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# Tunnel Inspection 4.0

## Smart Tunnel Maintenance using Artificial Intelligence

Switzerland

Presented by : Alžběta Prokopová





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# Facts & Figures Amberg Group Ltd



## Foundation

Since 2016 Holding "Amberg Group Ltd"



## Facts

- 100 % family owned
- 4 companies
- 400 employees worldwide
- 8 subsidiaries on 3 continents



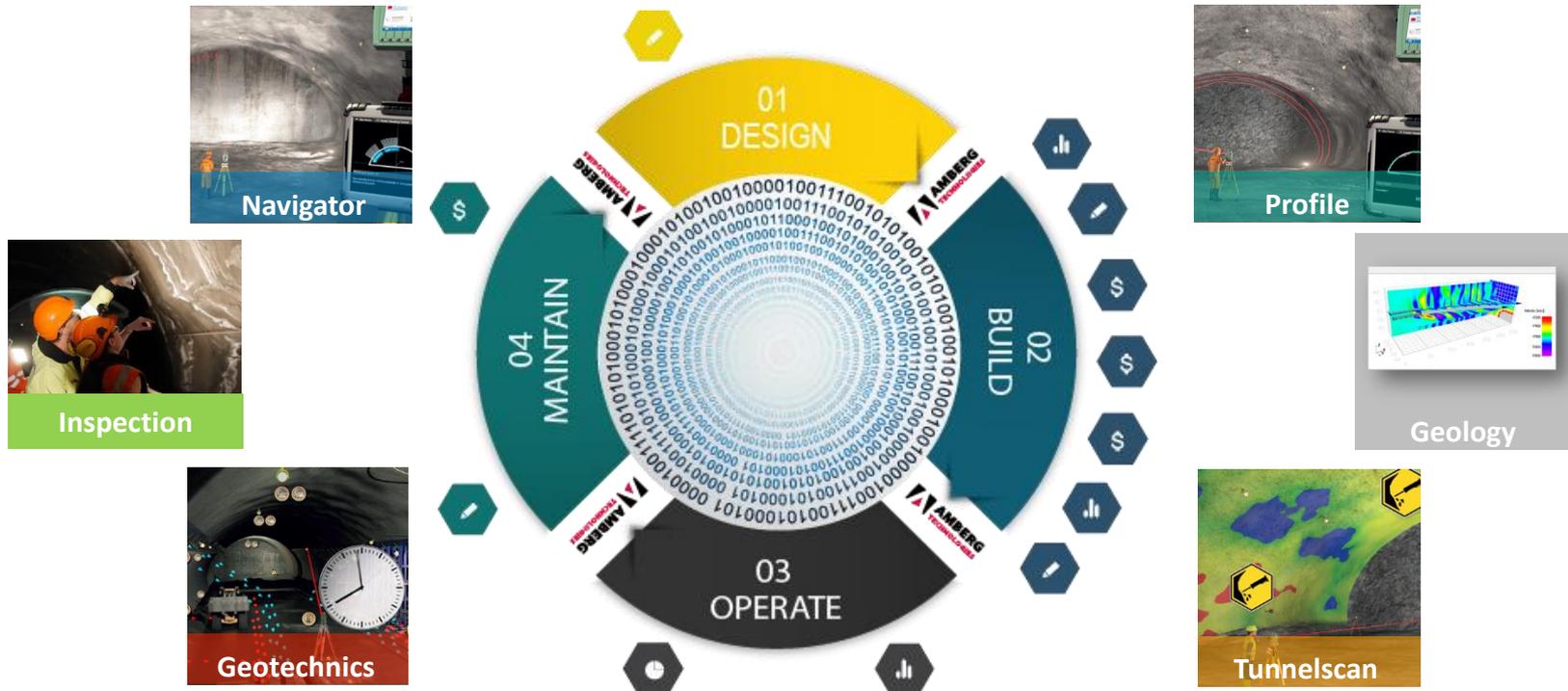
## Offerings

- Engineering Services
- Surveying Solutions
- Test Gallery
- Logistics solutions

Amberg Group is addressing the challenges of growing urbanisation with solutions for a smart use of space both underground and aboveground.



