

FBG Sensors Applications & Challenges

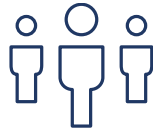
Peter Lowy
Sales Manager

Place: XXX
Date: May 2023





SYLEX - INTRODUCTION



Employees
250-300



Revenues
20-25M €



Production capacities per month
200.000 Fiber optic terminations
2.000 Industrially packaged FBG sensors



Customers worldwide per year
200

Fiber optics – technological DNA of the company

- ▲ Contract Manufacturing & custom design services
- ▲ Family-owned, located in Slovakia, EU
- ▲ 28 years on the market



FBG SENSING CHALLENGES AT REAL LIFE APPLICATIONS

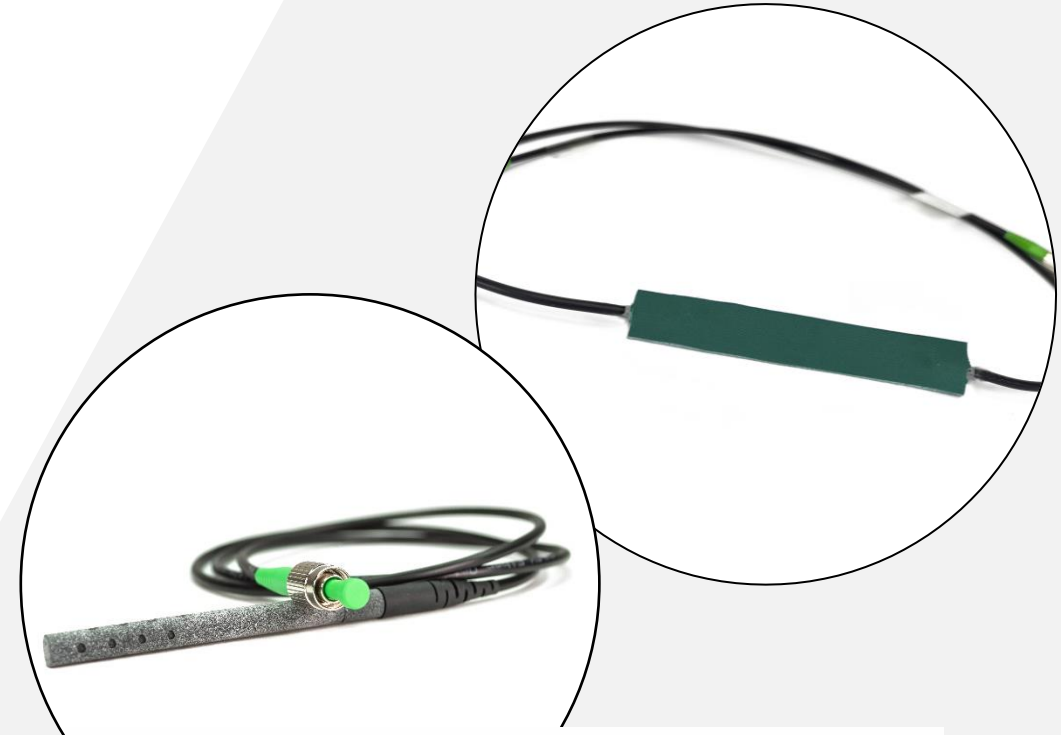


CHALLENGE:

- Fully dielectric construction embedded within a composite
- Glue-able to the surface

RESPONSE:

- **DSP-01** Dielectric Strain Patch
- **DTP-02** Dielectric Temperature Patch
- **HS-01** Humidity (moisture) sensor
- **P-05** Pressure sensor



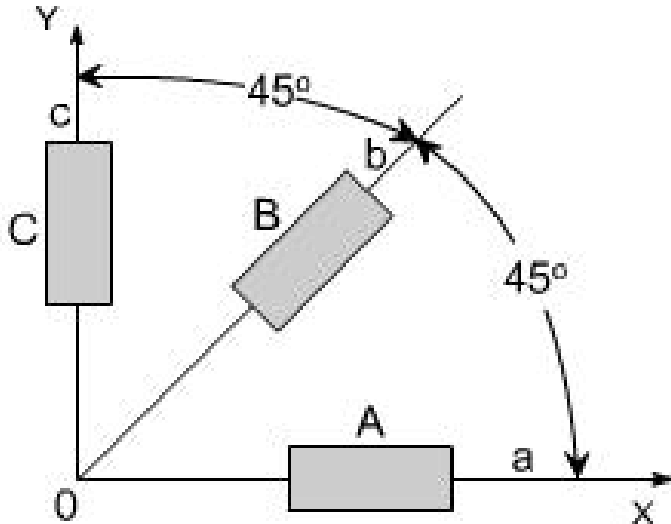
Strain analysis

CHALLENGE:

- 3-direction measurement
- Surface-mountable or spot-weld
- Chainable construction
- Temperature compensated

RESPONSE:

- **SMR-T** Surface mountable rosette
- **SWR-T** Spot-weld rosette

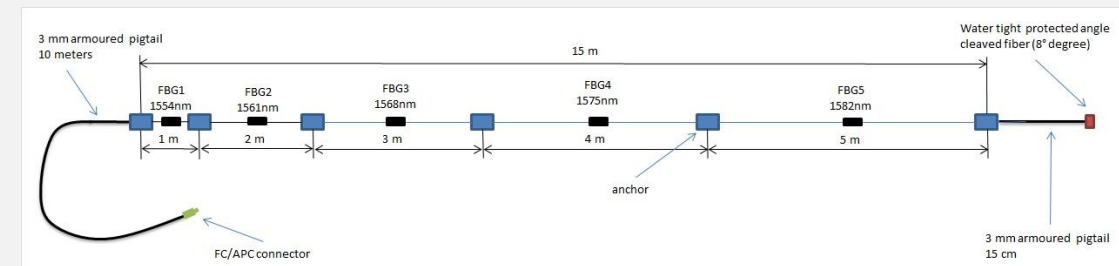
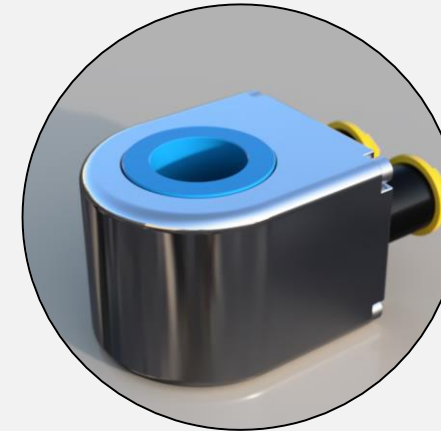


CHALLENGE:

- Soil conditions monitoring
- Embeddable sensors
- Chainable construction

RESPONSE:

- **EPC-01** Earth Pressure cell
- **ALC-01** Anchor Load cell
- **MSA-01** Multi-strain array for boreholes

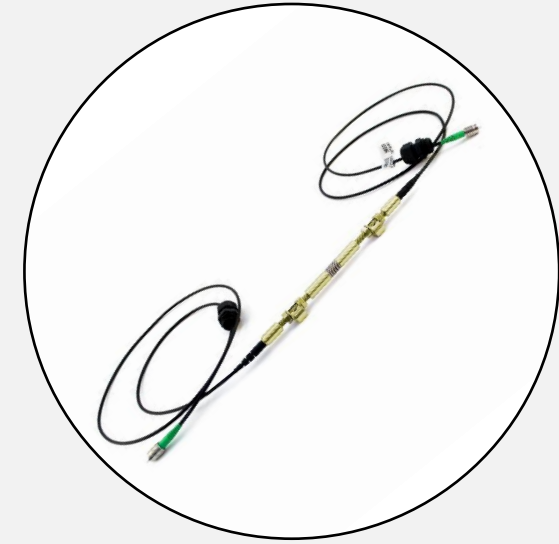
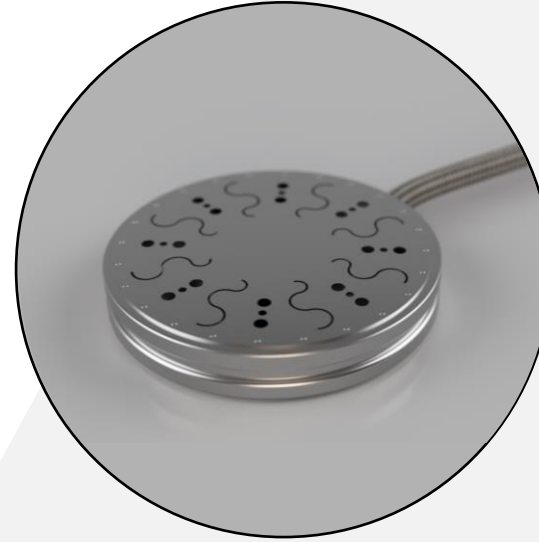


