Belgisch Wegencongres
Congrès belge de la Route
LEUVEN · 4-7.04.2022

Capteurs intelligents et l'internet des objets au service de la construction de routes

FEHRL

FEHRL is a Forum for R&D&I composed of national research institutes, universities and transport authorities

FEHRL

Innovative roads for everyone's mobility

Our mission is to serve society by accelerating the development and facilitating the deployment of collaborative science, technical knowledge and innovative solutions for the road infrastructure sector

FEHRL

We want to co-create a Forever Open and Integrated Transport Infrastructure as a cornerstone for modern mobility

FOREVER OPEN ROAD
Redefining Road Transport for the 21st Century
FEHRL's Flagship Programme

FORx4 - FOREVER OPEN
ROAD, RAIL, RUNWAY AND RIVER
Infrastructure Innovation for seamless mobility

Project information

SENSKIN (“SENsing SKIN' for Monitoring-Based Maintenance of the Transport Infrastructure”)

- H2020 – MG8.1a-2014 (MOBILITY for GROWTH 2014-2015) – Smarter design, construction and maintenance
- Type of action: Research and Innovation
- Funding: 3.8 Meuro
- Consortium: 9 RTD Partners, 2 Road administrations, 2 Highway / bridge operators, 2 associated partners

Structural Health Monitoring Definition

"Damage detection and characterization strategy for engineering structures
Condition assessment of infrastructures"

- Monitoring of changes to the material and/or geometric properties of a structural system
- Static and dynamic behavior monitoring
- Changes in boundary conditions
- Examination of ability of structure to perform its intended function after time/event/aging etc.

SENSKIN

Structural Health Monitoring of Transport Infrastructures

- **Structural Health Monitoring** (SHM) has a predominant role in the management of transport infrastructure

- SHM systems in different types of structures contribute to a
  - safer
  - smarter
  - more efficient
- network of building, transportation infrastructures and energy structures

SENSKIN

Problem Definition

- Current SHM methods rely on the use of point sensors
- Dense network of sensors is required to monitor a structure, which is costly (and inpractical)
- Conventional sensors fail at relatively low strains
- Sensor communication systems are unreliable in extreme service conditions (no foolproof alarm of an imminent structural collapse)
- Data obtained from sensors not employed routinely to define the most cost-effective and environmentally acceptable intervention

