NLS
NATIONAL
LAND SURVEY
OF FINLAND

Increasing spatial data accuracy in Finland using Artificial Intelligence

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Outlines

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- The ATMU project
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AI Team







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Education background: Master and Doctoral degrees in Computer science and Geomatics

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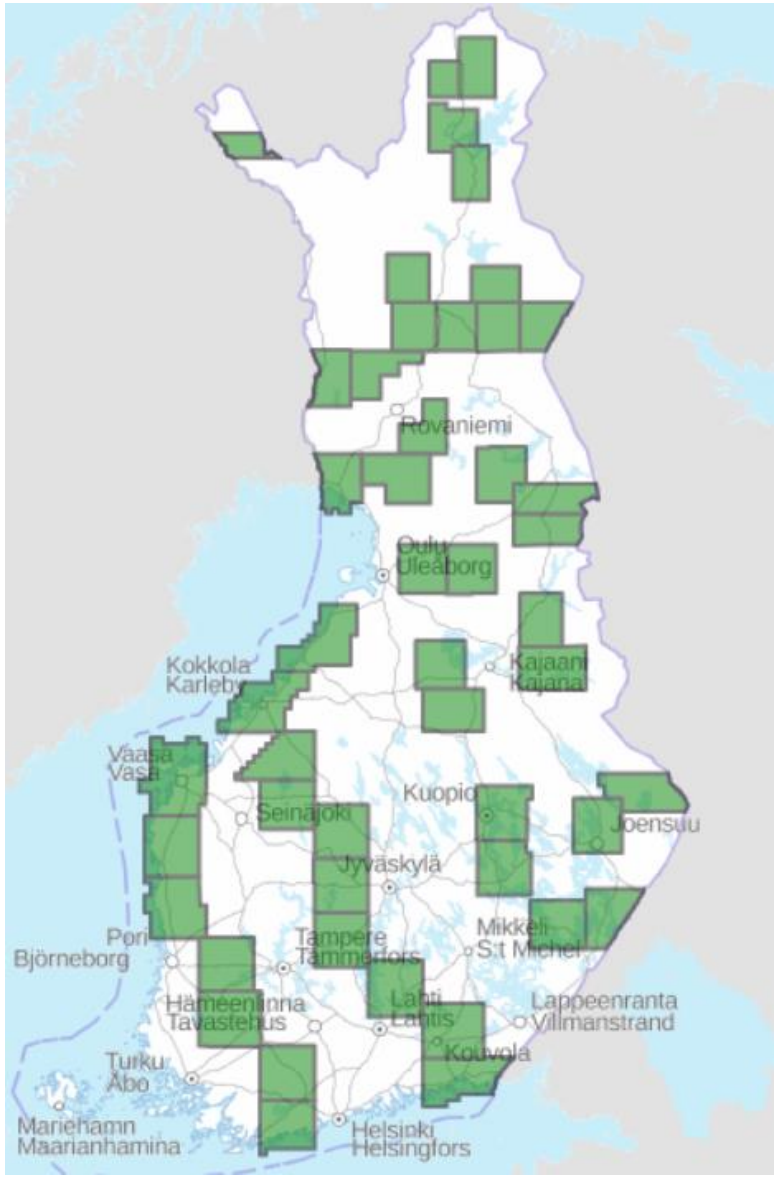
Finland

- **Area**: 338 440 km²
- **National Land Survey of Finland** (NLS)
  - **Aerial imaging programme**: 1/3 of the country annually
  - **Lidar programme**: 1/6 of the country annually
  - **Change updating**: 100 human forces annually



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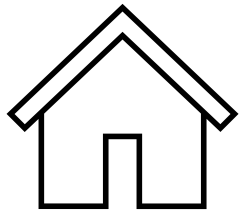
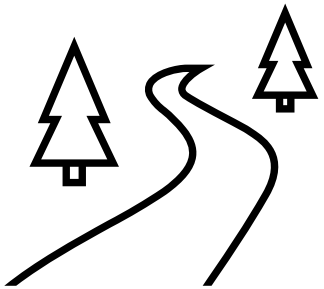
The ATMU project
--- Introduction

