ISSN 2320 - 2602

Volume 3, No.3, March 2014

International Journal of Advances in Computer Science and Technology

Available Online at http://warse.org/pdfs/2014/ijacst07332014.pdf

A Novel method of Replacing Manual Pipeline analysis with an automatic Image analysis and processing

A.Prema(1),Prof . Dr.Ramanmurthy(2),

(1).Research Scholar,Department of Computer Science,
Karpagam un iversity,Coimbatore,Tamilnadu
Email-id: unjanai@gmail.com

(2).Chairman and Head, Department of Computer Science and Mathematics,
Osmania University, Hyderabad
Email-id:mv.rm50@gmail.com

ABSTRACT

This paper provides the introduction to the proposed research work on image analysis. In this paper, the reasons to carry out this research work is discussed widely, with proper and necessary examples and sample pictures. At the end of this paper, the basic idea to do this research work is clearly understood.

Keywords:
Pipeline, Corrosion, Rusting, Fatigue cracking, pipe pressure, PIG, Raster Image, Existing pig, PNPN, unsupervised learning,

1. INTRODUCTION

Pipeline transport is the transportation of goods through a pipe. Most commonly liquids and gases are sent. As for gases and liquids any chemically stable substances can be sent through a pipeline. Therefore ,sewage water or even beer pipelines exists today, but the most valuable are those transporting crude petroleum and refined petroleum product including fuels, natural gas and bio-fuels.

1.1 How long does it run?

Generally such pipelines run for more than 1000kms, sometimes it crosses country's borders (Famous Alaska pipeline for example to say).These oil-pipelines exist for more than 100 years. When lifetime is counted, the quality of the pipeline has to be maintained by checking for corrosion, at given intervals of time, usually it is five years once. The common causes for oil-pipe defects are:

1. Corrosion
2. Exacavation Damage
3. Human Error
4. Material Failure
5. Natural Force Damage
6. Other outside force damage, this is shown in percentage

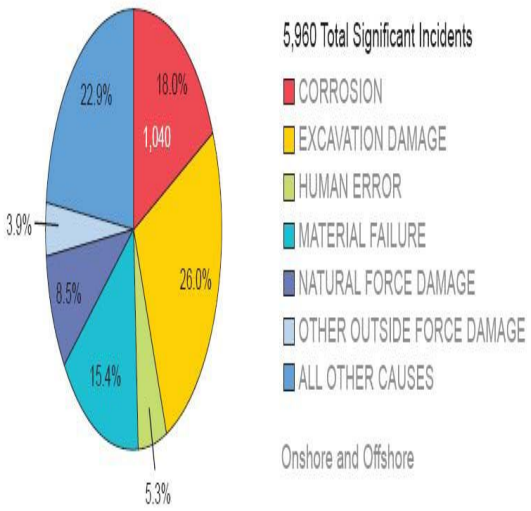


Figure 1: Pie diagram(Data Courtesy PHMSA filtered incident Files)

This report has been structured to address the following subjects:

- Description of the types of corrosion found on pipelines and the methods of management for each pipeline
- Current methods to assess the extent or severity of corrosion on an existing pipeline
- Standards and regulations governing pipeline corrosion inspection and management
- Methods used by the industry to manage the risk of corrosion

- Current research and development programs directed at developing better tools and methods to Manage corrosion, and identifying gaps that are not being addressed
- Elements of an effective corrosion integrity management program

2.WHAT IS CORROSION?

Corrosion [1] is the gradual destruction of materials, by chemical reaction with its environment. This means electro-chemical oxidation of metals in reaction with an oxidant such as Oxygen.

Rusting-the formation of Iron oxides is a well-known example of electro-chemical corrosion.

Many structural alloys corrode merely from exposure to moisture in air, but the process gets strongly affected by exposed to certain substances.

Corrosion can lead to form a Pit or Crack or it may affect a wide area of surfaces. A Pit or Crack, leads to oil-leakage which ends at making a great loss, to the oil world's income.

Figure 3: An example of general deep pitting corrosion with some pits joining to form larger pits and interconnected pitting.

