Preliminary Results of Forest Inventory with Low Cost SLAM LiDAR

LOCATION

30 X 30 METERS SAMPLE AREA IN PILAWA FOREST

Hardware:

- Mandeye Pro-Series
- Spencer Measuring Tape
- Haglöf Mantax Caliper
- Haglöf Vertex 5

Software:

- Mandeye Software
- CloudCompare
- QGIS
- 3DFIN (3D Forest INventory)

INTRODUCTION

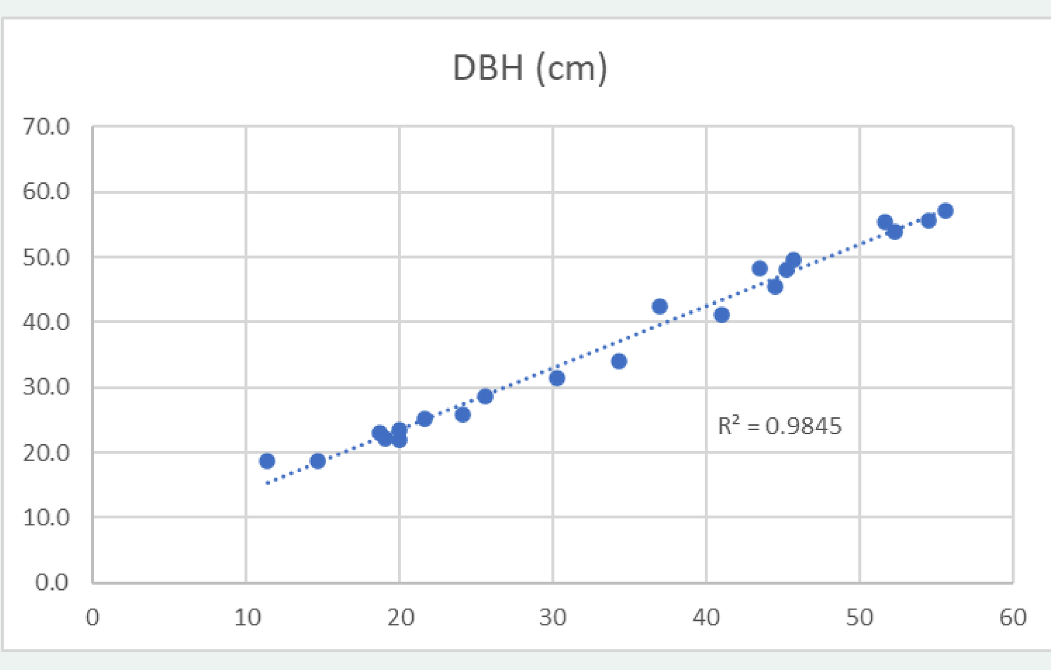
Monitoring forest health and tracking growth are important facets of being able to use forest resources efficiently. With this in mind, the ability to update existing forest inventory data in real-time with precise and timely measurements offers immense utility. Forest inventories, which largely comprise the descriptions of large forest areas, are frequently used to track forest growth and form the base for harvesting decisions. However, conventional forest inventory methods can be time consuming and sometimes require multiple teams to cover large areas. The use of LiDAR in forest inventories can reduce the time expenditure and increase the efficiency of forest inventories. Although many LiDAR platforms are still comparatively expensive, low-cost LiDAR units may be a viable alternative solution for forest inventories. Several studies have explored this idea, but there are still some barriers. Chiefly, in tree detection and obtaining reliable and accurate positioning in forest conditions are still challenges. The main objective of this research is to demonstrate the utility of LiDAR-based SLAM for forest inventories. In order to implement SLAM LiDAR, 3DFIN (3D Forest INventory) was used for tree identification and biometric calculations. 3DFIN allows fully-automated sensor-agnostic calculations of DBH and height from point clouds. This research was conducted on a 30 x 30 m sample area in Pilawa, Poland.

