

DEVELOPMENT OF A DRONE-BASED GROUND-PENETRATING RADAR (GPR) SYSTEM TO MEASURE PIPELINE DEPTH OF COVER AT WATER CROSSINGS

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As was witnessed during the tragic flooding in November 2021, in southern British Columbia, Canada, surging rivers have the power to scour out riverbeds and embankments, potentially exposing buried pipelines. Often, pipelines become exposed during this scouring and are susceptible to vortex-induced vibrations that can literally shake the pipeline apart. During these high-water events, pipeline operators will shut in their lines to avoid a breach of the pipeline. These pipeline shut ins cause service outages and result in lost revenues that increase each day until the pipeline can be restarted. Restarting a pipeline requires confirmation that the pipeline is not exposed, and its integrity has not been compromised. The standard operating procedure to verify pipeline integrity is to have surveyors wade into a river or use a boat to measure the river profile and determine depth of cover using a device that must be physically placed on the riverbed. Waiting for water levels to drop to a safe level to allow this activity can take days to weeks. We are developing a lightweight ground-penetrating radar (GPR) system that can be deployed from a multirotor uncrewed aerial vehicle (UAV or drone) for use over pipeline water crossings. The GPR system should be capable of measuring 1) water depth, 2) the depth of cover above a shallowly buried pipeline, and 3) the position of the water surface relative to the drone. Moreover, in order to satisfy current regulatory requirements for flying UAVs and operating a GPR, the system must be capable of flying at less than 1 metre above the ground or water surface. Recent tests using a 100 MHz antenna system show that bathymetry can be measured in water depths of at least 2 metres. Further improvements to the antenna configuration, onboard GPS, an independent altimeter, and their mount positions on the UAV should enable improved performance. We present here the results of initial testing and development plans, including results from testing sites in Alberta, Canada.