TECHNISCHE UNIVERSITÄT DRESDEN

Faculty of Forest, Geo and Hydro Sciences Institute of Photogrammetry and Remote Sensing

Reconstruction of 3D forest structure with hemispherical imagery and laser scanner data

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Outline

- Motivation
- Forest Inventory Parameters
- Study Site and Instruments
- Method
- Outlook

Reconstruction of spatial forest structure

- detailed information on forest structure important
  - forest management and monitoring
  - assessment of wood quality and tree health
  - estimation of biomass volume
  - research on radiation transfer models

- manual measurements
  - destructive
  - time-consuming and labour-intensive
  - error-prone and biased by observer

Forest Inventory Parameters

- diameter at breast height at 1.3m (A)
- trunk profile
- tree height (B)
- height at which the crown begins (C)
- crown perimeter and area (D)
- Leaf Area Index (LAI)

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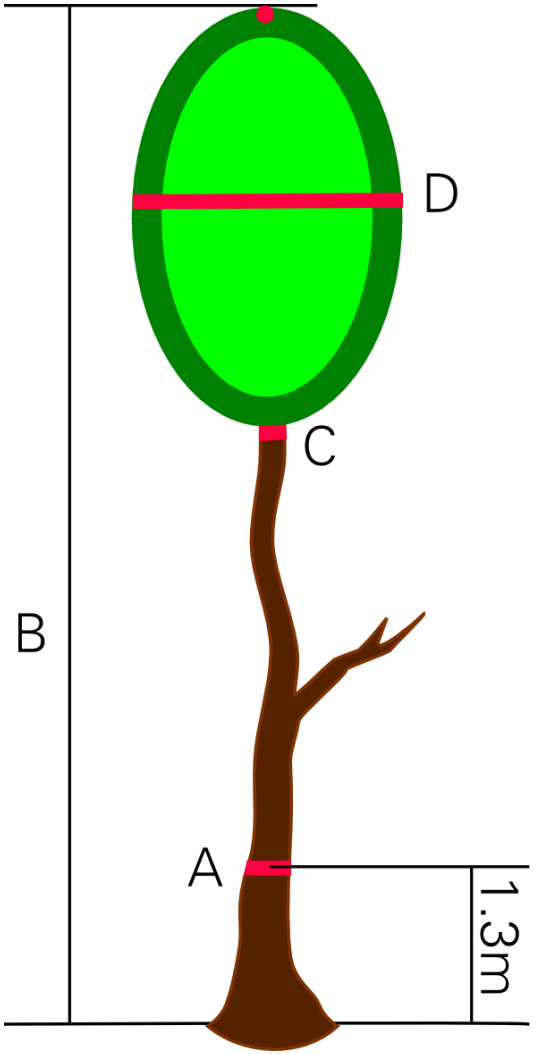


Study Site

src: Google Maps

Hemispherical Imagery

- aims
  - segmentation of plant parts, i.e. leaves, trunks
  - determination of LAI
  - co-registration with laser scanner data
- dependent on illumination conditions

Terrestrial Laser Scanning

- fast, efficient capturing of objects
- point-wise sampling of visible object surfaces
  - polar coordinates
  - intensity values, i.e. reflection amplitudes
- generation of 3D point clouds
  - more than 140 Mio. points per scan

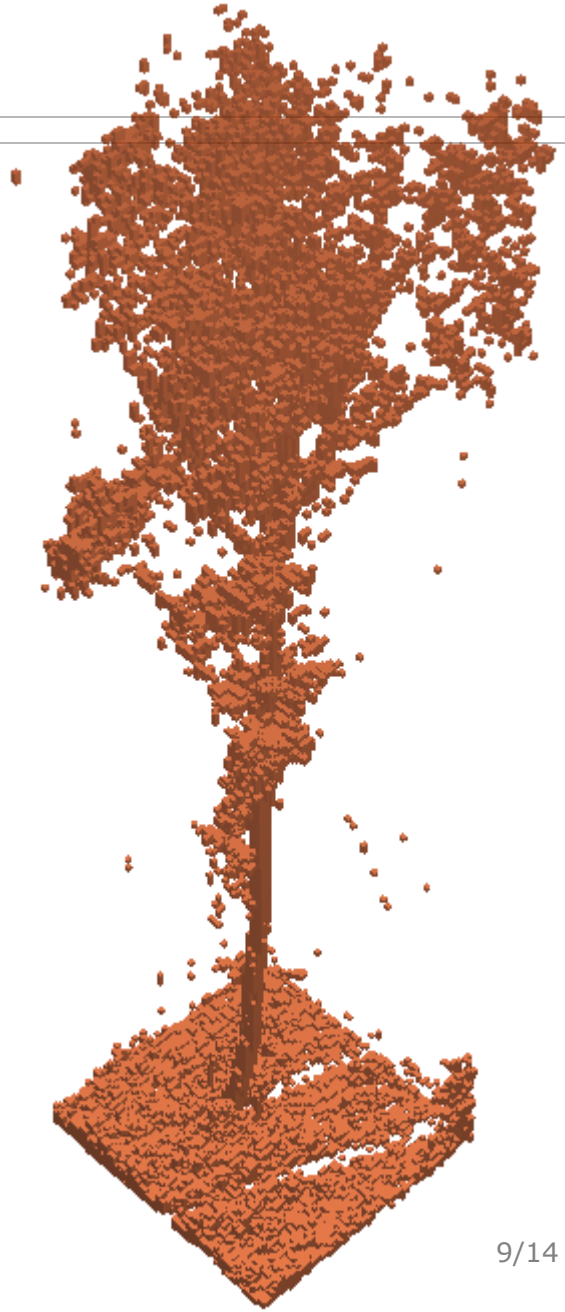
Zoller+Fröhlich Imager 5006i

Retrieval of spatial tree structure

- 3D point clouds of single trees
- determination of trunk center line by modified Circular Hough Transform

