Inspection En Pipeline

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Implementation of the Pipeline Inspection, Protection, Enforcement, and Safety Act of 2006 and Reauthorization of the Pipeline Safety Program
Innovative Electromagnetic Sensors for Pipeline Crawlers
Implementation of the Pipeline Inspection, Protection, Enforcement, and Safety Act Of 2006
Developing a New Market

Implementation of the Pipeline Inspection, Protection, Enforcement, and Safety Act of 2006
Low-cost Sensors for Natural Gas Pipeline Monitoring and Inspection
Arctic Undersea Inspection of Pipelines and Structures
The International Conference on Pipeline Inspection, June 1983, Edmonton, Alta., Canada
Evaluation of Pipeline Integrity by On-line Inspection
Pipeline Inspection and Health Monitoring Technology
Pipeline Safety
Latvijas Gaze. Inspection of Pipeline. Final Report. Cathodic Protection, Phase 2
API 1169 Pipeline Construction Inspector Examination Guidebook
Natural Gas Pipelines
INSPECTION OF PIPELINE WELDS.
Pipeline Safety, 1969
High Voltage Electrical Inspection of Pipeline Coatings Prior to Installation

AVA DECKER

Multi-modality Nondestructive Evaluation Techniques for Inspection of Plastic and Composite Pipeline Networks

BiblioGov
In the 1950s, the Savannah River Site built an open, unlined retention basin to temporarily store potentially radionuclide contaminated cooling water from a chemical separations process and storm water drainage from a nearby waste management facility that stored large quantities of nuclear fission byproducts in carbon steel tanks. The retention basin was retired from service in 1972 when a new, lined basin was completed. In 1978, the old retention basin was excavated, backfilled with uncontaminated dirt, and covered with grass. At the same time, much of the underground process pipeline leading to the basin was abandoned. Since the closure of the retention basin, new environmental regulations require that the basin undergo further assessment to determine whether additional remediation is required. A visual and radiological inspection of the pipeline was necessary to aid in the remediation decision making process for the retention basin system. A teleoperated pipe crawler inspection system was developed to survey the abandoned sections of underground pipelines leading to the retired retention basin. This paper will describe the background to this project, the scope of the investigation, the equipment requirements, and the results of the pipeline inspection.
Oil and Gas Pipelines
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Internal inspection of

pipelines is an important tool for ensuring safe and reliable delivery of fossil energy products. Current inspection systems that are propelled through the pipeline by the product flow cannot be used to inspect all pipelines because of the various physical barriers they encounter. Recent development efforts include a new generation of powered inspection platforms that crawl slowly inside a pipeline and are able to maneuver past the physical barriers that can limit inspection.

At Battelle, innovative electromagnetic sensors are being designed and tested for these new pipeline crawlers. The various sensor types can be used to assess a wide range of pipeline anomalies including corrosion, mechanical damage, and cracks. Battelle is in the final year on a projected three-year development effort. In the first year, two innovative electromagnetic inspection technologies were designed and tested. Both were based on moving high-strength permanent magnets to generate inspection energy. One system involved translating permanent magnets towards the pipe. A pulse of electric current would be induced in the pipe to oppose the magnetization according to Lenz's Law. The decay of this pulse would indicate the presence of defects in the pipe wall. This inspection method is similar to pulsed eddy current inspection methods, with the fundamental difference being the manner in which the

current is generated. Details of this development effort were reported in the first semiannual report on this project. The second inspection methodology is based on rotating permanent magnets. The rotating exciter unit produces strong eddy currents in the pipe wall. At distances of a pipe diameter or more from the rotating exciter, the currents flow circumferentially. These circumferential currents are deflected by pipeline defects such as corrosion and axially aligned cracks. Simple sensors are used to detect the change in current densities in the pipe wall. The second semiannual report on this project reported on experimental and modeling results. The results showed that the rotating system was more adaptable to pipeline inspection and therefore only this system will be carried into the second year of the sensor development. In the third reporting period, the rotating system inspection was further developed. Since this is a new inspection modality without published fundamentals to build upon, basic analytical and experimental investigations were performed. A closed form equation for designing rotating exciters and positioning sensors was derived from fundamental principles. Also signal processing methods were investigated for detection and assessment of pipeline anomalies. A lock in amplifier approach was chosen as the method for detecting the signals.

Finally, mechanical implementations for passing tight restrictions such as plug valves were investigated. This inspection concept is new and unique; a United States patent application has been submitted. In this reporting period, a general design of the rotating permanent magnet inspection system is presented. The rotating permanent magnet inspection system is feasible for pipes ranging in diameter from 8 to 18 inches using a two pole configuration.

