Multi-sensor rail track detection in automatic train operations

Master's thesis in Data Science

Student: Attila Kovacs

1st Advisor: Lukas Rohatsch (FH Technikum)

2nd Advisor: Daniele Capriotti (M2C Expert Control GmbH)

Alignment: 15.03.2024

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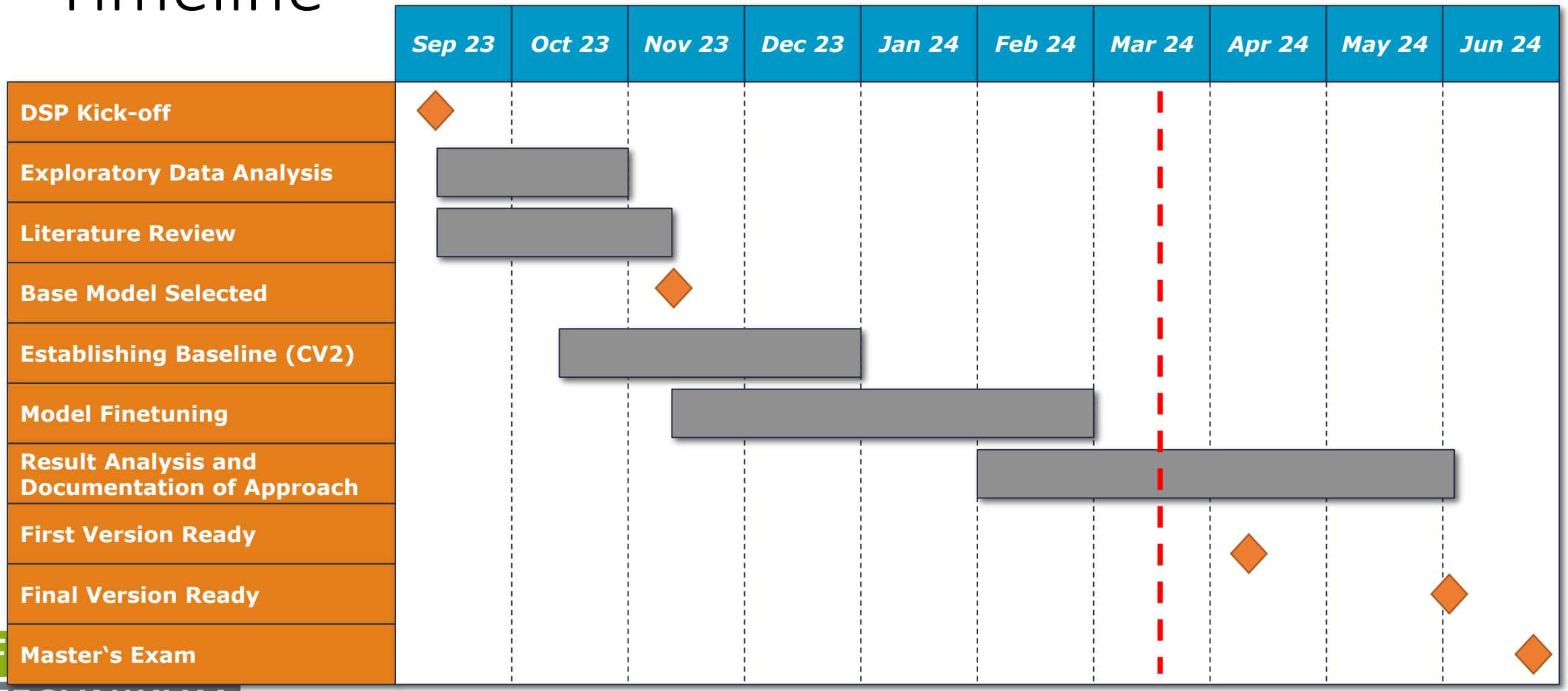
Outline