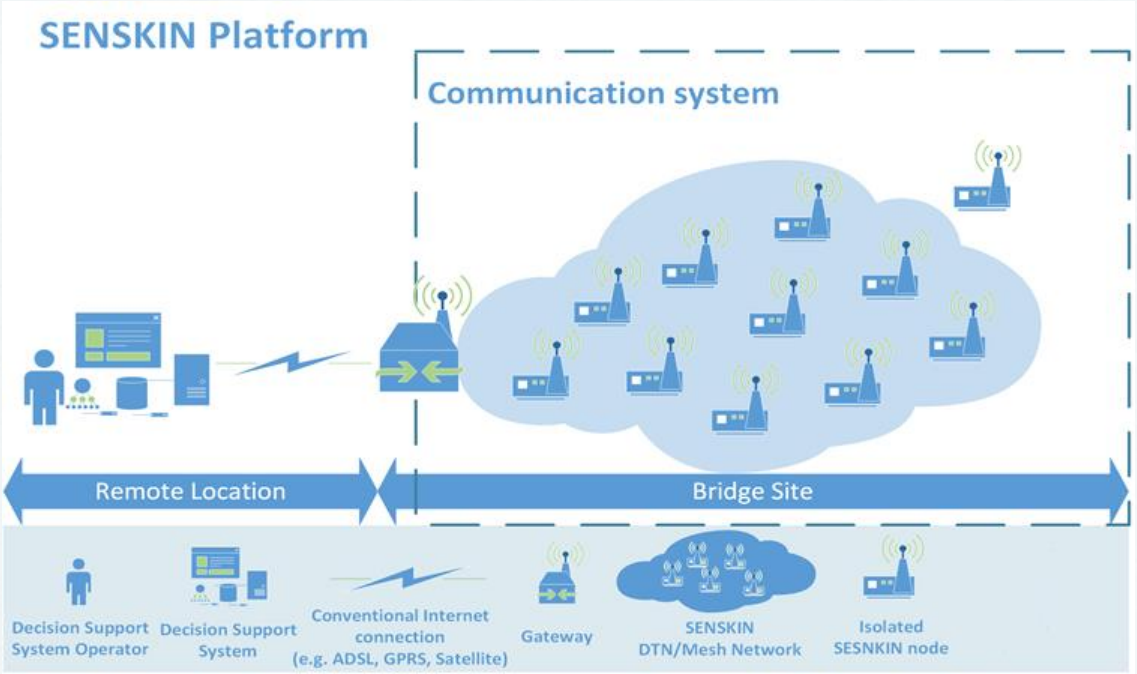
SENSKIN

SENSKIN - objectives

- Develop a dielectric-elastomer and micro-electronics-based skin-like sensing solution

- Use a Delay Tolerant Network
- Develop a Decision-Support-System
- Implement the above in the case of bridges and test, refine, evaluate and benchmark the monitoring system on actual bridges

SENSKIN system architecture



SENSKIN

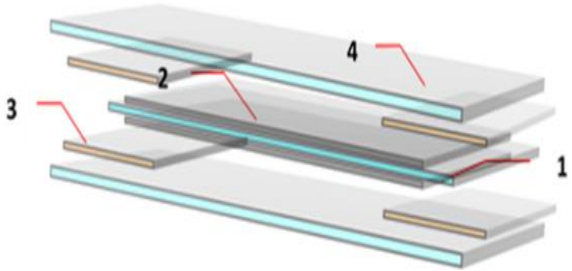
The SENSKIN system (1/7)

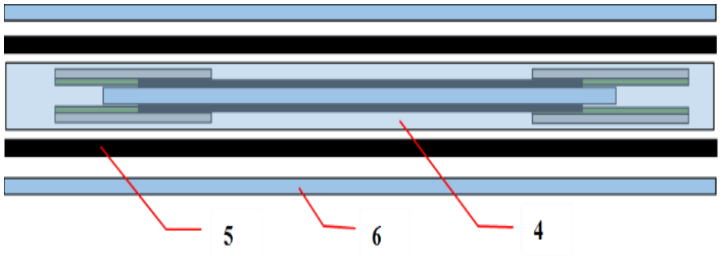
The SENSKIN system comprises of the following modules/sub-systems:

- Polymer Sensor (the SENSKIN sensor)
- Data Acquisition (DAQ)
- SENSKIN Node
- Conventional Monitoring System
- Gateway
- Decision Support System

The SENSKIN system (2/7)

