

Pipeline Damage Prevention Radar (PDPR) 3rd Quarterly Report

July 8, 2016

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Prepared for: *DOT, PHMSA*

Project Title: *Pipeline Damage Prevention Radar (PDPR)*

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For quarterly period ending: *June 30, 2016*

1. Technical Status

The second quarter of the Pipeline Damage Prevention Radar (PDPR) project focused on writing the test procedure, finishing planning, and performing the flight testing at ImSAR (Task 4). Preparations for flight testing at PG&E (Task 5) have been made as detailed below, but the flight testing at PG&E has been postponed. The SAR detection and near-real-time algorithms (Task 3) have been matured as well.

1.1 Flight Testing at ImSAR (Task 4)

During this period, we finalized plans for the flight testing in Springville, UT and performed the flight test. The testing occurred from June 6th to 9th and included imaging 5 locations in the Springville, UT area with the ImSAR-provided SAR systems and optical imagery. The areas included: 1) Lakeshore (rural), 2) Spanish Fork (urban), 3) Springville Main Street (urban) 4) Provo Cemetery (semi-rural), and 5) Birdseye (rural).

In each location, except the Springville main street, various targets of different sizes were staged to understand the detection sensitivity. The targets included shovels, wheelbarrow, mid-sized car, large SUV, pickup, backhoe, small (1') corner reflectors and large (4') corner reflectors. Data was taken using ImSAR's ultra-wide-band radar, X band radar, Ku band radar, and optical system. Targets were staged under foliage of different types and in the open.

During the test, precise locations and times of the staging of each target were carefully recorded in order to assess detectability.

Preliminary processing of the data looks encouraging. The larger targets are clearly detectable in the data using Magnitude Change Detection (MCD) processing. We are currently working through some challenges in the data including sporadic inertial measurement unit (IMU) drop-outs, minor mis-registrations, and occasional blurred images. ImSAR is aware of these data anomalies and is working to understand root cause and correct these in their system.

1.2 Preparations for flight testing at PG&E (Task 5)

During this period, we have received FCC Authorization for the Sacramento area. The FCC experimental license has been approved for subsection of UWB bands, for a portion of the S-band downlink frequency, and for the full X and Ku bands. We plan to re-assess the PG&E testing during the next quarter.

1.3 SAR Algorithm Development (Task 3)

During this period, we have matured the SAR detection algorithms. These algorithms were completed for the Springville testing, and continue to be matured based on the Springville testing. The following paragraphs describe the algorithms that were matured during this period:

A spatial filter has been developed to reduce false alarms from detections that do not resemble the targets of interest. These include detections that come in “long strips” caused by bright metallic objects such as railroad tracks and wires.

A visual observation tool known as the SAR Explorer (SAR-X) has been developed to allow users to quickly identify locations of areas flagged by the algorithm as containing potential dig-ins and other objects of interest. The SAR-X is a web-based tool that is best utilized by Google Chrome located at sar.latlogic.com.

A shape-file mask was added to the processing to include only areas that are within the pipeline right-of-way. Since the SAR images a much wider swath than the area of interest, the shape-file mask is critical to reducing false alarms from surrounding areas.

In addition, the algorithms have been set up for near-real time processing. A workflow control process has been developed for operational use of the algorithms.

2. Payable Milestones

As described in Sections 1 above, the Project Deliverable and Payment Milestones were completed as summarized in **Table 1**.

Item	Milestone	Status	Comments
7	Task 6, Quarterly status report	Complete	This document
5	Task 3, SAR Algorithm Development	Completed	Maturation will continue, but basic algorithms are complete
8	Task 4, Flight Testing at ImSAR	Test Report in progress	Flight testing was completed, but the Test Report will be delivered next quarter
	Project Peer Review	Completed	May 25, 2016