MINE.IO
A Holistic Digital Mine 4.0 Ecosystem

TU BERGAKADEMIE FREIBERG
TUBAF
The University of Resources.
Since 1765.

Integrating a Drill Rig into the Digital Mine 4.0 Ecosystem

SME Annual Conference – 24th February 2025

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Co-funded by the European Union

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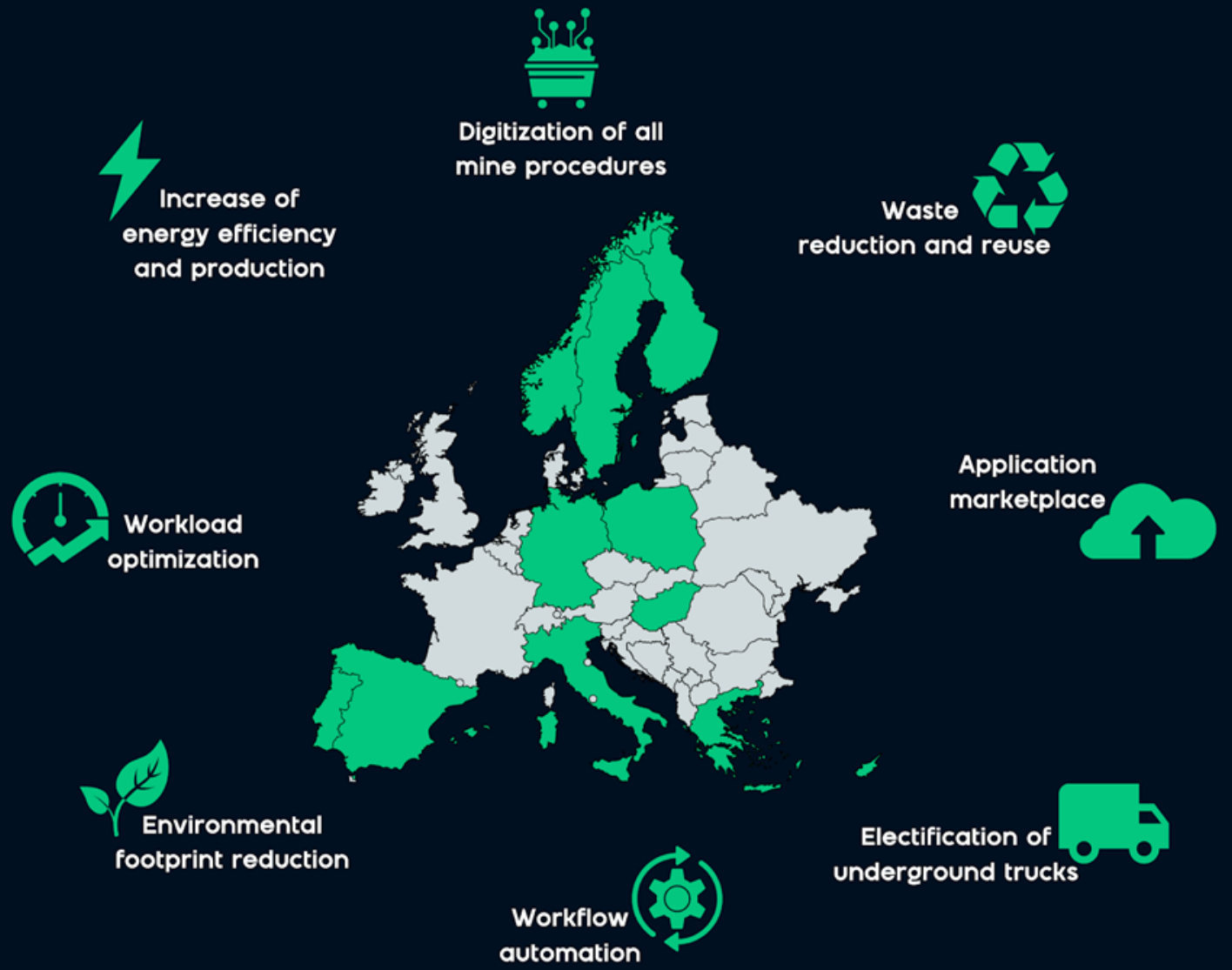
Mine.io aims to provide solutions that will build a novel mining digital ecosystem and a systemic structure for the implementation of Industry 4.0 in mining industrial environments.

