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Data-driven evaluation with BEPROACT

11th Silesian Road Forum
21.04.2026 | Dr. Dirk Jansen & Jan Borchers | BASt

The BeProAct Project

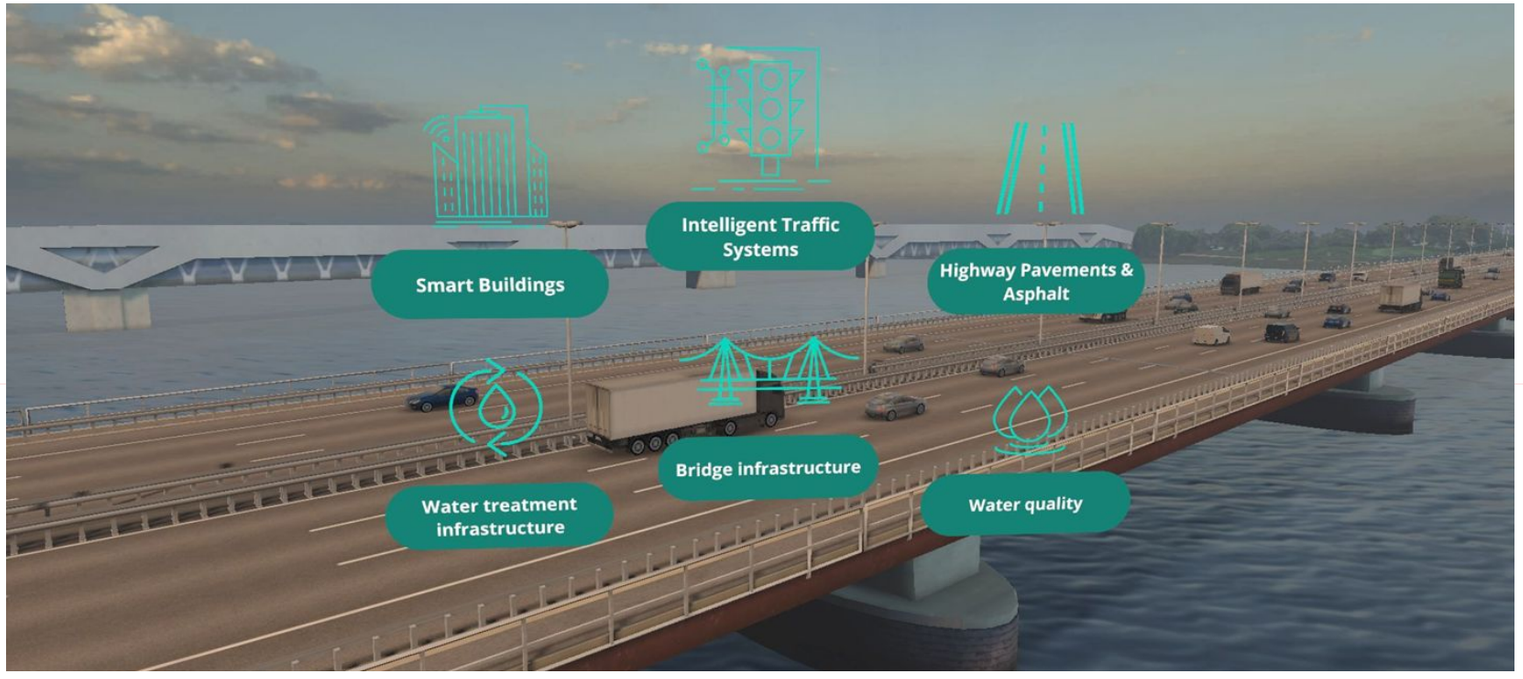
Building an Ecosystem to PROACTively develop data-driven asset management

- Interreg North-West Europe Project
- Total project budget: 10,2 million euros
- Project period: March 2024 to June 2027
- 11 partners from 6 countries

The BeProAct Project

Building an Ecosystem to PROACTively develop data-driven asset management

- 6 asset types
- 5 Pilot Cases in the Pavement Asset Cluster



Pilot Cases

- Asphalt Life Prediction models
- Pavement Structural Assessment Framework
- RFID sensor application in asphalt
- Low cost WIM (EasyWIM)
- Optic fiber sensors for pavements