- The Advanced Technology for topographic Map Updating (ATMU) project employed deep learning technology for object detection and change recognition



Convolutional neural network
Transfer learning

Building detection and change recognition



Convolutional neural network
Multitask learning

Road detection and change recognition

Convolutional neural network

Watercourse detection

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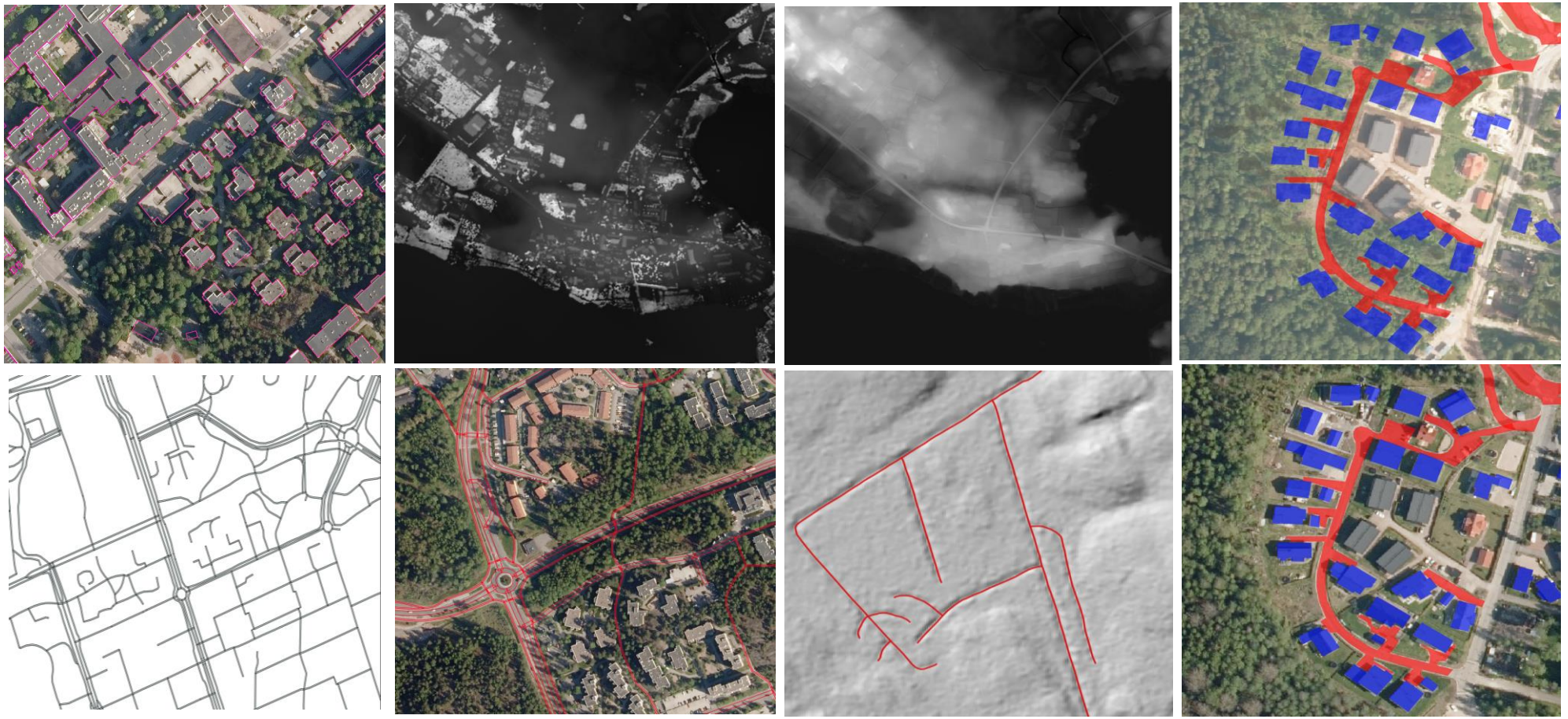
The ATMU project

