A Method for 3-Dimensional Stem Reconstruction and Analysis

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Introduction

There is often a need to analyse tree stems 3-dimensionally for properties such as stem form, ring structure, branch properties and various other characteristics. A solution that has recently become popular is that of CT-scanning of stem sections. The extraction and transport of stem sections from the forest as well as the capital and running cost of CT-scanning equipment makes this a fairly expensive method. In this project a rapid and relatively low-cost method for the 3-dimensional reconstruction of full tree stems was developed that can provide some of the data typically available from CT-scanning. This system can be used in the field by 2 persons so that no transport of logs are required.

Objective

The objective of this project was to develop a low cost and rapid method to create three-dimensional models of tree stems in-field. The internal wood structure including branch structure and growth ring structure had to form part of the model.

Methods

Design specifications:
- Maximum log diameter: 45cm
- Maximum log length: 300cm
- In-field use, easy transport and assembly. To be assembled and used by 2 people

Image reconstruction
- Using Image analysis software ImageJ, reconstruct 3D image of log

Results and discussion

Main practical lessons learned:
- The correct chainsaw size (power) and chain type are imperative for good surface quality of cross sections;
- The frame to which chainsaw is attached must not be linked to frame of digital camera to avoid vibrations when digital images are taken;
- Minimum distance between cross sections possible was about 15mm. This made knot / branch reconstruction less accurate;
- At a mean resolution of 25 cross sections per 2.5 m log, 8 logs could be completed per day including all work such as felling and cross cutting of trees;
- Good images and log reconstruction possible. See comparison of ring width measurements below:

Conclusion

The method developed enabled 3-dimensional stem reconstruction and analysis. For some properties such as shape and growth ring structure a high degree of accuracy was possible.