

osmos
STRUCTURAL HEALTH MONITORING

STRUCTURAL HEALTH MONITORING

FRANÇOIS-BAPTISTE CARTIAUX

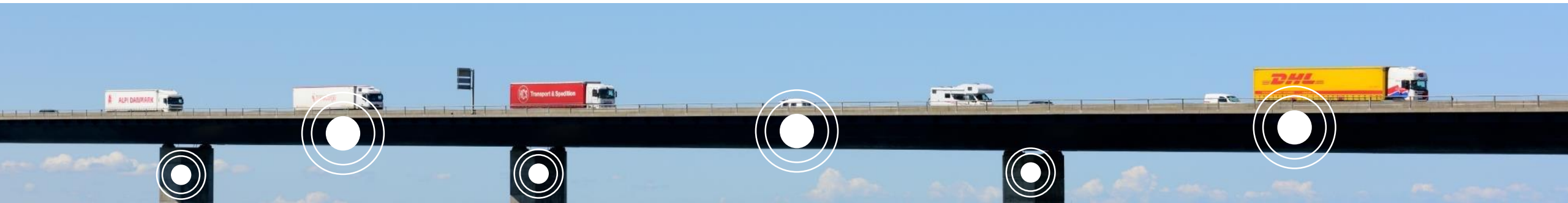
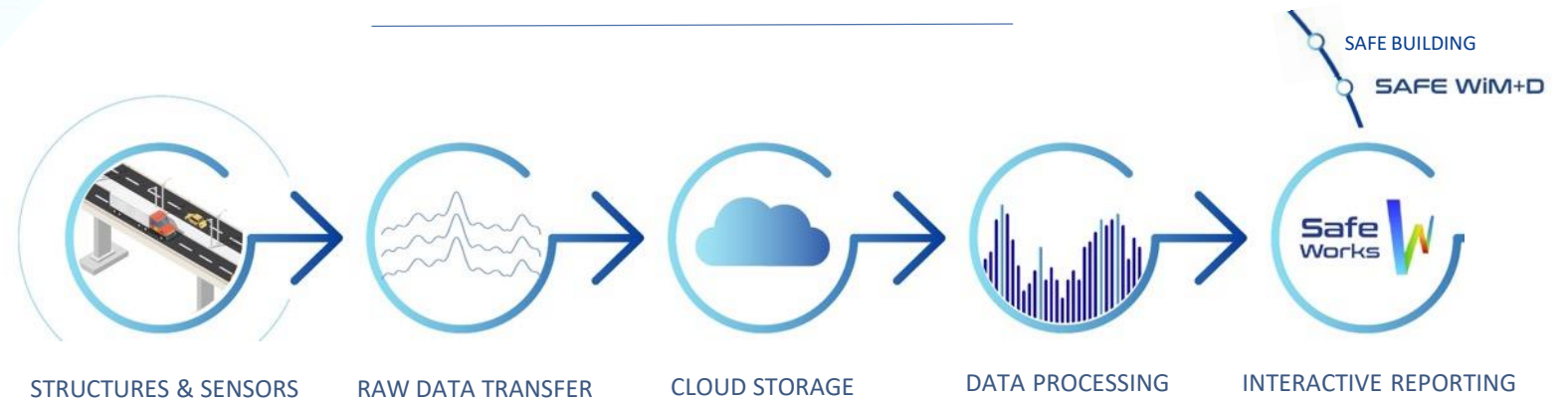
EPIC ONLINE TECHNOLOGY MEETING ON OPTICAL FIBER SENSING FOR
STRUCTURAL HEALTH MONITORING 2022-11-07

osmos

A UNIQUE INTEGRATED MODEL



FROM MONITORING TO CUSTOMER REPORTING



SELECTED PROPRIETARY WIRED AND WIRELESS SYSTEMS



OSMOS optical strand: long base, rugged and accurate

EDAS OPTICAL STRANDS: STRAIN AND DEFORMATION MEASUREMENT



AAA SENSORS TRI-AXIAL ACCELEROMETER

An accelerometer is a device that measures proper acceleration in order to check dynamic properties and vibration magnitudes.

LIRIS OPTICAL STRANDS: STRAIN AND DEFORMATION MEASUREMENT



LIRIS TILTMETER

A tiltmeter is a sensitive inclinometer designed to measure very small changes from the vertical level in structures.



OSMOS EDAS UNIVERSAL EXPERT ACQUISITION SYSTEM

The OSMOS expert data acquisition system consists of a smart station to which is connected a network of wire-based sensors.

