Land Cover Classification Using Full-waveform Lidar Data and Remotely Sensed Image

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Abstract

Full-waveform lidar scanner has been available to the commercial sector. Compared to traditional discrete-return system, which only provide a single range distance to a target, full-waveform systems record the entire time history of laser pulses with a high resolution sampling interval. This study set out to integrate geometric information derived from waveforms and spectral information derived from remotely sensed image, in order to improve the classification accuracy of surface features. Riegl LMS-Q680i full waveform lidar data and WorldView-2 imagery were collected over areas covered with various surface features, such as buildings, vegetation, grassland and asphalt.

Fundamental waveform observables, such as echo amplitude and pulse width, were selected as echo features. Also, a terrain feature, slope, was considered. In order to remove noisy feature information, averaging neighborhood analysis with 0-0.5 m, 0.5-2.5 m and >2.5 m height interval, was applied to all selected echo observables. WorldView-2 images were employed to acquire Normalized Difference Vegetation Index (NDVI) and Near-Infrared-2 (NIR-2) as additional classification features. The Decision Tree classifier was chosen to implement a classification procedure.

A comparison was made between those lidar data with and without neighboring echo analysis. It was found that the overall accuracy of the classification was improved by 7% with neighborhood analysis; the Kappa value was improved by 5.92%. Furthermore, neighborhood echo analysis, together with NDVI image, was taken into account, in order to discriminate artificial and natural ground. The results showed that the overall accuracy of the classification was improved by 5%; the Kappa value was improved by 4.25%. A neighborhood echo analysis, together with NIR-2 image, was 2% better and the Kappa value was 1.21% better than those using only waveform

information. This study demonstrates that integrating lidar geometric information and image physical information, with averaging neighborhood analysis, can improve the classification accuracy of land cover.

Keyword: LiDAR, Full Waveform, Decision Tree.