CAAP Quarterly Report

Date of Report: January 12, 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

Prepared by: Zhigang Shen

Contact Information: Zhigang Shen,
Associate Professor
College of Engineering
University of Nebraska–Lincoln
113 Nebraska Hall, P.O. Box 880500
900 N. 16th Street, Lincoln, NE 68588-0500
Email: shen@unl.edu
Phone: (402) 472-9470

For quarterly period ending: 12/31/2019

Business and Activity Section

(a) Contract Activity

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

2) **Material purchased:** two more pipeline inspection rovers were manufactured and assembled, including one 4-wheel drive rover. Three new power-train batteries were purchased, and eights camera mounting seats were fabricated.

(b) Status Update of Past Quarter Activities

1) Part 1 Technology / platform development

Task 1.1: Design, prototype, and test the pig device with all the mounted devices and cameras

This task is 100% completion.

Task 1.2 Setup the testing pipe platform in the working space of UNL Structural Lab.

This task is 100% completion.

Task 1.3 Identify, develop, and test algorithms for internal pipe surface RGB-D mapping

This task is 70% completion.

Task 1.4 Identify, develop, and test algorithms for internal pipe surface thermal image mapping

This task is 20% completion.

Task 1.5 Identify, develop, and test Machine Learning algorithms of corrosion detection using thermal image channel.

This task is 20% completion.

2) Cost share activity

The PI dedicated 0.2 FTE in this quarter to the project.

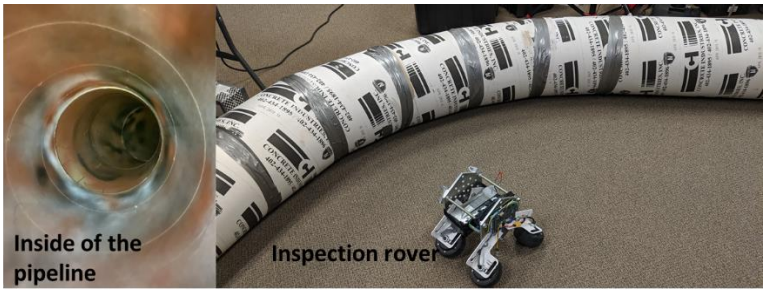
The major research activities in this quarter include:

1. A 3D Solidworks model of the inspection rover was completed. The simulations is under way to simulate the inspection rover's travel in the pipeline testing bed.
2. Different camera layouts were tested to achieve the best modeling outcomes.
3. Several 3D pipeline stitching algorithms have been tested. The qualities of the 3D models generated by each algorithm were evaluated. Virtual odometer method was used to improve the quality of the pipeline modeling, and to improve defect locating performance.
4. Convolutional Neural Network (CNN) architectures in corrosion identification were tested and evaluated.

1. Experimental Program in the Quarter

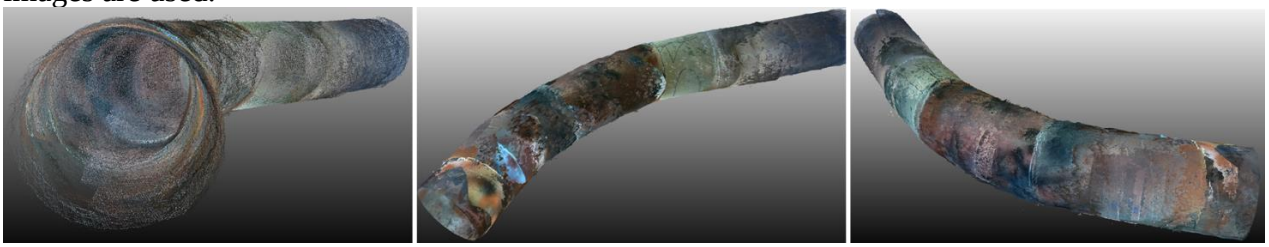
2.1 *Experimental design:*

Rover and camera integrations were tested and evaluated to get the best configurations of the inspection rover. Stitching algorithms were tested and evaluated using the partial pipeline models.



2.2 Results and Discussions:

Rover and camera integrations were tested and evaluated to get the best configurations of the inspection rover. The following partial point-cloud model was created based on the low-resolution images. The accuracy improvements of 3D modeling are expected when the higher resolution images are used.



2. Future work

In the 6th quarter the team will focus on improving the point-cloud modeling by increase the camera resolution, which currently is constrained by the embed computer processing power. A higher performance embedded computer is expected to be purchase in the Quarter 6 to improve the 3D modeling performance.

References: N/A