

# Railway track fault detection

Thesis presentation

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# Table of Contents

Problem statement

Model description

Results

Discussion

Conclusion

# Railway track data



SDS inspection vehicle



FMK-008 vehicle

MÁV Central Rail and Track Inspection Ltd.

Performs rail and track inspection

2 inspection vehicles

Equipped with camera systems

Close view of the rail

Approx. 3.5-minute sample video provided

Additional hundred hours of footage

## Examples



Normal rail



Normal rail



Normal rail

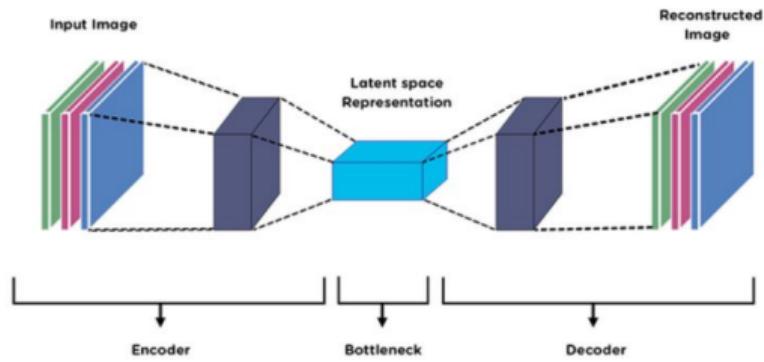


Rails covered with grass



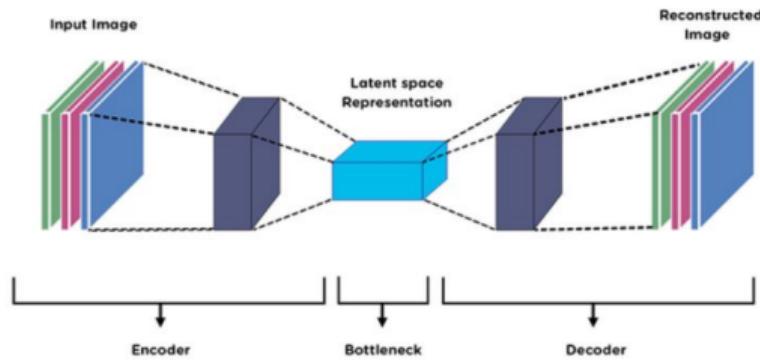
Double rails

# Model structure



Encoders: VGG19 (BN)  
ResNet50  
EfficientNetV2L  
Decoder: Inverse VGG19

# Model structure



Encoders: VGG19 (BN)  
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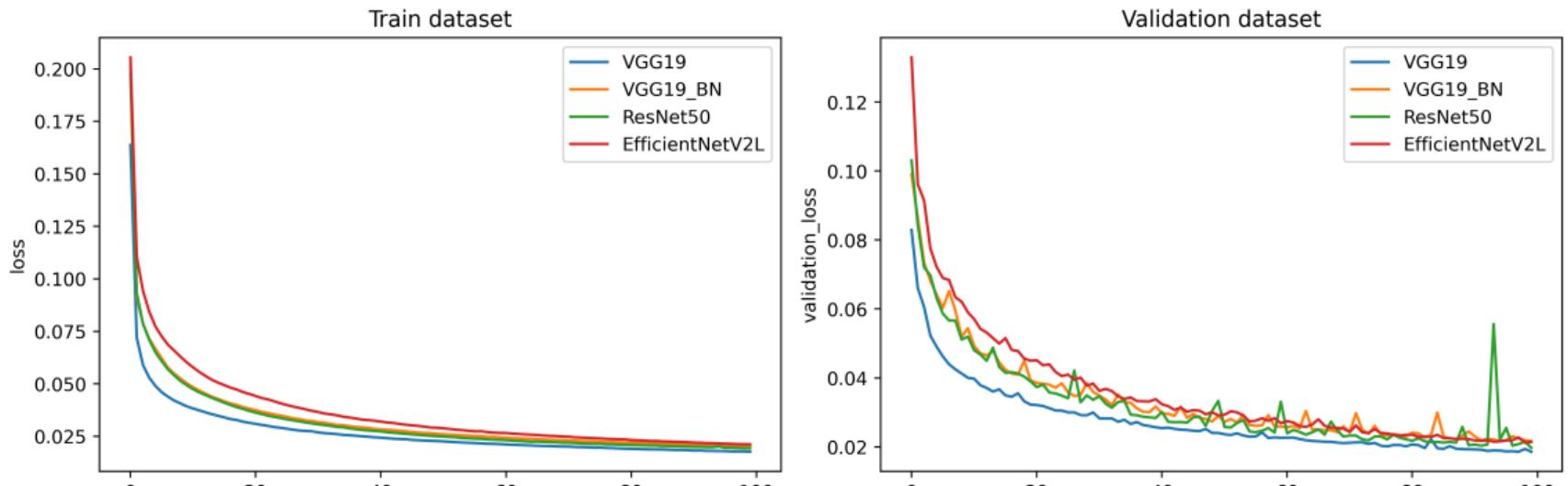
## Anomaly detection

