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Improvement of Weld Images using MATLAB –A Review

[1]A.P.Nagarajan., [2]Christy V.Vazhappilly, [3]Sukesh O.P., [4]Vivek Rajdhan J., [5]Rajavelu.S., [6]Prashanthkumar.S.

[1]*Assistant Professor, Dept.Of Mechanical Engineering, Tamilnadu College of Engineering, Tamil Nadu, India.*
[2,3]*Assistant Professors, Dept.Of Mechanical Engineering, Jyothi Engineering College, Kerala, India.*
[4, 5,6]*PG-Scholars, Dept.Of Mechanical Engineering, Kumaraguru College of Technology, Tamil Nadu, India.*

Abstract *:- In recent years, gamma rays are been used as an improvement method or a tool along with the combination of image processing technique. It has been giving out better result in the detection of any flaws, or hole in case of the weld metal images and they are being adapted and improved ever since. Image processing is the vast area that has its roots in various fields and some of the important areas, where they have been used are in x-ray image, gamma rays and biometrics (iris & fingerprint) using the template matching technique. The radiography test is done using gamma rays for the given input expecting to display the places that has been affected or the ones with flaws in case of a welded metal, using the met lab technique, such as fuzzy and edge detection methodologies along with the filtering process called a gabor filter which is expected to provide corresponding result which is known as a film that is to give better output. The fuzzy technique is the one that has the attention as of know by all the researches since is known exact result like true or false value it can instead provide a degree of results sounds in between range of values as into help with detection of flaws and noises like the salt and pepper (black and white) error that appears in the image (weld image) this type of error may reduce the quality of weld metal image with a usage of fuzzy method the degree of errors are stated. The edge detection is another technique in image processing that detects the outer surface of the weld image perfectly like the active contours and canny operators, along with its own method and pre-processing are smoothing while segmentation is used to state the different region of the image and how they are split and are helpful to define the region that are with defects. The Gabor filter that is used in edge detection is said filter how the defects of the weld image that is given.*

Keywords: - *Radiographic images, Image processing, MATLAB*

I. INTRODUCTION

I.1 Radiography testing

Radiography is a Non Destructive Testing method to find out internal discontinuities present in a component or assembly. It is based on differential absorption of penetrating radiation by the part being inspected. A radiograph is a photographic record produced by the passage of x-rays or gamma rays through a test specimen on to a film, the radiography with x and gamma rays are called conventional radiography. It is most widely practiced by industry for quality control of welds, casting and assemblies.

I.2 Gamma Rays

Gamma rays are produced by natural and artificial radioactivity. Natural radio activity was discovered by Henri Bequeral in 1896. The phenomenon of spontaneous emission of powerful radiations exhibited by heavy elements is called radio activity. Those elements which exhibit thus activity arc called radioactive elements. Eg: uranium, Polonium, Radium, Radon, Thorium, 10 Actinum and mesothorium.

Radio activity is confined almost entirely to the heaviest element from 83 to 106. The phenomenon of spontaneous emission of highly penetrating radiations from heavy elements of atomic weights greater than about 206, occurring in nature, is called natural radio activity. The elements which exhibit this property are called radioactive elements. The atoms of radioactive elements emit radiations composed of three distinct kinds of rays i.e. X, □ and □. Radio activity is unaffected by any external agent like high temperature high pressure, large electric and magnetic fields etc., Radio activity induced in an element by bombarding it with particles neutrons, protons and other particles or radiation is called artificial radio activity. The artificial radioactive elements usually, but not always, have short life times. They emit electrons/positions and gamma rays.

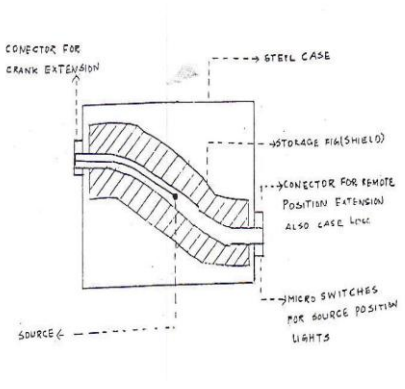

Figure.1. Instrumental Setup

II. EXPERIMENTAL PROCEDURE

II.1 Image Formation

i) Penetration & Differential Absorption

X-and gamma rays posses the capability of penetrating materials, even those that are opaque to light. In passing through matter, some of those rays are absorbed. The amount of absorption at any point is dependent upon the thickness and density of the matter at that point; therefore the intensity of the rays emerging from the matter varies. When this variation is detected and recorded, usually on film, a means of seeing within the material is available.

