CAAP Quarterly Report

Date of Report: April 1, 2019

Prepared for: *U.S. DOT Pipeline and Hazardous Materials Safety Administration*

Contract Number: 693JK31850006CAAP

Project Title: Predicting Remaining Fatigue Life of a Dent with Corrosion Using Advanced Measurements and Modeling

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For quarterly period ending: March 31, 2019

Business and Activity Section

(a) Contract Activity

Held multiple Skype phone meetings with Georgia Tech, Colonial Pipeline and Fleet Technologies discussing material selection and experimental design in months of January, February and March 2019.

Acquired candidate legacy material from Fleet Technologies for nonlinear ultrasound (NLU) measurements in March 2019. The first material is a single grade of X42 material, although mechanical and acoustical tests will determine the exact material properties.

(b) Status Update of Past Quarter Activities (Second Quarter Activities)

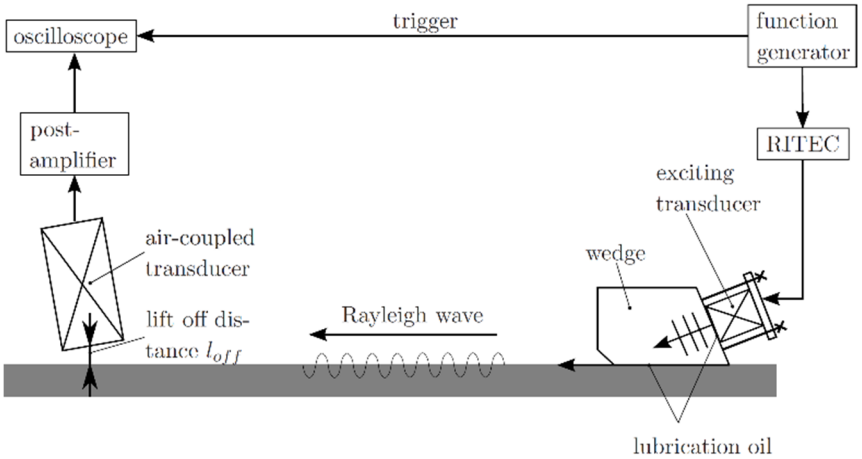
The primary activities in the second quarter was on Task 1: Baseline nonlinear ultrasound (NLU) measurements on virgin specimens of three different pipe grades to quantify the effect of material variability on the measured NLU parameter, β. Developed a candidate measurement technique for baseline NLU measurements that is proving to be successful. Observed cumulative nonlinearity in representative stainless steel (SS) 304 specimens.

(c) Cost share activity
Legacy material provided by Fleet Technologies to the Georgia Tech team, with an approximate value of $500.

Personnel services support/expenses from Georgia Tech: support for PI Laurence Jacobs, Dr. Jin-Yeon Kim (doctoral level Research Scientist), Denis Pfeifer (Masters student) and Mr. Eyosias Gideon (Bachelors student) with an approximate cost of 12% total.

(d) Task 1: Baseline NLU measurements on virgin specimens from three different pipe grades

Worked with Fleet and Colonial to procure legacy pipe specimens.



Modified experimental setup for NLU measurements on these specimens. A schematic of this experimental setup, shown in the figure to the left consists of a contact piezoelectric (PZT) transducer plus wedge and a non-contact air-coupled ultrasonic receiver. The modifications include proper angle for incident waves for the pipe material, and changes to the scanning system for pipe geometry.

1. Background and Objectives in the 2nd Quarter

1.1 Background

Determine material variability in a series of legacy pipeline materials provided to Georgia Tech by Fleet Technologies. It is critical to understand if changes in the measured acoustic nonlinearity parameter β due to this material variability will be greater than the anticipated changes due to the accumulated fatigue and plastic damage.

1.2 Objectives in the 2nd Quarter

The measurements this quarter focused on a surrogate SS 304 material where we demonstrated a cumulative behavior of the second harmonic. This behavior is critical to show that the system is truly measuring material nonlinearity.

2. Experimental Program in the 2nd Quarter

2.1 Experimental design

Demonstrate repeatability of NLU measurements using the setup with a contact PZT transducer and non-contact air-coupled receiver. A schematic of this setup is shown in the figure above.

3. Results and Discussions

Determined cumulative increase in second harmonic on surrogate SS 304 material. These results demonstrate that the proposed measurement procedure is repeatable and should be robust enough to measure β in the pipe material.

4. Future work

Continue with nonlinear ultrasonic measurements in the pipe material to determine material variability. This work will consist of examining multiple propagation paths both longitudinally and circumferentially along the pipe material.

Prepare specimens for mechanical testing.