STEM VOLUME MEASUREMENT OF TEMPERATURE NATURAL FORESTS FROM MOBILE MAPPING POINT CLOUDS

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Motivation

Stem volume is a key attribute in forest inventory

- Stem volume is the basis of timber and carbon estimation.

- The global timber market is expected to grow to $1.15 trillion by 2028.

- Temperate forests provide high valuable hardwood but grow slow.

- An automated solution is needed to localize and measure every single stem.

Objective

## Stem volume with LiDAR remote sensing

- Mobile mapping systems provide large area and high-density point clouds. However,

    1. Understory is too complex to detect and segment stems

    2. Irregular stem shape results in inaccurate stem volume

- Can we derive accurate single stem volume in complex temperate forests with mobile mapping point clouds?
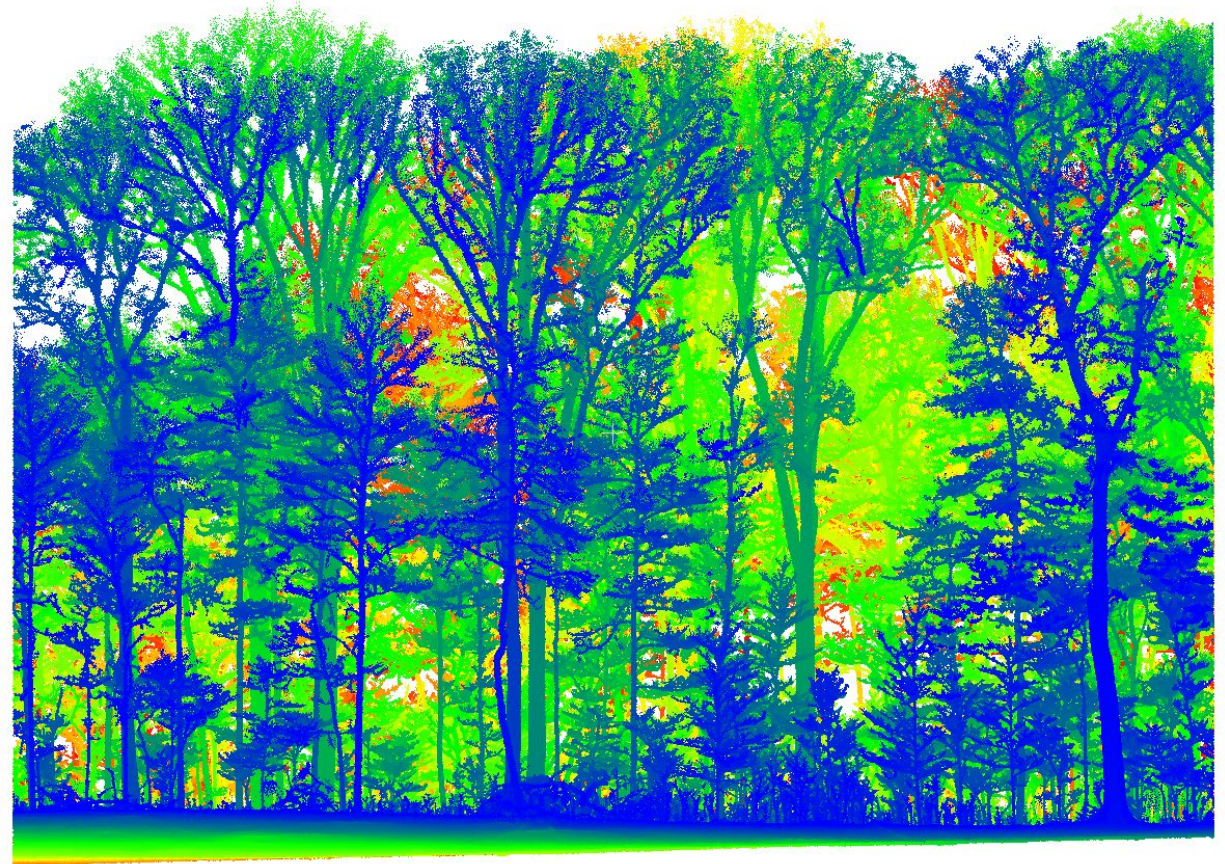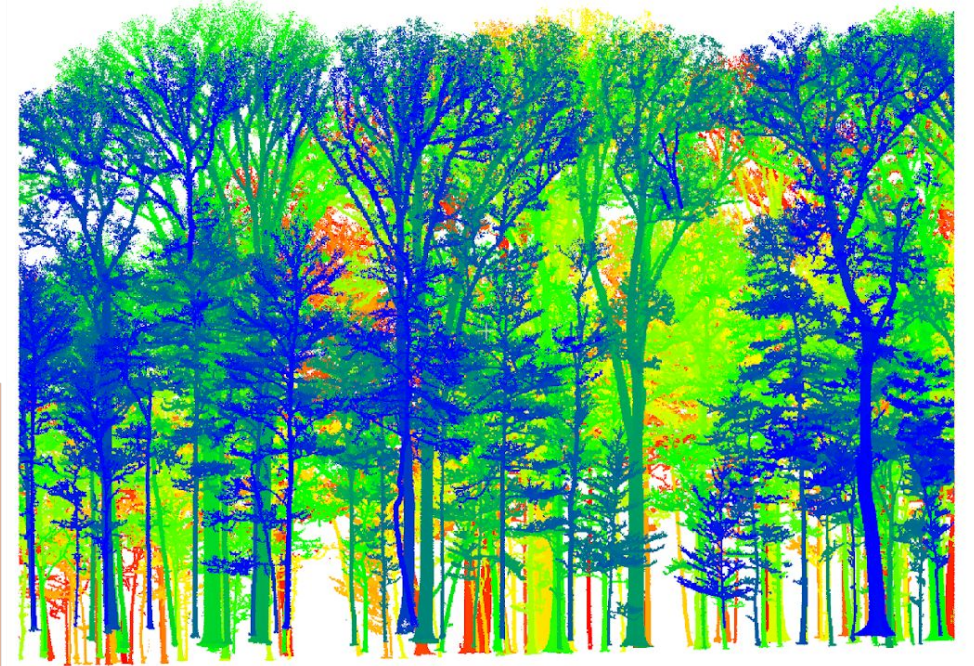
