Individual tree height and DBH extraction using multi-scan ground-based LiDAR data

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Abstract: Accuracy forest structural parameters are crucial to forest inventory, carbon cycling and wildlife habit modeling. LiDAR (Light Detection and Ranging) is a novel technique to measure the forest structural parameters. This paper describe a pilot research to extract the forest structural parameters, such as tree height, DBH (diameter of breast height), and the position of each individual tree using the terrestrial LiDAR. The basic data sets have been provided using a terrestrial LiDAR (Riegle, LMS-Z360i), and a vertical and horizontal scanning was introduced to obtain point cloud of the whole scene. First of all, an ICP (Iterative Closet Point) algorithm was introduced to get the transform matrix of each range image and to make multiple range images together. Based on the whole data sets, a variable scales and threshold filtering method was used to classify the information from ground and the information from forest. Meanwhile, the DEM (Digital Elevation Model) and CHM (Canopy Height Model) were generated from the classified point cloud. Finally, a stem detection algorithm was used to extract the position of individual tree based on the spatial distribution difference of the point cloud. Meanwhile, a slice at the 1.3m above the ground was extracted and rasterizing. A circle fitting algorithm was used to retrieve the DBH based on the grid and tree height was calculated using the height difference between the vertex and nadir. Comparison between automatic extracted individual tree height and DBH with those measured manually shows a high

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correlation. The coefficient, RMSE and MD (Mean Difference) is 0.95, 0.76m and -0.26m for tree height, and 0.89, 3.74cm and -1.17cm for DBH, respectively. Our methods and results confirm that terrestrial LiDAR can provide nondestructive, high-resolution and automatic determination of forest inventory parameters.