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Pilot Case
Asphalt Life Prediction models

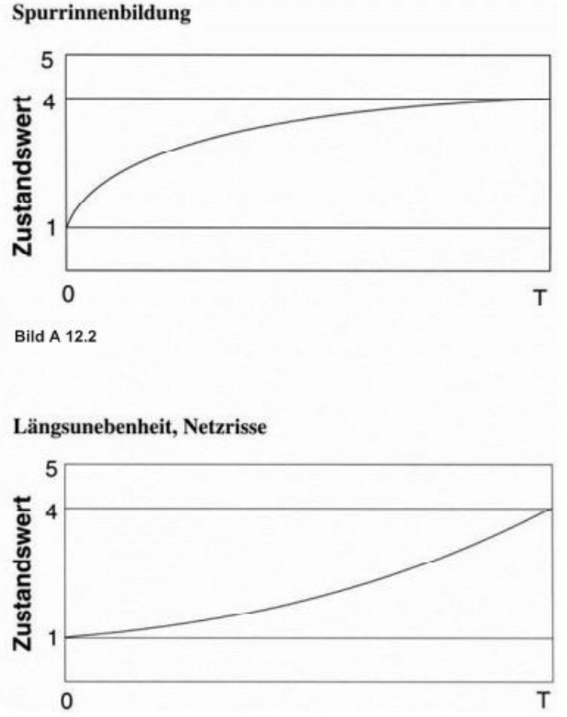
Asphalt Life Prediction models

Objective

- Predict the asphalt service life based on the surface condition at network level

Current Status

- Fixed functions are used to predict the future condition in the German Pavement Management System (PMS) for planning maintenance measures



Asphalt Life Prediction models

Approach

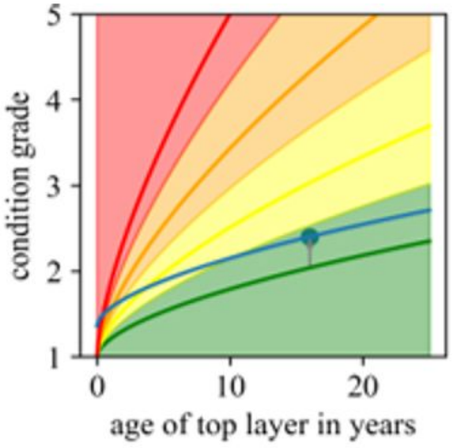
Preprocess data from the German network → Identify proper algorithms → Train algorithms on data → Test and validate the algorithms

- Condition data from the German condition measurements on network level are used
- In addition traffic data and construction data are used
- Neural networks and Markov matrices have been identified as promising algorithms for a prediction

Asphalt Life Prediction models

Results

- Newly developed algorithms are mostly better than the old approach
- There is a difference between the pavement surface characteristics
  - Rutting is comparably easy to forecast
  - Surface Cracking in road pavements at network level is hard to forecast



Publications:

- Borchers, J.-H., & Sotto, L. F. P. D. (2025). Transverse evenness prediction in asphalt pavement using an artificial neural network. In Eberhardsteiner, L., Hofko, B. & Blab, R. (Eds.), AM3P Proceedings (pp. 543-546). TU Wien, E230-03 Road Engineering. https://doi.org/10.34726/10560
- Torres-Alves, G. A., Lontra, B. M., & Borchers, J.-H. (2025). Pavement deterioration and service life prediction: A Markov probabilistic approach to rutting, cracking, and unevenness. In Li, Y. & Frangopol, D. M. (Eds.), IALCCE Proceedings. https://doi.org/10.1201/9781003595120-19

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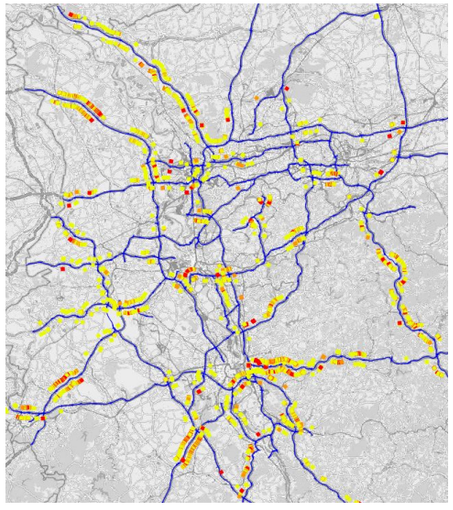
Pilot Case
Pavement Structural Assessment Framework

Pavement Structural Assessment Framework

Objective

- Development of a framework to incorporate TSD measurement data into a network-level structural assessment of flexible pavements.