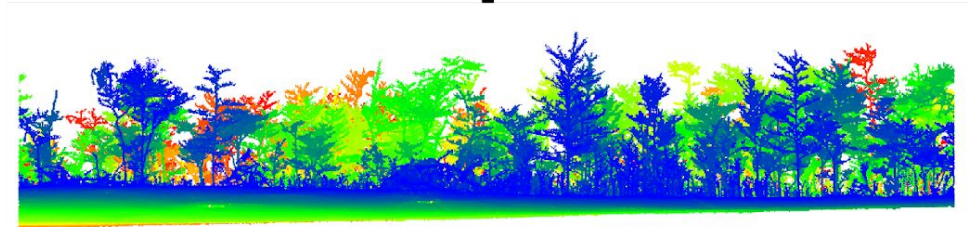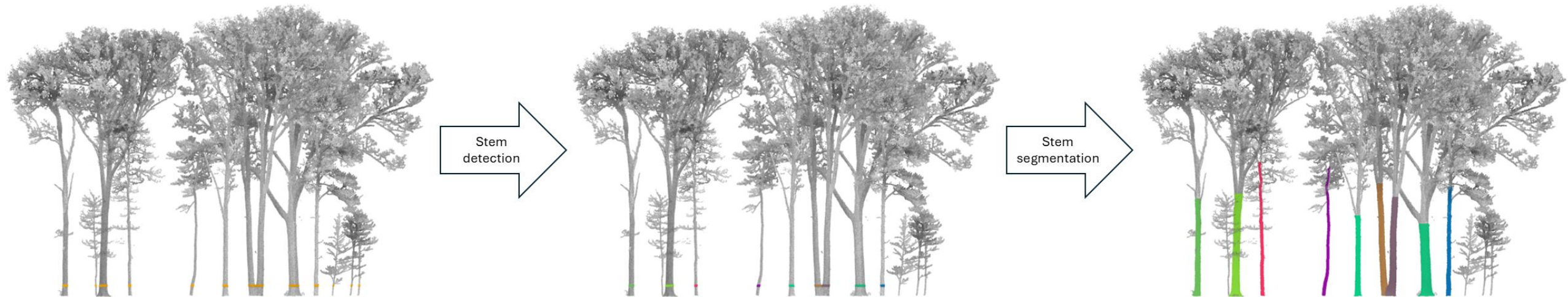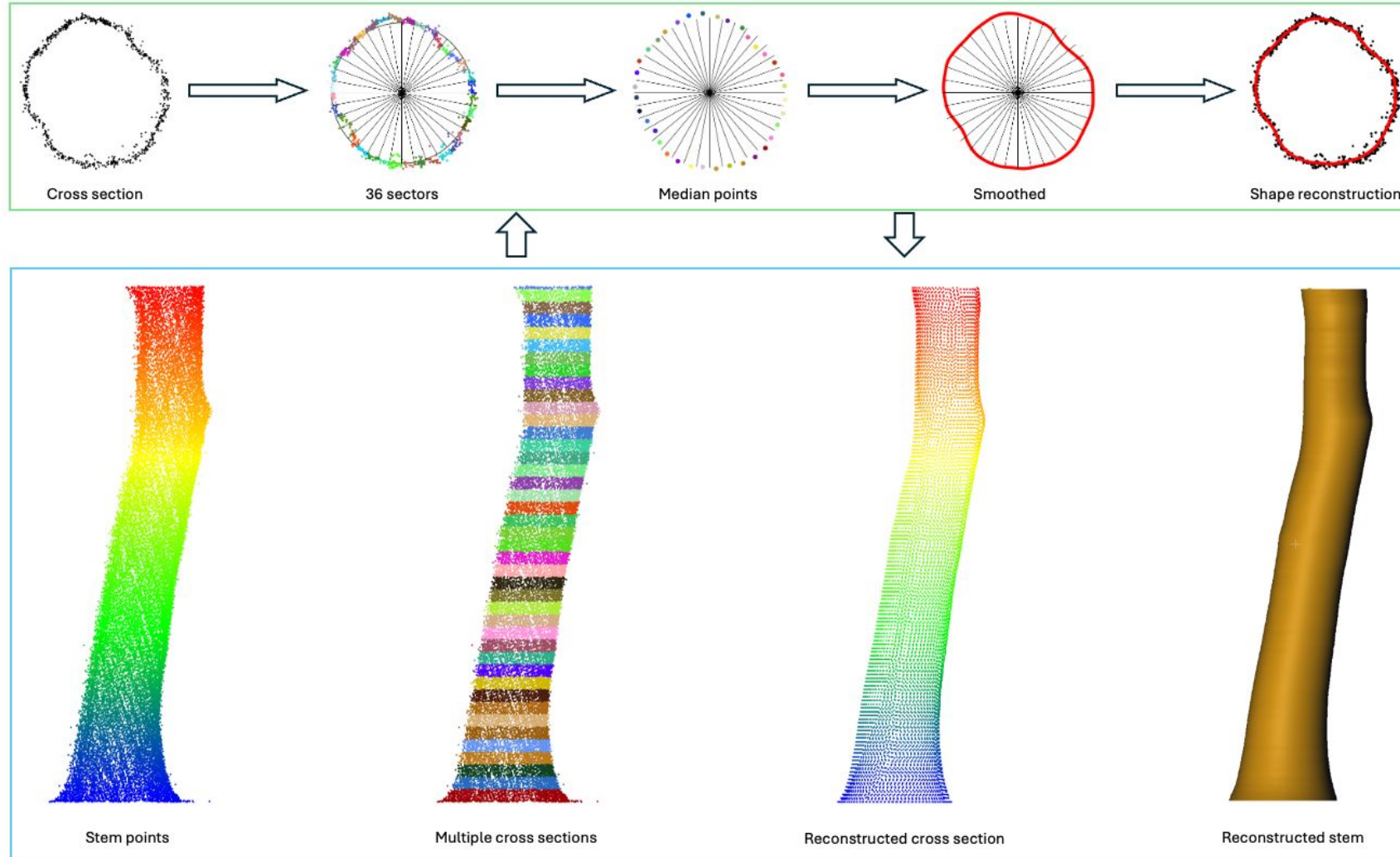## Deep learning for understory removal
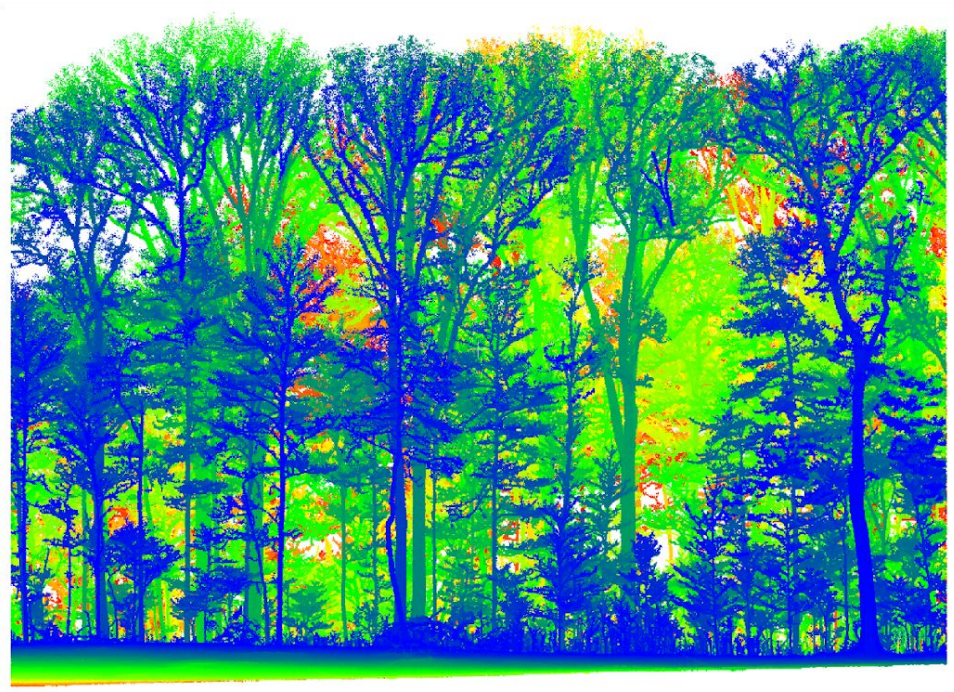
Methodology: stem detection and segmentation
Bidirectional Stem Growing (BSG)

