

# Railway Inspection with Deep Learning

Joël Casutt  
Smart Maintenance Conference  
03.09.2019





460 012-8



Defect Detection



Fingerprinting



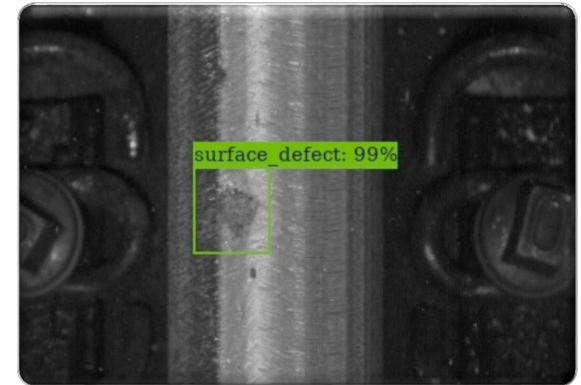
51 Inspectors



250 Defect Types



23'000 defects per Year



# Diagnostic Trains

- 160 Km/h
- 18 Cameras
- 10 GB/Km





# Diagnostic Trains

- 200 Km/h
- 14 Cameras
- 9 GB/Km







# Defect Detection for Railways

## Weather

- Rain
- Snow
- Ice

## Artefacts

- Dirt
- Leaves
- Chewing gum

## Geometry

- Forms
- Shapes
- Switch

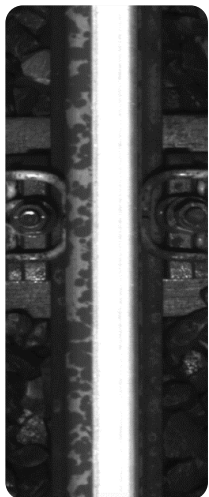


# Projekt Railcheck

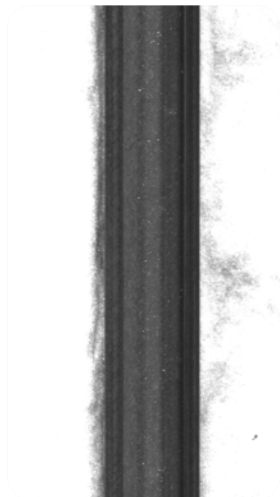
# Input Data



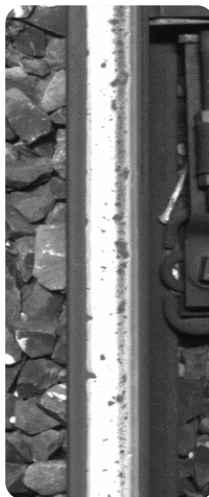
Rain



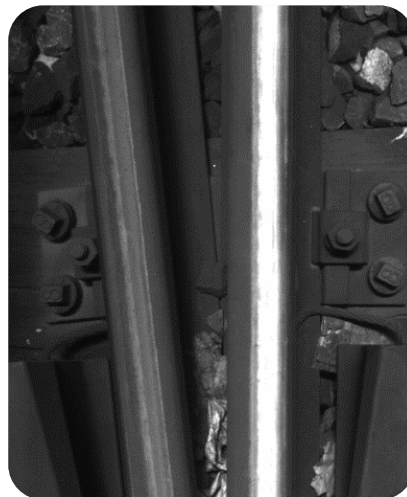
Snow



Dirt



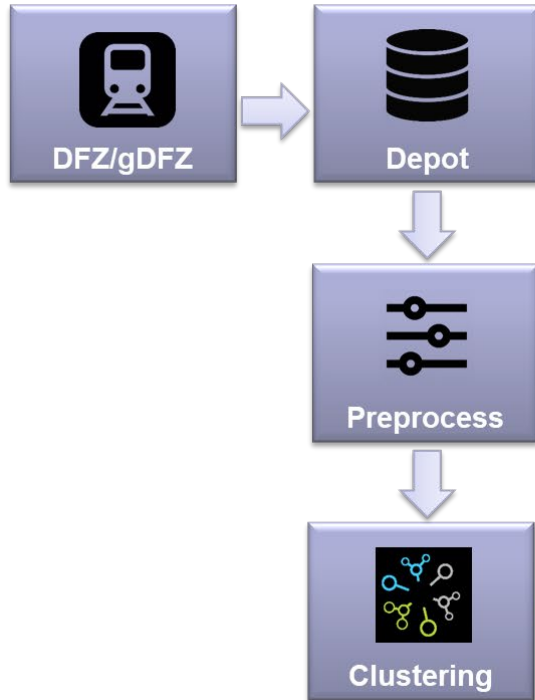
Switch



Street

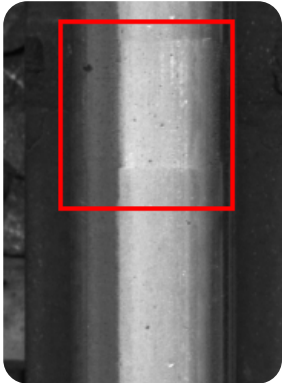


# Processing Pipeline

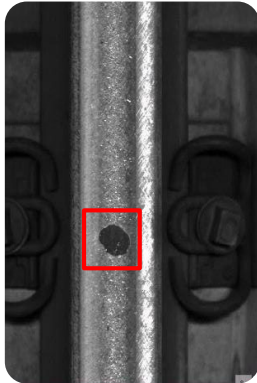


# Anomaly classification

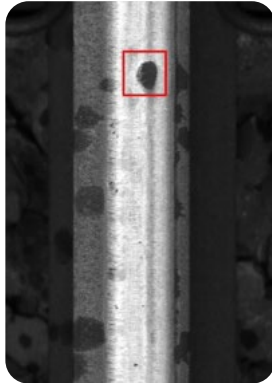
Welding



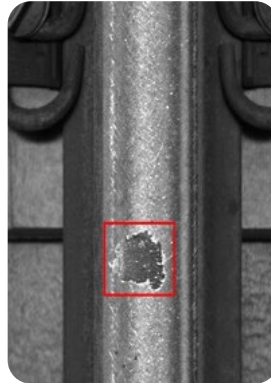
Plastic Particle



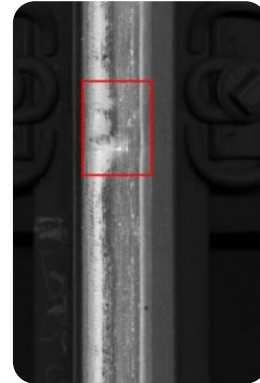
Surface Defect



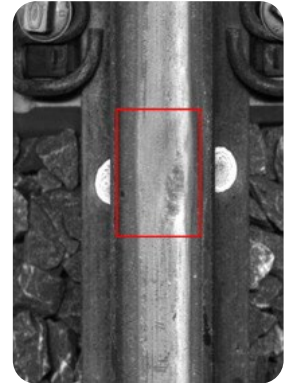
Chewing Gum



Squat



Wheel Slip





# Data Labelling

SBB Labeling Tool v0.9.17.0 - Railcheck\_SBB\_Itp

Home Image Batch Processing Export

New Open... Save Save As... File Image File Browser

Extra Large Large Medium Small List Tiles

Navigation Back Next prev Label next Label

Labels

View File to Screen Magnifier Add or Edit Refresh

Image Tools

Image File Browser

20170919\_162415

20170919\_162415#20\_00451621\_0112905464.png  
20170919\_162415#20\_00451661\_0112915460.png  
20170919\_162415#20\_00451701\_0112925456.png  
20170919\_162415#20\_00451741\_0112935452.png  
20170919\_162415#20\_00451781\_0112945448.png  
20170919\_162415#20\_00451821\_0112955444.png  
20170919\_162415#20\_00451861\_0112965440.png  
20170919\_162415#20\_00451901\_0112975436.png  
20170919\_162415#20\_00451941\_0112985433.png  
20170919\_162415#20\_00451981\_0112995429.png  
20170919\_162415#20\_00452021\_0113005425.png  
20170919\_162415#20\_00452061\_0113015421.png  
20170919\_162415#20\_00452101\_0113025417.png  
20170919\_162415#20\_00452141\_0113035413.png  
20170919\_162415#20\_00452181\_0113045409.png  
