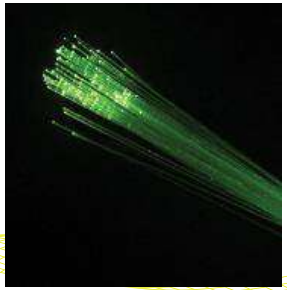
fibrisTerre

Distributed Fiber Optic Strain and Temperature Sensing: Adding Smart to Infrastructure




GÉANT Workshop, November 2025

fibrisTerre Systems GmbH

Nils Nöther

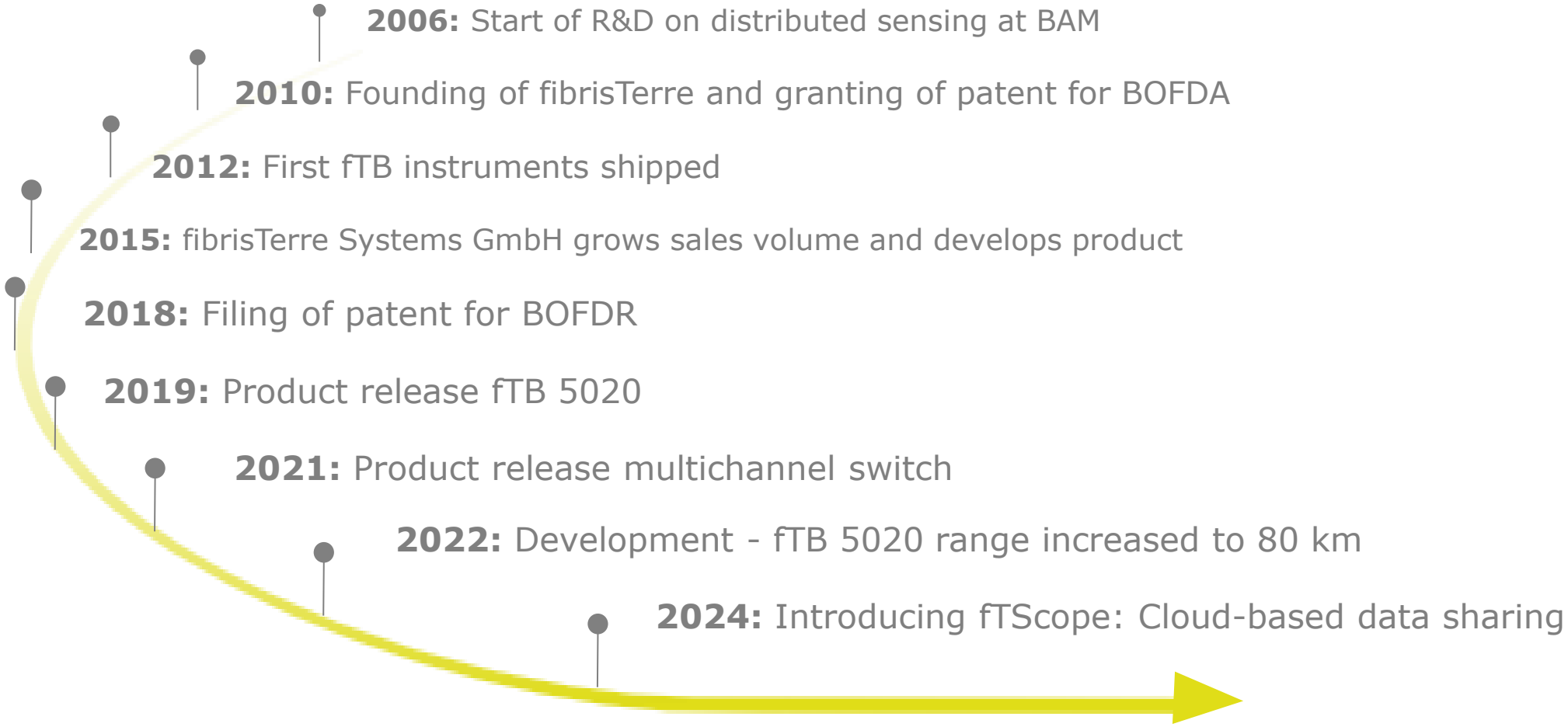
fibrisTerre – The Company

fibrisTerre – designer of the pioneering BOFDA / BOFDR technology from the heart of Berlin

- Reliable, cutting-edge monitoring solutions for industry and infrastructure
- Excellence in fiber-optics, electronics design and user-oriented software development
- Bringing the solution into the field: Strong expertise in the world of structural health monitoring

Latest innovation. Earliest detection.

fibrisTerre – Company History



Smart structures for the 21st century

Enhancing production efficiency

Structural health monitoring: Getting the whole picture on workload, hotspots, throughput and load capacity

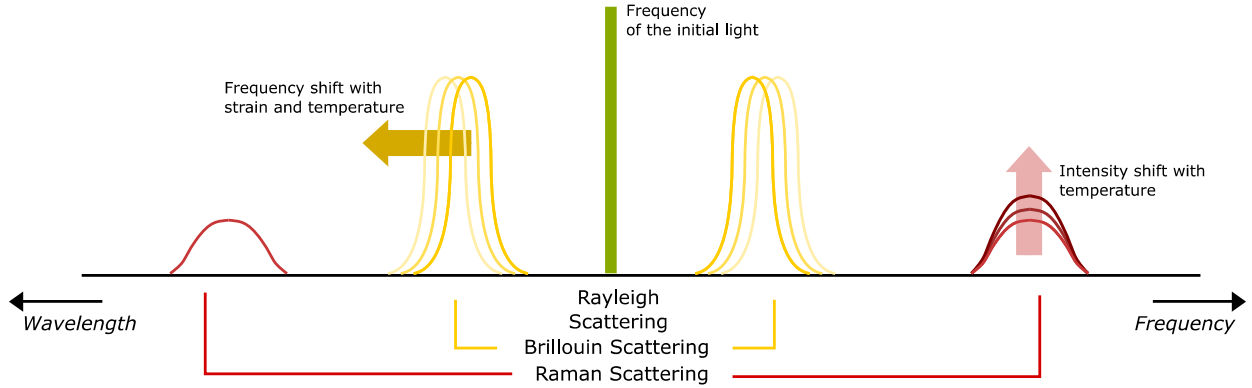
Ensuring safe operation

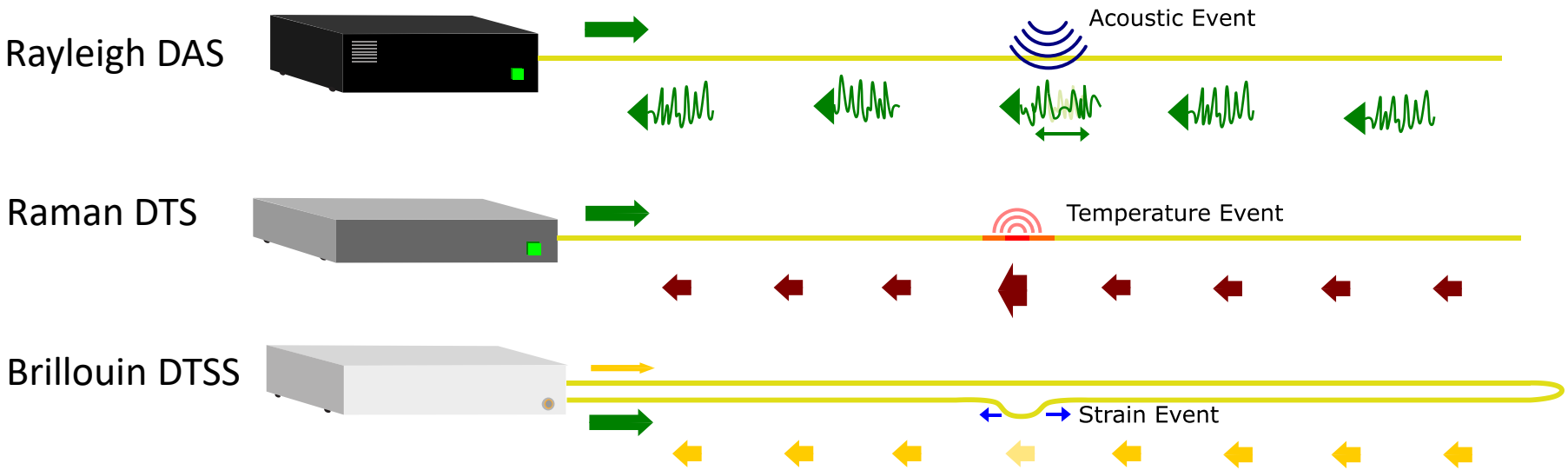
Early damage detection to prevent failure and minimize downtimes

