Northeast GAS ASSOCIATION

NYSEARCH

Technology Brief

Development of Technologies to Support Robotic Systems for the Inspection of Unpiggable Natural Gas Pipelines

Description: **A number of technologies, such as mechanical damage/ovality sensor, rescue tools, in-line recharging system, and crack detection sensors are being developed to enhance NYSEARCH's commercial robotic system for the in-line inspection of unpiggable natural gas pipelines.**

Status: **Several components are commercialized; rescue tool, crack sensor and cleaning system work is ongoing**

BENEFITS

A range of robotics platforms for the inspection of unpiggable pipelines, developed with funding and leadership from NYSEARCH and its industry and government partners, was commercialized starting in late 2010. A related effort is now supporting efficient, reliable and safe deployment of the robotics systems in order to expand application and capabilities during the same job. In this project, a number of technologies have been developed, tested and some already commercialized. Through this work, the capabilities of these robotic systems are enhanced and the efficiencies associated with their deployment are increased significantly.

BACKGROUND

A major milestone of NYSEARCH's effort in developing technologies for the inspection of the thousands of miles of unpiggable pipelines in the U.S. was reached in late 2010 when Pipetel Technologies Ltd. introduced the technology to the market by unveiling Explorer 6/8 a tool designed for the inspection of 6" – 8" unpiggable pipelines. Since then, the EXP 10/14, EXP 20/26 have been commercialized and will soon by followed by EXP 30/36 and EXP 16/18. The Explorer range of inspection platforms are tether-less, self powered (via batteries), modular robotics tools with a wall loss sensor integrated on them that communicate with the operator via wireless technology and are able to be launched, operated and retrieved under live pipeline conditions. In 2011, the research and development effort shifted to addressing issues pertaining to increased efficiencies in the deployment of these technologies and introduction of additional sensors for increased application and value to the members and industry.

There are two areas of need for new technologies to support the robotic platforms deployed or to be deployed in the near future. The first is the introduction of additional sensing capabilities. The current systems are equipped with sensors able to measure wall loss due to corrosion. Additional capabilities need to be introduced in these systems, especially capabilities in detecting and sizing mechanical damage in pipelines, mainly in terms of dents and ovality issues, given that following corrosion, these are known to be the next most prevalent defects encountered in pipelines. In addition, crack detection is important. The second area is that of increasing the efficiencies, and thus lowering the cost of the gas company's job support for the robots. Technologies that could increase the reliability of the robots, extend their operational range, and provide cleaning capabilities that would allow inspection of "dirty" pipelines would be very valuable.

TECHNICAL APPROACH

With cofunding from SDTC (Canadian government), NYSEARCH retained Invodane Engineering of Toronto, Canada, to carry out engineering studies and develop prototype systems for a number of technologies that will enhance robotics technologies for inspecting unpiggable pipelines.

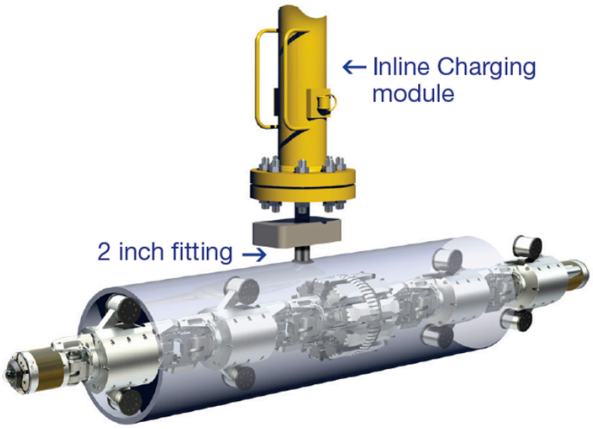

Figure 1: Commercial In-Line Charging Product

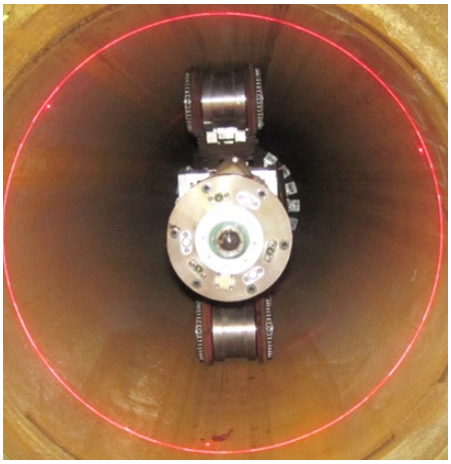

Figure 2: Laser-based Mechanical Damage/Ovality Sensor platforms

In one of the two early tasks, an in-line battery charging system was designed and tested and is now commercialized (see Fig. 1). This new system allows the robots to be recharged while in the pipeline, i.e. without having to remove them from the pipeline, which accelerates the charging process and extends the range of the robot and reduces the need for launching equipment. Through the same access point, the system also provides means for deploying an antenna in order to increase the wireless range of the robot.

Another early effort in this project was to develop capabilities for sensing mechanical damage, dents and ovality in pipelines. Through combined use of laser technology and high resolution camera imaging, the mechanical damage/ovality sensor is now fully tested and released for use with the commercial platforms (see Fig. 2).

In the third task, a working prototype system was designed and built for cleaning debris (shavings) generated at the access point where the pipeline is tapped in order to install the launcher system. This system is now available for commercial jobs. In addition, concepts were evaluated and one selected for overall cleaning of debris and liquids in the main pipeline ahead of inspection and that concept is now in place for full development and testing. Also, as part of the original Supporting Technologies project, a task was completed to develop various solutions for a vehicle able to retrieve the robots in case of failure inside a pipeline. This rescue tool has now been fully evaluated in the lab and is being completed with field testing in funders' pipes. As with all systems under consideration in the overall program, this system is designed to be scalable to all sizes.

In a separate phase of the project, NYSEARCH is also developing with Invodane/Pipetel means for adding crack detection sensors to the unpiggable inspection platform. After completing a thorough feasibility study, the team agreed to selection of a combination of transverse MFL sensing with EMAT sensing to address the different high priority crack conditions that funders wanted addressed. The crack sensor module is moving to the testing and commercialization stage in the near future.

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