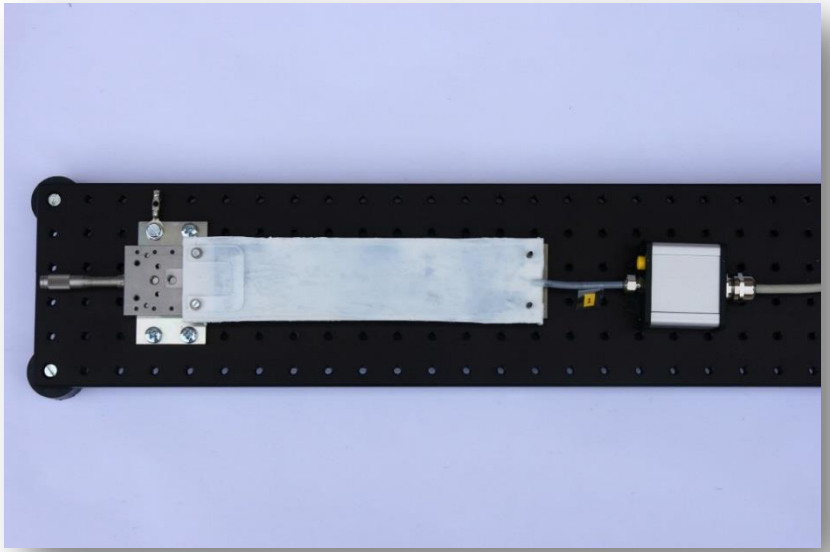
- Polymer Sensor – the SENSKIN sensor





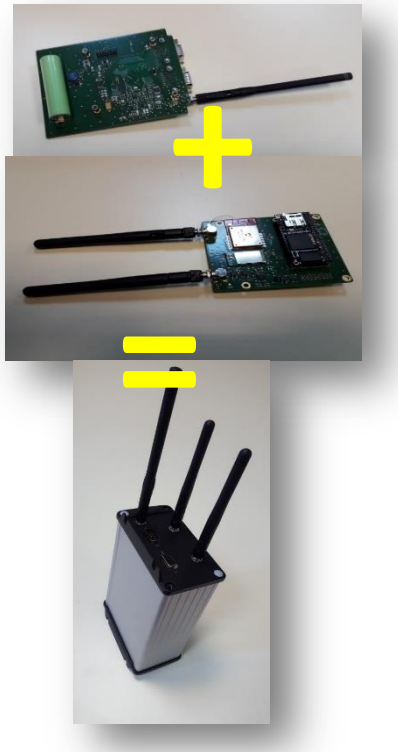
The SENSKIN system (3/7)

- Data Acquisition (DAQ)



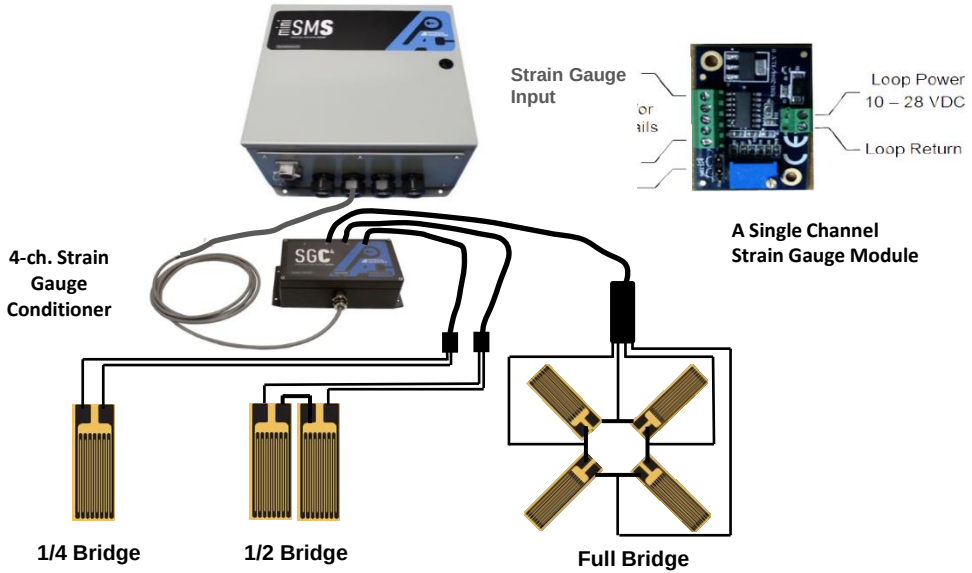
The SENSKIN system (4/7)

- SENSKIN Node
  - Integrated system in casing (bottom)
  - Node Capabilities:
    - Connectivity to sensor (via DAQ)
    - Connectivity to local gateway
    - Low-power operation
    - Power management implementation



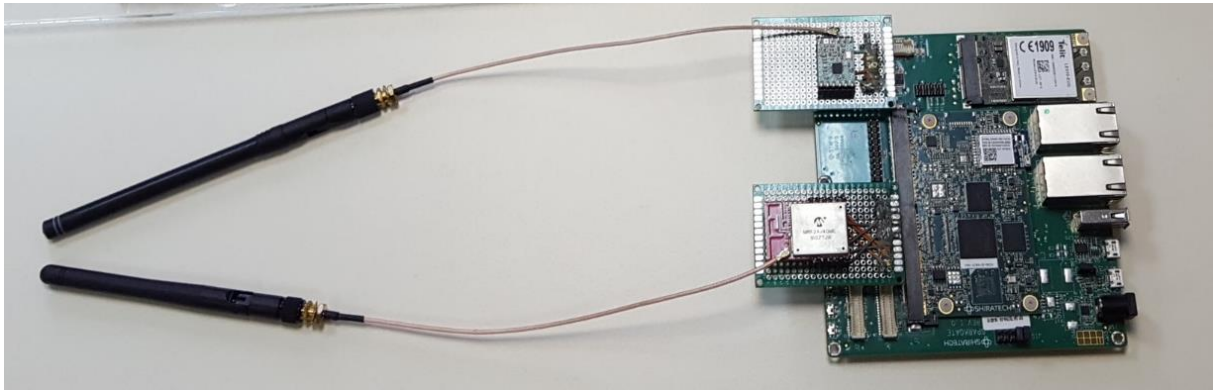
The SENSKIN system (5/7)