--- Training datasets



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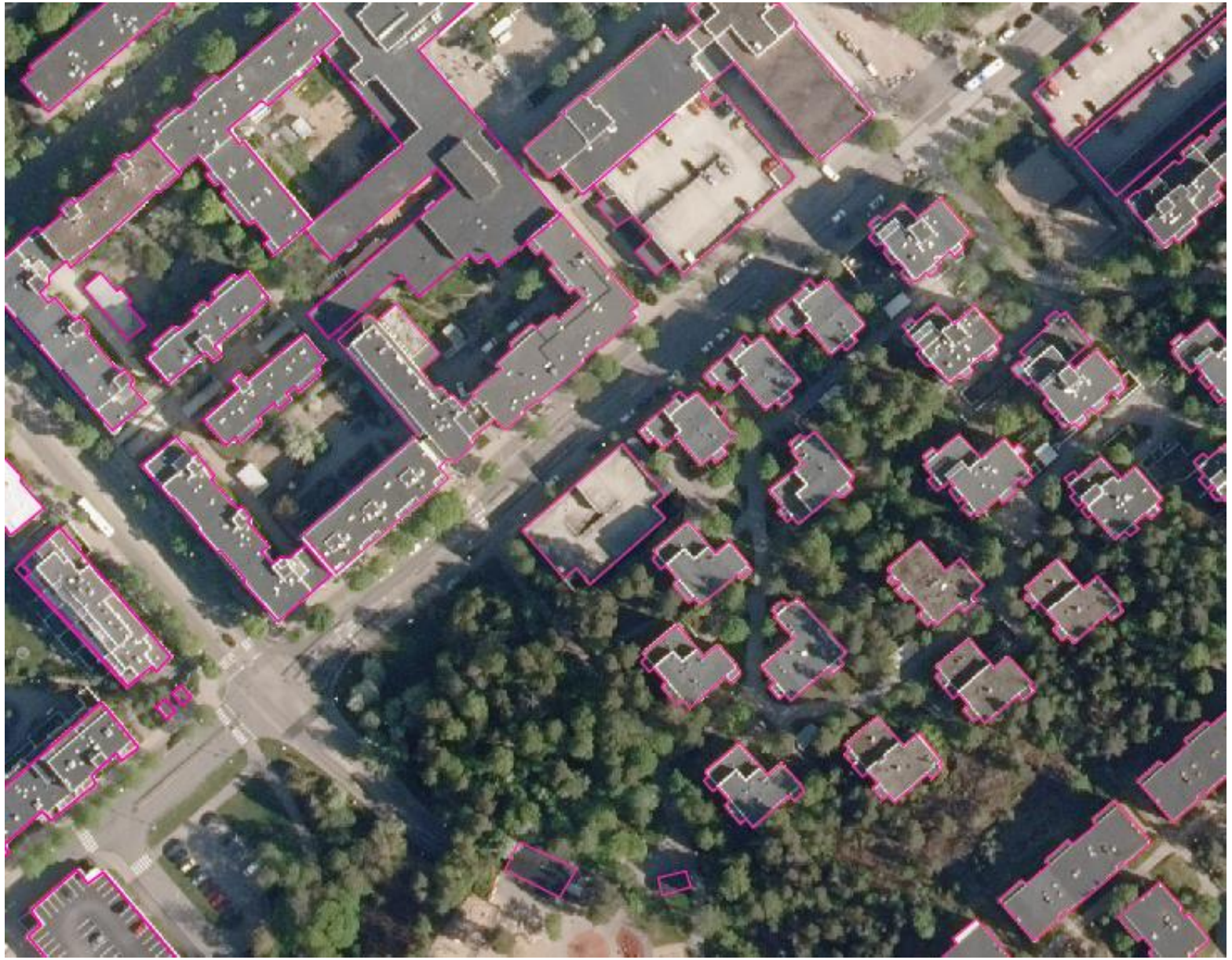
The training data for building detection



