# Toward Permanently Installed Pipeline Monitoring Systems

**Ehsan Dehghan-Niri, Alireza Farhidzadeh, Salvatore Salamone**
Smart Structures Research Laboratory (SSRL), Department of Civil, Structural, and Environmental Engineering,
University at Buffalo

## Main Objective

This project was awarded to Dr. Salvatore Salamone in order to design and implement a built-in monitoring system for corrosion-damage assessment in pipelines. The proposed system will be able to operate in a dual monitoring mode: 1) real-time continuous and 2) routine-based inspections.


Figure 1. Current technology problem and motivation.

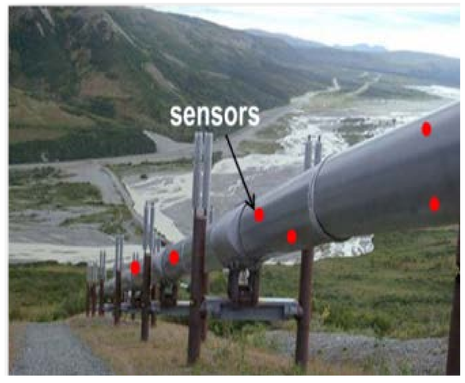


Figure 2. Potential Solution: Structural Health Monitoring (SHM) System

## Project Approach/Scope

In this project we introduce a multi-helical ultrasonic imaging (MHUI) approach, for corrosion monitoring of cylindrical structures. The MHUI exploits the fact that since there are hypothetically infinitely helical paths between a pair of transducers, multiple lines can be inspected between each transducer pair, instead of only a single line. A probabilistic reconstruction algorithm capable to take into account the contribution of different helical waves is used to map a quantity of interest such as pipe wall thickness loss.

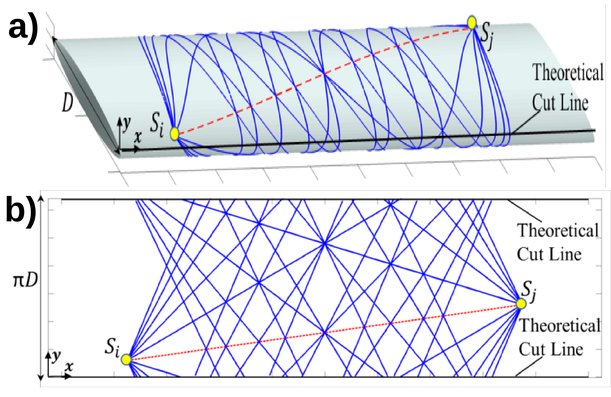


Figure 3. Helical paths between a pair of transducers: a) 3-D view b) unwrapped plate representation

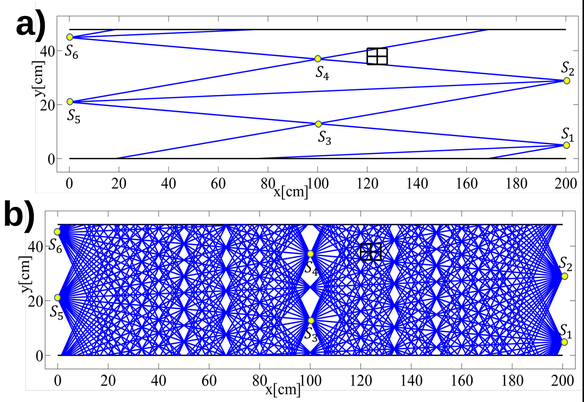


Figure 4. a) Traditional sensor network coverage, b) MHUI coverage.

## Results to Date

Experimental tests were carried out on a steel pipe instrumented with six piezoelectric transducers. Three thickness recesses simulating corrosion were considered. Results shown in Figure 6 demonstrate the efficacy of the proposed approach by identifying the simulated damage at the correct locations and qualitatively monitoring damage growth.

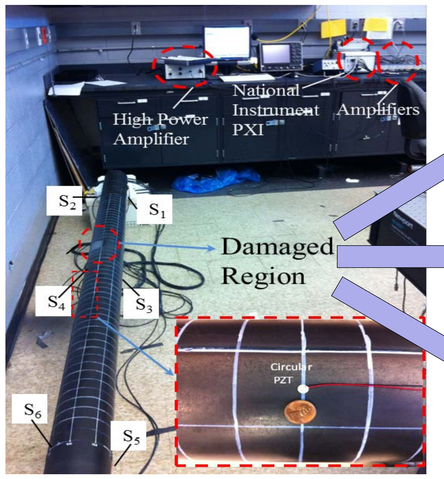


Figure 5. Experimental setup.

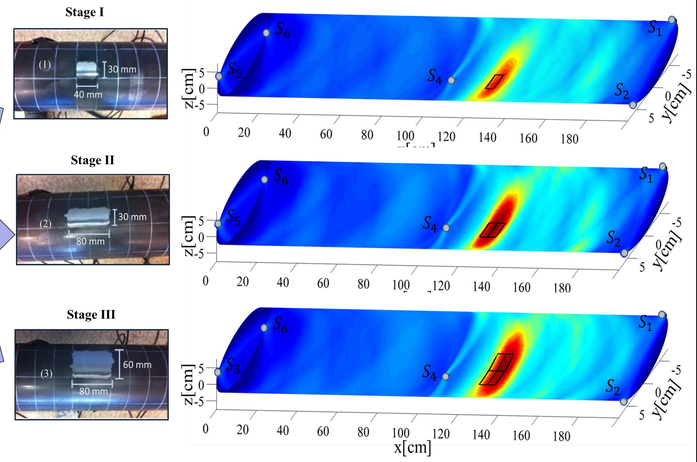


Figure 6. Reconstructed images of three damage stages.

## Acknowledgments

Funding for this research has been provided by the United States Department of Transportation (DOT), Pipeline and Hazardous Materials Safety Administration's (PHMSA) under the Competitive Academic Agreement Program (CAAP) (#DTPH56-13-H-CAAP03).

## References

E. Dehghan-Niri, S. Salamone, "A Multi-helical ultrasonic imaging approach for the structural health monitoring of cylindrical structures", Structural Health Monitoring: International Journal, accepted, July 2014.

## Public Project Page

Please visit the below URL for much more information:

https://primis.phmsa.dot.gov/matrix/PrjHome.rdm?prj=507