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Segmentation of homogeneous forest plots within point clouds for forest plot characterization

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Point clouds derived from laser scanning or image matching provide valuable information on vegetation characteristics, which are of interest for forest management and environment administration.
In that context, several recent studies describe approaches of detection and segmentation of single trees in point clouds.
However, for habitat descriptions, tree level information and delineation is not always the appropriate scale for studies of ecosystem processes as for many such processes as for example water cycle, a broader view on the habitat is needed. However, few approaches address larger scale segmentations, i.e. delineation of areas within a forest that are homogeneous regarding some defined criteria.
In our study, we aim at detection of homogeneous forest areas of relevant extent for ecosystem processes under study within point clouds. Thereby, challenge is to appropriately generalize habitat structure. For example, a forest plot can exhibit a heterogeneous vegetation structure on small scale, i.e. comprise of sparsely distributed trees containing many gaps between single trees. Ecosystem processes can be assumed to be similar over this entire area and the area, thus, should be considered homogeneous.
In our study, we demonstrate the feasibility of segmenting homogeneous forest areas on a scale that is relevant for ecosystem processes. We use textural features as well as forest metrics, both derived directly from the lidar point cloud with point densities around 10-20 points/m2. We found the derived features to be descriptive for plot characterization and, thus, to be valuable for the segmentation task.
Emphasis is put on the scale on which features should be extracted as well as on appropriate generalization strategies of forest characteristics in the segmentation framework. For feature extraction, relevant neighborhood for feature calculation is in the range of tree size (10-15m) while for subsequent segmentation, generalization is achieved by a top-down segmentation approach.
The feasibility of our method is demonstrated in Liechtenstein and Austria using leaf-on and leaf-off data, respectively.
We conclude that point cloud features used in previous studies alongside with segmentation frameworks used in context of single tree detections are suitable also for segmentation of homogeneous forest areas.

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