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The ATMU project

--- Deep learning technologies

Building detection

UNet model

Input data
True orthophotos
Building vectors
DEM and DSM

Output data
Building outlines

Expert evaluation (Yes)

Road detection

RoadVecNet model

Input data
Orthophotos/True orthophotos
Road vectors

Output data
Road edges
Road surfaces

Expert evaluation (Yes)

Watercourse detection

UNet model

Input data
0.5m Lidar-DEM
Watercourse vectors

Output data
Segmented watercourses

Expert evaluation(No)

Change recognition

NestNet2 model

Input data
True orthophotos
Labels with changed areas

Output data
Polygons of changed areas

Expert evaluation(Yes)

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The ATMU project

--- Results: building detection

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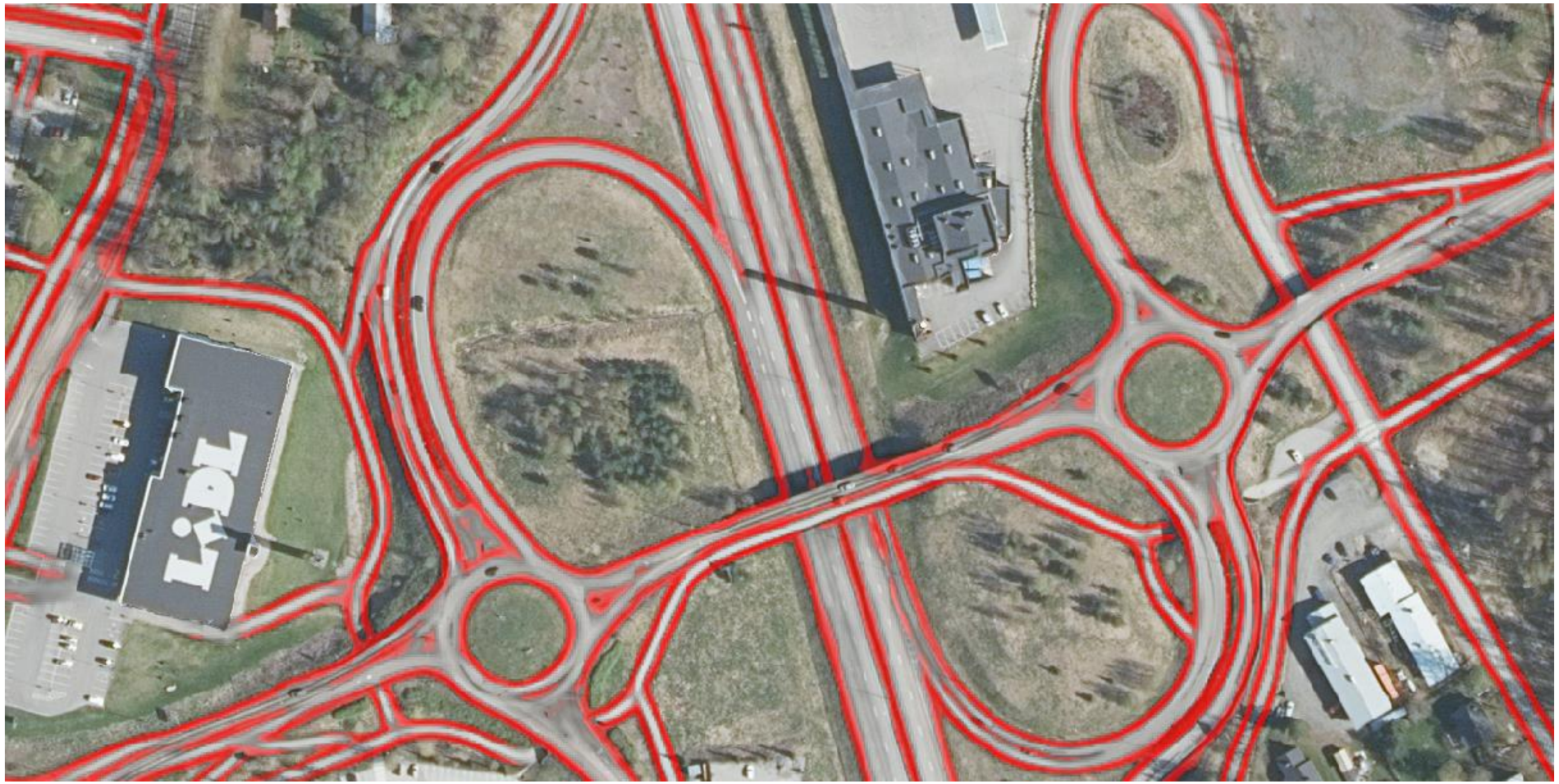
The ATMU project