Loss between input and output exceeds a certain limit

Isolation forest algorithm on the bottleneck vectors

Additional layers added between Bottleneck and Decoder to match output size

# Learning curves



Learning curve comparison of different encoders

# Reconstructed images

VGG19



VGG19 BN



# Reconstructed images

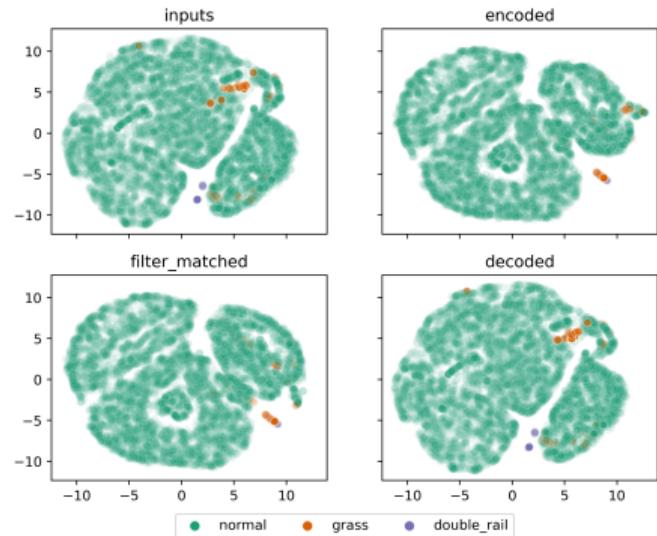
ResNet50



EfficientNetV2L

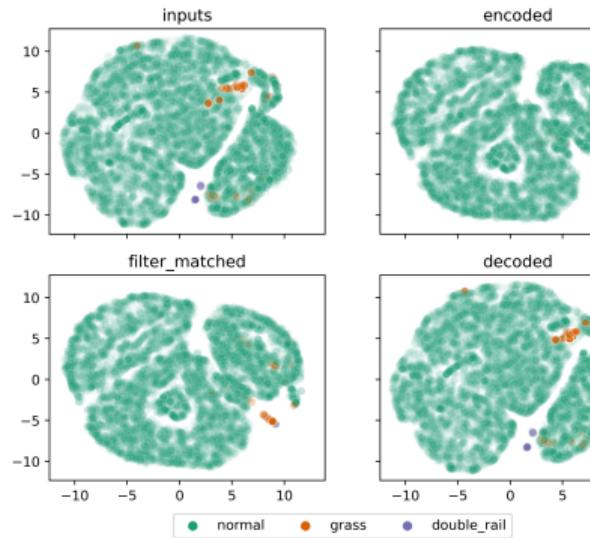


# Latent space visualization

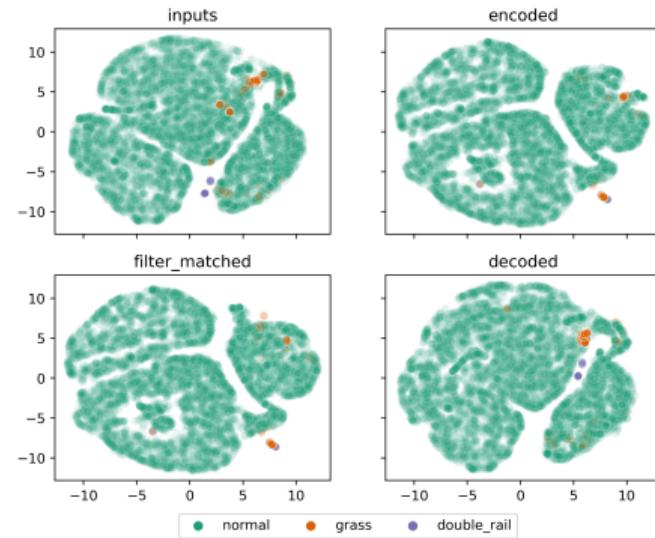


VGG19

# Latent space visualization

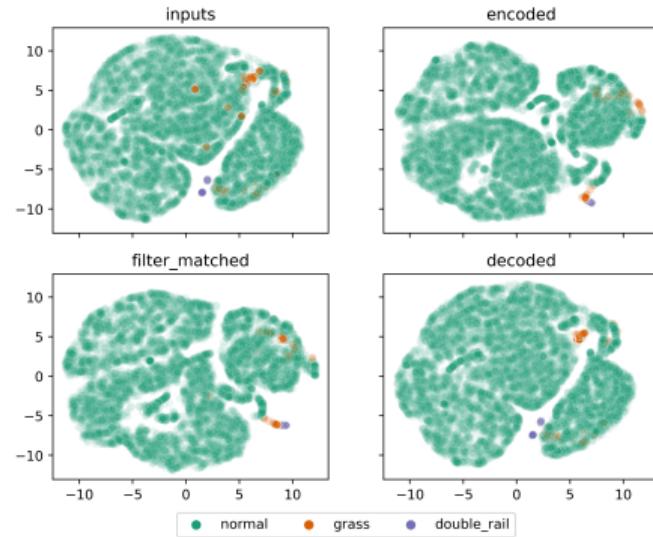
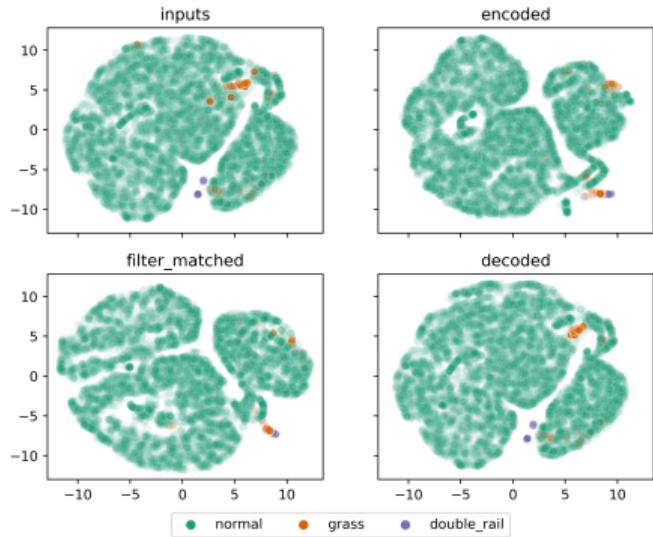


