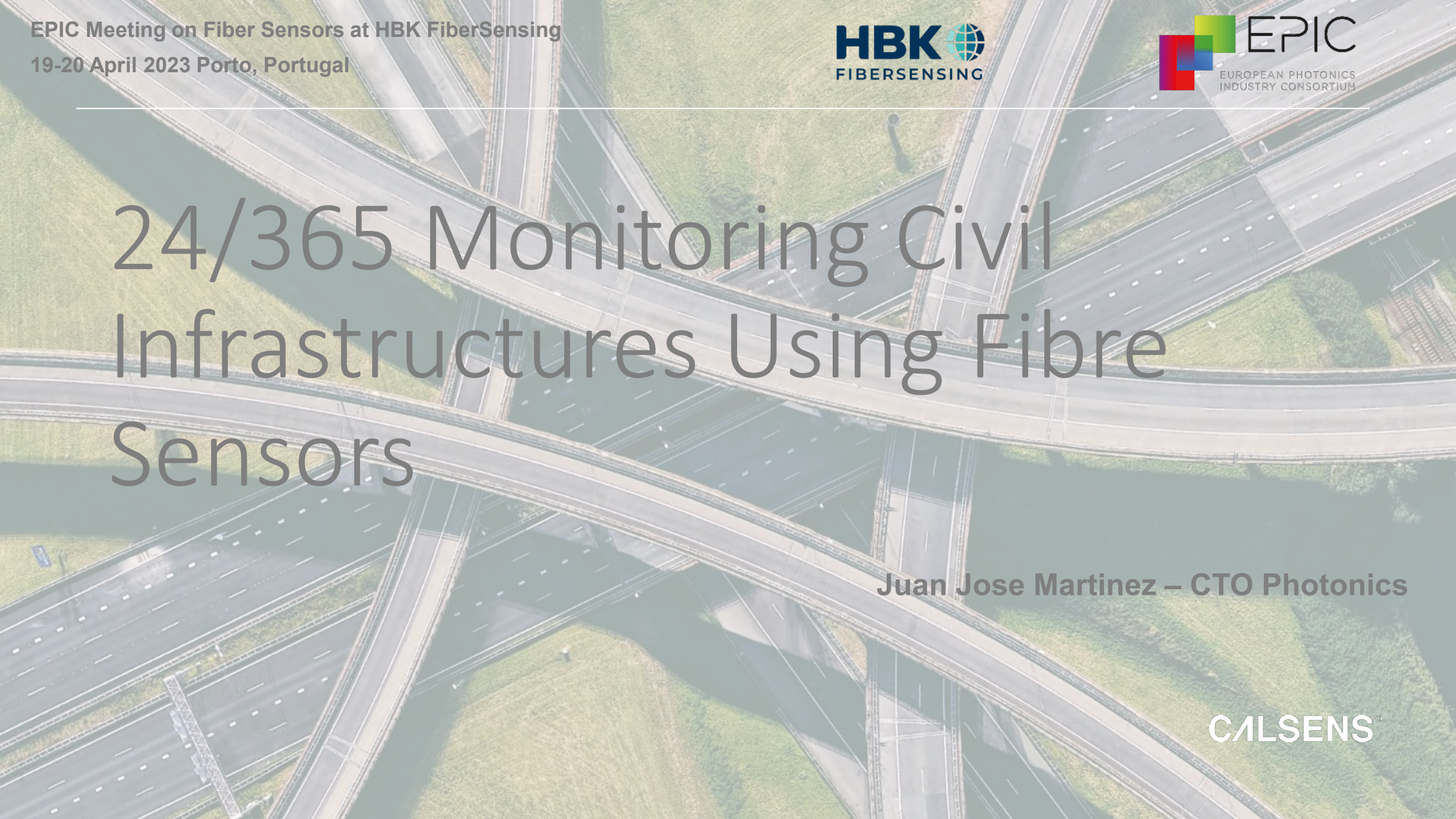
EPIC Meeting on Fiber Sensors at HBK FiberSensing
19-20 April 2023 Porto, Portugal



24/365 Monitoring Civil Infrastructures Using Fibre Sensors

Juan Jose Martinez – CTO Photonics

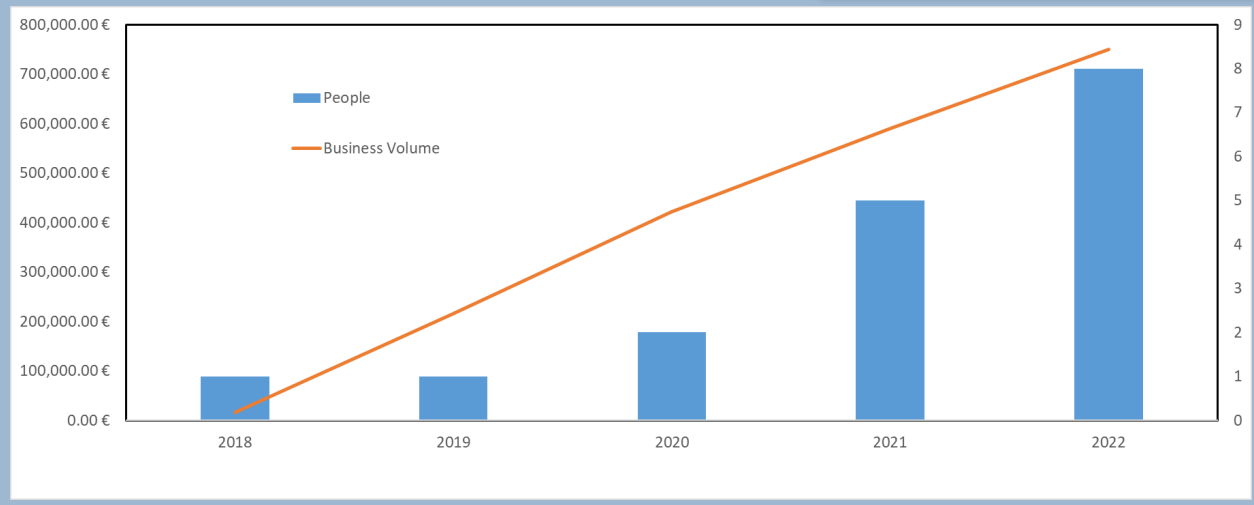
1. **The Company: Who are we? What we do?**
2. Our approach: How we do it?
3. Where do we apply our solutions?
4. New research, future developments

The Company

SME founded in 2013 as UPV spin-off taking advantage of their infrastructures and talent.

Multidisciplinary young team combined with the experience of the partners. Highly specialised personnel both in civil engineering and optics.

600.000€ business volume in 2021 with predicted steady growing in the following years.



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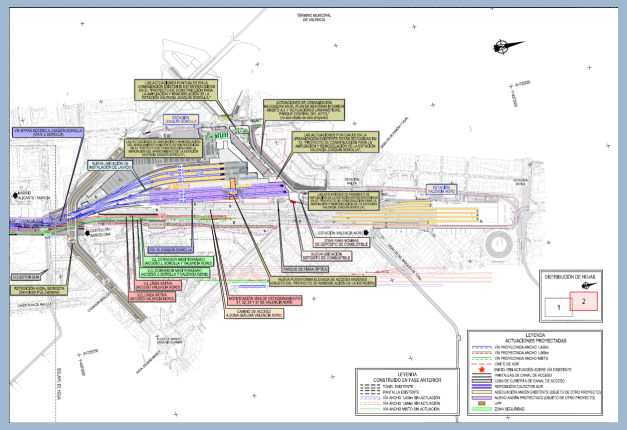
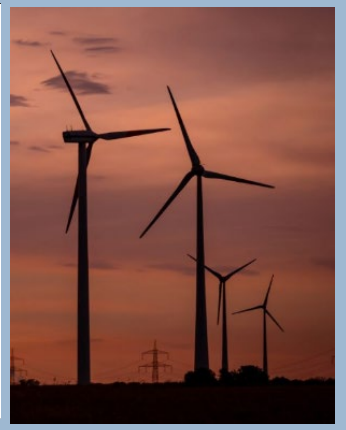
The Company

What we do: Provide real-time continuous structural monitoring for different civil engineering applications (bridges, buildings, vehicles, energy generation infrastructure) measuring temperature, strain, deformation, etc, through the use of novel optical sensors.