# Cover the entire Tunnel life-cycle



# Tunnel Inspection with Artificial Intelligence





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Why now?

5000% km

tunnels built per year



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# Why now?

The composite image consists of three panels arranged horizontally. The left panel shows a perspective view of a server room with rows of server racks illuminated by green lights. The middle panel is a diagram of a neural network with four blue input nodes, five green hidden nodes, and one red output node, all connected by lines. The right panel shows a top-down view of a green server circuit board with various components and connectors.

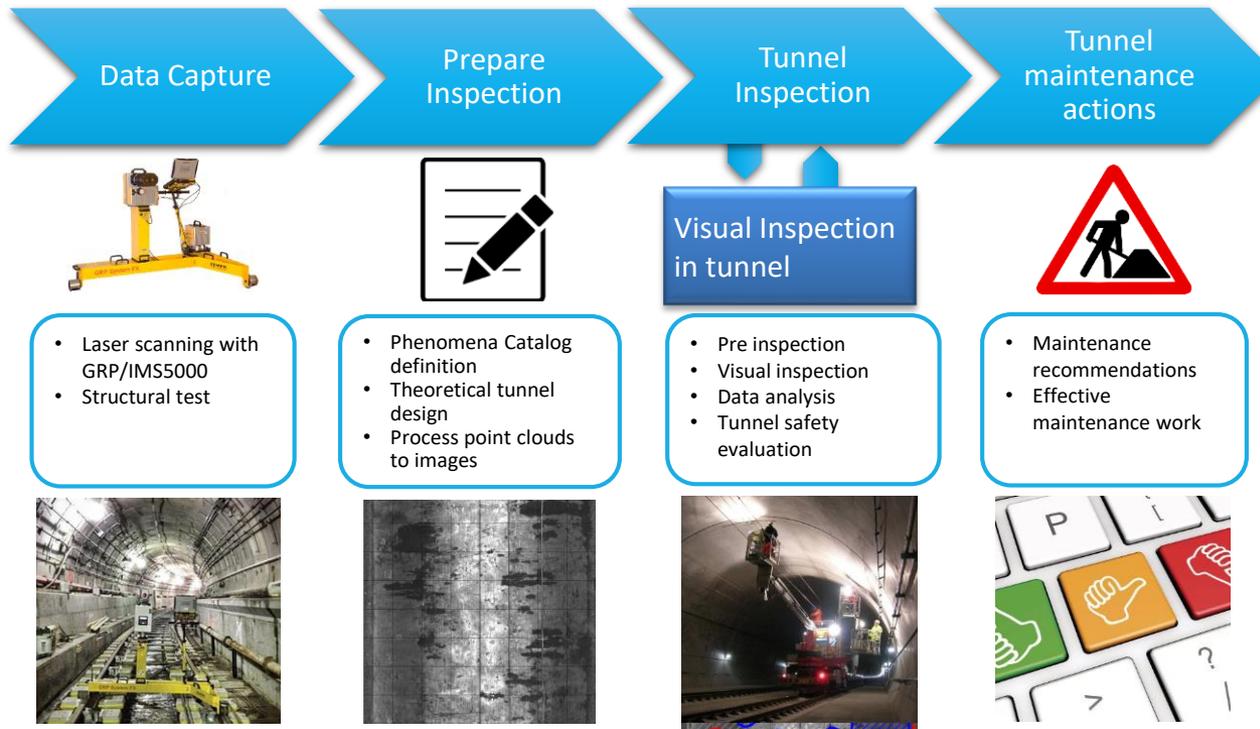
Large Datasets

Good Models

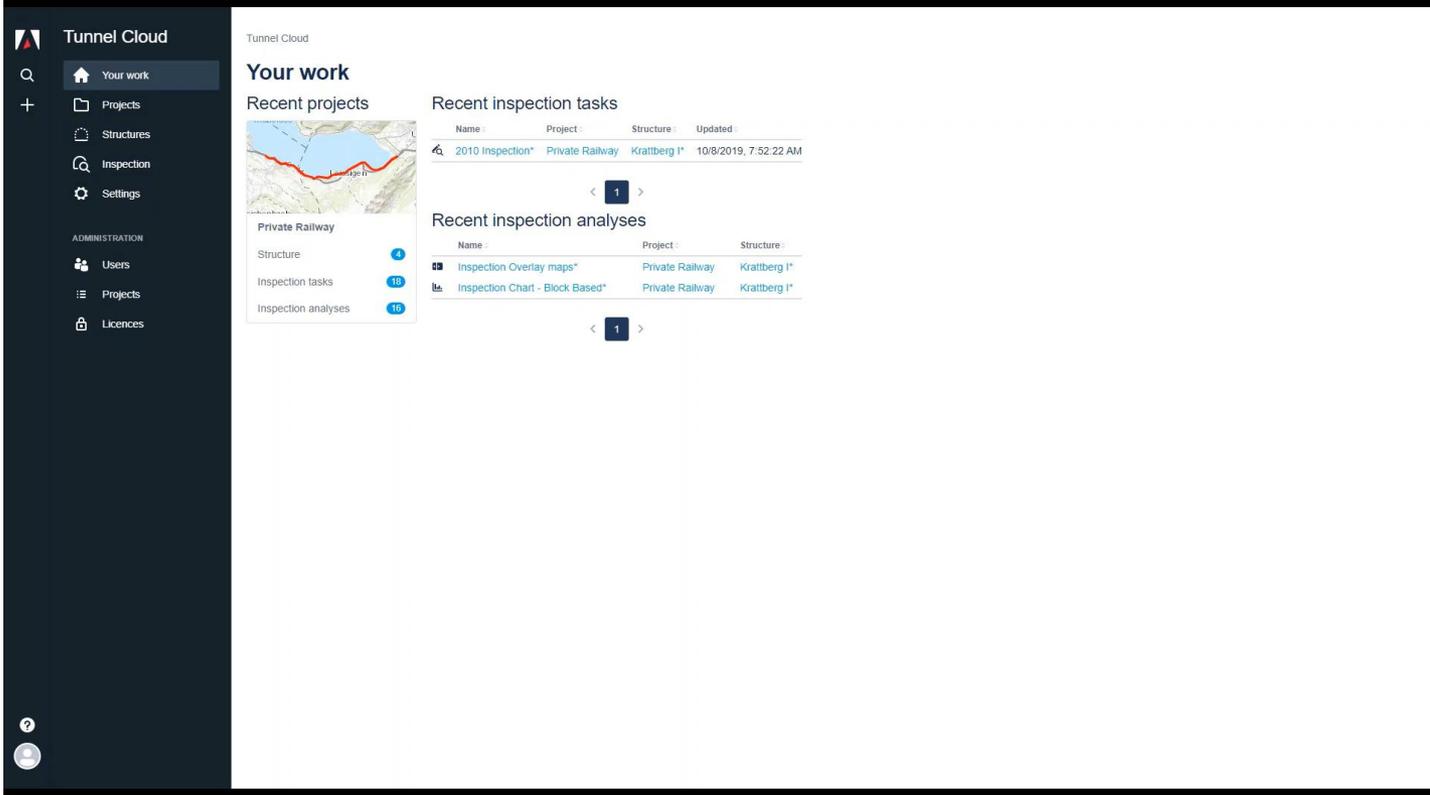
Lots of Computation

@xsteenbrugge

# Tunnel Inspection workflow



# Amberg Inspection Cloud Platform



The screenshot displays the 'Tunnel Cloud' web application interface. On the left is a dark sidebar with navigation options: 'Your work', 'Projects', 'Structures', 'Inspection', 'Settings', and an 'ADMINISTRATION' section containing 'Users', 'Projects', and 'Licences'. The main content area is titled 'Your work' and is divided into three sections:

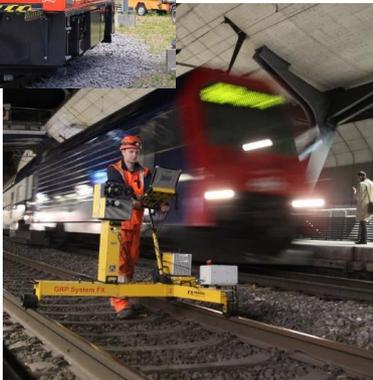
- Recent projects:** Features a map of a tunnel project labeled 'Private Railway' with a red line indicating the tunnel path.
- Recent inspection tasks:** A table listing tasks with columns for Name, Project, Structure, and Updated. One task is visible: '2010 Inspection\*' for 'Private Railway' at 'Kratlberg I\*' updated on '10/8/2019, 7:52:22 AM'.
- Recent inspection analyses:** A table listing analyses with columns for Name, Project, and Structure. Two analyses are visible: 'Inspection Overlay maps\*' and 'Inspection Chart - Block Based\*', both for 'Private Railway' at 'Kratlberg I\*'.

# AI - Detection of damages from Images

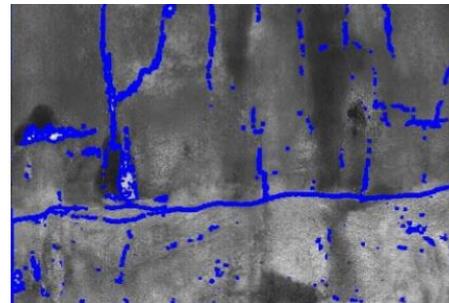
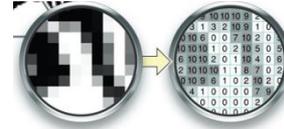
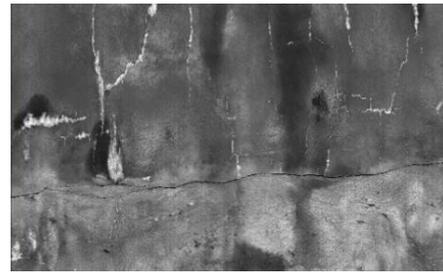
**Mobile Mapping**



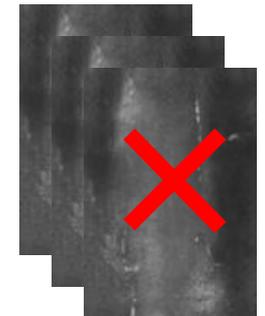
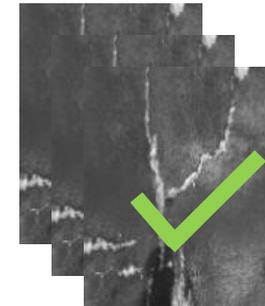
**Trolley**