Picture courtesy: www.eclipsesscientific.com

Corrosion and cracking on the external or internal surfaces of in-service pipes, tanks, or other industrial assets reduces the integrity of the material and potentially reduces the service life of the equipment.

This Research Work presents the types of defects encountered in the pipeline industry and the sizing methods that can be used for assessment of the defects.

This paper has been prepared to present an exclusive method to overcome this unavoidable condition of holes and cracks in an oil-pipeline.

2.1Cracking

Many forms of cracking exist in the various industries that utilize material and equipment susceptible to cracking.

Four types of mechanically and chemically assisted cracking that may occur in industrial equipment include:

- Fatigue cracking,
- Stress corrosion cracking,
- Hydrogen induced cracking, and
- hot hydrogen attack (Hoppenbrouwers, 2000)

Figure 2:Picture showing a crack in an oil pipe

Cracks may form as isolated cracks or within colonies. Cracking within colonies may result in the cracks on the periphery of the colony being deeper than the cracks at the centre of the colony. This may be observed because the effect of cracking within a colony environment may act as a stress relieving mechanism causing reduced crack growth for cracks located in the centre of the colony while the cracks on the periphery continue to grow.

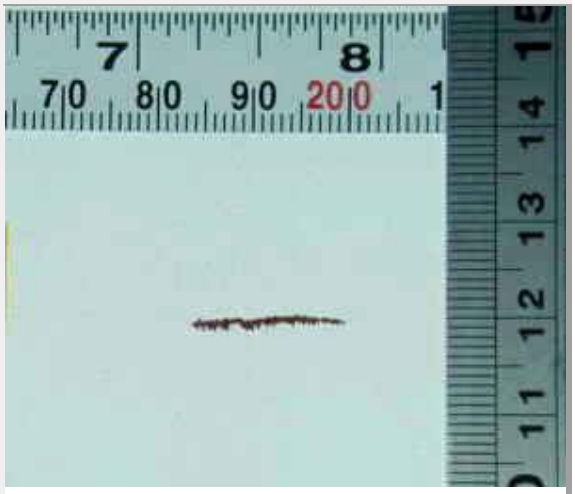


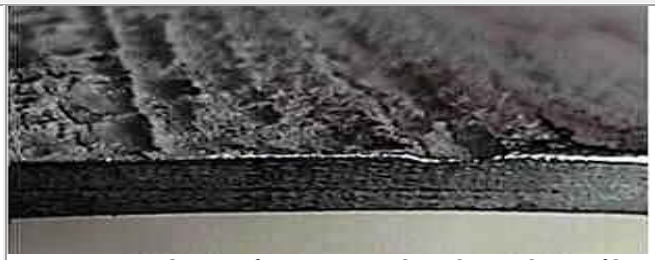
Figure 4:The scale measurement of a crack

Figure 5:Single and co-parallel cracks

Cracking within Corrosion

The combination of cracking within a corroded area is commonly seen in the field and represents a unique issue because when the crack depth is added to the depth of metal loss due to corrosion a significant indication depth can be obtained. A combined penetration depth of corrosion and cracking can lead to a significant total depth.

crack



A cross sectional view of corrosion and cracking. This profile illustrates that when the combined depth of the corrosion and cracking is considered a significant percentage of the total wall thickness may be lost.

Figure 6: Cracking may occur following corrosion paths as this photograph shows. Consequently, cracks may occur at varied angles relative to the pipe axis.

In situations where corrosion and cracking co-exist, same side sizing of the crack depths can still be achieved. The approach calls for the corrosion to be profiled followed by sizing of the crack. This type of sizing application presents certain problems due to the introduction of an irregular surface and typically requires automated post processing techniques to obtain the required information.