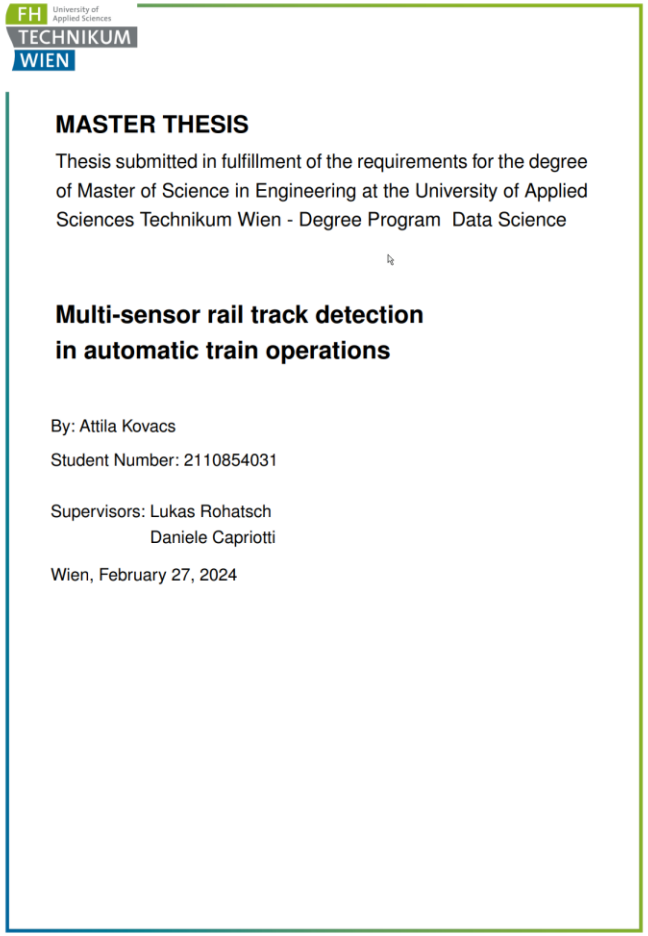
- Time plan
- Writing thesis
- New labeling approach
- Isolating tracks as polylines

Timeline



Writing thesis

~ 5000 words



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MASTER THESIS

Thesis submitted in fulfillment of the requirements for the degree of Master of Science in Engineering at the University of Applied Sciences Technikum Wien - Degree Program Data Science

Multi-sensor rail track detection in automatic train operations

By: Attila Kovacs

Student Number: 2110854031

Supervisors: Lukas Rohatsch
Daniele Capriotti

Wien, February 27, 2024

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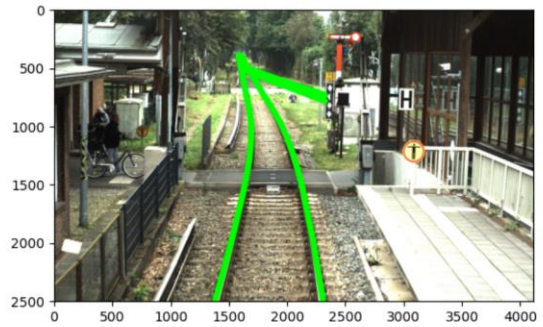
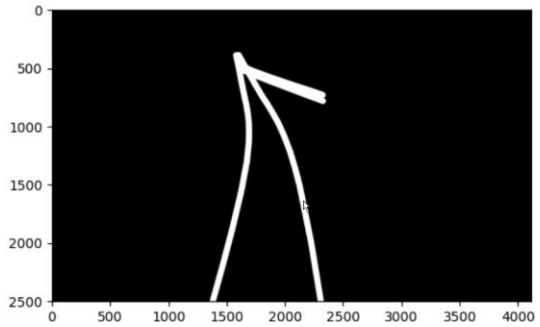
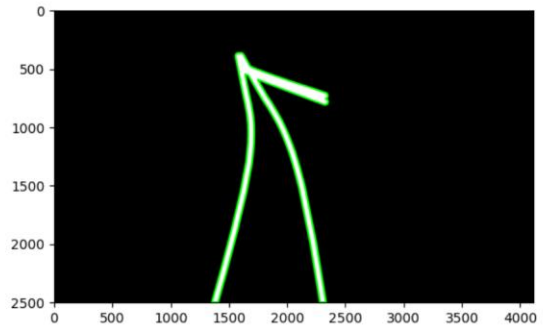
Labeling approach



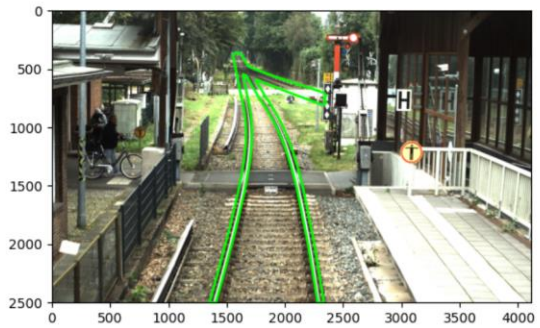
(a) Estimate thickness of such that the lines cover the tracks.



