AUSTRIA VIENNA 2024 IRSC INTERNATIONAL Railway Safety Council

RISE: Safeguarding structural health for steel bridges

DI Dr. Franz Forstlechner, ÖBB-Infrastruktur AG
DI Christoph Schwald, TÜV AUSTRIA HOLDING AG

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Vienna, Austria
Aula der Wissenschaften

DI Christoph Schwald

EVP R&D and Innovation, TÜV AUSTRIA HOLDING AG

- **Independent Austrian testing**, **inspection**, **certification** and **education services provider**
- +3,500 employees in +30 countries deliver **safety**, **security**, **quality** and **sustainability**
- **Innovator** of **testing services**, **processes** and **products**
- **Railway specialist**
  - Notified body for **ECM Certification** and **CSM Assessment**
  - **Inspection body ISO/IEC 17020**, **Certification body ISO/EC 17065**
  - **Designated/Notified/Assessment body** of entities responsible for maintenance & **IV railway package** of the EC
  - **Testing of infrastructure- & vehicle components**, overhead lines, bogies, damping systems, sleepers etc.; **cyber security** and **data science services** and much more

DI Dr. Franz Forstlechner

Bridges Specialist, ÖBB Infrastruktur AG, Austria

- With around 18,400 employees, we plan, develop, maintain and operate the entire ÖBB rail infrastructure; train stations, routes, buildings, terminals, telecommunication systems and hydropower plants for environmentally-friendly railways.
- We manage the total property assets and are therefore one of the largest property owners in Austria. In our company, the majority of ÖBB apprenticeships and the railway-specific, operational and technical training are integrated.
- On behalf of the federal government, we invest more than 3 billion euro into the Austrian rail network each year and provide state-of-the-art railway technology. ÖBB-Infrastruktur AG is a 100 percent subsidiary of ÖBB-Holding AG. It is wholly owned by the Republic of Austria.

Motivation of ÖBB Infra for a systems solution for Structural Health Monitoring (SHM) for Steel Bridges

Safeguarding structural health of bridge infrastructure is a key objective for a railway network operator.

Maintenance and reinvestment measures should be able to be carried out without affecting the ongoing operation of the railway network. This requires better data-based forward planning capability.

However, there is currently no data-based digital technical solution that can be widely used.

ÖBB Infra and TÜV AUSTRIA have taken on this challenge together…

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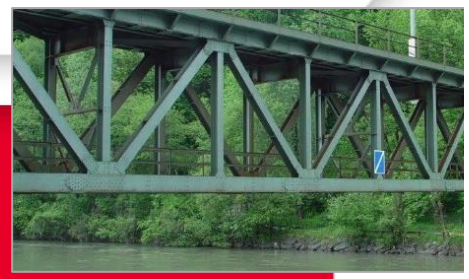
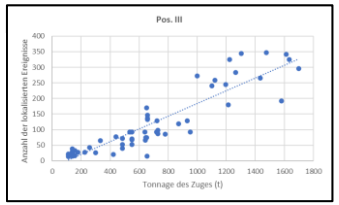
ÖBB INFRA TÜV AUSTRIA

Collaboration ÖBB Infra & TÜV AUSTRIA on Structural Health Monitoring (SHM) for Steel Bridges



2017-

- Proof that degradation under operational load (scheduled train crossings) can be detected with the acoustic emission method.

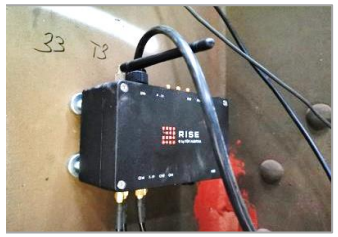


2021-

- Partner in Rail4Future, a funded research project initiated and led by ÖBB Infrastruktur AG / R&D with a multidisciplinary consortium: Technology development and verification on various bridges in the rail network, on bridge components in the lab and with large-scale tests.

