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Volunteering for the future – Geospatial excellence for a better living

Application of AI tools to the inventory of technical and transportation infrastructure based on UAV data

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Presentation schedule

- Some words about the research project
- Methodology
- Experiments and results
- Conclusions

About the research project

R&D works in inventory and modelling of key technical and transport infrastructure objects in BIM technology using AI tools in the process of drone data processing

Faculty of Geodesy and Cartography
WARSAW UNIVERSITY OF TECHNOLOGY

skysnap

The National Centre for Research and Development

Project ID: POIR.01.01.01-00-0980/20

About the research project

MAIN GOAL:

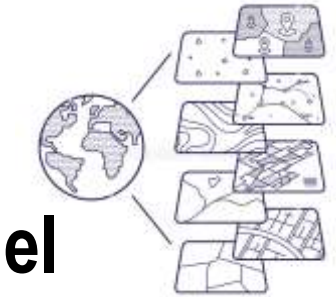
AI tools for inventory and modelling key technical and transportation infrastructure objects

Real World

UAVs

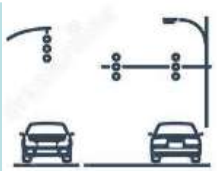
AI

BIM



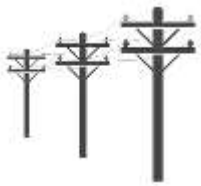
GIS World Model

Methodology for corridor objects recognition

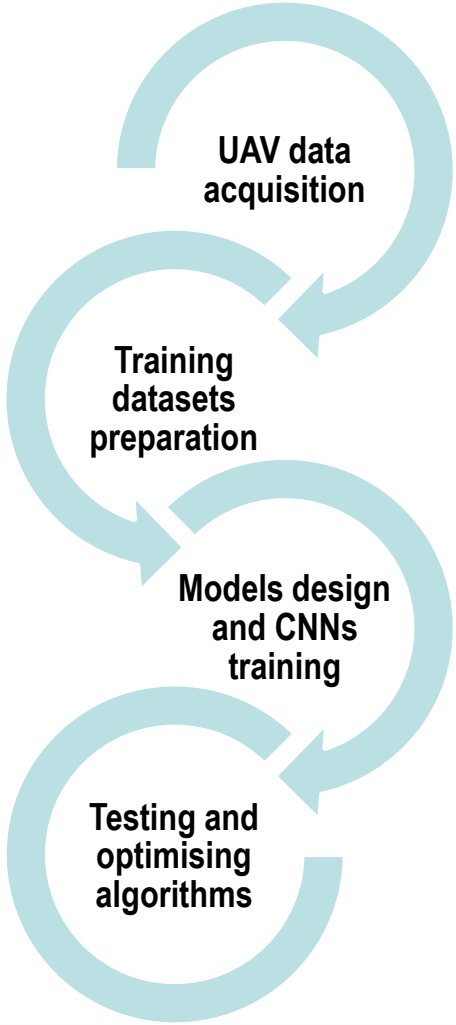


- Streetlamps
- Executed ground works and heaps
- Construction layers (aggregate and asphalt/concrete layers)

