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PEC PSP

Sustainability is our mission.

iBridge Monitors

Helping engineers make *informed* decisions.

iBridge Monitors

How much is your structure deviating from design?

iSHM –Long-term measurement of structural integrity.

How much is traffic damaging your bridge?

iBWIM –Real-time measurement of heavy goods vehicles.

2 Systems, built around a common core.

Hybrid systems can be tailored to individual needs.

iSHM Structural Health Monitoring

Tracking long term changes in bridge geometry.

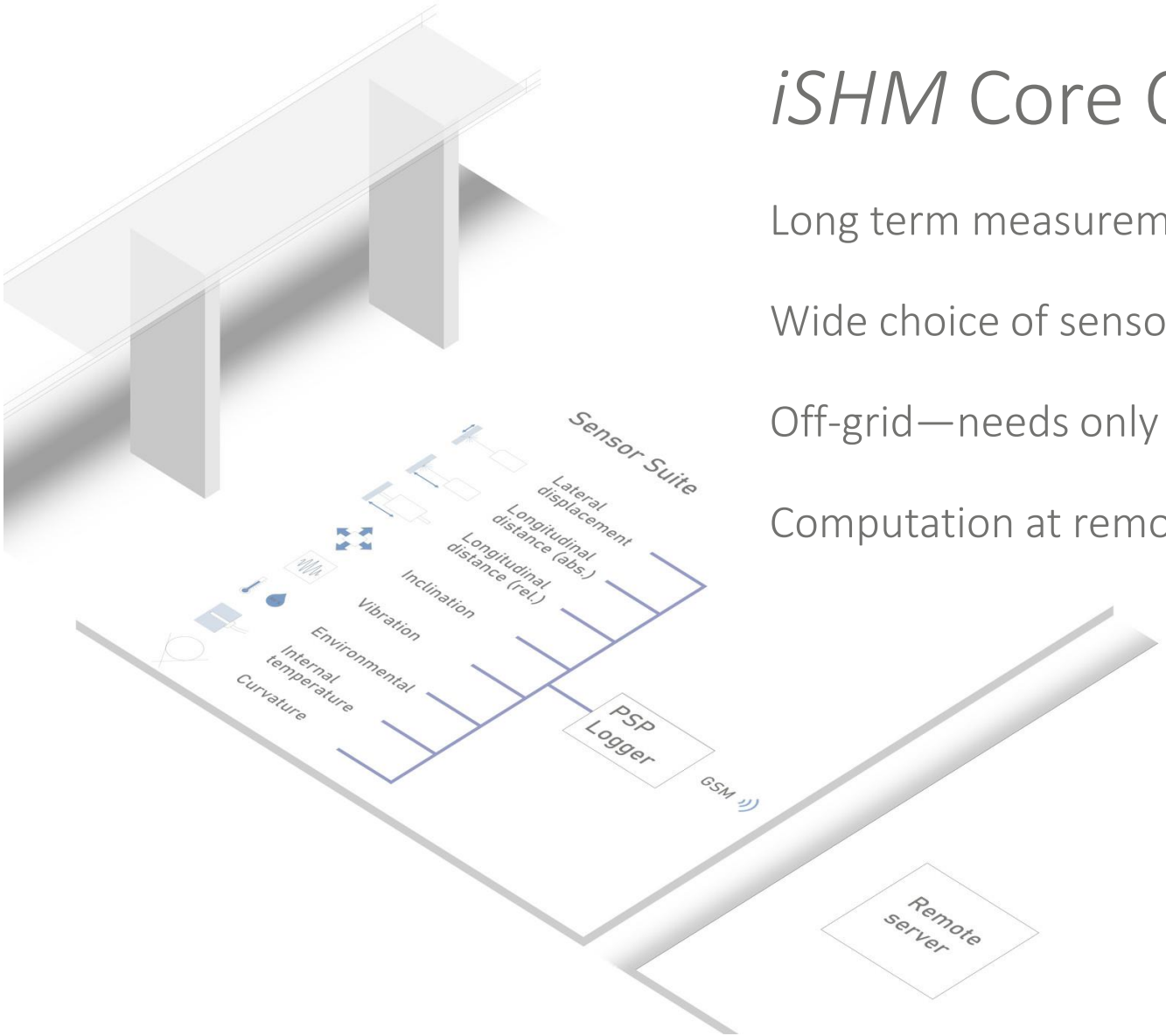
iSHM Core Concept:

Long term measurements

Wide choice of sensors

Off-grid—needs only network coverage.

