

FBG Sensors Applications & Challenges

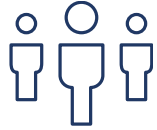
Peter Lowy
Sales Manager

Place: Porto
Date: April 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

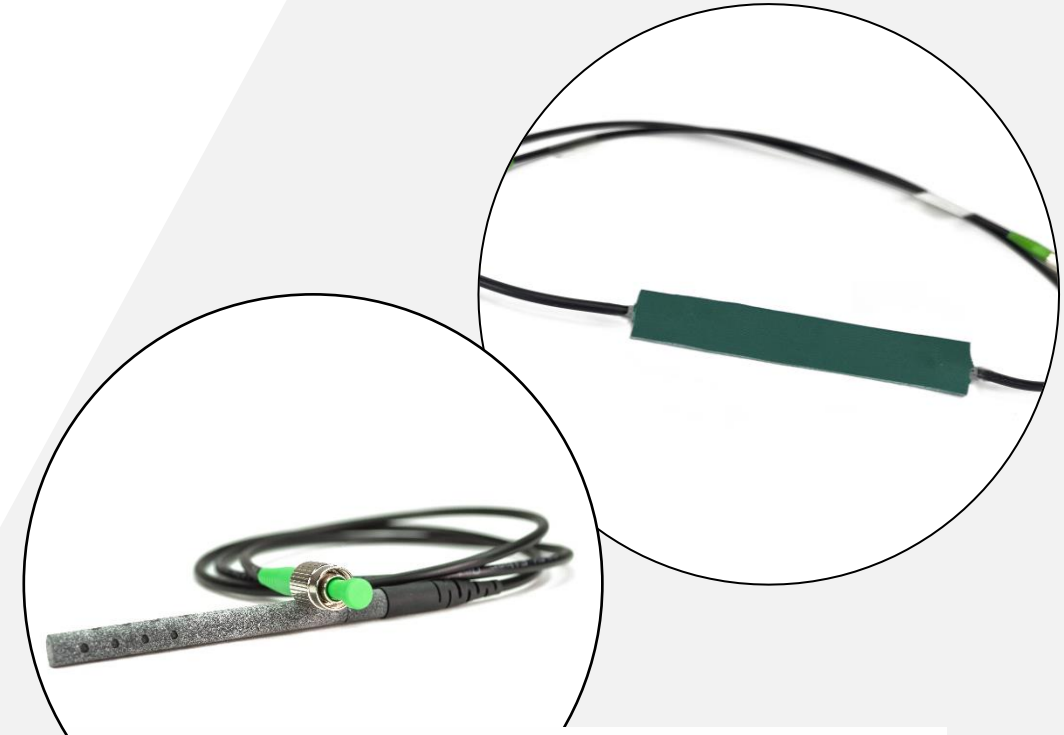


CHALLENGE:

- 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



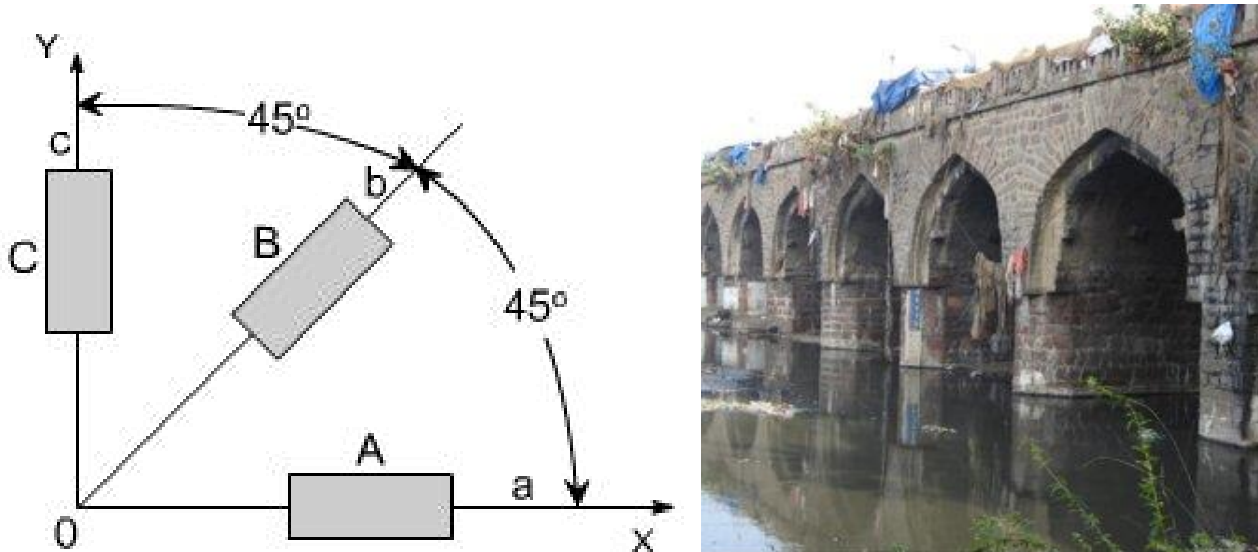
Strain analysis

CHALLENGE:

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

RESPONSE:

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

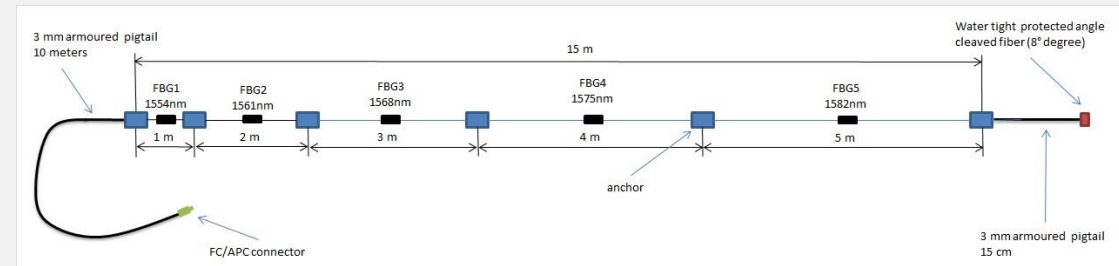
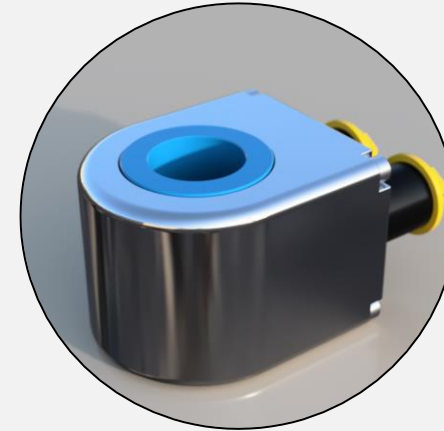


CHALLENGE:

- 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

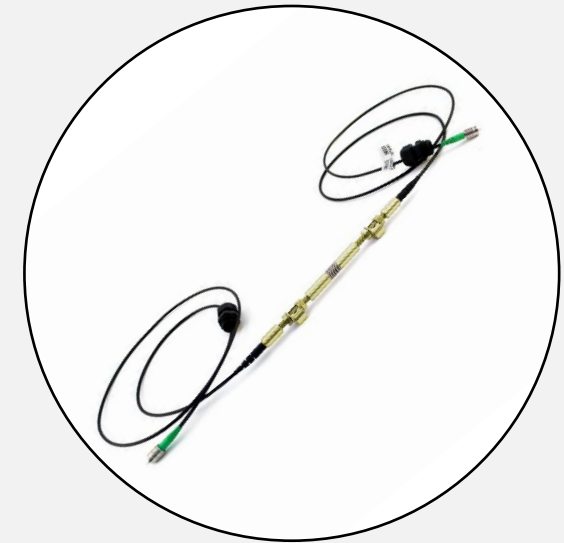
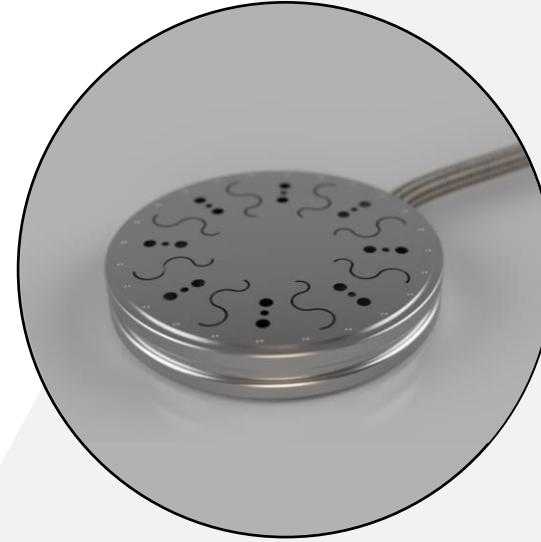


CHALLENGE:

- 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



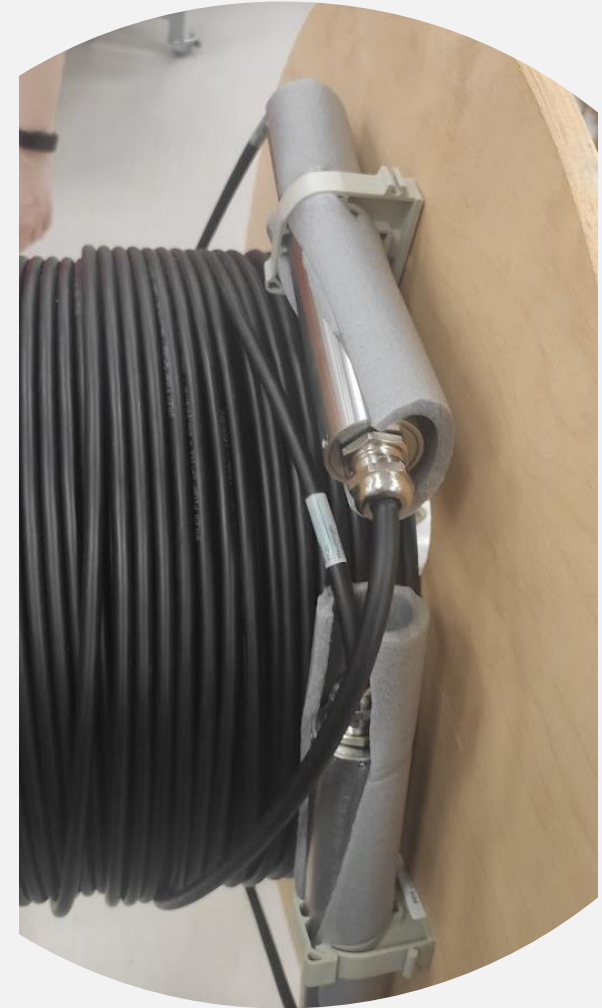
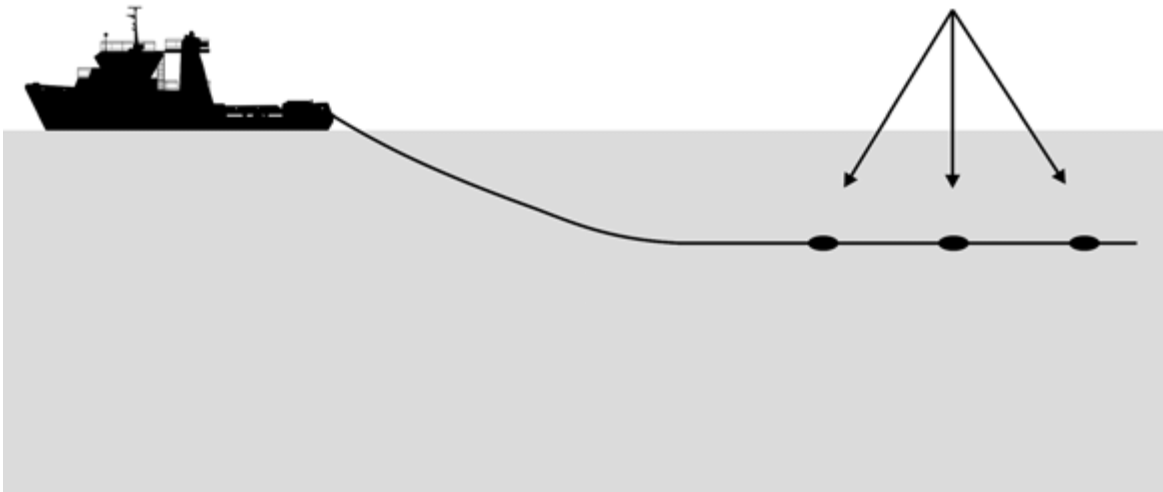
Marine survey

CHALLENGE:

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

RESPONSE:

- Marine **Temperature & Pressure** array



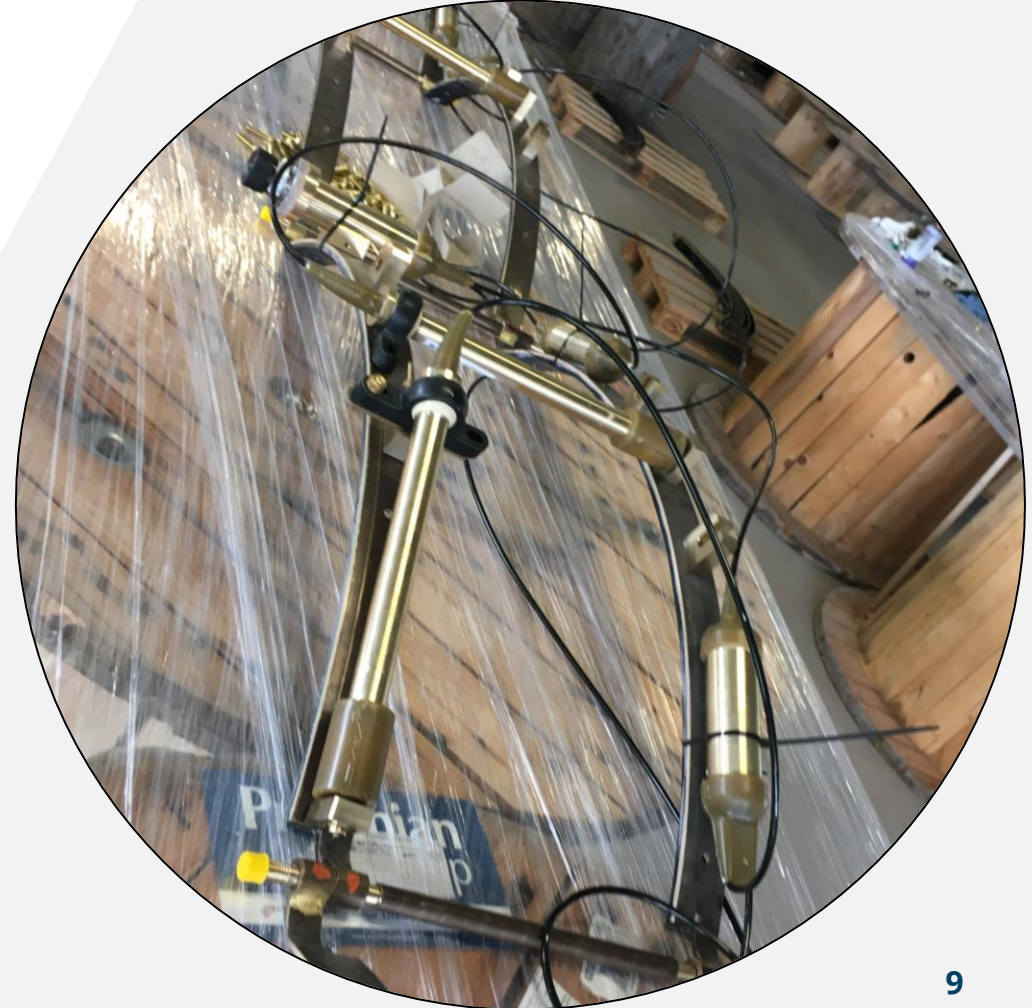
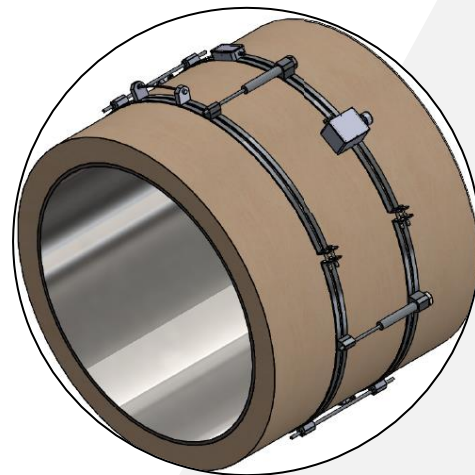
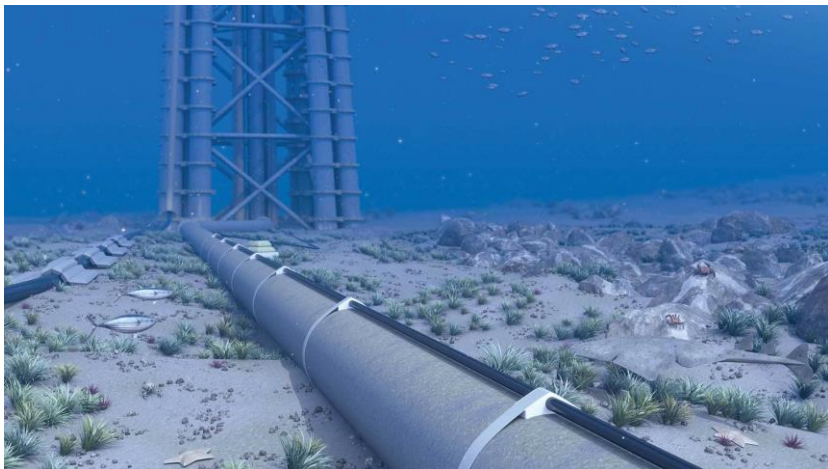
Sub-sea objects

CHALLENGE:

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

RESPONSE:

- Marine **Pipe-Belt**

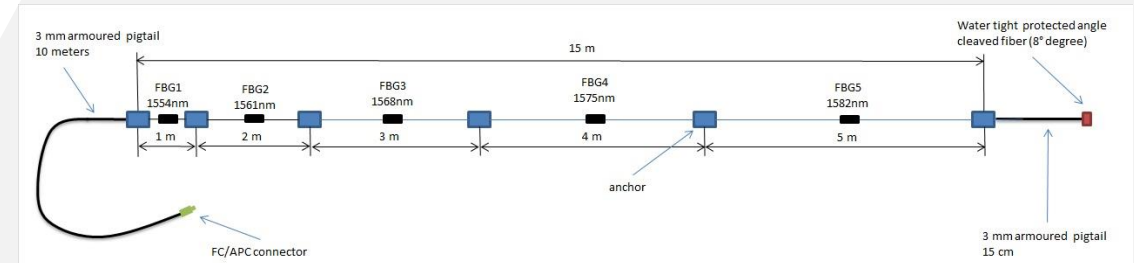
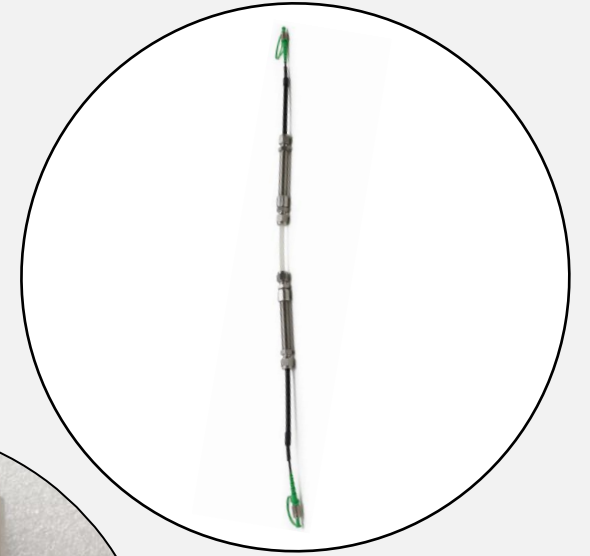


