

Railway track fault detection

Thesis presentation

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Problem statement

Model description

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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

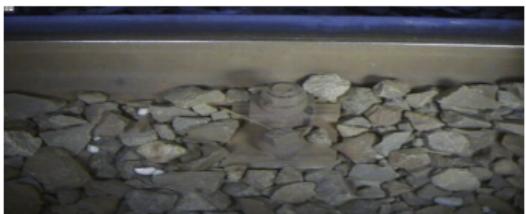
Approx. 3.5-minute sample video provided

Additional hundred hours of footage

Examples



Normal rail



Normal rail



Normal rail

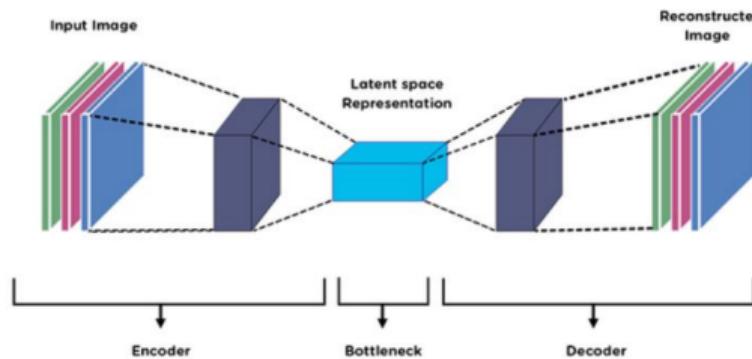


Rails covered with grass



Double rails

Model selection



General structure of Autoencoders

Encoders:

VGG19 (BN)

ResNet50

EfficientNetV2L

Bottleneck

Filter matching

Decoder:

Inverse VGG19

Anomaly detection

Loss-based

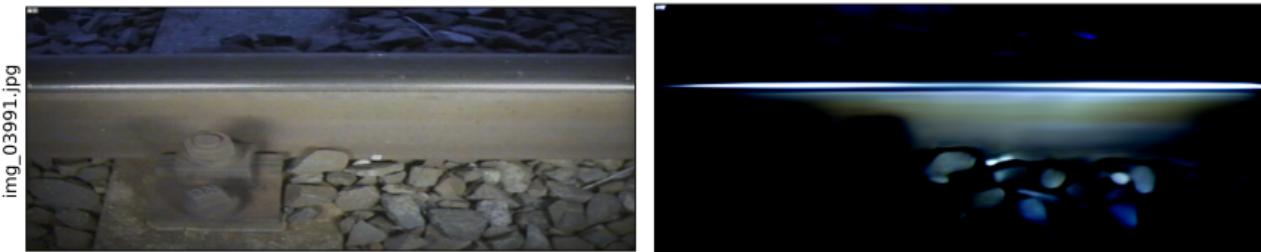
Isolation Forest

Reconstructed images

VGG19



VGG19 BN

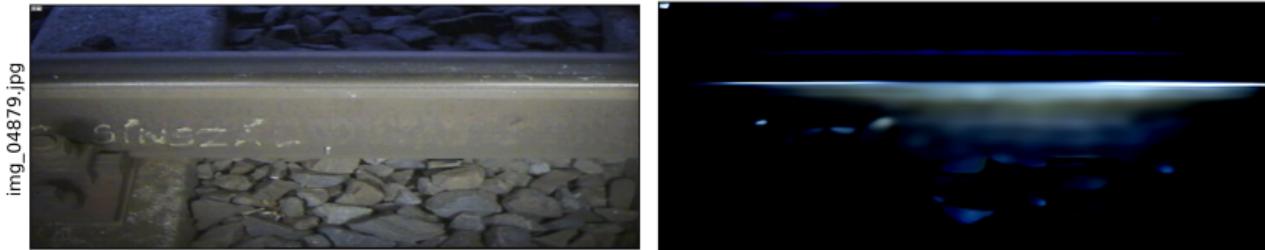


Reconstructed images

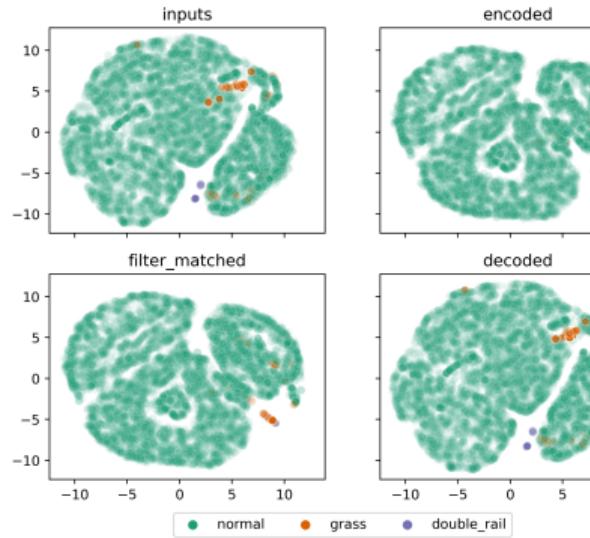
ResNet50



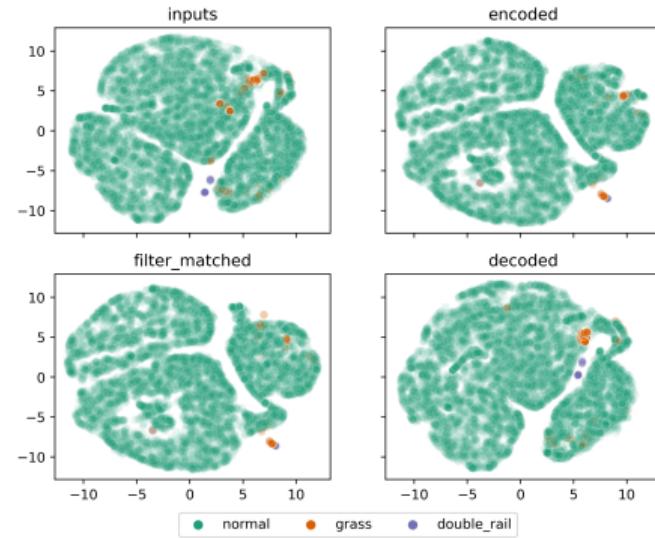
EfficientNetV2L



Latent space visualization

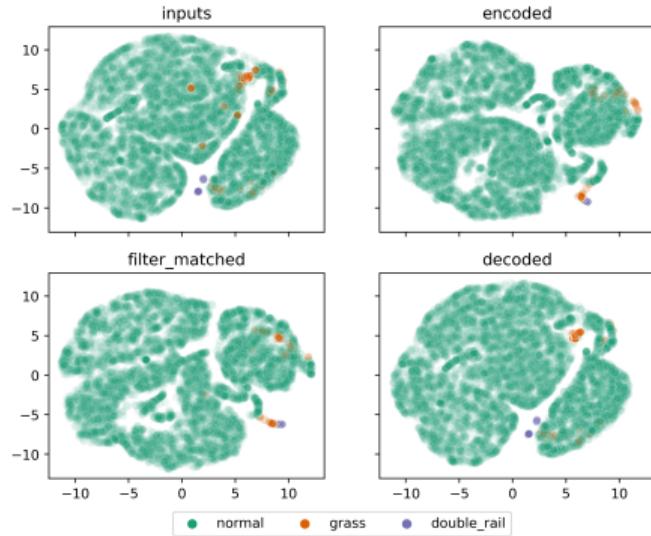
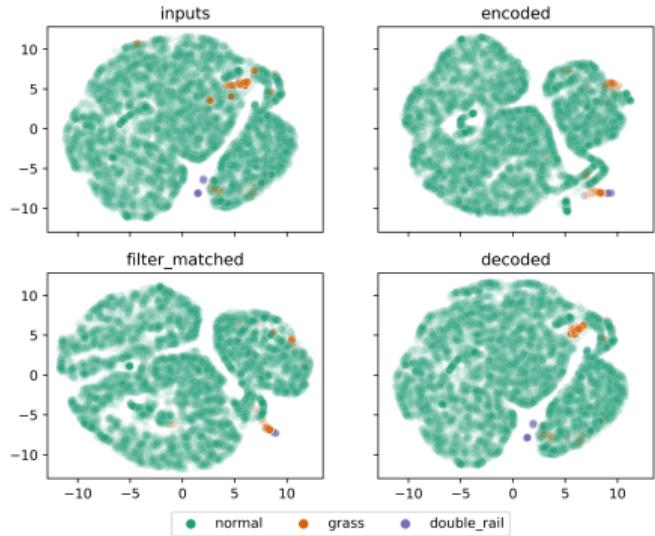