The real-time data and our monitoring services provide invaluable added value to the operation of infrastructures in terms of safety and reduced maintenance costs.

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Origins and background

Our origins in the ICITECH-UPV institute, an European leader research centre in the construction and structural engineering fields.

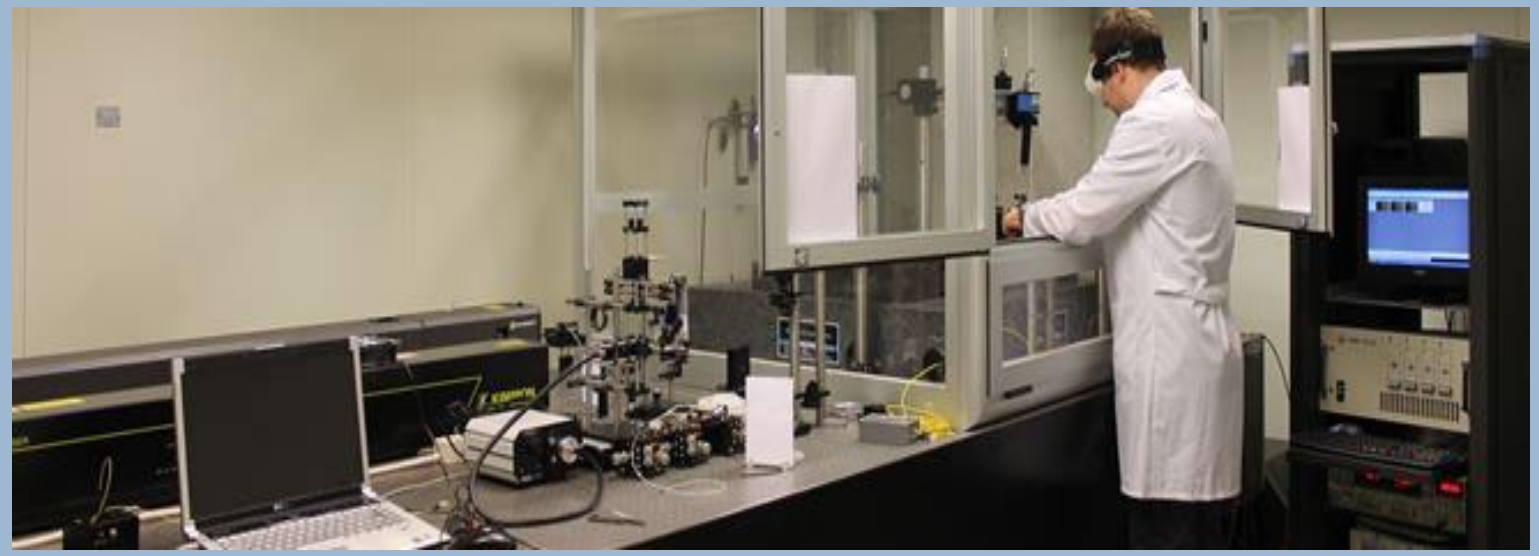
One of the largest structural testing laboratories in Europe.

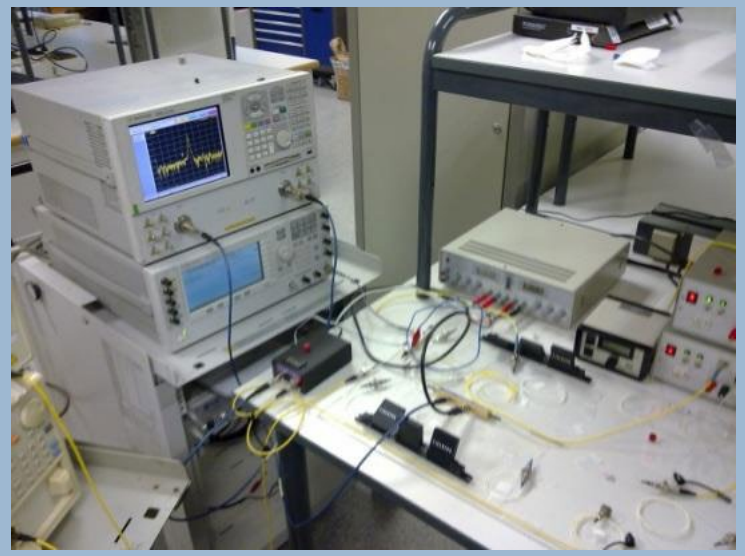
Knowledge and test ground for all our advanced projects, and availability of the advanced formed personnel.

Origins and background

We combine the expertise in civil engineering and structure analysis and testing with our own facilities to manufacture fibre optical sensors.

Unique and custom fabrications and collaboration with international research centres to go beyond the state of the art in optical sensors





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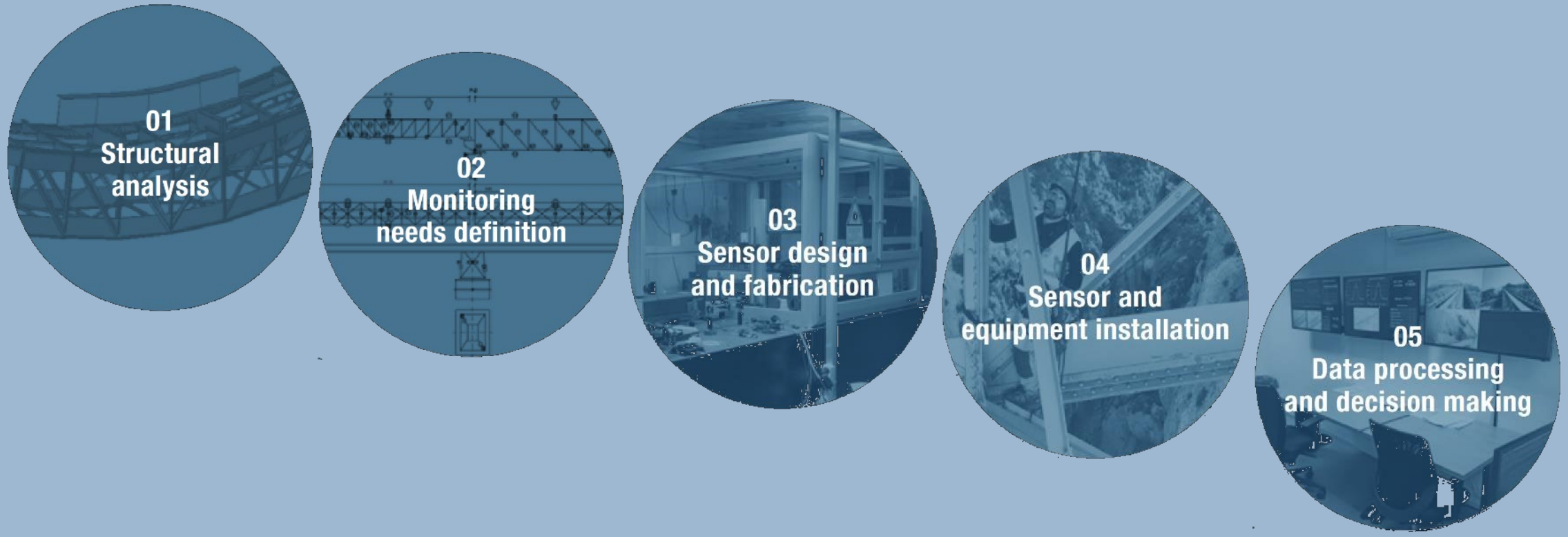
Approach to civil engineering solutions

Our multidisciplinary team allow us to have an holistic approach to the design and implementation of a complete SHM system.