Computation at remote server.



iSHM

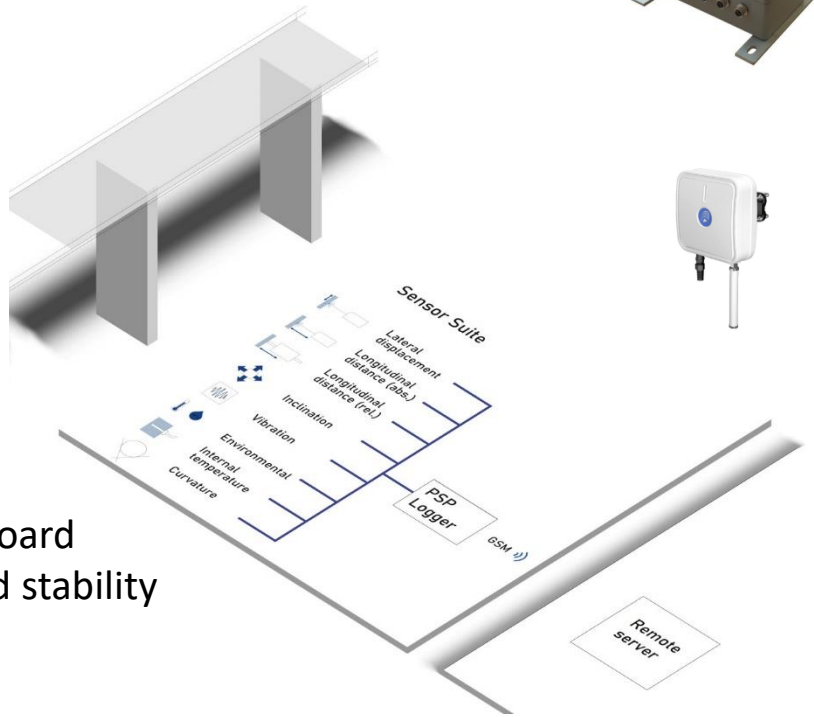
Long term measurement of subtle changes requires low noise, high precision electronics.

We use specially developed smart sensors with:

- On-board digitisation,
- Temperature compensation,
- Connected with industrial LAN.

iSHM

PSP Logger—self-powered, Independent, robust.

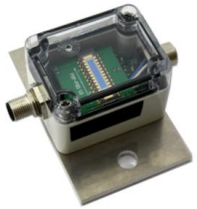


Periodic communication with server. Logger will cache data if link cannot be established.

Smart sensors—on-board digitisation: improved stability and accuracy.