- 25 partners
- 7 pilot use cases
- €14M budget
- 42 months



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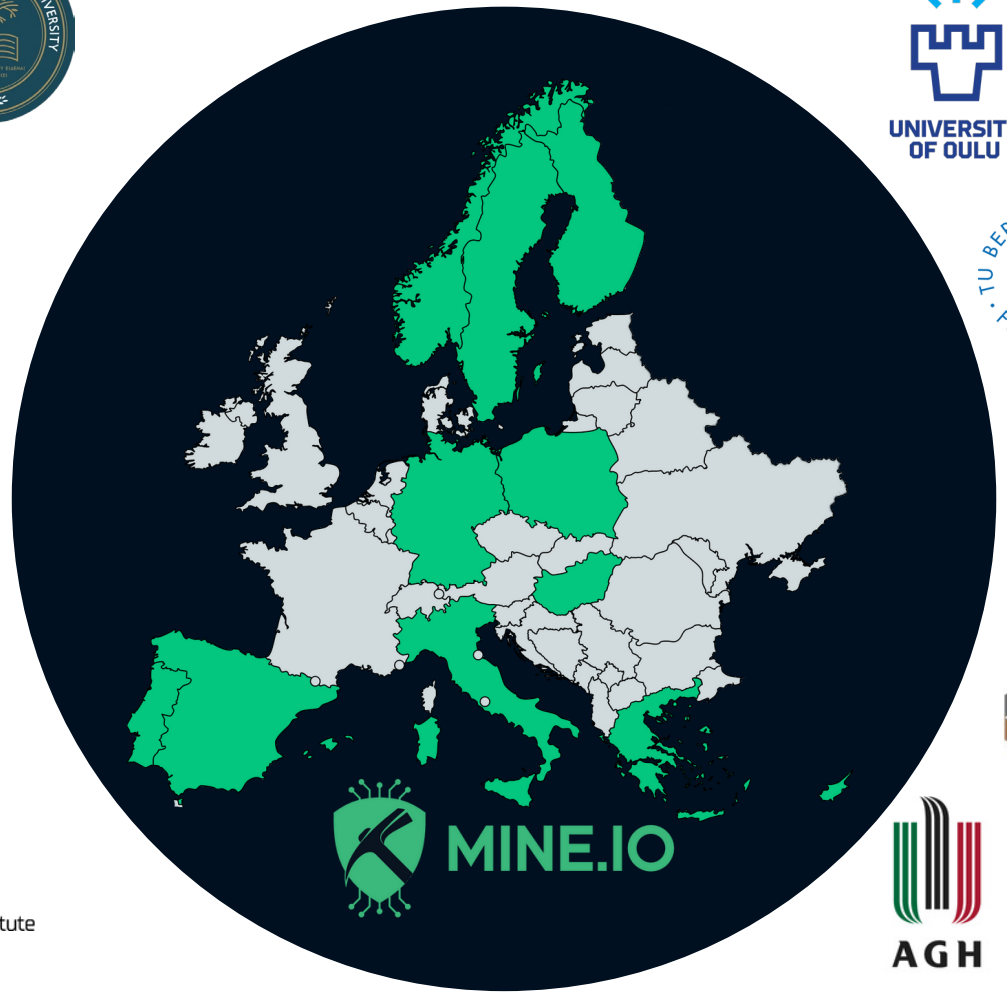
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Pilot Site - Research and Education Mine

- TU Bergakademie Freiberg (TUBAF)
- Partners :
  - Lulea University of Technology (LTU)
    - Material Evaluation during Drilling
  - Institute of Communication and Computer Systems (ICCS)
    - Predictive Maintenance
  - Jotne Connect, Innov-acts, Frontier Innovations and LTU for integration into the Mine.io platform

https://en.wikipedia.org/wiki/Saxony#/media/File:Locator_map_Saxony_in_Germany.svg

Research and Educational Mine (FLB)

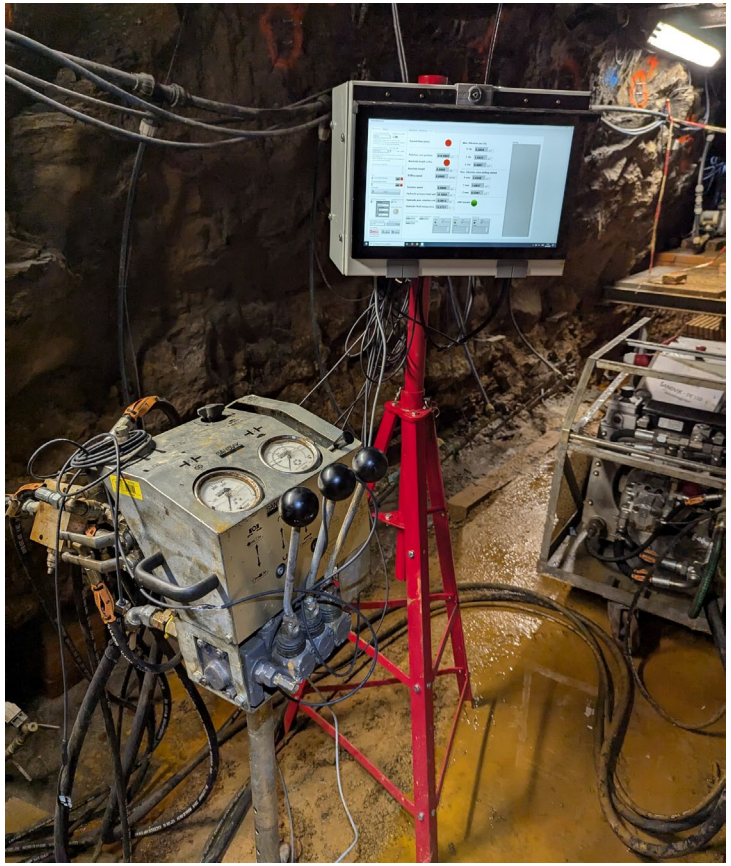
- 1,270 km of horizontal routes in the past
  - 129 km of open horizontal routes
  - 19 km used for research
- 15 levels to a depth of 750 m
  - 5 levels still accessible
- 33 underground labs
- 48 international partners from 26 countries

Digitisation of Drilling Operations

- Equip the Sandvik DE110 with a data acquisition system
  - Add sensors and data logging system to the drill rig
  - Real-time measurements and transmission to the cloud
- Operate the Sandvik DE110 in the mine
  - Test drilling at well known location
  - Test drilling with different drill bits (new & used)