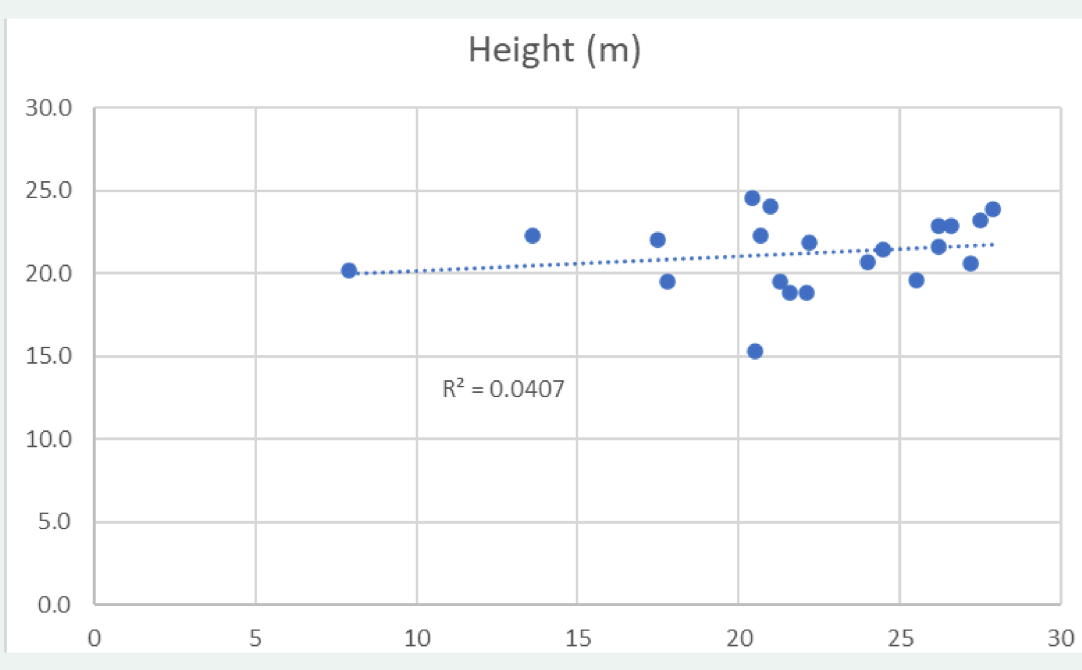
RESULT AND DISCUSSION

- 26 trees were detected from LiDAR data.
- Based on manual measurements, there were 22 trees.
- Based on proximity position coordinates between those two data, 21 trees are validated.
- LiDAR can detect 95.5% of trees in the sample area.
- For DBH --> RMSE = 3.3 and BIAS = 2.8
- For Height --> RMSE = 4.9 and BIAS = -0.8