Sensor Suite

Standard Strain Gauge



Curvature Sensor

Ring Strain Gauge

Displacement Sensor

Environmental Sensor

Full Bridge Strain Gauge

Internal Temperature Sensor

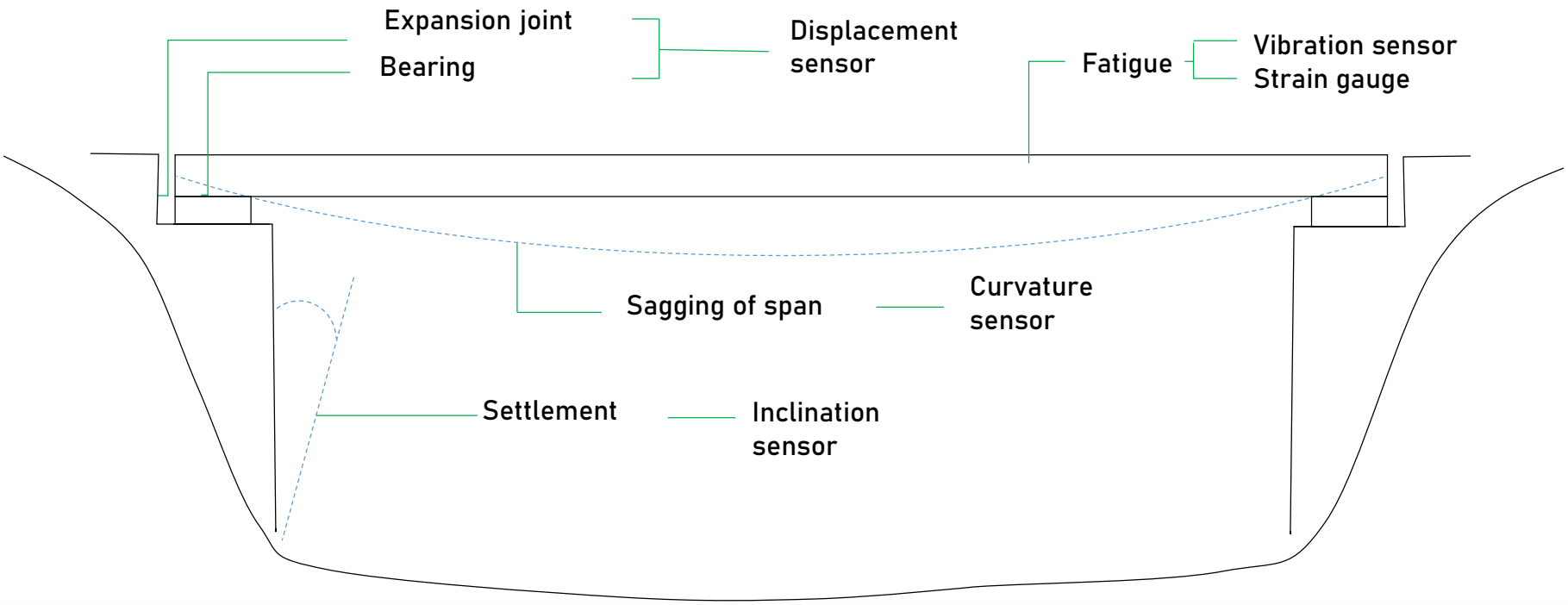
Laser displacement Sensor

Rosette Shear Sensor

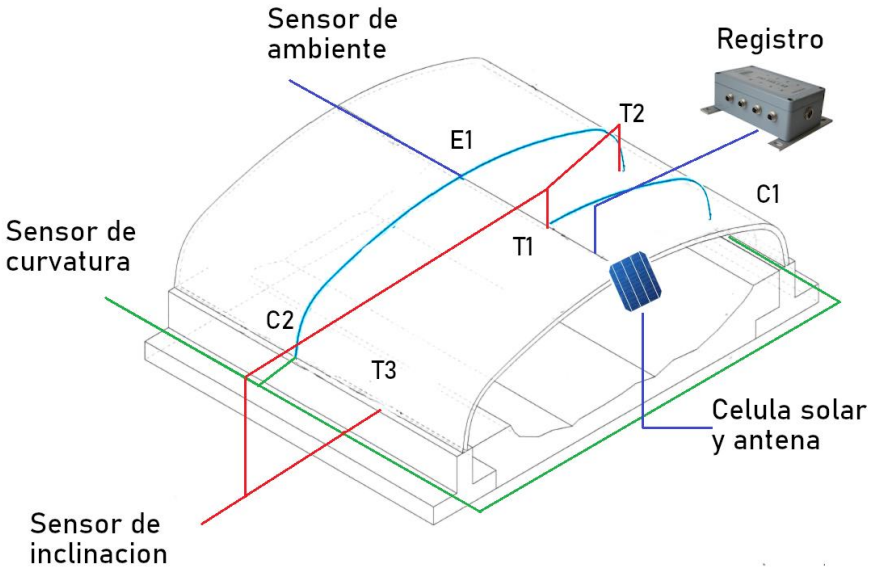
Acceleration Sensor

Inclination Sensor

iSHM: What do we measure?



Sensor layout for culvert



How are systems installed?

On-Site

Typical workload, based on 2-man team:

- Installation (1-2days)
- Calibration (2 days)
- De-installation (0.5 days)
- Re-installation (0.5 days)

Training

Installation

- Demonstartion installation on pilot bridge.
- Commisioning of a trainee installed system.

Software

- Introduction to online monitoring system.
- Introduction to maintenance planning system.