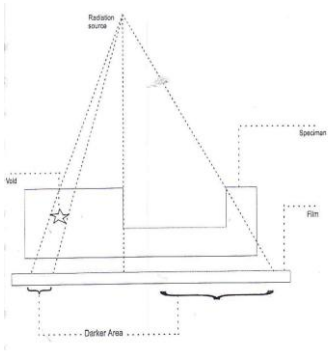

Figure.2. Source 1

Radiography consists of using the penetration and differential absorption characteristics of radiant energy to examine material for internal discontinuities. Figure.4 illustrates the absorption characteristics of radiation as used in the radiographic process. The specimen absorbs radiation but, where it is thin or where there is a void, less absorption takes place. The latent image produced in the film, as the result of the radiation passing through the specimen, when the film is processed. Since more radiation passes through the specimen, in the thin and void areas, the corresponding areas of the film are darker.

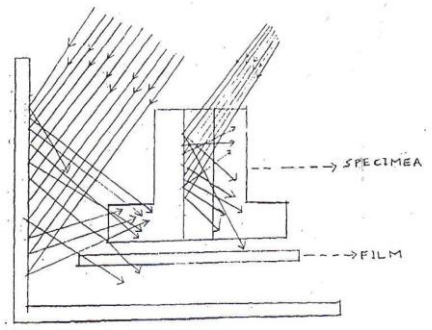

Figure.3. Source2

II.2 Image Processing

i) Filter (Signal Processing)

Filter is a device or process that removes from a signal some unwanted component or feature. Filtering is a class of signal processing, the defining feature of filters being the complete or partial suppression of some aspect of the signal. Most often, this means removing some frequencies and not others in order to suppress interfering signals and reduce background noise. However, filters do not exclusively act in the frequency domain; especially in the field of image processing many other targets for filtering exist. Correlations can be removed for certain frequency components and not for others without having to act in the frequency domain.

There are many different bases of classifying filters and these overlap in many different ways; there is no simple hierarchical classification. Filters may be:

- Linear or non-linear
- Time-invariant or time-variant, also known as shift invariance. If the filter operates in a spatial domain then the characterization is space invariance.
- Causal or not-causal: depending if present output depends or not on "future" input; of course, for time related signals processed in real-time all the filters are causal; it is not necessarily so for filters acting on space-related signals or for deferred-time processing of time-related signals.
- Analog or digital
- Discrete-time (sampled) or continuous-time
- Passive or active type of continuous-time filter
- Infinite impulse response (IIR) or finite impulse response (FIR) type of discrete-time or digital filter.

ii) Edge Detection

Edge detection provides an intrinsically more rigorous means than thresholding for initiating image segmentation. However there is a large history of ad hoc edge detection algorithms, In fact edge detection has long been an alternative path to image segmentation and is the method pursued whichever way is inherently the better approach, edge detection has the additional advantage in that it immediately reduces by a large factor the considerable redundancy of most image data.

Edge detection is the name for a set of mathematical methods which aim at identifying points in a digital image at which the image brightness changes sharply or, more formally, has discontinuities. The points at which image brightness changes sharply are typically organized into a set of curved line segments termed edges. The same problem of finding discontinuities in 1D signal is known as step detection and the problem of finding signal discontinuities over time is known as change detection. Edge detection is a fundamental tool in image processing, machine vision and computer vision, particularly in the areas of feature detection and feature extraction.

The purpose of detecting sharp changes in image brightness is to capture important events and changes in properties of the world. It can be shown that under rather general assumptions for an image formation model, discontinuities in image brightness are likely to correspond to

- discontinuities in depth,
- discontinuities in surface orientation,
- changes in material properties and
- Variations in scene illumination.

III. RESULTS AND DISCUSSIONS

III.1 Method of data analysis

In the paper, the images are analyzed in quantitative way using the computer, with the platform of MATLAB.