Experimental results and theoretical calculations provide the basis for selection of the critical design parameters. The parameters include a significant magnet to pipe separation that will facilitate the passage of pipeline features. With the basic values of critical components established, the next step is a detailed mechanical design of a pipeline ready inspection system.

The Pipeline Inspection, Protection, Enforcement, and Safety Act of 2006; Implementation Review and Discussion of Safety Assessment Intervals for Natural Gas Pipelines Springer Nature

Internal inspection of pipelines is an important tool for ensuring safe and reliable delivery of fossil energy products. Current inspection systems that are propelled through the pipeline by the product flow cannot be used to inspect all pipelines because of the various physical barriers they may encounter. To facilitate inspection of these

''unpiggable'' pipelines, recent inspection development efforts have focused on a new generation of powered inspection platforms that are able to crawl slowly inside a pipeline and can maneuver past the physical barriers that limit internal inspection applicability, such as bore restrictions, low product flow rate, and low pressure. The first step in this research was to review existing inspection technologies for applicability and compatibility with crawler systems. Most existing inspection technologies, including magnetic flux leakage and ultrasonic methods, had significant implementation limitations including mass, physical size, inspection energy coupling requirements and technology maturity. The remote field technique was the most promising but power consumption was high and anomaly signals were low requiring sensitive detectors and electronics. After reviewing each inspection technology, it was decided to investigate the potential for a new inspection method. The new inspection method takes advantage of advances in permanent magnet strength, along with their wide availability and low cost. Called rotating permanent magnet inspection (RPMI), this patent pending technology employs pairs of permanent magnets rotating around the central axis of a cylinder to induce high current densities in the material under inspection.

Anomalies and wall thickness variations are detected with an array of sensors that measure local changes in the magnetic field produced by the induced current flowing in the material. This inspection method is an alternative to the common concentric coil remote field technique that induces low-frequency eddy currents in ferromagnetic pipes and tubes. Since this is a new inspection method, both theory and experiment were used to determine fundamental capabilities and limitations. Fundamental finite element modeling analysis and experimental investigations performed during this development have led to the derivation of a first order analytical equation for designing rotating magnetizers to induce current and positioning sensors to record signals from anomalies. Experimental results confirm the analytical equation and the finite element calculations provide a firm basis for the design of RPMI systems.

Experimental results have shown that metal loss anomalies and wall thickness variations can be detected with an array of sensors that measure local changes in the magnetic field produced by the induced current flowing in the material. The design exploits the phenomenon that circumferential currents are easily detectable at distances well away from the magnets. Current changes at anomalies were detectable with commercial low cost Hall Effect sensors.

Commercial analog to digital converters can be used to measure the sensor output and data analysis can be performed in real time using PC computer systems. The technology was successfully demonstrated during two blind benchmark tests where numerous metal loss defects were detected. For this inspection technology, the detection threshold is a function of wall thickness and corrosion depth. For thinner materials, the detection threshold was experimentally shown to be comparable to magnetic flux leakage. For wall thicknesses greater than three tenths of an inch, the detection threshold increases with wall thickness. The potential for metal loss anomaly sizing was demonstrated in the second benchmarking study, again with accuracy comparable to existing magnetic flux leakage technologies. The rotating permanent magnet system has the potential for inspecting unpiggable pipelines since the magnetizer configurations can be sufficiently small with respect to the bore of the pipe to pass obstructions that limit the application of many inspection technologies. Also, since the largest dimension of the Hall Effect sensor is two tenths of an inch, the sensor packages can be small, flexible and light. The power consumption, on the order of ten watts, is low compared to some inspection systems; this would enable autonomous systems to inspect longer distances between

charges. This project showed there are no technical barriers to building a field ready unit that can pass through narrow obstructions, such as plug valves. The next step in project implementation is to build a field ready unit that can begin to establish optimal performance capabilities including detection thresholds, sizing capability, and wall thickness limitations.

In-line Inspection Systems Qualification BiblioGov

This practical reference book attempts to answer many of the questions and problems associated with pigging and pipeline inspection technology applied to oil, gas and products pipelines both on- and offshore. The book discusses why, when and how to pig a line, intelligent pigs, interpreting data, economics, environmental considerations and risk assessment, and rehabilitation and repair. Among the new features of this edition are on-line inspection techniques, US regulations, inspection of the Trans Alaska pipeline, gel pig technology, interpreting intelligent pig results, on-line repair, internal cleaning and coating, and when to renew a pipeline.