Current Status

- The existing pavement evaluation method in Germany is based on the surface condition of the pavement only

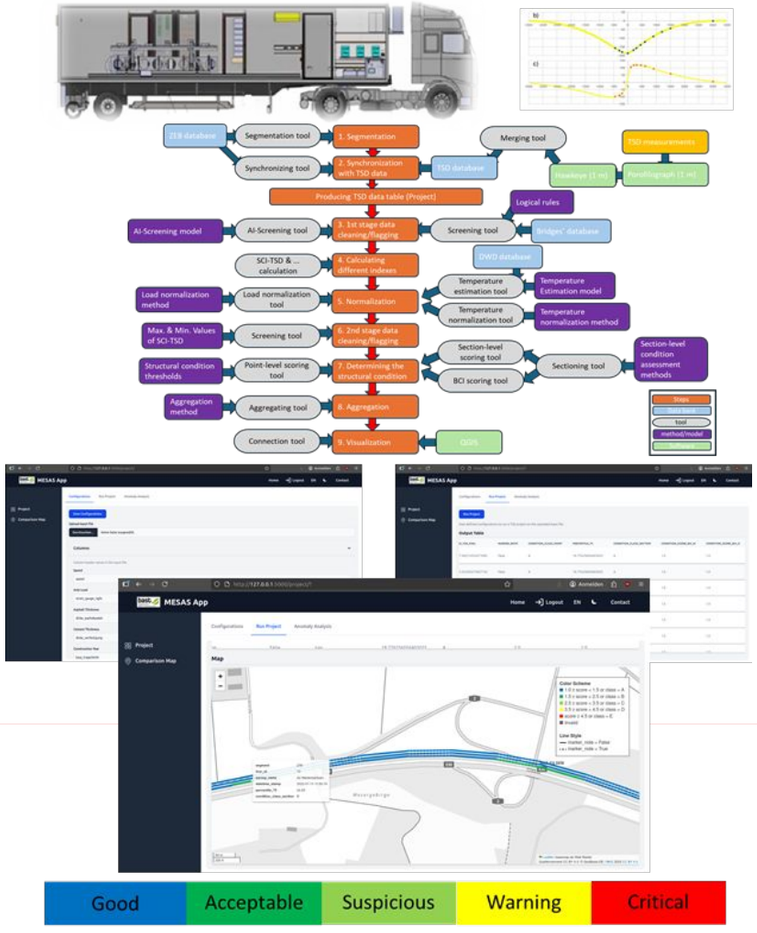
Use existing TSD for measurements → Develop a framework → Testing the Framework → Develop a product based on the framework

