Chapter 16

Defect Detection Approach Based on Combination of Histogram Segmentation and Probabilistic Estimation Technique

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ABSTRACT

Defect Detection is a problem that has received much attention from image processing scientists. If defect detection is done correctly and accurately, it can be used in visual inspection systems. Consequently, many different methods have been proposed to solve this problem. Most of these methods have computation complexity and they do not guarantee for accurate results in every application. In this article an approach is proposed for defect detection based on a main box included two stages. In the first stage the image is divided into the two groups of pixels based on histogram segmentation and in the second stage the defects in defected group are highlighted based on Probability estimation algorithm by using a train stage. This approach by using a train set, guarantees the accurate result for near all of the applications of defect detection. In result part to prove the quality of proposed approach, the algorithm is applied on stone images to detect the porosity.

1. INTRODUCTION

The use of visual inspection systems are in many industrial and commercial applications. There are many visual inspection systems such as defect detection of metal, tiles, fabric inspection and etc. Consequently, since now many different methods have been proposed to solve this problem, such as Defect detection of tiles using 2D Wavelet transform and statistical features (Ghazini, Monadjemi, & Jamshidi, 2009) and Wavelet based methods on patterned fabric defect detection (Ngan, Pang,
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Yung, & Ng, 2006). In both of these methods, wavelet filters are used to analysis & detect the defected parts of textiles. Texture Defect Detection System with Image Deflection Compensation (Lin & Yeh, 2009) and fast texture feature extraction method based on segmentation for image retrieval (Chen, Chen, & Chien, 2009) are some of other approaches which are proposed to defect detection. In Alimohamdi and Ahmadyfard (2006) the authors are proposed a new approach based on Optimal Gabor filters to detecting skin defect of fruits, it can be useable in Visual Inspection Systems. Some of defect detection approaches are compared in Puchalski, Gorzelany, Zagula, and Brusewitz (2008) by Xiang. Near all of the previous methods have complexity in computation steps and some of them don’t guarantee an accurate result for every application or various models of defects. So in this article, an approach is proposed to defect detection without these mentioned problems. Proposed approach is working in two stages that combined in a main box. In the first stage via using histogram segmentation algorithm, the digital image is dividing to two groups of pixels. First group for certainly non-defected pixels and second group for other pixels. In the second stage by using a train step and maximum likelihood concept and probabilistic estimation, the defects are highlighted through second group of pixels. One of the most important advantages of this approach is the ability of it’s to cover the color images. The proposed approach is used the intensity of pixels in color bands to increase the quality of results.

Because using train set of non-defected pixels, so the proposed approach have ability to use in every applications and every model of defects. Finally in the result part, the proposed approach is applied on digital images of some models of stones to detect the porosity and defects. The results prove the quality of this approach.

1.1. Organization

The reminder of this paper is organized as follows: Section 2 is related to the description of histogram segmentation algorithm and Section 3 is related to the description of probabilistic estimation algorithm. Section 4 describes the main approach of this paper and finally, the results and conclusion are included.

2. HISTOGRAM SEGMENTATION

Since now many different methods have been proposed for image segmentation. Such as Image segmentation based on histogram or Image segmentation based on clustering or Segmentation using shape information. All of the segmentation approaches can use for defect detection, but the output results of them are not accurate. Gray-level Histogram Segmentation is one of the methods that segments the digital images to two or more groups of pixels. In this paper this method is used to segment the image into the two groups of pixels. One of them for certainly non-defected pixels and another one for maybe defected pixels. Consequently, histogram segmentation effort to find a threshold to divided the gray-levels of image into the two groups like Figure 1. Where if the grey-level of pixel $P \leq T$ then pixel $P$ is a defect and else Pixel $P$ is a non-defected pixel. So an algorithm can define to achieve this aim as follow. First of all normalized histogram of input image should define. Then the minimization thresholding method (Haralick & Shapiro, 1991) should use to determine the threshold. Minimization thresholding define an Equation 1 and say the optimum threshold determines by minimizing (1).

$$\sigma_o^2(T) = \sigma_o^2(T)p_o(T) + \sigma_b^2(T)p_b(T)$$  \hspace{1cm} (1)