RTU 60. SSTC section
"Geomatics"

RĪGAS TEHNISKĀ UNIVERSITĀTE

Tree parameter detection using UAV LiDAR data

Student: Reinis Cimdiņš (181RBM001)

Field of studies: Innovative Solutions in Geomatics
Level of studies: Master 1st year

Supervisor: Lauris Goldbergs

RĪGA 2019

Actuality

Remote sensing sensors provide extensive variety of data types and resolutions that are getting more and more accessible. Availability and technological achievements make remote sensing data attractive to many sciences and different applied cases. Remote sensing make data collection easier and processes more time and cost effective. Forest resource inventory and forest condition assesment has significant economical and ecological importance. Remote sensing in Latvian forestry has been used for dacades but mostly using optical sensors. Laser scanning is active sensor and it’s availability and data quality is cloud and other optical conditions independant. LiDAR (light detection and ranging) sensors have been developed to level when it is possible to mount them on UAV (unmanned areal vehicle) platform. UAV data provide higher point cloud density then aiplane based laser scanning and that gives new perspectives for tree paremeter detection and forest inventory.

Aim: Find out how UAV LiDAR data can be used for tree level forest inventories in Latvian conditions.

Tasks:

1. Assess tree segmentation options in point cloud, using different approaches.
2. Evaluate tree height detection appropriateness with local maxima algorithm.

Data:

1. Two echo laser scanner
2. Subset's mean point cloud density 318 points/m^2
3. Data accuracy 5 cm
4. Scanning range up to 100 m
5. Wavelength 903 nm
6. ~300 000 points per second
7. GNSS RTK antenna

Used softwares: ArcMap RStudio

Figure 1. Yellowscan Surveyor (Dronefly, 2018)

Data

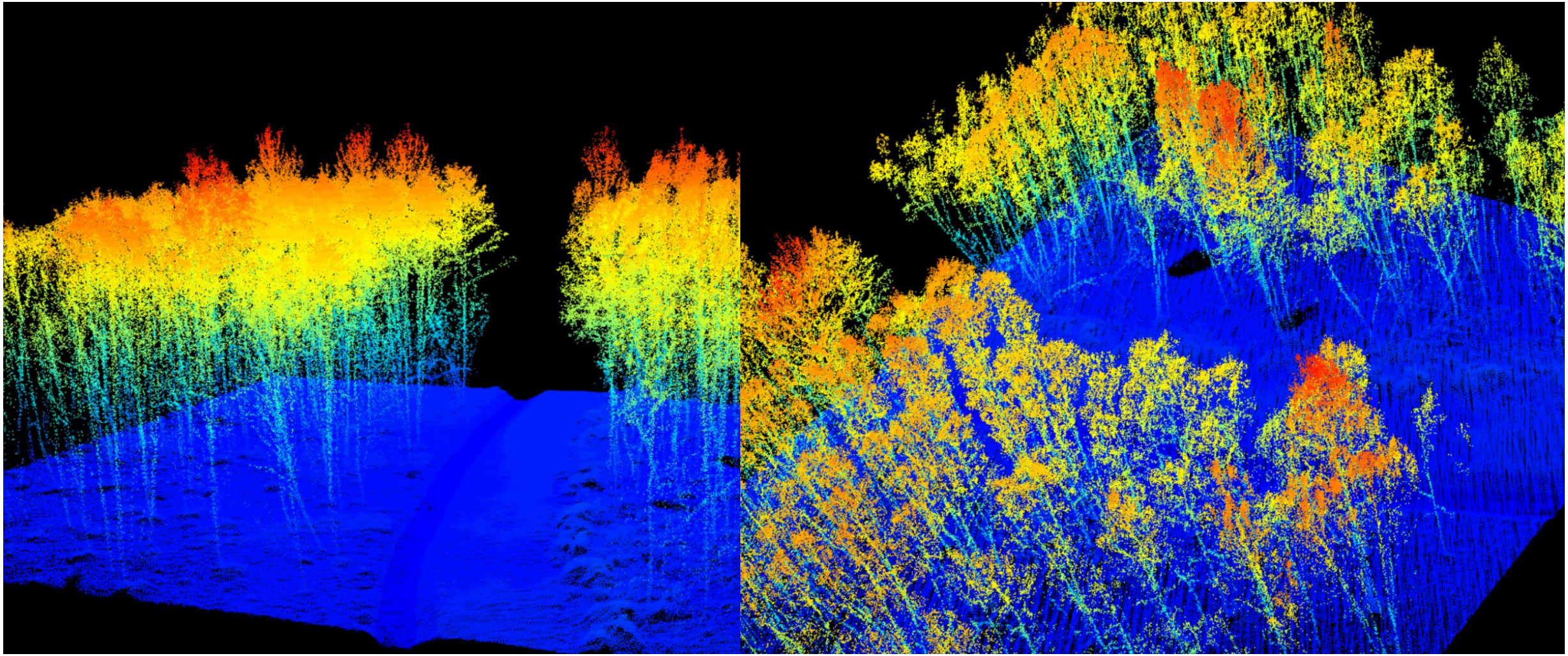

Figure 2. UAV LiDAR point cloud (Geolux, 2018)