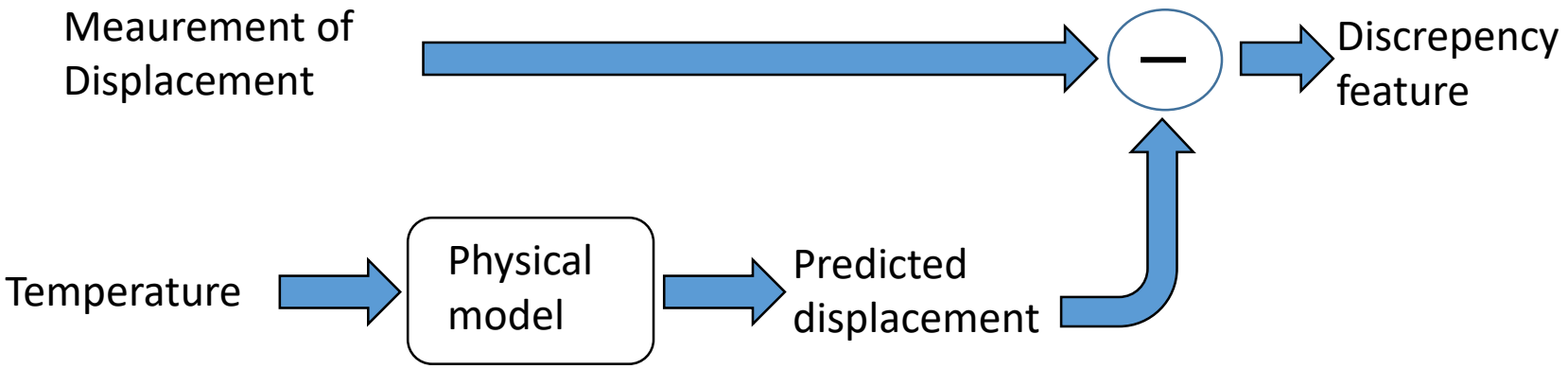
iSHM Model based features

iSHM measurements are strongly affected by temperature.

- Variation due to temperature will often drown out the interesting data.
- Often the absence temperature induced variation is itself an important cue.

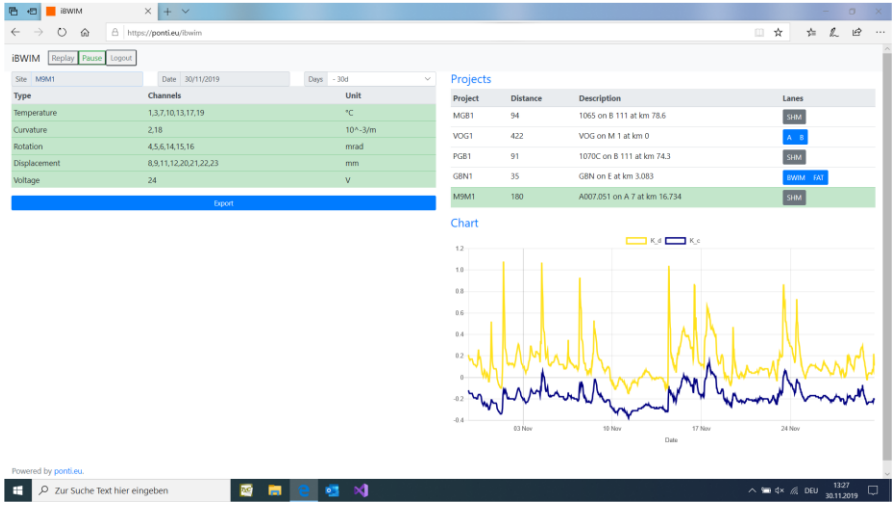
We use a simple physical model to predict the value of the measurement, then use the discrepency beween the prediction and the measurement as our feature.