CHALLENGE:

- 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

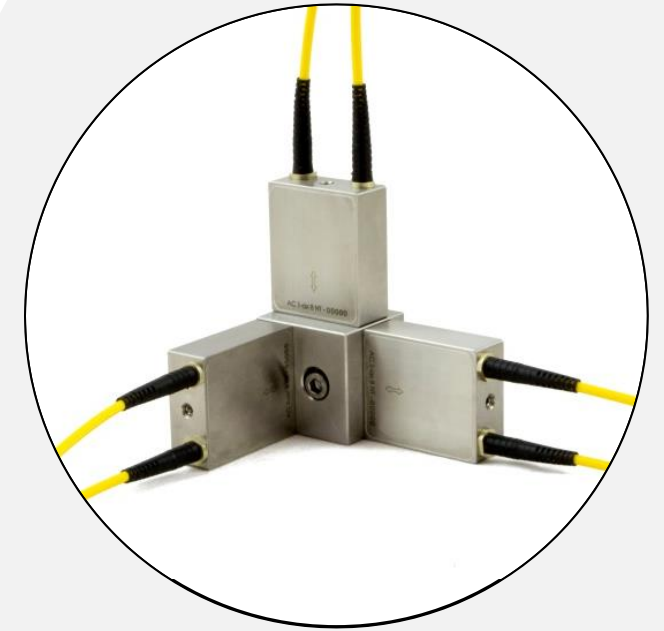


CHALLENGE:

- Tilting & vibrations

RESPONSE:

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



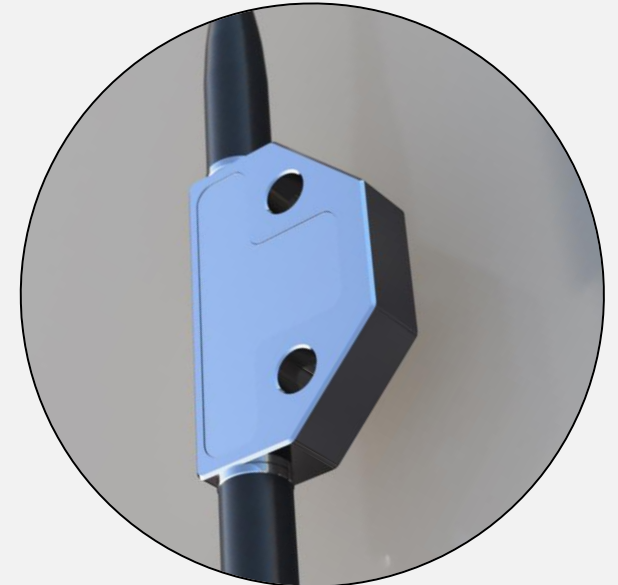
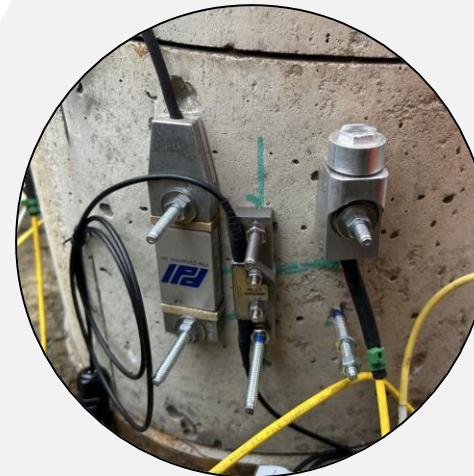
High shock sensors

CHALLENGE:

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

RESPONSE:

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

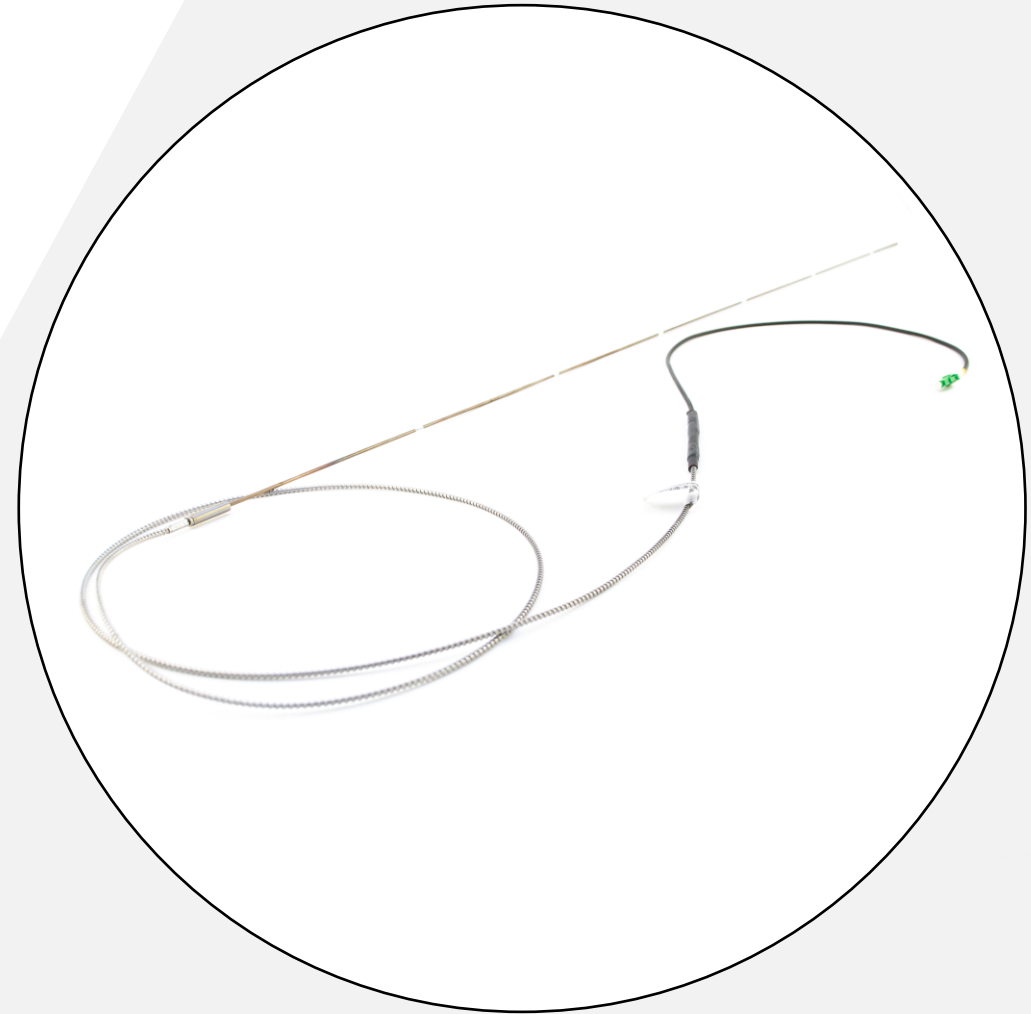


CHALLENGE:

- Vibrations
- High temperatures
- Long-term stability

RESPONSE:

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

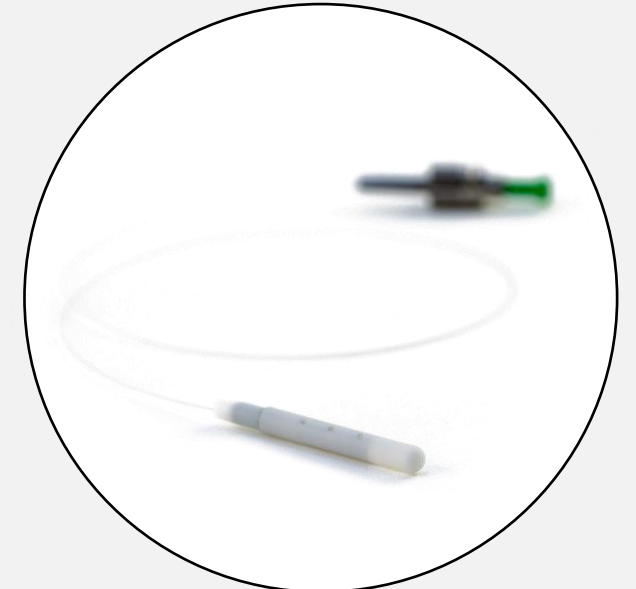
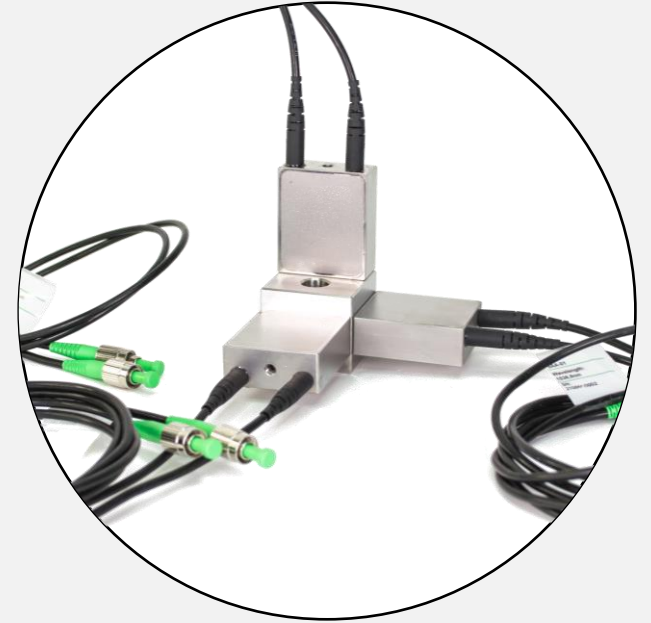
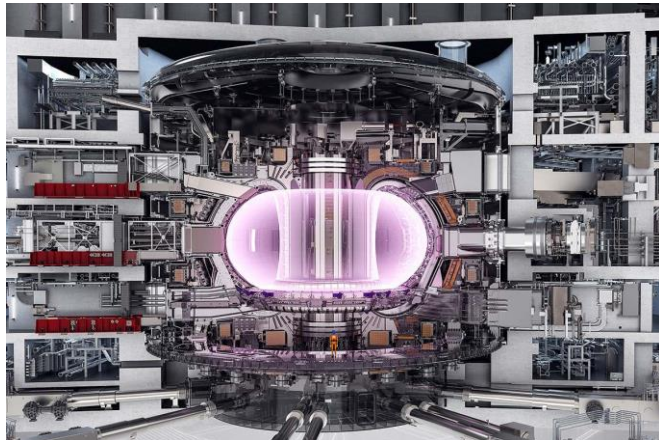