Methodology: stem reconstruction

Sector Median Point (SMP)

Experiments

Datasets

Tab 1. Summary of the main characteristics for datasets used in this study.

|	Dataset I	Dataset II	Dataset III	Dataset IV
Country	US	US	Germany	Switzerland
Dominant species	Oak, walnut, elm	Maple and oak	European beech	European beech, fir
Area (m2)	32708	25584	11632	7843
# of trees	1443	454	407	160
Stem density	441	177	349	204
Understory complexity	315	235	130	877
Season	Leaf-off	Leaf-on	Leaf-off	Leaf-on
Mobile mapping system	Hovermap ST	Hovermap ST	ZEB Horizon	ZEB Revo RT
Average point density	11554	25033	4312	15777
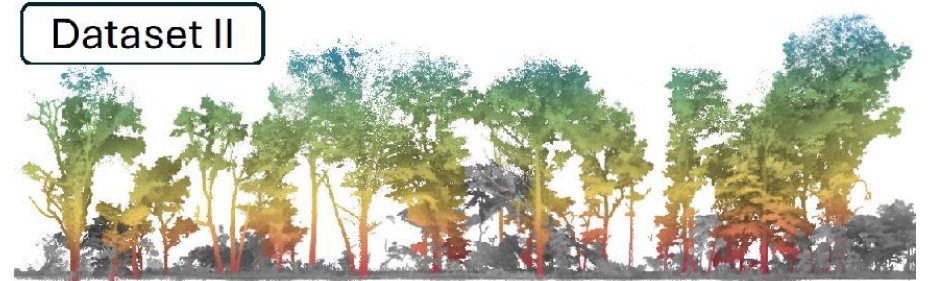
Experiments

Results

Tab 2. Stem detection accuracy on four datasets.

	Completeness	Correctness	Mean accuracy of detection
Dataset I	99.1%	100%	99.6%
Dataset II	98.2%	100%	98.7%
Dataset III	100%	100%	100%
Dataset IV	95%	100%	97.5%

Tab 3. Quality assessment of stem reconstruction.

	Earth mover's distance	Hausdorff distance	Chamfer distance
Dataset I	0.18	0.96	0.23
Dataset II	0.16	0.75	0.21
Dataset III	0.19	1.25	0.25
Dataset IV	0.15	0.74	0.21
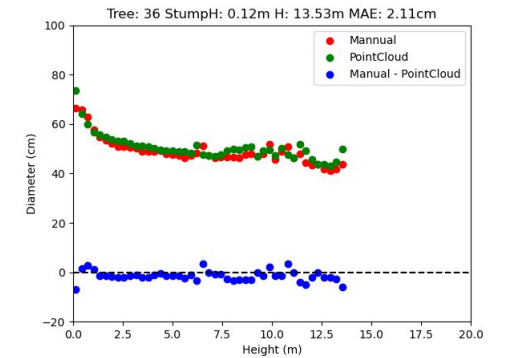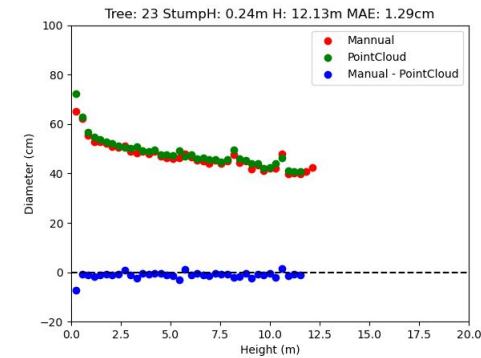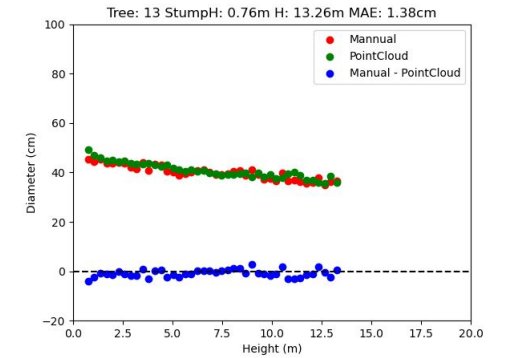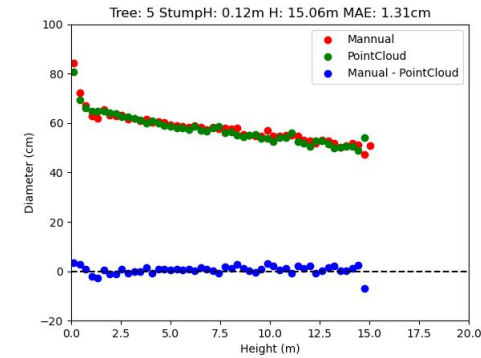
Conclusion