Digitisation of Drilling Operations - Objectives

- Provide detailed status information to the operator
- Increase the efficiency of the drilling process
- Get a faster learning curve for new operators
- Evaluate and analyse the rock being drilled in real time
- Analyse the wear of the drill bit in real time



Digitisation of Drilling Operations – Material Evaluation during Drilling

- Using advanced tools for data filtering and normalisation
- Drilling situation evaluation through AI-supported analysis
  - Identifying the boundaries between the ore vein and the host rock
  - Identifying the rock quality (e.g. fracture zones)

Digitisation of Drilling Operations – Predictive Maintenance

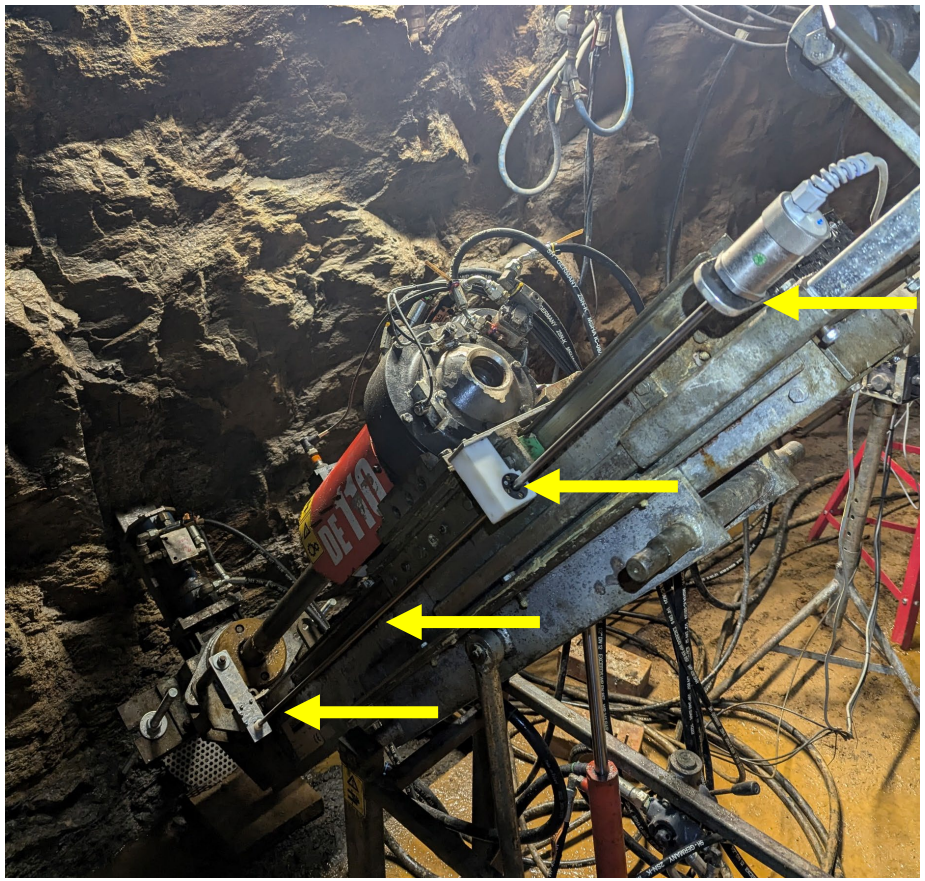
- Predictive Maintenance module is implemented in the form of
  - A machine learning analytics process development tool
  - Automated machine learning (AutoML)
  - Deep learning
- Identify actual equipment degradation and predict future health status
  - Detects anomalies, predicts the wear of the drill bit, and provides recommendations about maintenance actions

Digitisation of Drilling Operations

Different sensors are installed

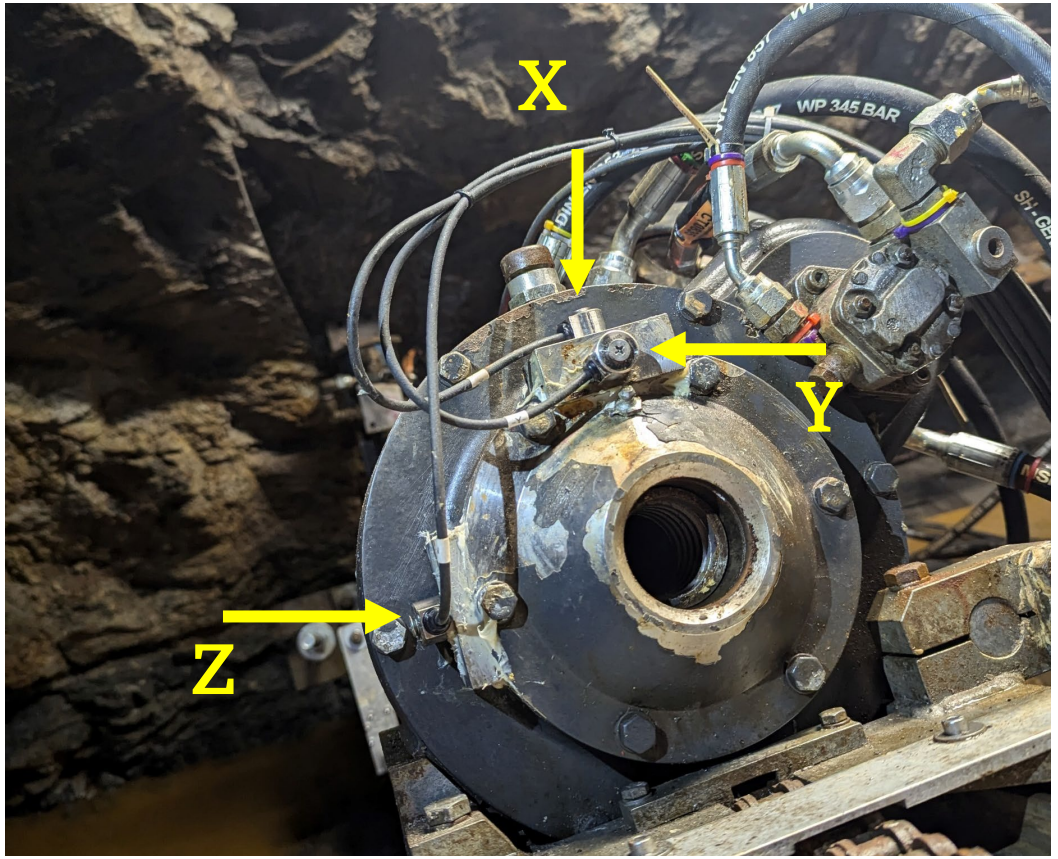
- Displacement transducer - drilling length and penetration speed
- Accelerometer - Drilling rig vibration
- Rotational speed - Drill rod speed
- Hydraulic pressure sensor - Hydraulic pressure on 2 circuits for the rotation unit and the bar chuck
- Temperature sensor - Temperature of the hydraulic circuit in front of the radiator