Processing

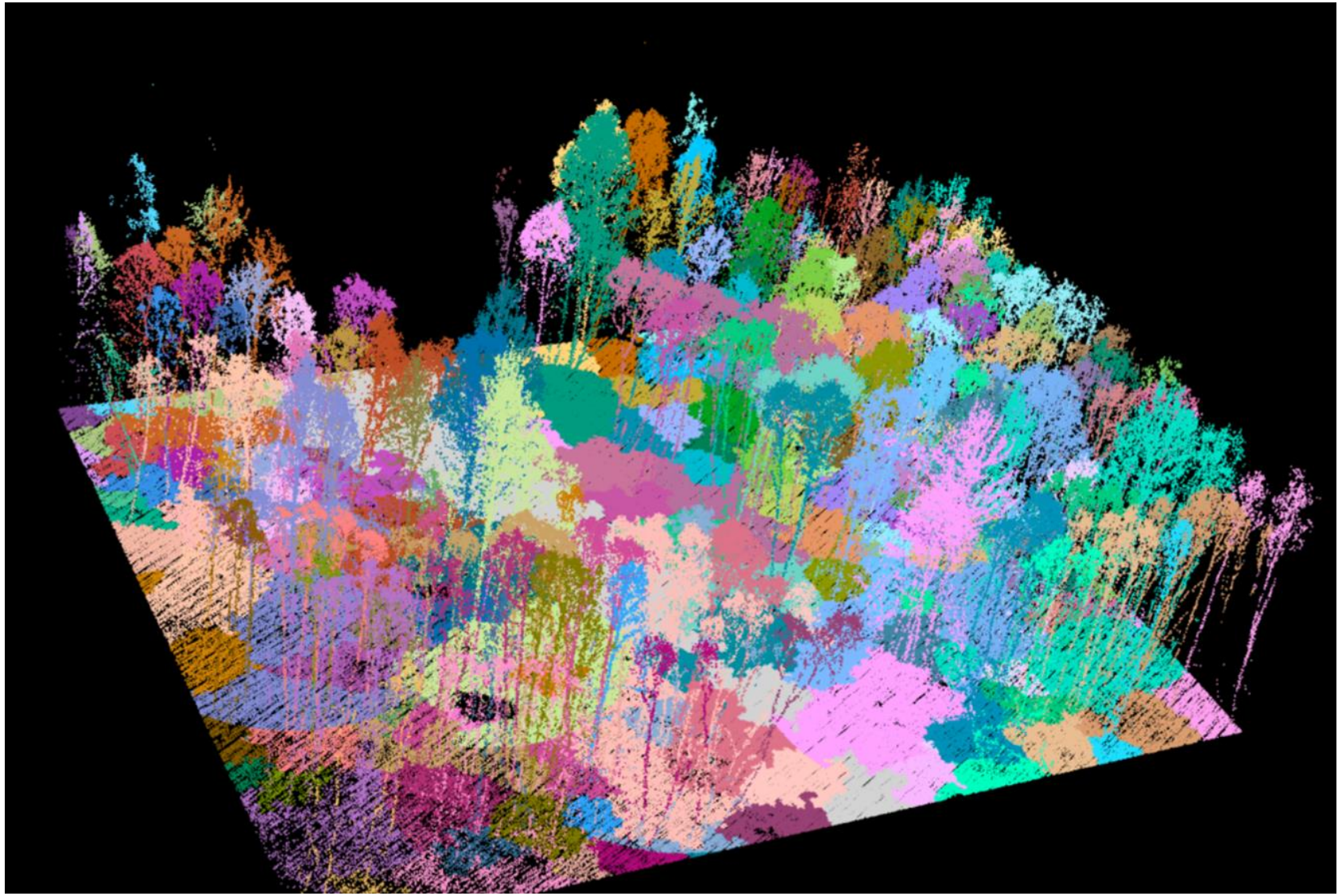

Figure 3. Directly segmented point cloud (Cimdiņš, 2019)

Direct tree segmentation using point cloud and Li2012 algorithm.

Point cloud was normalized and then tree seperation was made based on horizontal tree spacing differences between tree top and bottom.

Used software: RStudio

Processing II

Table

loc_koki

Tree_ID	Tree_H	X	Y
2	11.135755	501337.640486	254953.041957
3	9.86265	501352.140486	254953.041957
4	7.194563	501359.640486	254953.041957
5	14.365834	501365.140486	254953.041957
6	8.718094	501367.640486	254953.041957
7	5.93675	501321.640486	254952.541957
8	14.000501	501326.640486	254952.541957
9	9.286636	501320.140486	254952.041957
10	11.241473	501334.140486	254952.041957
11	7.730814	501353.640486	254952.041957
12	13.036036	501336.140486	254951.541957
13	10.321745	501341.140486	254951.541957
14	6.374965	501356.640486	254951.041957
15	10.295216	501338.140486	254950.541957
16	10.262823	501364.640486	254950.041957
17	6.590163	501346.140486	254949.541957
18	9.440995	501360.140486	254949.541957
19	13.398601	501334.140486	254949.041957
20	12.769373	501325.140486	254948.541957
21	10.763094	501335.640486	254948.541957
22	10.76156	501369.140486	254948.541957
23	13.671618	501321.140486	254948.041957
24	14.996334	501328.640486	254948.041957
25	11.662352	501349.140486	254948.041957
26	7.090609	501356.140486	254947.541957
27	12.22016	501324.640486	254947.041957
28	11.284741	501335.140486	254947.041957
29	10.837329	501336.640486	254946.541957
30	10.251363	501361.140486	254946.541957
31	8.89894	501364.640486	254946.541957
32	11.857824	501328.640486	254946.041957

