



Forest Technology
Research Group

DETECTING AND VISUALIZING OLD LOGGING TRAILS FOR UPCOMING THINNING OPERATIONS

Omid Abdi, Jori Uusitalo, Veli-Pekka Kivinen & Ville Laamanen

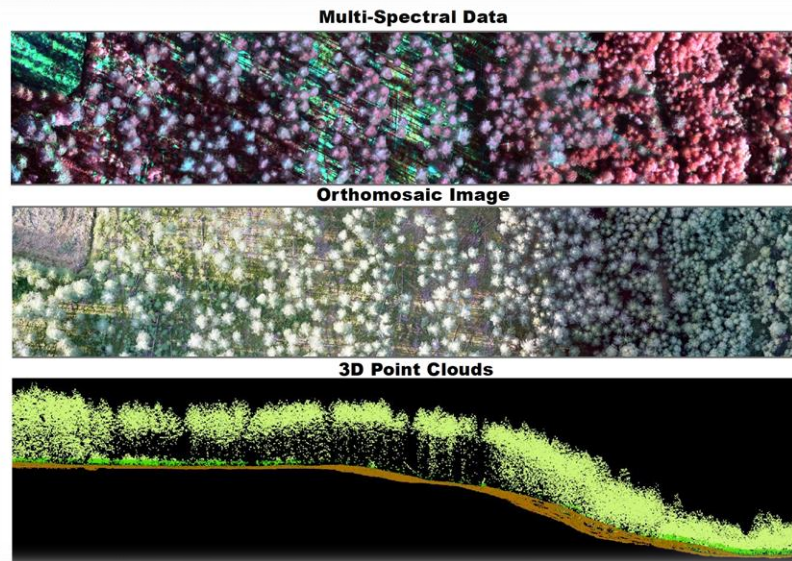


LUOMUHAKKUU-PROJECT

This work is part of the Luomuhakkuu-project that is funded by the NextGenerationEU -funds