20170919\_162415#20\_00452221\_0113055405.png  
20170919\_162415#20\_00452261\_0113065400.png  
20170919\_162415#20\_00452301\_0113075396.png  
20170919\_162415#20\_00452341\_0113085392.png  
20170919\_162415#20\_00452381\_0113095388.png  
20170919\_162415#20\_00452421\_0113105384.png  
20170919\_162415#21\_00452466\_0113115380.png  
20170919\_162415#21\_00452505\_0113125376.png  
20170919\_162415#21\_00452545\_0113136471.png  
20170919\_162415#21\_00452585\_0113146467.png  
20170919\_162415#21\_00452625\_0113156462.png  
20170919\_162415#21\_00452665\_0113166458.png  
20170919\_162415#21\_00452705\_0113176453.png  
20170919\_162415#21\_00452745\_0113186449.png  
20170919\_162415#21\_00452785\_0113196445.png  
20170919\_162415#21\_00452825\_0113206440.png  
20170919\_162415#21\_00452865\_0113216436.png  
20170919\_162415#21\_00452905\_0113226432.png  
20170919\_162415#21\_00452945\_0113236428.png  
20170919\_162415#21\_00452985\_0113246424.png  
20170919\_162415#21\_00453025\_0113256420.png  
20170919\_162415#21\_00453065\_0113266416.png  
20170919\_162415#21\_00453105\_0113276412.png  
20170919\_162415#21\_00453145\_0113286408.png  
20170919\_162415#21\_00453185\_0113296404.png

9132 9032 8932 8832 8732 8632 8532 8432

Labels

Go to position

Line ID

Track

Kilometer 0.000000

Track Information

Live Position (km)

Valid info found for image

Official km: 73.267279

File Name: 2017.09.2017 16:24

SSCount: 452002

SSI Count: 113200500

LineID: 415

TrackName: BNK121.1-SEN7011.2

TrackID: 21163200

TrackType: 1

OfficialKilometer: 73.267512762046

MeasuredSpeed: 118.6944

Date: 19.09.2017 14:29

VehicleOrientation: Forward

Kilometrage: Decreasing

Temperature: 11.49667

Latitude: 47°11.41412' N

Longitude: 7°37.82920' E

Altitude: 461.3

PassengerSpeed: 200

Label Settings

Create Template...

Misc

Category

Color Cyan

CreationTime 15.11.2017 11:35

Description

ID Oberflächenfehler

Rectangle 0=177.0214,1=11055.95,...

Size 83.74463; 103.6074

Tags

Templates

Remove

Drag a column header here to group by that column

#	ID	Category	Type
G	GOOD		Image
B	BAD		Image
O	Oberfläch...		Rectangular
J	Joint		Rectangular
N	NOT CLEAR		Rectangular
S	Squat_Ein...		Rectangular
T	Schleuder...		Rectangular
W	Welding		Rectangular