VGG19

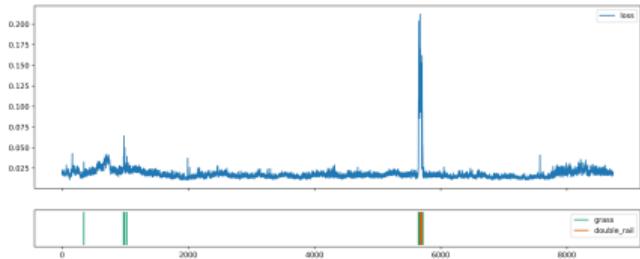


VGG19 BN

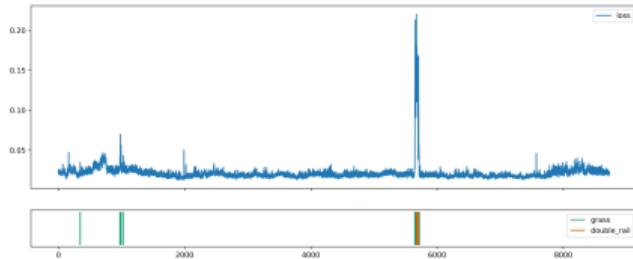
# Latent space visualization



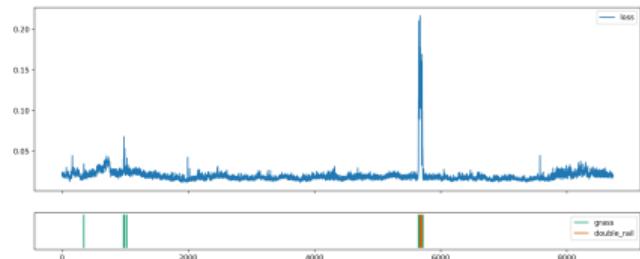
# Loss based outliers



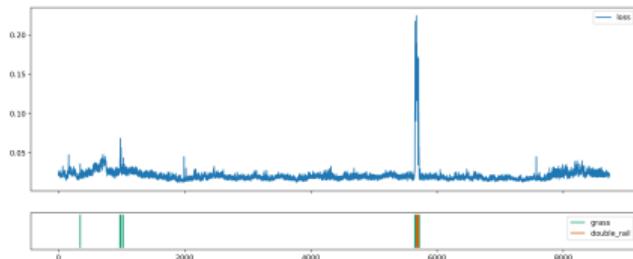
VGG19



VGG19 BN

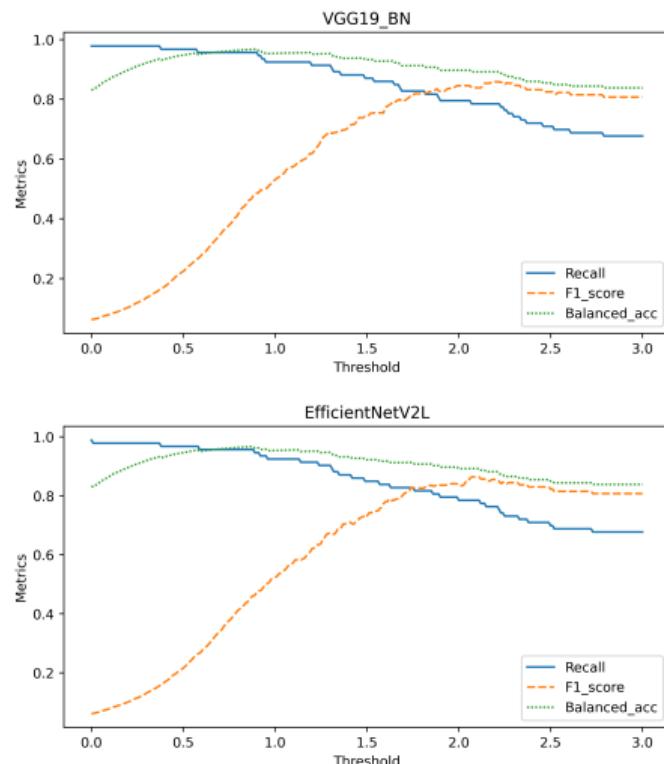
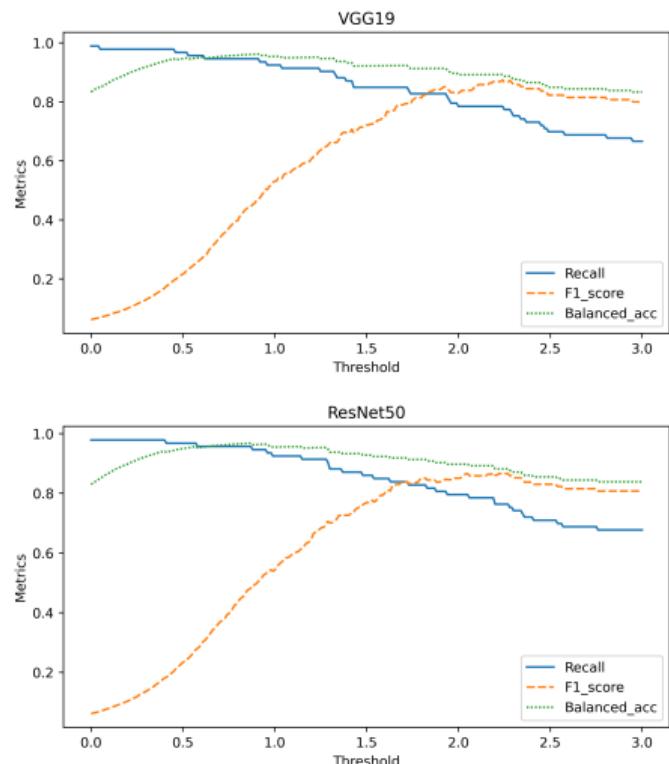


