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A Structural Health Monitoring Company

Smarter Structures, Safer World !

Advanced Health Management of Civil Infrastructure Using a Scalable Active Sensing System

Outline

1. Project Overview
2. Project Accomplishments
3. Ongoing Development and Application
4. Demonstration

NIST-TIP Project Overview

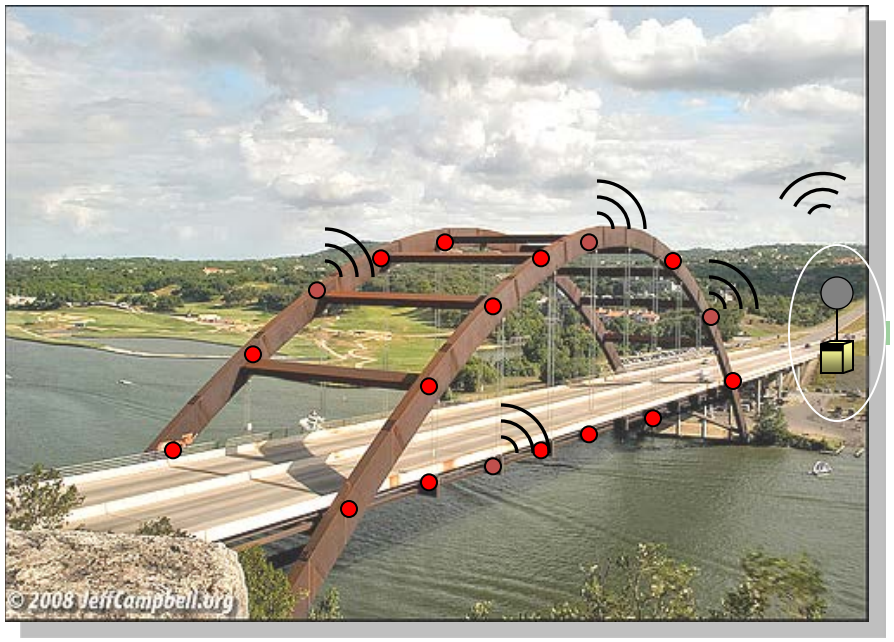
Design of SCANSⁿ System

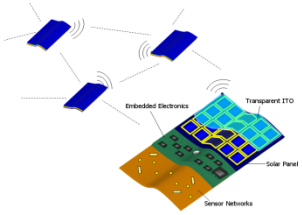
Information flow

- **"SCANSⁿ Node"**
- **"SCANSⁿ Router"**
- **"SCANSⁿ Master"**

- SHM Hardware - Local
- Data processing algorithm - Local
- Integrated Wireless Communication - Local

- *High Speed Computer* & Server - Remote
- Global Monitoring Algorithm - Global
- New Communication protocol - w/Satellite





"SCANSⁿ Master"

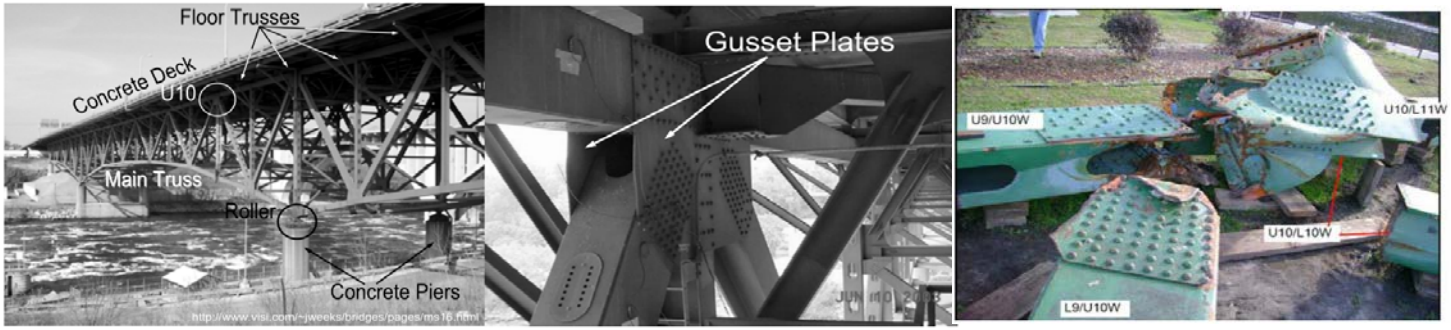
Server Room Dedicated for each Bridge Structure