2022-

- Development of a user friendly, robust and stand-alone systems solution for Structural Health Monitoring on steel bridges by TÜV AUSTRIA in close coordination with ÖBB Infra / Bridge construction & structural engineering: **RISE** (**R**emote **I**nspection **S**ystem **E**dge)



2023-

- First successful long-term monitoring projects with RISE in the rail network.

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Acoustic Emission Technology

- **Microscopic crack growth** releases ultrasound wave packets ⇨ **Acoustic Emission** (AE)
- Wave packets are detected by piezoelectric sensors
- Detection and localisation of **crack growth**

Structural Health Monitoring

- Monitoring the **material response** to **operational load**
- Assessing **structural integrity** and **rate of degradation**
- Monitoring enables
  - determination of **maximum utilization of remaining useful life**
  - **risk-based inspection, asset management** and **predictive maintenance** strategies

Acoustic Emission is a powerful technique to identify, locate and assess crack growth

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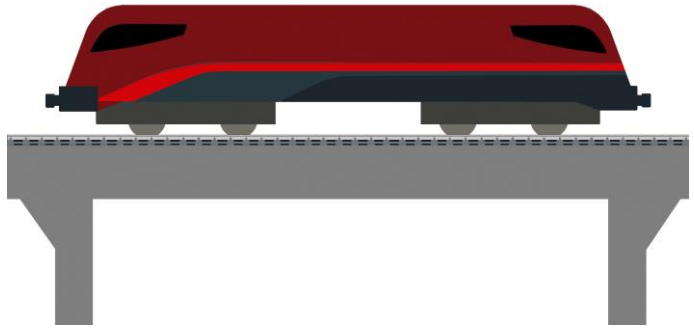

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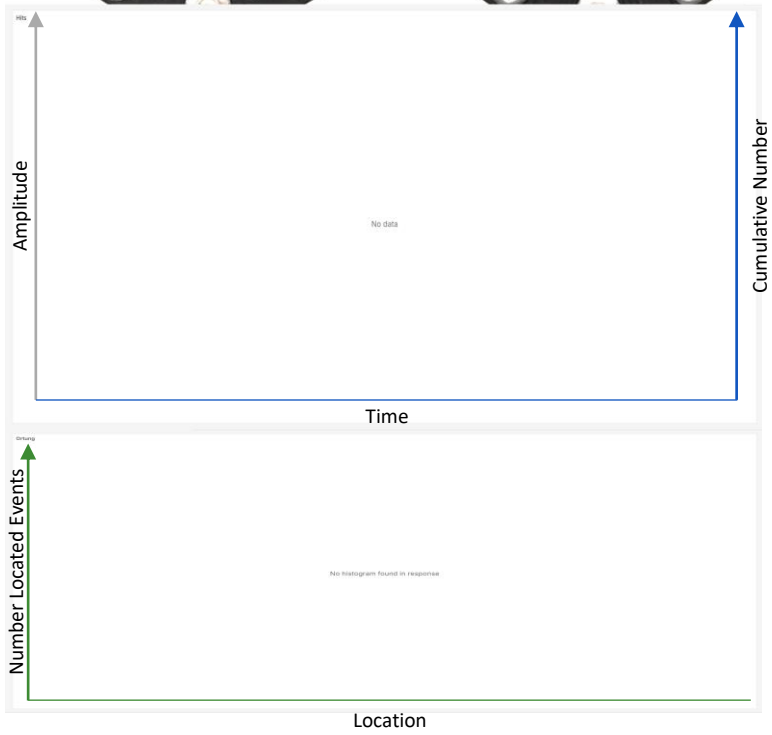

