College of Engineering
Department of Mechanical & Industrial Engineering

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To Predict ▶ To Design ▶ To Perform

ME, ECE Capstone Design Programs

On-Line Phased Array Ultrasonic Testing (PAUT) System to Detect Scarfing Defects

Esosa Agbongiator, Asad Al-Ghaithi, Dakota Havard, Michael Wascom, Tongyao Wu, Saiyada Zamin

STUPP CORPORATION
THE ENERGY-FILLED COMPANY

Objective

Design a proof of concept on-line PAUT system to detect scarfing defects in pipe developed by a faulty weld trimming tool.

Background

A phased array ultrasonic testing (PAUT) system is an advanced technique of a conventional ultrasonic testing system in which multiple beams are pulsed at different time delays to create an image.

Figure 1: PAUT System

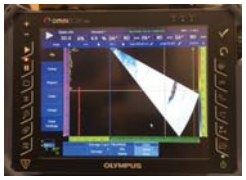


Figure 2: PAUT System Readings

Engineering Specifications

Functional Requirements	Explanation
Control Probe Position	Ability to adjust
Dissipate Heat from Wedge	To prevent failure
Operate Safely	Consider worker safety

Measurable Specifications	Value
Pipe Diameter	20 inches
Maximum Probe Temperature	140°F
Temperature of Pipe	254°F

Engineering Analysis

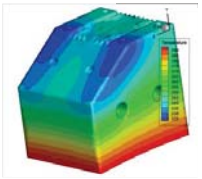


Figure 3: Temperature Distribution at Steady State

Wedge

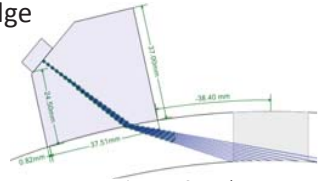


Figure 4: Scan Plan

Curved Rail

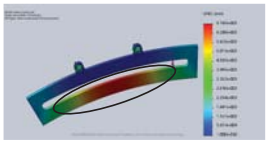


Figure 5: Rail Deflection Due to Load

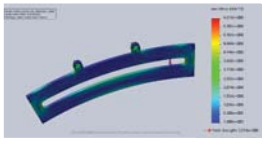


Figure 6: Stress Applied on Rail

Manufacturing and Assembly

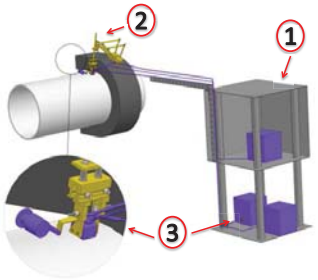


Figure 7: Product Architecture

Figure 8: Assembled System

1 → Base Structure
2 → Probe Adjustment System
3 → Scanning System

Figure 9: Probe Holder

Safety and Testing

Figure 10: Base Structure – Support

Figure 11: Probe Adjustment System – Accuracy and Stability

Figure 12: Scanning System – Wedge Sits Flush on Pipe

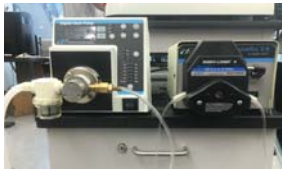
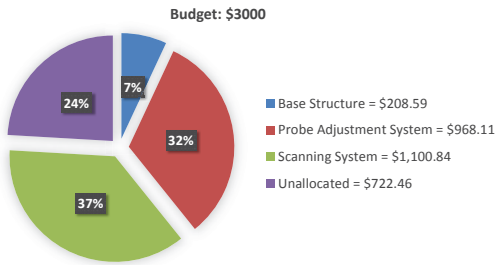


Figure 13: Scanning System – Couplant (left) and Coolant (right) Pump Fittings

Budget



September	October	November	December	January	February	March	April
• Research • Concept Development	• Modeling • Design Analysis	• Design Revision	• Purchasing	• Purchasing	• Manufacturing	• Assembly • Testing and Validation	• Testing and Validation

Sponsors: Dr. Warren Liao and Dr. Muhammad Wahab

Advisor: Dr. Shengmin Guo