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ROBUST FOREST CLASSIFICATION USING HYPERSPECTRAL IMAGING, LASER SCANNING AND SATELLITE IMAGERY

Abstract

Wood products are an important export for Russia. Understanding the status of trees and their classification is an ongoing task for many organizations. Currently, documentation of forests is done manually and there is a number of initiatives to implement automatic forest classification. A particular case described in the present paper showcases how aerial survey data supplements satellite imagery in order to achieve higher classification accuracy of forest tree species. Moreover, applicability of different data types, such as LiDAR, RGB, and hyperspectral (NIR and VIS) for the task at hand is investigated. In the paper, we present the experiment to use hyperspectral forest classification (using a UAV), which is then used in the context of satellite imagery, airborne laser scanning, and manual identification. We actively employ machine learning algorithms for classification and recognition tasks.

The project began with an expedition to the northern region of Arkhangelsk (Russia) in August 2018. The main goals of the expedition were data acquisition with the help of UAVs (one RGB and one hyperspectral), as well as observing various weather conditions and their effect on the data collected. Validation of the results was performed in four separate polygons, where in-situ data was collected by manually recording tree locations and species. In this project we evaluated the precision of trees identification from UAV hyperspectral data, helped by ALS and high-resolution satellite imagery (50 cm).

Supervised machine learning algorithms, namely Support Vector Machine (SVM) and Random Forest (RF), were applied and evaluated for automatic tree species classification task. Preliminary exploratory data analysis using unsupervised techniques was also done and described. An object-based classification has been performed by delineating individual tree crowns beforehand with the help of LiDAR data. Various hyperspectral features have been identified for use in classification algorithms complemented by on-ground spectroscopic benchmark data.

In this paper, we prove applicability of the proposed method and workflow in real life application. Results validation was done using data from the observation parcels, where trees were manually labeled. The next step is design of a system with finely tuned filters, which will make possible robust species classification at a cost much lower than hyperspectral imaging. We aim at classification accuracy of 90% that will allow for change proposal for current forestry policy and legislature to enable the use of UAVs in forestry for classification purposes.