- Conventional Monitoring System



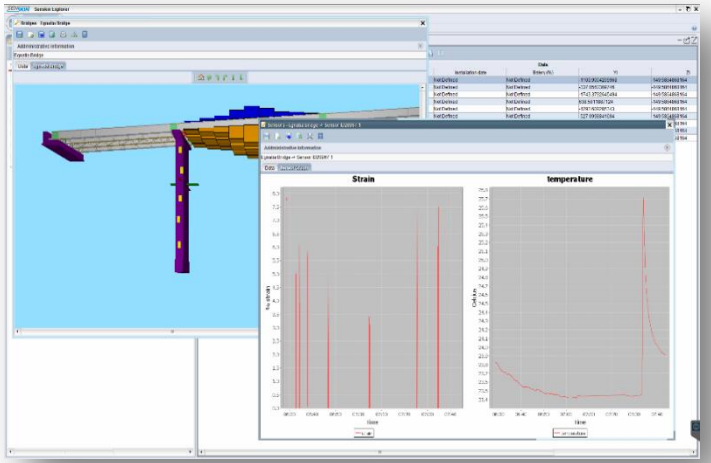
The SENSKIN system (6/7)

- Gateway



The SENSKIN system (7/7)

- Decision Support System
  - End-User Interface
  - Positioning of sensors and data presentation
  - Methodology for maintenance decision, based on:
    - bridge structural condition
    - LCC and LCA analysis of rehabiliation options

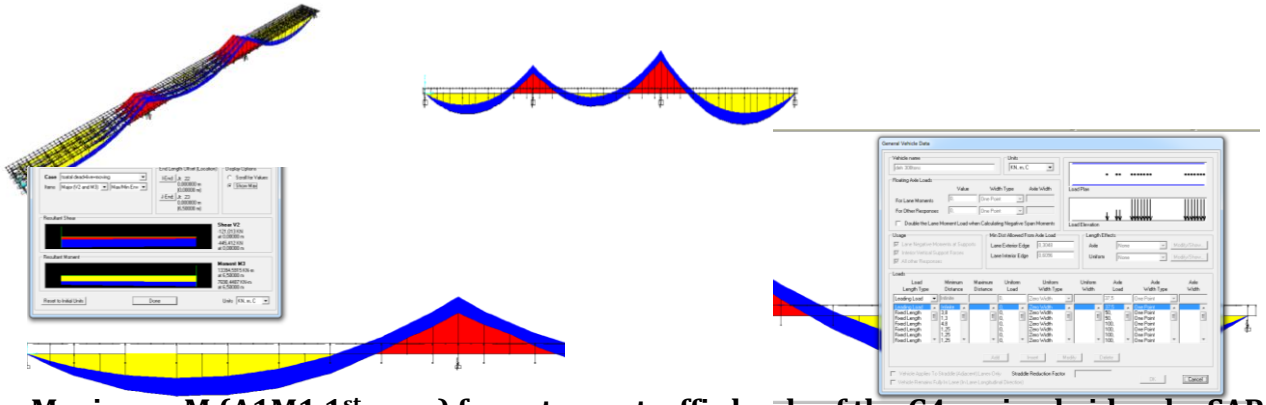


System installation and validation

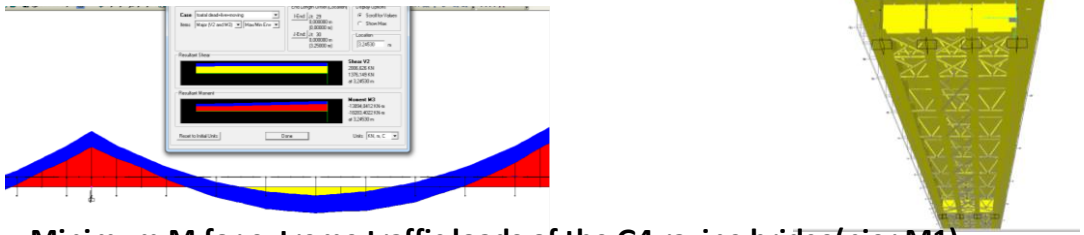
Bosporus 1 suspension bridge in Istanbul