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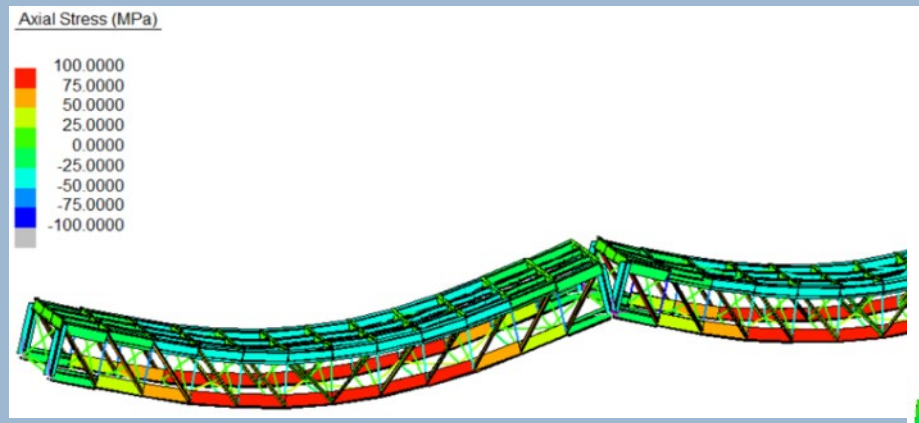
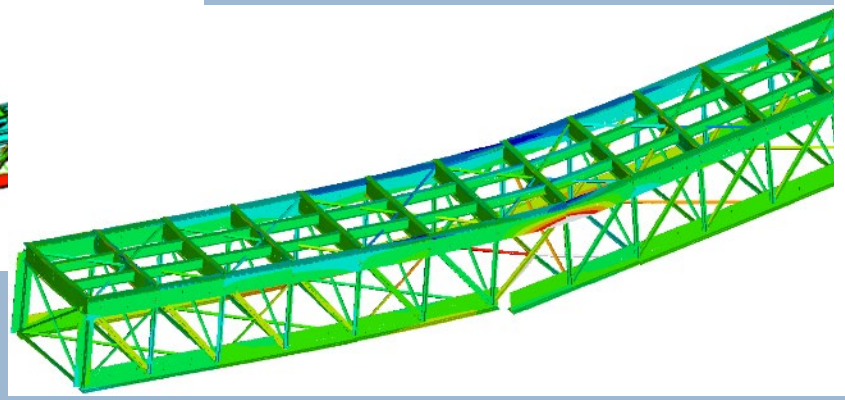
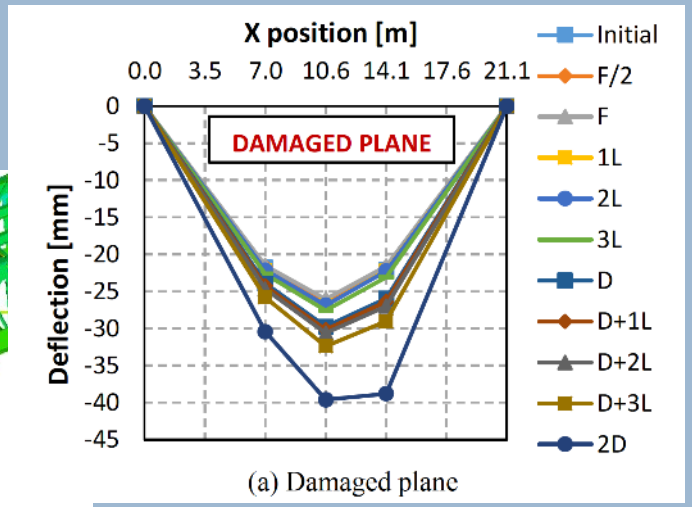
1 Structural Analysis

Fist step, we design a complete model on how the structure will react. To understand the structure a complete structural analysis is required.







Not only reflect the normal behaviour, but also what to expect in case something fails, or, best case, something is about to fail. Different damage and fatigue scenarios are studied to associate them with their sensor response.

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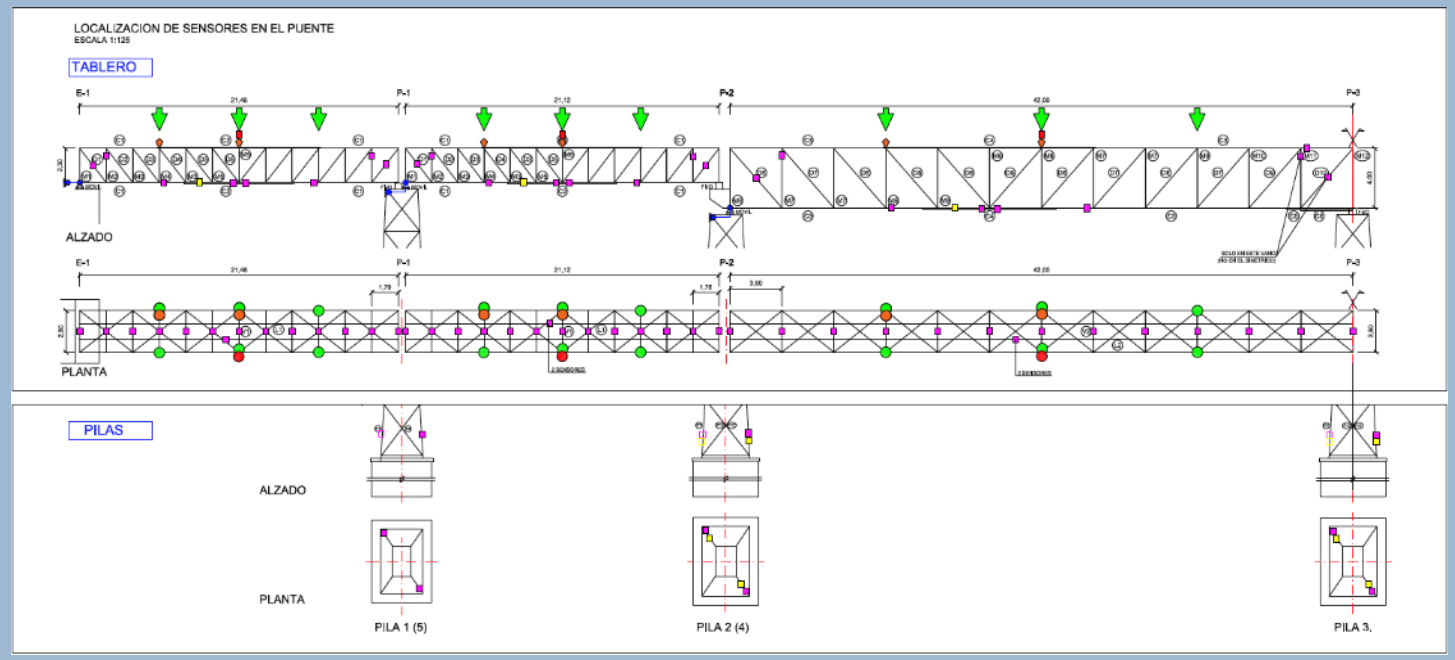
2 Definition of monitoring

From the previous point, the critical parameters that define the structure behaviour are obtained: (vibrations, strains, displacements, etc)



These magnitudes and the points where they require to be measured are what will define futures steps and are the key on how the sensors will be used.

