ABBY-NET E^3-Systems Research Project Update 2019:
#1a: Deep/Machine learning to support restoration assessment - seedling detection

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Project summary

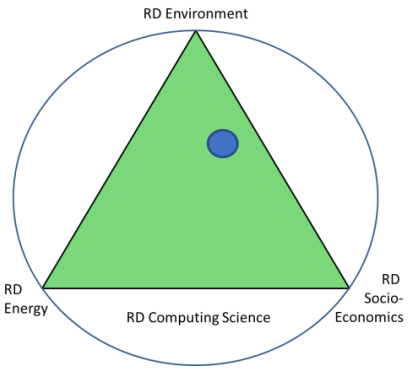
Remote-sensing based survival assessments and establishment surveys will benefit tremendously from automated workflows capable of handling large volumes of data. In this research, we assessed the effectiveness of machine-learning algorithms for automatic detection of coniferous seedlings along Boreal 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 result. 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 at a variety of resolutions given adequate training. Predictably, medium and large seedlings can be detected better (large-seedling MAP > 0.99; medium-seedling MAP > 0.85) 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.

Contribution to E3-system and 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 Abby-Net. 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 of the Boreal Ecosystem Recovery and Assessment (BERA) project near Conklin, Alberta.

Final Outcomes

The work will be submitted to the MDPI Remote Sensing Journal with the work title “Automated detection of conifer seedlings in drone imagery using convolutional neural networks”