International Benchmarking of terrestrial Image-based Point Clouds for Forestry

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Introduction

- In recent years, the photogrammetric technique based on structure from motion (SfM) and dense image matching showed the capability of generating accurate dense point clouds;
- The implementation of this technology in real forest environments is challenging due to the difficulty of correspondence recognition;





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Goal of the benchmark

- Evaluate the performance of terrestrial image-based point clouds in plot-level forest inventory through an international benchmarking;
- Investigate whether the image-based point clouds can be an alternative solution to the more expensive terrestrial laser scanning (TLS) derived point clouds
- \rightarrow Benchmark founded by ISPRS Scientific Initiative





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Study Areas

 Altogether, ten plots are established in the five countries Austria, China, Czech Republic, Finland, and Slovakia. One plot will be established for each type of forest stand. The plots vary in size, tree species composition, tree density, and topography

Study site	Shape	Size (m) Diameter / square length	Tree species	Stem Density [stems/ha]
Austria 1	Circular	40	Picea abies	533
Austria 2	Circular	40	Fagus sylvatica	390
China 1	Circular	30	Taxodium distichum	410
China 2	Circular	30	Liriodendron chinensis	609
Czechia 1	Square	50	Fagus sylvatica	280
Czechia 2	Square	50	Picea abies	272
Finland 1	Square	32	Pinus sylvestris	479
Finland 2	Square	32	Pinus sylvestris, Betula sp.	869
Slovakia 1	Circular	20	Abies alba	875
Slovakia 2	Circular	15	Quercus petraea	651



Austria

Plot 1



Shape: circular; Diameter: 20 m Norway Spruce

Plot 2



Shape: circular; Diameter: 20 m European beech





Plot 1





Shape: circular; Diameter: 30 m Cypress Shape: circular; Diameter: 30 m Chinese tulip tree



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Czech Republic

Plot 1



Shape: circular; Diameter: 20 m European beech Plot 2



Shape: circular; Diameter: 20 m Norway spruce



Finland

Plot 1



Shape: Square 32 m Scot pine





Shape: Square 32 m Scot pine & Birch



Slovakia

Plot 1



Shape: circular; Diameter: 20 m Silver fir, European beech, Norway spruce

Plot 2



Shape: circular; Diameter: 15 m Sessile oak, European hornbeam



Data

- Reference data:
 - Diameter at breast height (DBH) was measured by a diameter tape
 - Tree position was measured by total station
- Point clouds:



Photo acquisition

 Images were acquired using a stop-and-go mode. Plots situated in Austria, China, Czech Republic, Slovakia were collected by a camera held on a tripod, and the path of data collection was around and inside the plots and two diagonal lines. Plots in Finland will be collected by a hand-held camera from a path surrounding the plots.

Graphical illustration of photo acquisitions







Photo pre-processing





TLS acquisition

- Multi-scan positions
- Plots situated in Austria, Czech Republic and Slovakia were scanned by Riegl VZ-2000 scanner, in Finland by LeicaHDS6100 scanner, in China by Riegl VZ-400i.
- The positions of the scanner were around plots and also inside them.
- The number of positions was based on the plot conditions.
- Co-registration of the individual scans
- Point cloud available in x-y-z-intensity



Equirectangular Projection → TLS angle increments and measured ranging values are plotted in 2D



Tasks for Participants

- Digital terrain model
 - For each plot a DTM with a spatial resolution of 0.5 m have to be delivered as tif-file. The DTMS have to be extracted from the image- and the TLS-based points clouds separately.
- Detection of trees and estimation of DBH
 - Tree positions plus DBH for each plot and TLS and SfM Data separately
- Filename: BenchCRP_Plot_**_CRP/TLS.txt Structure:

1	X1	Y1	D1
2	X2	Y2	D2
3	X3	Y3	D3



 Participants will provide a document where they describe the principle of algorithm for DTM, DBH and tree location estimation. Furthermore, the information about the level of automation has to be provided: fully automatic, semi-automatic or manual.



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You are invited to participate....

- Please feel free to contact us if you have any question and please feel free forward this invitation to your colleagues who might be interested in participating in this project.
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- Thank you for your attention

