Boreal Ecosystem Recovery & Assessment
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REMOTE SENSING TEAM FALL 2018: *SEMISUPERVIZED OBJECT DETECTION IN UAV IMAGES*

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Project summary

Remote-sensing based survival assessments and establishment surveys will benefit tremendously from automated workflows capable of handling large volumes of data under a variety of conditions. In this research, we assessed the effectiveness of machine-learning algorithms for semi-supervised detection of coniferous seedlings along seismic lines. We used convolutional neural networks (CNN) as a feature extractor, and an object detector to classify seedlings. The best model achieved a mean-average-precision (MAP) value of 0.81, which allows us to detect eight out of ten seedlings with an error rate of 20%. We also saw that by using a pretrained CNN, we could achieve high MAP (>0.65) values with as few as 200 training annotations. A combination of leaf-on and leaf-off images produced the best results. Further tests on simulated flying altitude (pixel size) showed that algorithms trained at one resolution could not be applied effectively to imagery at another resolution, but that machine-learning approaches to seedling detection could perform well under a variety of conditions given adequate training. Predictably, medium and large seedlings (large-seedling MAP > 0.99; medium-seedling MAP > 0.85) can be detected better than small seedlings (MAP > 0.7).

Progress to date

A Masters thesis from Ludwig-Maximilian University on this topic was completed in January 2018. An accompanying journal manuscript is in preparation.

Management implications

Remote-sensing workflows can perform stocking assessments under the correct conditions, but we require automated workflows that can scale effectively over large areas. This work represents the first in a series of several planned projects evaluating the role of machine-learning algorithms in BERA. It demonstrates that machine learning is an effective strategy for performing seedling detection across a range of environmental conditions (leaf-on and leaf-off) and pixel sizes, given appropriate training.

Geographic location

The experiments took place in the Kirby South study area near Conklin, AB.