Automatic Detection of Welding Defects in Radiographs for Launch Vehicle

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1. Introduction

Launch vehicle carries payloads such as spacecraft and satellite into space. High reliability is required for launch vehicle. Manufacturing of reliable components is a basis for reliability of launch vehicle. Welding is a process used widely during manufacturing components of launch vehicle. Welding defect reduces structural strength of the components. So welding defects should be inspected precisely after welding process. Until now, a person inspects welding radiographs and judges pass or failure. But inspection by a person has a limitation in point of consistency of inspection result.

This study suggests an image processing algorithm for automatic detection of welding defects in radiographs. This is a first step for automation of welding inspection. We developed unique algorithm for detecting defect in welding radiographs which have very irregular image quality.

2. Algorithm for detection of welding defect

Digitized image is obtained by digital scanning of radiography film or digital radiography machine.

First step of image processing algorithm is separating welding area from the image. Lower edge of welding area is determined by following procedure. Pixel gray value is obtained from bottom of image to +y direction at one x position. Pixel of smaller gray value than criteria is set zero. First pixel where larger gray value than criteria occurs is lower edge of welding area at one x position. This is performed from x=0 to x=W. Upper edge of welding area is determined by the same method. Fig. 1 shows the result of welding area separation from the image.

Second step is separating welding defect from welding area. Distribution of gray value along x and y directions is irregular. So conventional simple threshold algorithm cannot separate welding defect from welding area and Fig. 2 shows this. Fig. 3 shows raw gray value distribution along y direction at left and center position of x direction. It is fitted as second order polynomial and this is shown in Fig. 3. Pixels near center is excluded from fitting. Pixel where difference between raw gray value and fitted value is smaller than criteria is determined as defect. Fig. 4 shows that welding defects are separated from welding area by the new algorithm.

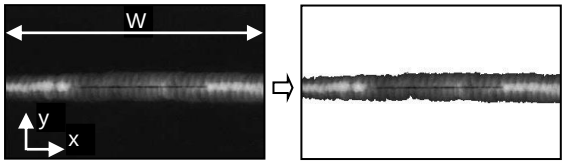

Fig.1 Separation of welding area from image

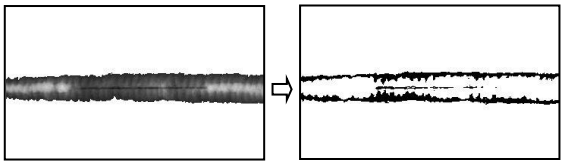

Fig.2 Separation of welding defect from welding area by conventional threshold algorithm

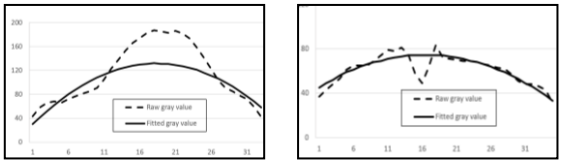

Fig.3 Distribution of raw gray value and fitted value along y direction at x=left and center position of welding area

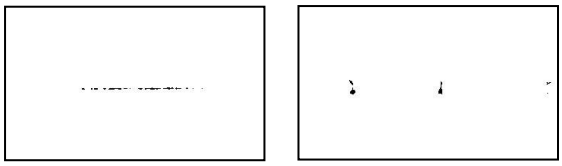

Fig.4 Separation of welding defect from welding area by new algorithm for lack of penetration and slag inclusion defects

References

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