Low-Cost, Full-Field Tool for In-Ditch Deformation Measurement

Technical Brief

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Introduction

Gas and oil pipelines are subject to a number of defects or anomalies that can impact fitness for service and potentially compromise the safety of the pipeline. The three major types of anomalies are corrosion, cracks, and mechanical damage. Several analyses of the occurrence of anomalies in pipelines have highlighted mechanical damage (typically from third party excavations) as the most frequent source of leaks and ruptures, either immediately on impact or after a time delay. The most common type of mechanical damage is dents, sometimes associated with secondary features such as prints, gouges, external corrosion, or cracks.

Background

In-line inspection (ILI) using autonomous internal tools or pipeline inspection gauges (pigs) is the first step in the assessment process. ILI is able to detect the presence of dents, but the information obtained is not sufficiently detailed to determine the fitness for service. Excavation at the damage site and subsequent coating removal is thus required in order to inspect the damaged region in a more direct manner. The resulting in-ditch assessment is typically obtained from a caliper measurement that yields the damage depth as a fraction of the wall thickness. DOT regulations use the fractional depth to determine whether immediate repair is required or a 60- or 180-day reassessment is allowed. More specialized mechanical tools have some ability to determine the actual shape or profile of the damaged region from an external measurement, but they have limited spatial resolution and are not in wide use. In summary, currently used techniques for assessing dents are not accurate enough for reliable determination of fitness for service.

Summary of Work to be Accomplished

In this project, Intelligent Optical Systems will build on earlier results to evaluate the effectiveness of its novel surface-profiling tool for mechanical damage evaluation based on the real-time processing of a single digital image. This inexpensive, full-field approach provides the full shape of the damaged region with high accuracy, and overcomes current limitations in the assessment process. In Phase I, Intelligent Optical Systems will develop algorithms and software to process simple digital images, assemble a laboratory prototype, inspect dents in pipe samples provided by PRCI and provide the data to Blade Energy Partners for evaluation of fitness for service using its finite element models.