Features: iSHM Model based features



iSHM: Outputs

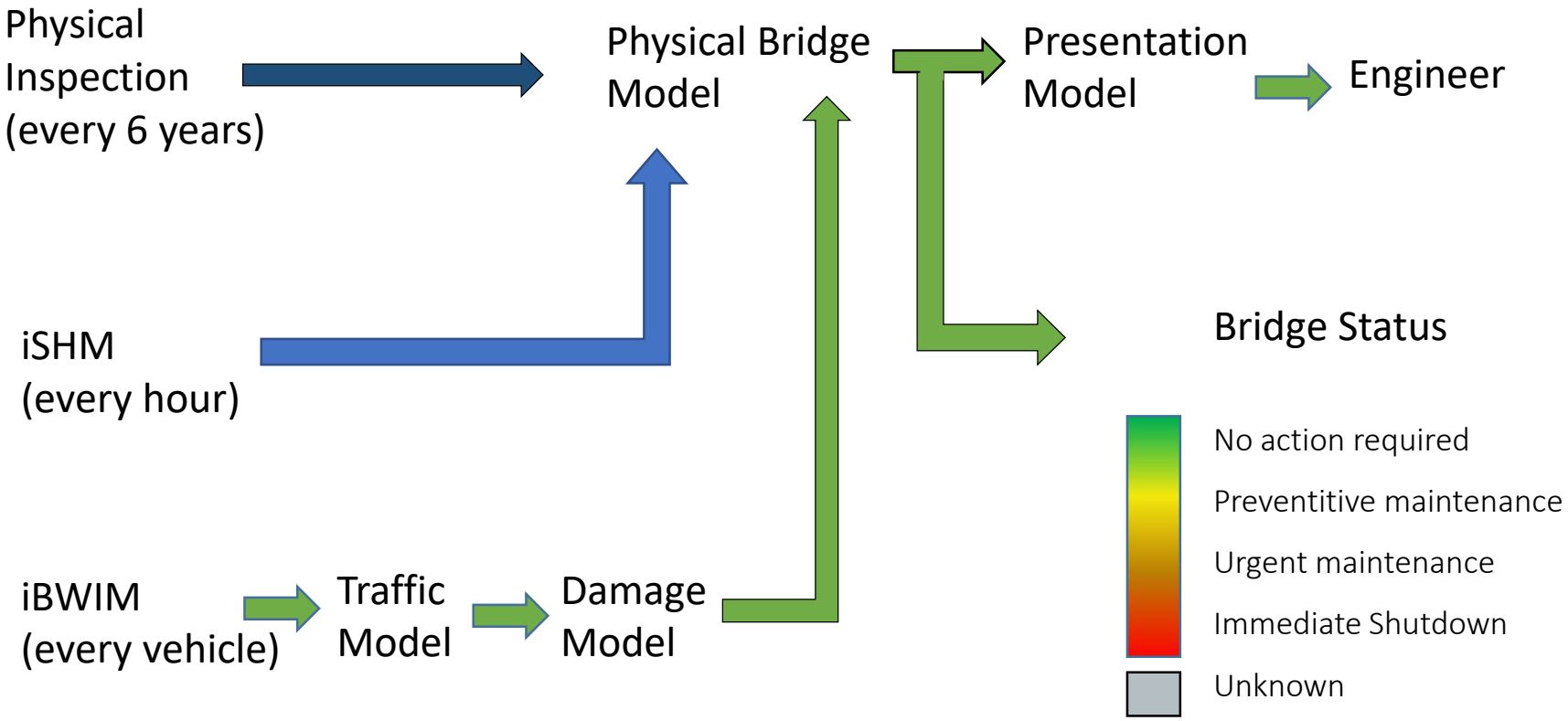
- Online record of measurements
- Online physical model of the bridge in near real-time
- Analysis of time series and trends
- Detection of transient events
- SMS alert when parameters exceed defined range



Estimating the condition of the structure

Given measurements how do we assess the status of the structure?

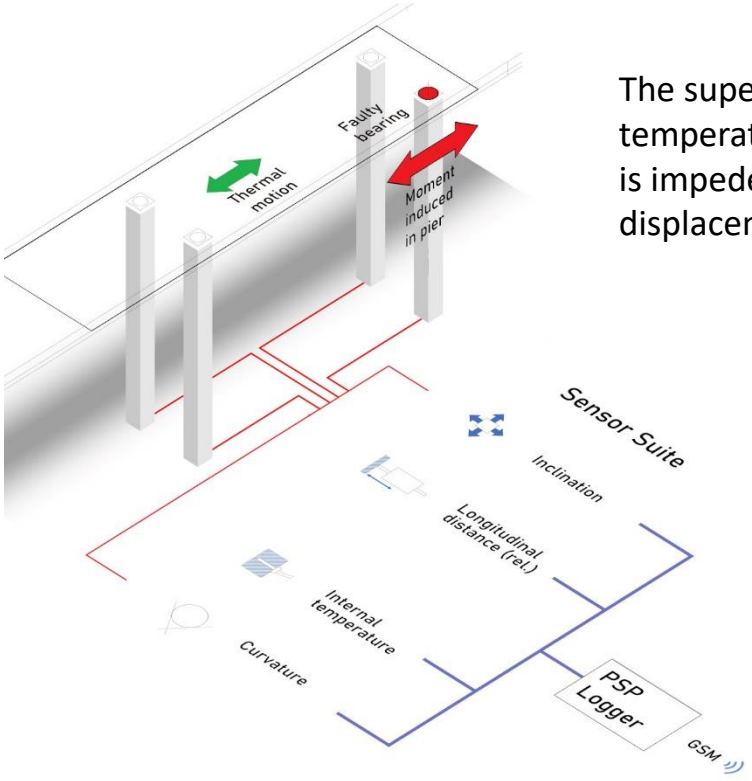
How do iBridge Monitors support decisions?