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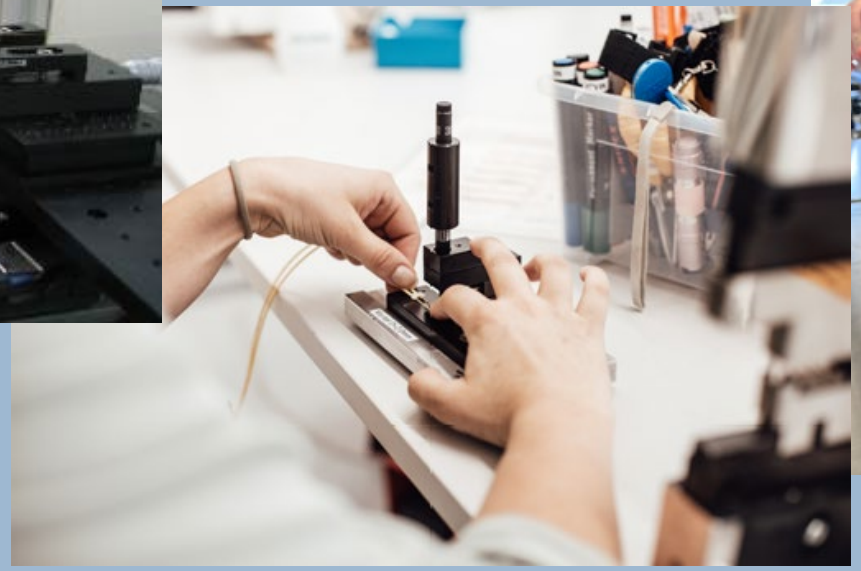
3 Sensor design and fabrication

In the next step sensors are chosen. Based on previous steps and what we want to measure, the custom design of our own fibre optics sensors (FGBs and others) is made: from the fibre lab to the embed, protection and external elements that allow for their proper deployment in the field.



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4 Sensor installation in the field

The deployment of the sensors chosen in previous steps is not trivial, special if the structure is already built and in operation. Our expert personnel can handle the proper installations in the field following the precise parameters to obtain the desired magnitudes without noise or interference for undesired phenomena.

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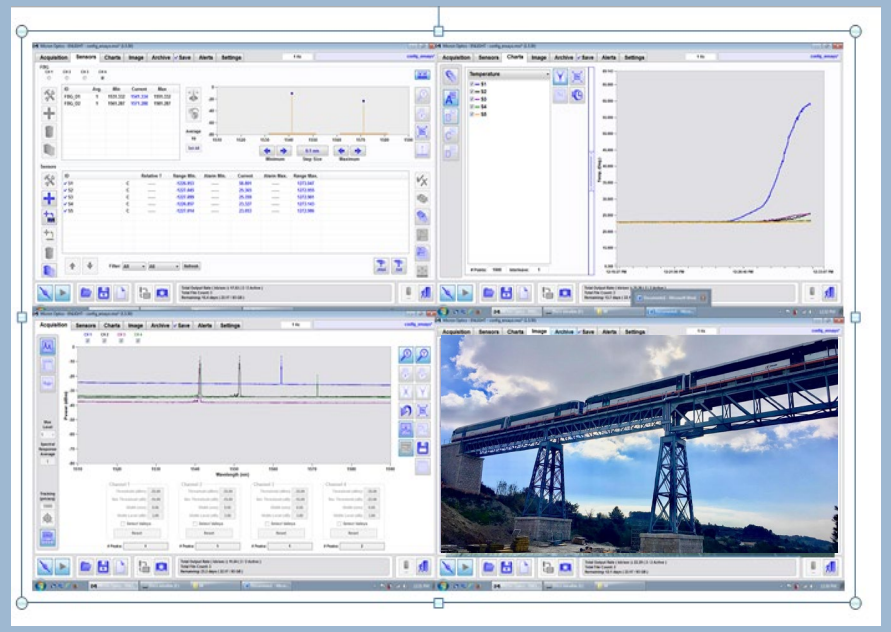
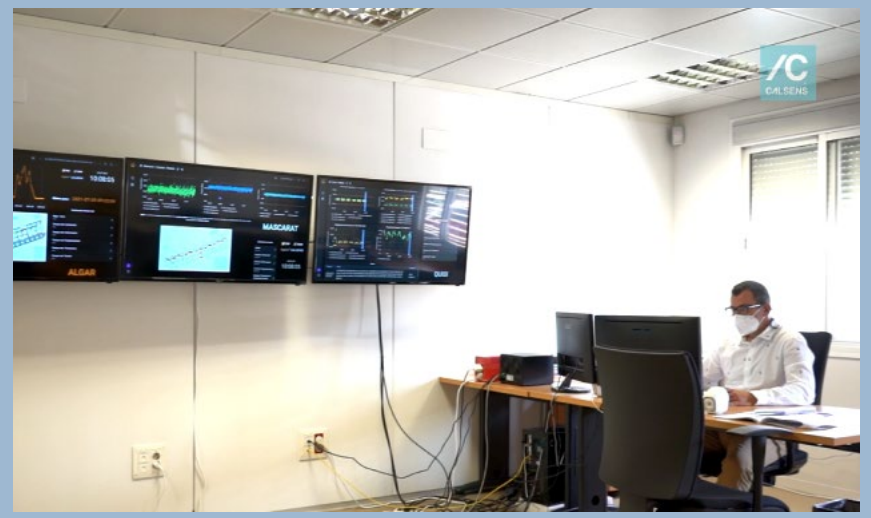
5 Real time processing and decision making

All the information compiled by the sensors must be analysed, is key to extract conclusions in real time so critical events can be detected and scheduled alarms can be triggered to achieve 24/7 structural health monitoring.





