Tree height estimation in a young forest stand using UAS photogrammetry

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The Norwegian Forest Seed Center uses traditional field-based methods in order to measure tree heights in their seed test stands. This is a time consuming and hence expensive way to gather the desired data. In this project we wanted to study the accuracy of Canopy Height Models (CHMs), derived by subtracting a LiDAR based Digital Terrain Model (DTM), from Digital Surface Models (DSMs) based on UAS photogrammetry. Given acceptable results from this study, the Norwegian Forest Seed Center might start use UAS for tree height estimation in their seed test stands.

The aerial images were acquired in November 2013 by Norwegian contractor Asker Oppmaling, using a Aibotix X6 hexacopter with a Olympus E-PL5 camera. Images were acquired from the UAS flying at two different heights, approximately 50 meters and 80 meters above ground level (AGL) respectively. From these two data sets, two different DSMs were successfully generated; one consisting of images acquired from 80 meters AGL and one consisting of a combination of images acquired from 50 meters and 80 meters AGL. In order to derive CHMs, a LiDAR DTM was subtracted from the DSMs. Actual tree heights in the 2.5 hectare stand were measured in the field during the summer of 2013. Each single tree inside the area of interest was identified using local maxima algorithms, and deviations from field measured tree heights were calculated.

Preliminary results indicate that the CHMs provide a good representation of the actual vegetation in the forest. Average elevation errors were estimated to 0.0108 and 0.0168 meters for the 80 m and the 50-80 m DSM respectively, based on 9 Ground Control Points (GCPs) measured with differential GNSS-receiver.