Figure 7:Picture showing how a crack is measured using a Ruler

3.IMPACTS OF CORROSION GLOBALLY AND IN INDIA

Degradation of pipelines is the result of the persistent attack by the environment on pipeline materials (coatings, welds, pipe, etc.). Buried pipelines are located within ever changing environmental conditions that may lead to a corrosive environment.
(Information are obtained from the report published by the National Energy Board in 1996 entitled "Stress Corrosion Cracking on Canadian Oil and Gas Pipelines")

Pipe Coatings

Buried pipe is coated to offer protection from the surrounding environment. A breakdown in the coating will result in pipeline metal being exposed. The material used for coating pipes varied over the years as technology evolved.

3.1 Pipe pressure[3]

Corrosion, in particular cracking, is related to the pressures exerted on the pipe. As the pressures within the pipe are increased, the growth rates for cracks also increase. The circumferential stress (hoop stress) generated by the pipeline operating pressure is usually the highest stress component that exists.

Cleaning and Coating

From the moment a pipe is coated with a Pipe clad fusion-bonded-epoxy coating, and installed into a harsh environment, maximum corrosion protection is assured. The unique chemical characteristics of our coating are carefully engineered for optimum protection of pipes.

Pipe clad fusion-bonded-epoxy coating protects against underground soil stress, bacteria and fungus attacks, soil acids and alkalis—as well as the corrosive elements associated with underwater use, including saltwater, wastewater, petrochemicals, solvents and corrosive gases.

These coatings are designed for application on a wide variety of pipe sizes and wall thickness and can be utilized as the corrosion layer for a single, dual and three layer applications.

3.2 Existing Pipeline Intervention Gadget(PIG)[2]

While buildup in a pipeline can cause transmittal slows or even plugging of the pipeline, cracks or flaws in the line can be disastrous. A form of flow assurance for oil and gas pipelines and flowlines, pipeline pigging ensures the line is running smoothly.

The maintenance tool, pipeline pigs are introduced into the line via a pig trap, which includes a launcher and receiver. Without interrupting flow, the pig is then forced through it by product flow, or it can be towed by another device or cable. Usually cylindrical or spherical, pigs sweep the line by scraping the sides of the pipeline and pushing debris ahead. As the travel along the pipeline, there are a number functions the pig can perform, from clearing the line to inspecting the interior.

Figure 8:A PIG

There are two main hypotheses for why the process is called "pipeline pigging," although neither have been proved. One theory is that "pig" stands for Pipeline Intervention Gadget. The other states that a leather-bound pig was being sent through the pipeline, and while it passed, the leather squeaked against the sides of the pipe, sounding like a squealing pig.

Figure 9: Debris after pigging

Similar to cleaning your plumbing line, **utility pigs** are used to clean the pipeline of debris or seal the line. Debris can accumulate during construction, and the pipeline is pigged before production commences. Also, debris can build up on the pipeline, and the utility pig is used to scrape it away. Additionally, sealing pigs are used to remove liquids from the pipeline, as well as serve as an interface between two different products within a pipeline. Types of utility pigs include mandrel pigs, foam pigs, solid cast pigs and spherical pigs.

Figure 10: Pipeline pig

Inspection pigs, also referred to as in-line inspection pigs or smart pigs, gather information about the pipeline from within. . The type of information gathered by smart pigs includes the pipeline diameter, curvature, bends, temperature and pressure, as well as corrosion or metal loss. Inspection pigs utilize two methods to gather information about the interior condition of the pipeline: magnetic flux leakage (MFL) and ultrasonics (UT).

MFL inspects the pipeline by sending magnetic flux into the walls of the pipe, detecting leakage,

corrosion, or flaws in the pipeline. Ultrasonic inspection directly measures the thickness of the pipe wall by using ultrasonic sounds to measure the amount of time it takes an echo to return to the sensor

Beause every pipeline is different, there is not a set schedule for pigging a line, although the quantity of debris collected in a pipeline and the amount of wear and tear on it can increase the frequency of pigging.

Today, pipeline pigging is used during all phases of the life of a pipeline. **Since it has to be carefully maintained and minor demerits of locating cracks are the main reason to replace this with a computerized tool(as discussed in this research paper)**

PIG is controlled by a Robot manually,whereas the research that is being done is a digitized camera,that can travel inside just like a PIG and sent pictures to the system's database and mathematical morphology is applied to find the defect.