- Rail sleepers
- Railway track
- Traction network

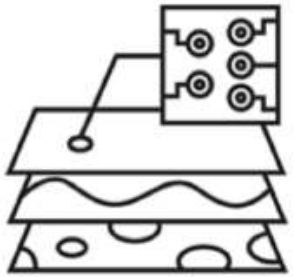


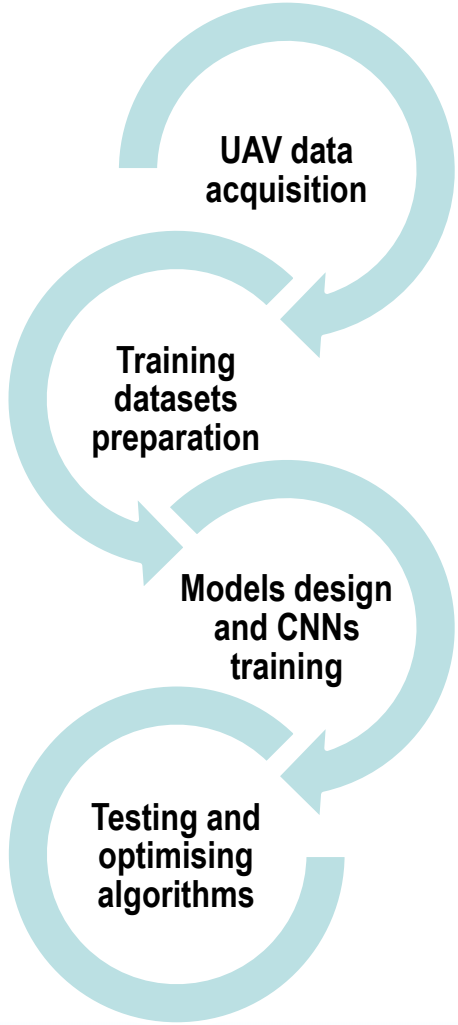
- Executed ground works and heaps
- Power poles
- Powerlines



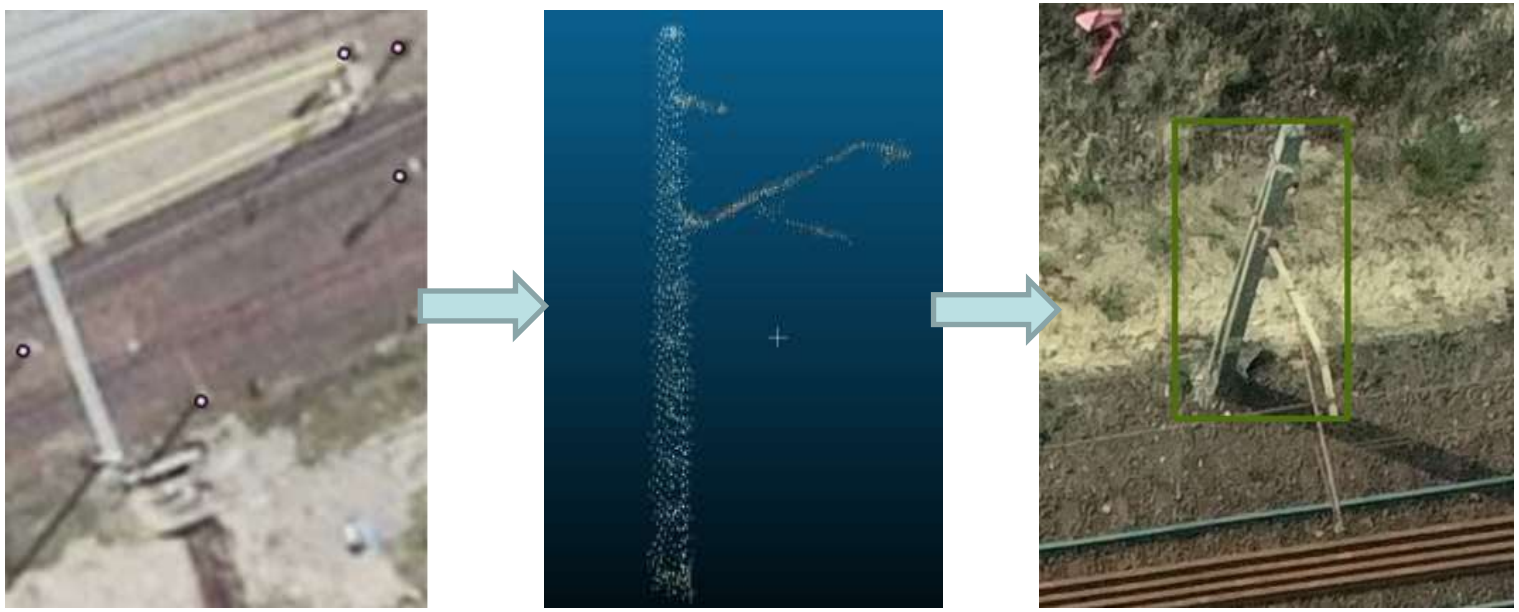
Methodology for corridor objects recognition

