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organized as follows. Section II deals with the methodology

and Section III describes results and discussions followed by

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II. METHODOLOGY

The weld extraction is the first step in the development of
defect detection and classification systems for weld

radiographs. Much effort has been made to automate

the process of defect segmentation and detection with the

assistance of digital image processing techniques. Segmentation of weld defects is the most crucial part in
defect detection to ensure defects do not ‘escape’ from the

segmented image. In addition, radiographic images often


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An Innovative Method for Defect Detection in

Digital Radiography Images

Dr. T. Srikanth, Dr. V. Kamala

Abstract—The process of detecting the weld defect plays a

vital role in the Non Destructive Testing (NDT) filed. An

Innovative method for extraction of defects in digital

radiographic welding images using mathematical morphology

is proposed in the present paper. The proposed algorithm initially

uses Wiener filter for enhancing the input weld image. Then

the

Raleigh probability distribution function is used to highlight

the
defects and the boundaries of the weld region. Next

mathematical morphological top-hat transformation is used to

extract the defects existing in the input weld image. Then, the

Otsu’s global threshold method is used for binary conversion

and the morphological opening followed by closing operations

is used to smooth the detected defects. The experimental results

clearly exhibit the efficacy of the proposed scheme.

Index Terms— Closing, Opening, Otsu’s Method, RPDF,

Top-Hat, Wiener Filter.

I. INTRODUCTION

Non Destructive Testing (NDT) is the technique of

identifying the properties of material without making any

damage. In the field of non destructive testing (NDT), the

most important stage concerns the detection of welding

defects. This could be very hazardous when dealing for

example with rail roads, gas pipes, wheels, etc. Fortunately,
radiography remains among the most adapted NDT

processes for the control of welds of metallic pieces, because

of its simplicity and its speed of implementation. In parallel,

the development in the field of information technologies in

particular in image processing, made it possible to invent

new radiographic inspection methods able to detect and

identify automatically welding defects by increasing the

quality of information while decreasing diagnosis duration.

Ioannis Valavanis et al. [1] presented a method for detecting

discriminating discontinuities in the weld images that

may correspond to false alarms or defects such as worm

holes, porosity, linear slag inclusion, gas pores, lack of fusion

or crack. Juan Zapata et al. [2] described an

adaptive-network-based fuzzy inference system to recognize

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assistance of digital image processing techniques. Segmentation of weld defects is the most crucial part in
defect detection to ensure defects do not ‘escape’ from the

segmented image. In addition, radiographic images often
contain noise. Inappropriate techniques may lead to the escape of defects. Image processing operations improve the qualities of an image. They can be used to improve an image’s contrast and brightness characteristics, reduce its noise contents, or sharpen it details. The wiener filter can be defined as a Mean Squared Error optimal stationary linear filter for images degraded by additive noise and blurring. It not only performs the deconvolution by inverse filtering (high pass filtering) but also removes the noise with a compression operation (low pass filtering). So, the present paper first applies preprocessing technique by using an adaptive 7×7 Wiener filter. After preprocessing the input radiographic weld image, the next important step is to detect the weld region where this weld region consists of defects. To detect this region, the present paper used Raleigh Probability Density Function (RPDF). The RPDF of the input image is computed by the Equation (1).

\[
\text{RPDF}(x, y, \mu) = \frac{I(x, y)}{\mu^2} \left(1 - \frac{I(x, y)}{\mu^2}\right)
\]

(1)

Where I(x,y) is the pixel value at location (x,y), \(\mu\) is the mean of the input image. The RPDF is computed for each pixel value of the preprocessed weld image and the weld region is extracted. From the extracted weld region, the defects existing in the weld region are obtained by applying mathematical morphological operations. Mathematical morphology is well suited for handling geometrical structures of the input image. The present paper uses morphological Top-Hat transformation. Combining image subtraction with opening results is called top-hat transformation. An important use of top-hat transformations is in correcting the effects of non uniform illuminations. Next, the Otsu’s global thresholding method is applied to detect the weld defect. On the binary thresholded image, the opening followed by closing operation is applied to smooth the detected weld defect.

III. RESULTS AND DISCUSSIONS

The proposed algorithm is tested on various defective radiographic weld images. In this paper the results of three weld defective images are presented. The stepwise results of the proposed method for defect detection are shown in Fig. 1 to 3. The results clearly indicate that by applying wiener filter, noise is removed and the dark portions are enhanced in the input image. By the second step of applying RPDF operation, the weld defects and boundaries of the weld region are obtained. Then by using morphological top-hat transformation, the boundaries of the weld region are suppressed. Then the defects in the input weld image are given by the binary image computed by Otsdu’s global threshold method. Finally with the opening followed by closing morphological operation, fine interior defective weld segments are identified.

Fig. 1 Step By Step Results Of The Proposed Defect Detection Algorithm For Image 1 (A) Original Image (B) Wiener Filter (C) RPDF (D) Top-Hat (E) Binary (F) Opening-Closing.

Fig. 2 Step by step results of the proposed defect detection algorithm for Image 2 (a) original image (b) Wiener Filter (c) RPDF (d) Top-hat (e) Binary (f) Opening-Closing.
IV. CONCLUSION

The present paper proposes an innovative method for extraction of defects in digital radiographic welding images. The proposed method detects various types of defects and improves the computation complexity efficiency by using morphological operations. The future enhancement consists of quantifying the detected defect in the weld region with feature vector for classifying the defected weld images.

REFERENCES


