Weekly Report Week 1 & 2

[redacted]

Landscape CV

January 17, 2025

1 Time Log

1.1 What did you do this week?

- Registered for CS 8903
- Read various publications related to Terrestrial Lidar measurements and data
- Had initial meeting with Dr. Cannon
- Reviewed recording of meeting with Dr. Stroud and Computational Experts
- Developed Initial Research Plan

1.2 What will you do next week?

- Gather a list of tools that process LiDAR data for forestry
- Narrow that list to determine what would be the best tool to either port to R or add on to

2 Abstracts

Hartley, Robin J. L., Sadeepa Jayathunga, Justin Morgenroth, and Grant D. Pearse. "Tree Branch Characterisation from Point Clouds: A Comprehensive Review." Current Forestry Reports 10, no. 5 (October 1, 2024): 360–85. https://doi.org/10.1007/s40725-024-00225-5

Purpose of Review

Since the late 1990s, researchers have been increasingly utilising digital methodologies to assess the branch structure of trees. The emergence of commercial terrestrial laser scanners during this period catalysed an

entirely new domain focused on point cloud-based research. Over the years, this field has transformed from a complex computational discipline into a practical tool that effectively supports research endeavours. Through the combined use of non-destructive remote sensing techniques and advanced analytical methods, branch characterisation can now be carried out at an unprecedented level.

Recent Findings

While terrestrial laser scanning has traditionally been the dominant methodology for this research domain, the increased use of mobile laser scanners and unmanned aerial vehicles indicates a transition towards more mobile platforms. Quantitative structural modelling (QSM) has been pivotal in advancing this field, enhancing branch characterisation capabilities across diverse fields. The past five years have seen increased uptake of 2D and 3D deep learning techniques as alternatives.

Summary

This article presents a comprehensive synthesis of approximately 25 years of research in the field of digital branch characterisation, reviewing the data capture technologies and analytical methods, along with the forest types and tree species to which these technologies have been applied. It explores the current trends in this dynamic field of research, research gaps and some of the key challenges that remain within this field. In this review, we placed particular emphasis on the potential resolution of the significant challenge associated with occlusion through the utilisation of mobile technologies, such as mobile laser scanners and unmanned aerial vehicles. We highlight the need for a more cohesive method for assessing point cloud quality and derived structural model accuracy, and benchmarking data sets that can be used to test new and existing algorithms.

3 What you did and proof

This period consisted primarily of getting started with the project and getting familiar with the relevant literature. Below is a snapshot of a list of some of the articles identified and reviewed as well as a snapshot of the research plan.

Name		Link
A Lidar Point Cloud Based Procedure for Vertical Canopy Structure Analysis And 3D Single Tree Modelling in Forest	2	https://www.mdpi.com/1424-...
The use of terrestrial LiDAR technology in forest science: application fields, benefits and challenges	1	https://link.springer.com/article/...
Obtaining the three-dimensional structure of tree orchards from remote 2D terrestrial LIDAR scanning	1	https://www.sciencedirect.com/sci
Practical optimal registration of terrestrial LiDAR scan pairs	1	https://www.sciencedirect.com/sci
Observing ecosystems with lightweight, rapid-scanning terrestrial lidar scanners	1	https://zslpublications.onlinelibrary
Terrestrial Laser Scanning	1	https://link.springer.com/chapter...
Terrestrial laser scanning: a new standard of forest measuring and modelling?	2	https://academic.oup.com/aob/arti
Terrestrial Laser Scanning for Vegetation Analyses with a Special Focus on Savannas		https://www.mdpi.com/2072-...
Segmenting Individual Trees From Terrestrial LiDAR Data Using Tree Branch Directivity	2	https://ieeexplore.ieee.org/abstrac
Segmentation of Individual Trees From TLS and MLS Data	1	https://ieeexplore.ieee.org/abstrac

Figure 1 10 of the 20 publications identified and reviewed

Algorithm Development

Action	Justification	Plan if Action Fails	Status
Utilize the framework developed by Zhong et al. in *Segmentation of Individual Trees From TLS and MLS Data* to segment individual trees.	The proposed framework provides a process to follow regardless of exact techniques used for each step. This creates a good baseline to start from and iterate on.	Understand the root cause of the failure and see if the framework can be adjusted to be salvaged. If not, investigate other methods for individual tree segmentation	Proposed

Modal Selection/ Model Training

Action	Justification	Plan if Action Fails	Status
Compare various quantitative structure modelling (QSM) methods for speed, accuracy and simplicity. Primarily compare segmentation models with "skeleton" models such as AdTree.	QSM is the state of the art for creating detailed models of trees from terrestrial LiDAR data. Comparing the various methods will provide us with one or more routes to base ongoing work on or provide multiple methods to do analysis, with quantified tradeoffs.	Understand the root cause of the failure and see if the what may need to be adjusted for the work to be salvaged. If not, investigate other methods for creating models of individual trees, or broader methods for analyzing Point Cloud data, including the potential use for Deep Learning models.	Proposed

Figure 2 Sections of the research plan I was responsible for