Installation of a Displacement Transducer



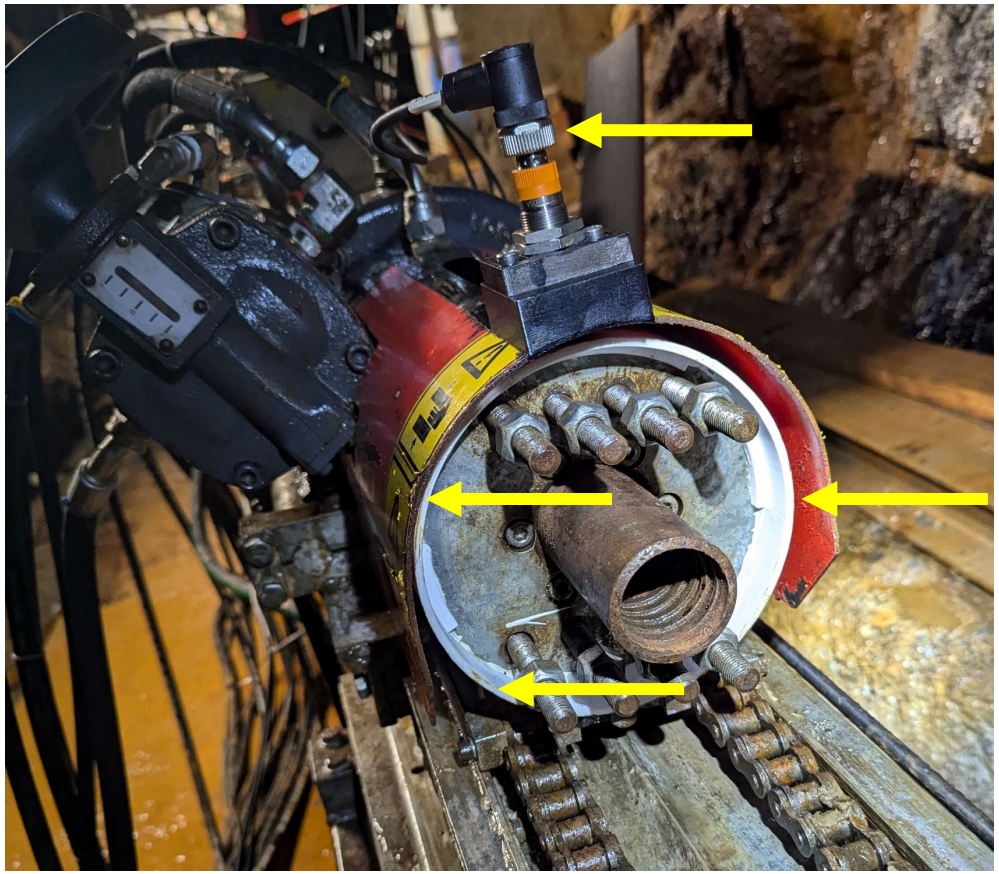
Installation of Accelerometers

- Acceleration sensors are installed in 3 directions

