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APPLICATION OF REMOTE-FIELD EDDY CURRENT (RFEC) TESTING TO INSPECTION OF UNPIGGABLE PIPELINES

Phase 2–Design of RFEC System for Integration with Explorer II Robot

Many pipelines contain internal restrictions that do not allow the passage of inspection pigs that use conventional inspection technology. In the first phase of this project, the feasibility of a remote-field eddy current (RFEC) inspection method was investigated for this purpose. Subsequently, a second phase was added to the original project to design an RFEC system for integration with the Explorer II robot under development at Carnegie Mellon University. Results described below are from Phase 2.

The Explorer II robot consists of a series of approximately seven modules that are linked together to form a self-propelled device that can travel untethered through a pipe. The robot is designed for pipe that ranges in diameter from 6 to 8 inches. In order to accommodate sharp bends in the pipe, however, the robot and sensor modules must have the capability to collapse to 4 inches in diameter. Designs were developed for RFEC exciter and detector modules that meet these size requirements. The detector module contains a series of 48 sensors on spring-loaded, retractable arms. The arms expand to the required pipe diameter and retract as necessary to negotiate bends or obstacles in the pipe. It was envisioned that the exciter module would also expand and retract; however, given the size constraints involved, it was determined that a fixed-diameter exciter coil was necessary. Tests confirmed that good signals from target defects in the pipe were obtainable with the fixed-diameter exciter.

Electronic circuitry was designed for both the detector and exciter modules. This circuitry multiplexes and digitizes signals from all 48 sensors. The signals are then processed by a digital signal processor to perform the function of a lock-in amplifier (phase-sensitive detector). Tests showed that processing the signals in this manner produced results equivalent to those obtained previously with analog instrumentation. This approach greatly simplifies the electronic circuitry because it eliminates the need for multiple channels of lock-in amplifiers. Circuitry was also designed to generate the drive signal for the excitation coil.

Preparations are underway for an upcoming demonstration test of the RFEC system. For this test, an eight-channel version of the RFEC system is being developed. Electronic circuitry has been developed and is currently undergoing testing. An eight-sensor version of the detector module mechanical device has been fabricated and is undergoing testing. Two 8-inch-diameter test pipes have been configured with simulated corrosion defects and are being used to develop and evaluate the RFEC demonstration system.

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