**European unionin
rahoittama**
NextGenerationEU



Multi-Spectral Data

Orthomosaic Image

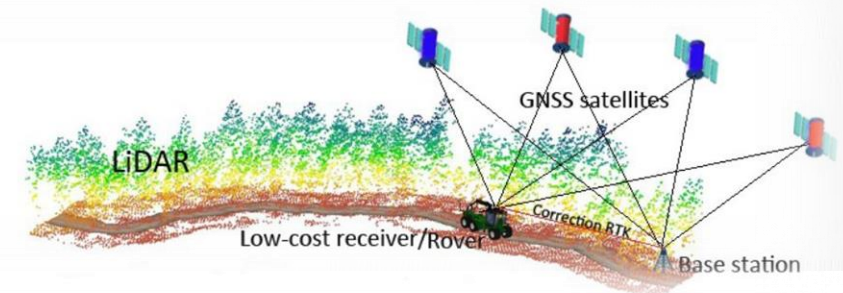
3D Point Clouds



Single tree detection



Forest simulation





THINNING OPERATIONS AND LOGGING TRAIL

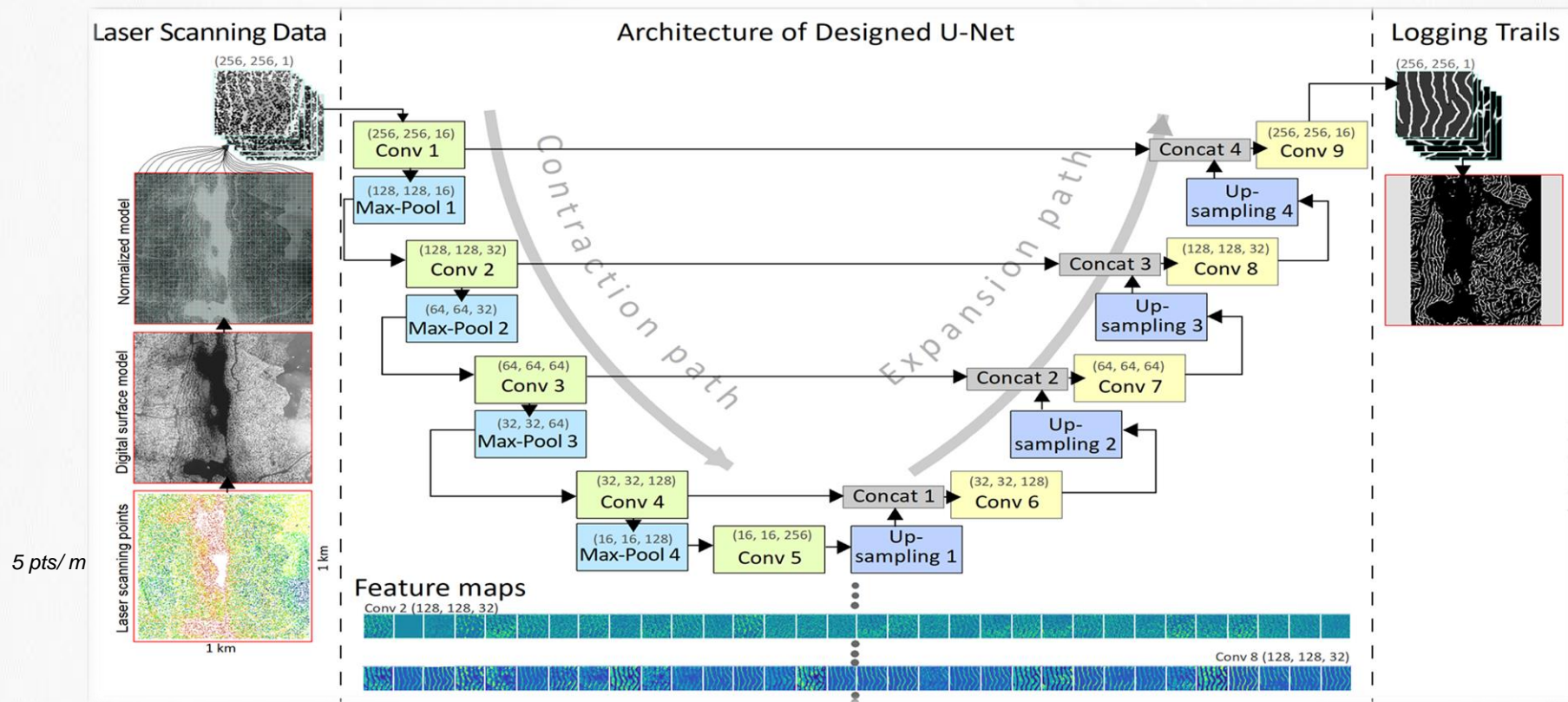
- Thinning Operations in RFM (Establishment, **Thinning**, and Final felling)
- Logging Trails in Thinning (First thinning, 4m width, 20m spacing)
- Challenges: Addressing Old Logging Trails (OLTs) Identification and Overthinning Concerns



Photo by Jori Uusitalo



OLT DETECTION USING UNET



Abdi, O.; Uusitalo, J.; Kivinen, V.-P. Logging Trail Segmentation via a Novel U-Net Convolutional Neural Network and High-Density Laser Scanning Data. Remote Sens. 2022, 14, 349. <https://doi.org/10.3390/rs14020349>



OPTIMIZING HARVESTER'S MAPS

- Evaluating Operator Proficiency: Assessing Operator Compliance with OLTs
- Optimizing Layer Updates: Enhancing Operator Efficiency through Layer Management



OptiMap, Ponsse (Background Layer, and Work Area Maps)



TEST SITES

- Metsä Forest harvesting operation on Finsilva owned site
- Pine –dominated stands
 - 40-50 years
 - Second thinning
 - Growing stock roughly 200 m³/ha
 - Mean stem size – dbh 19-21 cm
- Logging operation during the coldest period of the year (late February)
 - Peatland



Karvia site (Photo by Jori Uusitalo)



OLT-LAYERS AND ANCILLARY LAYERS

- KML files containing OLT layers were seamlessly integrated into the Ponsse Opti2 Map
- Background maps, including Terrain, CHM, and DSM, were incorporated as ancillary layers
- Operators underwent training to effectively utilize and switch between different layers within Opti2