Templates Label Browser

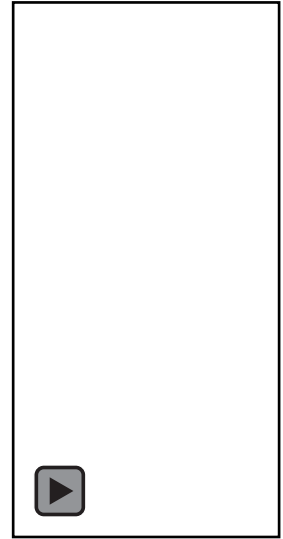
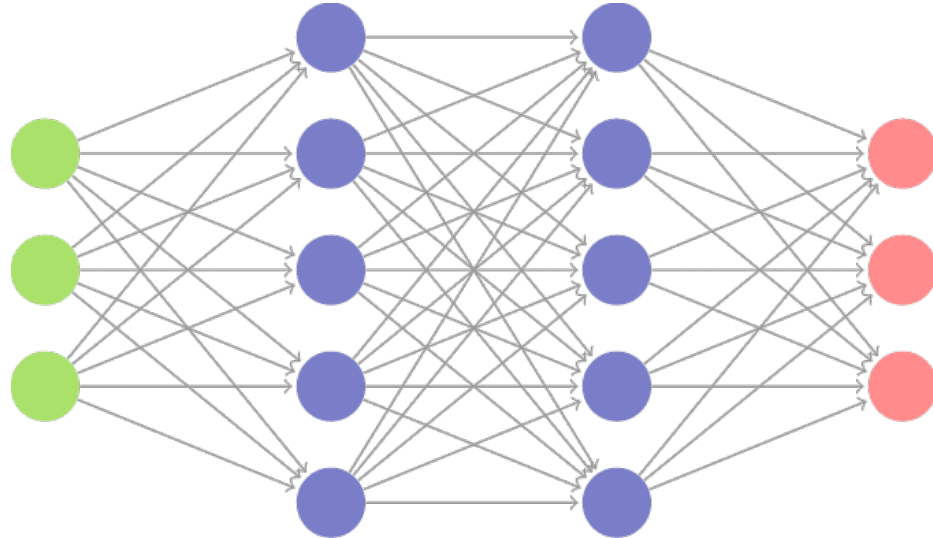
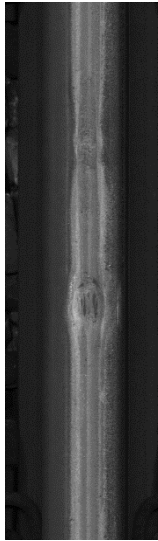
512x19992

Record 639 of 1128

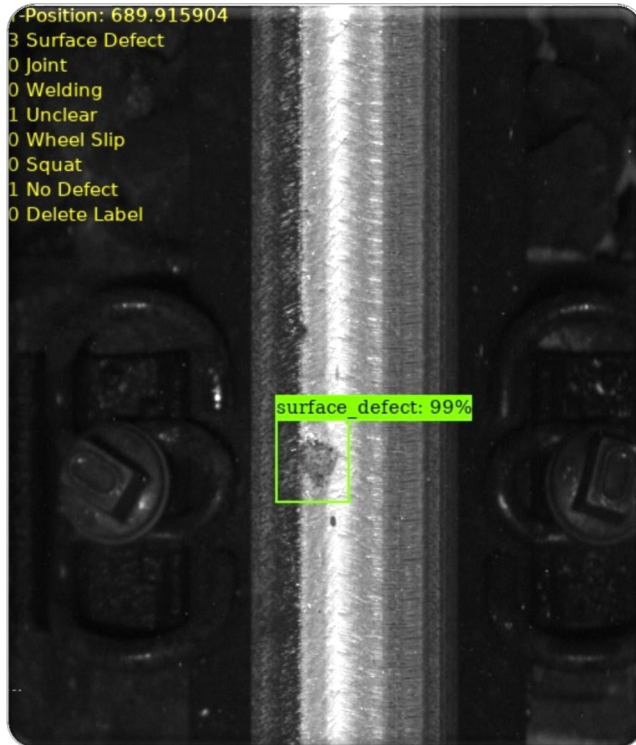
Search 20170919\_162415

\\WUD-SERVER01\Diamond\_data\Surveys\TSM\02\045\_R\_IMG\20170919\20170919\_162415\20170919\_162415#21\_00452785\_0113196445.png Labels of image: 3

