CAAP Quarterly Report

Date of Report: July19, 2020
Prepared for: *U.S. DOT Pipeline and Hazardous Materials Safety Administration*
Contract Number: 693JK31850013CAAP
Project Title: A Fast and Low-cost Method to Automate Detecting, Locating, and Mapping Internal Gas Pipeline Corrosion using Pig-mounted Thermal and Stereo Cameras

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For quarterly period ending:12/31/2020

Business and Activity Section

(a) Contract Activity

1) **Contract modification**: No contract modification is expected in this quarter.

2) **Material purchased:** N/A

(b) Status Update of Past Quarter Activities

1) Part 1 Technology / platform development

Task 1.6 *Identify, develop, and test Machine Learning algorithms of corrosion detection using 3D profile channel. Corrosion and defect spots of different sizes and shapes will be marked on the maps automatically after 3D-profile matching corrosion features are found.*

This task is 75% completion.

Task 1.7 *Develop efficient data fusion approach to generate more reliable detecting result than single channel method (such as using weighted average method by estimating the optimal weight factor of data from each channel)*

This task is 20% completion.

Task 1.8 *Develop the tool to enable precise overlay of images of the detected corrosion spots in all three channels to assist with corrosion formation monitoring and evaluations.*

This task is 50% completion.

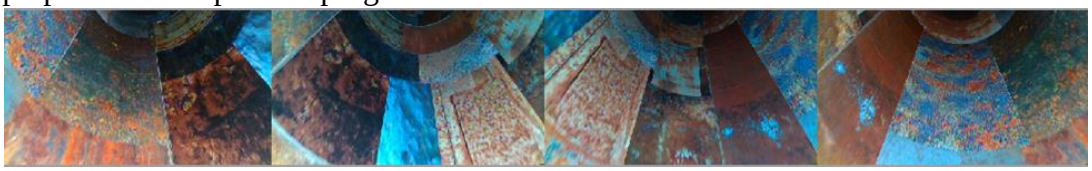
2) Cost share activity
N/A

3) The major research activities and outcomes in this quarter include:

1. A corrosion image database was created, which contained more than 400 difference corrosion texture images collected from online. The corrosion images were used for assisting with pipeline 3D modeling, as well as corrosion detection. Figure 1 shows how these corrosion images were used to create the internal pipe corrosion scene.

Figure 1. An example of a pipe section with artificial corrosions patterns

2. Pipeline 3D internal reconstruction using images
   The team explored using corrosion texture features to improve the outcomes of the optical flow based 3D reconstruction. Figure 2a shows the raw RGB images acquired by the robot's cameras. Figure 2b shows the reconstructed 3D pipeline. A journal article is in preparation to report the progress.



(a) Raw images captured by the inline robot

(b) Reconstructed 3D pipeline with corrosion patterns

Figure 2. An illustration of the image-based 3D pipeline reconstruction.

4) Next quarter

1. In the 10th quarter the team will focus on deep learning-based corrosion detecting, locating, and mapping.