SHM Demonstrator at NPL:
Two Years of Monitoring Experience and Future Challenges

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Energy Harvesting Network Workshop

(Structural Monitoring)

Project 2009-2011

- Full-scale demonstrator - to show benefits of SHM

- Reference specimen - to assess the performance of monitoring techniques throughout the year

- Accelerated testing - to provide information suitable for lifetime prediction

- Advanced mathematical tools for damage detection based on well-documented history of events

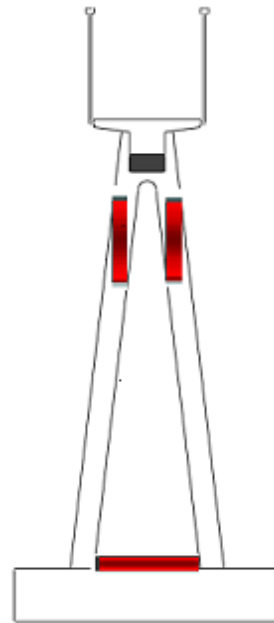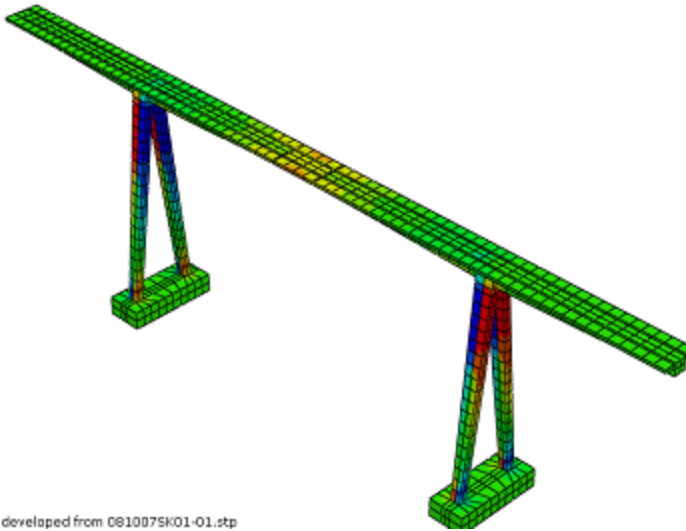- Collaborative project – over 40 partners and contributors