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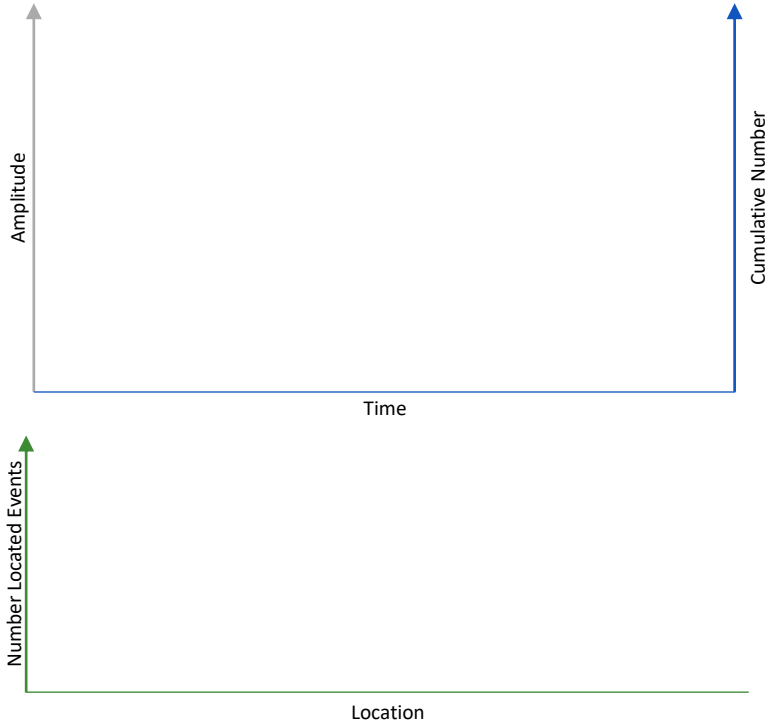

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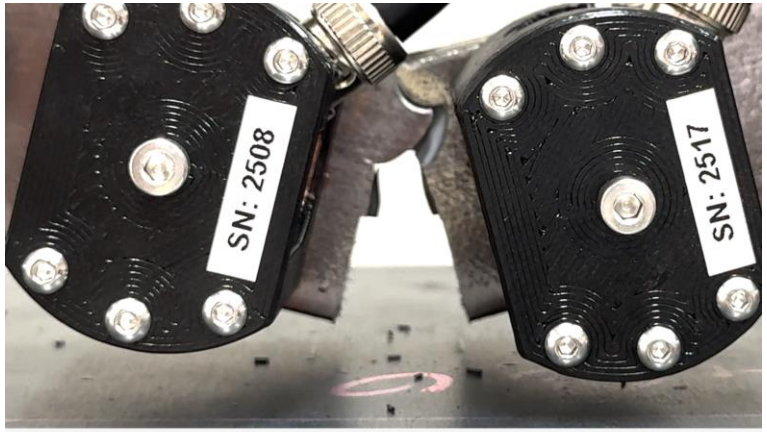

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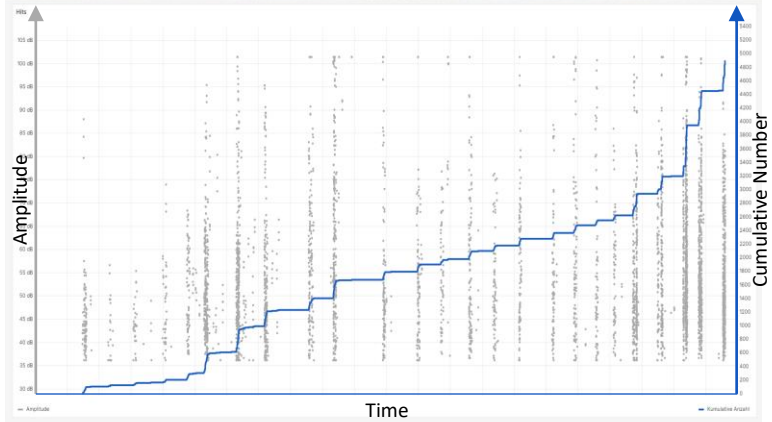