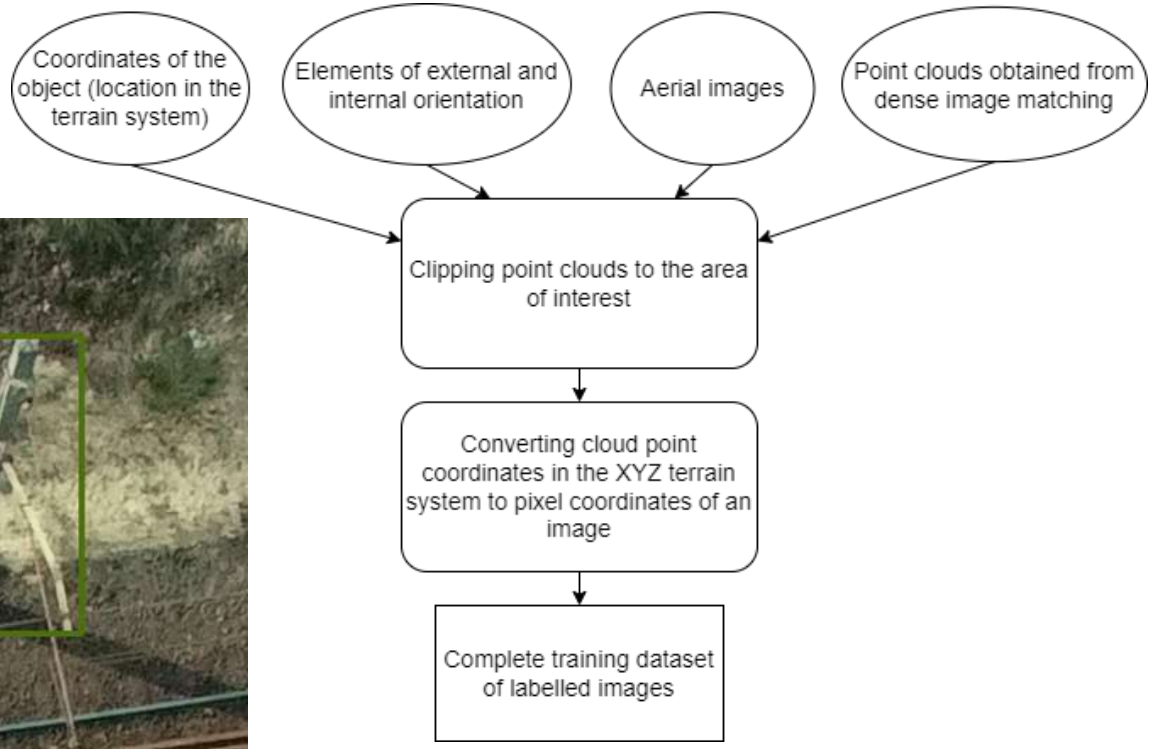
UAV data/photogrammetric product	Neural network operation
• Images • Orthophotomaps • Point clouds from DIM • LiDAR point clouds	• Detection • Semantic Segmentation • Instance Segmentation





Preparation of training datasets





Examples from a training dataset on a traction pole example using a methodology to automate training data preparation.

Detection of traction poles and sleepers on orthophotomaps

RetinaNet architecture with the ResNet-50 backbone network

First approach:
93.3% accuracy on the validation set for the railroad sleeper class;
50.0% accuracy for the traction pole class.

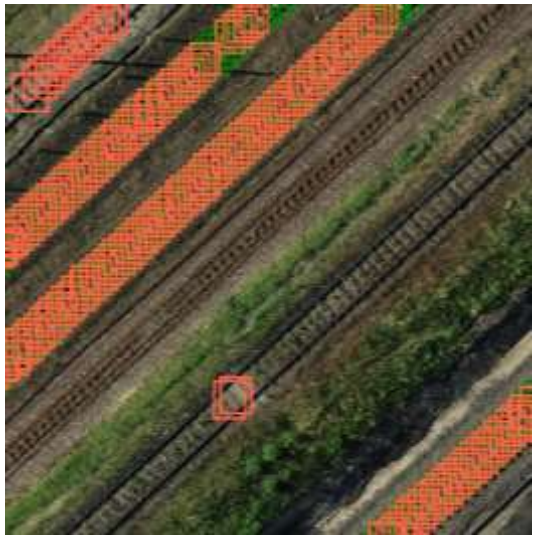
Detection of traction poles and sleepers on orthophotomaps

Changes in the approach:

- Included data augmentation (scale, rotation, and colour augmentation)
- Detection of high elements, such as traction masts, or in the other part of the project, streetlamps will be done based on georeferenced images or in point clouds
- Use a more significant number of more diverse data