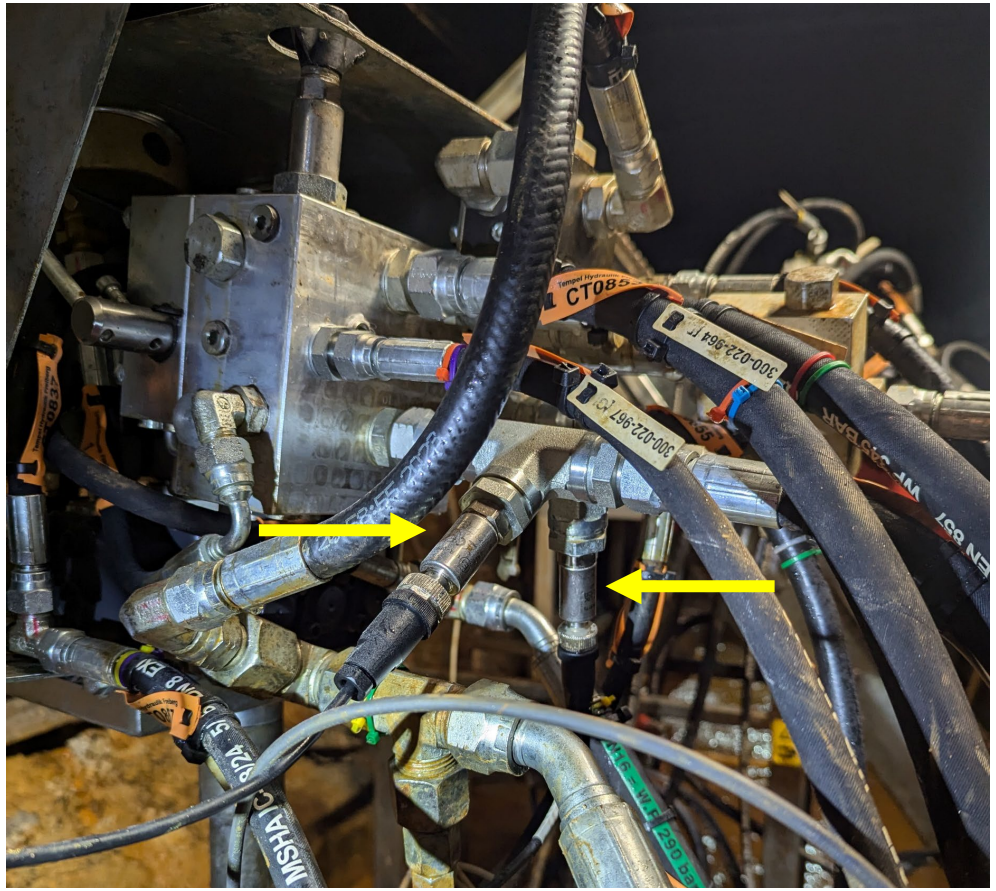


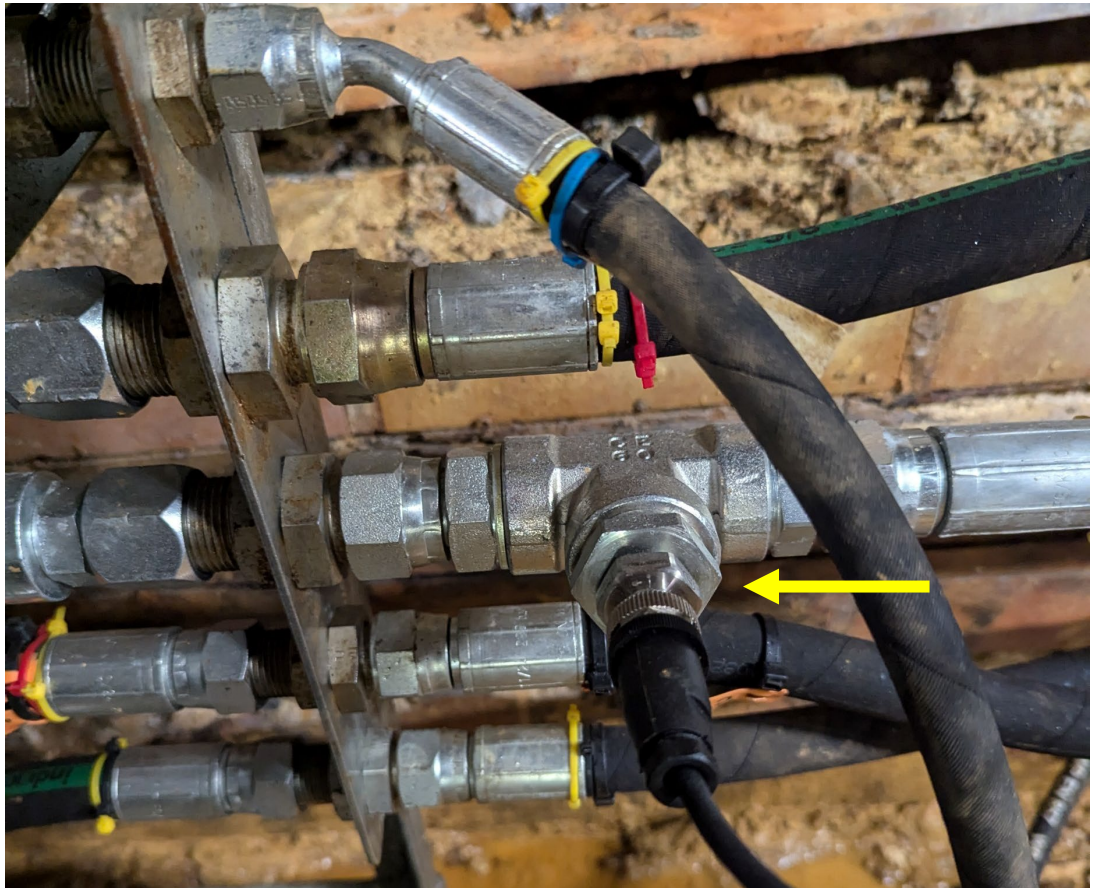
Installation of Rotational Speed Sensor

