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The potential of UAV laser scanning in forest inventories

Di Wang (1), Markus Hollaus (1), Norbert Pfeifer (1), and Günther Bronner (2)

(1) Department of Geodesy and Geoinformation, TU Wien, 1040 Vienna, Austria, (2) Umweltdata GmbH, 3012 Wolfsgraben, Austria

Forest management, harvest operation, ecological conservation and relevant decision making need information from inventories. Conventionally, forest inventories were carried out mainly from field measurements with simple tools, and from field samples. Several vital tree attributes such as diameter at breast height (DBH), tree height, and species were collected at individual tree level. Various other attributes then can be inferred. For example, stem curve (i.e. taper function) can be interpolated by mathematical functions. The relation of different components of trees is often estimated by allometric functions based on DBH, tree height or other parameters of interest. In addition, these attributes are often aggregated to plot-level. For deriving taper functions for individual plots the required field measurements would be too expensive and therefore, the available taper functions are based on few sample trees.

Recent advancements of remote sensing techniques, especially terrestrial laser scanning (TLS) showed promising potential in forest inventories. It acquires millions of 3D points, which enables fast determination of forest attributes in an automatic manner. Some additional attributes that cannot be directly measured in traditional field inventories such as stem curve and volume, even ecologically related parameters such as leaf area index (LAI) can be estimated with high precision. The deficiencies of the employment of TLS in forests include limited terrain accessibility, area coverage, and visibility in top canopy layer. On the other hand, the next geospatial frontier, UAV-borne Laser Scanning (ULS) is emerging as a candidate for forest inventories. The high density and accuracy of ULS data enable the modeling of individual tree with fine details up to branch level. In addition to its plot or transect level coverage, it achieves a high level of completeness with respect to the top canopy layer. Therefore, it generates a high potential especially in exhaustive forest attributes estimations.

This contribution explores the potential of ULS data in forest inventories. As previous work was concentrated on deciduous forests, the objective of this contribution is to demonstrate the applicability of ULS data for automatic estimation of tree attributes for coniferous dominated forests. DBH, tree height, stem taper function, and other canopy related parameters will be closely examined. The achievable accurateness and completeness of the results will be shown and discussed for a study area in federal district of Lower Austria. The dominant tree specie is Spruce with heights up to 26 m. The first results of the detected trees, derived taper functions and stem volumes are promising and show a very high degree of completeness and correctness even for coniferous forests with dense canopy covers.