- 100 Hz sampling rate for synchronized measurements of various quantities
- Connected to cloud by ethernet, 3G/4G

Ready to connect Optical Strand & all analogical sensors

- Accelerometers
- Anemometers
- Weathervanes
- Extensometers
- Hygrometers
- Tiltmeters
- Piezometers
- Temperature probes
- Strain gauges
- Lasermeter ...

OPTICAL STRANDS – STRAIN AND DEFORMATION MEASUREMENT

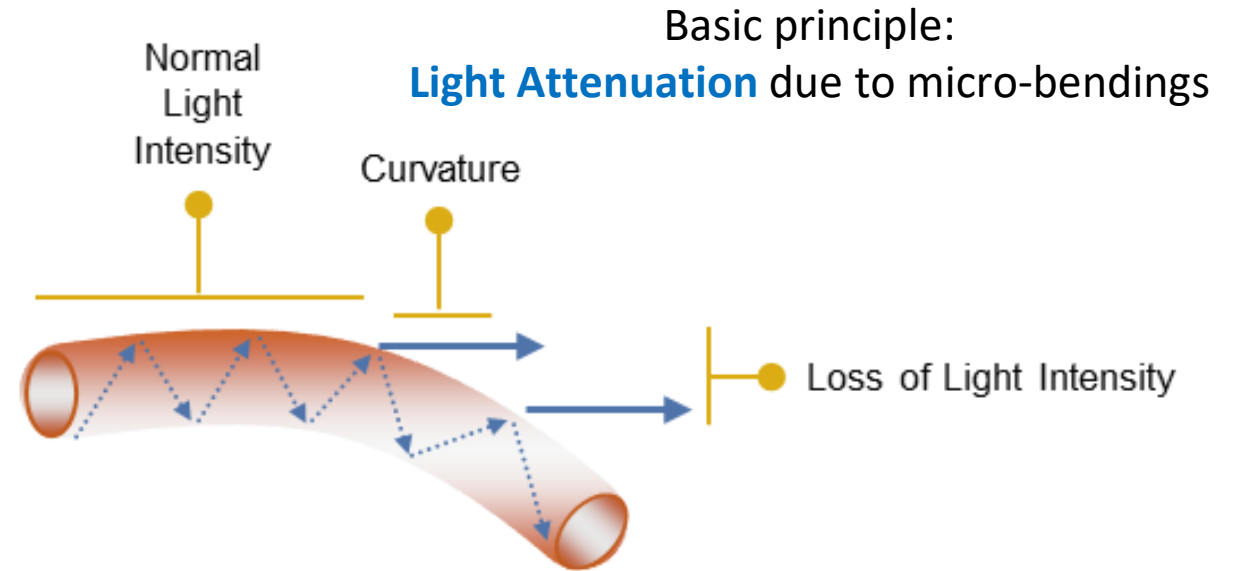
Continuous Strain Measurement through braided fiber optics



From Lab to Factory:
An **Improved Solution** since 2001,
More than 1000 applications worldwide



Wired or **Wireless Solutions**



A **Multi-Task Long-Gage Strain Sensor**:

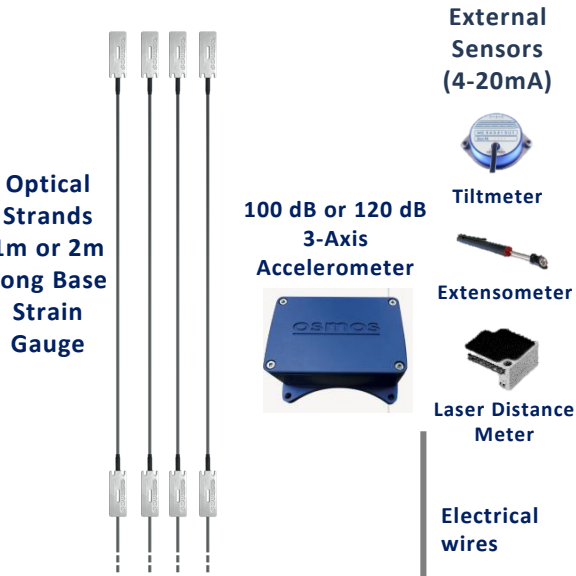
Continuous measurement at
100Hz Sampling over several years