Satellite

Unknown **beyond Acellent's Scope**

Targeted Applications

- Gusset Plates of Truss Bridges



- Pipelines

Accomplishments of NIST Program

Developments Under NIST TIP

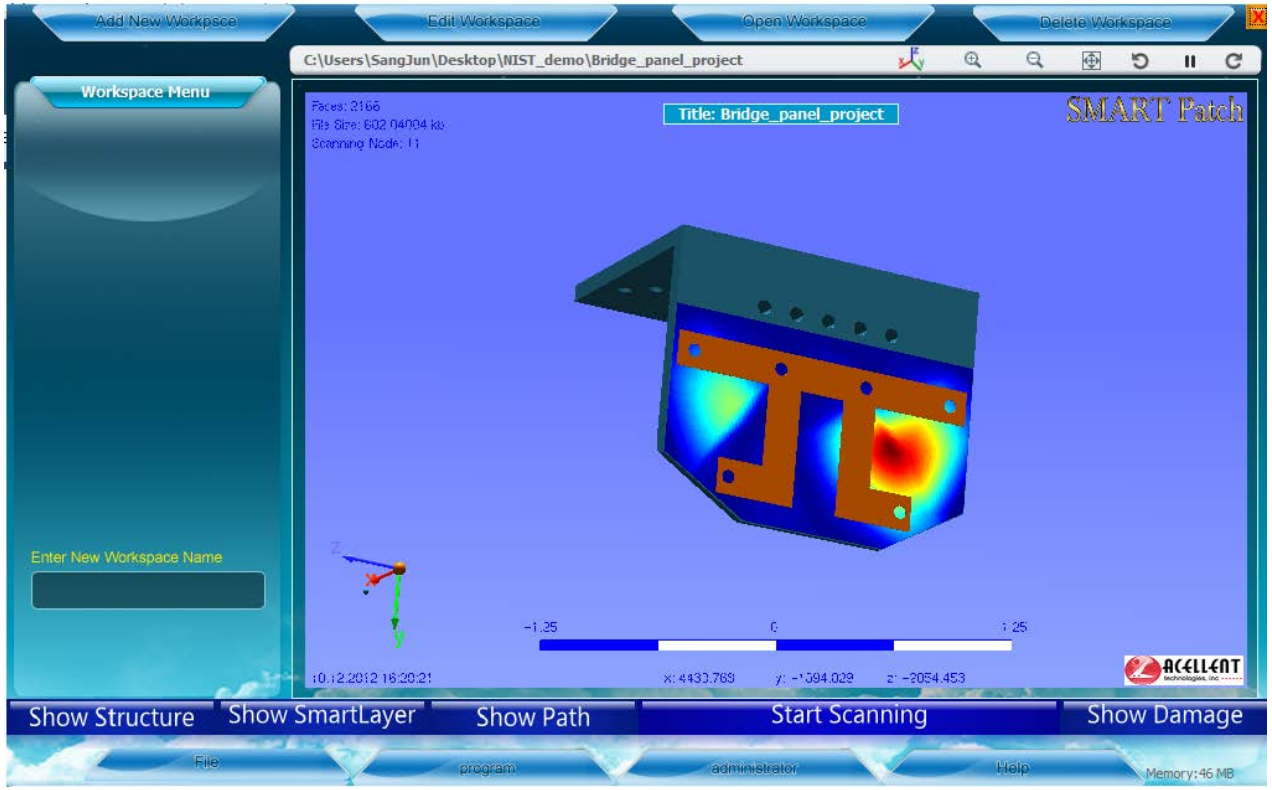
1. Hardware development
2. Global System Management
3. Local Damage Detection and Display
4. System Testing and Validation

Hardware Development

- The size of the current data acquisition system: 24x8x30 cm^3 (9 lbs) for the main box and 19x12x5 cm^3 (1.5 lbs) for the Switch Amplifier (SA) box + a laptop to operate the system and the data post-processing.
- The size of the final SCANSn node system: 10x8x26 cm^3 (~4 lbs) (The SA box will be integrated into the main box)