**Classic**

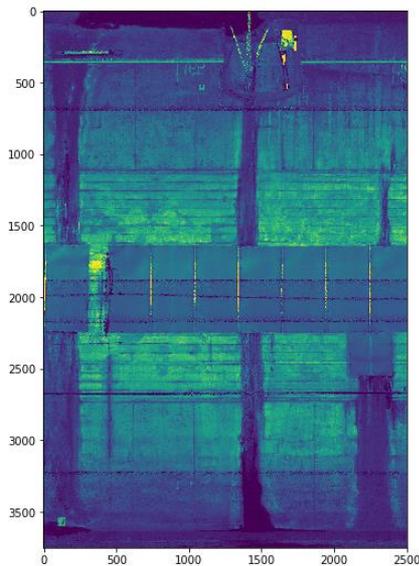


**Deep Learning**

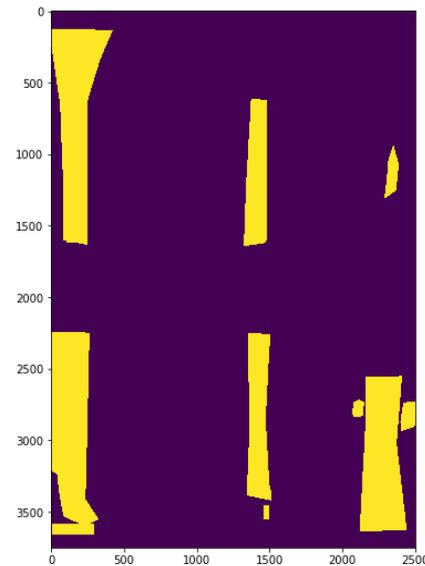


# Results – Wet areas

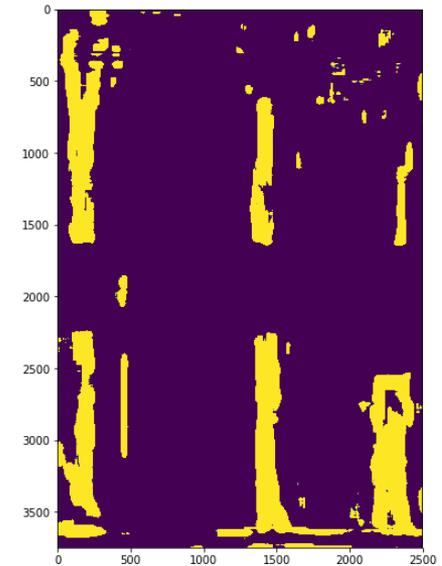
Input image



Inspection  
(manually)

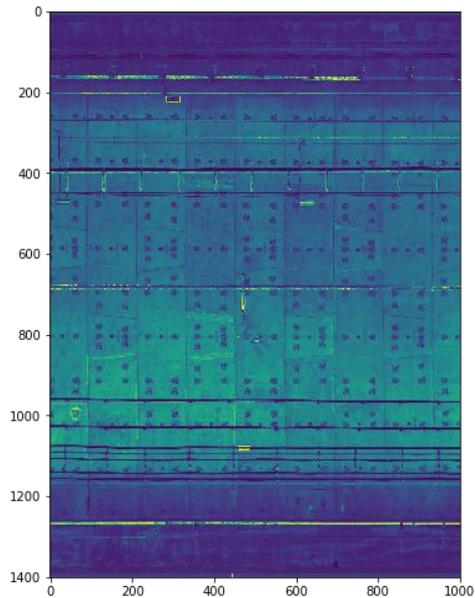


Deep learning  
(automatic)

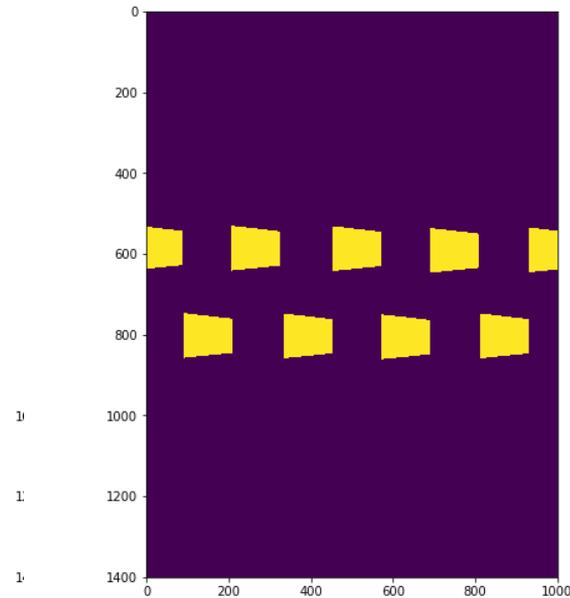


# Results – key stones

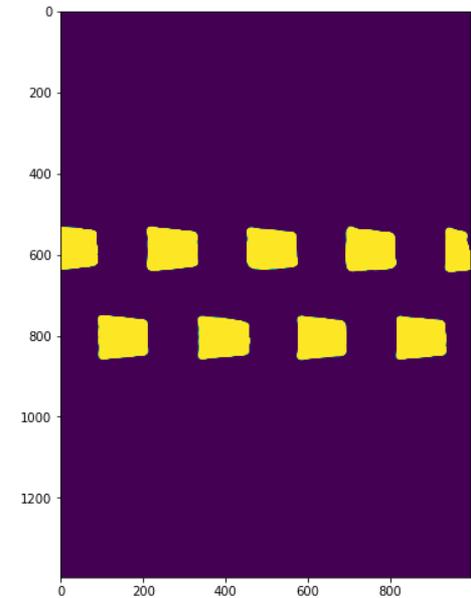
Input image



Inspection  
(manually)