Managing the risks

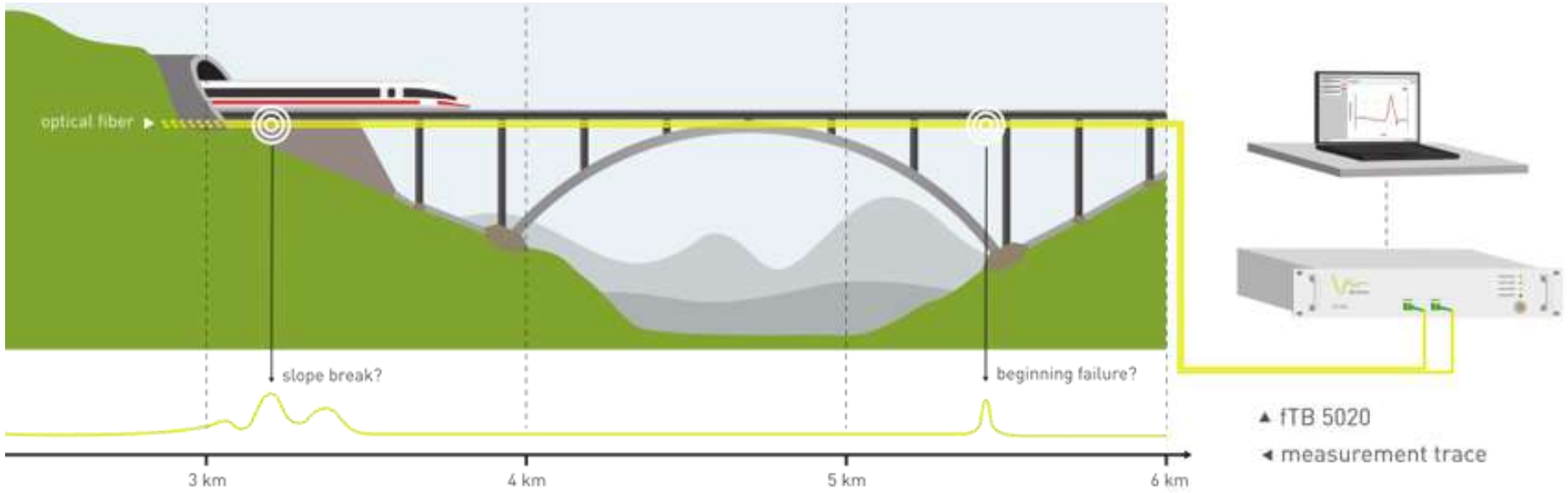
Integrity and condition monitoring for targeted and timely repairs

Technology overview: DAS, DTS, DTSS





Distributed Strain and Temperature sensing



- A telecom fiber becomes an uninterrupted **strain** and **temperature** sensor
- Spatially continuous monitoring
- Delivering data as often as you want

The DTSS System for industry assignments

Distributed strain and temperature sensing with the Brillouin optical frequency domain analysis.

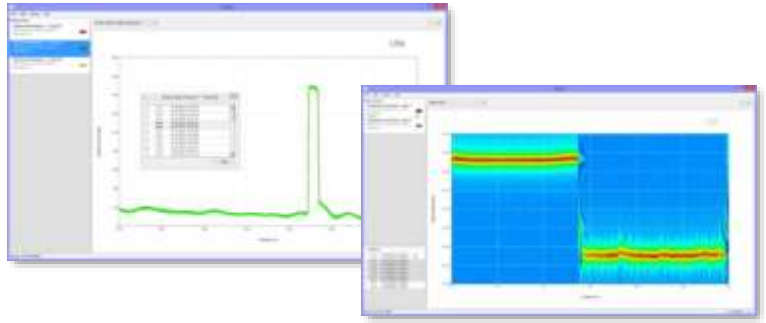
Technical outline:

Loop configuration (BOFDA):

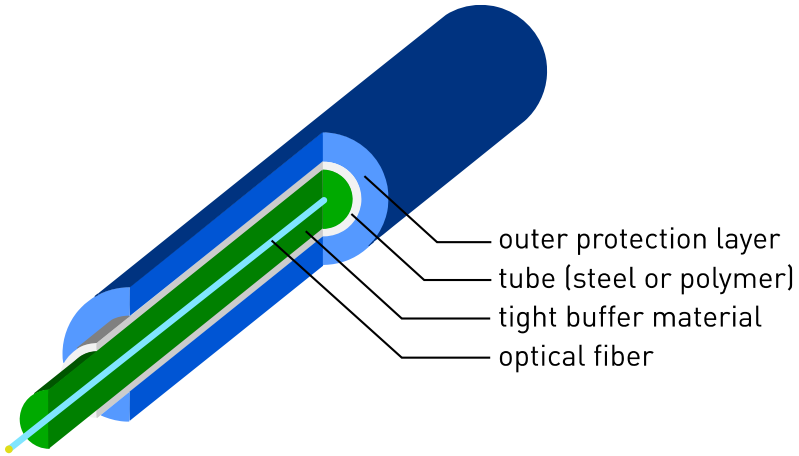
- Spatial resolution: < 0.2 m
- Measurement length > 80 km
- Repeatability: < 0.1°C, 2 µm/m

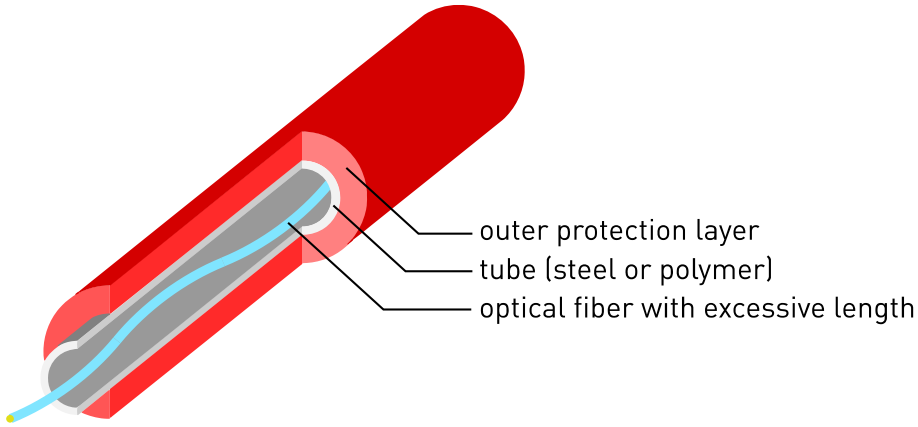
Single-ended configuration (BOFDR):

- Spatial resolution: 1.5 m
- Measurement length: > 25 km
- Repeatability: < 1°C, 20 µm/m



Fiber-optic sensing cables for DTSS





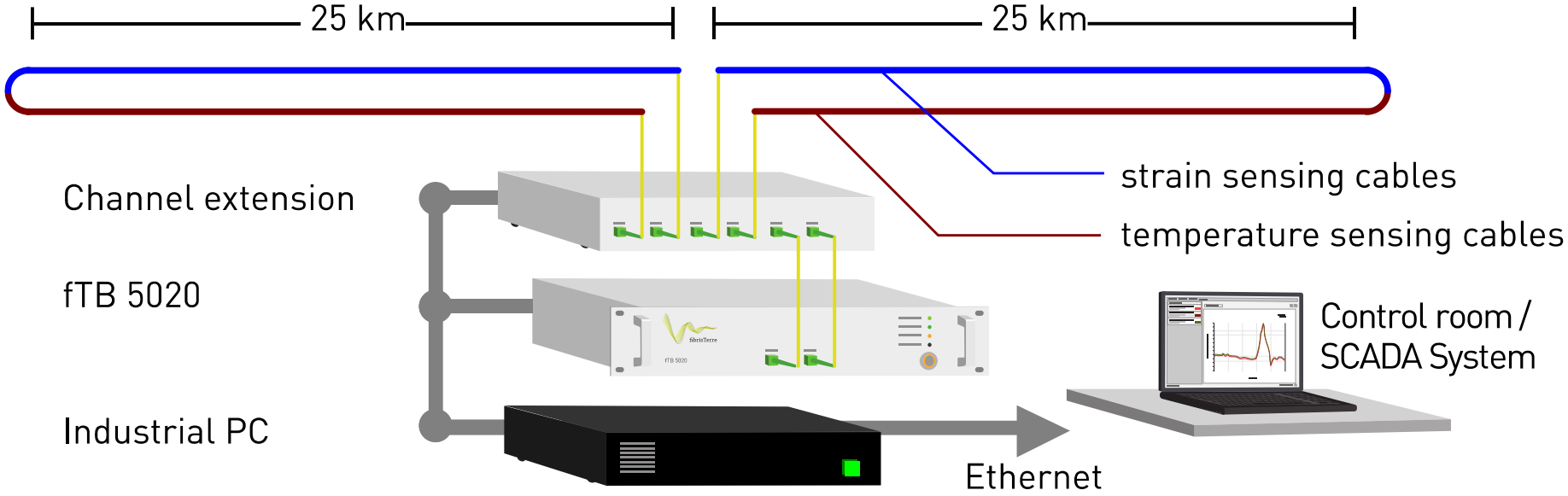
Strain sensing cable:

- Tight-buffered design for strain transfer into the fiber
- Metallic or non-metallic designs
- Round or rectangular cross sections

Temperature sensing cable:

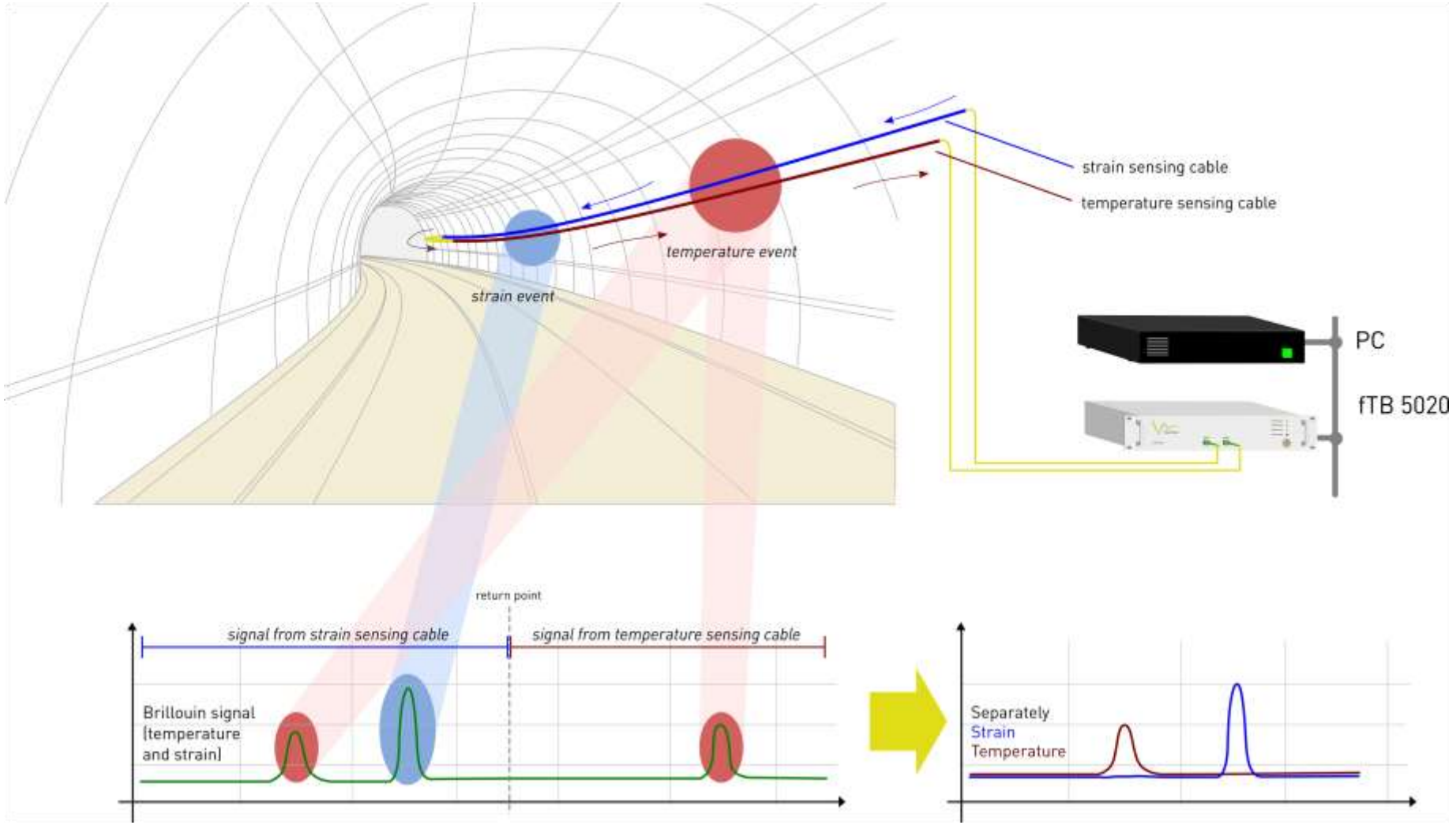
- Loose-tube design for strain decoupling
- Excessive fiber length inside tube
- Metallic or non-metallic designs

Typical installation set-up for 24/7 monitoring operation



- Loop configuration can be used for temperature compensation
- Fiber-optic switches for channel multiplexing
- Data transfer to control room by Ethernet connection

Separating Temperature and Strain in DTSS



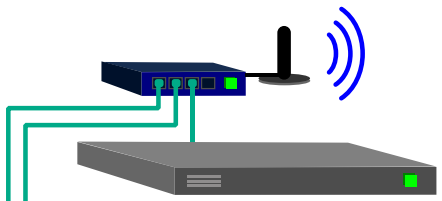
Connectivity to the real world: Data interfacing

Getting insight from the data:

Real-time feed into file transfer, SCADA systems, and our new fTScope cloud database

5G router with Wifi,
VPN, Ethernet switch

Local computer



fTView
Instrument control
Raw data processing
Local data storage

save to proprietary format

.msr

fTScope
Online Dashboard
Control Interface | Cloud Data Base

Easy multi-user data sharing
Data history and filtering
API: Direct data access via URL

fTB 5020
Interrogator Unit

Fiber-optic switch
for channel extension

to fiber-optic sensing loops

fibrisTerre as a solution provider

The team behind a successful monitoring project:

Sensing solution provider

Excellence in technology, software and data interfacing

Cable manufacturer

The best fiber-optic sensing cable for each task

System Integrator

In the field – installation, operation and analysis

Owner and operator

Gets: Sustainable monitoring for critical assets

Selected projects 2010 – 2025

Railway embankment, DE

Tunnel, China

Tunnel construction, AT

Pipeline, Canada

Urban sewerage, Singapore

Gravity dam, Iran

Offshore pile, China

Pipeline, Peru

Water supply, South Africa

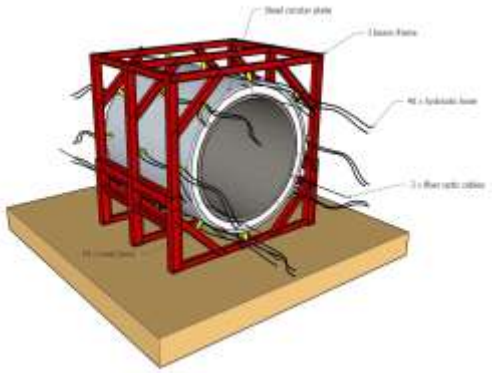
Singapore’s used water underground infrastructure

50 km of tunnels and link sewers with internal diameters ranging from 3 m to 6 m are going to be longitudinally monitored, with more than 100 km of hybrid (strain and temperature) fiber optic sensing cables.

Construction of DTSS Phase 2 began in 2017 and is scheduled to complete by 2025.

