A Fully Automated Approach to Classifying Urban Land Use and Cover from LiDAR, Multi-spectral Imagery, and Ancillary Data

Jason Parent and Qian Lei

Abstract

Light detection and ranging (LiDAR) and high resolution multi-spectral imagery have great potential to generate land cover/use maps at a fine scale and across large areas as the availability of both types of data are becoming increasingly widespread. These data must be processed in relatively small subsets due to their large volumes; however, conventional classification techniques typically cannot be fully automated and thus are unlikely to be feasible options when processing large high-resolution datasets. The purpose of this research was to develop a fully automated algorithm that is capable of deriving 1-meter resolution land cover and land use information from LiDAR data, multi-spectral imagery, and ancillary data.

The algorithm uses a decision tree approach to identify urban land cover features based on both structural and spectral properties. These properties include height, surface roughness, return intensity, presence/absence of ground returns, single versus multiple returns per pulse, brightness in visible and near-infrared wavelengths, and normalized difference vegetation index (NDVI). Pixel-based properties were used initially to classify each land cover class while minimizing omission error. A series of object-based tests were then used to remove errors of commission. Urban land use was inferred from land cover features using object geometry and spatial context information along with ancillary data. Parcel and census data were used to identify building features as single-family, multi-family, and non-residential. Feature shape and size were used to distinguish roads from parking lots. A hierarchical, thematically-detailed land cover/use map was derived for geographically diverse sample areas within Connecticut. Accuracy assessments of both land cover and land use classifications showed that our proposed methods are robust across the range of urban to rural landscapes in Connecticut. Overall accuracy of the urban land covers (buildings, low impervious cover) is 95.3%. Land use maps will be assessed through comparisons with those currently in use by planners and decision-makers in Connecticut.

Key words: land cover, land use, LiDAR, decision-tree classification, urban