Simulation of specular surface imaging based on computer graphics: application on a vision inspection system

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Abstract

The main purpose of this paper is to detect surface defects on reflecting industrial parts. A system based machine vision is designed to detect surface defects in geometry. Through specific lighting devices, defects can be imaged, and then image segmentation is processed. And a real-time inspection of reflective products is possible.

1. Introduction

Highly reflective surfaces inspection is a problem met frequently within the automatic control of industrial parts [1]. Usually, this work require to be done manually by human. But the results of detection is impacted to human's subjective and tiredness.

The human eye does not necessarily see all the defects. The error rate is relatively high. The system described by this paper based machine vision is a particular lighting device system that enables efficient real time defect detection and some of the features design performed via computer graphics simulation [2].

2. Specular surface imaging

2.1. Lighting principle

Figure 1 illustrates the lighting principle. In the first case, without defect, the surface reflects a dark zone of the lighting. In the second case, the defect deflects luminous rays coming from the luminous zone and so, the defect appears as a clear spot in a dark zone.

2.2. Implementation

Through experiments, researchers can find that the size of the defect signature on the image depends on the distance between the light transition and the defect, as shown in Figure 2.

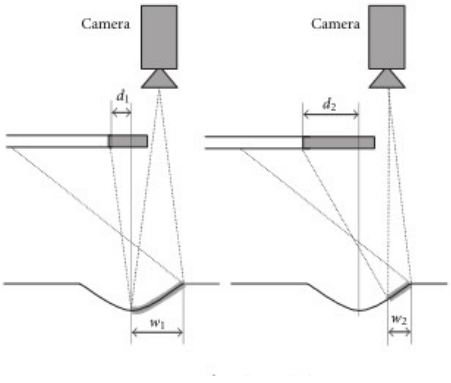

Figure 2: Defect size variation.

As shown in Figure 3, it represents a defect size (percentage of real size) versus the distance between two light transitions and the center of the defect (normalized by the defect dimensions) and the corresponding images.

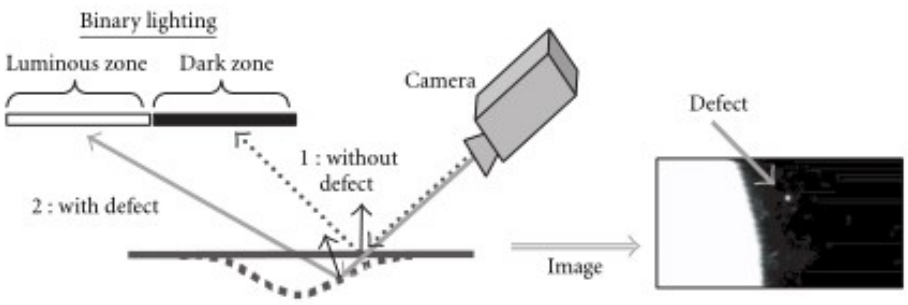

Figure 1: Lighting principle.

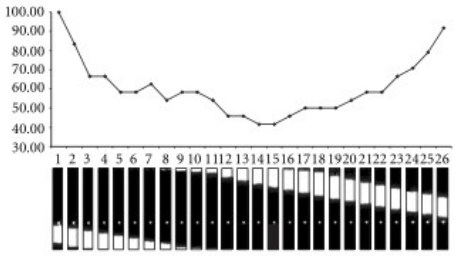

Figure 3: Defect size variation versus distance to the first light transition (experimental results).

Reference

[1] A. C. Sanderson, L. E. Weiss, and S. K. Nyar. Structured highlight inspection of specular surfaces. *The IEEE Transactions on Pattern Analysis and Machine Intelligence*, 10(1):44–55, 1988. 1

[2] R. Seulin, F. Merienne, and P. Gorria. Simulation of specular surface imaging based on computer graphics: application on a vision inspection system. *EURASIP Journal on Advances in Signal Processing*, 2002(7):649–658, 2002. 1