Resolution of **1 $\mu\text{m}/\text{m}$**

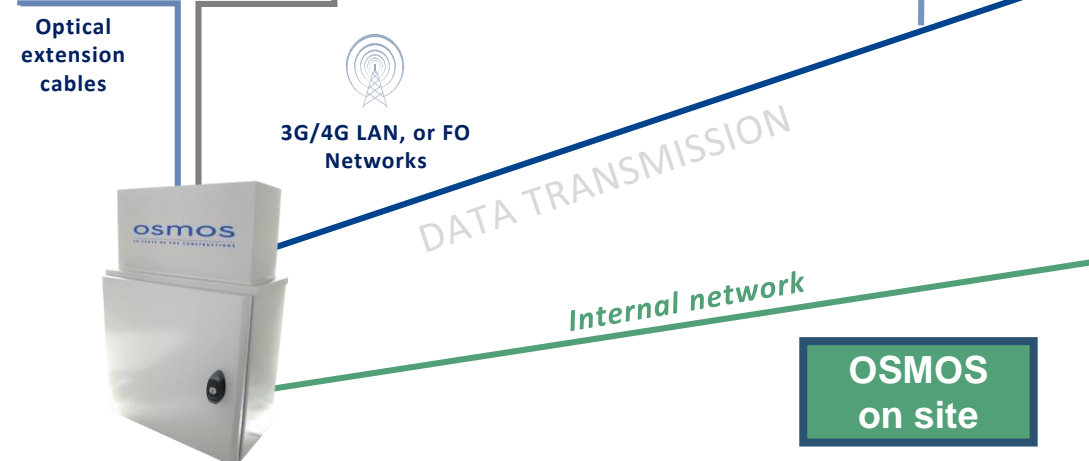


**EDAS
EXPERT DATA
ACQUISITION
SYSTEM**

LIRIS WIRELESS IOT DEVICES



- Data
- Information
- Analysis & Reports
- Alarm Management System (AMS)



- Data
- Information
- Analysis & Reports
- Alarm Management System (AMS)



OSMOS GROUP INVESTS SIGNIFICANTLY TO INCREASE SCIENTIFIC KNOWLEDGE IN ITS FIELD OF ACTIVITY

Research focus at the forefront of massive SHM data analysis

- **Detection of anomalies and damage** by combining mechanical knowledge and mathematical data science methods.
- **Analysis of structural aging and life cycle** : probabilistic fatigue, stochastic maintenance, predictive analysis.

Many research partnerships with leading university laboratories

- Four thesis, many internships and postdoctoral works since 2019.



Université

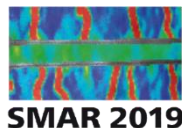
de Strasbourg

Active participation in the SHM scientific community

- Several publications and conference presentations each year



IWSHM 2017
11th International Workshop on Structural Health Monitoring
September 12-14, 2017
Stanford University, CA



EUROSTRUCT



IALCCE 2023
EIGHTH INTERNATIONAL SYMPOSIUM
ON LIFE-CYCLE CIVIL ENGINEERING



www.osmos-group.com

ENGINEERING MODULES



ADDITIONAL
MODULE

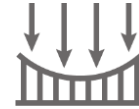


Alert thresholds setting

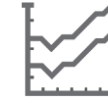
STATIC DATA PROCESSING



Measurement reports



Conversion to Civil Engineering values



Correlation study



Temperature compensation algorithm

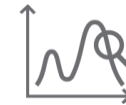
DYNAMIC DATA PROCESSING



Dynamic analysis



Advanced dynamic analysis



Statistic analysis



Deterministic fatigue



Operational Modal Analysis

INDEPENDANT MODULES



Weigh-in-motion and deformation WiM+D®

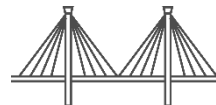


Pre-stressed cable break detection



Damage detection during and after an earthquake

MODELISATION



Parametric FEM of bridges



Finite Element Model calibration





CUSTOMER INTERFACE: CASE STUDY ON A RESERVOIR

The screenshot displays the OSMOS web application interface. At the top, there is a navigation bar with 'Accueil', 'Tous Mes Projets', and 'Localisation sur carte'. Below this, a sidebar contains navigation icons for home, folders, calendar, and share. The main content area is divided into several sections:

- Global Map:** A world map showing project locations with colored markers.
- Project List:** A table listing projects with columns for Project, Notation, Id, Project code, Start, End, Plans, and Plans points.
- Reservoir View:** A detailed view of a reservoir labeled 'Paroi 3' with sensor locations marked by letters A, B, and C.
- Deformation Data Table:** A table with columns for Note, Amplitude des déformations corrigées (mm/m), and Interprétation.
- Plan List:** A list of plans for 'Paroi3' with checkboxes for each plan (P3-C01 to P3-C10).
- Intervention Prioritization:** A horizontal bar chart at the bottom showing intervention priorities for various projects, color-coded from red (high priority) to blue (low priority).

