KØBENHAVNS UNIVERSITET

3D Lidar Point Cloud Analysis for Biomass Estimation

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INTRODUCTION

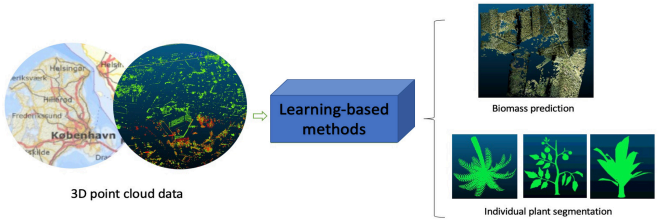

Figure 1. Introduction of the research

In our reseach, we aim to use and develop a large-scale 3D point cloud by UAV-lidar or satellite to analyze the biomass estimation, including the plant segmentation, above ground biomass prediction and carbon stock prediction. We use the city-size lidar point cloud data and our collected data for developing methods. Because the 3d point cloud contain more information including depth and density information, we can analyze the 3D point cloud data with specific classes, like ground, trees, buildings, water, etc. Through 3D lidar point cloud analysis, obtaining the precise segmentation and estimating the volume of the trees in the city-size dataset can lead to carbon stock prediction efficiently and effectively.

DATASETS

A. Whole Denmark Dataset

1. City lidar point cloud data from drone
2. Low density about 30 points/m^2 with Unbalanced, unstructured feature
3. Classified into ground, low vegetation, middle vegetation, high vegetation, building, water, noise, unlabeled, etc.

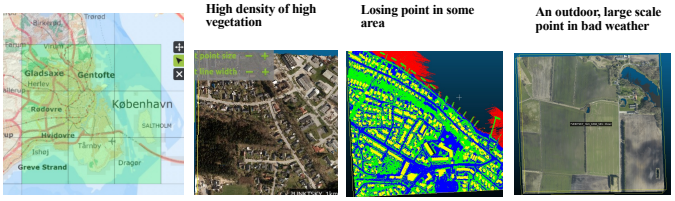

Figure 2. Description of the Denmark data

B. Collected Data by Our UVA-lidar

1. Location (A) of study site. Jutland, Denmark
2. Partitioning of lidar sample in 3 sub samples.
3. 2020: at each location, 1 m long AGB samples were collected in the direction of the sowing lines, and later oven-dried (65°C for 72 h).
4. 2021: shorter but more numerous samples.

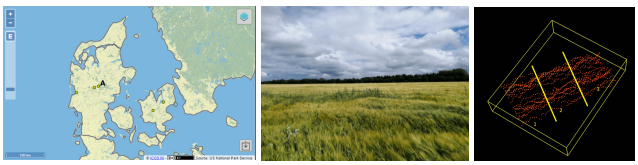

Figure 3. Description of collected data by our UVA-lidar

C. Other large-scale point cloud data benchmarks

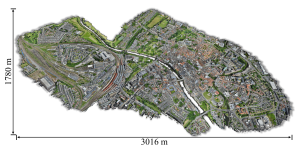

Figure 4. SensatUrban dateset

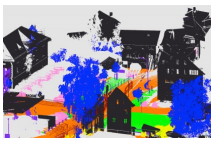

Figure 5. Senmantic3D dataset

Methods

1. Segmentation on Denmark Data

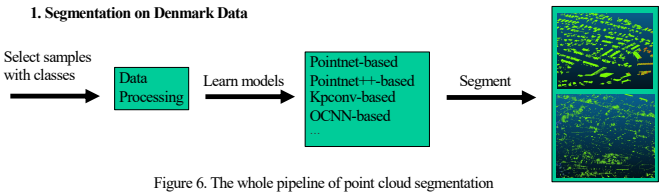

Figure 6. The whole pipeline of point cloud segmentation

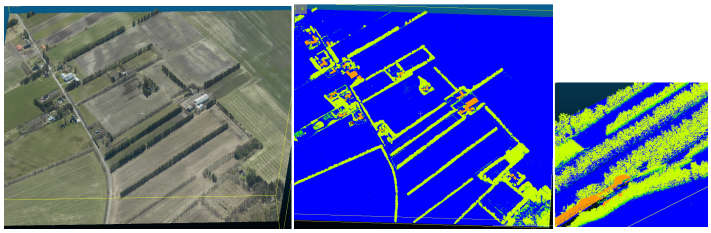

Figure 7. Visualization of the segmentation results

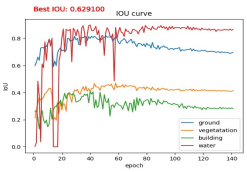

Figure 8. Visualization of the MIOU of pointnet++

Model methods	MIOU(%)
Pointnet-based	56.56
Pointnet++-based	62.91
O-CNN-based	65.43
KPConv-based	67.67

Table 1. Comparison of different methods

2. Regression on our collected data

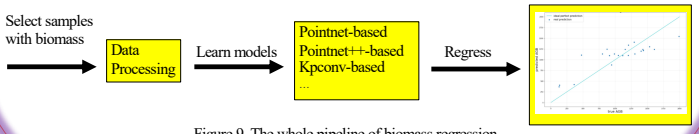

Figure 9. The whole pipeline of biomass regression

Conclusion

1. Estimation of the volume based on segmentation on Denmark data. Because there are no point cloud data with individual tree, we need to develop the data and some related methods to segment the individual tree, then analyze the volume of the trees.
2. Develop efficient segmention approachs to our collected data, lidar data and satellite data with multi-model methods.
3. Integrate and unify the methods of segmentation and prediction for biomass estimation, and effectively migrate in larger and more unfamiliar scenes.

References

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