Singapore’s used water underground infrastructure

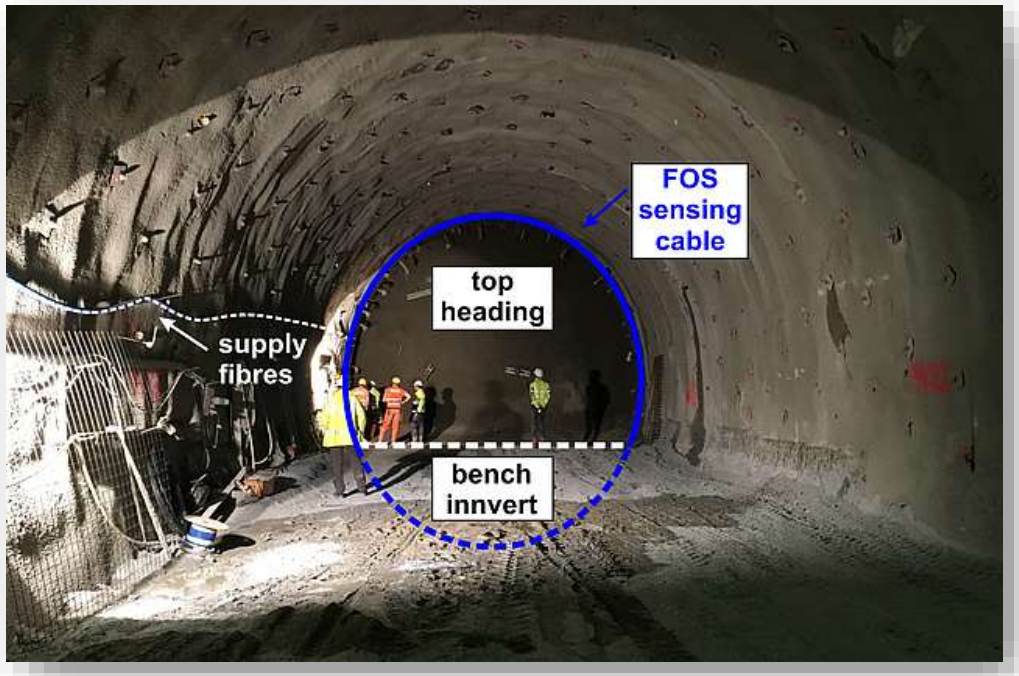
A mockup of part of the Deep Tunnel Sewerage System (DTSS) to be instrumented with FO sensing cables



Tunnel deformation monitoring: Semmering Base Tunnel, AT

Ongoing excavation and consolidation activities on the 27.2 km long railway tunnel.

Tunnel deformation monitoring: Semmering Base Tunnel, AT

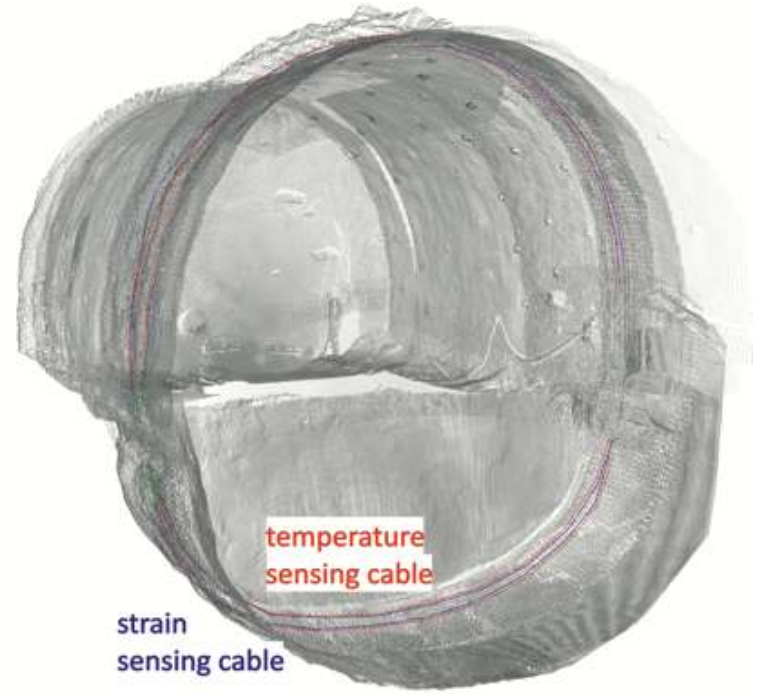


Shape sensing in shotcrete tunnel linings and shaft:

- Fiber-optic strain sensing cables installed in cross sections of tunnels and shafts
- Sensor position referenced by laser scans
- Displacement measurements from DFOS combined with geodetic readings

Monsberger, Lienhart: "Distributed fiber optic shape sensing along shotcrete tunnel linings: Methodology, field applications, and monitoring results." Journal of Civil Structural Health Monitoring, 2021.

Tunnel deformation monitoring: Semmering Base Tunnel, AT



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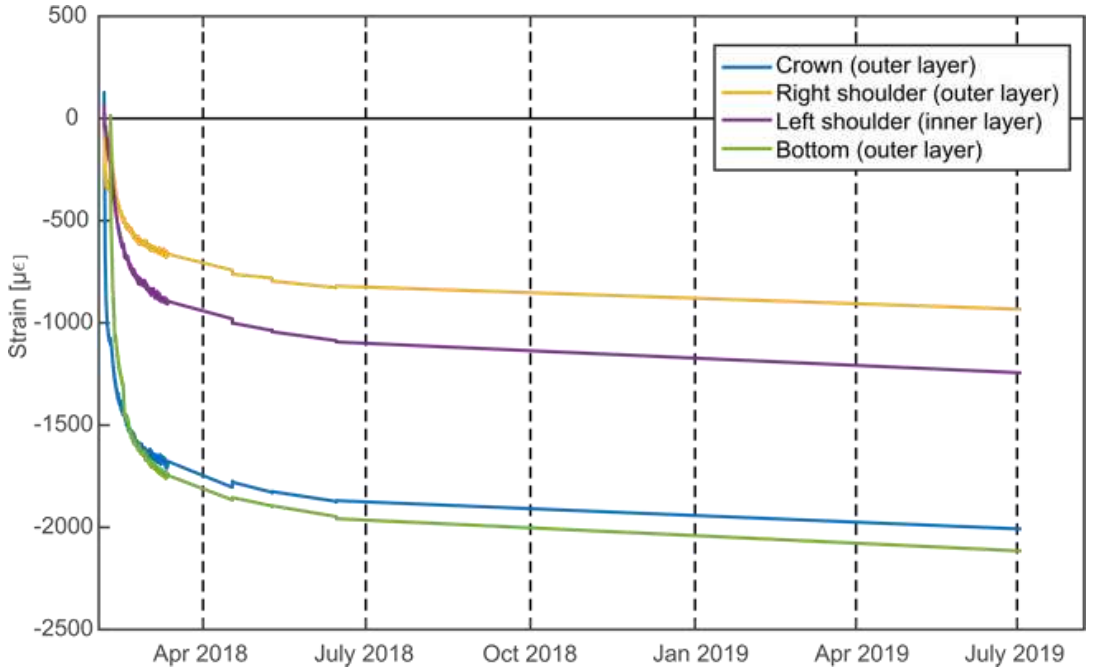

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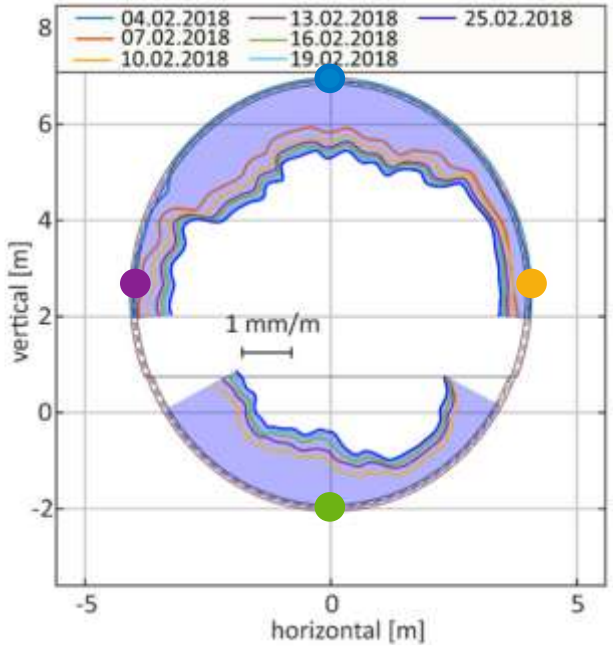