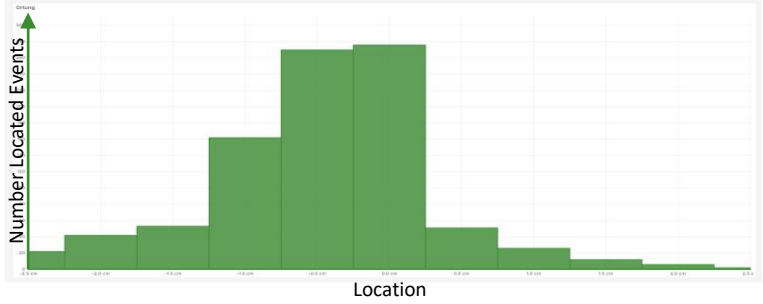

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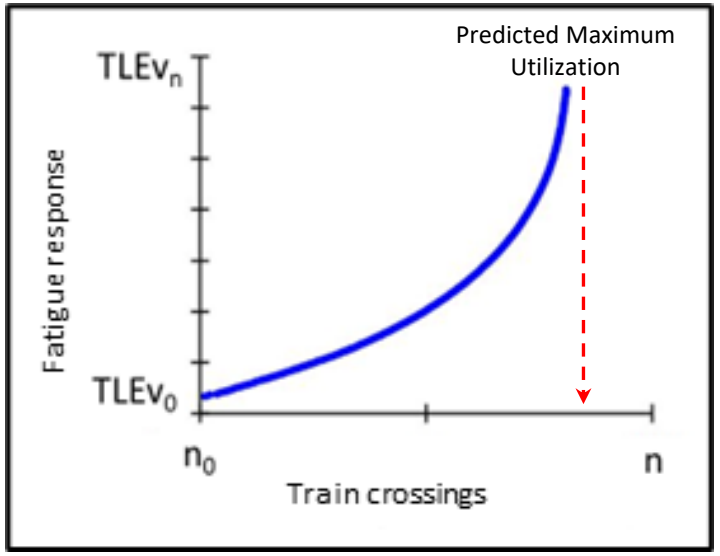
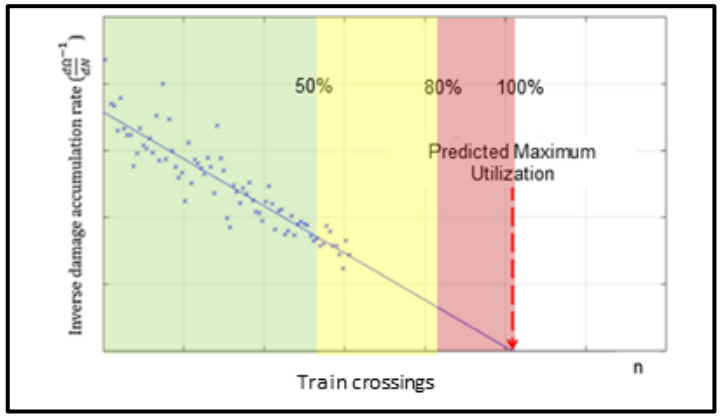
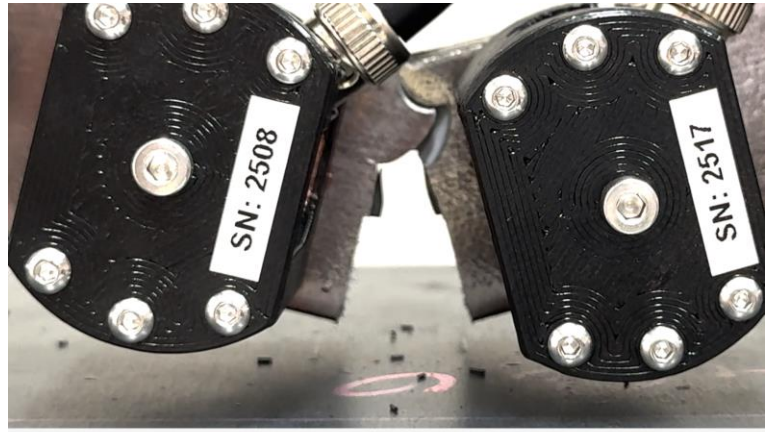
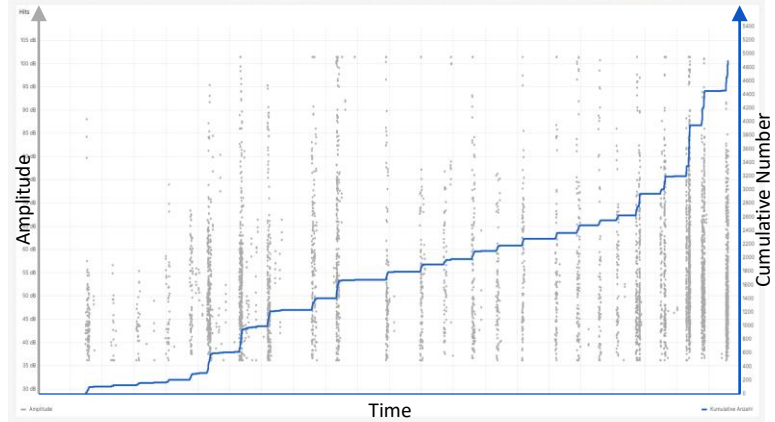
Maximum Utilization



