Testing the performance of hand-held personal laser scanning systems for precision forest inventory

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Introduction

- potential of **remote sensing** (RS) recognized in forestry science
- constant and rapid technological progress
- emergence and availability of progressively advanced **personal laser scanning** (PLS) systems
- continuous research on their application in forest inventory is inevitable

Research goals

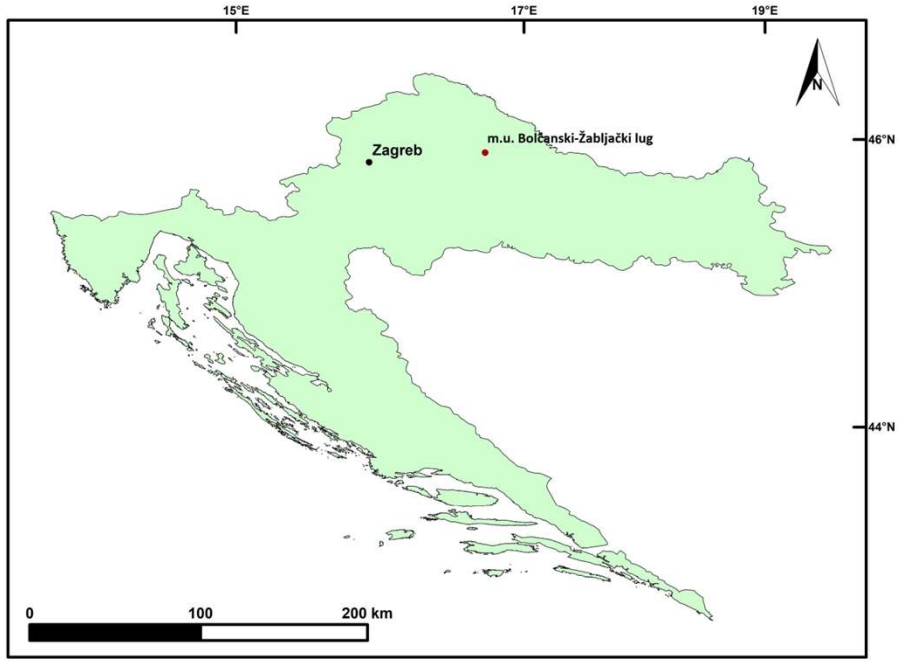
The goals of this study were to test:

1) **the accuracy of two, high-end hand-held PLS systems**

2) **various scanning schemes with different complexities**

Research area

- management unit "**Bolčanski-Žabljački lug**" in Central Croatia
- 100-year-old, mixed, lowland, even-aged **pedunculate oak forest** stand
- **one circular sample plot** with a radius of 12,62 m



Data collection - Field measurements

- leaf-off conditions in **February 2024**
- **diamater at breast height (dbh)** as reference data

Tree species	N of trees	Mean ± SD of	dbh range (cm)
			