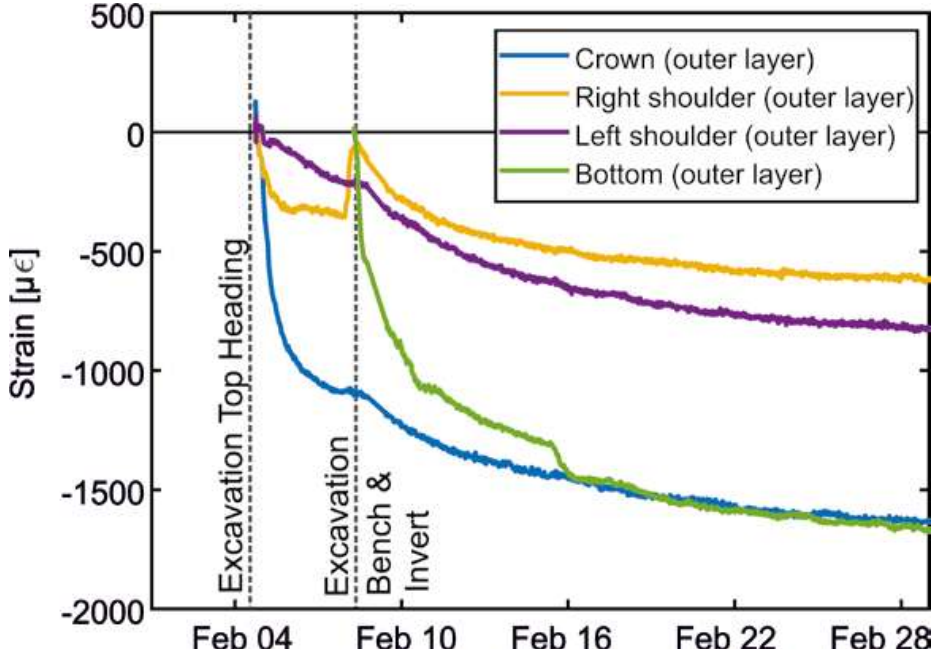

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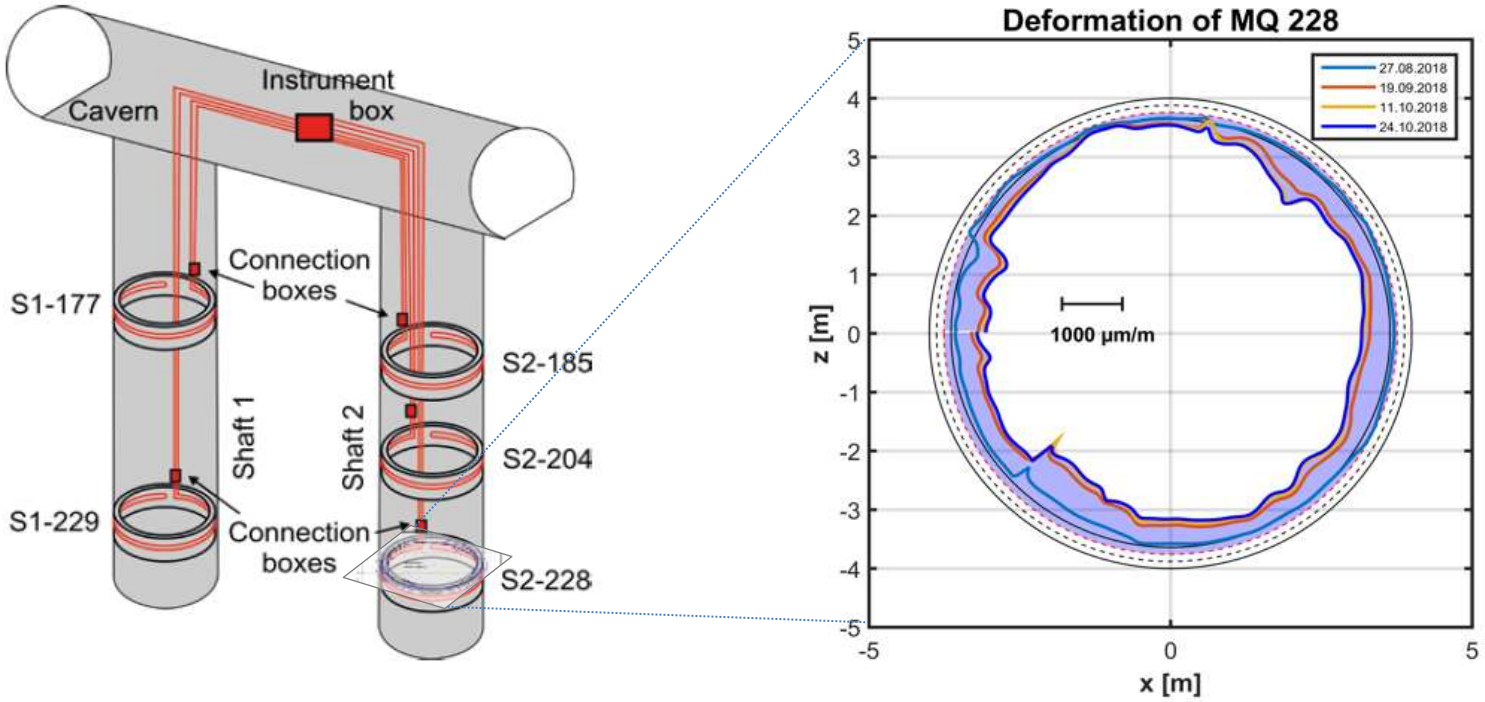

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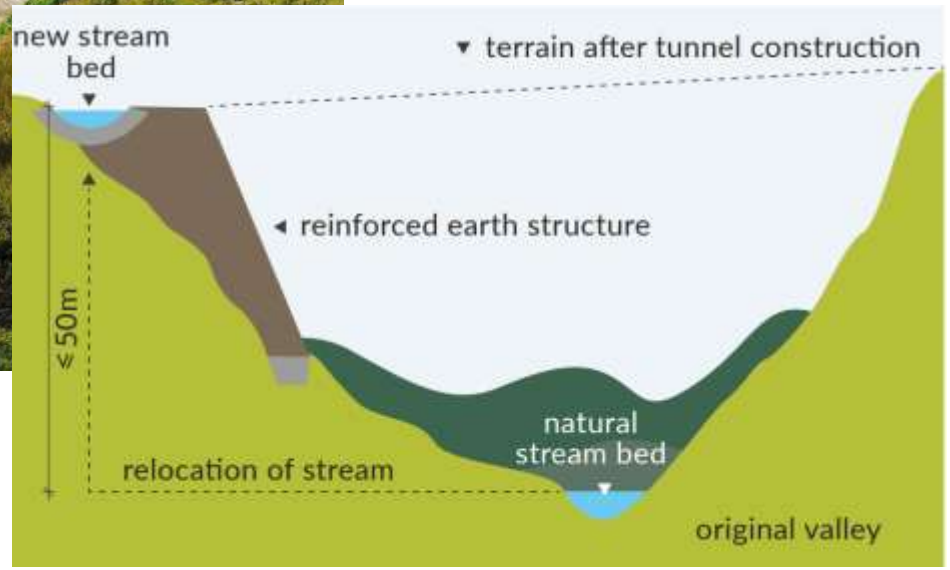
Slope stability monitoring: Longsgraben disposal site, AT