Retrieval of spatial tree structure

- analysis in voxel space
- voxel cell size ca. 10cm
- isolation of interesting component

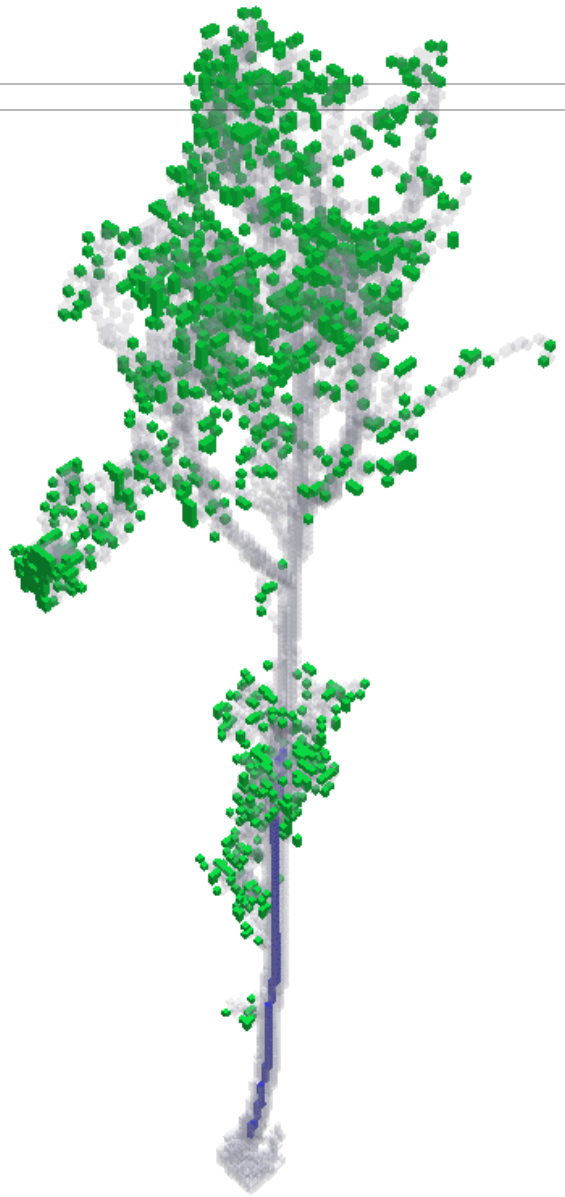


Retrieval of spatial tree structure

- determine location of branch tips by simplified distance transform starting at trunk center line
- apex voxel: voxels having larger or equal weights as their neighborhood

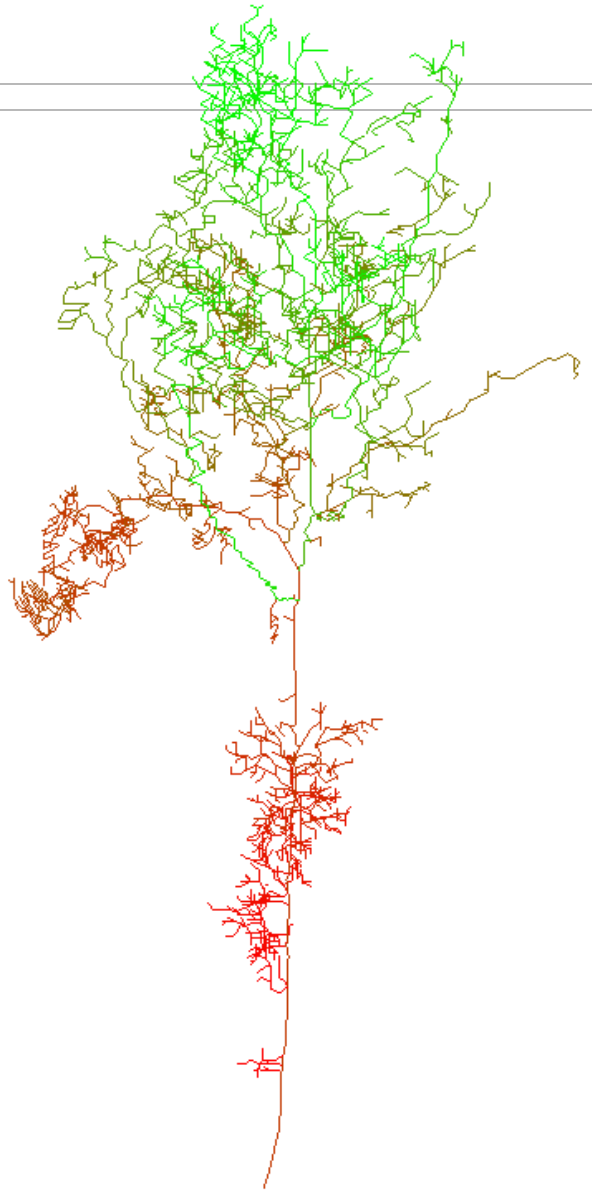
Retrieval of spatial tree structure

- interpretation of voxel space as connected graph
- greedy search of paths from apex voxel to trunk line in voxel space
- linking of crossing paths



Retrieval of spatial tree structure

- approximation of spatial plant structure as tree graph



The Vision

http://www.flickr.com/photos/dannybownes/3474407386/

- scanning and photographing the forest
- automatically on-site analysis and evaluation
  - plot of tree positions
  - forest inventory parameters
  - skeleton representations of all plants present

Thank you for your attention.