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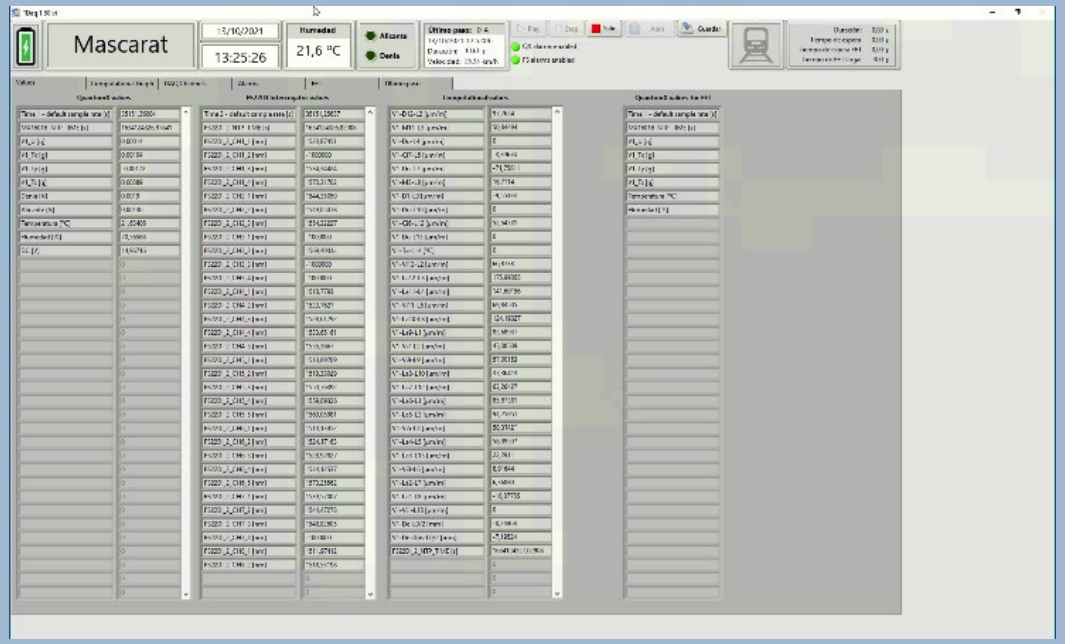
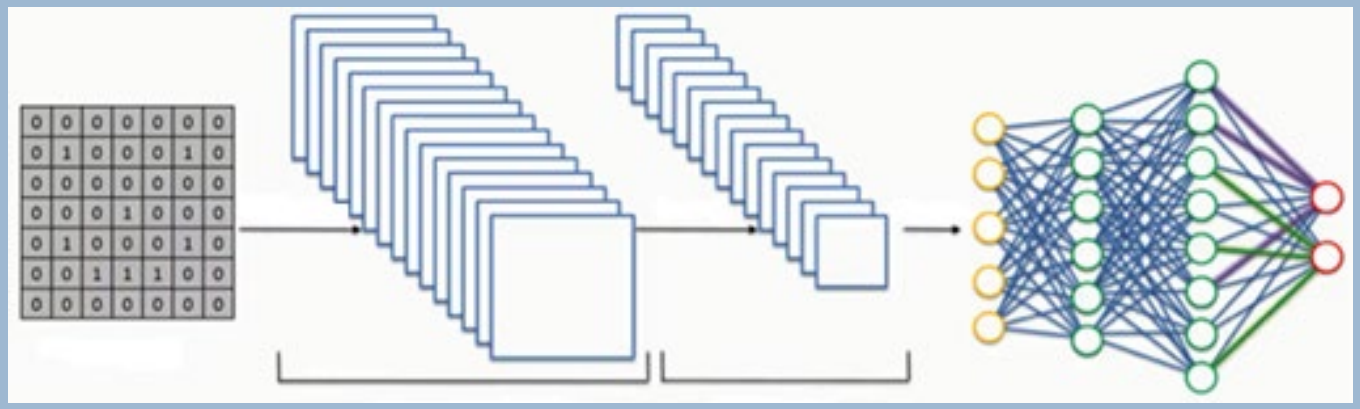
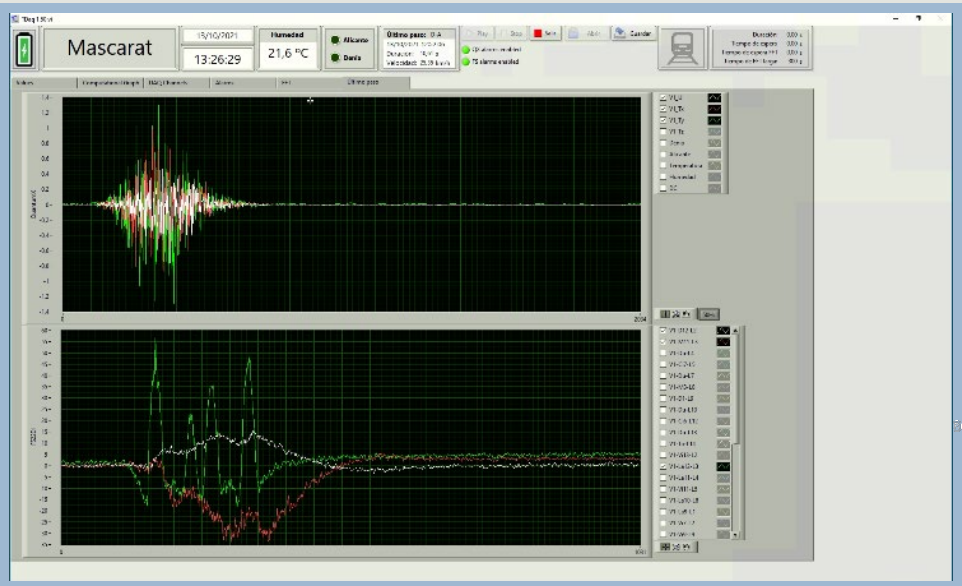
5 Real time processing and decision making

Huge amount of data acquired in real time in multiple infrastructures and transferred through 5G. Data filtering and processing in order to generate the desired alarms (SCADA integration application).







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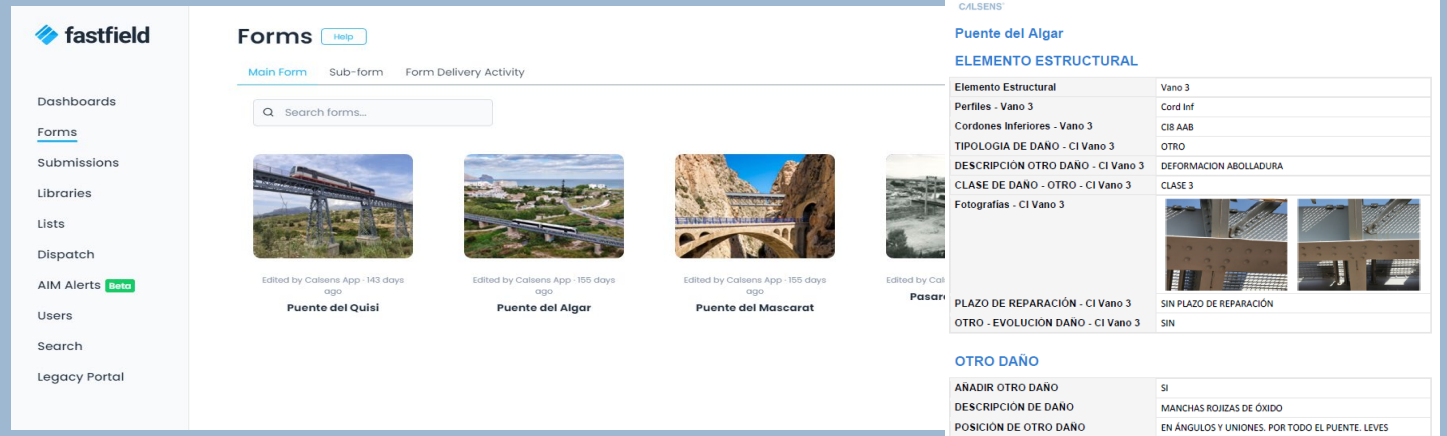
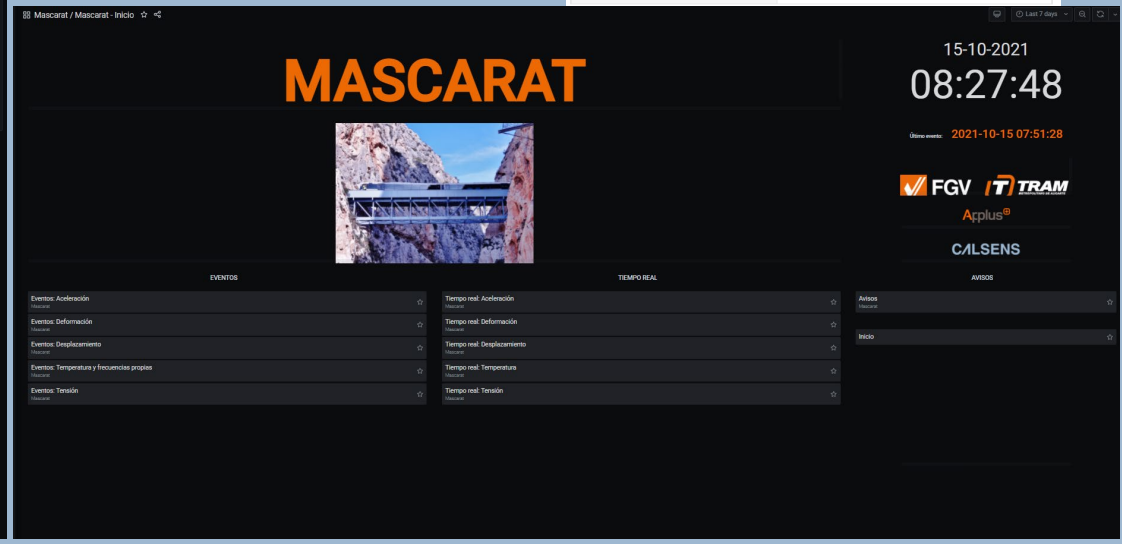
5 Real time processing and decision making

Own monitoring application technology 24/7. General overview, alarm generation and monitoring down to individual sensor configuration an values.