CHALLENGE:

- 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



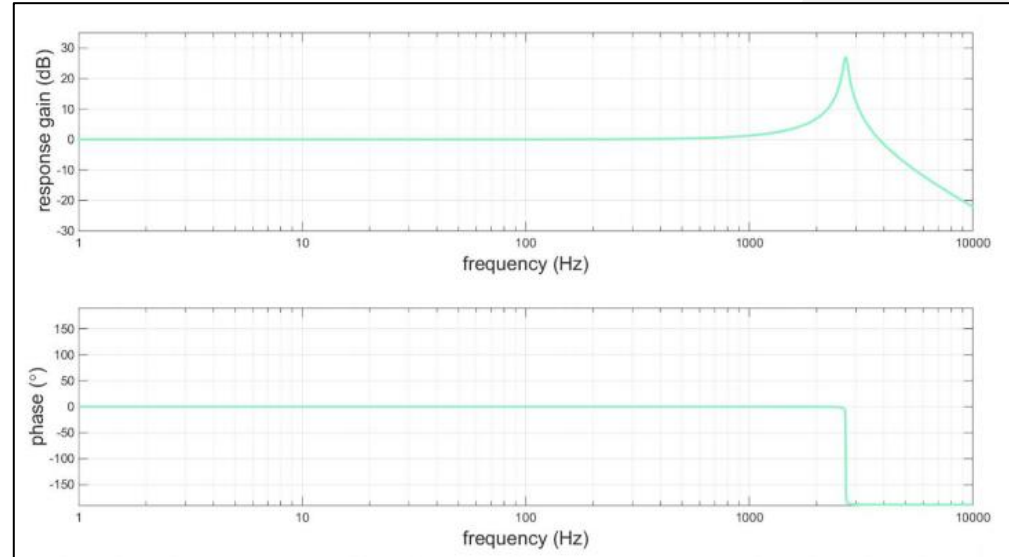
Dynamics & vibrations

CHALLENGE:

- Vibrations
- High temperatures

RESPONSE:

- **SAA-0x** accelerometers



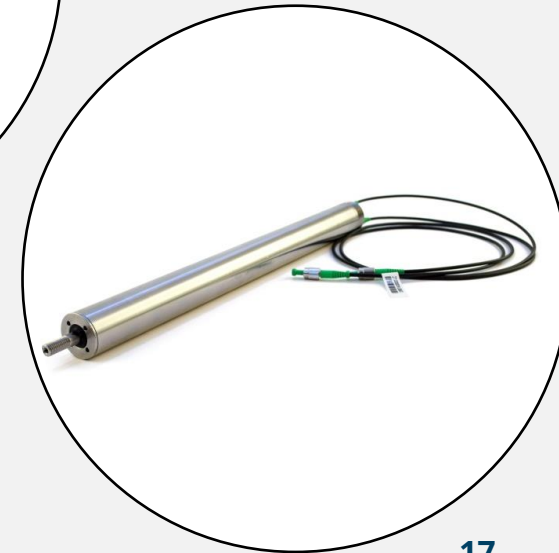
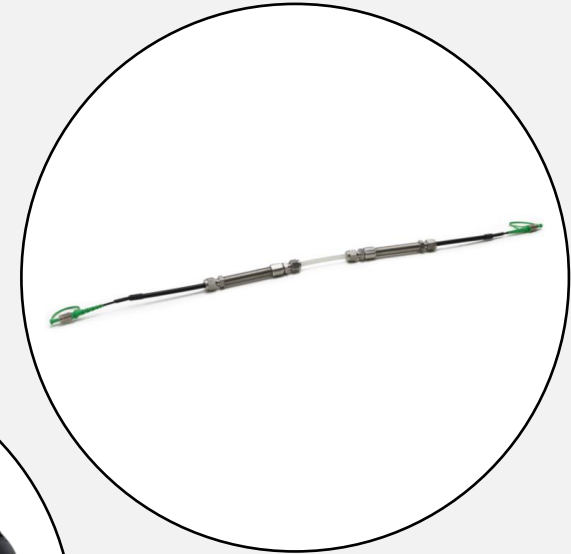
Bridge monitoring

