



## STRUCTURAL BEHAVIOR MONITORING (SBM)

### Innovative Concept towards Autonomous Intelligent Bridges

- SBM to clinical monitoring during acute illness is comparable with structural health monitoring (SHM) to regular checkups. SBM allows engineers to intervene as soon as problems arise so that cost effective mitigation countermeasures can be implemented in their daily practices.
- SBM is characterized by the following attributes (not all inclusive):
  - Damage/deterioration extension from a structure to sensors for direct monitoring of the structure.
  - Creation and application of functionally graded materials to nonlinearly relate the measured parameter to underlying physics.
  - Dual spatial data collections with locally high precision and globally distributed measurements.
  - Dual temporal data collections during and after an event for more reliable and accurate measurements.
  - Monitoring and mitigation integration for cost effective implementation of sensing technologies in structures.

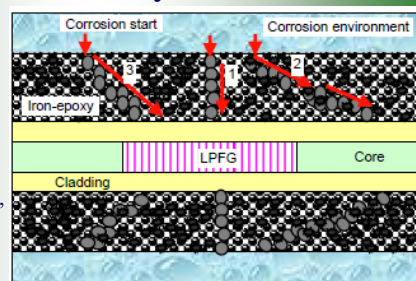
### Damage Extension

- When embedded near surface of a concrete girder, the two cracks in concrete penetrate through the coax cable sensor.



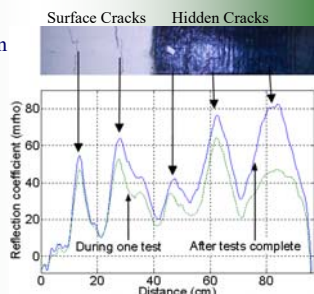
### Application of Functionally Graded Material

- Nano iron particles are coated on the surface of a long period fiber gratings sensor as a corrosion medium.
- Nano iron particles also change the refractive index of the optical sensor, particularly when corrosion occurs.



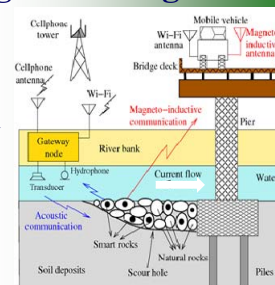
### Spatial and Temporal Dual Measurement

- One coax cable embedded into reinforced concrete column
- Local and distributed measurement in space
- During and after earthquake measurements over time – a unique memory feature



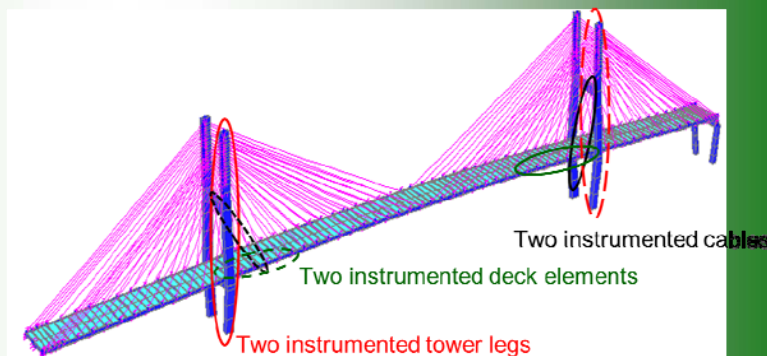
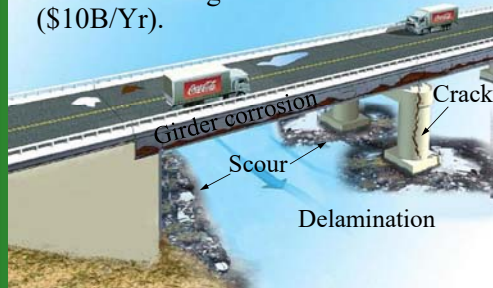
### Monitoring and Mitigation Integration

- Rocks are widely applied to prevent bridge piers and abutments from being scoured away – a riprap countermeasure solution.
- Smart rocks or rocks with embedded magnets or electronics are used to collect critical scour data such as the maximum scour depth. They can also be applied to monitor the efficacy of a riprap countermeasure over time.



### Application of SBM in a Hybrid Instrumented/Computational Model of Bridges

Scour is the #1 cause of over 1500 bridge collapses. Corrosion is the #1 reason for bridge maintenance (\$10B/Yr).



Sponsored by: National Science Foundation, California and New York Departments of Transportation, and CTIS University Transportation Center at Missouri S&T.