Proactive and Hybrid Sensing Based Inline Pipeline Defects Diagnosis and Prognosis

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Main Objective

This project was awarded to University of Colorado-Denver and Arizona State University in order to develop a new form of hybrid sensing technique that can identify and characterize injurious pipe body proactively with superior resolution and high sensitivity. The overall objectives of this research are two-fold: diagnosis-find existing damage at the earliest stage before it becomes failure critical; and prognosis-accurately predict the remaining strength and RUL of pipelining components.

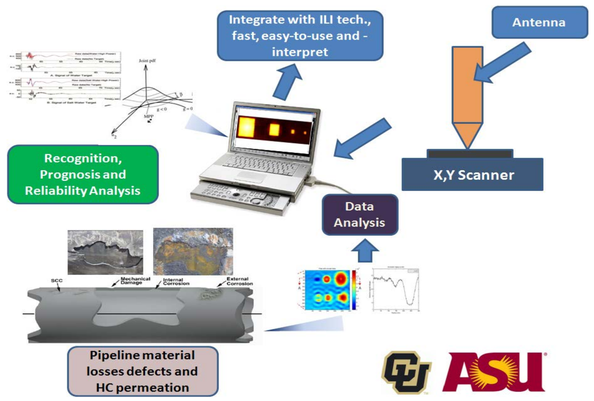

Figure 1. Overall CU-ASU System Diagram

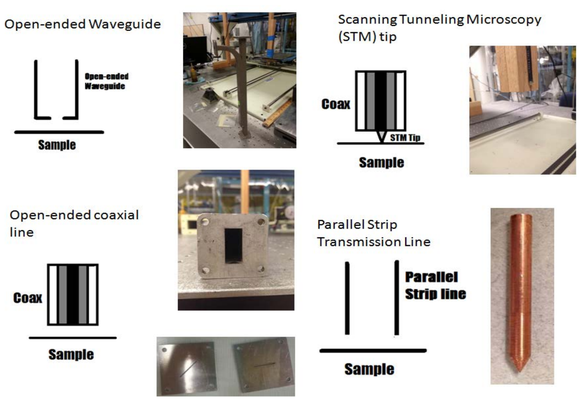

Figure 2. Types of CU Near-Field Microwave Microscope Probes

Project Approach/Scope

- Develop hybrid and multi-physics modeling tool for plastic piping material loss defects detection and quantitative characterization
- Multi-resolution near field microwave sensors and sensing system prototyping
- Integrated damage diagnosis (CU Denver) and prognosis (ASU) for the health management of pipeline systems.

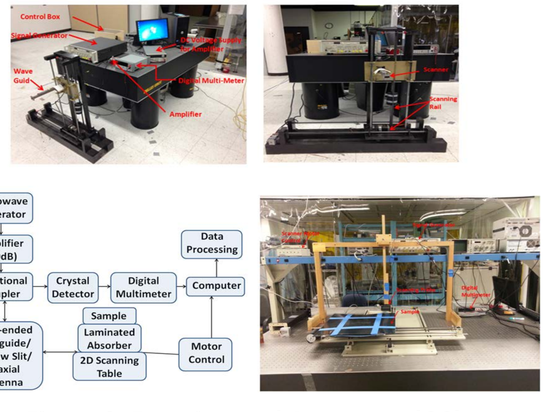

Figure 3. Experimental Apparatus (Q3)

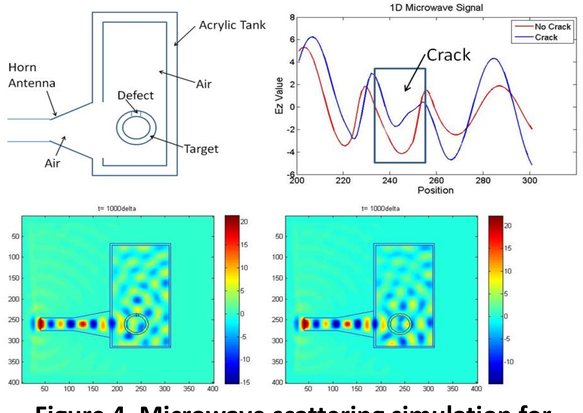

Figure 4. Microwave scattering simulation for injurious pipe body geometry

Results to Date

Different materials have been studied in our group, e.g. metal, PA-6 pipeline sample, and dielectric samples. The image results were processed multiple times to iteratively improve the transducer design. By improving the system design, better results have been obtained.

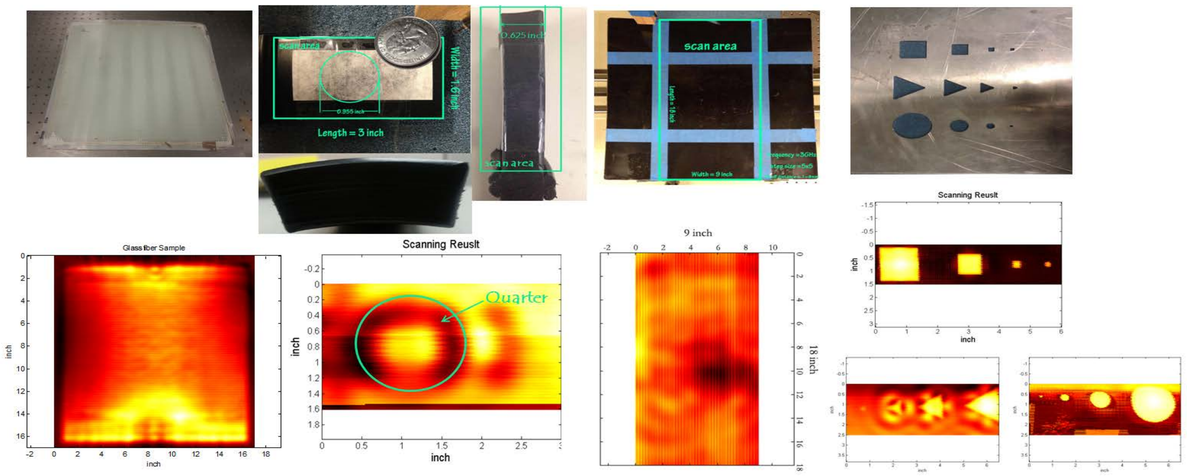

Figure 5. Damage imaging demonstrated at various resolutions (from left to right): PA-6, HDPE pipe, GFRP, Aluminum materials

Acknowledgments

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