Pavement Structural Assessment Framework

Results

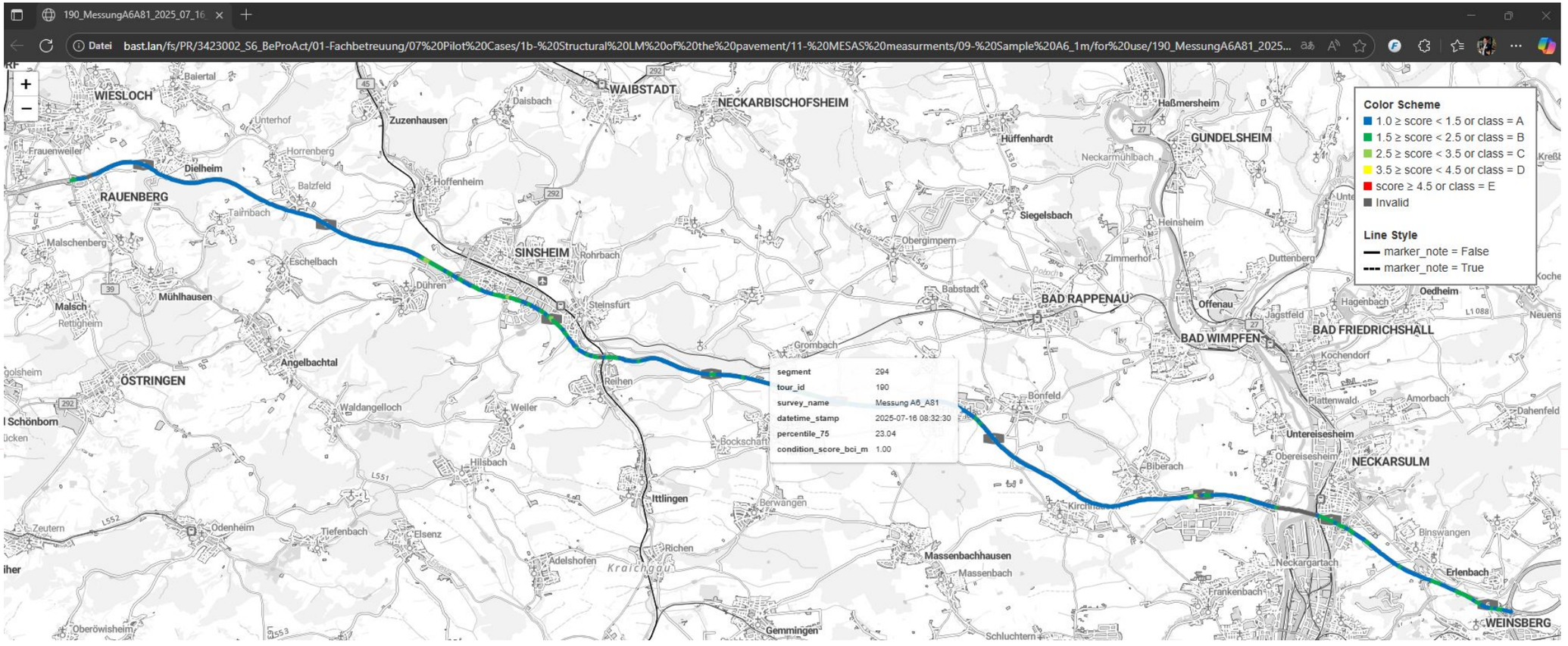
- Framework contains
  - AI-Driven Anomaly detection
  - Temperature normalization model
  - Calculation of the Bearing-Capacity-Score and Condition Class

- Framework is disseminated in an installable tool with a User Interface (UI)



Pavement Structural Assessment Framework

Results



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Pilot Case
RFID sensor application in asphalt

RFID sensor application in asphalt

Objective

- Explore the usability and application of RFID sensors (measuring temperature)

Approach

- Testing for different kinds of sensors with different frequencies
- Development of an encapsulation method (epoxy, PMMA)
- Determination of how RFID sensors can effectively and practically be embedded in road pavement layers during the paving process of a test track

RFID sensor application in asphalt

Results

- Initial results show promising signal reception from the sensors; however, further research is required

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Pilot Case
Low cost WIM - easyWIM

Low cost WIM (easyWIM)

Objective

- Development of a low-cost system for monitoring vehicle weight for the use in pavement design and structural assessment

Current status

- 21 WIM stations across Germany
  - High-quality data
  - High effort for installation and maintenance
  - Cost-intensive
- easyWIM aims to lower this barrier
  - Non-invasive
  - Less disruptive
  - Cost-effective

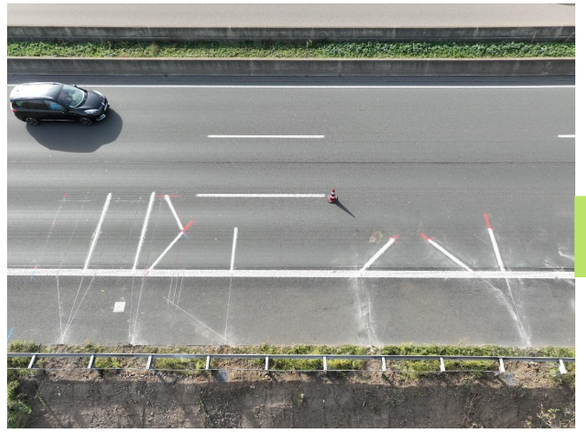
Low cost WIM (easyWIM)

Approach

- **Idea**
  - Weigh vehicles non-invasively using roadside ground vibrations.
- **Input**
  - Seismic Data: 3D roadside geophones
- **Method**
  - EasyWIM-Net: A custom CNN that fuses seismic and speed data to directly predict gross vehicle weight.

