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An improved version of Otsu's method for segmentation of weld defects on X-radiography images

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ABSTRACT

It is highly desirable to increase the accuracy of automatic weld defect detection in X-radiography for non-destructive testing and evaluation. For this purpose, a machine vision method is proposed for weld defect segmentation, using the Least Probability Weighted Background Group (LPWBG), an improved version of Otsu's method. This automatically selects a desired threshold value for segmenting the weld defects by adapting the Weibull distribution. The least non-zero probability value of gray-levels of the whole image has been considered as a weighted parameter of the background group of Otsu's within-class criterion. It has been determined that the resulting threshold value will always lie at the left bottom side of the unimodal distribution, especially when the defects are smaller than the background area. Existing approaches such as Otsu's threshold, valley-emphasis, neighborhood valley-emphasis, and weighted object variance have similarly been tried and compared with the proposed method. Our results establish that the proposed method provides satisfactory segmentation results over the others. The performance of the LPWBG method has been both evaluated and compared, using Misclassification Error measure (ME) with significant results.

1. Introduction

Defects are unavoidable during the welding process of materials. Non-destructive inspection of weldments is crucial to ensure the quality of the welds. Visual, ultrasonic and X-radiography techniques are among the most widely used non-destructive testing (NDT) techniques. However, due to subjectivity and complexity of manual assessment, automated detection of defects in weld X-radiography is preferred. In this regard, X-radiography testing of welds through machine vision is an effective approach, which is capable to avoid false assessment. Automated detection of weld defects using image segmentation is challenging because the radiography images have different characteristics such as contrast, presence of noises, and the small size of defects with varying intensities. In this paper, we focus on segmentation of defects, which is smaller than the background area in an X-radiography image.

Digital image processing techniques are employed on such images to segment the objects from the background [1,8]. One of the basic approaches to segment an image is the selection of suitable threshold based on intensities. Sezgin and

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