

Title

Dune vegetation classification using UAV-LiDAR point clouds

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Abstract

For European Union member states, it is mandatory to assign Natura 2000 areas and regularly monitor them. Currently, vegetation mapping is done mainly manually, which is a time-consuming and expensive practise. Unmanned Aerial Vehicles (UAVs or drones), manoeuvrable vehicles with which high-resolution measurements can be done, could increase automation in this process.

Combining RGB imaging from drones with Machine Learning has already shown promising results. However, RGB imaging has limitations; there should be sufficient daylight, and only the upper layer of vegetation can be monitored. The use of LiDAR could complement the use of RGB imaging due to its ability to penetrate through different layers of vegetation and due to the fact that it does not depend on light conditions. This thesis investigates the contribution that LiDAR point clouds could have in mapping vegetation in typical Dutch Natura 2000 areas, which are typically in coastal dunes.

In this thesis, a method is proposed to classify vegetation into herbaceous, shrub, deciduous and coniferous vegetation classes. First, a method is developed to obtain the height of the vegetation.

Using the height of the vegetation, the vegetation is divided into two classes: high vegetation (coniferous and deciduous trees) and low vegetation (herbaceous vegetation and shrubs). In this way, different layers of vegetation can be classified. For the classification of high vegetation, the points from the top of a raster cell to 5 metres below the top are considered. For the classification of the low vegetation, the points in the lower 2 meters of the vegetation are considered. Features are designed that summarise the vertical distribution of points in different ways. These features are used as input to a random forest classifier.

Using this classification method an accuracy of 85% could be reached to classify the higher vegetation into deciduous and coniferous trees. Using the method, spatial patterns in deciduous and coniferous trees are clearly visible; however, when looking at individual tree levels, still improvements can be made. For the lower vegetation, an accuracy of 73% could be reached to divide the vegetation into classes of shrubs, herbaceous vegetation and bare ground. The method generally performed well for the shrubs, but herbaceous vegetation and bare ground still was mixed at some points by the model. For both classification algorithms, the results and behaviour of the model showed high sensitivity to the training data.

This study has shown the potential of the use of LiDAR in the field of vegetation monitoring, especially in areas where cameras cannot reach, where LiDAR could have added value in vegetation monitoring.