Total	**15**	**28.6 ± 13.8**	**6.6 – 49.9**

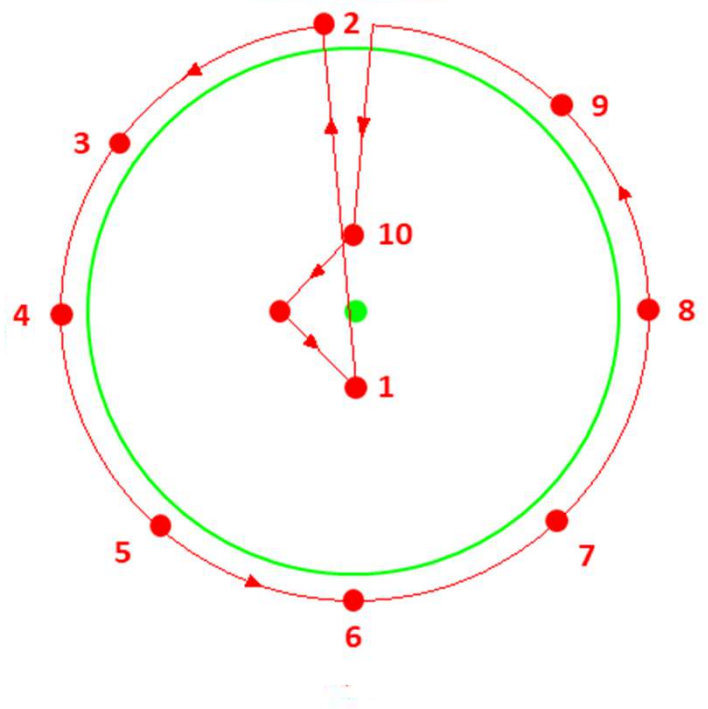
Data collection - PLS

- two different PLS systems were used: **GeoSLAM Zeb Horizon** and **Faro Orbis**

		Zeb Horizo	Faro Orbis
		100	120
Acquisiti		300,0	640,000
F horizo		360	360/290
Pr		up to 6	5 (mobile) / 2 (static)
Raw data		25-[illegible]	350

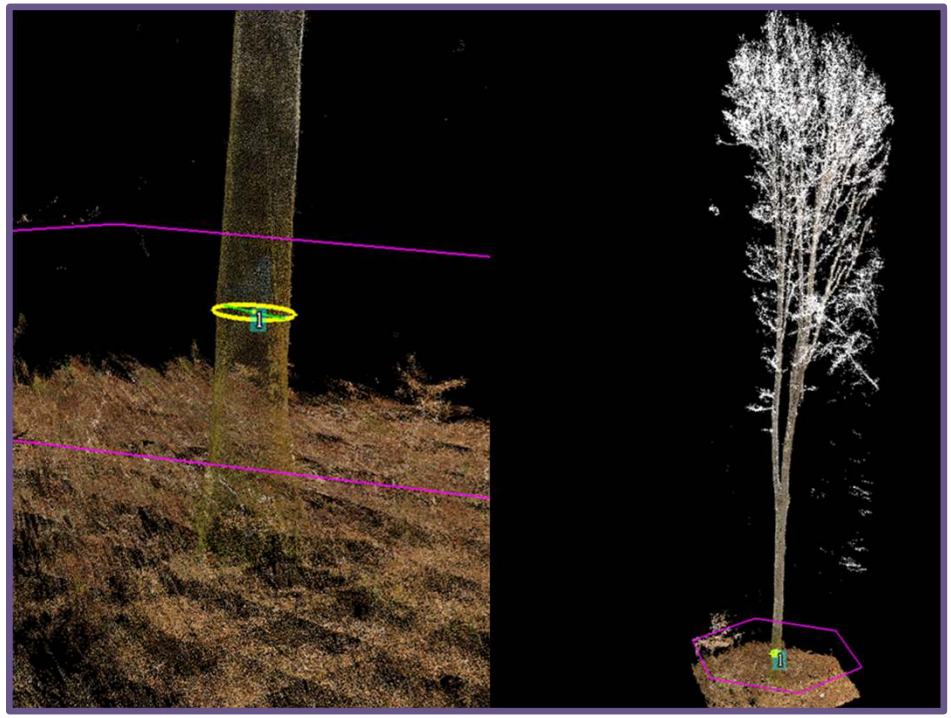
Data collection – PLS schemes

- **three pre-planned scanning schemes** of different complexity for both Zeb Horizon and Faro Orbis
- additional **two schemes** that incorporated **flash scans** for only Faro Orbis
- four **georeference** points



Data processing

- pre-processed in **Faro Connect** software
- point clouds processed in **LIDAR360 v7** software
- in total **eight different point clouds** processed