0 (0 out of 236 Selected)

loc_koki

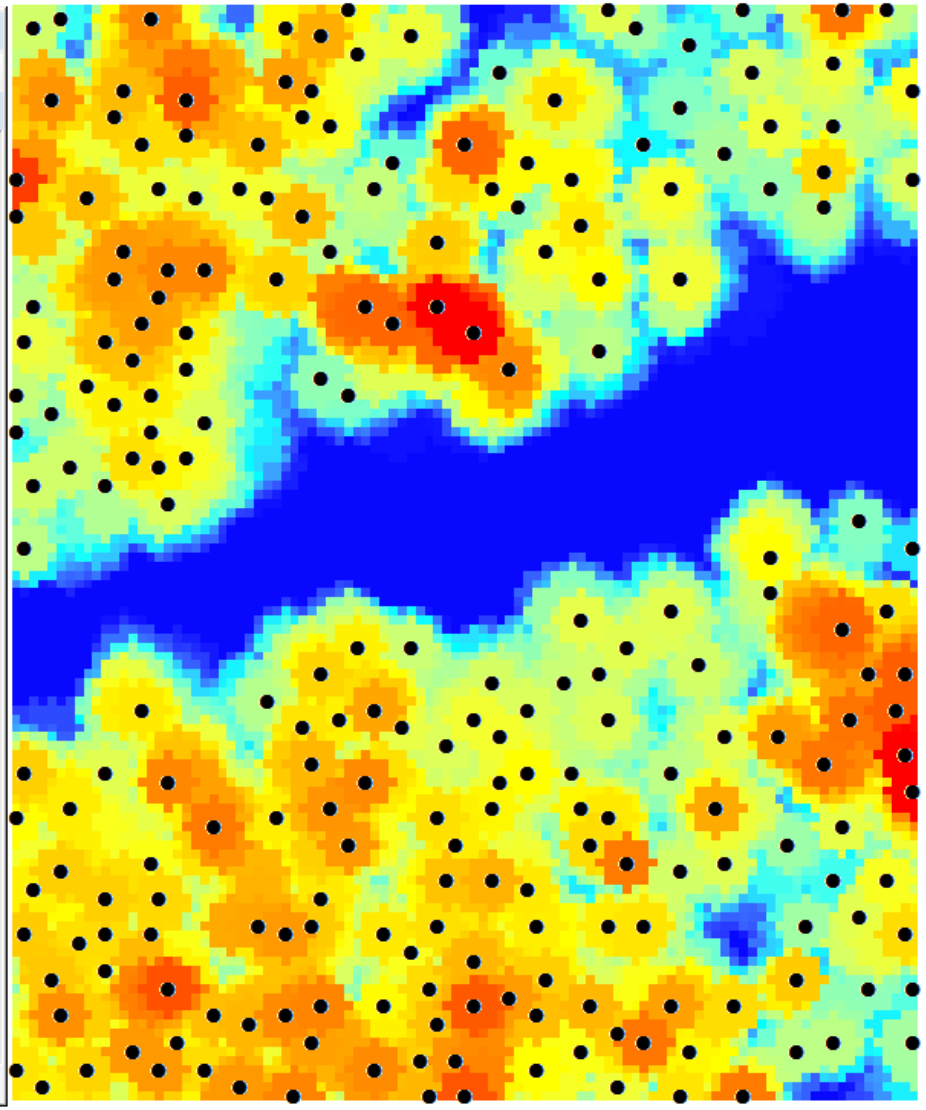

Figure 4. Segmented point cloud using CHM model (Cimdiņš, 2019)

Another tree location and stem height detection method was based on canopy height model (CHM) and local maxima raster analysis.

Used software: ArcMap

Conclusion

After this research it is possible to admit that UAV LiDAR is useful data source for forest inventory support. Data is valid for remote tree position and height detection

High density areal laser scanning data have significant potential in forestry but there is relatively small information about methodology and data processing approaches.

Further research

1. Have to do laser scanning in leaf on/off conditions in same compartments. LiDAR data up to 10 ha in managed and unmanaged coniferous and mixed forest types to better understand scanning relevance in various Latvian forest conditions including difficult multilayer canopy cases. Field work to aquire reference data with classic forest inventory equipment.
2. Evaluate tree parameter detection accuracy using direct point cloud and statistical modelling which is based on tree canopy parameters.
3. Make extensive theoretical and practical research about stem diameter detection using UAV LiDAR data.

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