CHALLENGE:

- Corrosion environment
- Water-tight design for submersible events
- High-grade alloy materials

RESPONSE:

- Marine **SC-01**
- Marine **MS-03**
- Marine **TP-03**
- **HSS-01** Hull Stress sensor



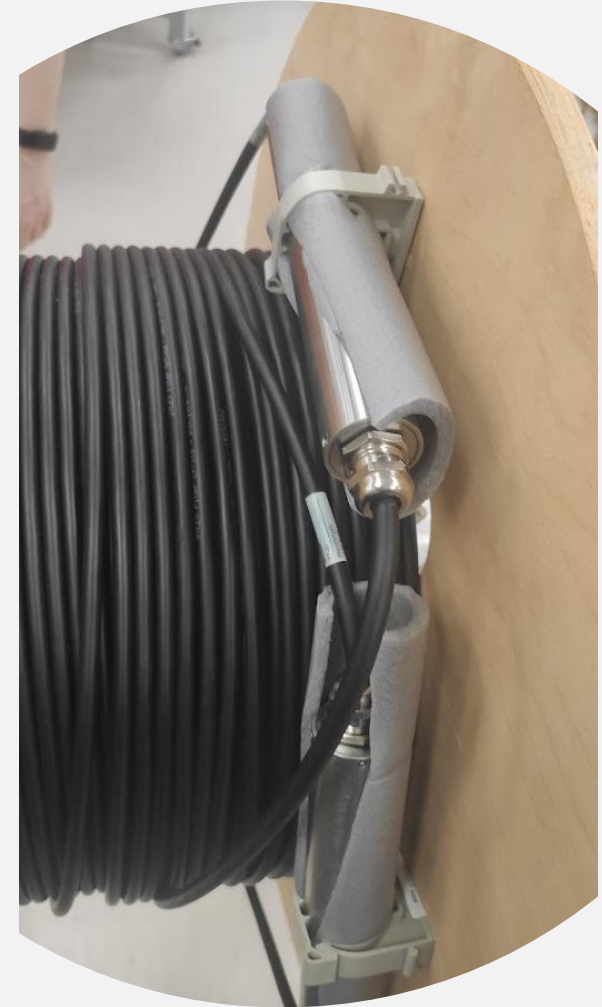
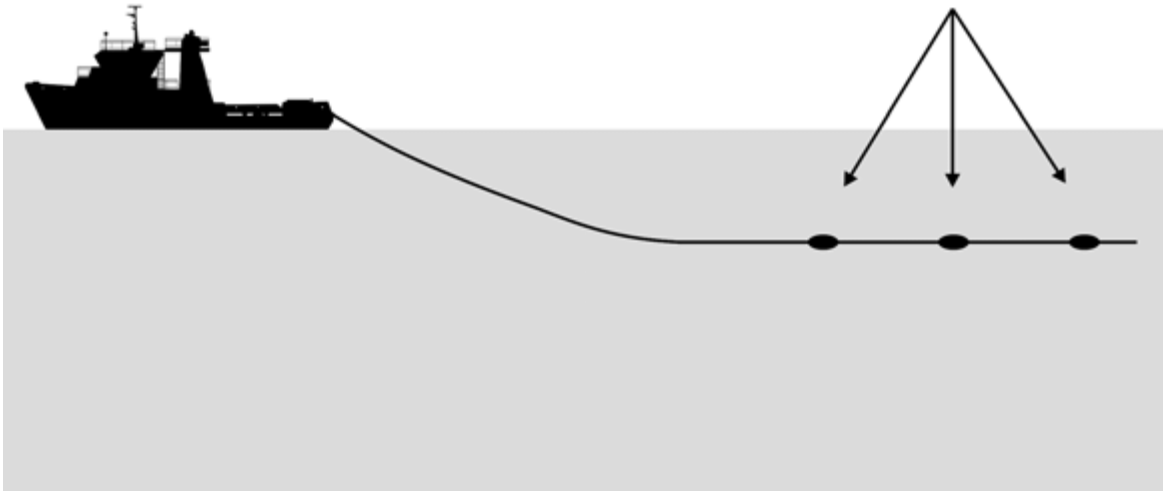
Marine survey

CHALLENGE:

- Water-tight design
- Special grade steel materials
- Tow forces along the array

RESPONSE:

- Marine **Temperature & Pressure** array



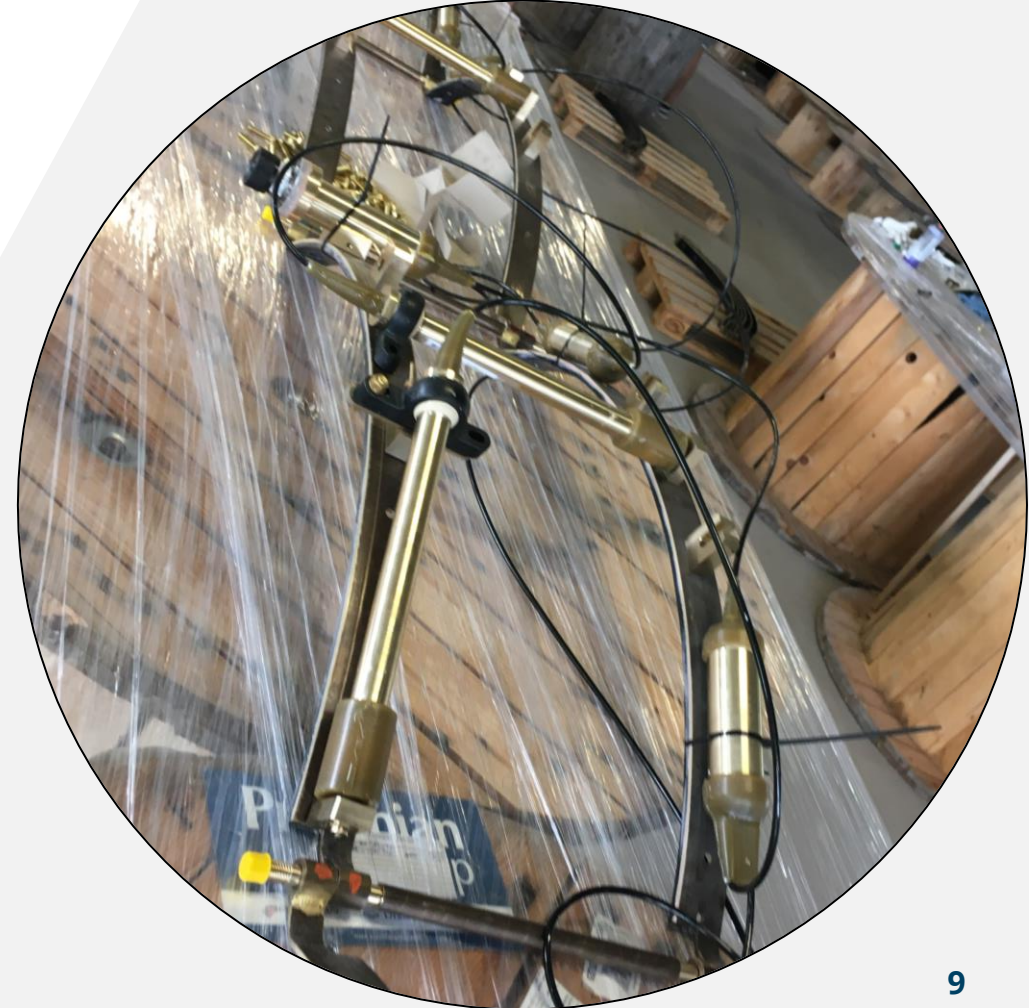
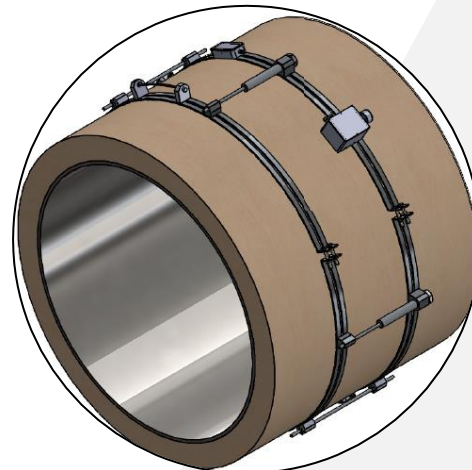
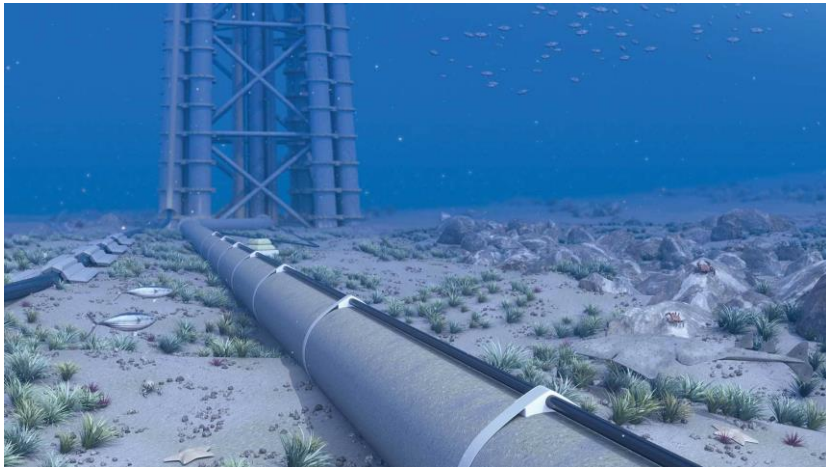
Sub-sea objects

