Internet of self-powered sensors : Towards a scalable long-term condition-based monitoring and maintenance of civil infrastructure

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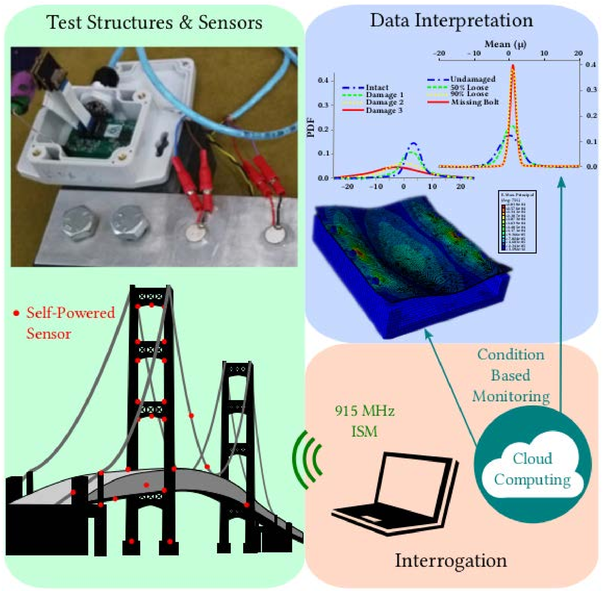
Challenge

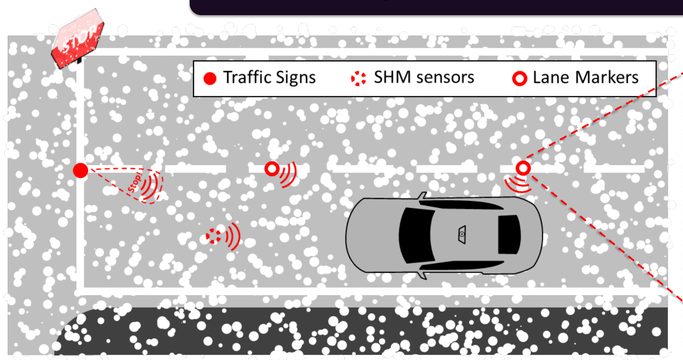
- **Monitoring the effect of rare events on a large infrastructure.**
- **Monitoring of failure progression using measured, statistical features.**
- **Real-time, large-scale and wireless interrogation of events.**
- **Actionable intelligence based on distributed events.**

Solution

- **A framework of Infrastructural Internet-of-things** using an array of self-powered, embedded health monitoring sensors
- **Novel variants of embedded self-powered piezo-floating-gate (PFG) sensors** that provide accurate spatial resolution in structural imaging
- **Low-latency, long distance wireless interrogation** using RF-triggering without compromising the lifespan of sensors.
- **Low-power variance based logic processor and communication protocols** that exploit inherent system uncertainties and channel properties
- **Novel structural failure prediction and structural forensic algorithms** based on historical data collected from PFG sensors at different spatial locations

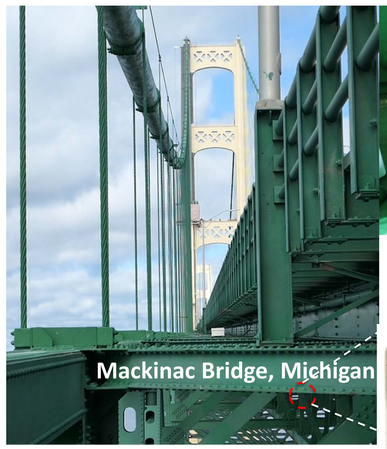


Broader Impact, Educational Outreach & TTP



I2V Sensor

- **Assisting drivers and autonomous vehicles** with additional layer of information using embedded sensors
- **Field testing using I2V sensors.**



- **Deployment study on the Mackinac Bridge, Michigan**

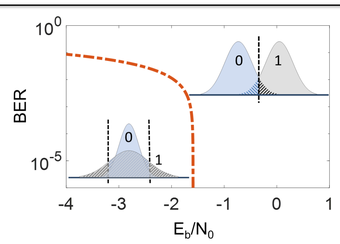
PFG Sensor Box

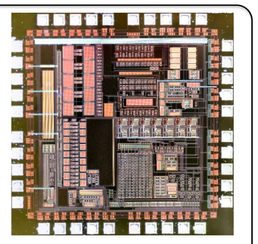
- **Startup formation for technology translation**

- **Monitoring failure in wind-turbines**

Scientific Impact

- **Multi-physics optimization** of energy scavenging, transduction, rectification and logic computation to improve the system's energy-efficiency and reduce the system latency.
- **Infrastructure-to-vehicular (I2V) communications** to collect the sensor data in real-time using vehicles moving at speeds greater than 45mph.
- **Fundamental limits on energy-per-bit** for communication and sensing using variance based informatics.
- **Physics-informed Deep Learning Approach for accurate stress prediction and damage tracking** – Bypasses the need computationally intensive Finite Element Methods (FEM).





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