EXTRACTING DATA FOR SINGLE TREES FROM PHOTOGRAMMETRIC CANOPY HEIGHT MODELS AND TRUE ORTHO PHOTOGRAPHS

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Top dieback and mortality of Norway spruce is a particular forest damage that has severe occurrences in scattered forest stands in southeast Norway. As a part of a project to study the extent and causes of the damage we are working on an algorithm for automatic detection dead and declining spruce trees for an entire county, - Vestfold. The data set is aerial imagery. The county was covered in 2007. Preliminary tests showed a considerable confusion between dead trees and bare ground. In order to avoid this confusion we have had the imagery automatically processed into a photogrammetric digital surface model (DSM) and true orthophotos. The data set derived from this processing was a 5 layer file, containing blue, green, red, and near-infrared, as well as the height above ground of the canopy height model (a DSM normalized by the terrain height, nDSM).

The idea is to detect single trees. We combine one spectral band (NIR) and the nDSM band by multiplying them, smooth this combined image, and identify local maxima to detect single trees. In this way we utilize the advantages of the nDSM, which represents canopy height of the stand, and the advantage of the NIR which contains brightness maxima close to tree tops. We then classify these local maxima, based on the 4 spectral bands, and for each of them using one pixel only. We made a training data set for 4 classes, i.e. 3 forest species classes (spruce, pine and broadleaves) as well as dead trees. The algorithm was developed using the national forest inventory (NFI) data set. This is a 3x3 km grid of permanent plots, all of which have accurate coordinates from dGPS measurements. We have compared various algorithms, including spectral angle mapper (SAM), a Bayesian classifier, as well as heuristic models.

Best results were obtained with the Bayesian classifier, with a simple Kappa =0.76 and overall accuracy of 81% for 4 classes of trees (spruce, pine, deciduous and dead). A major problem has been confusion between pine trees and dead trees. The Bayesian classifier was found to be superior compared with the others, as it has the ability to include prior probabilities. In this way dead spruce trees could be assigned with a low prior probability, which largely removed ‘false positives’, i.e. mainly live pine trees misclassified as dead trees.