Photo by Jori Uusitalo

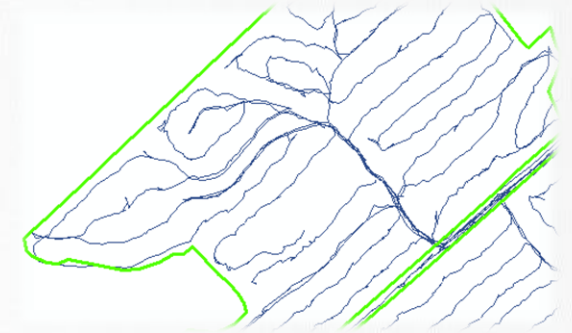


HARVESTER TRACES

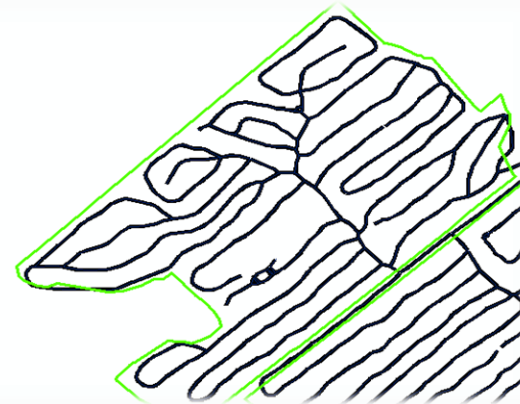
- Exporting harvester traces as shapefiles into GIS
- Smoothing the traces to find the centrelines of logging trails
- Assigning a width of 4 m as the area of logging trails



Traces in Opti2 (1)



Shapefiles (2)



Logging-trails area (4)

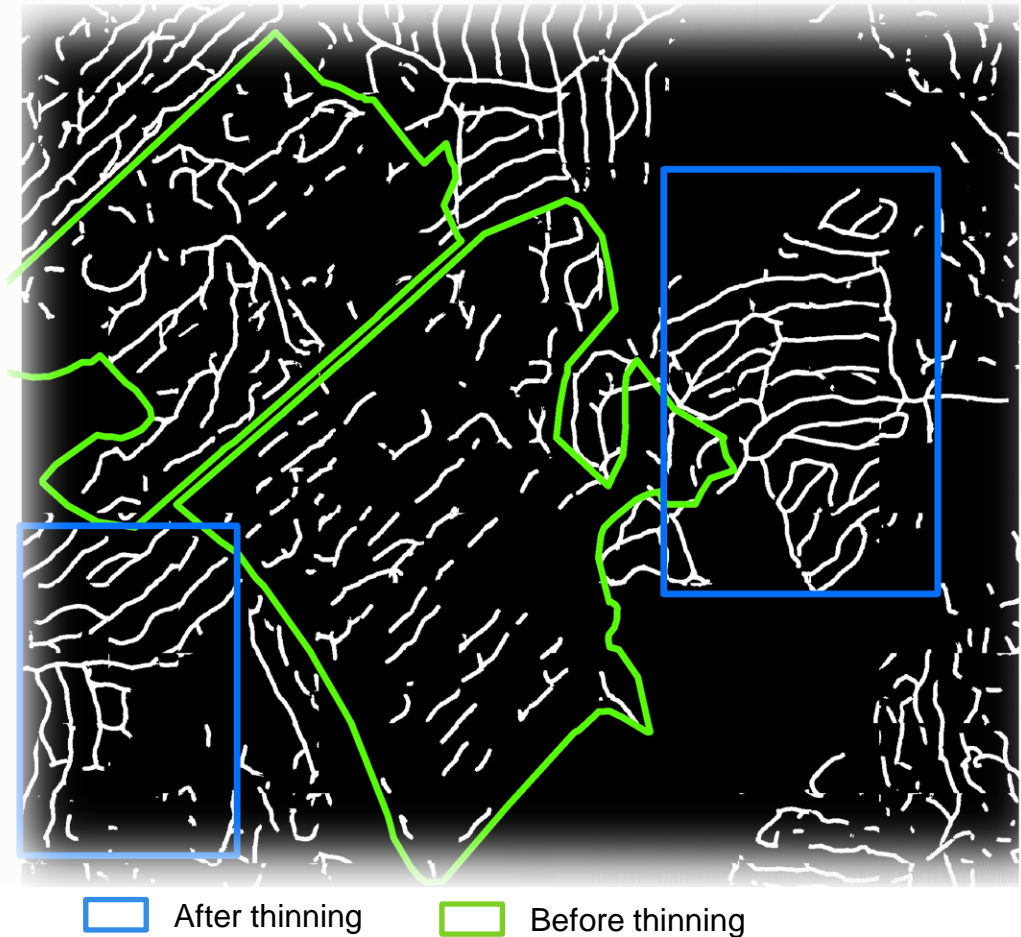


Centrelines (3)