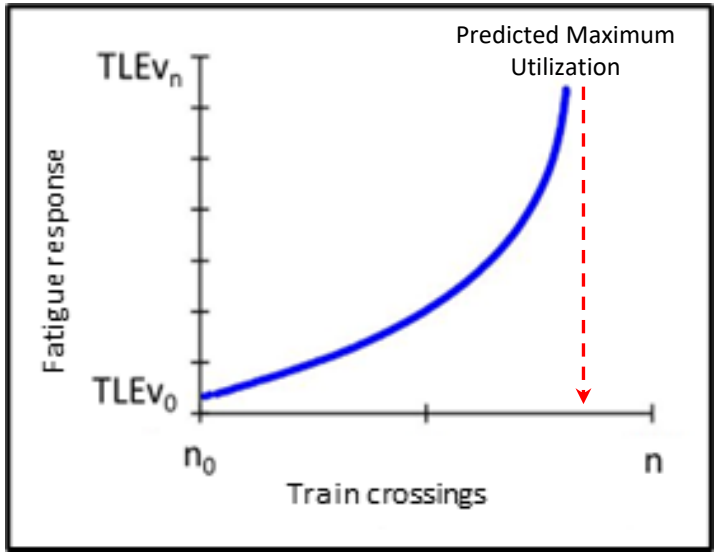


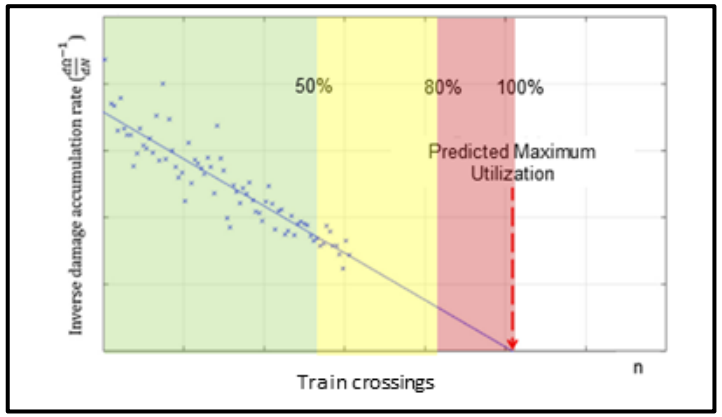




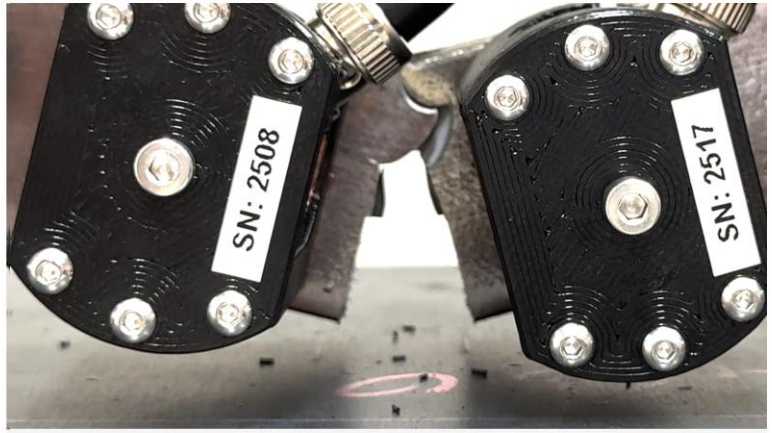
- Reference point is the beginning of the monitoring process
- The **recorded fatigue response** of the monitored area is **extrapolated to obtain the maximum number of train crossings** ⇨ **Maximum Utilization**
- Finally, the monitoring report states a recommendation for further actions with respect to the actual operational conditions given during the monitoring process.