3.3 WHAT IS OUR GOAL?

This paper is going to help us to find the defected parts in a coated pipeline, using a computerized program. A camera is sent inside the pipeline, where the pictures are taken and sent back to the system and it is stored in a database.

The camera travels to the entire length of a pipe, records the image for further study

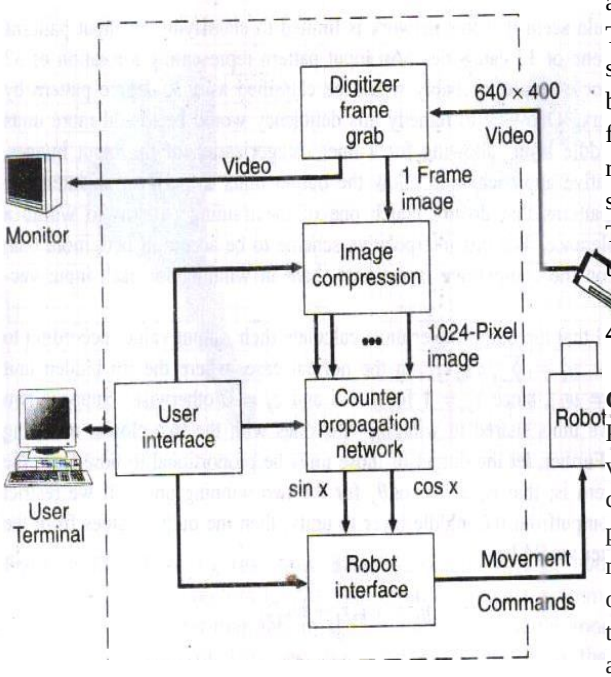


Figure 11:A schematic sketch of Robotic connection of the automatic process

The data in the database is analysed using an algorithm, where the pixel images which are converted to Raster images are read for defects.

4.RASTER IMAGES

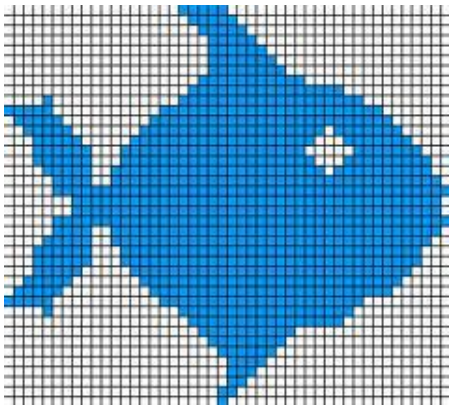


Figure 12:A Raster Display

A Raster image[4], also called a bitmap is a way to represent digital images. It can be created in a wide variety of formats, including the familiar .gif, .jpg, and .bmp. The image is represented in a series of bits of information that translate into pixels on the screen. These pixels form points of colour that create an overall finished image.

When a raster image is created, the image on the screen is converted into pixels. Each pixel is assigned a specific value that determines its colour. This format uses the red, green, blue (RGB) colour system. An RGB value of 0, 0, and 0 would be black, and the values go all the way through to 256 for each colour, allowing the expression of a wide range of values. In photographs with subtle shading, this can be extremely valuable.

The algorithm used for investigations is an unsupervised learning algorithm.

4.2 What is GTO?

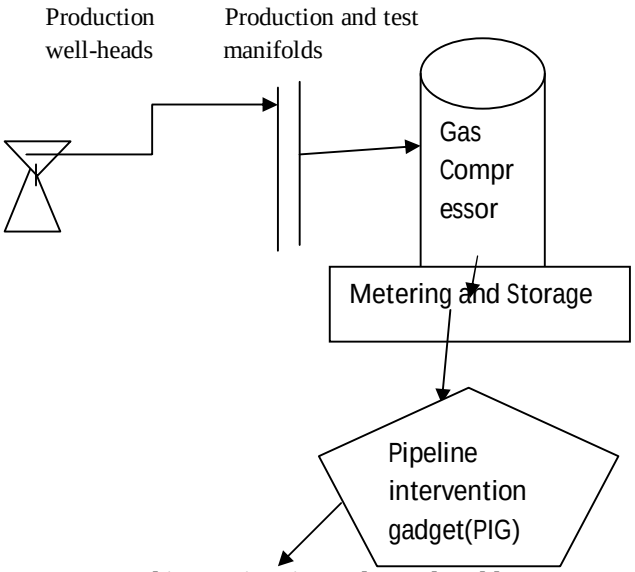
Gate turn-off thermistors (GTOs) are four-layer PNPN devices that act as switches, rectifiers, and voltage regulators. Like other **thermistors**, GTOs can be turned on by the application of a positive **gate** signal (g > 0); however, unlike other more conventional devices that can be turned off only at a zero crossing of current, GTOs can be turned off at any time by the application of a **gate** signal equal to zero.