Image processing toolbox™ in MATLAB provides a comprehensive set of reference standard algorithms and graphical tools for image processing, analysis, visualization, and algorithm development.

It can perform image enhancement, image deblurring, feature detection, noise reduction, image segmentation, geometric transformations, and image registration.

III.1.1) Main work

During this section, it devotes to find an appropriate image processing technique to apply in welding inspection, which helps for practitioners of the welding industry to improve inspection efficiency of defects recognition. On the other hand, the fact is that general and traditional image processing technology can't solve all the problems. It contributes to propose the improved image processing theory or algorithm to solve some the difficulties, which is regarded very useful for academics working with image processing because the development of image processing theory or algorithm can be further studied by those academics to use and apply widely in other areas.

During our experiments research, we main task is to answer how image segmentation and image enhancement applied in welding inspection and which one of these two shows good performance to be helpful for defects recognition.

Image segmentation is divided into three segmentation methods such as thresholding, clustering and edge detection. We plan to do the experiments all of these three method to see the evaluation performance of them. Threshoulding is regarded a fast and simple method to classify and segment the image information of the welding inspection films. It is widely used to fast image segmentation during general image processing.

Clustering is a specific segmentation method because it can classify the characteristic of the pixels by measuring their similarity. The characteristic of the pixels may be the gray scale, room space information and so on. It is used to segment images for good recognition during image processing.

Edge detection is the method more concerning about edge processing. Welding inspection films always have much detail information around the edges which is important to defects recognition. It is used to catch the detail information of edges for good recognition during image processing.

Image enhancement method such as denoising, histogram equalization does more working to enhance the concerning features noised by the psychical and external factors during image processing.

We collect the testing sample from actual images of welding detection for 2004 in Sinopec Pipeline Storage and Transportation Company. The actual images are stratified by the category of welding defects. We collect testing images from every category, especially in pore, crack, incomplete penetration and incomplete fusion, which is as followed:

Figure.4. Pore

Fig.5. Crack

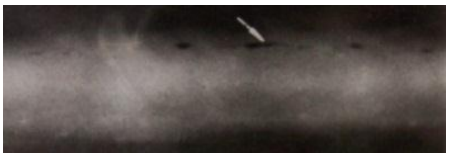

Figure.6. Incomplete fusion

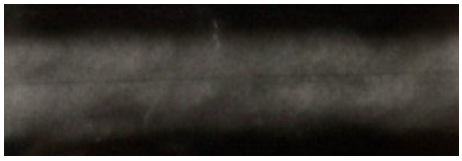

Figure.7. Incomplete penetration

III.1.2 Thresholding

a) Otsu' method

In MATLAB, Function: level=graythresh (I), it computes global image threshold using Otsu's method. The function uses Otsu's method, which chooses the threshold to minimize the interclass variance of the black and white pixels. The Figure.7 shows the segmented result of pore in group 1 using Otsu' method and the others will be shown in related appendix files.

Figure.7.1 Otsu' method

b) Histogram thresholding

The Figure shows the segmented result using Histogram thresholding and the others will be shown in related appendix files. Histogram thresholding is based on selecting the middle gray value as the threshold value between the two peaks.

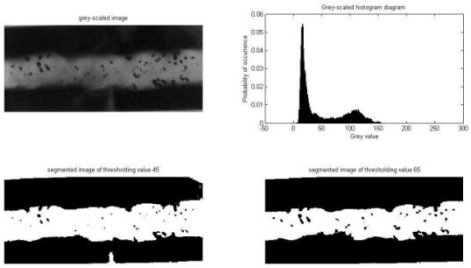

Figure.7.2 Histogram thresholding

III.1.3 Clustering

c) K-means clustering

In K-means algorithm, we firstly initiate cluster centers and then decide the number of iteration by a lot of tries to get the good quality of segmentation. The Figure 8 shows the segmented result using K-means clustering and the others will be shown in related appendix files.

Figure.8. Fuzzy C-means clustering

In MATLAB, algorithm of fuzzy C-means clustering is illustrated in the Figure 8.1 Each pixel point is clustered by initial cluster centers and then cluster centers are updated by loops. Seen in the following figure, variable of ttFcm is used to control the loop process.