VGG19

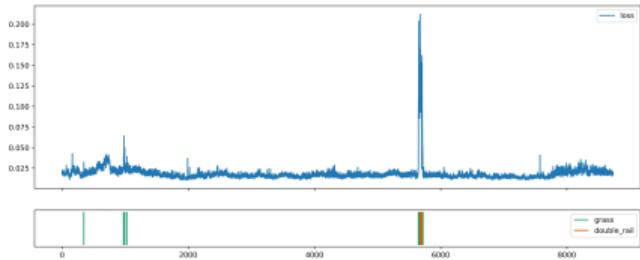


VGG19 BN

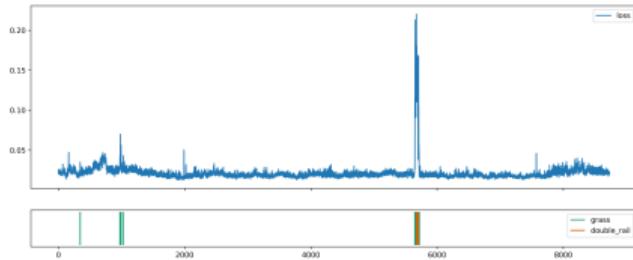
Latent space visualization



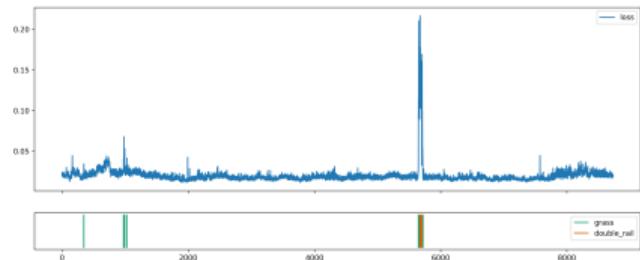
Loss based outliers