(b) Create mask (i.e., binary mapping of track labels and background).



(c) Extract contour of track label (see green boundary in mask).



(d) Polygon is enclosing the region of interest.

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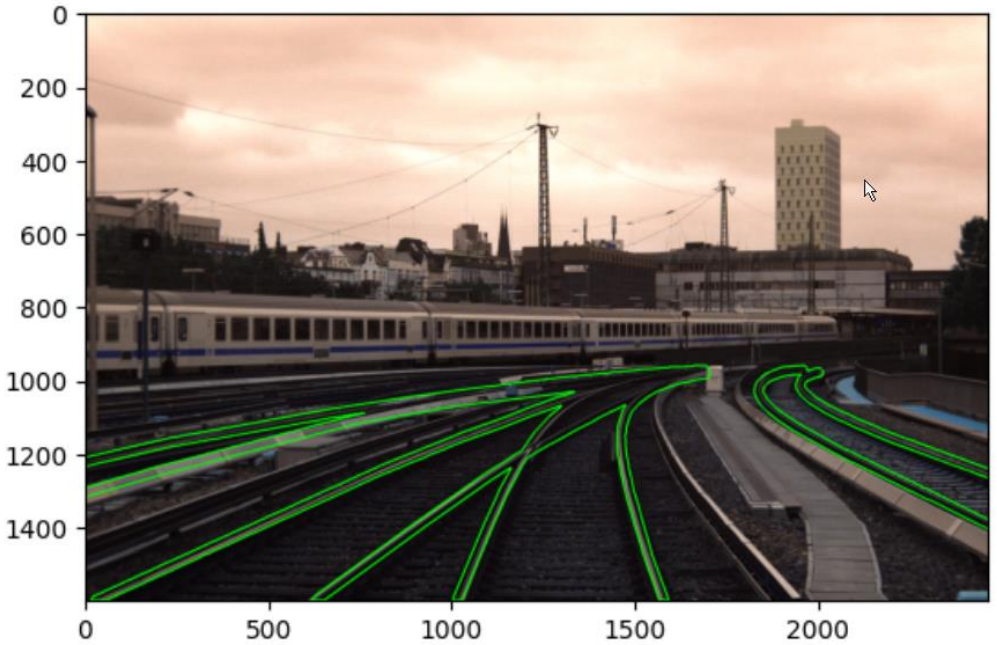
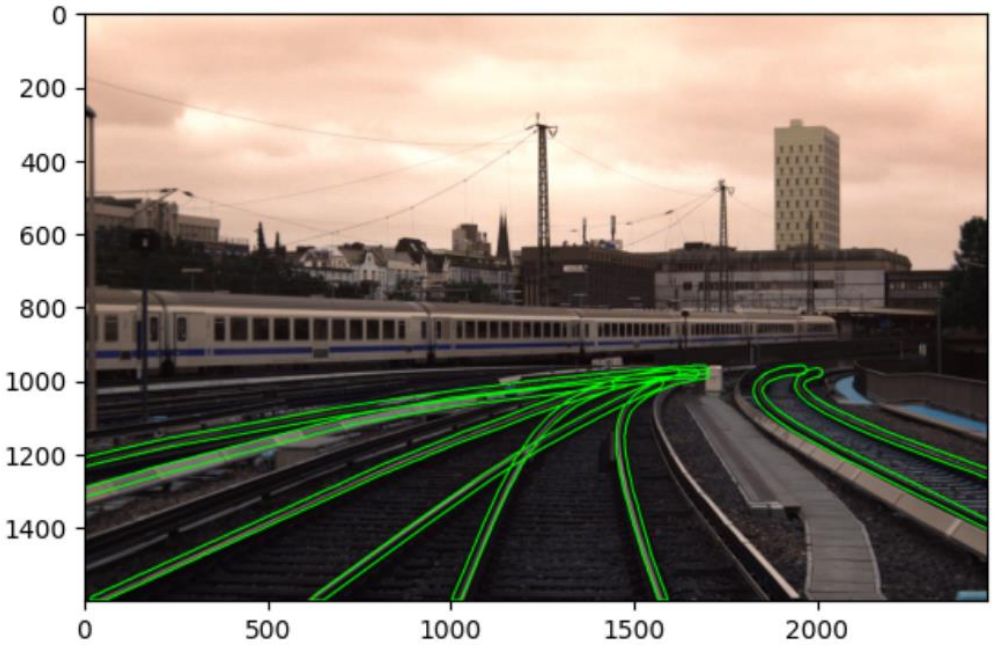
Labeling approach





