DEVELOPING A NEW AUTOMATIC VISION DEFECT INSPECTION SYSTEM FOR CURVED SURFACES WITH HIGHLY SPECULAR REFLECTION

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ABSTRACT. This paper aims to create an automatic vision defect inspection system that is capable of detecting defects on highly specular reflection curved surfaces, especially for chrome-plated surfaces. These are strongly specular surfaces with very weak diffuse reflection. It is impossible to detect all the defects in one image in which defects may be covered by highlight regions or do not appear because the defects’ shapes or positions are random when the object is illuminated. A set of images are captured under different illumination conditions with an optimized relative position and illumination parameter. In the set of images, the specular spots move smoothly on the intact surface and the defects appear randomly as the light source moves. A synthetic image in which specular spots have been removed is reconstructed from the set of images. Moreover, defects are integrated in the synthetic image with higher defect expressivities. Finally, defects can be extracted by combining template matching and morphology techniques. The presented automatic vision defect inspection system has been implemented and tested on a number of simulation images and actual highly specular parts. Encouraging experimental results show that our method is robust, effective and feasible.

Keywords: Vision defect inspection, Highly specular reflection surface, Image reconstruction, Morphological technique, Template matching

1. Introduction. Highly specular surfaces, such as machined surfaces, painted surfaces and plated surfaces are highly reflective, so their inspection is a difficult problem met frequently within the automatic control of industrial parts. Hereafter, we call these surfaces highly specular reflection (HSR) surfaces. The visual inspection of the appearance of metal components in most manufacturing processes mainly depends on human inspectors whose performance is generally subjective, variable, and therefore inadequate. An automatic vision inspection system offers objectivity, better reliability and repeatability and is able to carry out defect measurement to evaluate the industrial part’s quality. Kim and Koivo [1], for example, built a system for the automated inspection of wood surfaces. Piironen [2] developed an automated visual inspection system for rolled metal surfaces. Fernandez et al. [3] developed a surface inspection system for casting surfaces,