

Inclusion of boulders in ground point classification in airborne LiDAR data for digital terrain models

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ABSTRACT

Accurate segmentation of ground points from LiDAR point clouds is crucial for creating reliable terrain models, which in turn are important for route planning and navigation of heavy machinery in rough terrain. Point cloud density has increased significantly in recent years, and earlier work and algorithms, developed for lower density point clouds, may no longer be as effective. In forestry applications, LiDAR is particularly valuable for its ability to penetrate the canopy and capture detailed information about the forest floor. However, it is a challenge to segment points and identify the ground and obstacles, such as rocks, while also distinguishing non-obstacles, like bushes and undergrowth.

In this study, we evaluate the performance of different algorithms for ground point classification in airborne LiDAR data in a context where obstacles like stones and rocks are included in the ground class, resulting in terrain models useful for heavy machinery route planning and navigation. In total, 225 combinations of software, algorithms, and parameter settings were tested on seven field plots with different terrain characteristics. The evaluation is done using metrics such as Precision, Recall, F1-score, MSE in rasters, and visual inspection of mapped differences. Ground truth data is created by manually classifying points using the visually promising results of Terrascan as starting point.

The preliminary results show several algorithms performing well, but the performance is often highly affected by the parameter settings used for each algorithm. Computation time was comparable for the best performing Cloth Simulation Filter algorithms and Terrascan. There is a tradeoff between inclusion of obstacles and the amount of noise in the terrain model. The results show that it is possible to include obstacles in the ground class in airborne LiDAR data, and that the resulting terrain models can be useful for heavy machinery route planning and navigation.