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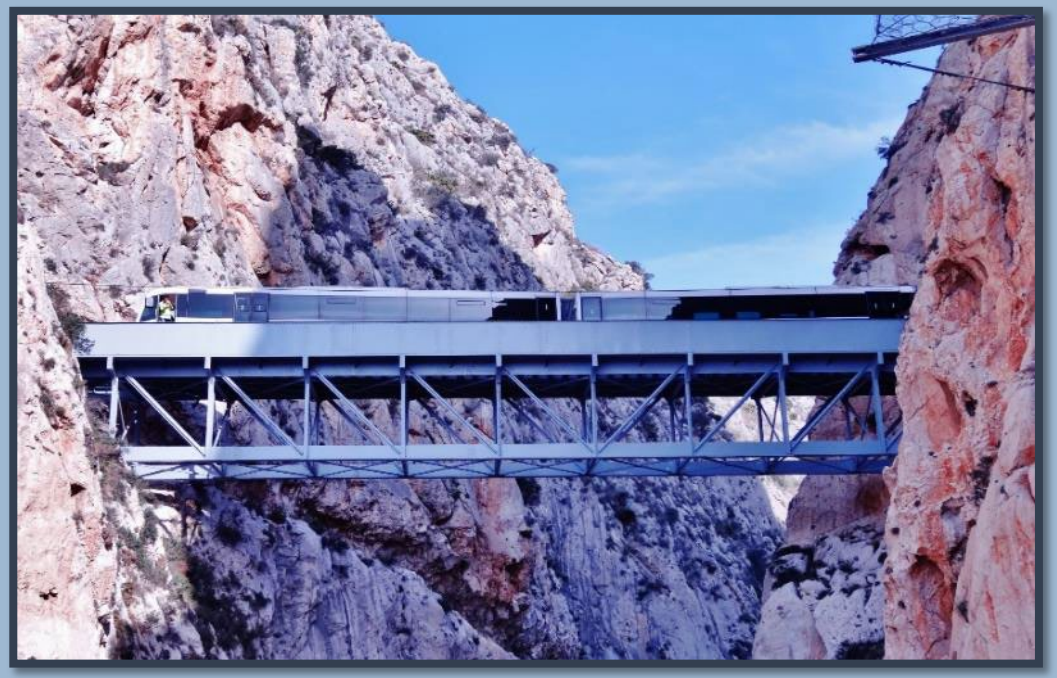
Railway Line Alicante-Denia, Spain

Structural analysis, instrumentation and safety report of Mascarat bridge dated in 1920.

Optic sensors, digital survey, accelerometers and Optic Fiber.



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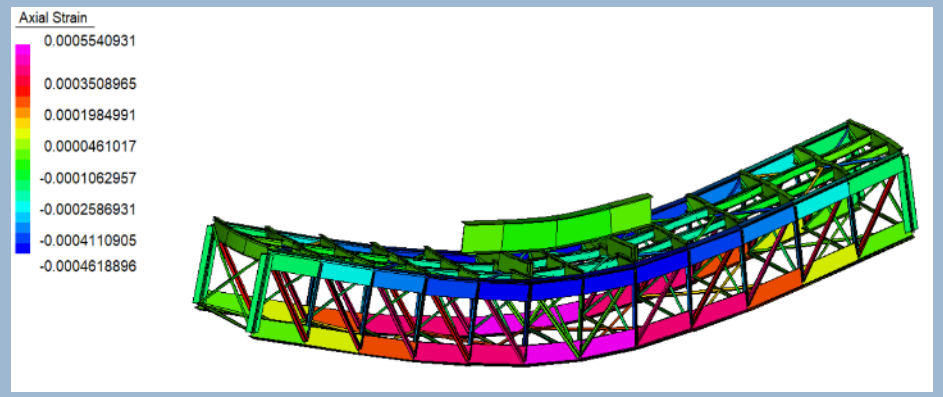
Quisi Bridge, Alicante, Spain

Fatigue Study in Quisi Bridge. Numerical modelling, material testing and instrumentation for a 1914 bridge

Laboratory testing of a 21 meter section with 50000 load cycles

Optical Instrumentation on site and on laboratory



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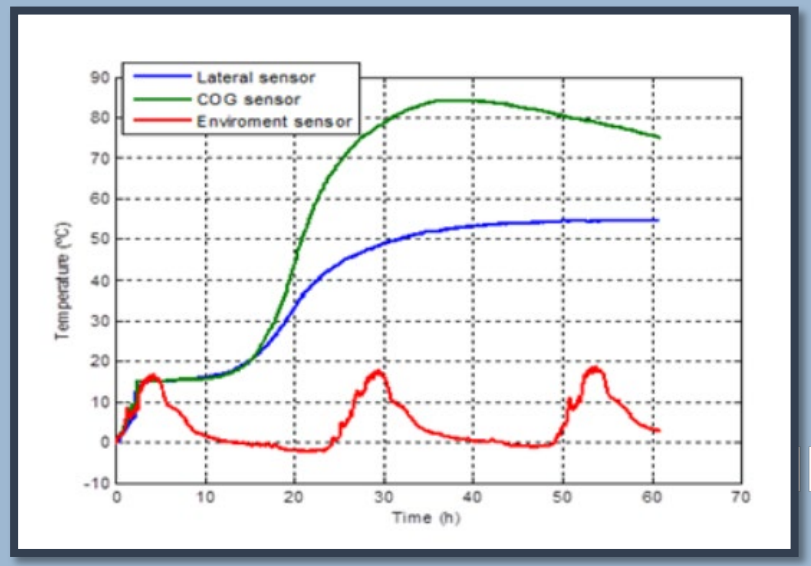
Castilla La Mancha Bridge, Toledo, Spain

Instrumentation of bridge Castilla la Mancha in Talavera de la Reina.

Cracks monitoring in concrete during sitting phase in foundations, temperature monitoring of concrete.