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



MACHINE LEARNING

From measured data to
valuable information





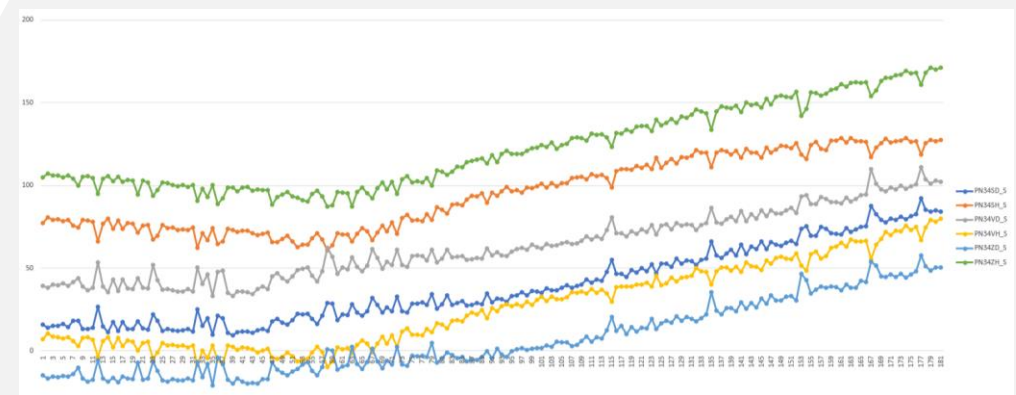
Monitoring with AI algorithms

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

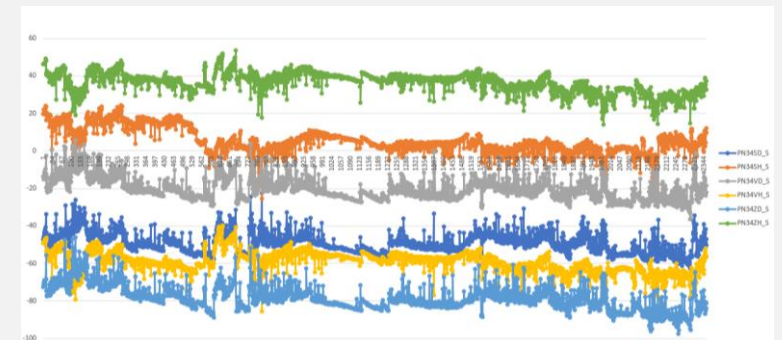
- Applicable to all structures
- Independent from sensor types or technology
- Data-driven approach

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



EPIC Questions





Future applications & challenges

EPIC questions

WHAT WE OFFER

- ▲ Custom sensor design services
- ▲ Contract Manufacturing / OEM production services
- ▲ AI / Machine learning data processing for your projects (pilot 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

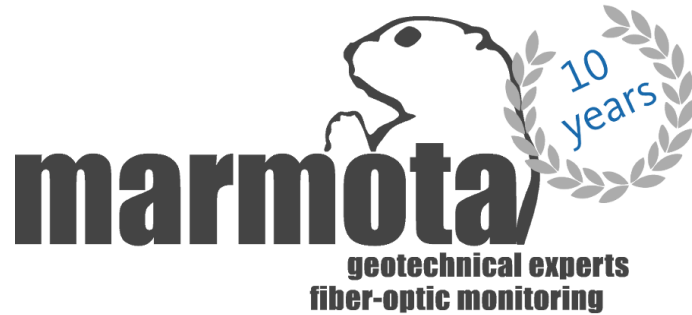
- ▲ Distributed sensing + FBG technology collaboration ... complementarity in solutions for clients
- ▲ Contract Manufacturing
- ▲ AI / Machine learning data processing for your projects: FBG or distributed sensing

WHERE YOU CAN HELP US

- ▲ Ideal interrogator:
 - ▲ Low-cost
 - ▲ Low-power consuming
 - ▲ Small form factor packaged
- ▲ Marine-grade submersible connectors & cables
- ▲ Cryo testing and calibrations
- ▲ Pilot projects for:
 - ▲ New developed sensors
 - ▲ AI / Machine learning data processing for your projects



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:

- ▲ All photos and pictures used in this presentation were used with courtesy of the original sources mentioned in the alternative text behind each picture (due to the limited space per slide).

Thank you

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Place: Porto
Date: April 2023

