

A Method of weld Edge Extraction in the X-ray Linear Diode Arrays

Real-time imaging

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Abstract

The weld edge extraction could decrease computation, avoid complex background processing and reduce computing time , so improve the efficiency of detection for internal weld deflections analysis of the Linear Diode Arrays real-time imaging. The adaptive median filtering is used to decrease noise for real-time weld image. Which the variance ratio of interclass and intraclass segmentation is applied to segment weld region by comparing with Sobel operator, Canny operator and iterative methods, Finally, the edge tracking is applied for the binary image, so weld image was extracted. Simulation results indicated that the adaptive median filtering effectively removes noise , and maintain the edge details of weld and deflection image; the variance ratio of interclass and intraclass segmentation could accurately distinguished between the welded metal and the base metal ;Edge tracking can get continuous weld image contours, finally weld image was accurately extracted according to the obtained results.

Keywords: real-time imaging ; weld image; The adaptive median filtering; the variance ratio of interclass and intraclass segmentation; edge tracking

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1. Introduction

X-ray digital real-time imaging detection technology has been widely used with its quick speed, high sensitivity, low cost characteristics and so on. A method of weld image extraction is proposed which based on the Linear Diode Arrays detector, its significance lies in which it can reduce Computation and avoid complex background processing, reduce computing time, and to improve the efficiency of detection for further analysis of the weld internal defects. The Matlab software is used to simulate the results.

2. Image decreasing noise

Because the images of X-ray digital real-time imaging is a real-time and dynamic, the image is subjected to a variety of conditions constraints which has low contrast, fuzzy and image details were submerged by the noise characteristics^[1] and so on, which has affected the results of weld analysis and assessment, therefore it is necessary that the image is decreased noise before the weld is extracted image. Generally, the filter processing has two requirements: one is making the image clear, another is that it doesn't damage the useful contours and edge information of the image. The adaptive median filtering can not only remove random and impulse noise, reduce distortion such as refined or rough of boundary, but also protect the detail when non-impulse noise is decreased.

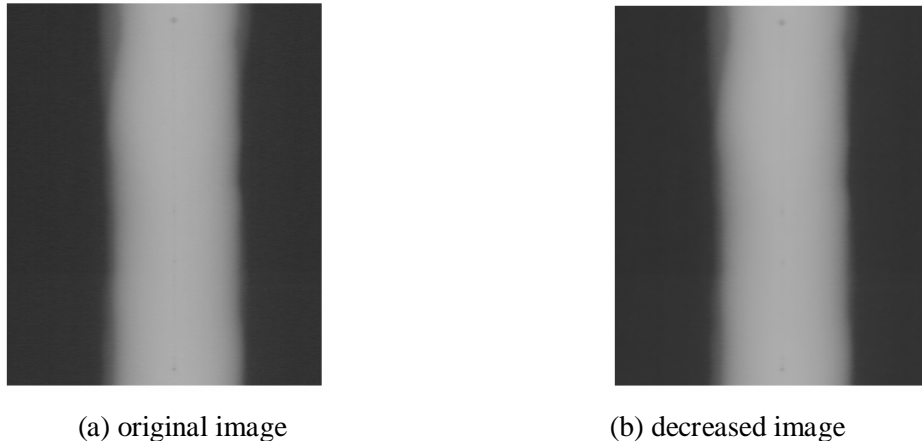


Fig.1 original image and decreased image

3. The method of weld edge extraction

The threshold and edge detection method of image processing has been holden the important status in the image segmentation application because of its intuitive and the simplicity. In this part Sobel operator, Canny operator, iterative method and the variance ratio of interclass and intraclass segmentation are compared in order that identifies suitable weld extraction method.

3.1 Sobel and Canny operator

Sobel operator determines the template through the partial derivative of horizontal and vertical direction.

John Canny proposed marginal check's three criterion^[2]: first, fine examination ability; second, the fine localization performance; third, it only has a response in corresponds the sole edge. canny operator uses the double thresholds value to identify the image threshold value, thus definite edge.

