Geophysical Research Abstracts
Vol. 19, EGU2017-5329-1, 2017
EGU General Assembly 2017

Automated estimation of leaf distribution for individual trees based on TLS point clouds

Zsófia Koma (1), Martin Rutzinger (2), and Magnus Bremer (3)

(1) Eötvös Loránd University, Budapest, Hungary (komazsofi@gmail.com), (2) Institute for Interdisciplinary Mountain Research, Austrian Academy of Science, Innsbruck, Austria, (3) Institute of Geography, University of Innsbruck, Innsbruck, Austria

Light Detection and Ranging (LiDAR) especially the ground based LiDAR (Terrestrial Laser Scanning - TLS) is an operational used and widely available measurement tool supporting forest inventory updating and research in forest ecology. High resolution point clouds from TLS already represent single leaves which can be used for a more precise estimation of Leaf Area Index (LAI) and for higher accurate biomass estimation. However, currently the methodology for extracting single leafs from the unclassified point clouds for individual trees is still missing. The aim of this study is to present a novel segmentation approach in order to extract single leaves and derive features related to leaf morphology (such as area, slope, length and width) of each single leaf from TLS point cloud data.

For the study two exemplary single trees were scanned in leaf-on condition on the university campus of Innsbruck during calm wind conditions. A northern red oak (Quercus rubra) was scanned by a discrete return recording Optech ILRIS-3D TLS scanner and a tulip tree (Liliodendron tulpifera) with Riegl VZ-6000 scanner. During the scanning campaign a reference dataset was measured parallel to scanning. In this case 230 leaves were randomly collected around the lower branches of the tree and photos were taken.

The developed workflow steps were the following: in the first step normal vectors and eigenvalues were calculated based on the user specified neighborhood. Then using the direction of the largest eigenvalue outliers i.e. ghost points were removed. After that region growing segmentation based on the curvature and angles between normal vectors was applied on the filtered point cloud. On each segment a RANSAC plane fitting algorithm was applied in order to extract the segment based normal vectors. Using the related features of the calculated segments the stem and branches were labeled as non-leaf and other segments were classified as leaf. The validation of the different segmentation parameters was evaluated as the following: i) the sum area of the collected leaves and the point cloud, ii) the segmented leaf length-width ratio iii) the distribution of the leaf area for the segmented and the reference-ones were compared and the ideal parameter-set was found.

The results show that the leaves can be captured with the developed workflow and the slope can be determined robustly for the segmented leaves. However, area, length and width values are systematically depending on the angle and the distance from the scanner. For correction of the systematic underestimation, more systematic measurement or LiDAR simulation is required for further detailed analysis. The results of leaf segmentation algorithm show high potential in generating more precise tree models with correctly located leaves in order to extract more precise input model for biological modeling of LAI or atmospheric corrections studies. The presented workflow also can be used in monitoring the change of angle of the leaves due to sun irradiation, water balance, and day-night rhythm.