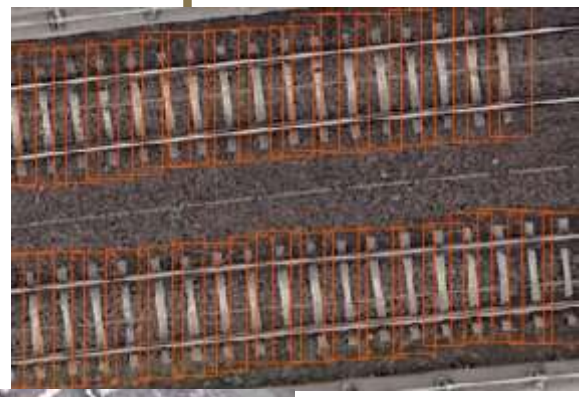
Parameter	Value
Recall	92.10%
Precision	82.80%
F1 score	86.60%

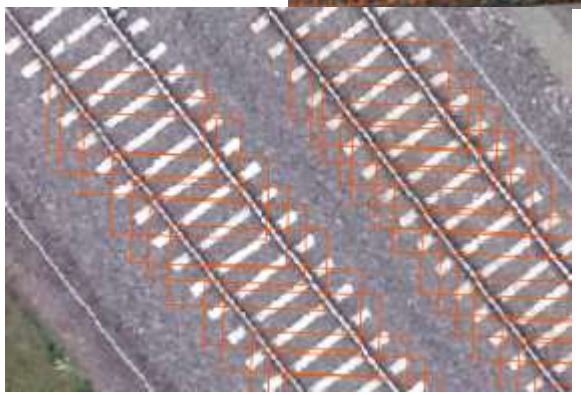




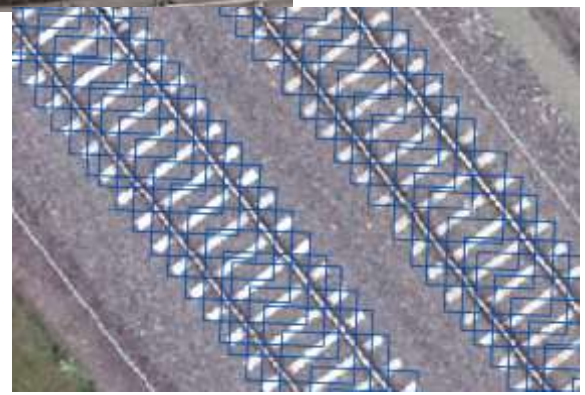
Results after added augmentation methods and more training examples for the rail sleepers detection model for the test dataset.

Detection of traction poles and sleepers on orthophotomaps





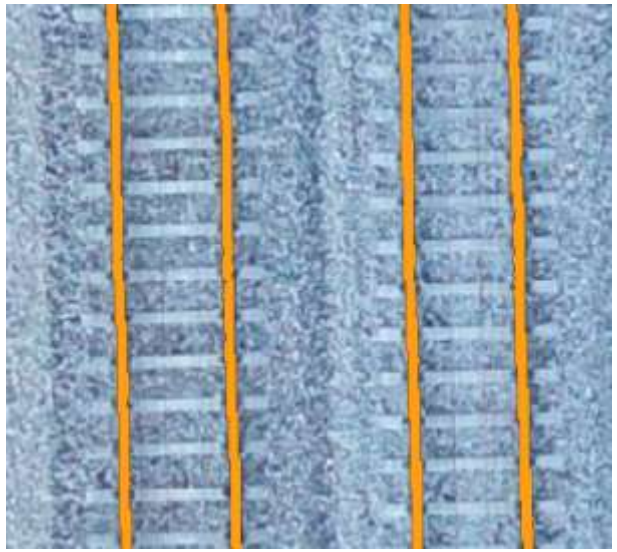
The result from the first training of the sleeper detection model



The model prediction results with added data augmentation and more training examples for the rail sleepers

