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Introduction

Swiss NFI field survey

- Sample plot (500 m²)
- Interpretation area (50m x 50m)

NFI data

 Highly suitable to get mean estimations about the Swiss forest.

Not representative on a forest stand level.

Good representation is crucial for certain forest questions, such as evaluating the **protective function of the forest**.

Enlarging the sample plot is required.



Field survey

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- Sample-plot center
- 1 Forest-boundary-line (FBL)
- 2 Circle for trees with DBH ≥ 36 cm
- 3 Circle for trees with DHB ≥ 12 cm
- 4 Circles for survey of young forest
- 5,6,7 Transect for survey of lying deadwood
- 8 Interpretation area (50 x 50 m)

Aerial photo interpretation

- O Raster-point outside FBL
- Raster-point on stocking element
- Raster-point on other ground cover

Introduction

Manual field survey for larger forest areas

- Extremely time-consuming
- Expensive

Remote sensing for enlarging the sample plots

- Terrestrial laser scanning
 - Point cloud generation
 - Highly reliable for computing tree positions and DBH
 - Heavy to carry and expensive
- Imaging and videos
 - Low-cost solution
 - Usage by non-experts
 - Fast and robust acquisition
 - Potential for forestry applications?





Imaging in forest environments

Monocular depth estimation [Hristova et al., 2022]

- Depth estimation from a single forest image
 DL-model





Original video



Videogrammetry in forest environments

Spherical videogrammetry mapping [Murtiyoso et al., 2022]

- Targets as visual cues during acquisition
 Single-camera point cloud generation
- Evaluation based on a single habitat tree



Our approach Spherical Stereo Videogrammetry

Stereo setup

- 2 Ricoh Theta Z1 cameras
- Known baseline between the cameras
- No need for visual targets

Study analysis on a forest plot level

- 3 forest plots with different forest complexity
- Video capture using the stereo spherical equipmen
- Comparison to single-camera videogrammetry
- Comparison to TLS



Our approach Point cloud generation

Agisoft Metashape Alignment of stereo frames

Spherical calibration
Baseline scale bars

Building dense point cloud





Our approach Tree position and diameter extraction

A. Point cloud denoisingB. Tree stem extractionC. Clustering into individual tree stemsD. Tree position and diameter



Performance analysis Tree positions





Swiss NFI | Swiss Federal Research Institute WSL | Remote Sensing Lectures 10.05.23

Performance analysis Tree diameters



Category 1: [0, 10] cm Category 2: [10, 20] cm Category 3: [20, 30] cm Category 4: [30, 40] cm Category 5: [40, 50] cm



Take-home messages

- The spherical cameras offer **big overlap** between corresponding stereo frames leading to successful frame alignment.
- The usage of stereo cameras makes it possible for the point cloud to be generated and correctly scaled without the need for visual targets.
- The stereo approach is highly reliable as the quality of the point cloud depends only on the captured content and not on the targets distributed during acquisition.



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Thank you for your attention!