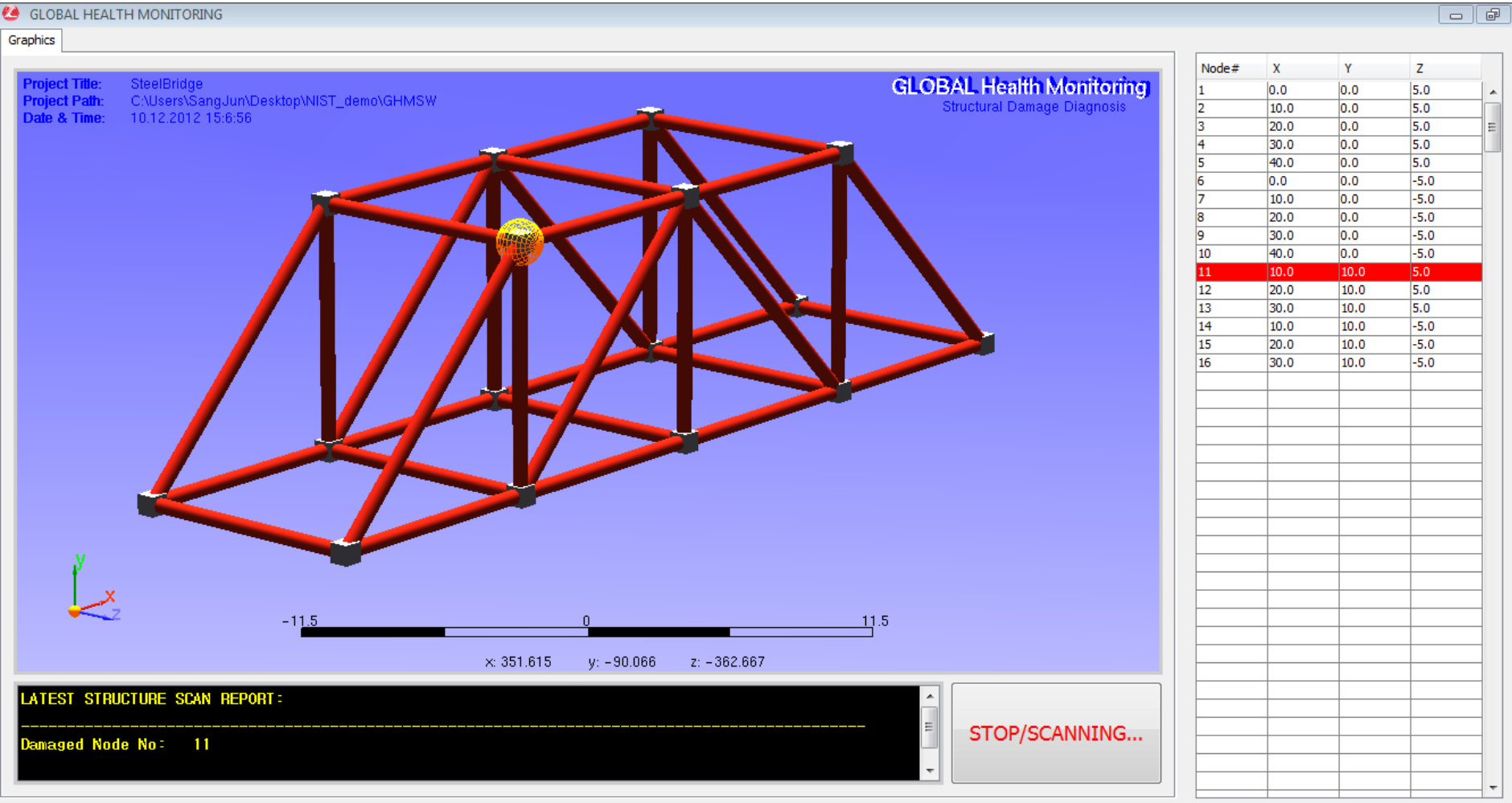
Damage Location and Display

- Developed 3D rendering from the 2D image for any arbitrary shape geometry
- Incorporated into the local damage detection software (Smart Patch), which is linked into the global health management software
- Mapped on 3D geometry of the structure of interest