CHALLENGE:

- Corrosion
- Water-tight design
- Special grade steel materials

RESPONSE:

- Marine **Pipe-Belt**

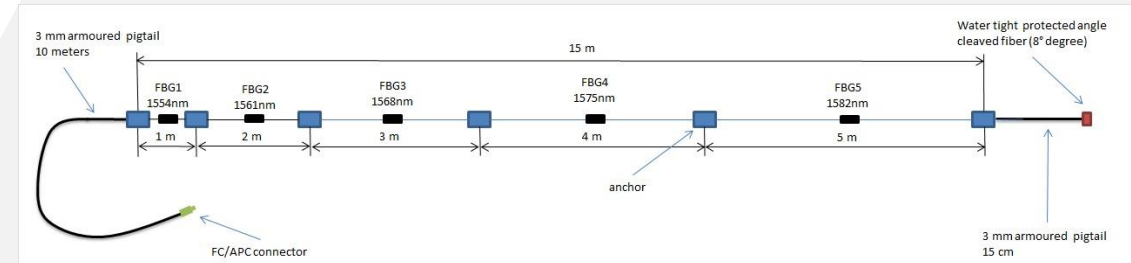


CHALLENGE:

- Low profile, embeddable
- Multiple measurement gauges
- Arrayed configuration

RESPONSE:

- **MSA-01** Multi-strain array for boreholes
- **SC-01** Long gauge strain & temp. sensor



Measurements in concrete

CHALLENGE:

- Concrete-embeddable design
- Chainable configuration

RESPONSE:

- **SB-01** Sister-bar
- **ES-03** Embeddable strain sensor
- **TP-03** Embeddable temperature sensor

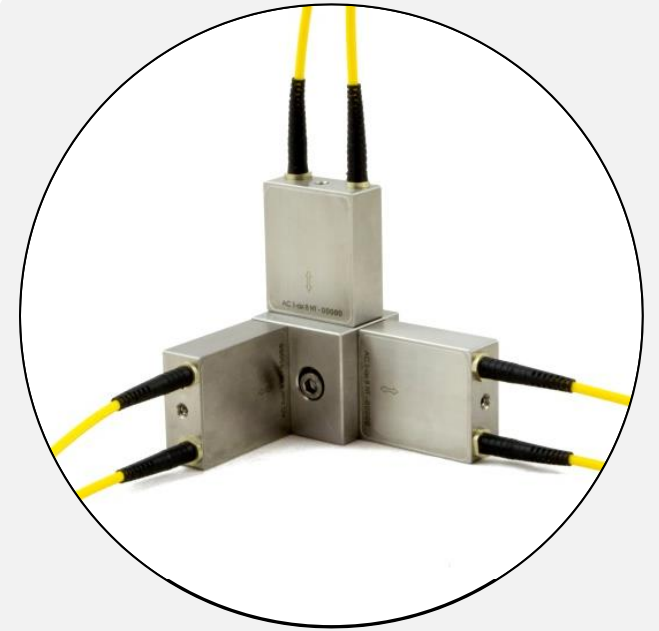


CHALLENGE:

- Tilting & vibrations

RESPONSE:

- **SAA-0x** Accelerometers
- **SAT-01** Tilt meter



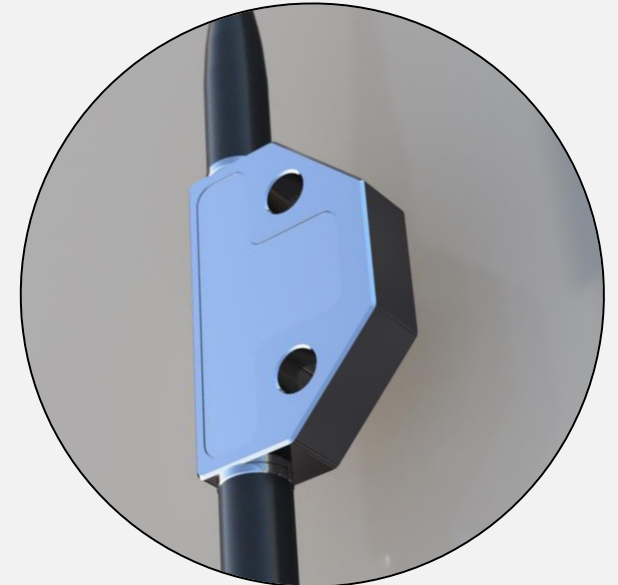
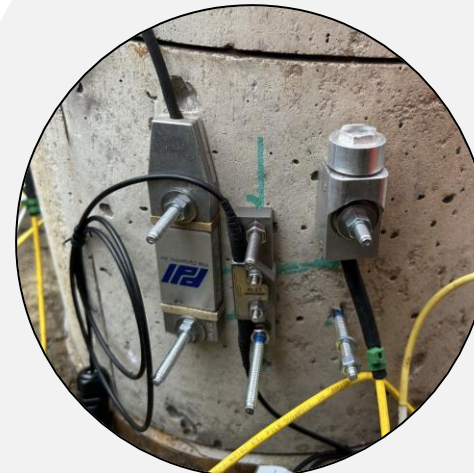
High shock sensors

CHALLENGE:

- Hundreds or thousands of G shocks
- Water-tight design
- Light-weight

RESPONSE:

- **HDSS** High-shock dynamic strain sensor
- **HDAC** High-shock dynamic accelerometer



Pipeline monitoring

CHALLENGE:

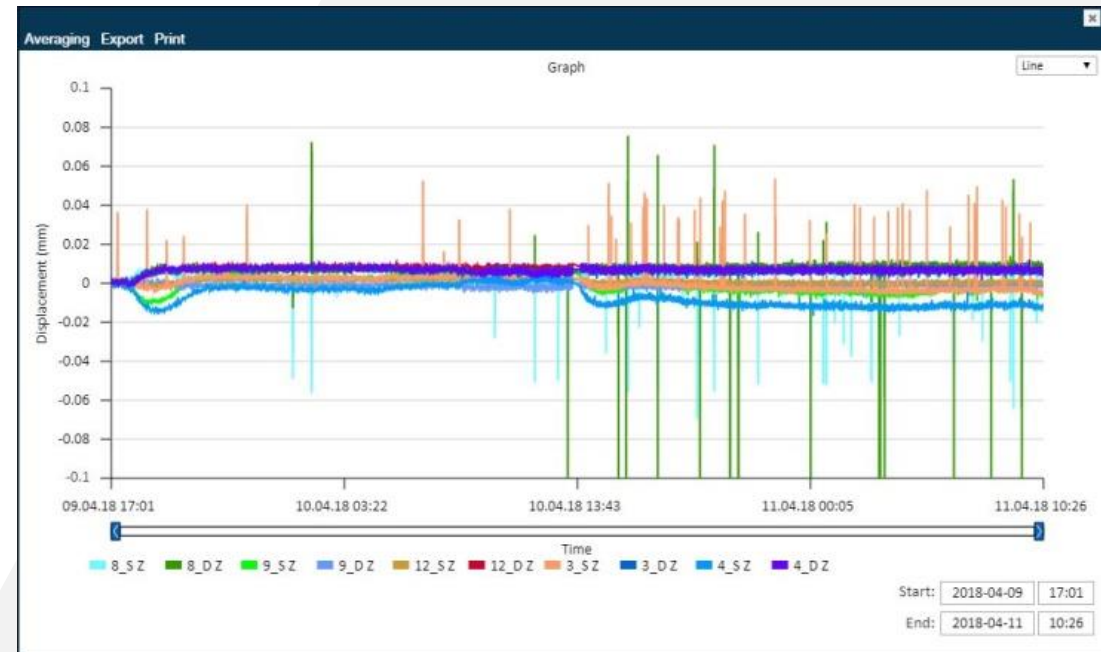
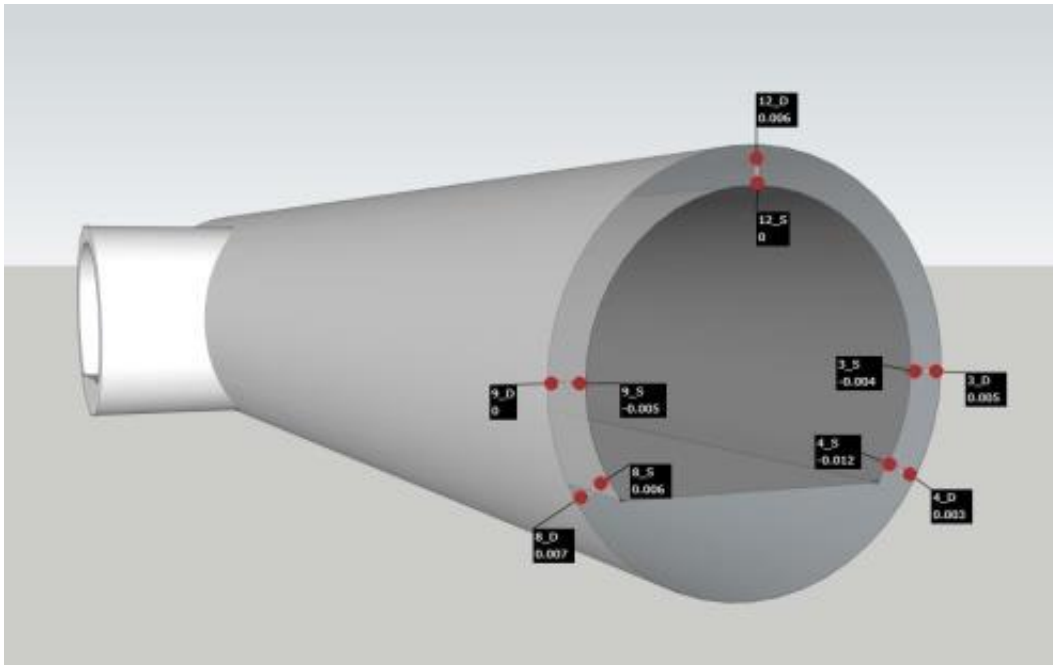
- Potentially explosive area
- Non-invasive mounting of sensors
- Arrayed configuration

RESPONSE:

- **SWA-01** Spot-weld sensor & Rosette
- **DSP-01** Dielectric Strain Patch
- **DTP-02** Dielectric Temperature Patch



Tunnel monitoring



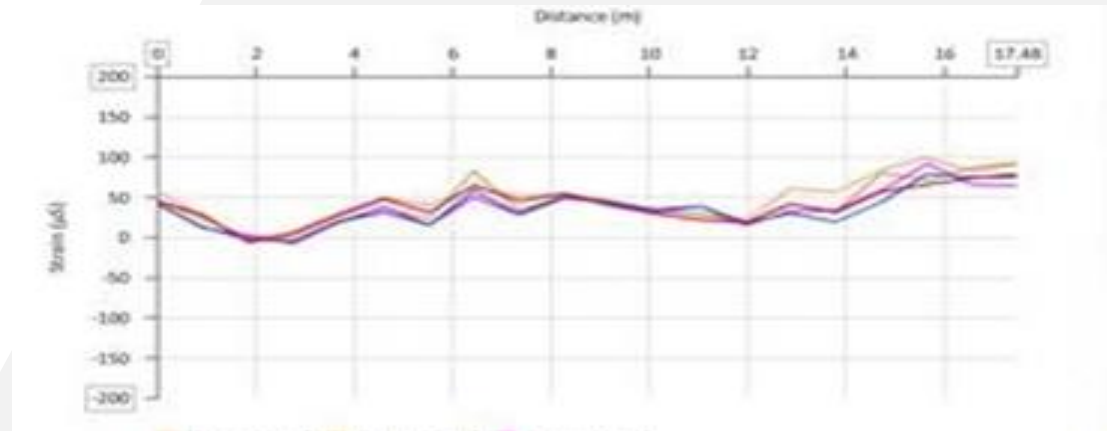
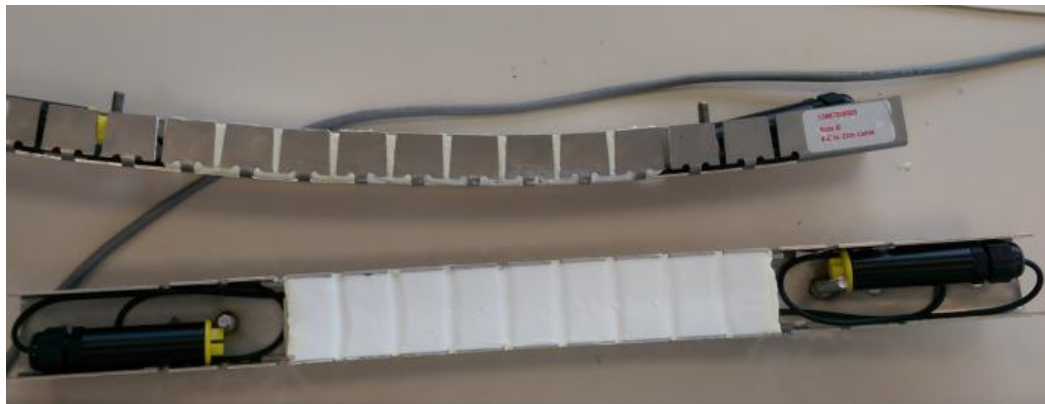
Sewer monitoring

CHALLENGE:

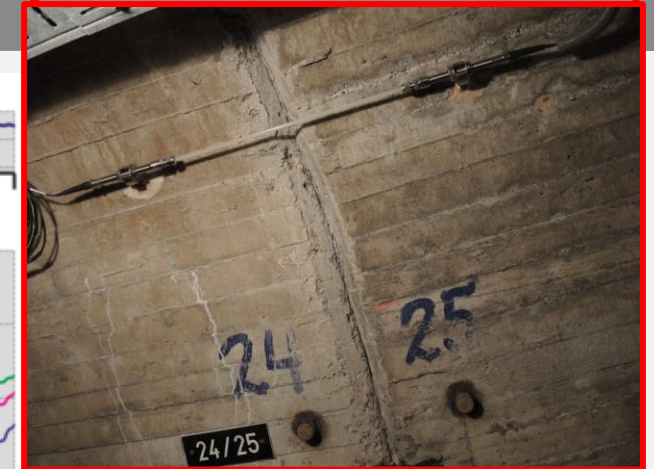
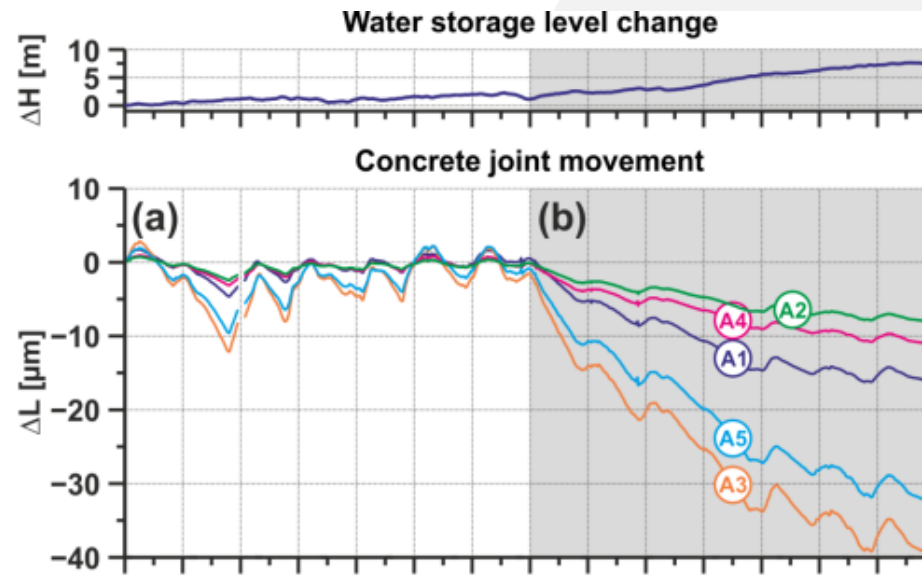
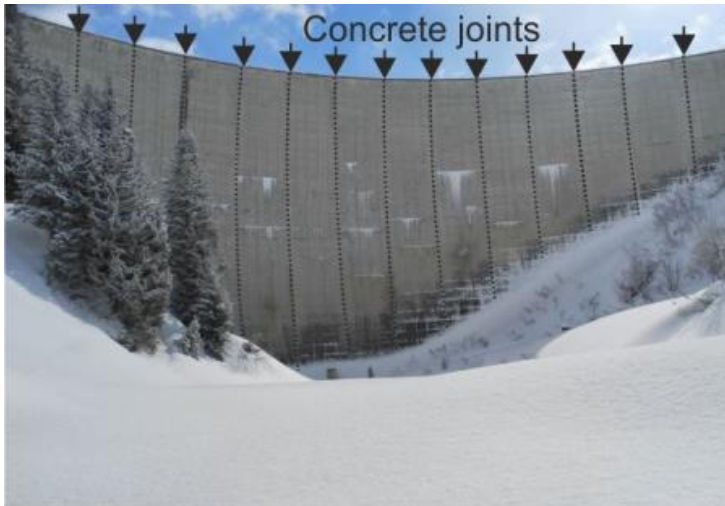
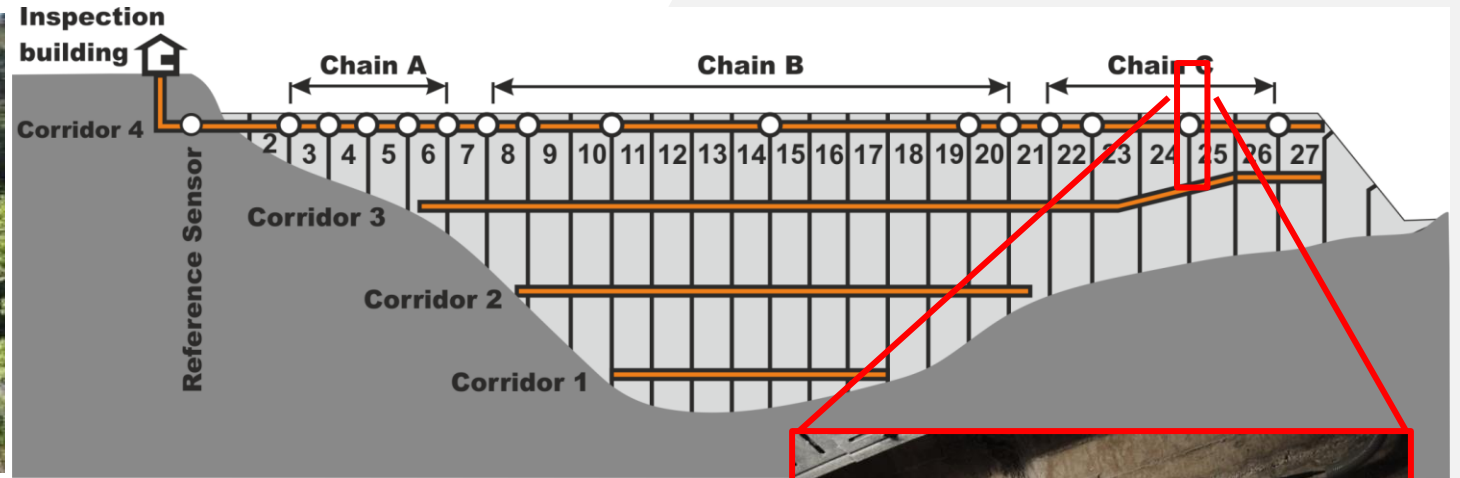
- Quick installation
- Curvature adaptation
- Explosive area

RESPONSE:

- **SDS-01** Sewer deformation sensor



Dam monitoring

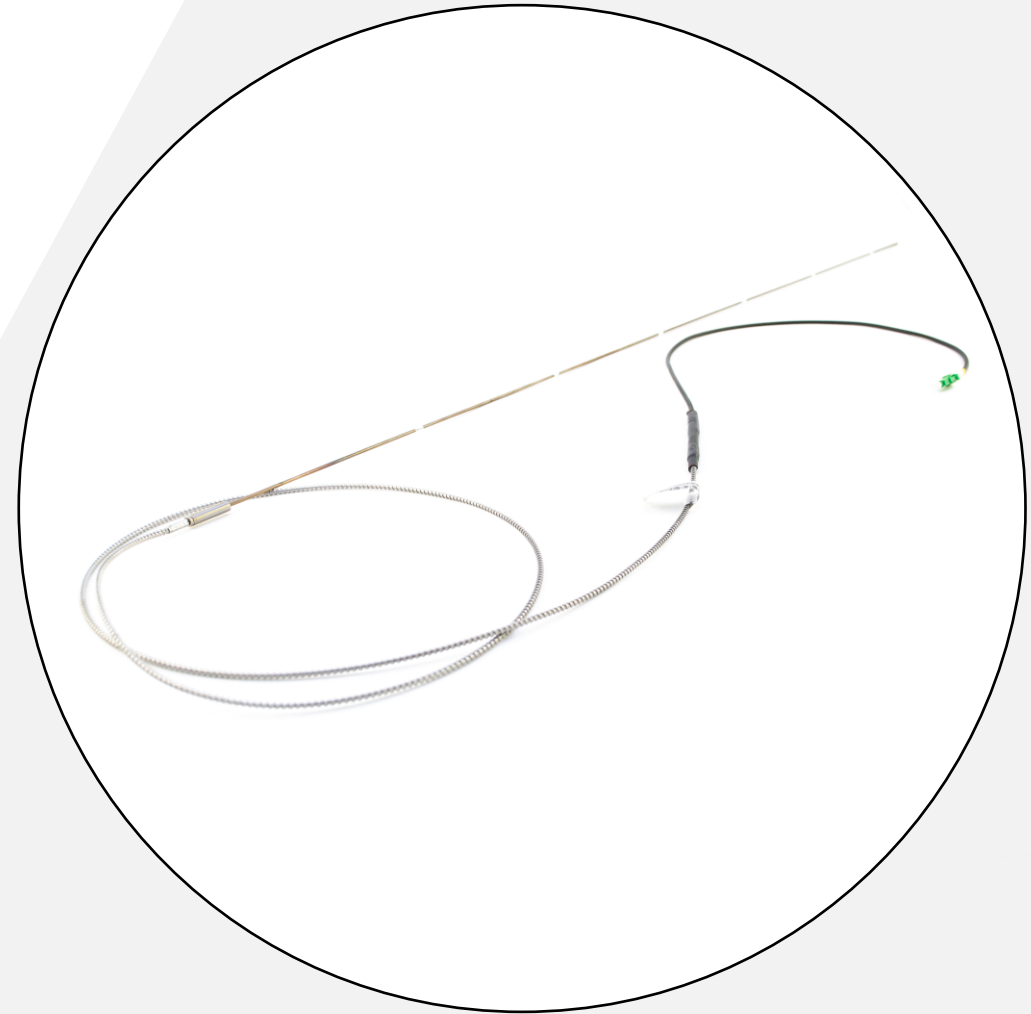


CHALLENGE:

- Vibrations
- High temperatures
- Long-term stability

RESPONSE:

- **HTA-01** High temperature sensor array

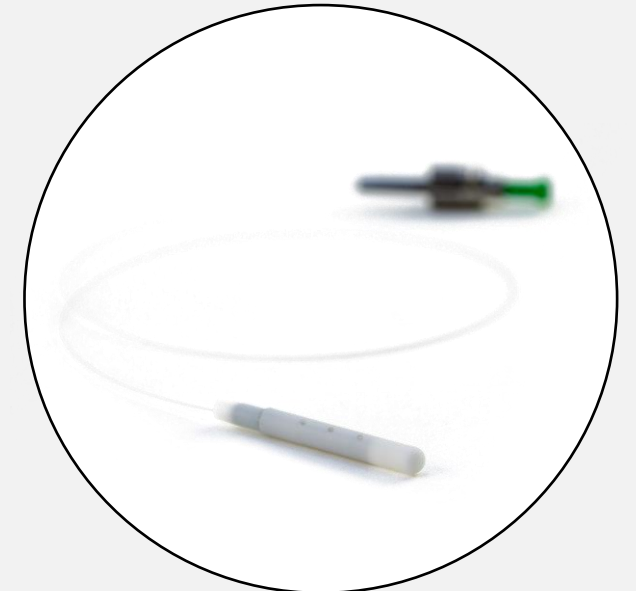
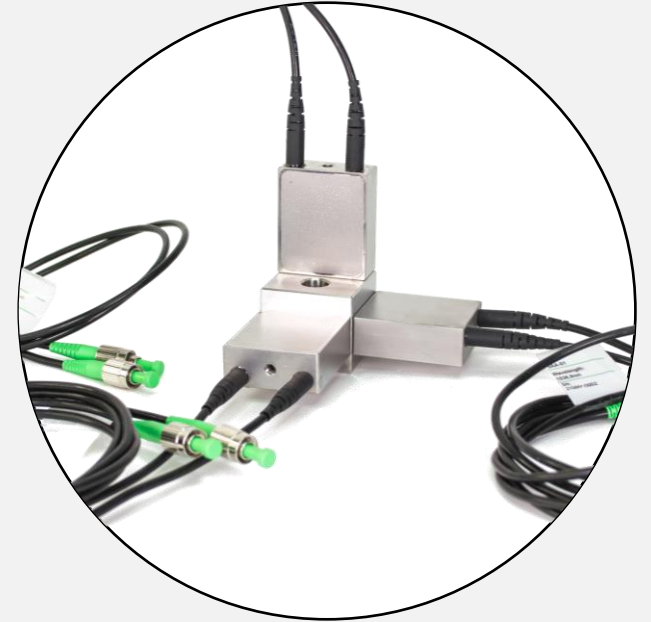
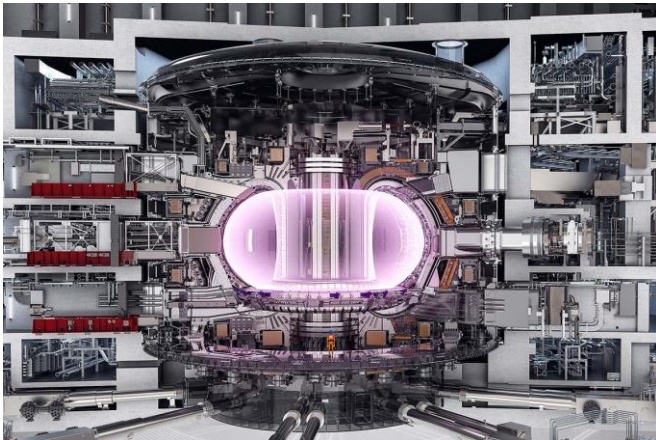


CHALLENGE:

- Ultra low and high temperatures
- Small form factor
- Radiation endurance
- Strong magnetic fields

RESPONSE:

- **CTP-01** Cryogenic temperature probe
- **PTS-01** Miniature high-sensitivity high temperature probe
- **ACC-0x** high temperature accelerometer

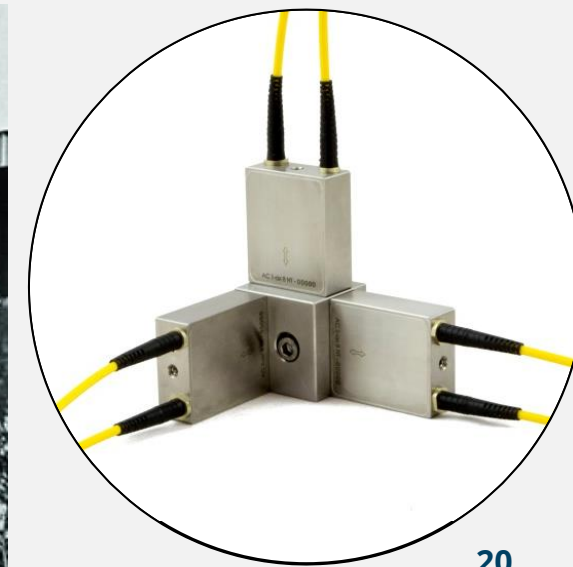
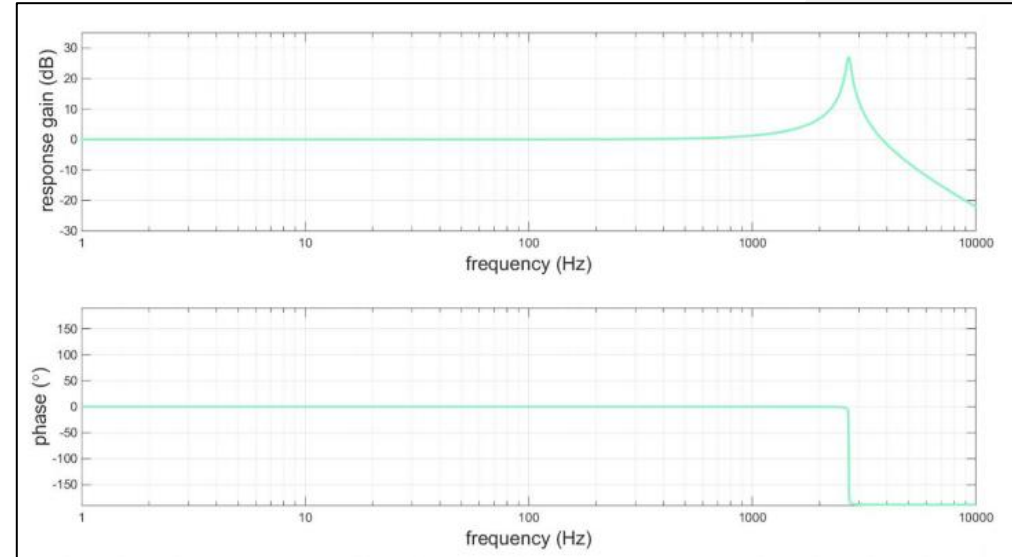


CHALLENGE:

- Vibrations
- High temperatures

RESPONSE:

- **SAA-0x** accelerometers



Bridge monitoring



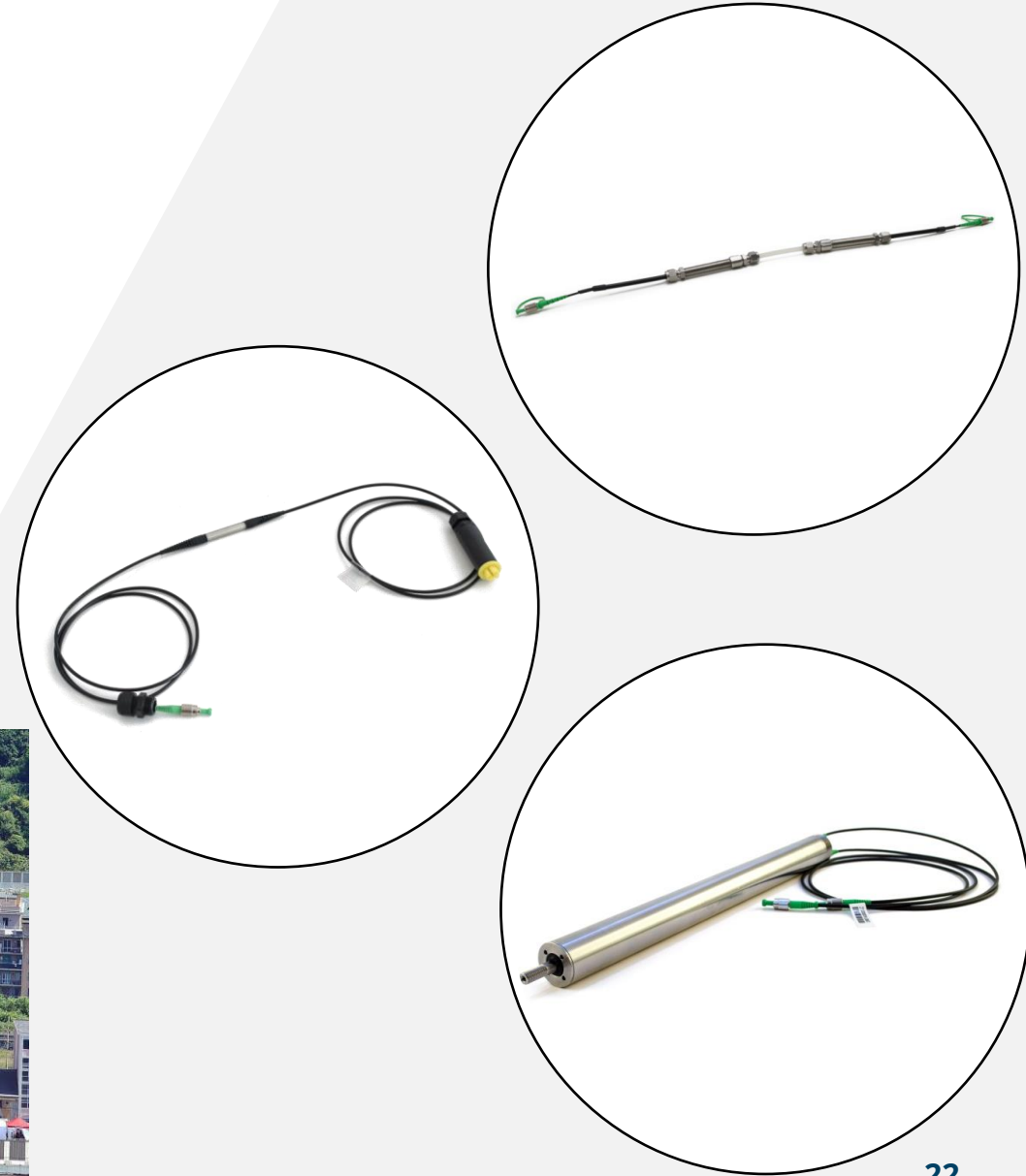
Bridge monitoring

CHALLENGE:

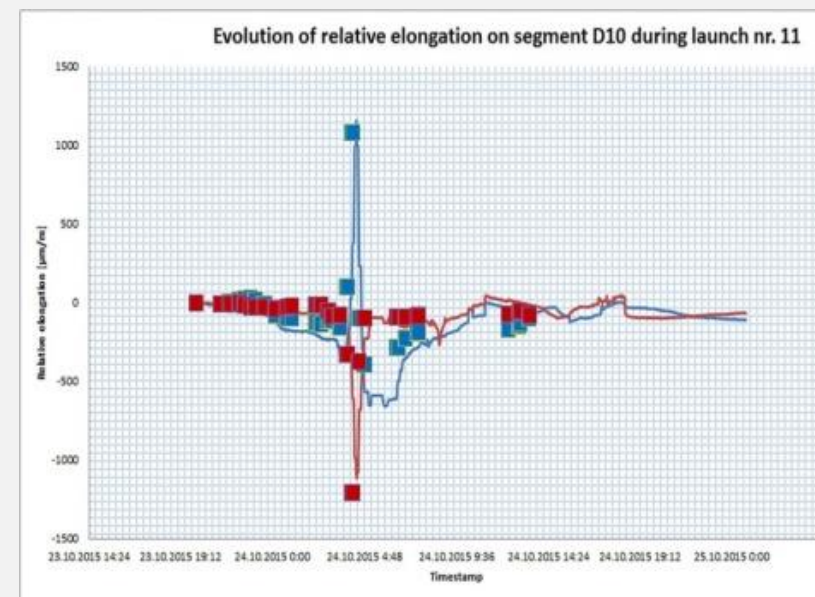
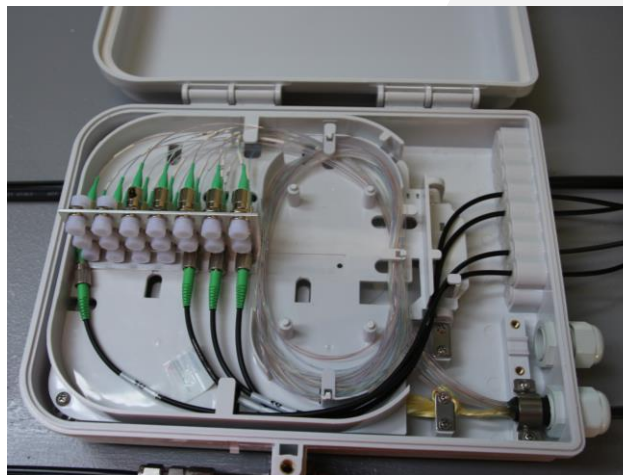
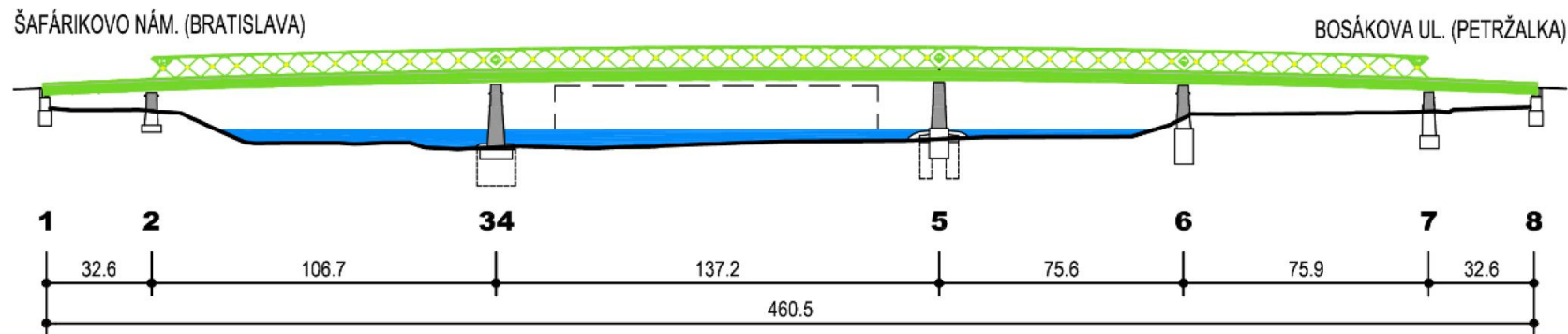
- Static + Dynamic analysis
- Quick installation
- Real-time data interpretation