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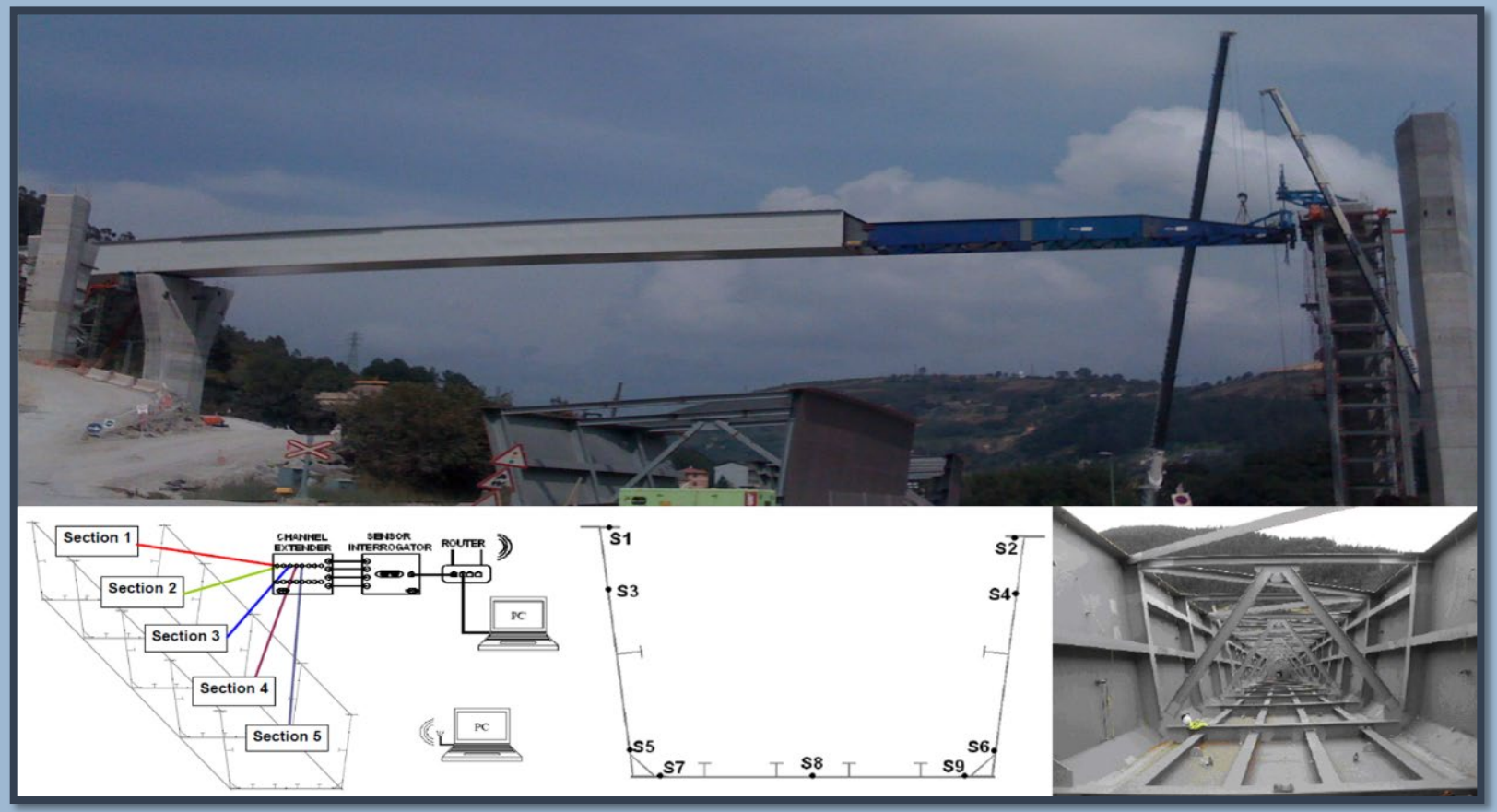
Kadagua bridge, Bilbao, Spain

Instrumentation and monitoring of a 105 span bridge during construction phase.
90 deformation sensors plus 10 temperature sensors for real time monitoring.



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Santo Ovidio Viaduct, Porto, Portugal

SHM during the construction of the Viaduct, structural behaviour during the construction and carry out proof load tests

More than 100 optical fibre sensors will be used controlling: strain of metallic elements, pile inclination, pile displacements, vibrations and more

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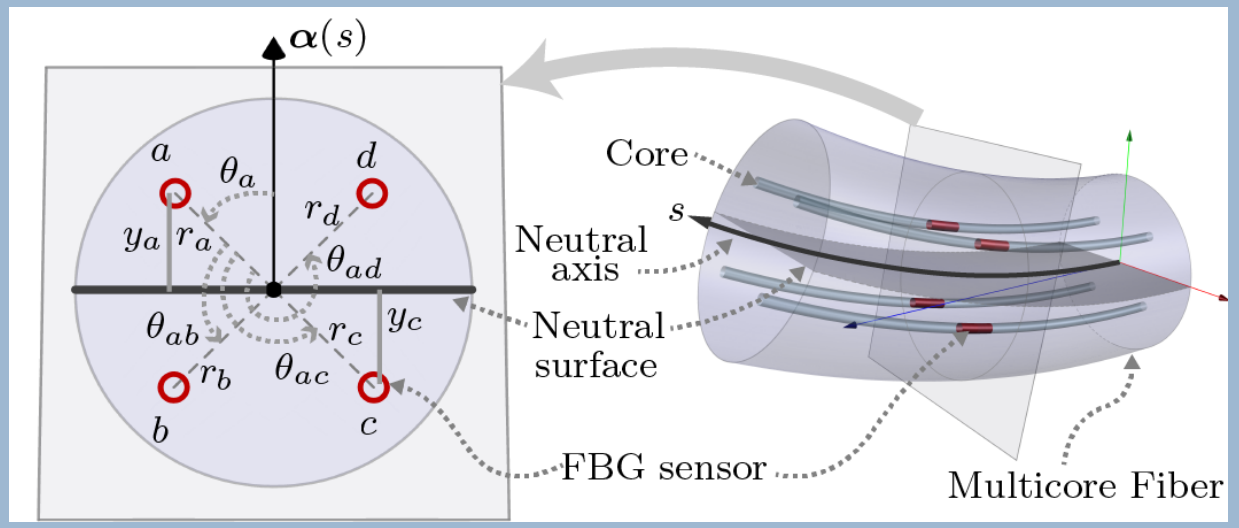
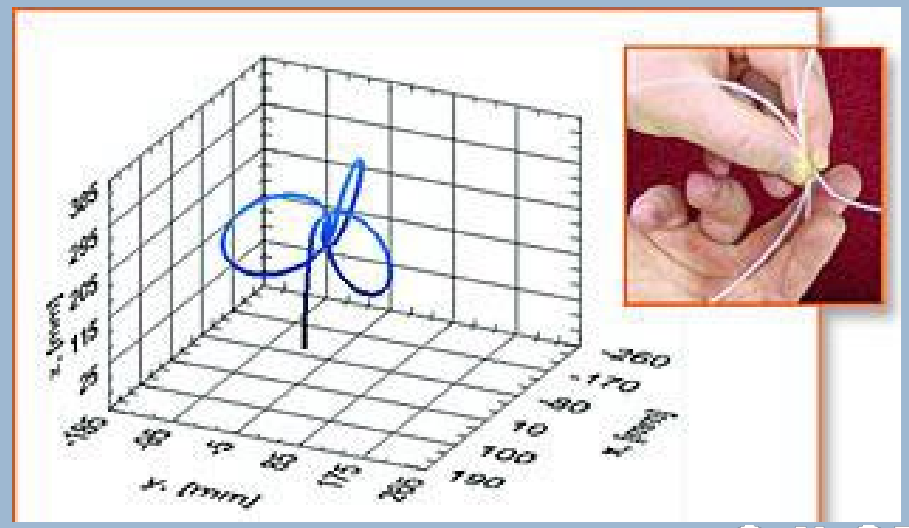
Shape Sensing

Patented technology for dynamic and real-time 3D shape measurement with novel applications for structural health monitoring.

Use of multicore fibre or fibre bundles to measure any shape with the fibre bundles attached and reconstruction of the deformations.

Tested in elements with length between few cm and hundreds of meters. 1 kHz refreshing rate real time acquisition.





