software, the whole tree mapping process included the following steps. Firstly, selecting a set of appropriate parameters by trial and error process to obtain an optimal segmentation result for tree coverage. The quality of segmentation was evaluated using the empirical discrepancy method. Then, a two-level class hierarchy was constructed combining the Nearest-Neighbor Classifier and the Fuzzy logic classifier. The parent classes (vegetation and non-vegetation) utilized the feature space composing of mean NDVI, ratio of Nir, mean VI, ratio of green band, and mean of red band. The inheritance classes (tree-possible and grass-possible) selected the mean difference to neighbors as the most key feature. After classification, we created two abstract classes (tree and non-tree) and selected Error Matrix Based on Samples to perform accuracy assessment for tree mapping. The result of accuracy assessment showed that the proposed method had produced 96.4% overall accuracy and 92.6% KIA. Finally, we calculated the tree coverage rate based on the statistical result of sum area of tree classification in urban area. This contribution demonstrated that visible urban tree crown coverage could indeed be mapped at a fine scale in VHR imagery. By comparing with visually interpreted tree coverage, we assessed both the thematic correctness of the class assignment and the identification of the tree locations.

Keywords Object-based; Segmentation; Tree crown coverage; Fuzzy Classification

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