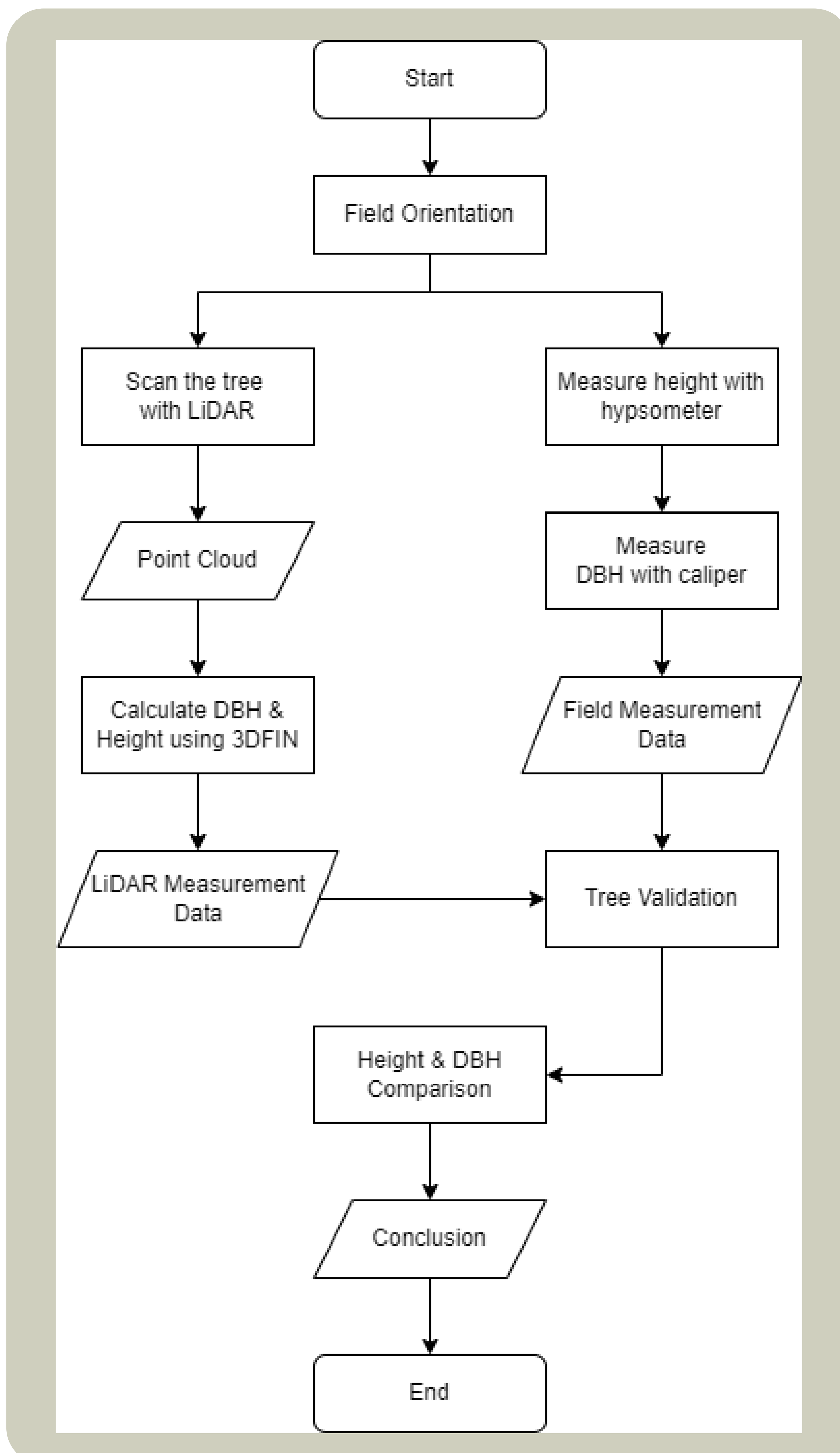
	DBH Manual	DBH LiDAR	DBH Difference
Average	33.9 cm	36.7 cm	2.8 cm
Percentage of Average Change	8.3%		

	Height Manual	Height LiDAR	Height Difference
Average	22.0 m	21.3 m	4.2 m
Percentage of Average Change	-3.4%		





METHOD



CONCLUSION

- LiDAR + 3DFIN **identified more trees** than manual measurements.
- Trees that had low and wide branches were identified by more than 1 tree.
- If a tree is not scanned thoroughly so that the point cloud on the main trunk is not perfect, 3DFIN will **not identify it as a tree**.
- LiDAR + 3DFIN was able to identify 21 of 22 trees **(95.5% of the total number of trees in the sample area)**, which means it only missed 1 tree.
- Calculation of tree dimensions obtained an average DBH difference of **2.8 cm** with a LiDAR DBH percentage that was **8.3% higher** than manual measurement DBH.
- The difference in height shows that the average is quite large, namely **4.2 m**, with the percentage of tree height on LiDAR being **3.4% lower** than the tree height on manual measurements. If seen from the point cloud results, this occurs because low-cost LiDAR penetration cannot reach the tip of the tree.

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