Eesti Gaas. Report on Project Execution and Finalization. Inspection of Pipeline in Estonia, Phase 1 Gulf Professional Publishing

GAO discussed pipeline safety, focusing on: (1) the uses and limitations of instrumented internal inspection devices in improving pipeline safely; and (2) actions taken pursuant to the Reston,

Virginia, pipeline incident. GAO noted that: (1) although internal inspection devices are the only pipeline inspection techniques that are able to detect internal and external corrosion without physical pipeline excavation, they are unable to detect longitudinal cracks and metal loss in pipe welds or travel through pipelines containing sharp bends; (2) the federal government lacks regulations on the frequency or use of smart pigs technology; (3) the Research and Special Programs Administration (RSPA) has completed the required feasibility study which recommended that periodic pipeline inspections be performed using smart pig technology and new or replacement pipelines be compatible with smart pig technology; (4) prior National Transportation Safety Board recommendations have sought to increase the use of smart pig technology and establish federal criteria on pipeline repair, however, pipeline inspections have remained largely unregulated; (5) while causes for the Reston pipeline incident are not known, RSPA ordered the pipeline operator to reduce the pipeline's operating pressure and inspect the damaged segment using smart pig technology; and (6) pipeline companies need to perform periodic pipeline inspections using smart pig technology as well other inspection techniques to ensure pipeline integrity and safety and minimize

incident damage.
Planning Inspection of Sewer Pipelines Using Defect-based Risk Approach American Society of Mechanical Engineers
A comprehensive and detailed reference guide on the integrity and safety of oil and gas pipelines, both onshore and offshore Covers a wide variety of topics, including design, pipe manufacture, pipeline welding, human factors, residual stresses, mechanical damage, fracture and corrosion, protection, inspection and monitoring, pipeline cleaning, direct assessment, repair, risk management, and abandonment Links modern and vintage practices to help integrity engineers better understand their system and apply up-to-date technology to older infrastructure Includes case histories with examples of solutions to complex problems related to pipeline integrity Includes chapters on stress-based and strain-based design, the latter being a novel type of design that has only recently been investigated by designer firms and regulators Provides information to help those who are responsible to establish procedures for ensuring pipeline integrity and safety
Implementation of the Pipeline Inspection, Protection, Enforcement and Safety Act of 2006 and Reauthorization of the Pipeline Safety Program Springer Nature
The Pipeline Inspection, Protection, Enforcement, and Safety Act of 2006;

implementation review and discussion of safety assessment intervals for natural gas pipelines : hearing before the Subcommittee on Energy and Air Quality of the Committee on Energy and Commerce, House of Representatives, One Hundred Tenth Congress, second session, March 12, 2008.

A Compensation Method for Spiral Error of Pipeline Bending Strain In-Line Inspection Createspace Independent Publishing Platform

This book describes the design, mathematical modeling, control system development and experimental validation of a versatile mobile pipe inspection robot. It also discusses a versatile robotic system for pipeline inspection, together with an original, adaptable tracked mobile robot featuring a patented motion unit. Pipeline inspection is a common field of application for mobile robots because the monitoring of inaccessible, long and narrow pipelines is a very difficult task for humans. The main design objective is to minimize the number of robots needed to inspect different types of horizontal and vertical pipelines, with both smooth and rough surfaces. The book includes extensive information on the various design phases, mathematical modeling, simulations and control system development. In closing, the prototype construction process and testing procedures are presented and supplemented with laboratory and field

experiments.

Pipeline Safety Inspection

John Wiley & Sons

The in-line inspection tool with an inertia measurement unit (IMU tool) is used to measure the centerline coordinate and bending strain for the oil and gas pipeline. In order to prevent the partial wear during inspection, the tool is used to install the supporting wheel at a regular angle to rotate circumferentially. However, the spiral errors are produced during the course of inspection and thus affect the accuracy of centerline and bending strain. To improve the inspection precision and reduce the incidences of spiral error, this article presents a spiral error compensation method not only to improve the inspection precision of centerline mapping, but also to calibrate and compensate for the bending strain of pipeline. The field pull through test was carried out in a section of oil pipeline, and the results showed that the spiral error could practically be eliminated, with the maximum repetition error reducing from 0.17 to 0.06m, and the precision of pipeline bending strain descending effectively from 0.04 to 0.02 %. The proposed method proved to be effective for improving the inspection accuracy of pipeline displacement and strain inspection.