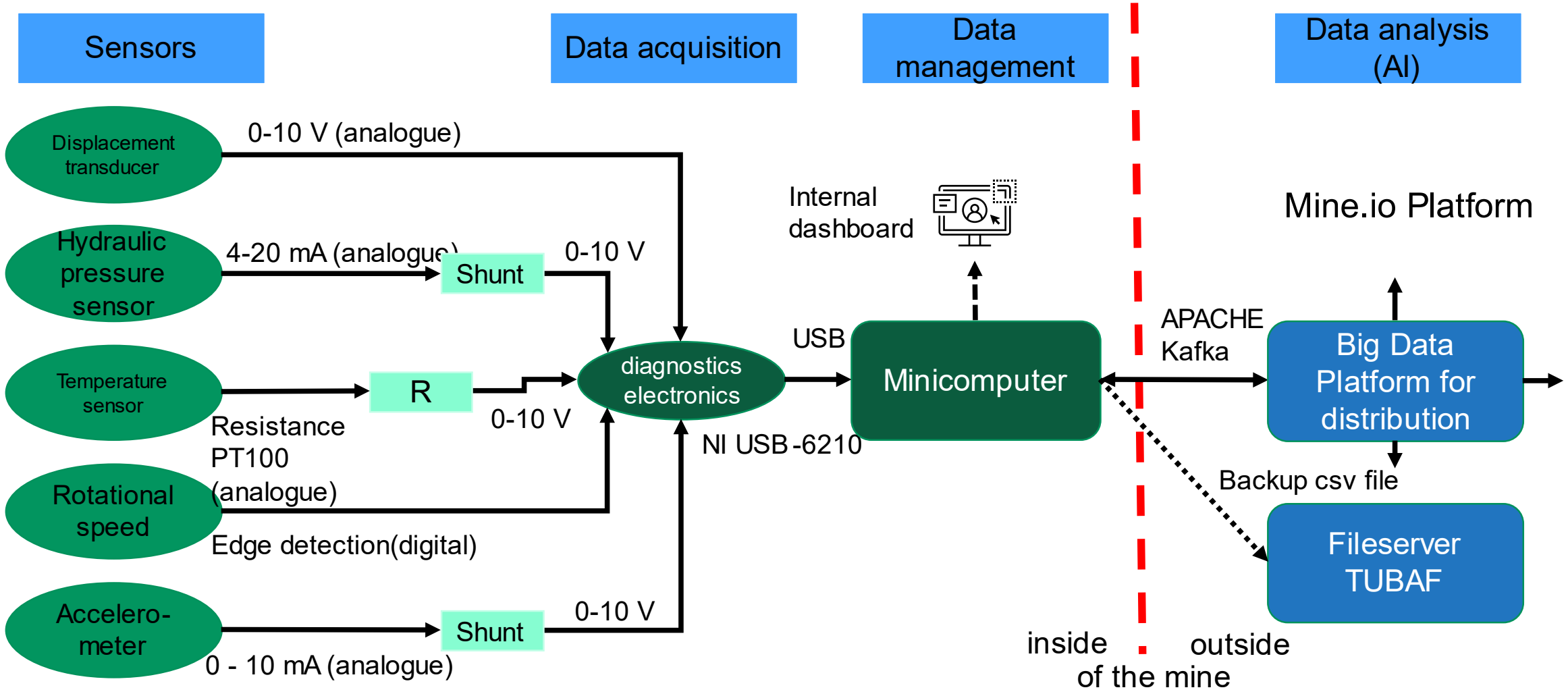
- Bearing less inductive rotary encoder
- Disc made of POM material with inserted metal strips as pulse generator