3.2 the variance ratio of interclass and intraclass segmentation and the iterative method

The variance expresses the statistics of the data distribution disproportionality, so two separate issues can be segmented by the variance through choosing the suitable gray threshold value. Usually the identical kind of question has a certain similarity, namely the variance is small, two different data variance is big, therefore the choice threshold value should cause the variances to be as far as possible big during two kinds of data, and causes the identical kind of question between the data variance to be as far as possible small. the variance ratio of interclass and intraclass segmentation is just segmented basing on this principle.

The iterative method chooses an approximate value as an initial value of the estimated, carries on the segmentation to produce the sub-image, a new threshold value is chosen according to the characteristics of sub-image, and then the new threshold value is used to segmented image, finally the wrong image pixel is fallen few after several cycle.

3.3 Simulation analyse

Simulation results using the Matlab software according to the above method are as follows:



(a) Sobel operator edge detection (b) Canny operator edge detection

Fig.2 edge detection of Sobel operator and Canny operator

Figure 2 (a) and (b) respectively shows Sobel operator edge detection and Canny operators edge detection, their threshold value is automatic selection. It can be seen that Sobel Operators can detect the general shape of images, but the image has a wide edge and intermittent from Figure 2 (a), which reason was mainly due to the fuzzy edge and the sensitivity of the noise for the first derivative; Because optical, sampling and image acquisition system Edge makes edge fuzzy; As the noise sensitivity of a first derivative, which causes instability of test results because of minimal noise impact, but complete smoothing of the image will cause details loss of the image edge.

It can be seen that the image edge texture detected by the canny operator is clearly excessive from Figure 2 (b), and the edge strength is not very obvious. This is mainly due to more texture and uneven illumination and other factors of the weld itself, which inevitably obtains the strength changes of the weld in texture while obtains the weld edge, and then results in too many marginal lines. Because the noise signal is a random process, the various factors make their noise became more complex in terms of the weld, thus make its edge detection operator become difficult.



(a) the variance ratio of interclass and intraclass segmentation (b) iterative method segmentation

Fig.3 the variance ratio of interclass and intraclass and iterative segmentation method

Figure 3 (a) and (b) shows the application result between the variance ratio of interclass and intraclass segmentation and iterative methods. It can be seen that two methods can both obtain the quite smooth binary images and the same basic shape. The threshold value of two methods is respectively 104.9988 and 105.69, their difference is less than one pixel, thus basically little effect on edge. But their running time and memory space occupied has big difference, the variance ratio of interclass and intraclass segmentation is twice faster than the iterative method in running time, the iterative method is eight times bigger than the variance ratio of interclass and intraclass segmentation from the memory space occupied.

The variance ratio of interclass and intraclass segmentation is built on the basis which the weld image is composed of the base metal and weld, in addition to considering variance, but also it uses the probability of base metal and weld as a weighted coefficient, the probability reflects the proportion of the base metal and weld in the weld image, therefore the application of the variance ratio of interclass and intraclass segmentation can be good segmentation for the extraction of the relatively large weld.

Taking the above factors, the variance ratio of interclass and intraclass segmentation is selected to obtain binary images.

4. Edge tracking

Edge tracking need to maintain the marginal nature and form closed contours. the paper identifies edge contour by finding the longest border of the binary image. The binary image edge tracking for Figure 3 (a) reached the continuous weld edge as shown in Figure 4, final image is shown in Figure 5.

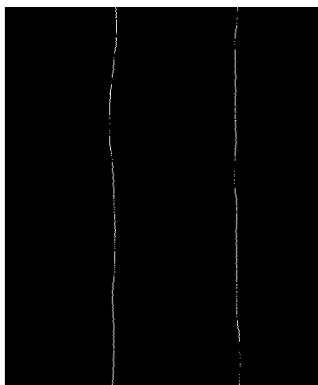


Fig.4 Contour of edge tracking



Fig.5 extracted weld

4. Consultation

(1) The adaptive filtering can effectively remove Salt and Pepper noise, smooth other non-impulse noise, and maintain the weld edge details .

(2) The variance ratio of interclass and intraclass segmentation not only enhances the contrast between the base metal and weld image, but also accurately extract weld region.

(3) Edge tracking can obtain the continuous contour and extract weld.

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