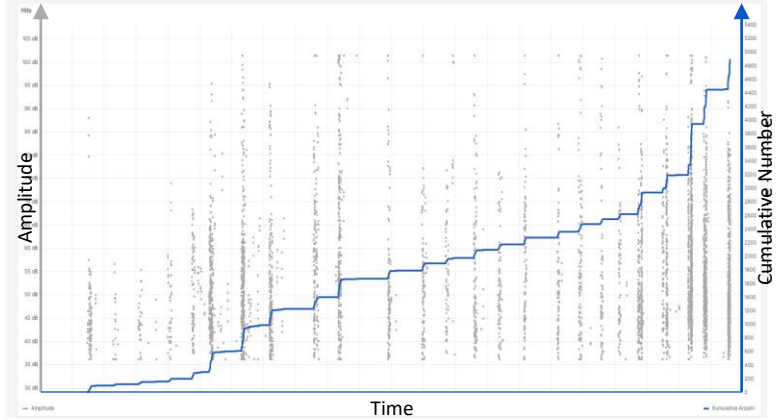
Assessment Scheme





If the method is applied consistently, the green zone is not left





Color Code	Condition	Recommendation
	Good	Next monitoring not later than in x years
	Fair	Inspection measures
	Bad	Inspection and safety measures

RISE Systems Solution

Data transmission via mobile network

Structural health status and trend analysis of the monitored area based on the operational conditions

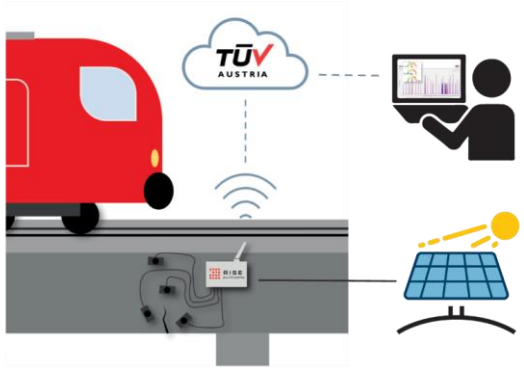
Sensors and RISE Device at the monitored asset

Data platform services for data acquisition
AI assisted computational models

tami web-interface:
Application specific monitoring Dashboards

RISE Systems Solution

RISE Device and Dashboard



Sensors, Device,
PV Power Supply

Rugged Transport Case

Quick & easy setup with
any mobile device

RISE is a **stand-alone system solution** for structural health monitoring based on acoustic emission technology.

The system is specifically designed for monitoring due to its **compact design, low power consumption** and **simple installation**.

RISE is a **unique system solution** for structural health **monitoring of hot spots / fatigue cracks**.

Use cases in the field

24/7 structural health monitoring for several months resulted in an assessment that no inspection or safety measures are required for the monitored area for the next 4 years

24/7 structural health monitoring on various positions for several months prove that application of corrosion protection within a given time period is justified

Summary & Take-Away

24/7 information on the condition of the bridge infrastructure increases the ongoing safety of railway operations.

Forecasting the maximum utilization of the existing bridge infrastructure enables the secured extension of the service life of steel bridges.

Reduction of track closures, reduction of special inspections.

Better advance planning of inspection, maintenance and reinvestment measures.

Easy-to-use overall digital solution optimized for daily use in bridge inspection.

RISE
® by TÜV AUSTRIA

Safeguarding structural health.
Anytime. Anywhere.

ÖBB INFRA

TÜV AUSTRIA

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Thank you for your attention!

Meet us at the RISE booth