OLT STATUS: BEFORE AND AFTER THINNING OPERATIONS

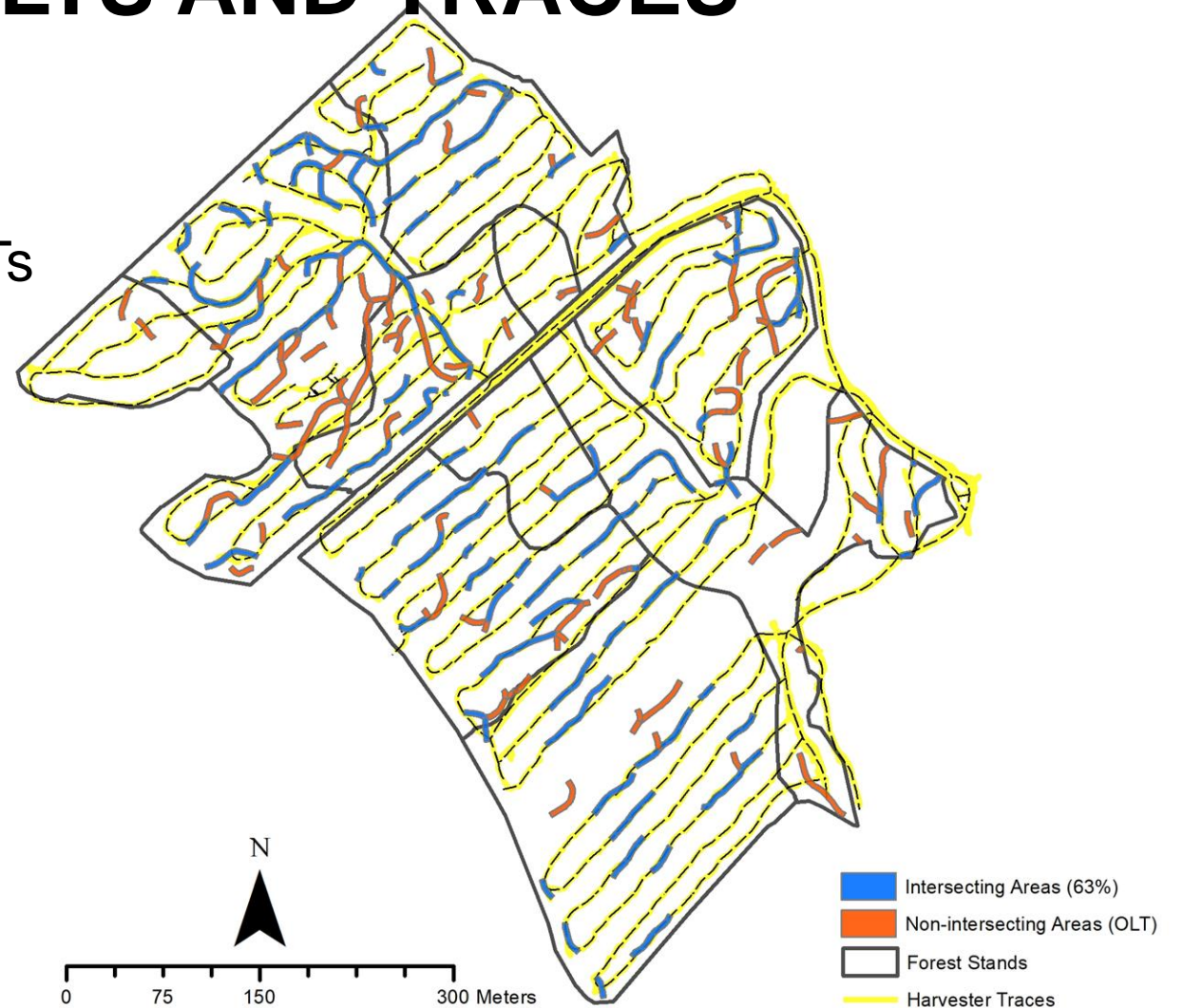
- Higher performance of our trained DL model in detecting OLT in stands that recently thinned
- Higher efficiency of OLT network in stands that have recently thinned
- Certain segments of OLTs are detected in mature stands that had not undergone thinning for an extended period

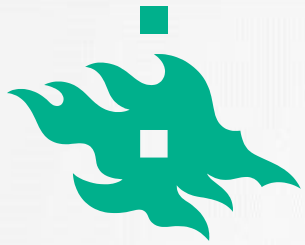




INTERSECTING OLTs AND TRACES

- Willingness of operators to trace OLTs was up 60%
- High intersecting areas in the stands with more efficient OLTs network
- Opti Map enhances tracing logging trails more accurately





OUTLOOK

- Explore the importance of map layers, regarding operator's perspectives
- Training operators with simulators updated with super resolution real forest environment map layers



Terrain



CHM



Ponsse Simulator