Low cost WIM (easyWIM)

Measurement and Dataset

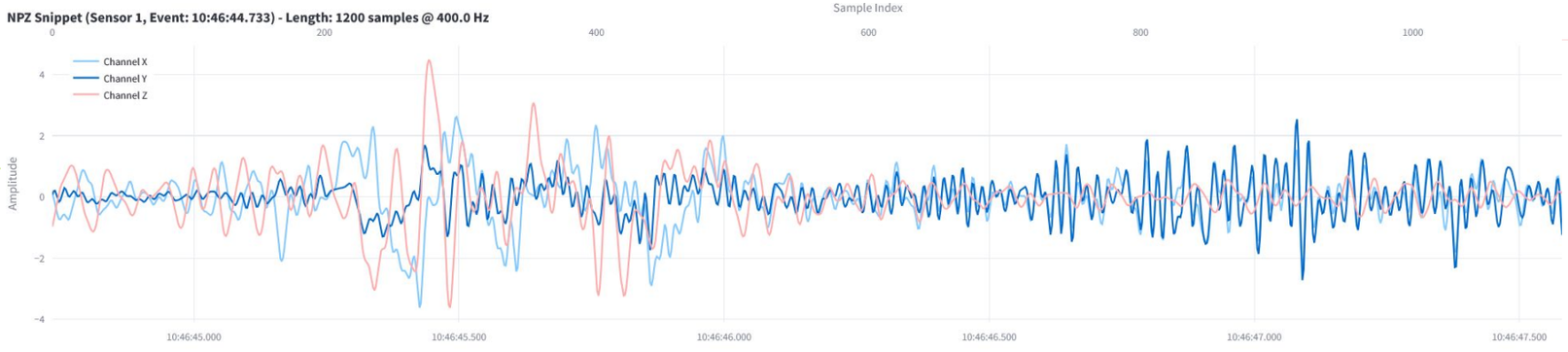


Reference System – Metadata (Ground truth)

- Event Timestamp: 2025-04-30 10:46:44.733
- Speed (km/h): 85.00
- **Weight (label): 14784.00**
- Vehicle Length: 16.969
- Axles Count: 4

Identify correlation and fit a neural network that predicts vehicle weight based on seismic measurements

Seismic sensors next to the road



Low cost WIM (easyWIM)

Results

- Strong correlation between seismic weight predictions and ground-truth WIM measurements

Conclusion

- Reliable weight prediction directly from ground vibrations
- Promising for infrastructure monitoring and screening

Publication:

Jablkowski, B., Fazekas, A., & Oeser, M. (2026). EasyWIM: Non-Invasive Vehicle Weight Monitoring via Seismic Sensing and Neural Networks. *Proceedings of the TRA 2026 Conference (to appear).*

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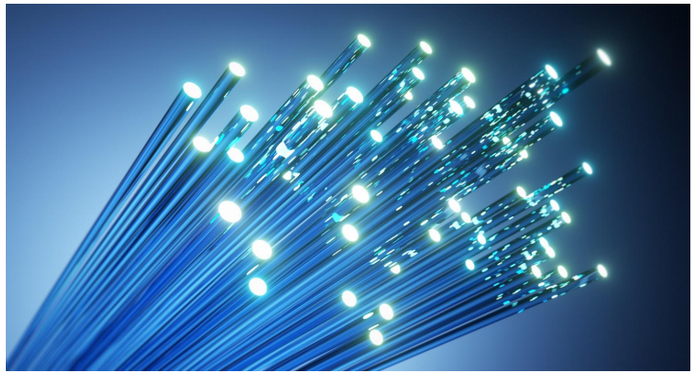
Pilot Case
Fiber optic sensors (FOS) for pavements

Fiber optic sensors (FOS) for pavements

Objective

- Explore the possibilities and limitations of fiber optic sensors in road pavements and their use for data-driven asset management.