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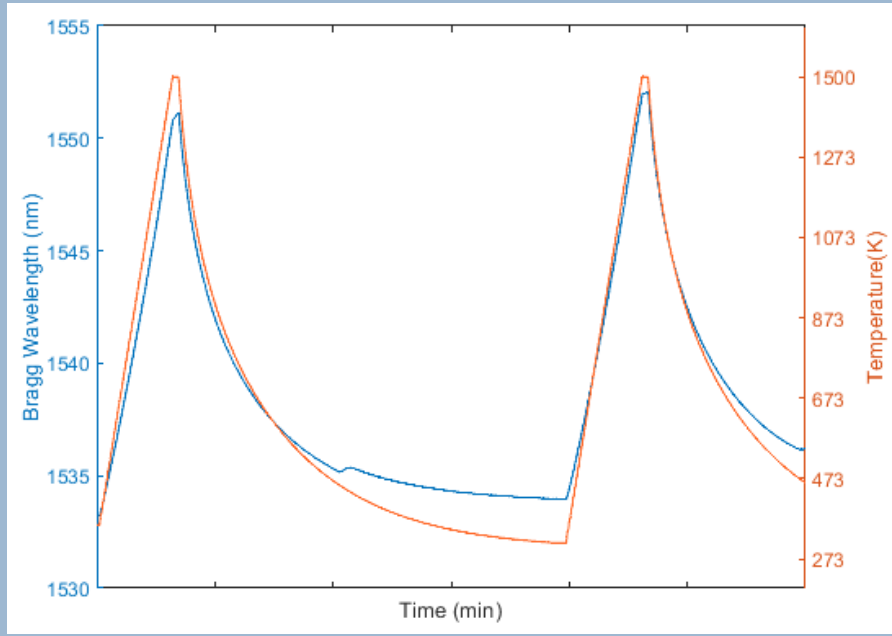
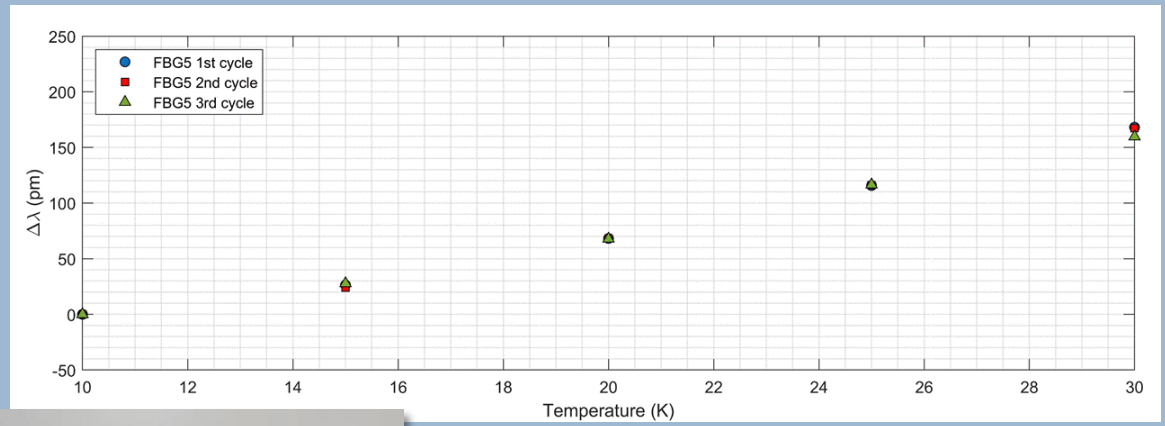
Extreme Temperature Measurements

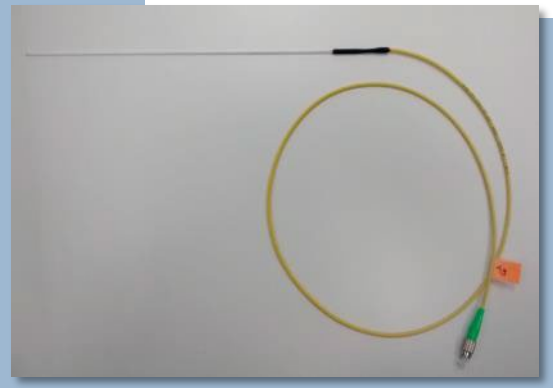
Development of novel optical fiber sensors capable of working in extreme temperature environments: Cryogenic (20ºK) and fire (1500ºK) applications.

Application in aeronautical and H2 energy solutions.

Continuous developments and future sensing up to 2000ºK.







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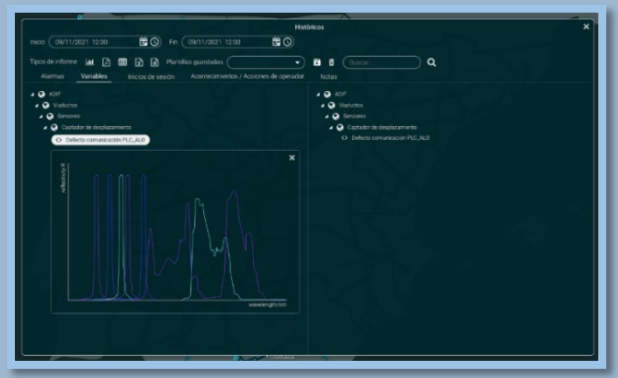
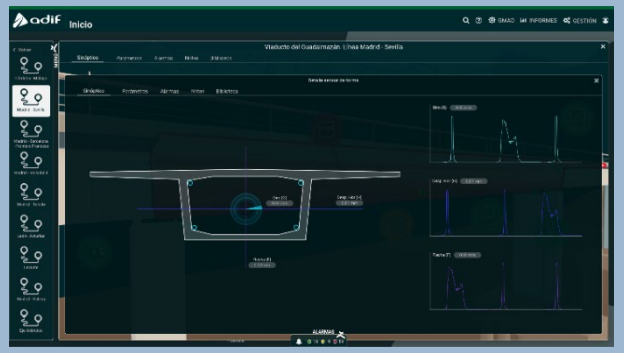
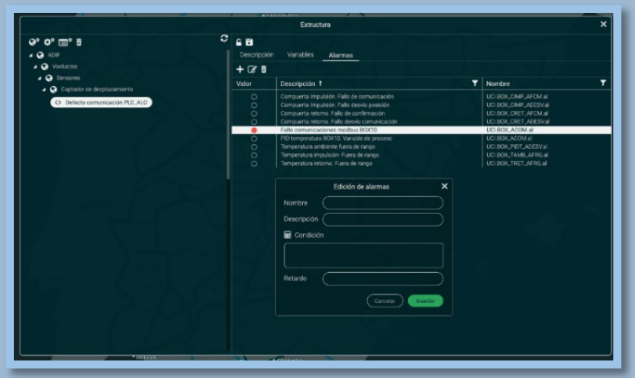
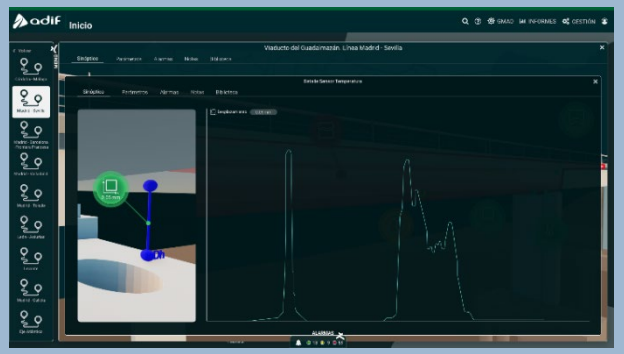
Advanced AI data processing

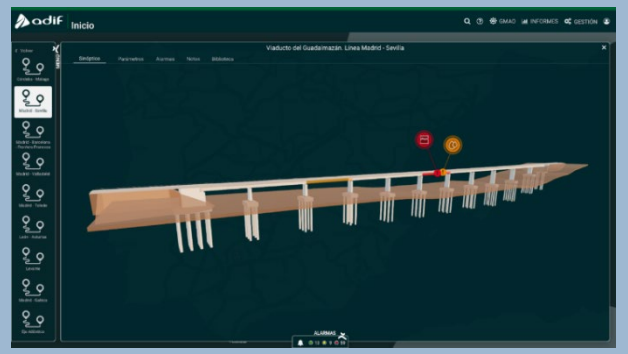
Huge corpus of data acquired in multiple active projects is being used to train, through machine and deep learning, predictive models for failure detection alarms and maintenance values. Combined with computer vision techniques.











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THANK YOU!

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