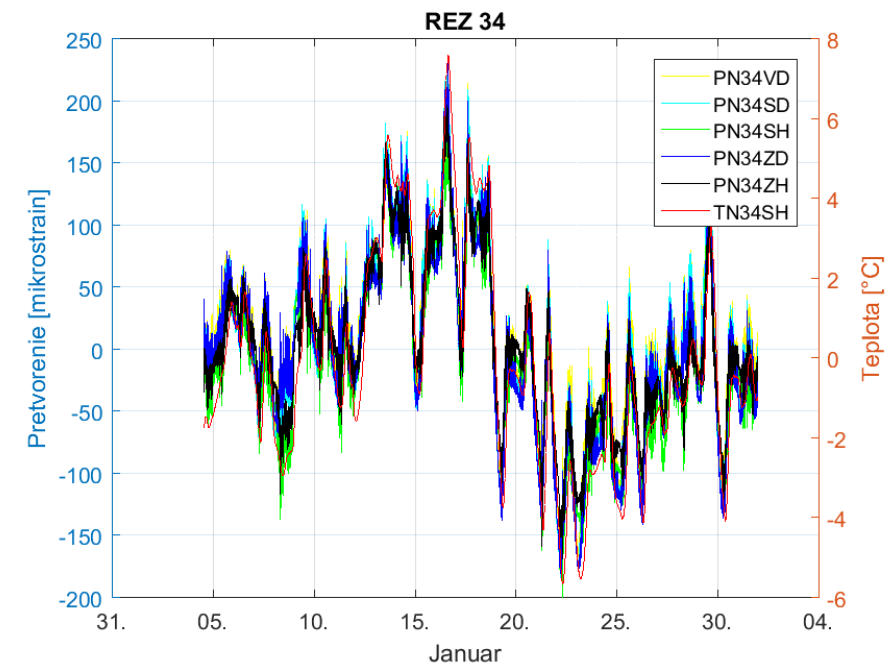
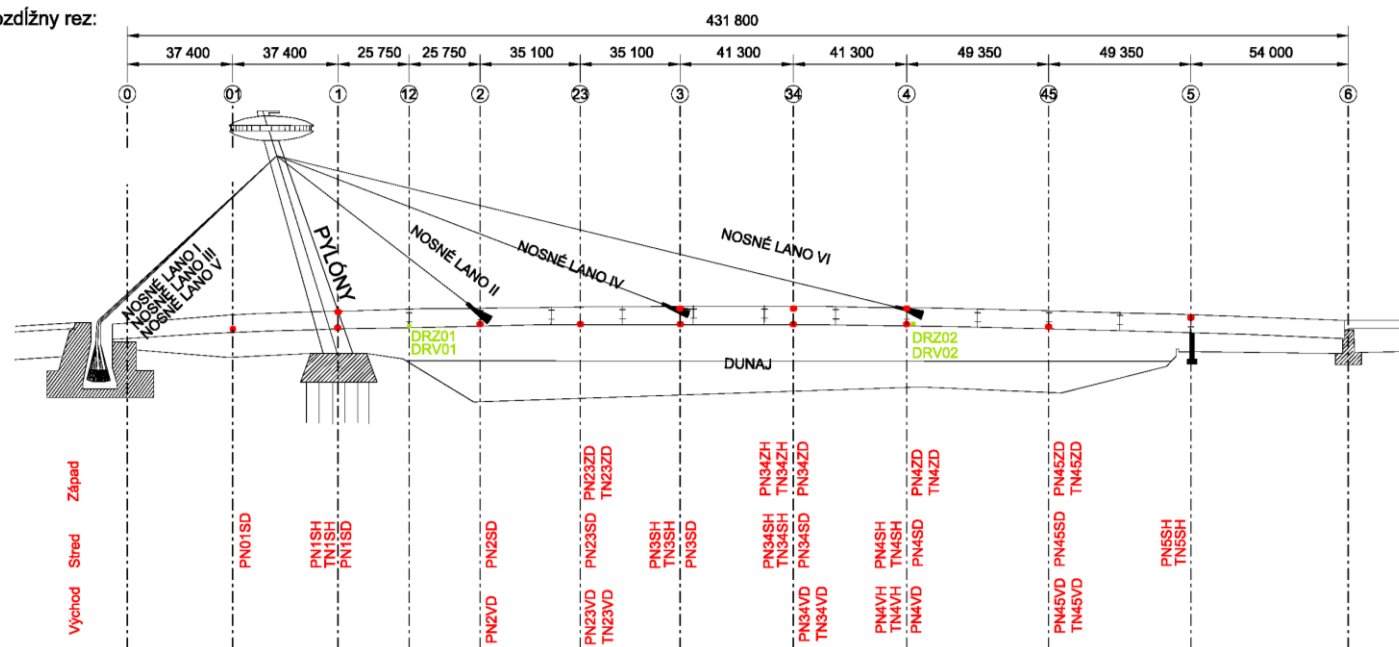
RESPONSE:

- **SC-01** Long gauge strain sensor
- **D-04** Displacement sensor
- **TP-03** Temperature sensor
- **SAA-0x** Accelerometers
- **SAT-01** Tilt meter



Bridge monitoring (2)





MACHINE LEARNING

From measured data to
valuable information





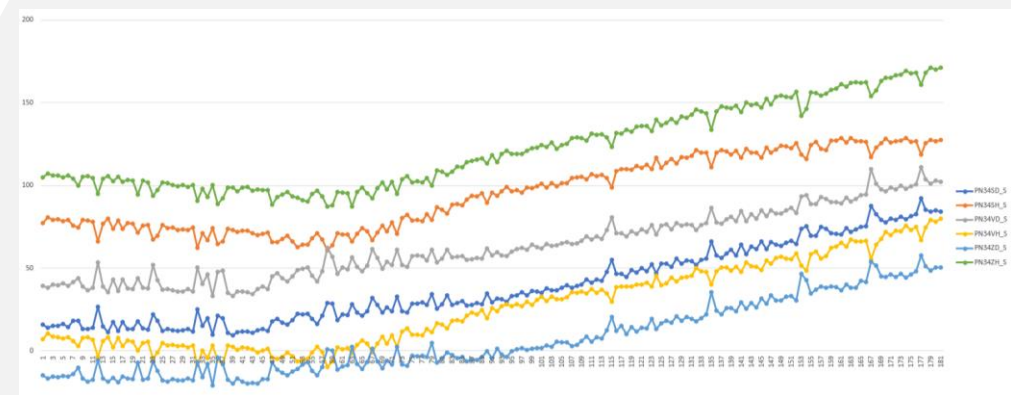
Monitoring with AI algorithms

Main objectives

- ▲ Identification of damage/degradation of the bridge structure
- ▲ Decision support for bridge structure management

Expected Outputs

- ▲ Identification of the abnormal state of the structure
- ▲ Localization of the problematic place of the structure
- ▲ Classification of the severity of the abnormal state
- ▲ Prediction of the degradation of mechanical properties of the structure



Manual statistics vs Machine Learning

Machine learning Software package

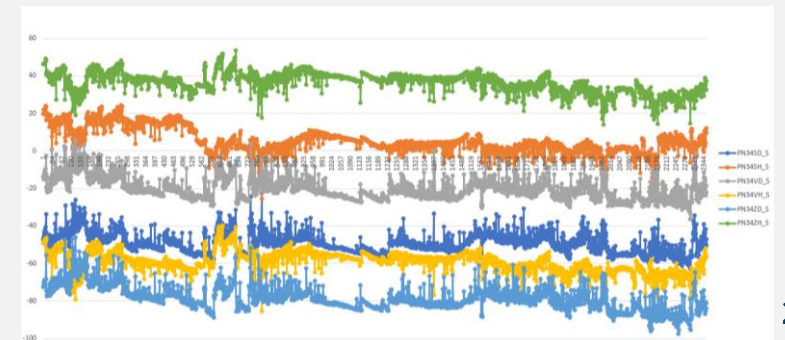
- Applicable to all structures
- Independent from sensor types or technology
- Data-driven approach

ML Principle

- Learning from data → Modelling → New data processing → Retraining of the model → and again

Lessons learned (1month)

- Behavioural model of the bridge created from the monitoring data (without the need for knowledge of structure)
- New correlations appeared
- Automated processing of large dataset in real-time.
- Recalculation of the model based on the new annotated data
- Degradation of elastic properties detected



CONCLUSIONS





Conclusions

WHAT WE OFFER

- ▲ Plug & Play sensing systems ready for quick installation
- ▲ Custom sensor design services
- ▲ Contract Manufacturing / OEM production services
- ▲ AI / Machine learning data processing for your projects

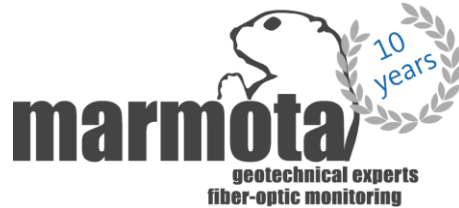
- ▲ 14 years experience with FBG technology
- ▲ Strong quality management and high-volume production
- ▲ High standards of business ethics and social responsibility

POTENTIAL WE SEE

- ▲ Distributed sensing + FBG technology collaboration ... complementarity in solutions for clients
- ▲ VW + FBG technology collaboration
- ▲ AI / Machine learning data processing for your projects: FBG or distributed sensing



BIG THANKS TO OUR PARTNERS



▲ ... and to many others whom we could not list here due to the limited space or for NDA reasons.

COURTESY:

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Thank you

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Place: XXX
Date: May 2023