# Train and use Neural Network



# Agree, that we don't agree



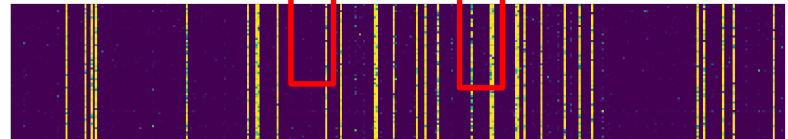
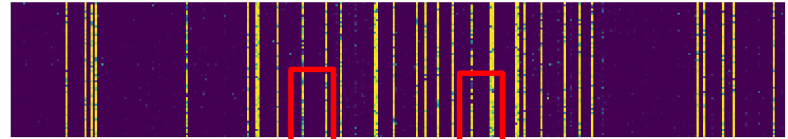
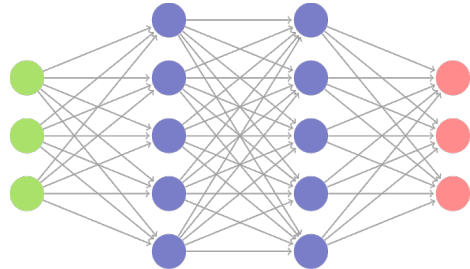
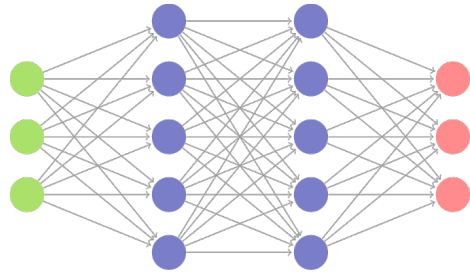
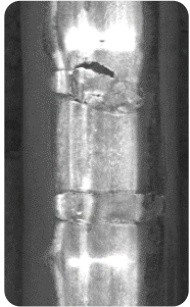
# Fingerprintig



?

=

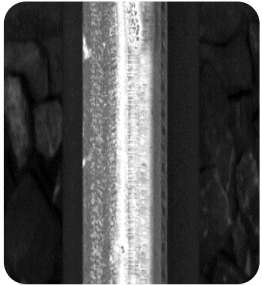




= ?