Pipeline Safety Testing/inspection Methods Study

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In response to a congressional request, GAO examined the

Department of Transportation's (DOT) Office of Pipeline Safety's development of the inspection cycle for natural gas and hazardous liquid pipelines, focusing on whether the: (1) office based the pipeline inspection cycle on sound risk assessments; and (2) Pipeline Inspection Priority Program (PIPP) would identify pipelines with the greatest potential safety risks. GAO found that: (1) in 1987, the office determined that it should inspect each pipeline inspection unit every 2.5 years; (2) although the office believed that the 2.5-year cycle was reasonable, it did not consider variations in relative safety conditions among individual units; (3) regional chiefs believed that the cycle was too ambitious because of the time required to perform other important compliance activities; and (4) the office expected its field inspectors to conduct 32 investigations per year at an average of 2.5 days per inspection, while field chiefs believed that inspectors needed between 2.5 and 7.5 days to complete an inspection. GAO also found that: (1) the office developed PIPP to identify the relative risk of pipeline companies and units on the basis of weighted safety factors; (2) the office could not ensure the reliability of program data, since it did not provide sufficient training on how to access the computer system or how to assign unit inspection priority codes; (3) pipeline inspectors had no consistent

guidance on how to assign unit safety risk priority codes; and (4) the office did not plan to use program data to evaluate its inspection cycle or staffing level.

Pipeline Inspection, Maintenance and Repair

The extensive adoption of plastic pipelines is a growing phenomenon in different fields of the industry, with applications that extend from municipal water and sewer systems to the water lines in nuclear reactors. The large-scale adoption is motivated by the unique features of plastics like corrosion and chemical resistance, low cost, and design flexibility. While the dielectric nature of plastic pipelines provides unique design capabilities, it also introduces new challenges for the operators when it comes to inspecting and ensuring the integrity of these pipelines' networks. In this study, a multi-modal approach is adopted to address the threats affecting the safety of small diameter plastic pipelines and explore possible inspection solutions for emerging materials like composites.Structured light endoscopes with RGB-D inspection capability were developed for the inspection of surface defects in small diameter pipelines with novelties a) Design and miniaturization of RGB-D structured light sensor with electronic stabilization, b) Development of an algorithm to automatically calibrate the sensor when placed in a cylindrical environment, c) Design of

a single shot phase measurement SL sensor that employs the sensor movement to improve the 3D reconstruction, and d) Design a stereoscopic SL sensor for 360-degree inspection.EM-based inspection was adopted to inspect subsurface defects and classify materials around the inspected pipelines. An investigative study was performed to test the probability of detecting cold fusion in butt fusion joints by using emerging NDE techniques, and a coplanar capacitive sensor was designed for the detection of legacy crossbores in gas pipelines.Finally, a thermoacoustic imaging system was developed in this study with potential applications for the inspection of composites and medical imaging. The novelties of this work can be summarized as follows: a) Development of a simulation model to study the thermoacoustic waves generation and the effect of multiple experimental parameters on the performance of thermoacoustic imaging systems, b) Improving the signal to noise ratio of pulsed TAI imaging systems by adoption non-coherent pulse compression.In summary, this study presents a multi-modal approach for the inspection of pipeline networks by adopting optical RGB-D imaging sensors for surface inspection, EM-based sensors for subsurface inspection and classification of objects outside the pipe, and finally, a hybrid imaging method with potential applications in medical

imaging and inspection of composites.

Standard Recommended Practice

Implementation of the Pipeline Inspection, Protection, Enforcement, and Safety Act of 2006 : hearing before the Subcommittee on Railroads, Pipelines, and Hazardous Materials of the Committee on Transportation and Infrastructure, House of Representatives, One Hundred Tenth Congress, second session, June 25, 2008.

The Pipeline Inspection, Protection, Enforcement, and Safety Act of 2006; Implementation Review and Discussion of Safety Assessment Intervals for Natural Gas Pipelines

