Detecting plant tropism from LiDAR data

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Keywords: species modelling, tree bending, gravitropism, phototropism

1 Introduction

Understanding plant tropism is crucial in planning for a successful plant cultivation, although detecting plant tropism is commonly done on young, small plants in a controlled environment ((Coutand et al., 2019)). It is not trivial to measure tropism on mature street trees without elaborate setups or techniques. However, it will be very useful to capture the tropism information of mature street trees for environmental analysis and simulation purposes, e.g., root-soil condition, shading, tree pruning, etc..

With the abundance of urban LiDAR scan data in Singapore, measuring plant tropism of mature street trees from LiDAR data can be attained. We propose a methodology to measure plant tropism effects directly from LiDAR data without field observation work.

Most existing works to detect plant tropism from remote sensing data are image-based methods, with some limitations of observing tropism in higher-order branches as they are concealed by dense leaves and other objects. On the other hand, reconstructed tree skeleton from LiDAR data (Lim & al., 2020) will enable the derivation of an actual plant's tropisms information. Such tropism info, when fed into the species modelling module (Gobeawan & al., 2021) to instil tropism effect on the species models, will potentially give clues on the living condition of plants and their interactions or compatibility with the environment.Thus, in this abstract, we present our preliminary work for modeling accurate species model with tropism of real trees.

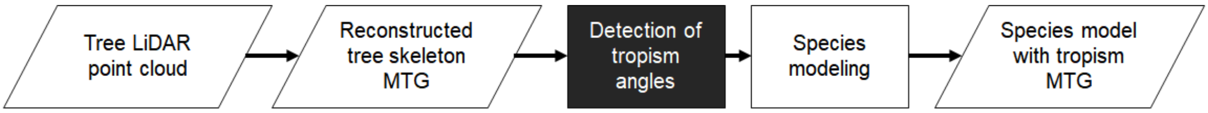

Figure 1: Workflow

2 Data and Methods

The workflow of plant tropism detection from LiDAR data is shown in Figure 1. A tropism angle, defined as an orientation difference between the tip of a branch with the base of the same branch, is detected from a tree skeleton (in MTG format) reconstructed from LiDAR point cloud (real tree data), and then fed into the species modelling module to generate a species model with tropism effect similar to that of real tree.

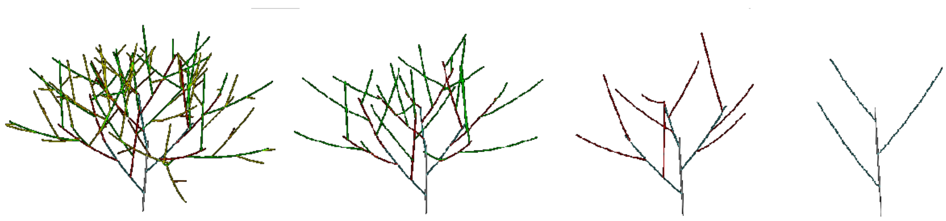

Figure 2: Branch grouping based on the branching order

To detect the tropism angles, the reconstructed tree skeleton is first parsed into groups of branches with the same branching order (Figure 2). Subsequently, an average tropism angle for each branching order group is calculated. The average tropism angles are then applied uniformly to the branches of the species models with the same branching order.

3 Results and Discussion

We present a preliminary result of tropism effects applied on two individual species models (Figure 3), with various configuration of tropism angles at proximal and distal parts of the tree. By applying average tropism angles uniformly across the branch group of the same branching order, the tropism effect of the species model may not be highly similar to that of the actual tree. However, assuming the tropism angles across the same branching order group are similar to one another, the tropism effect will be transferred to the species model just fine.

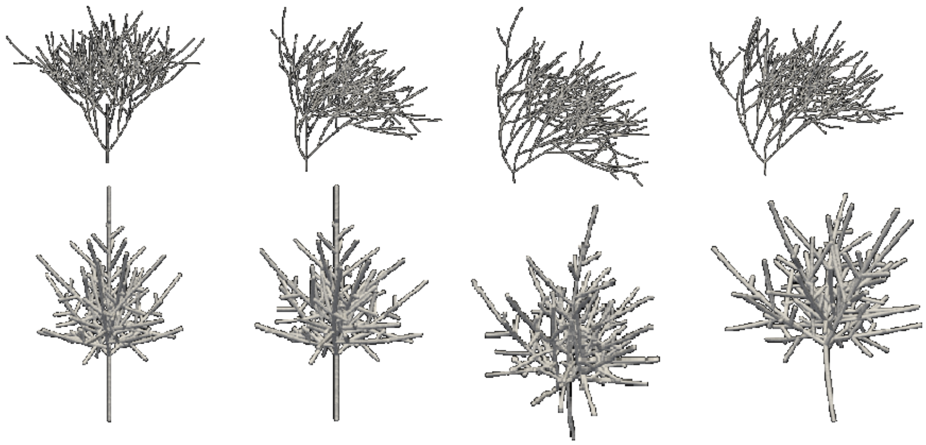

Figure 3: Row 1: *Samanea saman* – (proximal $0°$, distal $0°$), (proximal $0°$, distal $60°$), (proximal $30°$, distal $0°$), (proximal $30°$, distal $60°$), Row 2: *Hopea odorata* - (proximal $0°$, distal $0°$), (proximal $0°$, distal $60°$), (proximal $30°$, distal $0°$), (proximal $30°$, distal $60°$)

4 Conclusion

Tropism effect from real tree LiDAR data can be transferred to species models. This enables more realistic tropism effect on the species model. Work is ongoing to transfer all tropism angles from LiDAR data to the species models.

5 Acknowledgment

This research/project is supported by the National Research Foundation, Singapore under its Industry Alignment Fund – Pre-positioning (IAF-PP) Funding Initiative. Any opinions, findings and conclusions or recommendations expressed in this material are those of the author(s) and do not reflect the views of National Research Foundation, Singapore.

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