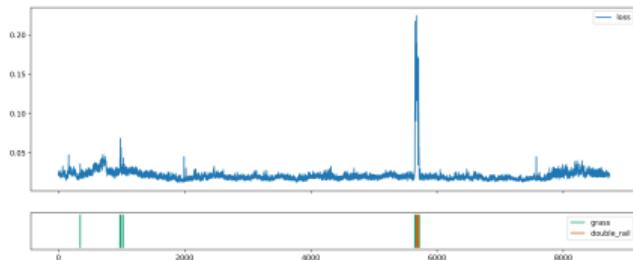
VGG19



VGG19 BN

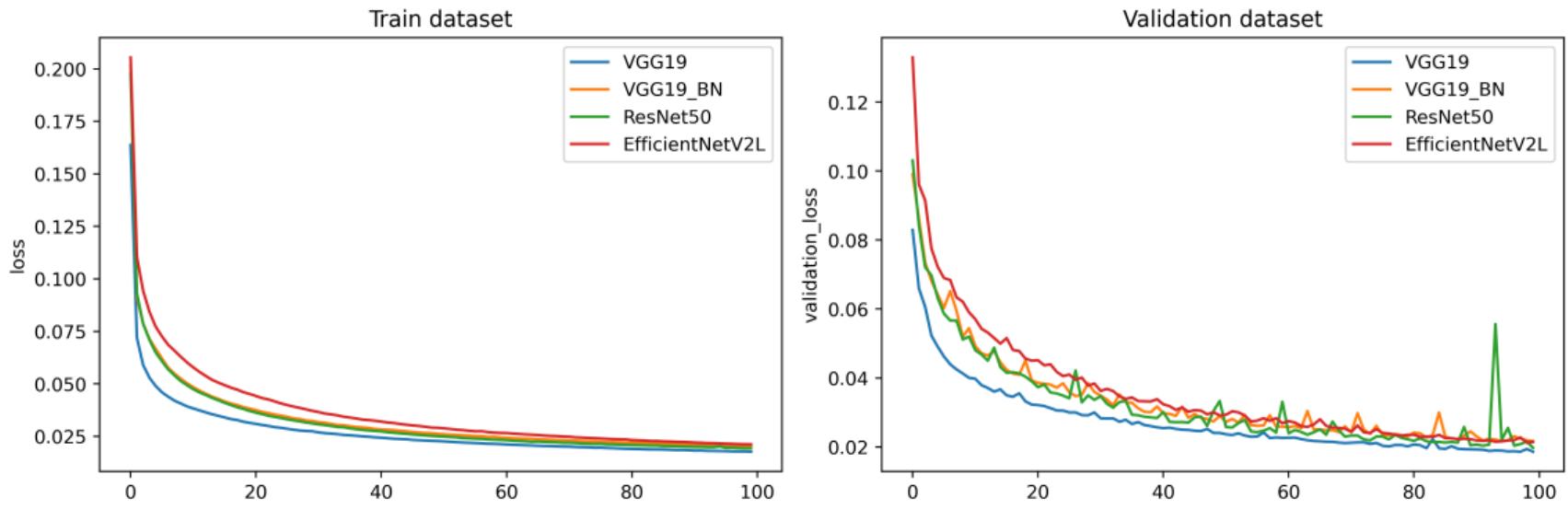


ResNet50



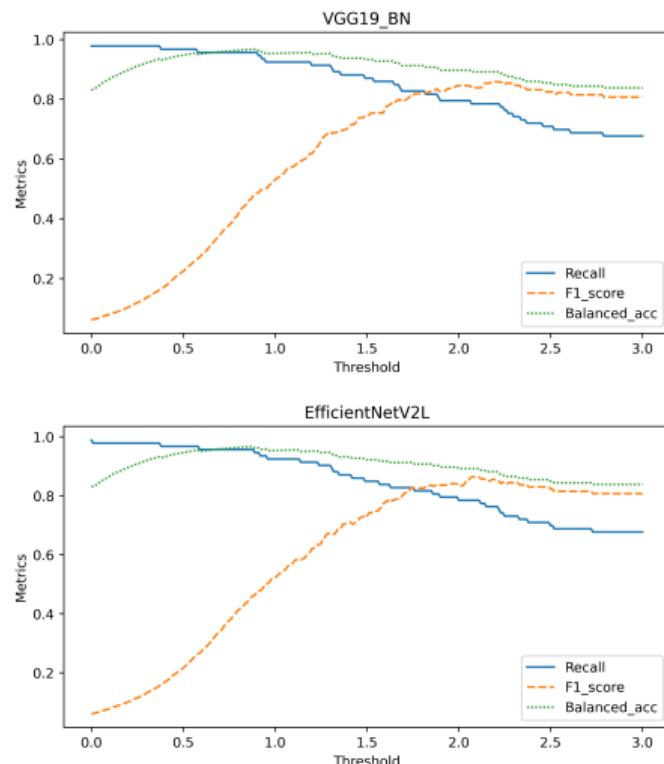
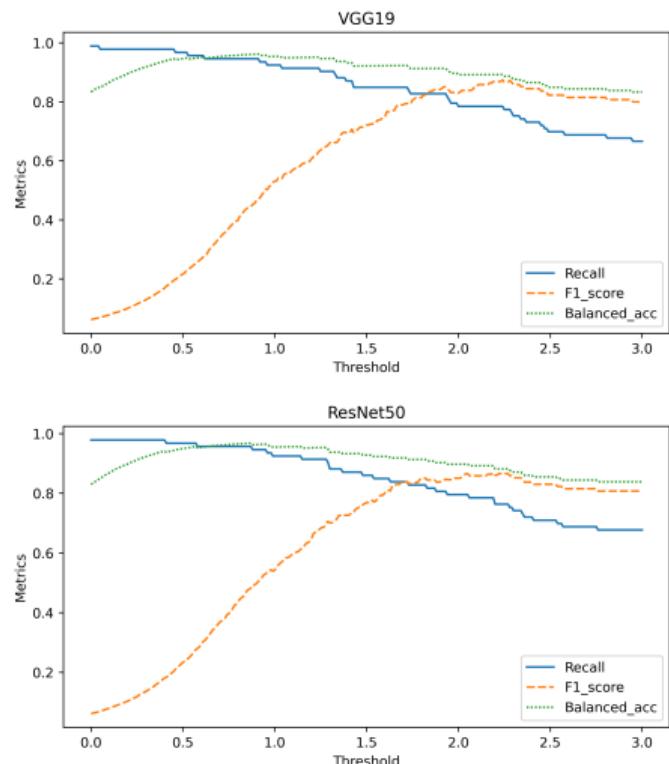
EfficientNetV2L