Example of sensing areas: deck

but with extra surfaces to allow strapped loads at ends of model

Sensing Areas

-2.050e-05
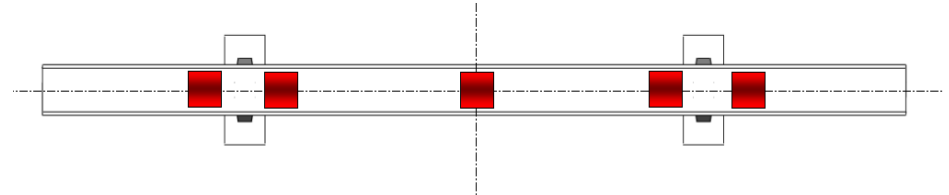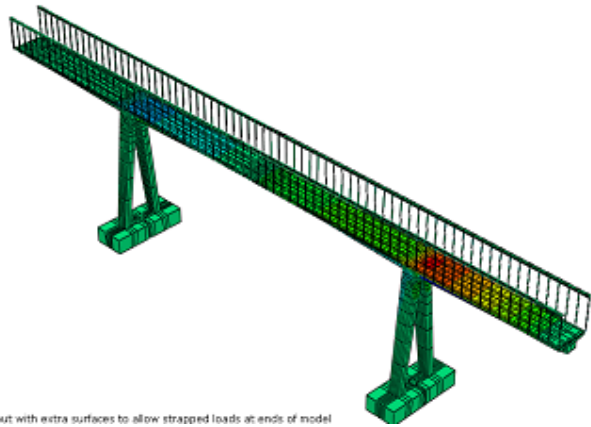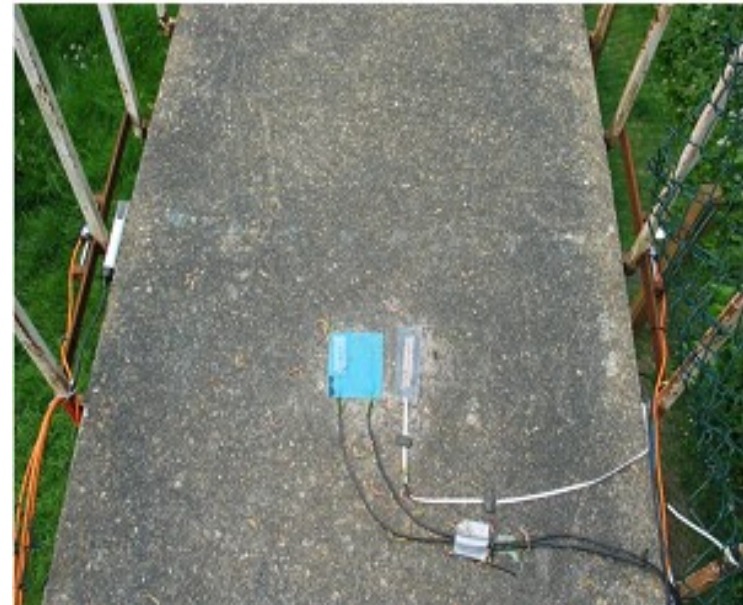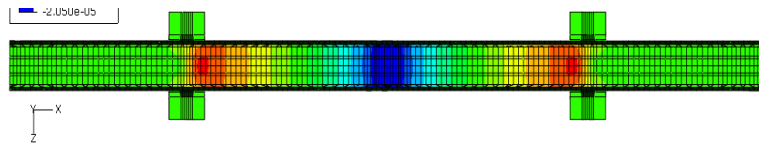
Example of sensing areas: columns

lv2 developed from 0810075K01-O1.stp

Monitoring technologies

Traditional:

Resistance strain gauges

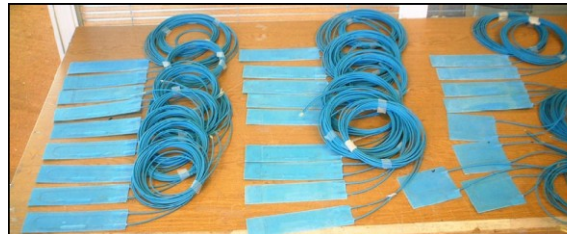Electrolevel tilt sensors

Vibrating wire sensors

Digital levelling

- Optical fiber Bragg gratings
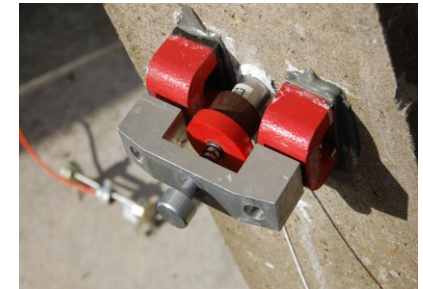- Distributed crack sensor
- Acoustic emission sensors

Image based:

Digital Image Correlation

3D laser scan

Video gauge technique

Summary

- Monitoring 18 different technologies over 180 sensors
5 monitoring acquisition systems

- FEA models of undamaged bridge updated using static and dynamic testing results