Due to the poor conditions of wastewater networks, there is an increasing need in the capital investments allocated for enhancing their condition. As per the Canadian Infrastructures Report Card, one third of the total lengths of sewer pipes in Canada is in fair to very poor condition (Canadian Infrastructures Report Card, 2016). As such, there is an urgent need for inspection planning tools, with which decision makers could assess the condition of pipelines and identify pipes with higher risk of failure. These tools are potentially of service in prioritizing and optimizing inspection activities that lead to decisions regarding appropriate courses of action, especially in cases of limited resources and funding. The goal of this research is to develop an optimization model for scheduling the inspection of sewer pipelines by

performing defect-based risk assessment. The risk of failure is determined to identify critical pipe sections; by combining likelihood and consequence of failure values using the Sugeno Fuzzy Inference System. The developed optimization model determines the inspection sequence of pipeline sections in addition to optimizing the utilization of inspection crews by minimizing both time and cost of inspections. The risk assessment model is divided into two sub models: likelihood and consequences of failure. Structural and operational defects and pipeline characteristics in an existing sewage network are used to develop the likelihood model that determines the structural, operational and overall condition ratings of pipelines. Method-wise, Bayesian Belief Network (BBN) is used to develop a static condition assessment model using probabilities of occurrences and conditional probabilities. Moreover, time dimension is introduced to the developed BBN model using logistic regression as temporal links which are required to convert BBN into Dynamic Bayesian Network (DBN). The accuracy of the model's prediction is examined through referencing of actual data, where the Mean Absolute Error (MAE) and Root Mean Square Error (RMSE) for the BBN model are 0.67, 1.06, 0.56 and 1.05, 1.60, 0.95 for structural, operational and overall conditions, respectively. The second sub-model

representing the consequences of failure is developed to determine the impact of sewer pipelines' failure using Cost Benefit Analysis (CBA). Developing this sub model involves identifying and analyzing costs of failure and benefits resulting from avoiding such failures. In order to validate the CBA model, actual costs from a real failure incident are compared with the proposed model's outputs. During the implementation of the CBA model, it is found that the indirect costs resulting from sewer pipelines' failure represent a significant portion of the total failure costs. The proposed risk assessment model is validated using actual data derived from inspected sewer pipelines. Cost savings of around 67% could be achieved if the risk assessment model is applied and deployed over ongoing inspection practices followed by municipalities. A Mixed Integer Linear Programming (MILP) model is developed to optimize scheduling of inspection activities by including sewer sections, time and cost of inspections. This model is developed using GAMS and solved using CPLEX to maximize the number of sections and minimize time and cost. The output from the MILP model is compared to the results of another model solved using the Genetic Algorithm (GA) approach. It is found that the MILP model could perform better than the GA model in terms of optimal solutions. Additionally, a

resulting inspection cost reduction of approximately 38% could be achieved when utilizing the MILP model. It is expected that the proposed inspection scheduling model could help decision makers better assess the condition of sewer pipelines and improve their decision-making on proactive or reactive measures. The proposed model could help allocate budgets more efficiently in addition, to being an enabler for better inspection programs, particularly in cases of limited funds and task forces.

Inspection of the Sloka Branch Pipeline. Final Report

Implementation of the Pipeline Inspection, Protection, Enforcement, and Safety Act of 2006 and reauthorization of the Pipeline Safety Program: hearing before the Subcommittee on Railroads, Pipelines, and Hazardous Materials of the Committee on Transportation and Infrastructure, House of Representatives, One Hundred Eleventh Congress, second session, May 20, 2010.

Modeling and Control of a Tracked Mobile Robot for Pipeline Inspection

This book includes six chapters aiming to introduce global pipeline inspection and health monitoring technologies comprehensively. The pipeline is the blood vessel of the energy system and a vital lifeline project. After many years of service, the pipeline gradually enters the aging stage. Pipeline inspection and health monitoring can

effectively reduce the failure and accident risks of the pipeline, and it is conducive to integrity management. Through case analysis, practitioners can have a deeper understanding of the application of related technologies.

Pipeline Safety

Of the subject matter -- Testimony. Johnson, Hon. Carl T., administrator, Pipelines and Hazardous Materials Safety Administration, U.S. Department of Transportation, accompanied by Stacey L. Gerard, assistant administrator -- Sammon, John, assistant administrator for Transportation, Sector Network Management, Transportation Security Administration, U.S. Department of Homeland Security -- Scovel, III, Hon. Calvin L., Inspector General, U.S. Department of Transportation -- Prepared statements submitted by members of Congress. Brown, Hon. Corrine, of Florida -- Costello, Hon. Jerry F., of Illinois -- Cummings, Hon. Elijah E., of Maryland -- Larsen, Hon. Rick, of Washington -- Oberstar, Hon. James L., of Minnesota -- Prepared statements submitted by witnesses. Johnson, Carl T. -- Sammon, John -- Scovel, III, Hon. Calvin L.

Pipeline Pigging Technology

Low-cost Sensors for Natural Gas Pipeline Monitoring and Inspection: Appendices A-J

Innovative Sensors for Pipeline Crawlers

Pipeline Inspection Chart 2014 [chart].