Longsgraben disposal site during the Semmering Base Tunnel excavation

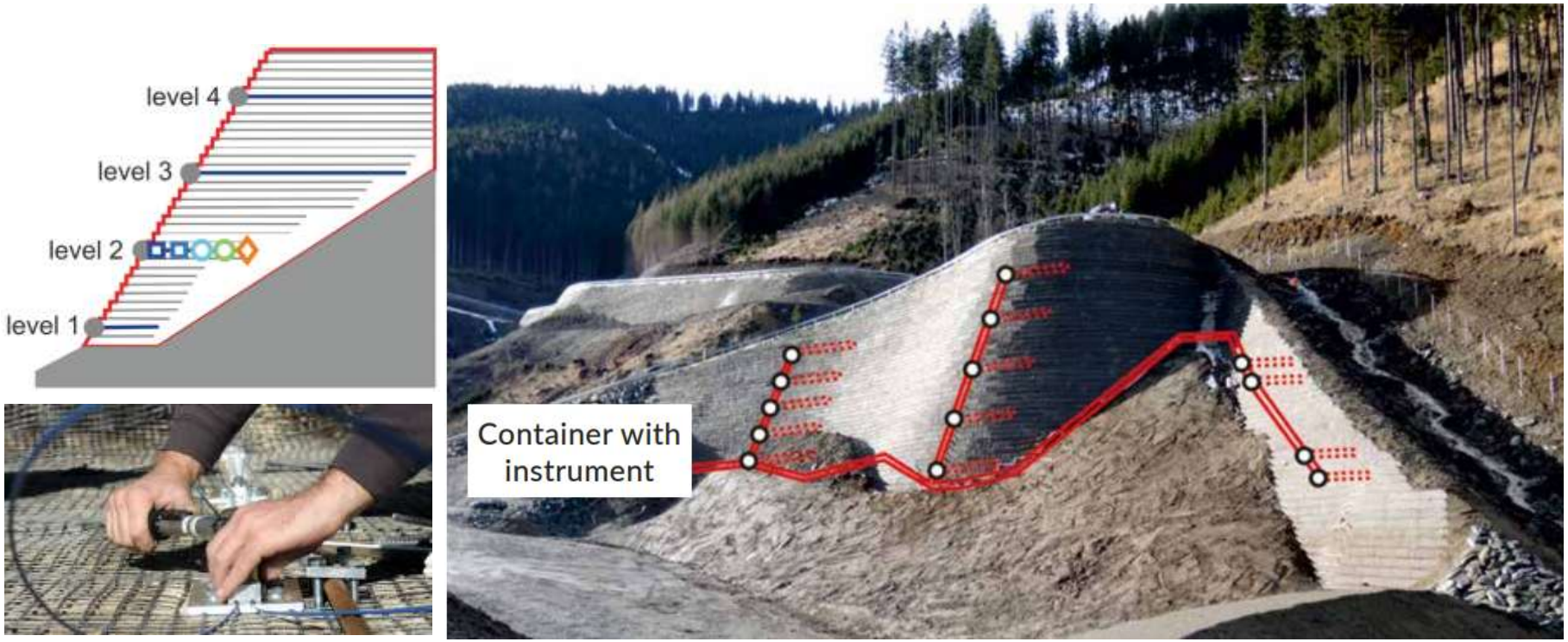
(photo courtesy Austrian Federal Railways © ÖBB/Ebner)



Rerouting the stream

Slope stability monitoring: Longsgraben disposal site, AT

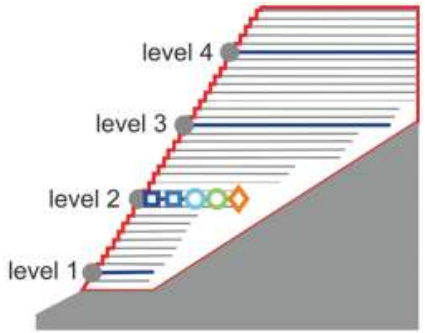
Geogrid and sensing cables deployed within the earth retaining structure

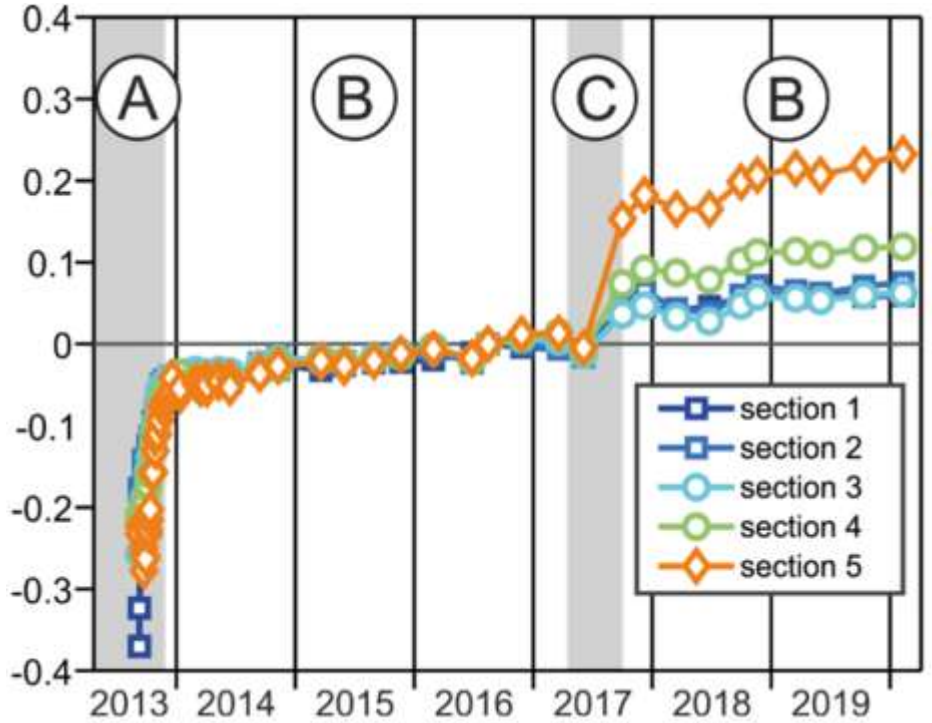


Lienhart W, Buchmayer F, Klug F and Monsberger CM Distributed fibre-optic sensing applications at the Semmering Base Tunnel, Austria. Proceedings of the Institution of Civil Engineers – Smart Infrastructure and Construction, https://doi.org/10.1680/jsmic.20.00006

Slope stability monitoring: Longsgraben disposal site, AT

Adding quantities of soil to widen the access road resulted in a sudden rise in strain measured within the earth structure (construction phase (C)).





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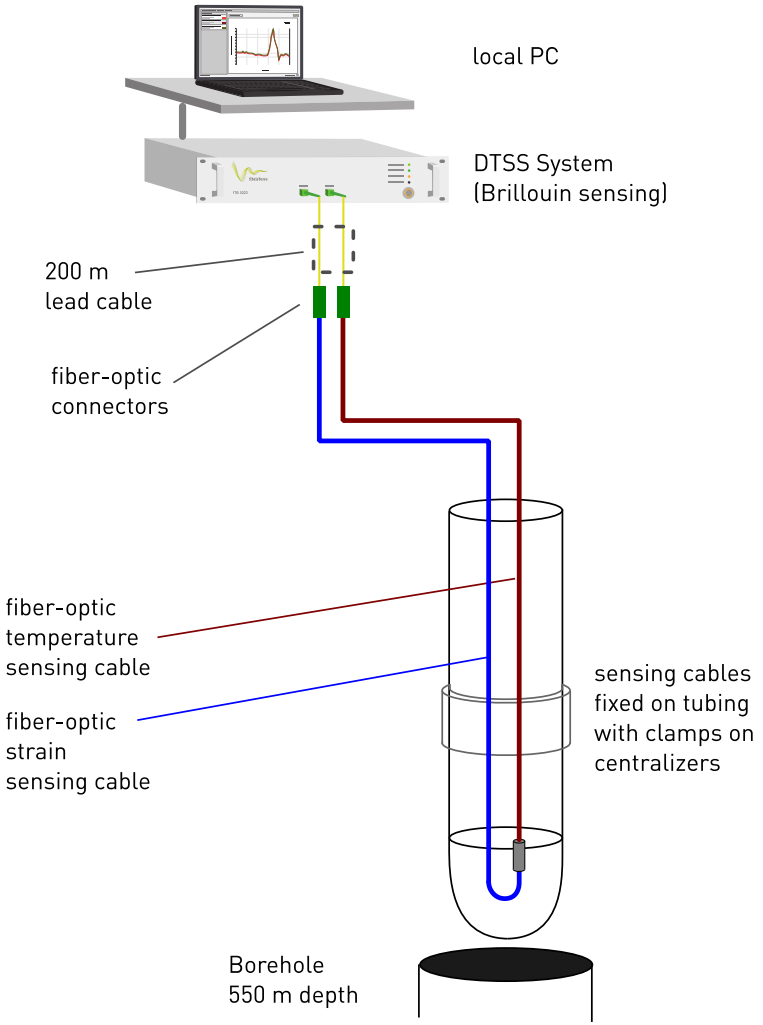
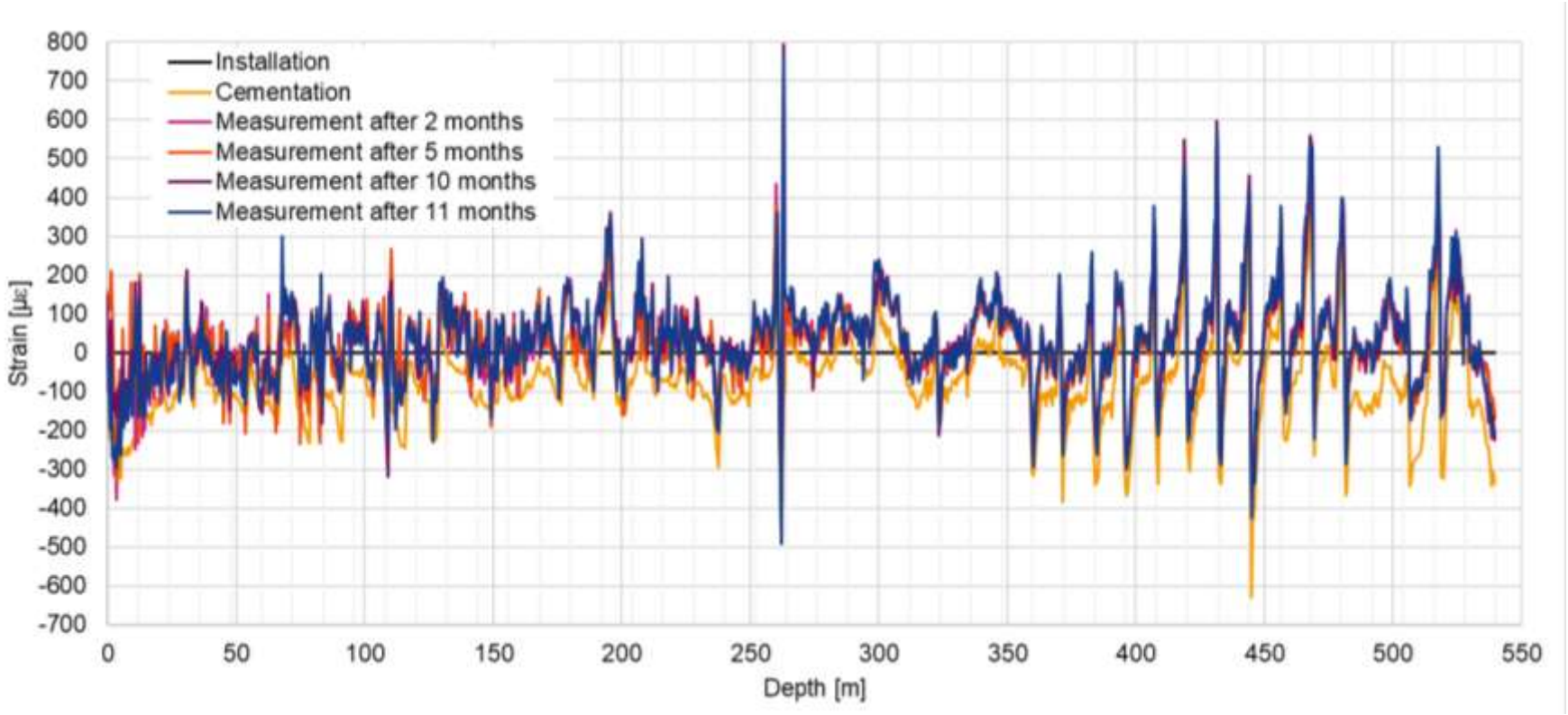
Casing monitoring – salt cavern well, Germany