Egnatia Motorway ravine bridge G4

System installation and validation

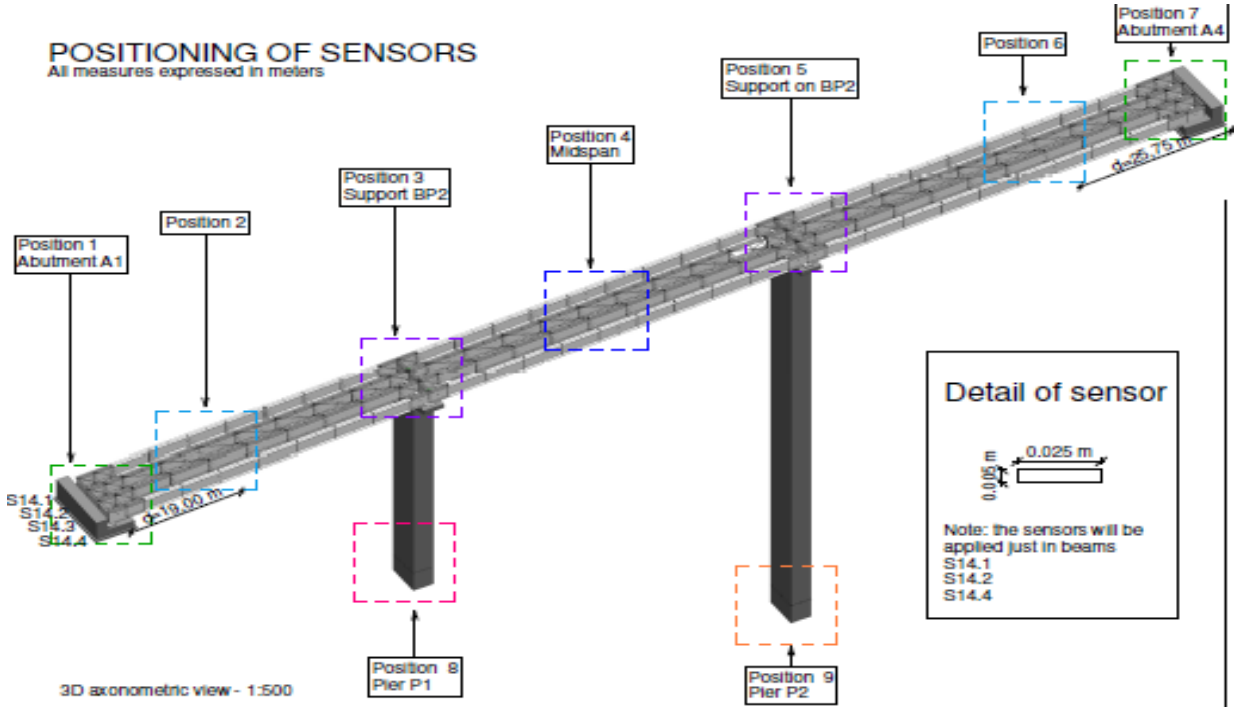


Maximum M (A1M1 1st span) for extreme traffic loads of the G4 ravine bridge, by SAP 2000NL



Minimum M for extreme traffic loads of the G4 ravine bridge(pier M1)

System installation and validation



System overall impact

- Monitoring and management systems increasing infrastructure capacity and optimizing maintenance costs for all transport modes
- Scarce bridge inspectors and structural engineers will be more efficiently used by reducing unnecessary inspections and optimizing the type of interventions
- Extension of the life span of ageing transport infrastructure
- New construction and maintenance techniques that enhance the performance and reliability of infrastructure

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ABR | Association Belge de la Route

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