# Defect Evolution

Nov. 16



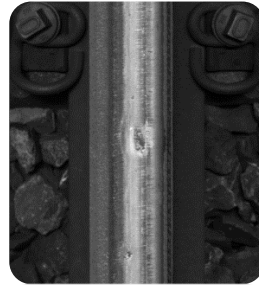
Feb. 17



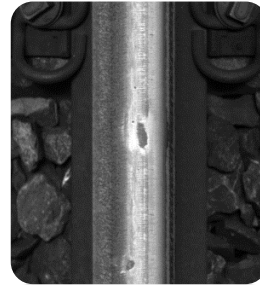
April 17



Mai 17

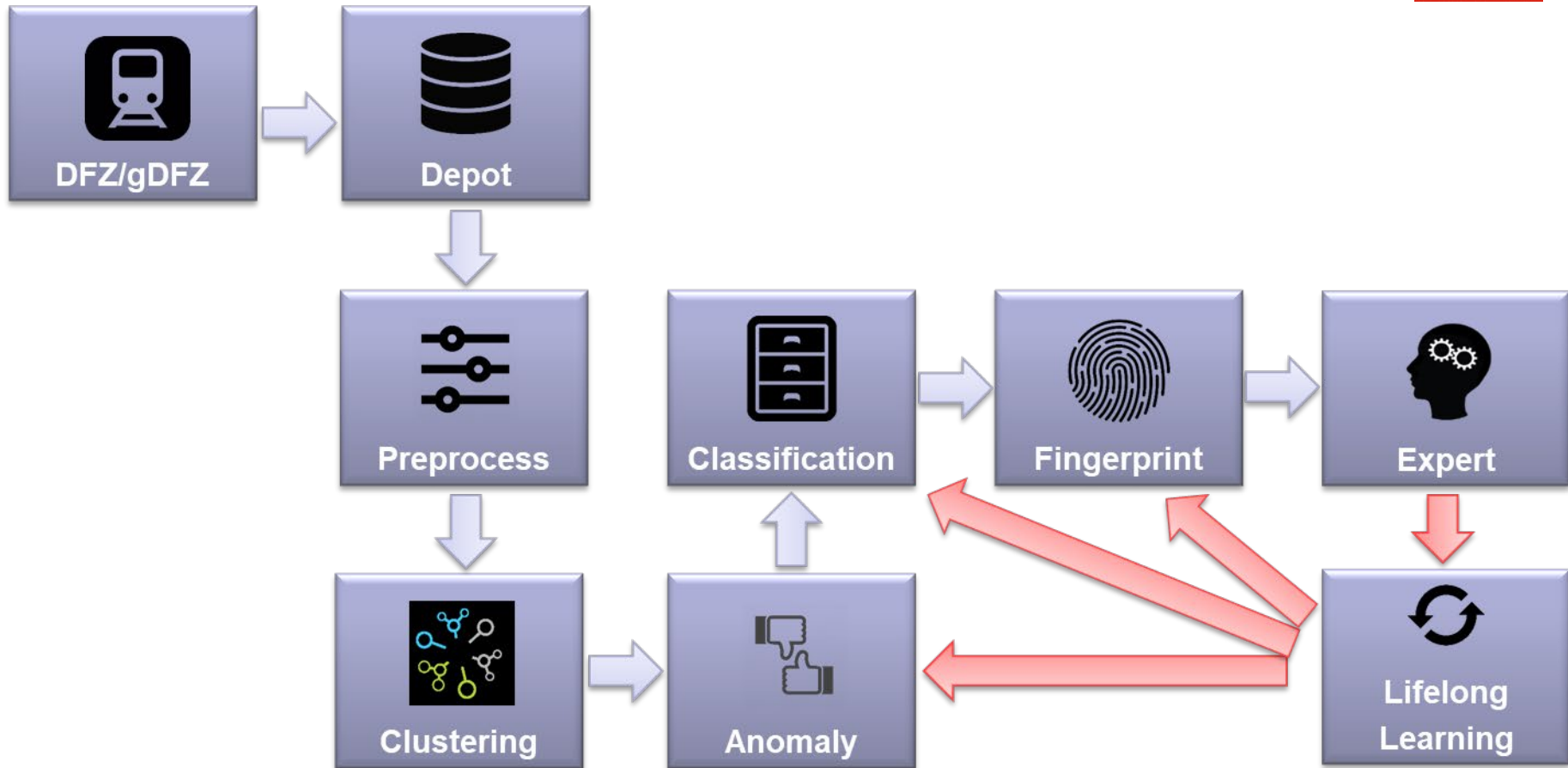


June 17



August 17



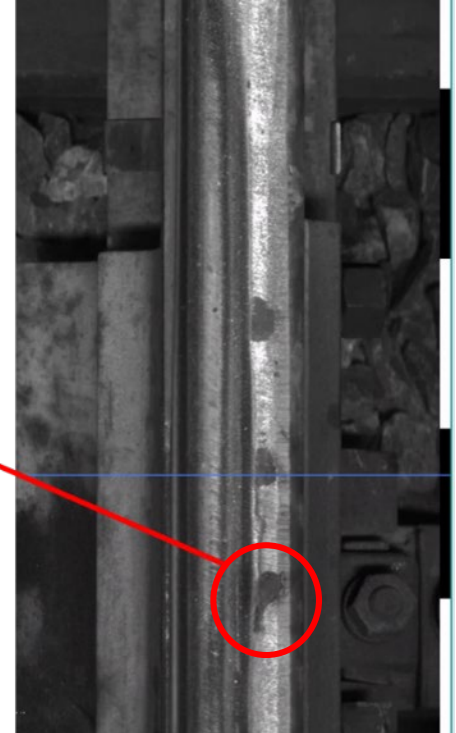
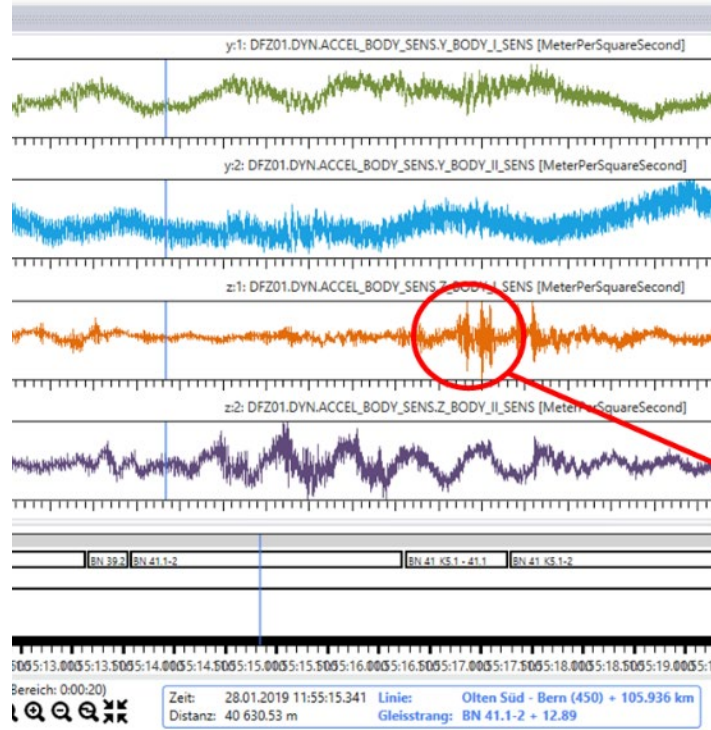