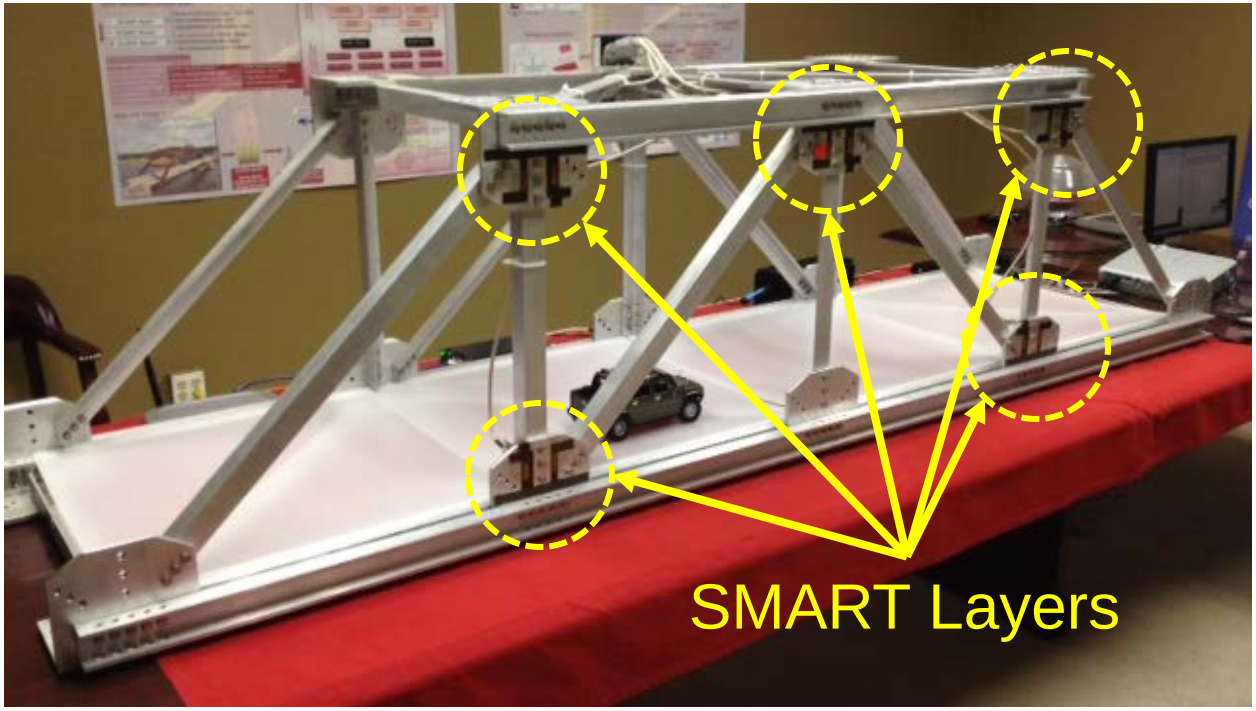
Global Interface

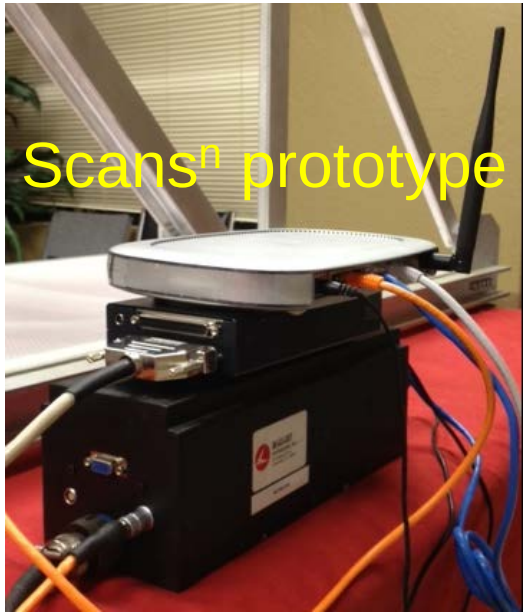
- Interface for managing the system on a global level



System Validation

- Bridge model with the Scans^{n}





Application of SCANS^{n}

Pipeline Corrosion Jeopardizes Safety of Refineries and Pipelines

Catastrophic event

Leakage happens
Wall thickness loss

Real-time active pipeline integrity detection system

24/7 On-line Monitoring for early alarm to prevent the loss by catastrophic event

On-Going and Past Commercialization Efforts

1. **State DOTs:** Discussions with state DOTs: Michigan DOT, South Carolina DOT to install and test the system on a steel bridge.

2. **Conferences:** Poster at EWSHM (European Workshop on Structural Health Monitoring), 2010. Up coming conferences are SPIE 2013 and IWSHM 2013.

3. **Government Proposals:** Teaming-up request from University of Colorado Denver for a BAA from FHWA

4. **Industries:** Application of the system in the energy, aerospace, civil infrastructure, marine etc industries.

5. **Patents:** Conceptual Design of SCANSn for Health Management of Civil infrastructure inventory.

6. **Publications:** Several Conference and Journal papers.

Conference Publications

- **SPIE Conference, March 2011**

"On suitability of feature extraction techniques for local damage detection for SCANS", S. K. Yadav, T. Kundu, S. Banerjee, and S. Beard
"On Energy harvesting modules in SCANSn system for Bridge Health Monitoring", Y. Justin, D. S. Ha, D. Zhang, and S. Banerjee
"Scalable Cognitive Autonomous Nondestructive Sensing network (SCANSn) for Infrastructure Health Management in United States", S. Banerjee, H. Chung, D. Zhang, S. Beard, and I. Li
"Advanced DPSM approach for modeling ultrasonic wave scattering in an arbitrary geometry", S. K. Yadav, S. Banerjee, and T. Kundu

- **IWSHM Conference, Sept 2011**

"Advanced health management of civil infrastructures using SCANSn system", S.Banerjee, H. Chung, D. Zhang, S. Beard, F.-K Chang, I. Li
"Effective damage sensitive feature extraction methods for crack detection using flaw scattered ultrasonic wave field signal", S. K. Yadav, S. Banerjee, and T. Kundu

Demonstration

Demonstration of global access and damage detection capabilities of SCANS^{n}/RAPID