GTO's are used here to record the values of the clustered image that occurs due to corrosion These

values are stored in the database for further investigations.

Figure 14:A Pipeline Inspection done manually

OIL AND GAS PRODUCTION PROCESS



This PIG is going to be replaced by our Research Model

Figure 13:The exact process

Implementing Unsupervised algorithm[5]

In machine learning, **unsupervised learning** refers to the problem of trying to find hidden structure in unlabelled data. Since the examples given to the learner are unlabelled, there is no error or reward signal to evaluate a potential solution.

This distinguishes unsupervised learning from supervised; learning and reinforcement learning.

Unsupervised learning is closely related to the problem of density estimation in statistics. Approaches to unsupervised learning include:

i.Clustering (e.g., k-means, mixture models, hierarchical clustering),

ii.Blind signal separation using feature extraction techniques for dimensionality reduction

Among neural network models, the self-organizing map (SOM) and adaptive resonance theory (ART) are commonly used unsupervised learning algorithms.

Study

Implementation for this paper starts with the pixel reading, the data in the database is read, and each and every pixel is verified using the unsupervised algorithm. During pixel examination, even a small error or blurred image, whose pixels are stored as mismatched data, are identified and they are further studied to find the defected part in the pipeline.

If there is a hole or a crack in the pipeline, the pixel image is not a clear one, the image is not visible properly and the data stored as pixel bits, will show the level of the defect with the help of the density of the bit-map or Raster image. The step by step process carried out by the algorithm:

Process 1: Evaluate the entire pipeline and save the images

Process 2: Convert the images in to Raster type images using the algorithm

Process 3: Feed the pixel data in to the database

Process 4: Read the data using Mathematical morphology to find the defects

Process 5: Match the data with the bit-maps to find out the exact location of the defects

Process 6: Convert the defected Raster image to normal images using modal analysis to rectify the defects in the pipeline,to proceed further:

CONCLUSION

In the light of the above mentioned description of the various aspects of Oil pipeline related issues, both technically and economically, a referral problem is formulated with specific Objectives, related to the application of Image processing to this problem.

REFERENCES

1.Oil and gas production handbook(An introduction to oil and gas production) [2006-2009,ABB oil and gas]

2.Difficult to PIG pipelines by David Wint,Global services

3. NACE RP0102-2002 In-Line Inspection of Pipelines

4.Computer Graphics by D.Hearn for Raster images

5.Unsupervised learning from Neural network by TDSanger

6.Pictures courtesy: www.ppsa-online.com, www.pipeline-pigging.com

7. S. Dey. SD-EI: A Cryptographic Technique To Encrypt Images. In Proc. Of IEEE international conference in Cyber Security, Cyber Warfare and Digital Forensic, pp. 28-32, Jun 26-28, 2012.

8.G. M. Priya and P. V. Kumari. Compression of Quasi-Group Encrypted Grayscale Images. International Journal of Scientific and Research Publications, vol. 2, No. 7, pp. 1-4, July 2012.

9. S. S. Kumar and H. Mangalam. Wavelet-based Image Compression of Quasi Encrypted Grayscale Images. International Journal of Computer Applications (0975 – 8887), vol. 45, No.12, pp. 35-39, May 2012.

10. R. Ye. A novel chaos-based image encryption scheme