Learning curves

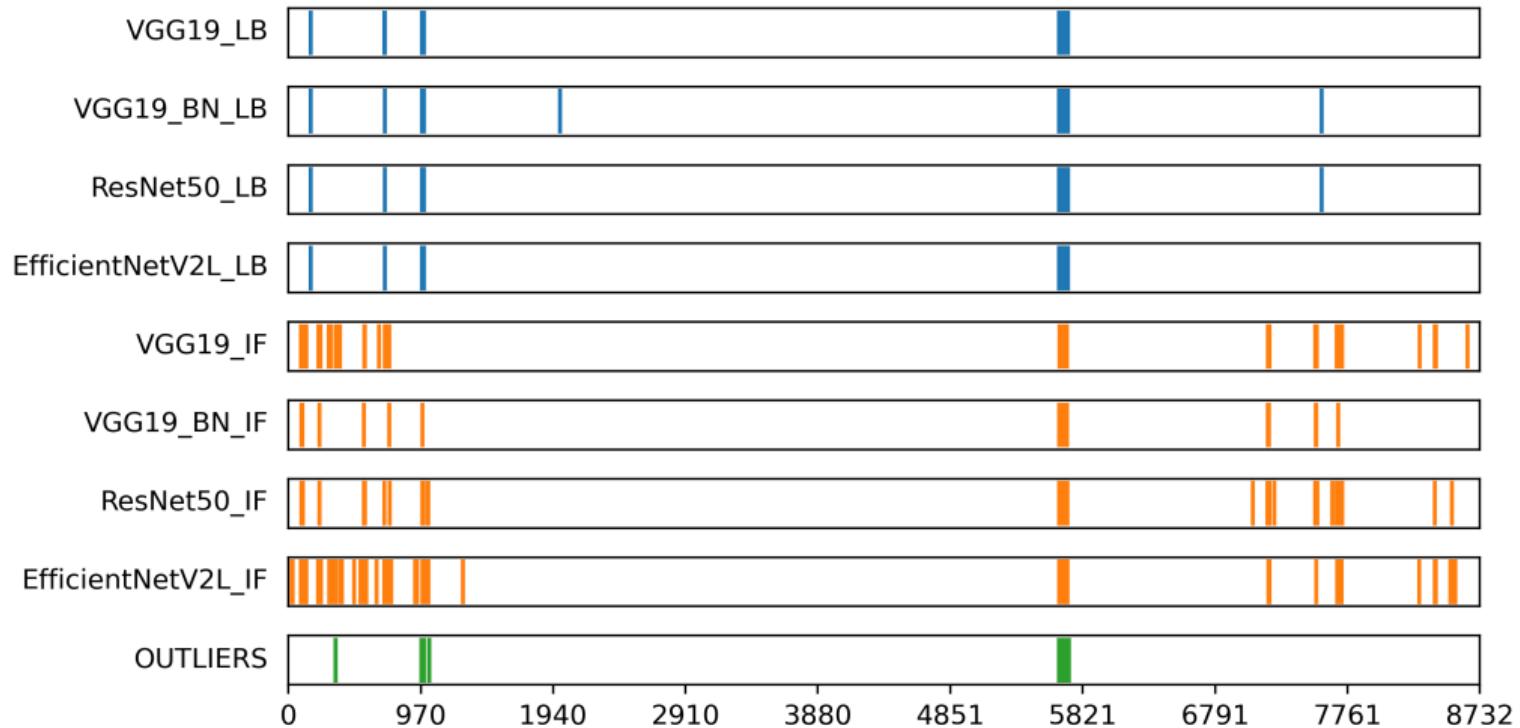


Learning curve comparison of different encoders

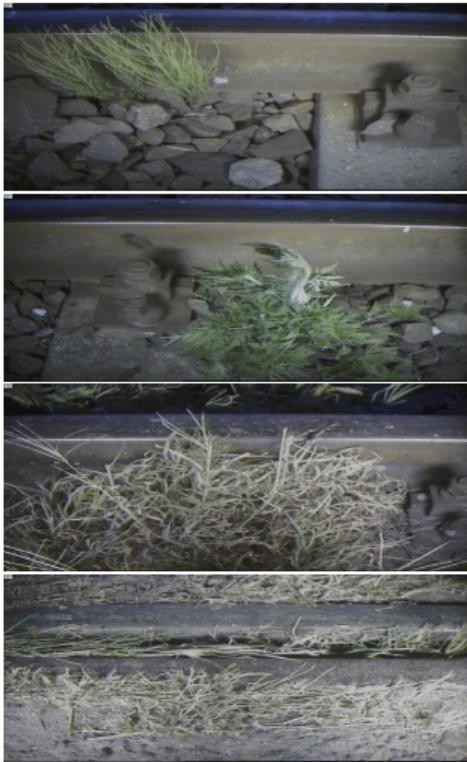
Loss-based threshold



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!