--- Results: Road detection



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The ATMU project

--- Results: Road detection with multitask learning technique

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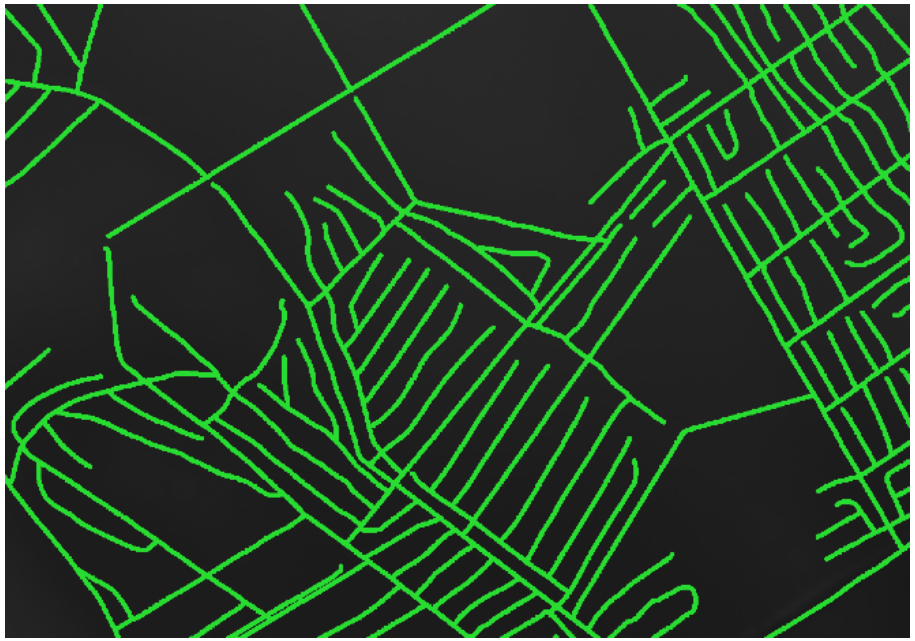
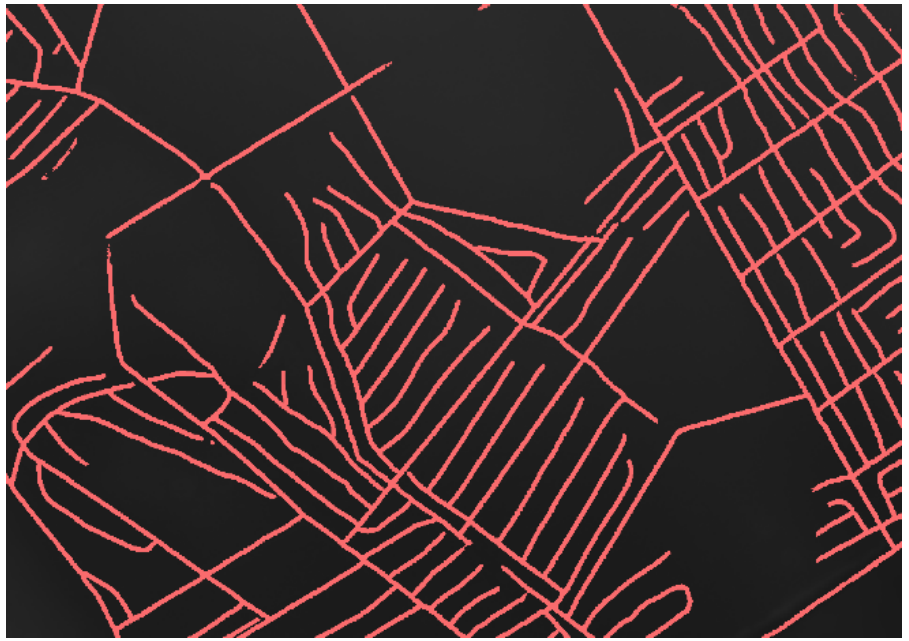
The ATMU project