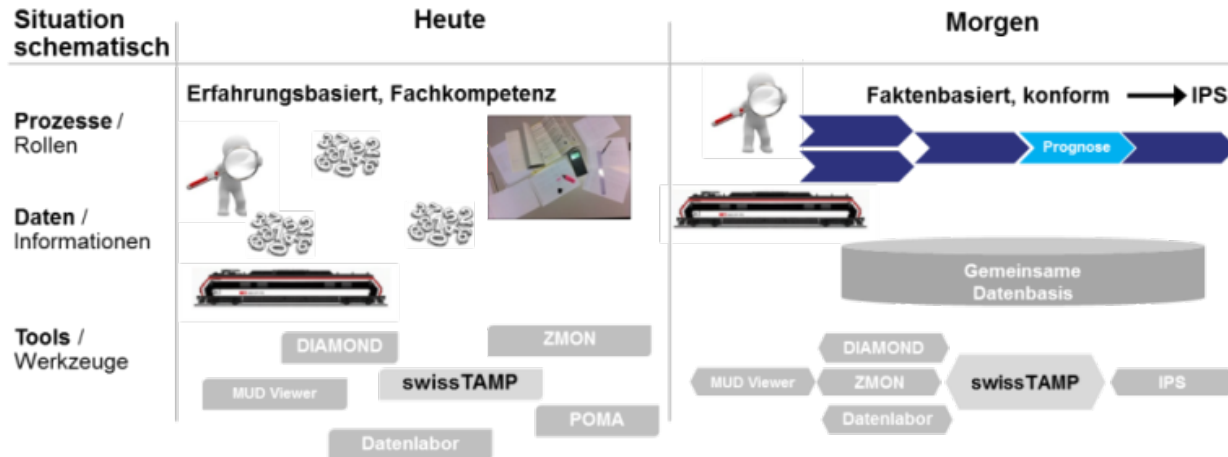
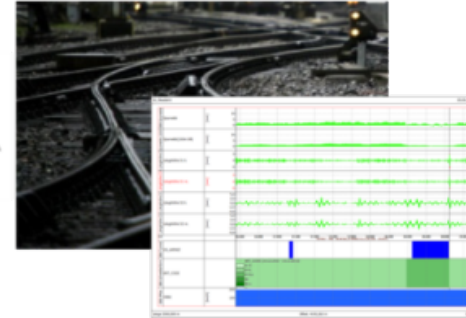
# Outlook

# ETH Mobilitätsinitiative – OMISM

- The exact time of measurement allows you to combine sensor data from multiple systems.
- It enables correlation between different types of measurement in order to improve system understanding and ultimately performance.
- First such projects are now starting
- One example is the combination of rail surface defects and acceleration measurements on the axle of the trains.



# Improving Predictive Maintenance and System Understanding





Rail under control and shaping the mobility of the future –  
simple, personal, connected.

Promoting the quality of life  
and competitive edge of  
Switzerland and its regions.