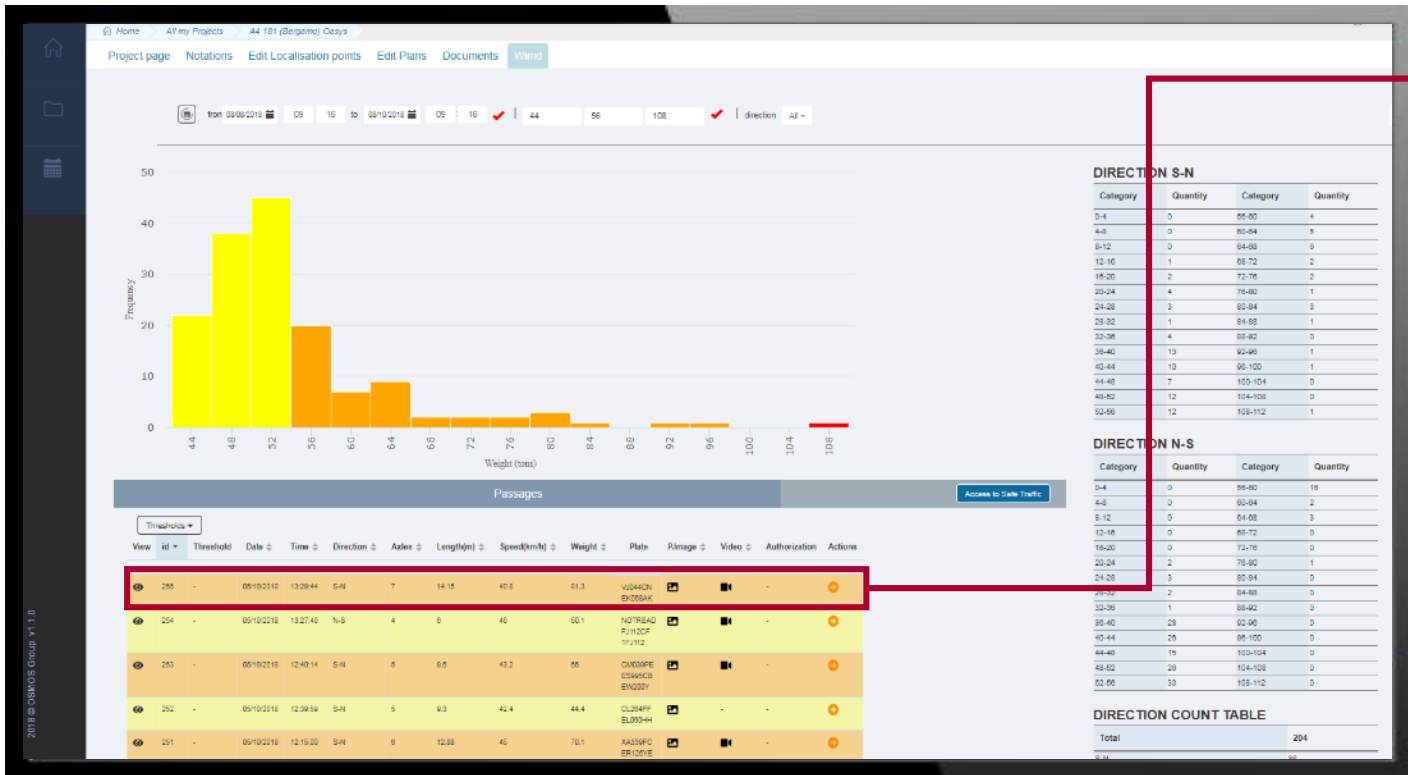
Note	Amplitude des déformations corrigées (mm/m)	Interprétation
A	< 0.25	Très stable
B	< 0.50	Stable, évolutions non négligeables mais normales
C	< 0.75	Moyen, évolutions à surveiller
D	< 1.00	Sensible, évolutions importantes
E	< 1.25	Critique, évolutions anormales pour un matériau de construction
F	> 1.25	Instable, risque de déformation irréversible du matériau (ou bien, capteur détérioré)