- Strain and temperature sensing cables were attached to the borehole casing
- Positioning was fixed by clamping the cables on the centralizers
- A pre-manufactured sealed loop element interconnects the cables at the low end

Casing monitoring – salt cavern well, Germany

Strain readings, baseline and temperature compensated:



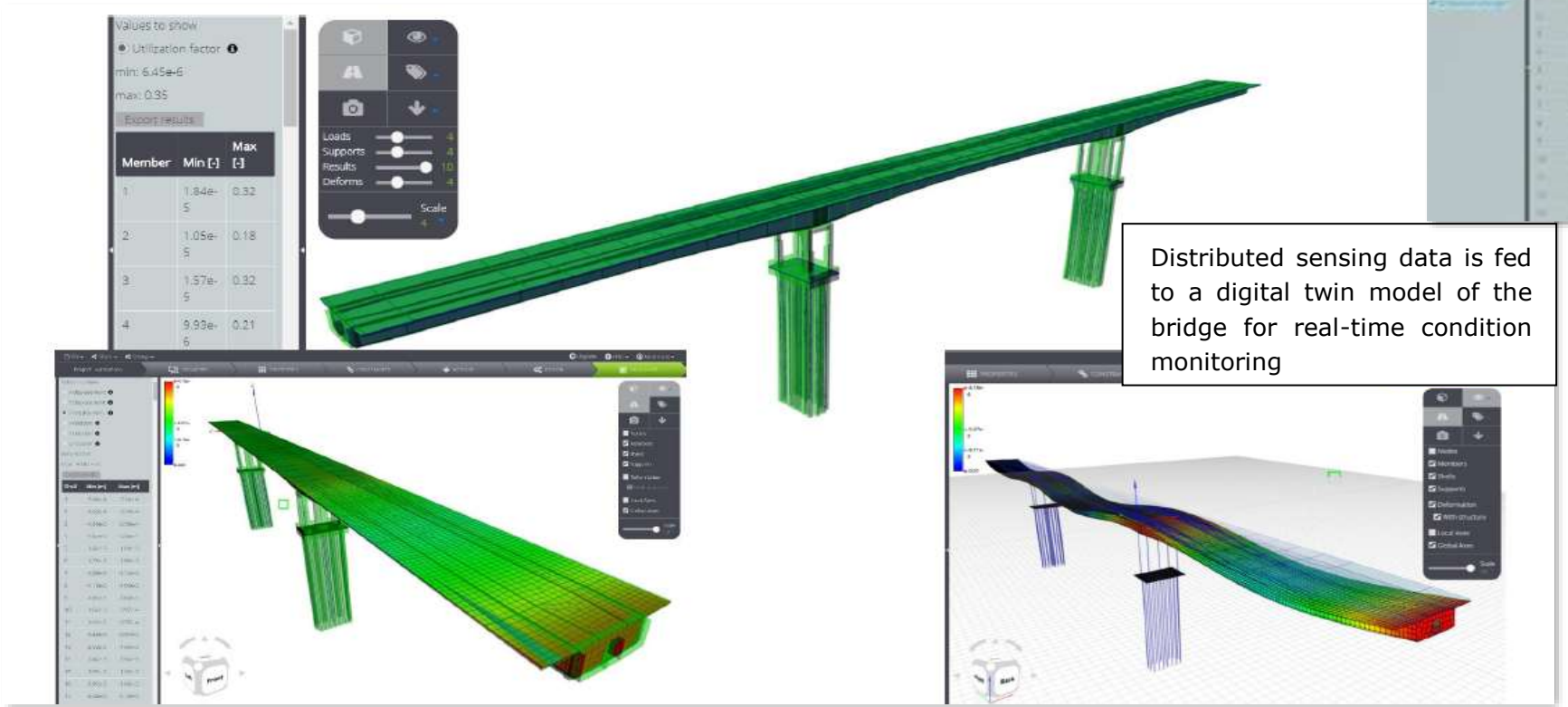
Bridge Monitoring and Digital Twin, Austria

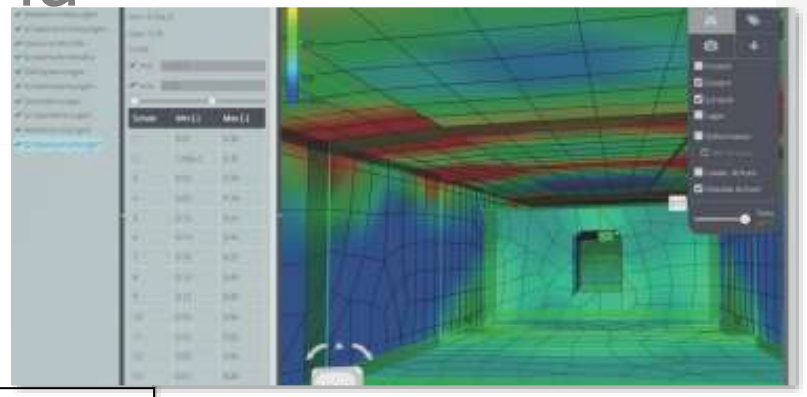
New construction with embedded sensors:

- Monitoring system less than 1% of project cost
- Decades of prolongation of life span expected due to monitoring system

Thomas Angerer, Massimo Penasa: "Digitaler Zwilling für Intelligentes Monitoring – Beispiel Terfener Innbrücke." 4. Interalpine Bautage, 2021.