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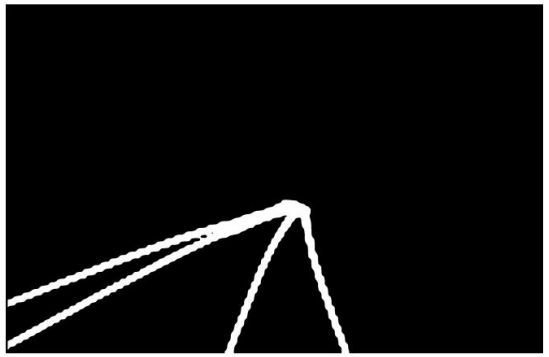
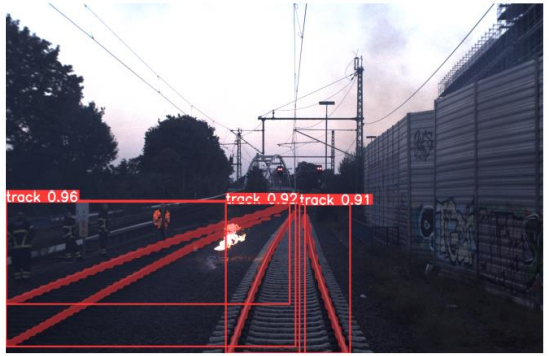
Results of different labeling approaches

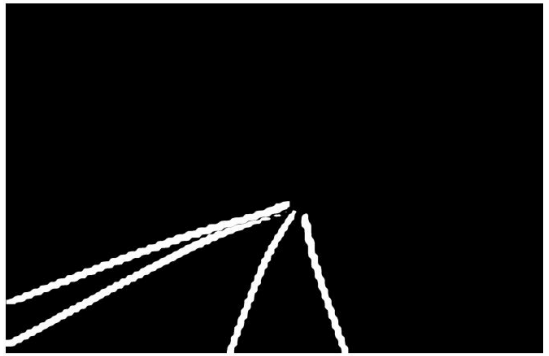
(a) Prediction image with unified labels.



(b) Prediction mask with unified labels.