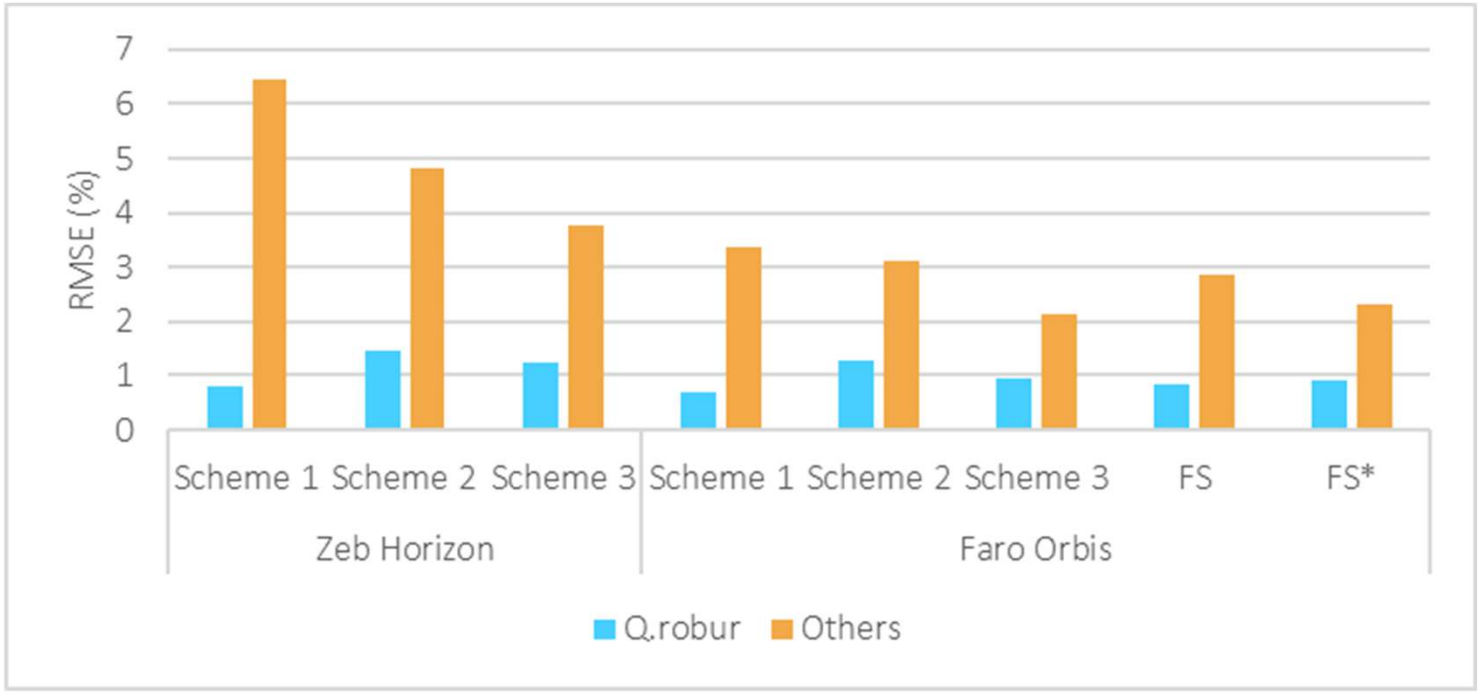
Results

- estimation accuracy of **dbh** for two PLS instruments (ZEB Horizon, Faro Orbis), and **different scanning schemes** in comparison to field reference data represented in centimeters

	ZEB Horizon			Faro Orbis				
Scheme	**1**	**2**	**3**	**1**	**2**	**3**	**FS**	**FS***
ME	**0.21**	**0.05**	**0.23**	**0.22**	**0.24**	**0.17**	**0.36**	**0.03**
SD	**0.95**	**0.81**	**0.76**	**0.49**	**0.52**	**0.37**	**0.32**	**0.42**
RMSE	**0.98**	**0.82**	**0.79**	**0.53**	**0.57**	**0.41**	**0.48**	**0.42**

Results

- **RMSE%** values by **Quercus robur** and other tree species



Conclusions

- Faro Orbis provides **more accurate dbh estimates** than ZEB Horizon
- obtained results revealed an **increase in** the PLS data **estimation accuracy** that corresponds to the **increase in complexity** of the scanning scheme
- Faro Orbis **flash scans** provide **slightly less accurate dbh estimates** compared to scheme 3
- **dbh estimates** vary based on the **tree species** (tree shape)

Thank you for listening!

Have a nice day!