Segmentation of railway tracks on orthophotomaps

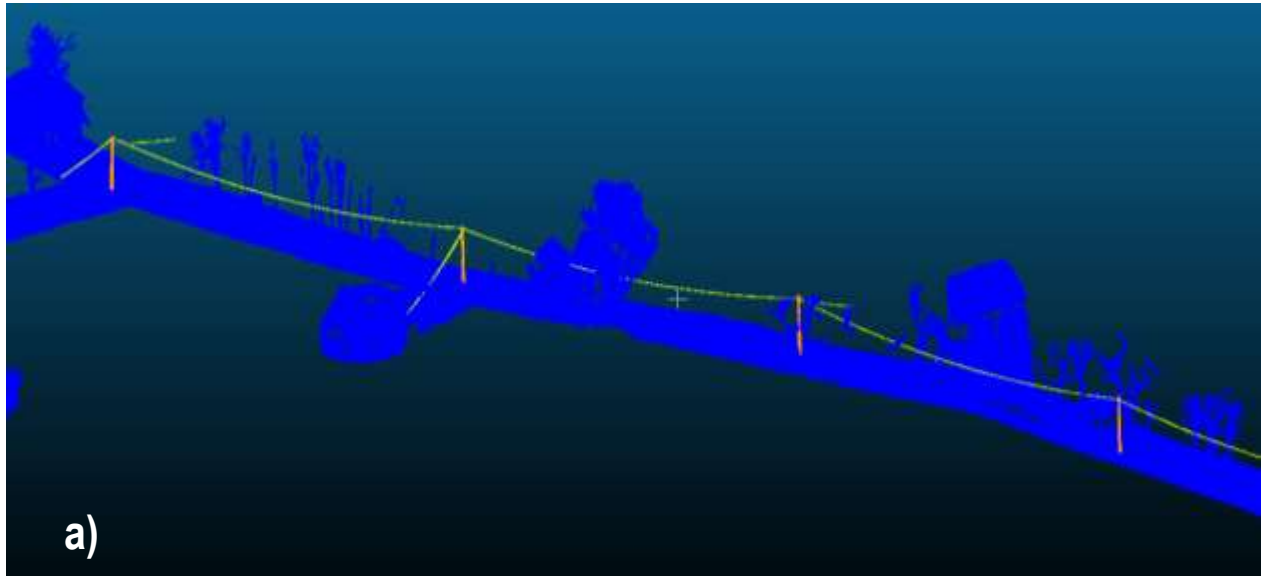


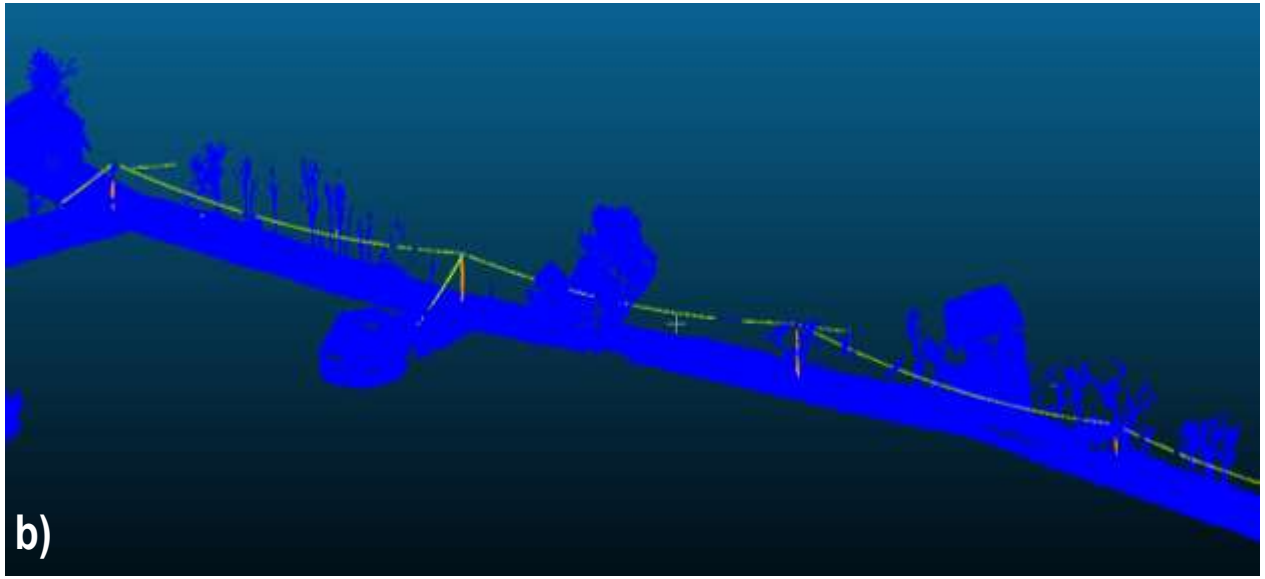



Segmentation results on different data from test datasets.