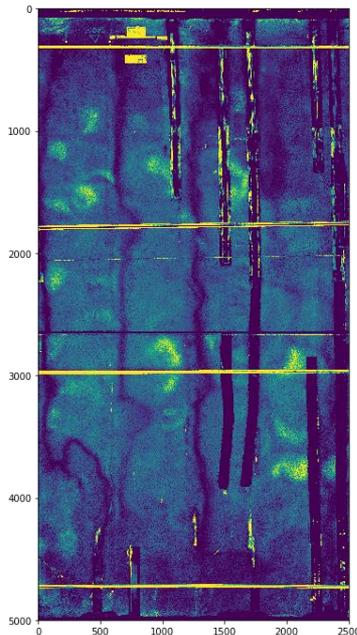


Deep learning  
(automatic)

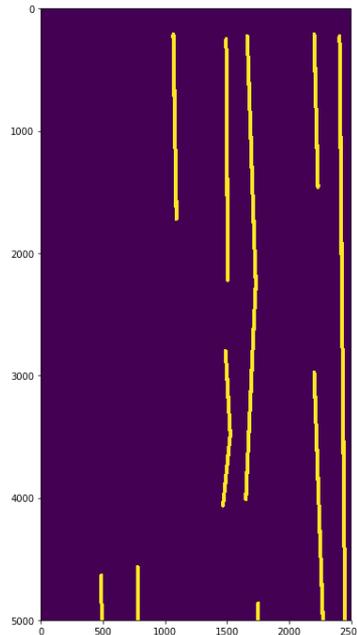


# Results – steel arches

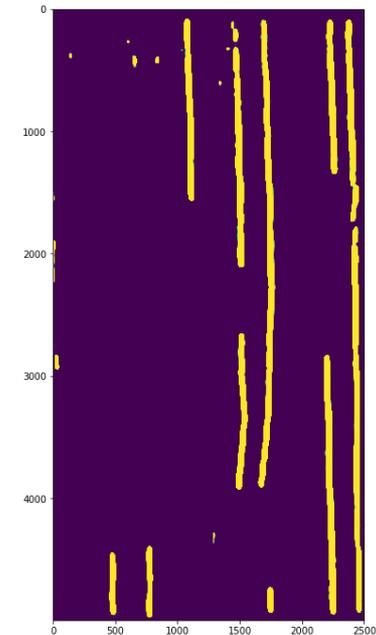
Input image



Inspection  
(manually)

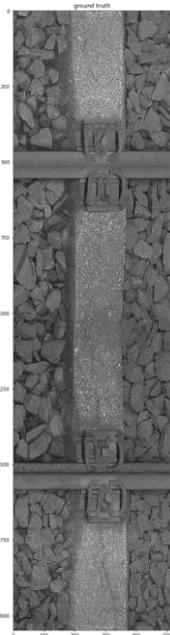


Deep learning  
(automatic)

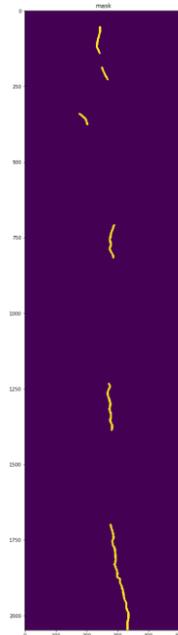


# Results – cracks in sleepers

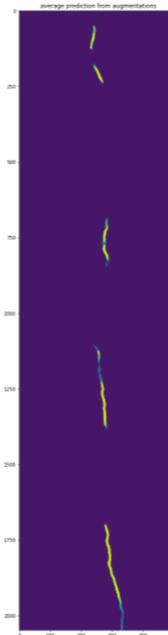
Input image



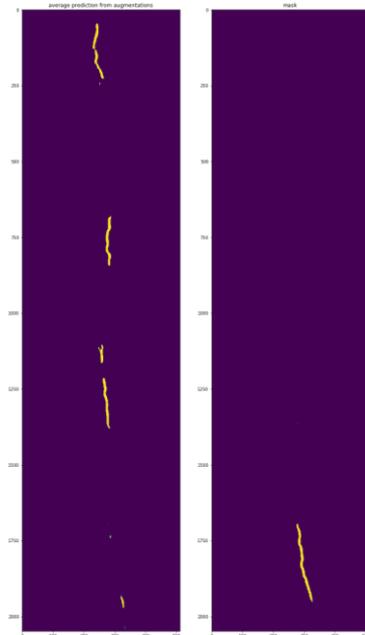
Inspection  
(manually)