--- Results: Watercourse detection





Left: Labels

Right: Prediction from UNet

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The ATMU project

--- Results: Change recogntion

2015 true orthophoto

2020 true orthophoto

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The ATMU project

--- Results evaluation for building detection

- Laajasalo island, Helsinki, covering an area about 17.5 km2
- Compared to different reference data such as national topographic data, Helsinki city's open building database, RHR symbols, Lidar data…
- Accuracy was up to 97.9%

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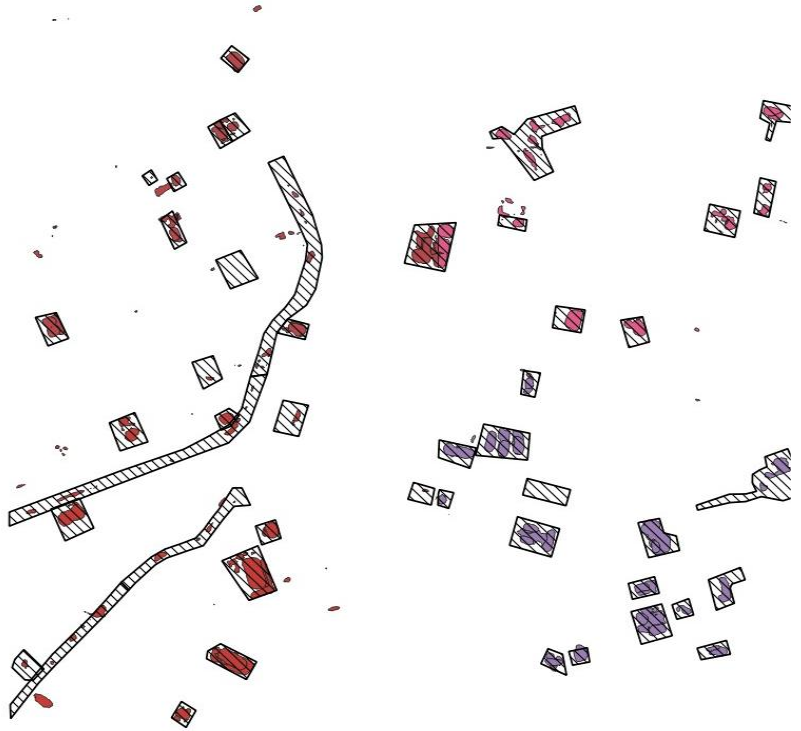
The ATMU project

--- Results evaluation for change recognition (96% changes found)

2015 true orthophoto

2020 true orthophoto



Detected changes vs reference data

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Outcomes

- 100,000+ km2 true orthophotos were produced during the project
- The UNet model for building detection has been trained with datasets from 20 production areas (each area covers about 3000 km2)
- With the expert evaluation, building detection method has reached an accuracy level (up to 97.9%) for practical application
- Road detection method was very promising although there was no quantative accuracy result
- For change detection, 96% of change areas were found according to the expert evaluation
- The project has made high-quality training data for building detection publicly available
- Three Master theses had been completed during the project

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Next AI project: the AI4TDB project

- Enhance the accuracy of topographic database by using the AI (AI4TDB)
- To utilize the trained UNet model from the ATMU project to make prediction of buildings from true orthophotos
- To employ the predicted buildings as references
- To improve the positional accuracy of building vectors from topographic database
- To continue developing the watercourse detection using the AI method

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Thank you for your attention!

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Advancing together

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