Achieved accuracy: 87%

Point Cloud Segmentation (model with RGB features)



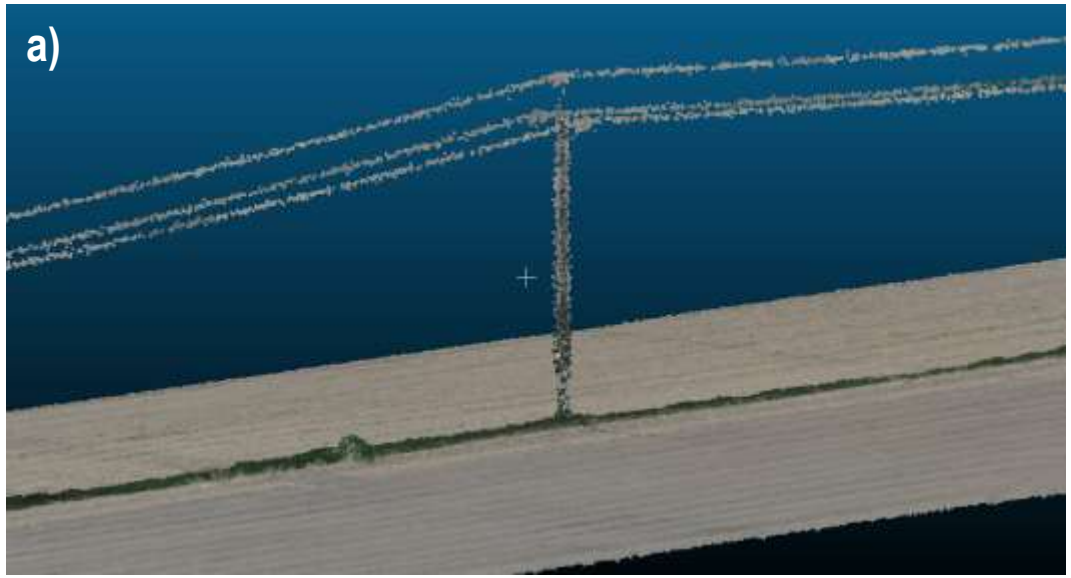


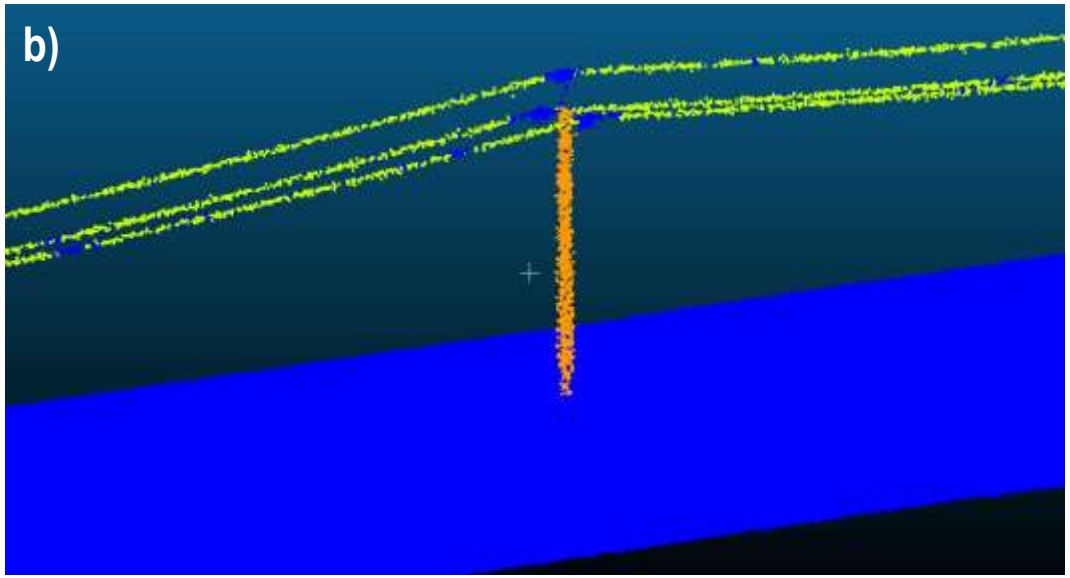
An example of the model output from the 3D point cloud segmentation approach (**power lines and power poles**).

a) ground truth point cloud from DIM, b) model result.