ResNet50

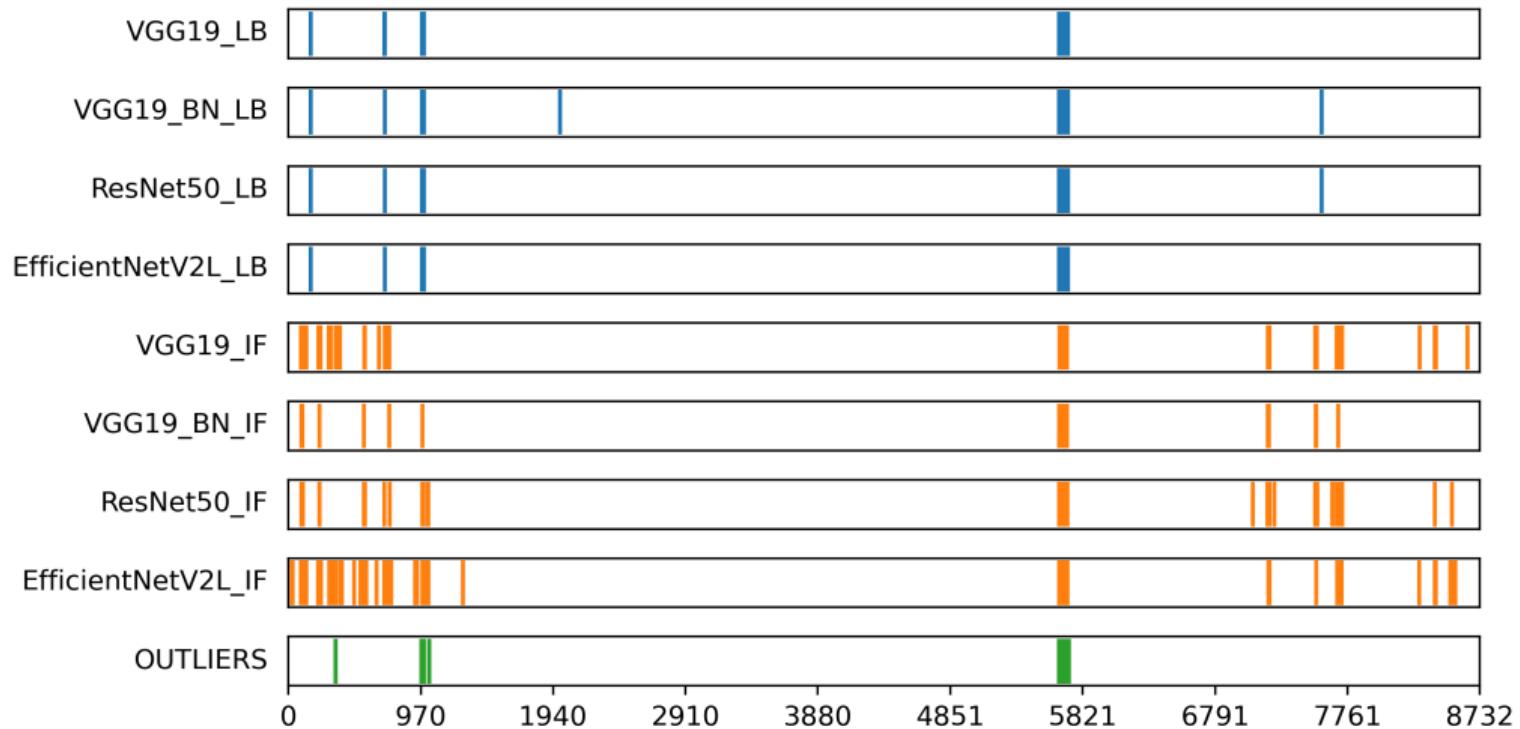


EfficientNetV2L

# Loss-based threshold



# Detected anomalies



# Anomaly clusters and false positives



# Conclusion and outlook

## Conclusion

Sample video processed with four different encoders

Applied two outlier detection methods

Major outliers identified

Behavior of NN is visualized using PCA and t-SNE

## Next steps

Image processing (histogram equalization)

Further models (NN, anomaly detection)

Model refinement, hyperparameter optimization

Further loss definitions

Segmentation of the image to limit action zone

Thank you very much for your kind attention!