Deep learning  
(automatic)



Deep learning Classification  
(automatic)



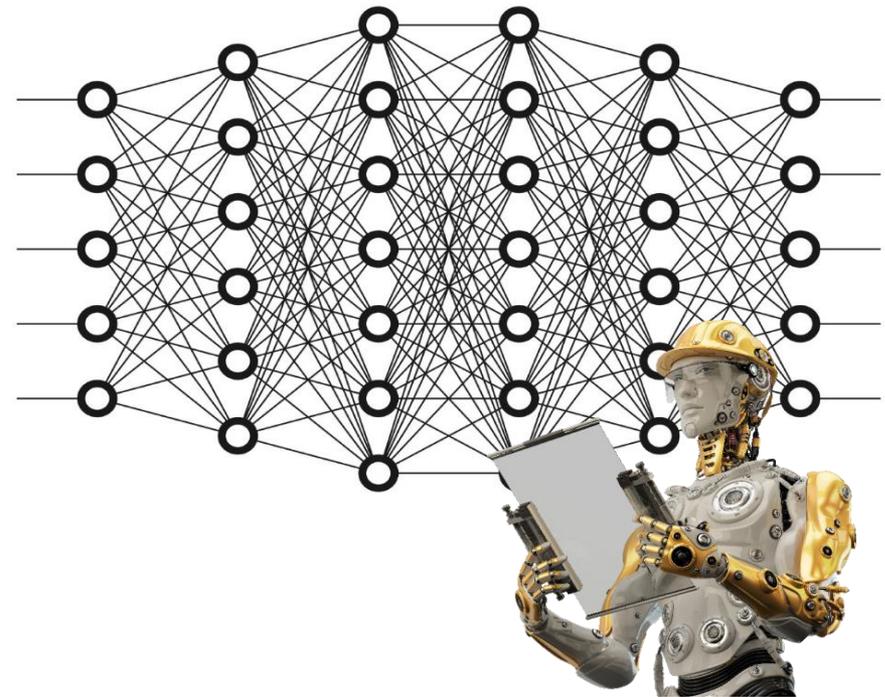


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# Main Achievements

- Increase efficiency by up to 60% when using Artificial Intelligence
- Use Amberg competence for training the neural networks
- Classification of entire infrastructure





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# Main Achievements

- Change tunnel inspection from periodically to event driven maintenance
- Decrease maintenance cost and increase safety