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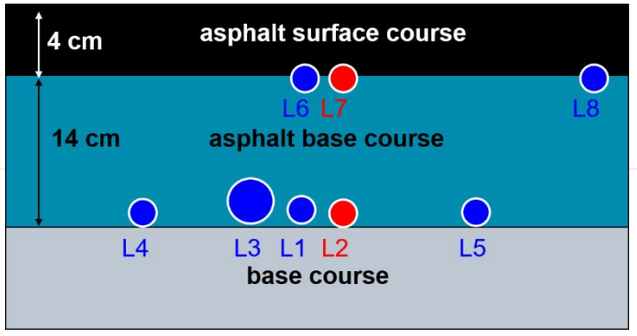
Approach

- Installation of FOS in asphalt and concrete pavements at the duraBASt test site

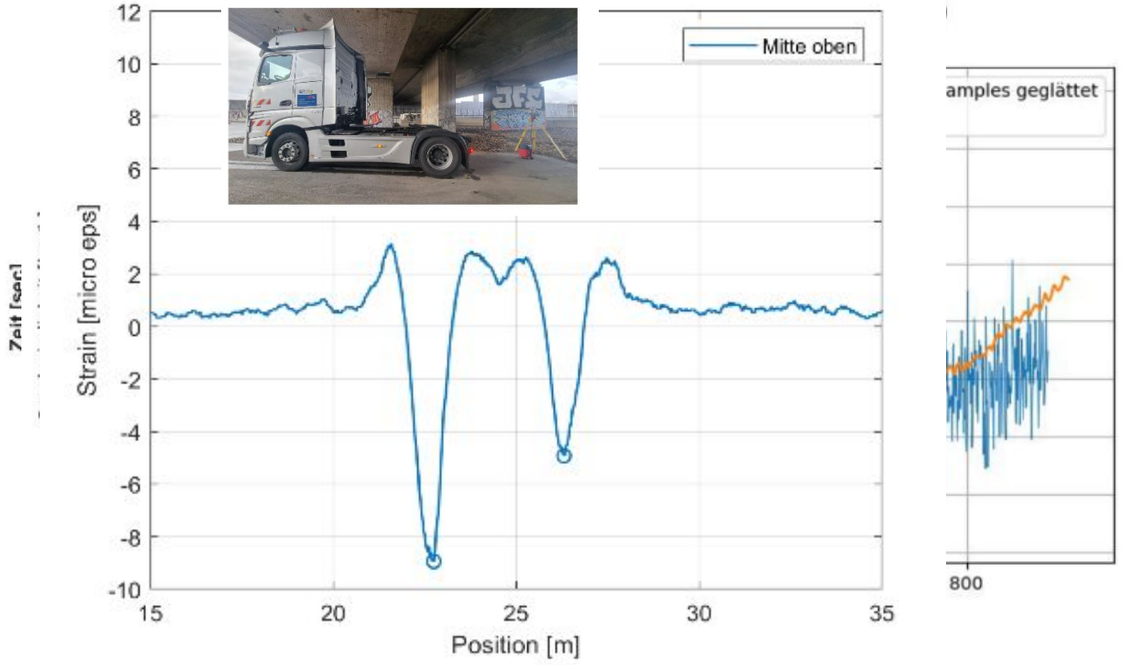


- Conduct test drives with defined loads on the pavement

Fiber optic sensors (FOS) for pavements

Results

- FOS are easy to install but the analysis is challenging
- FOS can measure many things
  - Position of vehicles
  - Speed of vehicles
  - Axle loads of vehicles
- Very promising measurement te



Publication:

Jansen, D., Ork, J., Oeser, M., Lienhart, W., Strasser, L., Lipus, M., Ganzer, M., & Agreiter, A. (2025, November). *Investigations into the use of distributed fibre optic sensors for detecting strain conditions in road structures* [Preprint]. engrXiv. https://doi.org/10.31224/5875

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Thank you!

I look forward to the joint discussion.

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