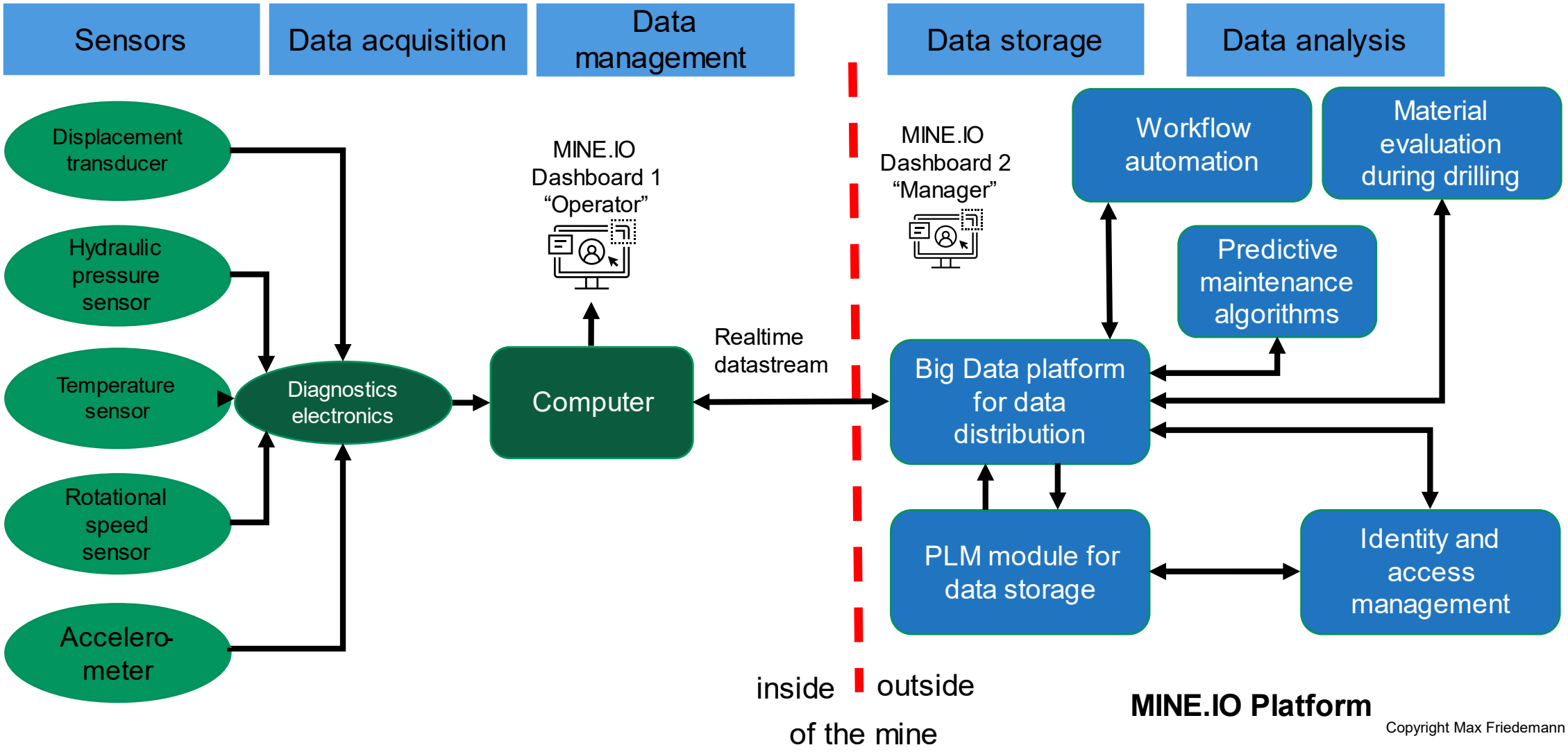


Installation of Pressure and Temperature Sensor

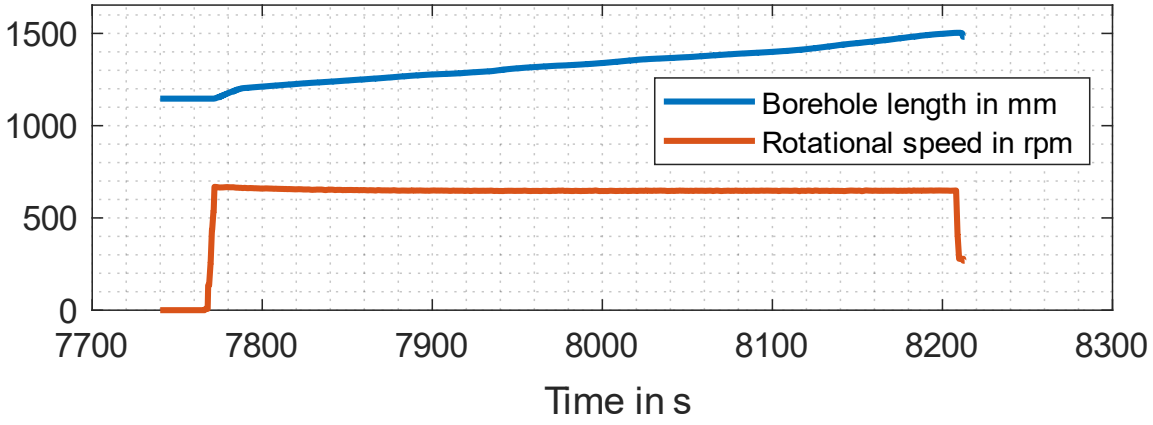


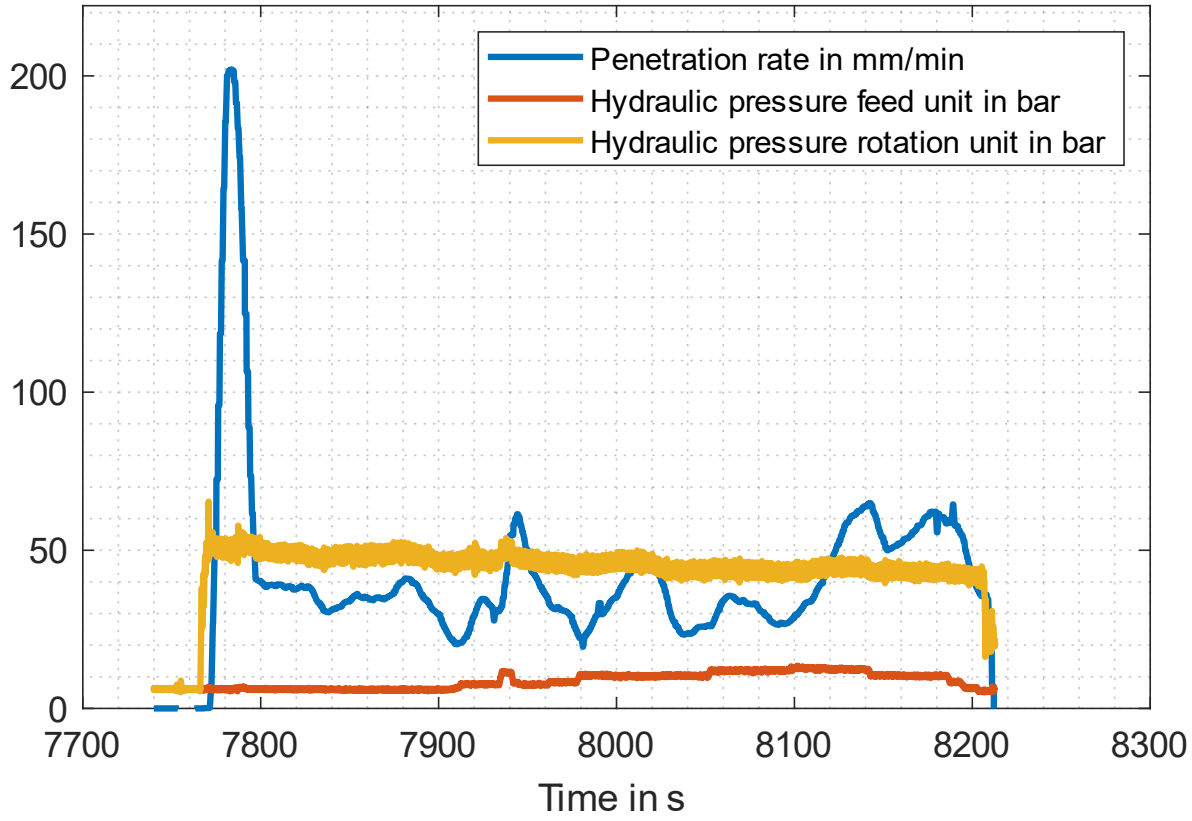






Data Analysis – First borehole – One section





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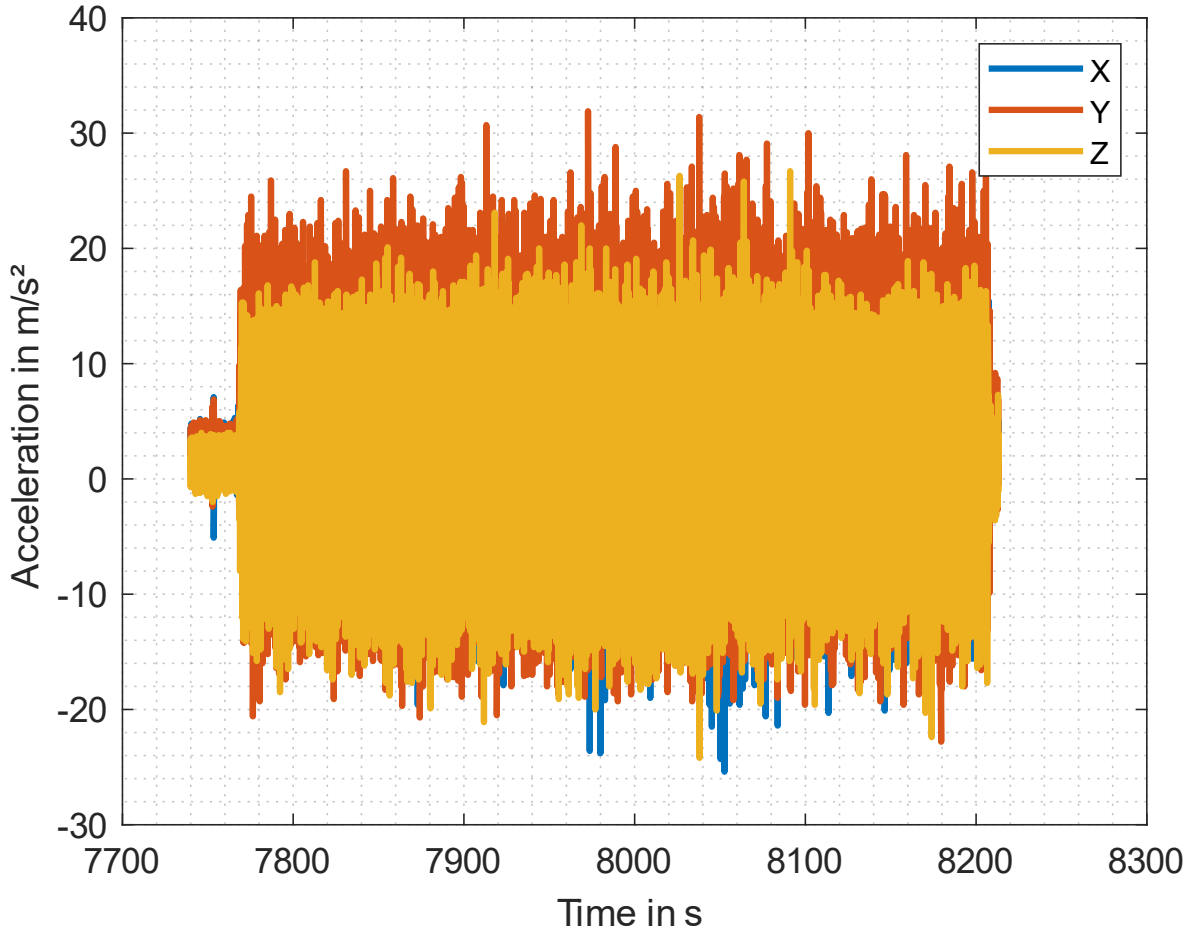

Digitisation of existing (old) devices

Proving the concept - digitisation of old machinery and integration into the digital mine is possible!

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Glück Auf!

Thank you for your attention!

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