- SINGLE INTERFACE CUSTOMER-OSMOS FOR DATA, INFORMATION, REPORTING AND REQUEST
- GLOBAL VISUALIZATION AND SCORING OF THE STRUCTURAL ASSETS BEING MONITORED
- TIMELINE AND PLANNING
- CUSTOMIZED REPORTS AND NOTIFICATION
- REAL TIME AUTOMATIC RESULTS FROM DATA ANALYSIS AND INTERPRETATION GENERATED BY ALGORITHMS CREATED BY CIVIL ENGINEERS AND DATA SCIENTISTS





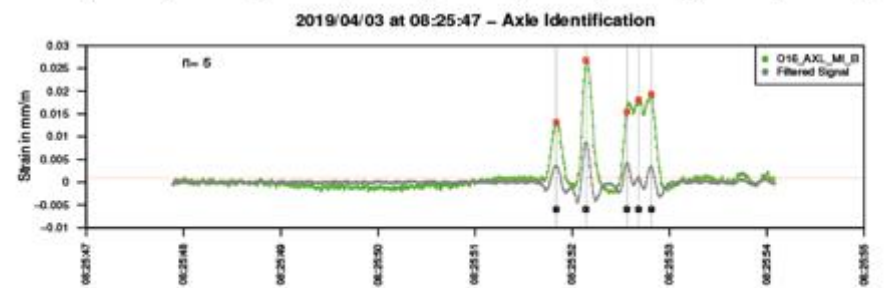
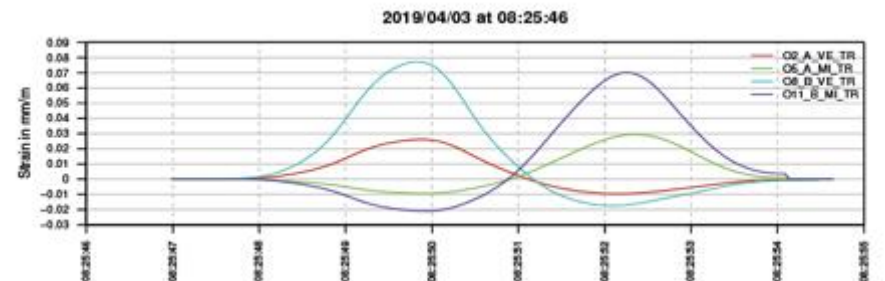
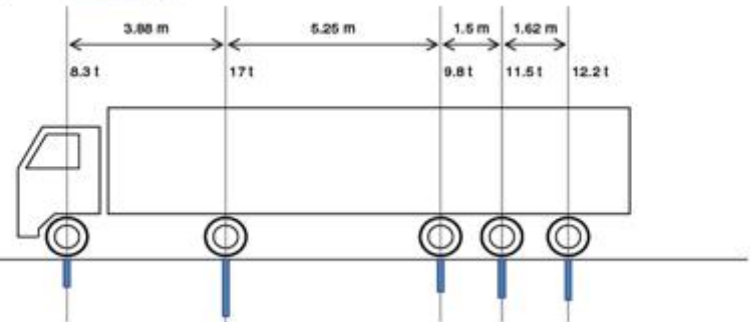
MONITOR BRIDGES AND WEIGH THE TRUCKS AT THE SAME TIME



Passage Data Sheet

Transit ID : 11029580 / 11029581 / 11029583
 Time : 2019/04/03 at 08:25:46 UTC
 Maximum Strain (mm/m) : 0.0773
 Gross Weight (tons) : 58.8
 Number of Axles : 5
 Speed (km/h) : 45
 Direction :
 Plate : XXXXX
 ID : 11029580

Confidence Level : 4 Reliable Result with good similarity to the load test cases



OUR SIGNATURE PROJECTS



INFRASTRUCTURES

Cairo Bridge, Kuwait

Implementation of OSMOS WiM+D® solution for Structural Health Monitoring (SHM) and weigh-in-motion on Cairo Bridge in Kuwait



CIVIL ENGINEERING AND INDUSTRIAL EQUIPMENTS



Grain silos, France

Structural monitoring of two grain silos in operation



ANCIENT HERITAGE

Cathédrale Notre-Dame de Paris

Assistance in the stabilization of the cathedral following the fire of April 2019



STANDARD AND PUBLIC BUILDINGS, HIGH-RISES



Stade de France, Paris

Monitoring of the stadium's suspended roof subject to climate stresses, since its construction more than 20 years ago





**OSMOS GROUP SA
37, RUE LA PÉROUSE
75116 PARIS, FRANCE**

**+33 1 71 39 85 15
WWW.OSMOS-GROUP.COM**