- First round of damage/repair cycles is completed

Challenges

- Installation / cabling / access

- Reliable data transmission and data quality

- Interpretation – data to knowledge – smart asset monitoring

Solution

energy-efficient network of mobile and wireless broadband network technologies

Wireless technologies

- Wireless MEMS: IEEE 802.15.4

- Wireless crack sensors: GSM
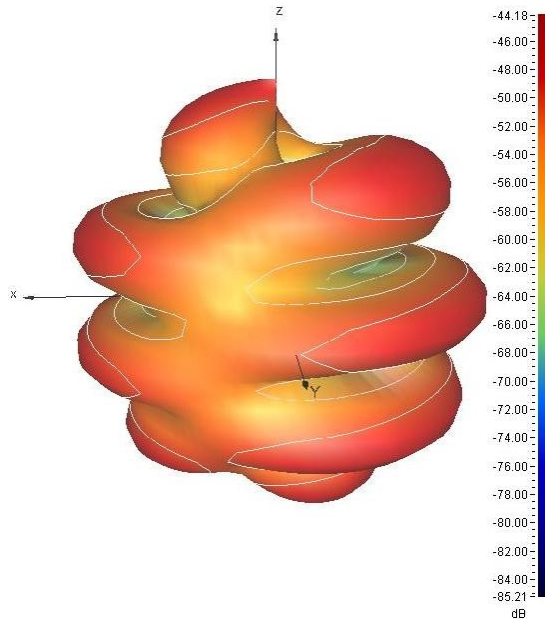
- Wireless: 433.875 - 434.650MHz
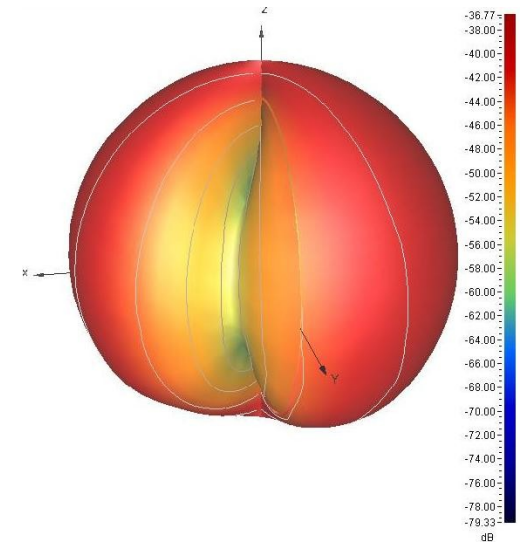
Optimal design is required

Optimal design:
complex system
with embedded antennas

Optimal design:
complex system (TQEM group)

