THE EFFECT OF BIOMASS AND SCANNING ANGLE ON LASER BEAM TRANSMITTANCE

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ABSTRACT:

During the last decade, there have been numerous scientific studies verifying the accuracy of digital elevation models (DEM) derived from airborne laser scanning (ALS). Since ALS has increasingly been used for nationwide digital elevation model data acquisition, optimizing ALS acquisition parameters is a topic of interest to national land surveys. In particular, the effect of the scanning angle and biomass on elevation-model accuracy needs further study in heavily-forested areas. The elevation-model accuracy is affected by, for example, the number of pulses hitting the ground, footprint size, terrain slope and, especially, vegetation. In order to better understand the effect of the biomass and scanning angle on the penetration rate of ALS signal through canopy and give further support to ALS studies, especially for scanning angles beyond 15 degrees of the nadir point, we conducted an indoor experiment using small spruce trees to represent forest canopy. The indoor experiment allowed us to measure the biomass reference accurately. We used manual thinning to produce various levels of biomass and scissor lift as the carrying platform. We measured the weight of every tree and the total biomass of trees after each thinning phase. We removed the material homogeneously from the trees, starting from the latest shoots. We used a FARO laser scanner in the experiment and attached it to the scissor lift. We scanned the experimental plot from four altitudes (about 3, 5, 7 and 9 m) and at six biomass levels (about 0, 6, 9, 14, 20 and 25 kg). The results show that signal transmittance through spruce trees is a function of biomass and scanning angle, but that the scanning angle only has a minor effect on the results. Biomass is the major parameter in determining the quality of the elevation model. While the results require further airborne experiments to be fully confirmed, they do imply that a scanning angle greater than 15 degrees can be applied in regions having low and moderate biomass, and due to the significant effect of the biomass on the transmittance, the airborne scanning missions must be carefully specified in heavily-forested terrain. We also found that terrestrial laser scanning experiments performed in an indoor laboratory-type setting yielded a relatively good understanding of the basic behaviour of and interaction between the target and laser scanning rather easily, but that it will be considerably more difficult to obtain similar results in a real-life experiment due to limited accuracy when collecting the reference data.

TOPIC: Lidar and laser scanning
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