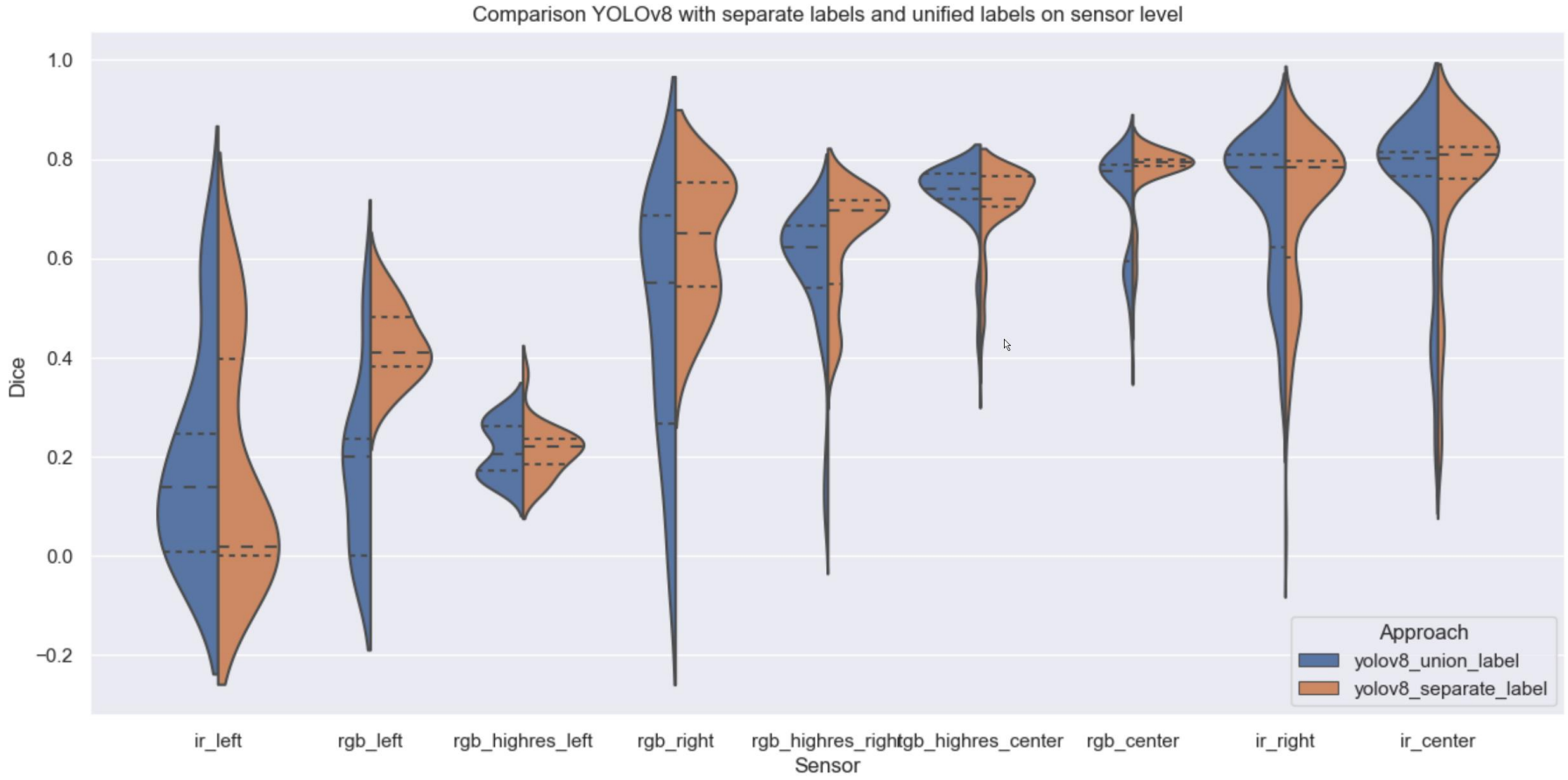


(c) Prediction image with separate labels.

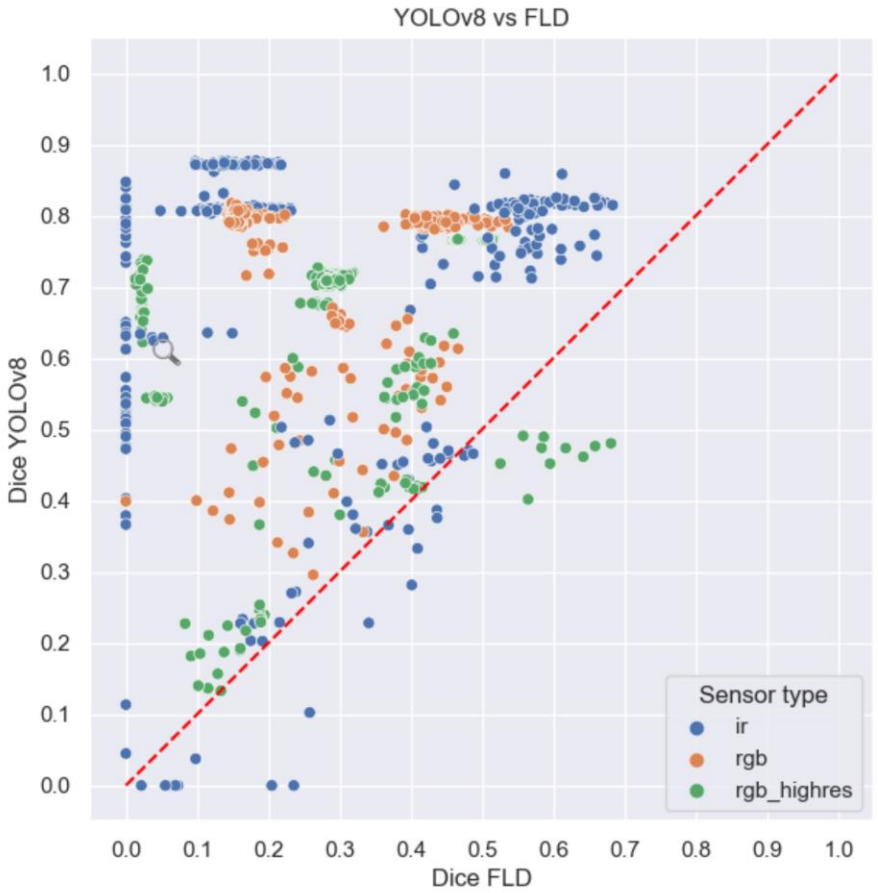


(d) Prediction mask with separate labels.