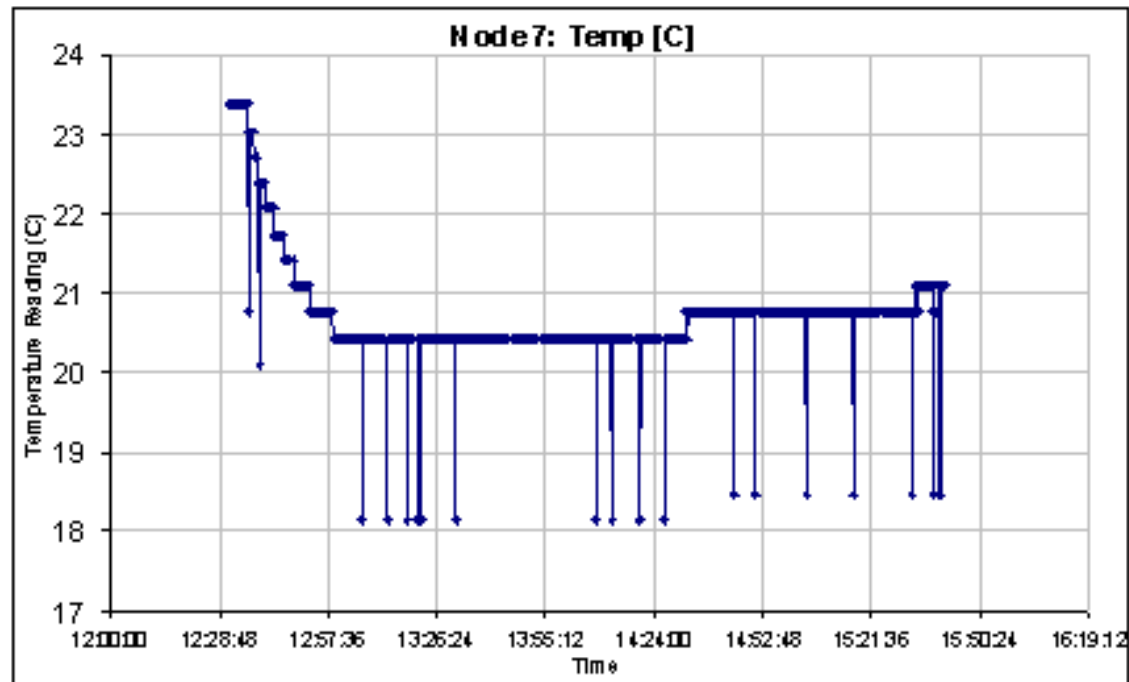**3D radiation pattern using cable**

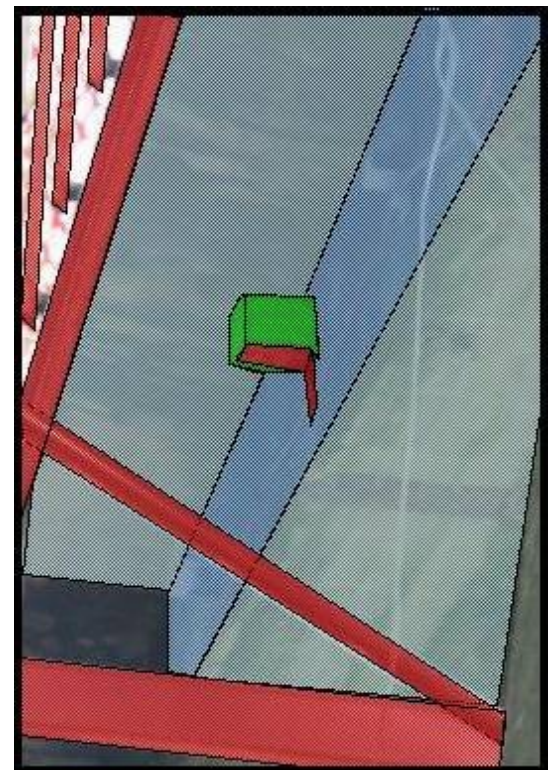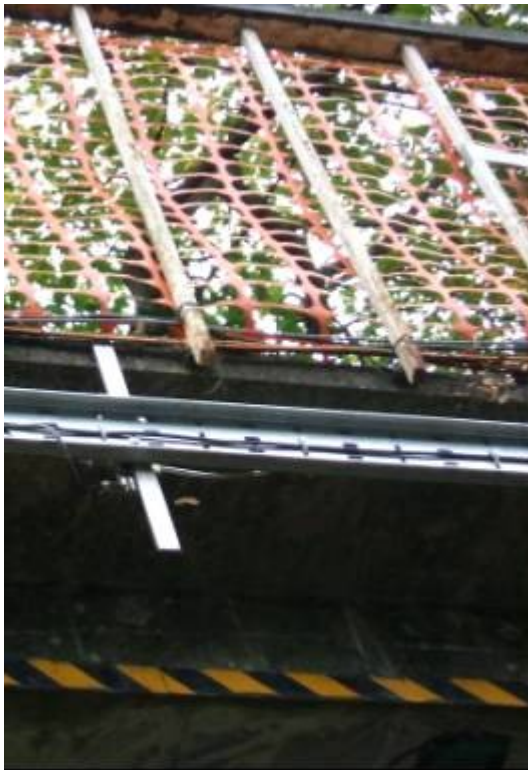**3D radiation pattern using optical fibre**

Contact Michael Collett michael.collett@npl.co.uk

Optimal design: shared power supply

Temperature Sensing

Optimal design:
harsh environment

Future work

- Assess the performance of real systems already in the field
- Time synchronisation
- Scalability
- Help design new systems
- Develop good practice

- Power is the key
- Will a stable power supply based on harvesting technologies be the last piece of the puzzle?

Asset Monitoring Centre - new NPL advanced demonstrator

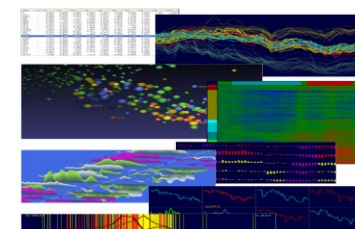**Environment monitoring: noise, air, water**

Satellite telemetry, Wireless and RF data transfer

Application server Cloud computing

NPL Centre

Intelligent structure

Image based analysis - deformation

Installed sensors - vibration, corrosion

Sensor fusion, reliability and calibration

Data mining Advanced statistical pattern recognition

Project 2012 subject to co-funding