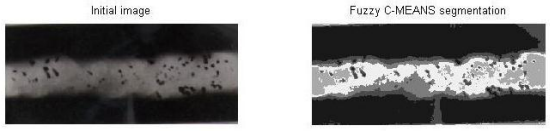

Figure.8.1 Fuzzy C-means segmentation

The traditional FCM clustering can shows good quality of image segmentation. But it is hard to present the segmentation results in terms of gray scale. Therefore, here is to propose an improved algorithm – Gray-scale based FCM clustering to present pixels segmentation. On the basis of the traditional FCM clustering, the use of the neighborhood pixel gray similarity to construct a new membership function, image clustering segmentation. This method not only effectively suppresses noise interference, and the wrong classification of pixels is easily rectified.

It is to generate new clustering center based on neighborhood pixel gray similarity. The Figure 10 shows the segmented result using Gray-scale based Fuzzy C-means clustering and the others will be shown in related appendix files.

III.1.4 Edge detection

For the gradient magnitude methods (Sobel, Prewitt, Roberts), thresh is used to threshold the calculated gradient magnitude. The Canny method applies two thresholds to the gradient: a high threshold for low edge sensitivity and a low threshold for high edge sensitivity. Edge starts with the low sensitivity result and then grows it to include connected edge pixels from the high sensitivity result. This helps fill in gaps in the detected edges.

The Figure 9 shows the segmented result using edge detection and the others will be shown in related appendix files. By comparisons with segmented results, we can see image detected by canny operator has complete and meticulous edge, which is illustrated in Figure 11. Based on qualitative evaluation, canny operator is better at detecting the edges than other three.

Figure.8.2 Edge detection

Application solution of image segmentation is as followed, which is also performed in Figure,

Figure.9. Initial image

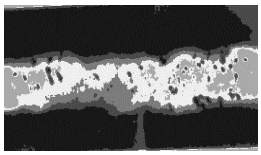

Figure.10. Gray-scale based FCM clustering

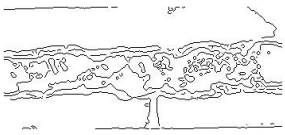

Figure.11. Canny edge detection

IV. CONCLUSION AND FUTURE WORK

We design experimental studies to research on the application of image segmentation in photoreceptor ray film of the ray inspection of welding. We take sampling as the method of data collection and then do data analysis by MATLAB. Data analysis contains subjective evaluation on application of image segmentation and objective evaluation on application of image enhancement.

"What is the current research situation of the ray inspection of welding?" and sub question "What is the current research situation of the image segmentation such as application situation, research history and so on?" It introduces the current research situation of welding ray detection in the first part. Shirai (1969) devotes to research on an algorithm for

Automatic inspection of X-ray photographs and Alaknandea et al (2006) pay more attentions on how to find the type of flaw and its causative factors. In addition, it describes current research situation of image segmentation in the second and third part. It gives the research history and application situation of popular image segmentation method such as thresholding, clustering and edge detection.

We find the answer about sub question "Could a solution for ray inspection of welding be proposed based on current theory within the field". We propose proposed solution of image segmentation or image enhancement application in ray inspection of welding.

We successfully answer sub question "How does our proposed solution for applying image segmentation perform in practical experiments?". We do feasible and performance analysis on our proposed solution of image segmentation or image enhancement application in ray inspection of welding. It is found that application of image segmentation is verified suitable to apply on photoreceptor ray film for ray inspection of welding. The comparison result between image segmentation and image enhancement.

a) Initial image, b) FCM clustering, c) edge detection, d) Image enhancement,

Figure. 11 Comparison result between image segmentation and image enhancement

Application of image segmentation is more competitive than image enhancement because that:

1. Gray-scale based FCM clustering of image segmentation performs well, which can exposure pixels in terms of grey value level so as that it can show hierarchical position of related defects by grey value.
2. Canny detection speeds also fast and performs well, that gives enough detail information around edges and defects with smooth lines.
3. Image enhancement only could improve image quality including clarity and contrast, which can't give other helpful information to detect welding defects.

After answering all the sub questions, main question can be answered. We get our conclusion that image segmentation is suitable to apply on photoreceptor ray film for ray inspection of welding.

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