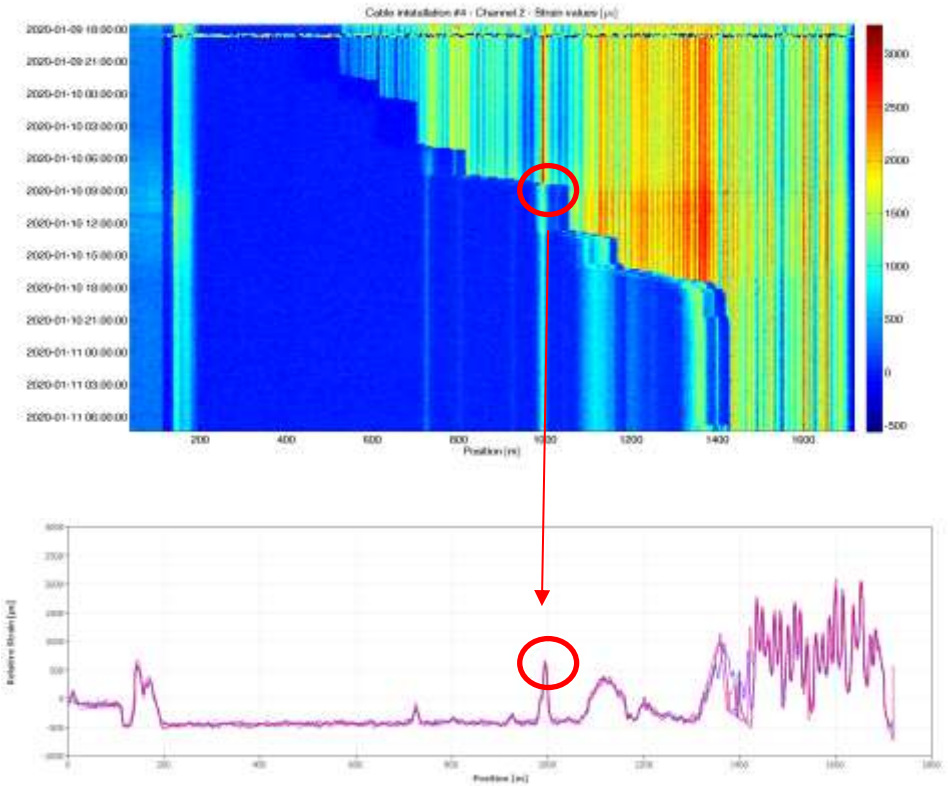
Bridge Monitoring and Digital Twin, Austria

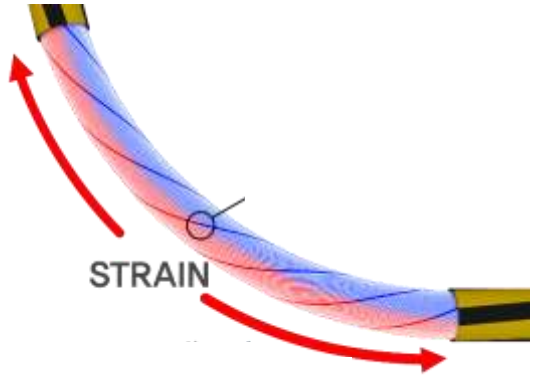




Distributed sensing data is fed to a digital twin model of the bridge for real-time condition monitoring

Power cable strain monitoring, Singapore





- Live strain monitoring during subsea cable installation from vessel
- Proof-of-concept for comprehensive sensing system along with DTS and DAS

fibrisTerre

In cooperation with AP Technologies Inc.

Project SmartVessel: Hydrogen Vessel Monitoring

Joint Research Project (Funding signature: 03ETB015E)

Composite vessels for energy storage

Improved SHM via distributed integrated sensors
- Different integration possibilities
- Concepts for protection of the fiber connector

Aktive Partner:

Wölfel, fibrisTerre, SIMPATEC, ITA RWTH AACHEN UNIVERSITY, heracle, KÜMPERS, Air Liquide, Fraunhofer IPT

Assoziierte Partner:

Volkswagen, Audi, EVONIK, EnergieAgentur.NRW

Gefördert durch:

Bundesministerium für Wirtschaft und Energie

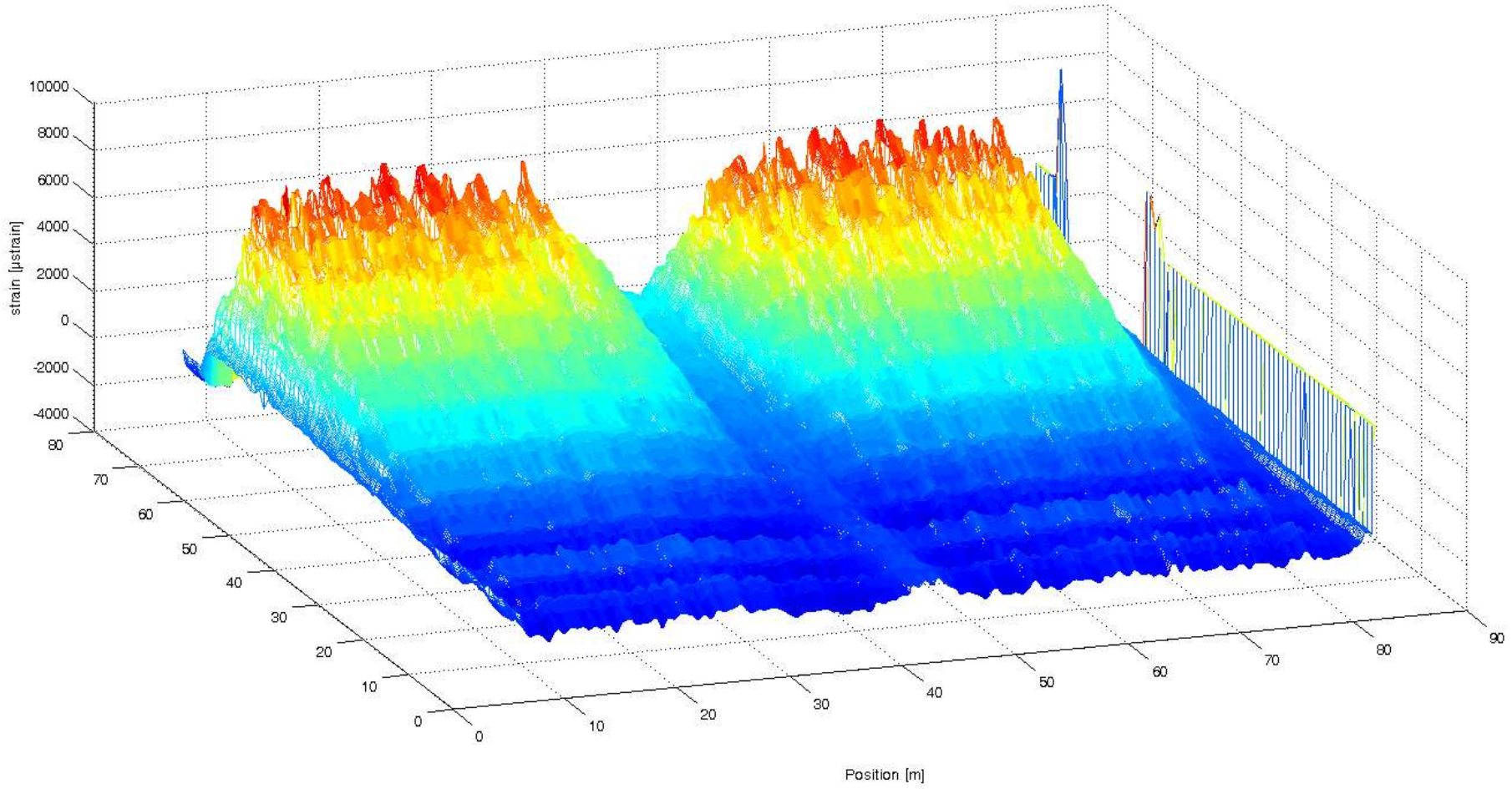
aufgrund eines Beschlusses des Deutschen Bundestages

Hydrogen vessels – Burst tests March 2022

Tests carried out:

- Burst tests on ITA's vessels
- One vessel equipped with 80 µm fiber from heracle
- Continuous strain measurements with fTB 5020 (fibrisTerre) and Luna OBR (IPT)
- Incremental pressure increase in BAM's testing chamber

Hydrogen vessels – Burst tests March 2022



Thank you for you attention!

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