Results of different labeling approaches



Results of different labeling approaches



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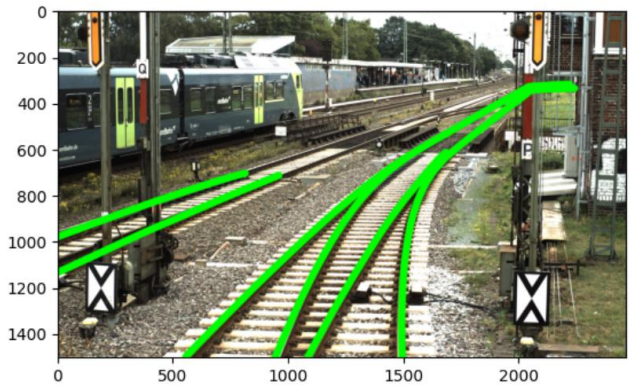
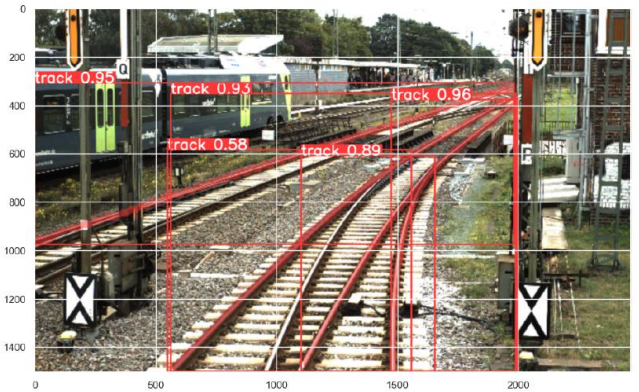
Example



(a) Image with ground truth label in green.

(b) FLD provides good prediction for main tracks; the side tracks are only partially segmented.



(c) YOLOv8 has many False Negative pixels – confidence values are given for each bounding box.

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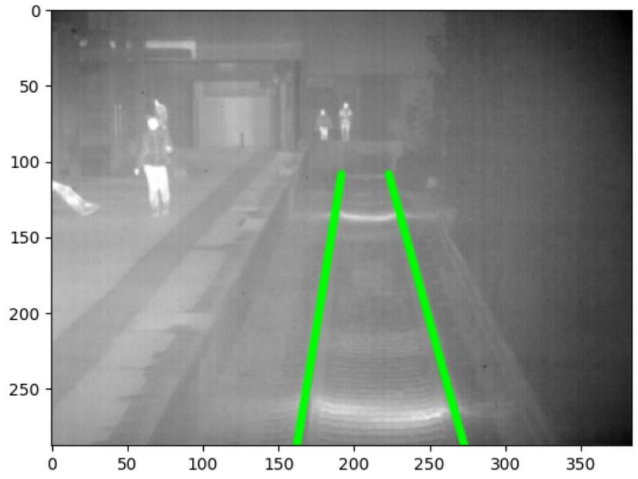
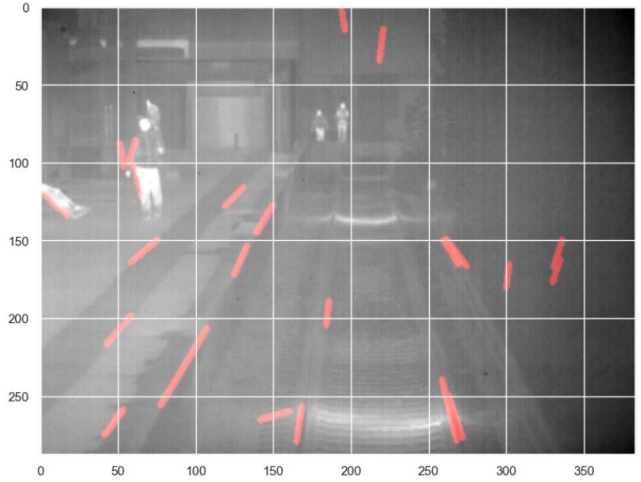
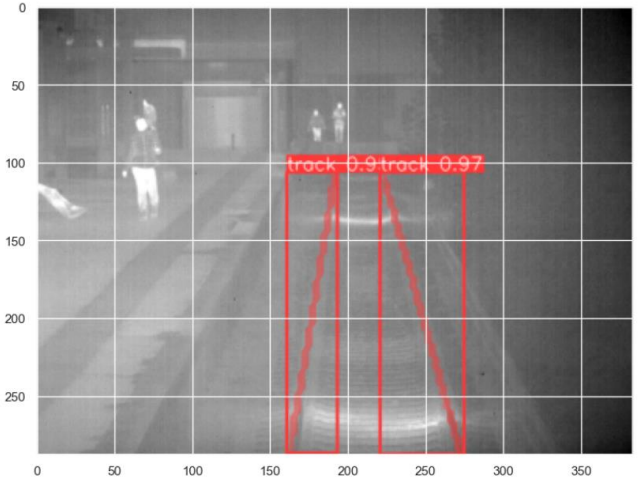
Example