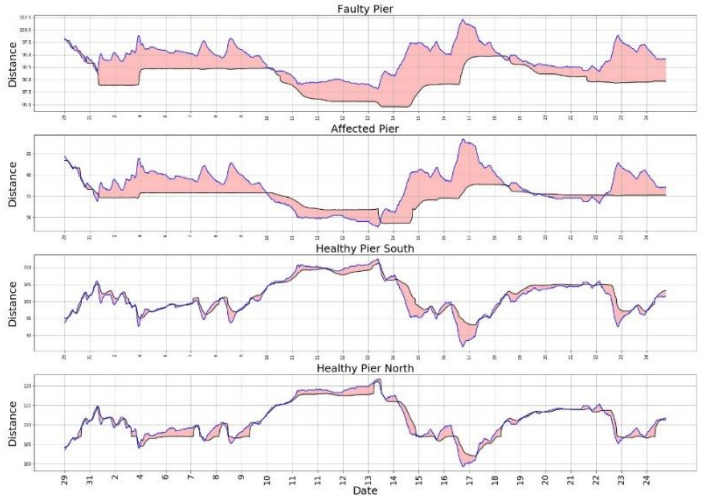
Case Study: M9 Linz, Austria

- 2x 4 lane road bridges, a total span >400m, >100,000 vehicles daily
- Fault was detected in one of the bridge bearings during routine inspection.
- Bridge remains open, because we are able to monitor the effect of the fault, and warn if it exceeds danger level.

Case Study: M9 Linz, Austria



The superstructure moves relative to the healthy piers according to temperature. If the bearing fails, the motion of the superstructure is impeded—there is a disparity (pink) between the actual measured displacement and the thermal prediction.



Case Study: Zauchen, Austria

Description: Railway, 2 tracks
Construction: Steel box girder (1908)
Requirements: Re-analysis for safety. Bridge approaching retirement, requires surveillance. Measure actual traffic loading.
Technical challenges: Weighing freight trains (typ. 180 axles) at full velocity (120 km/h).

Solution: 1 Spider system, semi-permanent (12 months)
Result: In addition to customer requirements, identified approach for linking stress cycles to single train events--relevant for residual lifetime prediction.

Case Study: Lesachtal, Austria

Bridges: Mattlinggraben and Podlanigrabben bridges in the Lesach valley.
Description: Roadway, 2 lanes
Construction: Steel box girder (1974)
Requirements: Both bridges are subject to landslip. Customer requires advanced warning of any detrimental effects on bridges

Solution: For each bridge 1 Spider system, powered by solar cell, used as a logger, for inclination and curvature sensors, reports back periodically to central server.
Result: At time of writing, the system has been monitoring continuously for over 1 year without human intervention.

Advantages of *iSHM* Approach

- On-site system is solar powered—no support infrastructure required, apart from mobile network coverage.
- Data logger supports multiple sensor types.
- Can be configured to measure individual events, at daily intervals, or at upto 3kHz.
- Communication with server can be event-driven (for speed) or at daily intervals (for power economy)

iSHM: Summary

- Measures selected bridge parameters over the long term.
- Easy to install—little or no disruption to traffic.
- Off-grid—only require mobile network coverage.
- Updates a model of the bridge that can be viewed from your office in near-real-time.

About PSP

- Founded in 2003
- Combines expertise in structural analysis with excellence in embedded systems and data analysis.
- Develops, installs and runs the iBWIM and iSHM systems.
- Sister company Petschacher Consulting perfrorms classical structural inspections and analyses.

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