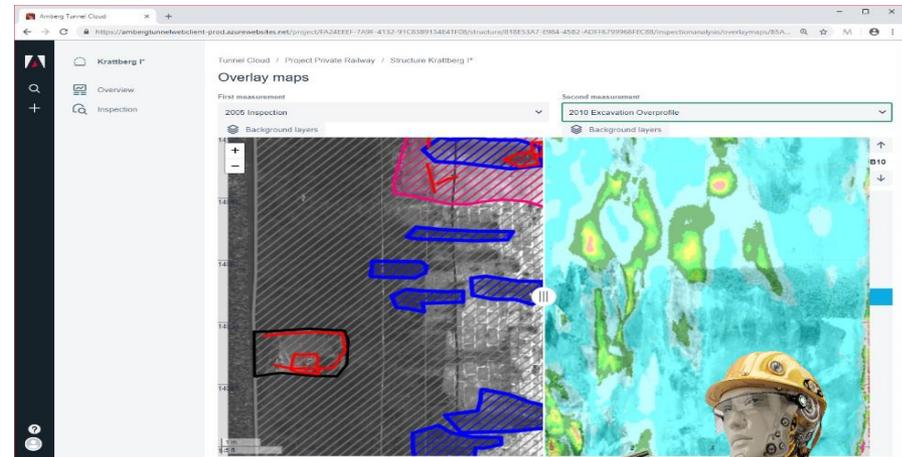


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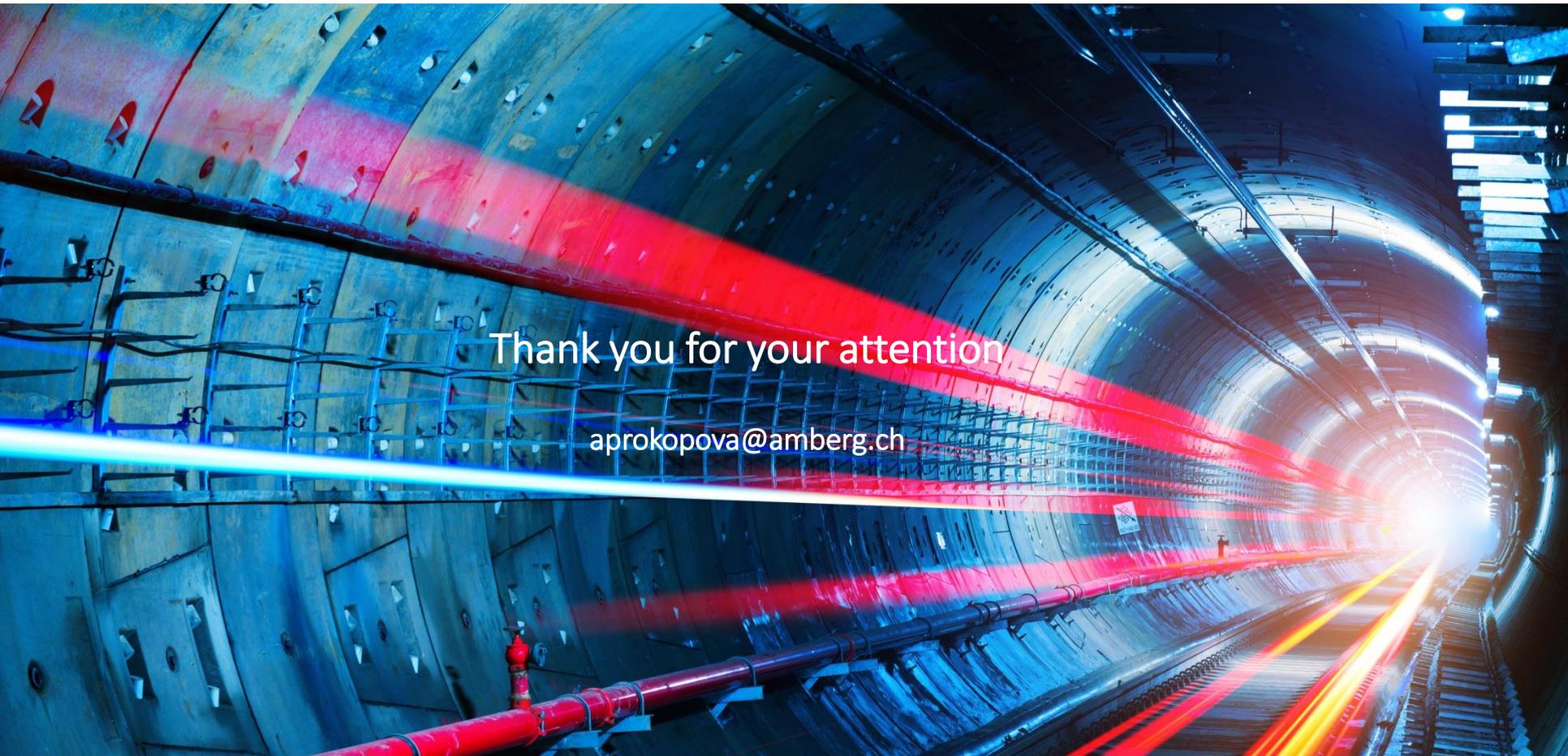
# Main Achievements

- Open database – support of Amberg Trolley and third party data
- Open API for intersection with other infrastructure (e.g. BIM2FM) tools





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Thank you for your attention

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Miami, USA 18<sup>th</sup> November 2019

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