Parameter	Value
Recall	66%
Precision	100%
F1 score	80%

Point Cloud Segmentation (model without RGB features)



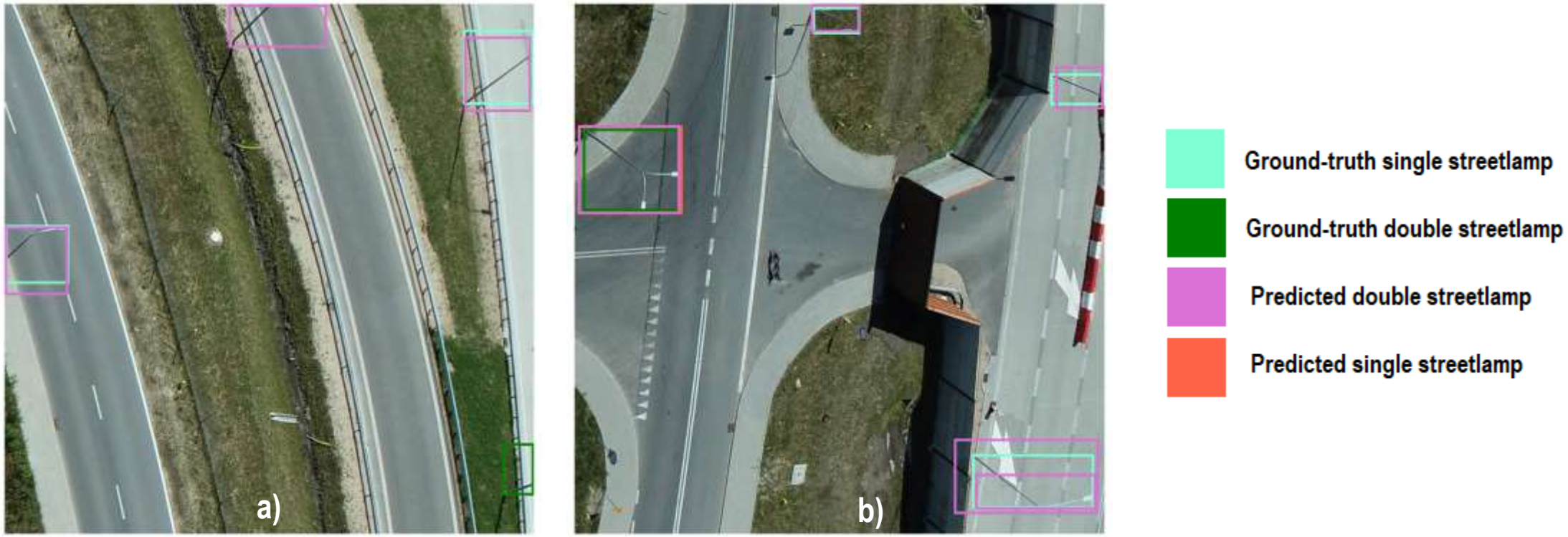


An example of the model output from the 3D point cloud segmentation approach (**power lines and power poles**).

a) source point cloud from LiDAR, b) model result.

Parameter	Value
Recall	66%
Precision	66%
F1 score	66%

Detection of streetlamps on images (under development)



Examples of detection results from a) validation set and b) test set for streetlamps.

Conclusions

- Initial experiments show that there is a great potential to obtain accuracy close to 90% on an independent test set, however, the results are very dependent on the number and representativeness of the training set
- The project demonstrates the potential of using AI methods in the inventory and modelling of technical and transport infrastructure objects
- Using proposed solutions accelerates the processing of data and reduces the workload
- The approach developed in the project enables the automation of data processing, acceleration of advanced analysis, and increased control over the construction process in a construction project lifecycle

Thanks for your attention

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