Stand-level single stem volume can be measured from mobile mapping point clouds
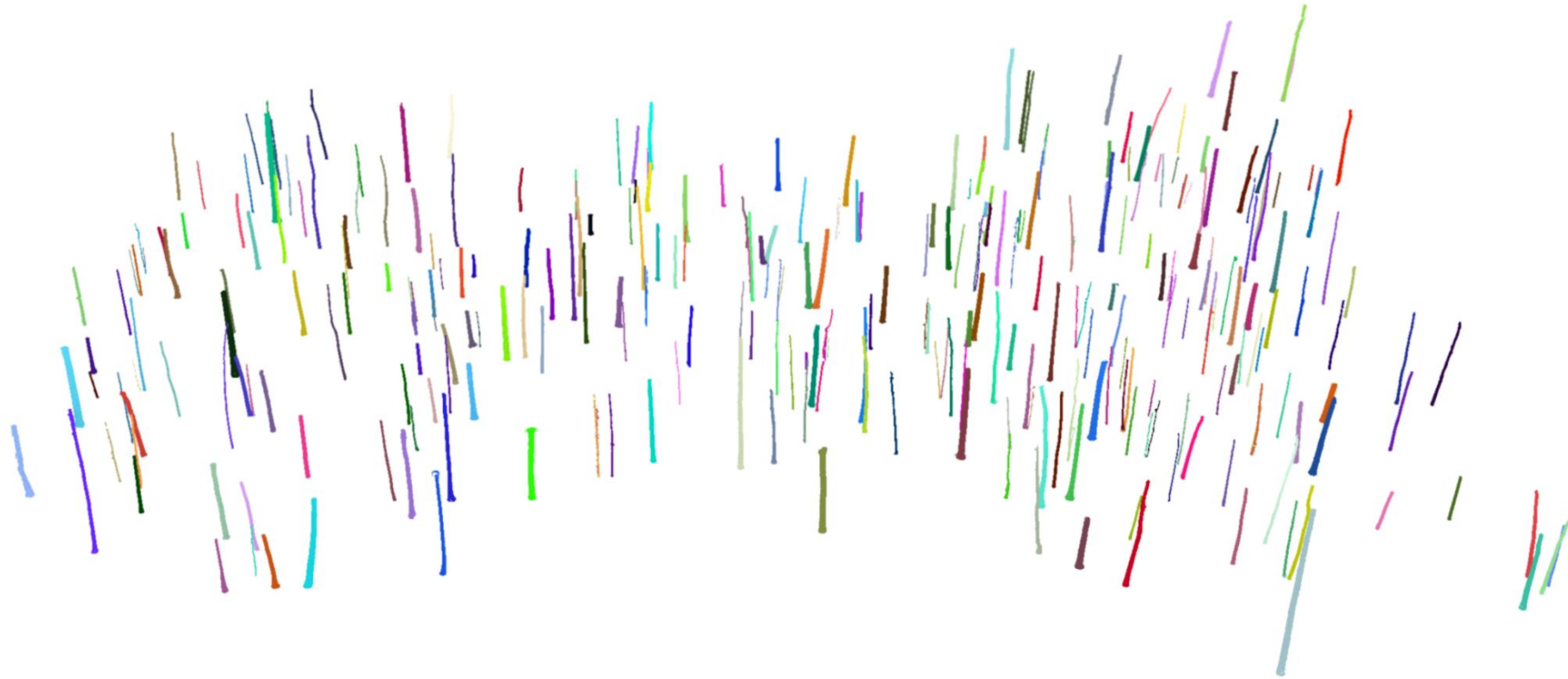
THANK YOU

Please reach out to jyshao@purdue.edu for more information.