RAMAIAH
Institute of Technology

DEPARTMENT OF ELECTRONICS AND COMMUNICATION

FINAL-YEAR PROJECT

TITLE: Signal Processing Approaches for Noise Reduction in Pulsed Thermography

SUBMITTED BY:

SATHVIK UDUPA	1MS15EC090	7760947325
TANVI KHANDELWAL	1MS15EC116	9886608681
VARUN ITTIGI	1MS15EC123	8867390418

PROJECT GUIDE:

Dr S Sethu Selvi, HOD E & C

Dr Sharath D, Research Scientist CIT

ABSTRACT

Introduction:

After implementing non-destructive testing on pipelines, we decided to continue working in the same domain. Our mini project detected the presence of defects in pipelines exposed to its surroundings. This was done by taking images of pipeline and passing it to the deep learning model which classified it as defected or not. We decided to work further on subsurface defects with new techniques, called Pulsed Thermography.

Conventional NDT techniques like Radiography Technique, Ultrasonic Technique, Magnetic Particle Techniques etc., have limitations in detecting near surface defects and its depth estimation. Hence, in recent years focus has been shifted towards advanced NDE techniques and signal processing approaches for better defect characterization. Pulse Thermography is one such technique which is being widely used for defect and material characterisation. In this study, we decided to use pulse thermography technique for defect characterisation in stainless steel material.

Objective:

To implement signal processing approaches in pulse thermography techniques for noise reduction in stainless steel material.

Problem Statement:

Different materials like metals, composites, ceramics etc., are used as structural materials in various industries like aerospace, petrochemical, nuclear power sector etc. It is important to inspect such structural components before and during their service for the presence of defects, because of these defects, if undetected may lead to premature failure of the components. Pulsed thermography being a non-contact and fast inspection technique is suitable for detecting subsurface defects. In pulsed thermography, getting good SNR from the raw signal is essential and is a challenging task. Hence, a dedicated signal processing algorithm needs to be developed for getting good SNR and better defect visualisation.

Proposed Solution:

For the present study, we have considered pulse thermography data of standard 316L stainless steel material obtained from IGCAR, Kalpakkam, which are one of the important structural materials used in the nuclear industry. Different signal processing approaches reported in the literature will be applied to the raw pulse thermography data. Then we will apply various deep learning algorithms on raw pulse thermography data, and compare the results with reported methods. After the comparison, the appropriate method will be selected, which will be used for analysing various stainless steel pulsed thermography data of actual components.

REFERENCES

[1] Muhsin Hassan, Rajprasad Rajkumar, Dino Isa, Roselina Arelhi,"Pipeline Defect Classification by Using Non-Destructive Testing and Improved Support Vector Machine Classification", International Journal of Engineering and Innovative Technology (IJEIT) Volume 2, Issue 7, January 2013.

[2] Ahmad Khodayari-Rostamabad, James P. Reilly, Natalia K. Nikolova, James R. Hare and Sabir Pasha, "Machine Learning Techniques for the Analysis of Magnetic Flux Leakage Images in Pipeline Inspection" IEEE Transactions on Magnetics 45(8):3073 - 3084 · September 2009.

[3] Advances in pulsed phase thermography X. Maldague *, F. Galmiche, A. Ziadi (2002).

[4] Defect characterization in pulsed thermography: a statistical method compared with Kohonen and Perceptron neural networks S. Vallerand, X. Maldague*(2000).

[5] Infrared thermography processing based on higher-order statistics. Francisco J. Madruga, Clemente Ibarra-Castanedo, Olga M. Conde, José M. Lo pez-Higuera,Xavier Maldague (2010)

[6] Optimization of pulsed thermography inspection by partial least-squares regression. Fernando Lopez,Clemente Ibarra-Castanedo,Vicente de Paulo Nicolau,Xavier Maldague (2014).

[7] Principal component thermography for flaw contrast enhancement and flaw depth characterisation in composite structures.N. Rajic (2002).

[8] Pulsed phase thermography reviewed.Clemente Ibarra-Castanedo & Xavier Maldague (2004).

[9] Reconstruction and enhancement of active thermographic image sequences (Jan 21, 2003) Steven M. Shepard, James R. Lhota, Bruce A. Rubadeux, David Wang, Tasdiq Ahmed.