A method of Ray digital imaging automatic Inspection on Tube to tube sheet welded joints Based on VC + +

Wei ZHAO [1, 2], Keqin DING [2], Guang CHEN [2]

1. College of Precision Instrument and Opto-Electronic Engineering;Tianjin University;
2.China Special Equipment Inspection and Research Institute
Building 2, Xi Yuan, He Ping Jie, Chao Yang District, Beijing 100013, China
Tel: +86-10-59068315, Fax: +86-10-59068319
E-mail:entapple@163.com Web:http://www.csei.org.cn

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Abstract

The ray Inspection technology is applied for the characteristics of the tube to tube sheet welded joints, and a linear diode arrays is used as the receiving device. The system drives the digital stepper motor control card by using VC++, and the output is subdivided to drive the rotating devices to accurately rotate a week. The linear diode arrays is fixed on the rotating devices so it can accomplish circle scan and then the signals are transferred to the PC to be further transformed to images and finally display on the screen. The algorithm of transformation from square matrix to circle-scanning stitching images is particularly discussed. Finally, according to the ray digital imaging automatic detection system, the special image processing methods are introduced, which were used to optimize the image.

Keyword: tube to tube sheet welded joints; digital imaging; image processing; images stitching

1. Introduction

Today's rapidly developing industrial production has proposed increasing demands in tube to tube sheet welding joints quality. The current detection methods all have some shortcomings. Penetrant testing can only detect the surface-breaking defects , magnetic particle testing can only detect surface and near-surface defects of ferromagnetic materials, ultrasonic technology has lower sensitivity to hole defects[1], ray film photographic method has a series of questions of film storage and environmental pollution. Therefore a special ray detection technology is proposed, which is digital imaging automatic inspection method on tube to tube sheet welded joints based on VC + +.

2. Principle of Digital Imaging Automatic Inspection Method

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In view of geometrical shape's particularity of the Plug-in type in the tube to tube sheet welding joints, the small focal point ray source is used, the ray source is anode small focal point X-ray machine or Ir192 γ- ray detection device.

The article introduces 0.6 * 0.6 mm of source size, 2.25 Ci of activity Ir192 γ-ray source detection device, the system detection principle as shown in Figure 1. Ray source enters into the tube from the front tube sheet, and is delivered to the pre-calculated position through focusing device, and makes the Circumferential exposed backward[2,3], which direction must pass through the tube and the tube sheet welding joints. A new style Linear Diode Arrays as a device is used to receive ray, which will be fixed on a automatic rotating device, and be led to its rotation of the week through the rotating device to achieve the tube to tube sheet welding joints automatic inspection, finally the whole welding joints image was performed image processing in order to generate testing results, thus the system realizes digital imaging .This imaging method can be applied to materials for the carbon steel and low alloy steel and stainless steel tube, such as plug-in tube and tube sheet welding joints inspection.

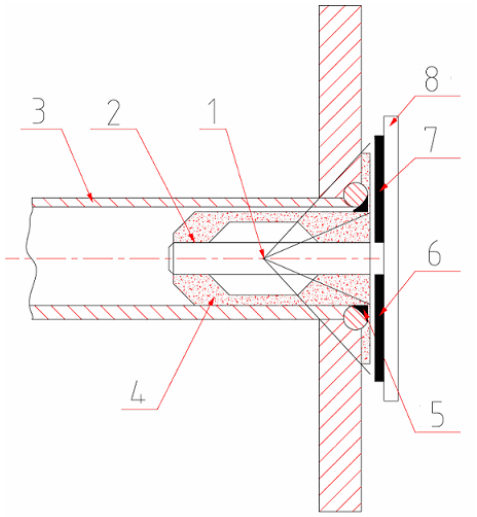

Fig 1. System Detection Principle diagram

1.ray source 2. Source drive pipe 3.tube 4. Shield block 5.welding joints
6. Counterweight 7. Linear Diode Arrays detector 8. rotating device

The software development of the detection system is based on Windows XP the platform, VC + + languages is used to realize the function, including hardware control module, detection module and image processing module. Among them, hardware control module control the motor speed, acceleration and routine; detection module include correction modeling, imaging parameters setting and image acquisition; image processing module include image filtering, image computing, visual images, defect markings and other functions, above modules is subjected to main program. Motor control card and Linear array detector acquisition card are installed in PC, which can complete the system control, image acquisition, processing and interpretation by the software.

Hardware control module sends the instruction for the control card to control motor movement, the control card analyzes and implements the instruction, the drive motor is subdivided to drive the motor, at the same time tell the current state of motor to the computer.

When the main program is started up, detection module firstly initializes the acquisition card, defines connected the camera model, then sets the imaging parameters including exposure time, the combined number of pixels and lines. Because the linear array detectors pixels have different the offset and gain, the program also includes PRNU correction or makes a new correction.

As linear array detectors effective receiver pixels and detection weld radius has the difference, so there is redundant data, which not only increases the burden on the post-processing software, at the same time is not conducive to the effective information extracted in the image processing part. Therefore, after the system is corrected by the PRNU, the data needs another interception the effective detection range, in order to generate a new array “pImage”, the follow-up image processing are generally the operation of the array.

The system carries out rotation detection. So this needs deal with an array “pImage” to transform into a circle scan graphics.

$$[A_{11},A_{12},,,A_{1n},A_{21},A_{22},,,A_{2n},,,,,,A_{m1},A_{m2},,,A_{mn}]$$

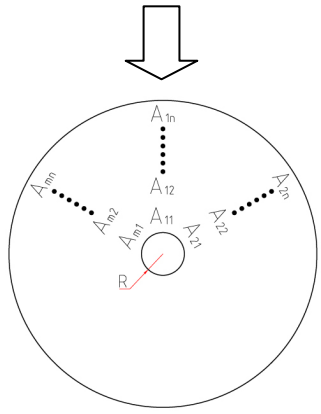

Fig.2 linear output data transformation results

m: A total number of scanned lines, the number makes weld imaging accuracy to meet the system requirements;

n：Linear array detector pixels per line (according to weld radius, omitting useless data, reducing the value of n);

R：The distance between linear array detector first imaging unit and the central axis of rotation;

The last generated image is a rectangle according to the detected radius, and reduce image size to view and position defection. Of course, the image processing method is used to show the image in order to further analyze the image and position defects. Such as rotary, gray transform, image filtering and so on. At the same time the image can also carry on part image processing.In addition, the linear array detector is of 12-bit A / D converter precision, gray output is 0-4095, the current computer operating systems can only support 8 bit gray image, so the final 12 bit images can be converted into 8 bit normal show.

3. Experiment and result

The system is developed in China Special Equipment Inspection and Research

Institute ray detection laboratory. Fig.3 and Fig.4 is respectively the resolution test card and weld imagebased on the system, it can be seen that the system can be used in a circular scanning and image acquisition, the resolution is up to 5 LP/mm.

Fig.3 the resolution test card image

Fig.4 weld image

4.Conclusion

The tube to tube sheet welding joints ray digital imaging automatic inspection system, firstly uses linear array detector rotating scanning system for weld circle scanning imaging, the system has higher detection sensitivity and space resolution, and can carry on real-time dynamic testing; Detected image is caught on histogram transformation, negative /

conversion, image zoom in or out and a series of transformation by the software, which facilitates the detection of defects for the staff; testing process is simple, defects positioning is accurate and improves the detection efficiency and reduce the cost of testing. The system can replace traditional film radiography method detection, has a clear technically advance, and can bring about significant economic and social benefits, so it has broad prospects.

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