(a) Image with ground truth label in green.



(b) FLD approach cannot detect tracks efficiently in the example image.



(c) YOLOv8 provides precise segmentation with high confidence.

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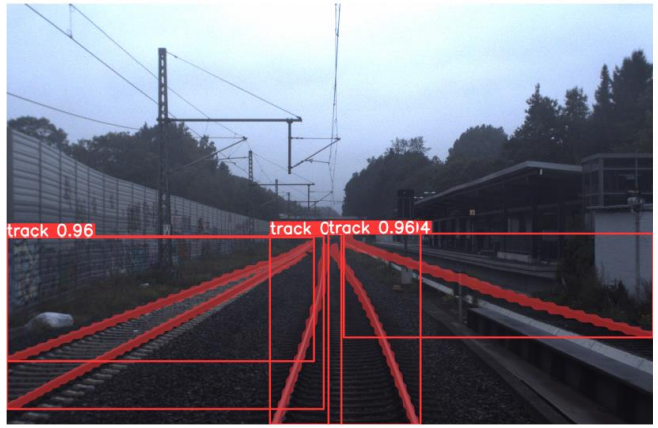
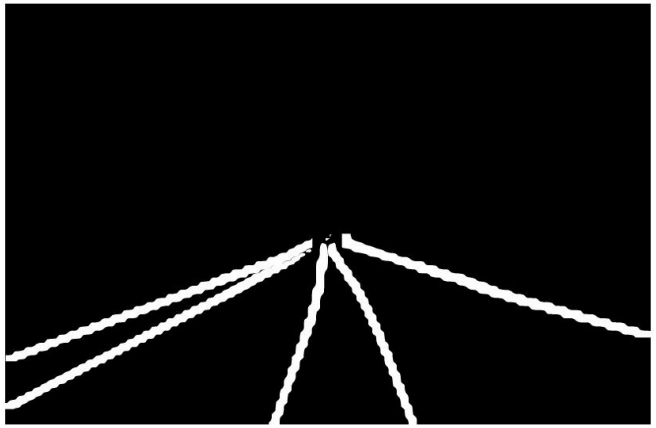
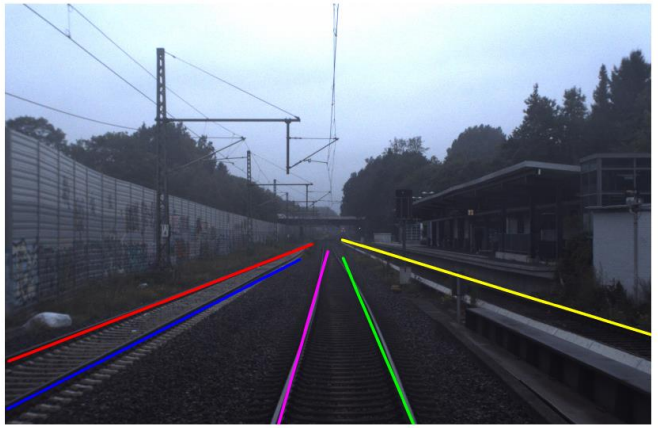
Isolating tracks as polylines



(a) Segmented image.



(b) Segmentation mask comprising four tracks.



(c) Each track can be identified separately.

Thank you!

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