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The High-speed Fabric Defect Detection Algorithm Based on the Image Layered Model

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Abstract

The high-speed fabric defect detection algorithm based on fabric image layered model is proposed to achieve the goal of accurate defect detection in the fabric production process. The image layered model assumes that fabric image is a superposition of the periodic texture background image, noise image, and defect image. Thus fabrics can be divided and conquered. Firstly, image preprocessing and mean sampling algorithms were used to suppress the background texture and interference image layer, and variances sampling was used for enhancing defect image layer. Secondly, the Otsu method was applied for determining the segmentation threshold to segment the defect image automatically, then clear and accurate defect image was obtained via image post-treatment algorithm. Finally, defect positions were marked by a labeling algorithm to prepare for subsequent offline processing. Experiments on common defect images from a standard defect library were described, and experimental results show that the proposed algorithm based on image layered model is reliable, accurate, real-time and well used in the industrial field.

Keywords: Fabric; Defect Detection; Image Layered Model; Otsu Method

1 Introduction

For textile enterprises, effective fabric defect detection is an important guarantee to improve product quality, increase product margins, lower production costs and enhance product international competitiveness. Because existing artificial defect detection are costly, and there are other shortcomings such as detection inefficiency and poor test results, automatic fabric defect detection is the focus of current research. Although researchers have proposed various detection methods, such as GLCM [1–3], fourier transform method [4, 5], wavelet transform, wavelet packet transform [6, 7], Gabor filter method [8, 9] and statistical methods [10, 11]. However due to the wide variety of fabric defects, there are a variety of limitations for the effectiveness of various detection algorithms. Therefore defect detection is still an important research focus.

The current researchers' focus is more on theoretical research, there are only a handful of practical research that has been conducted, and defect detection outcome is little. Our work

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based on theoretical research focuses on practical considerations. During algorithm research and design process, manufacturing practice requirements have been considered, such as various aspects of the feasibility, system speed, anti-interference ability, so there is a fresh vitality to this study.

In this study, a new efficient fabric defect detection model is demonstrated. Image layered model (see Fig. 1) provides a system-level defect detection method. With the constructed model, a series of simple algorithms were used to achieve the same standard of detection effect as complex algorithms. The image layered model method has a higher efficiency than complex algorithms. At the same time, image layered model provides a theoretical framework and a study tool for defect detection algorithm.

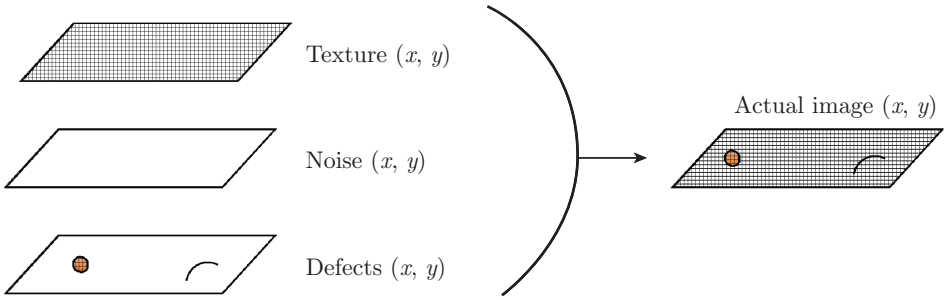

Fig. 1: Image layered model

In the proposed method, fabric defect detection is seen as a defect information extraction process. Fabrics and fabric defect are objective entities. Fabric and defect information is converted into a digital image of fabric defects by a machine vision method, and the digital image is rapidly processed and analyzed by a computer. Fabric defect image can be seen as a superposition of fabric and defect information. According to dialectics, the obtained image information don't truly represent fabric defect (thing in itself), but as a reflection (information is missing) and part of fabric defect information. Fabric image subjects to various noise interference in the process of information acquisition, transmission and processing. Therefore, according to the image layered model, the fabric defect image can be seen as a superposition of texture background image layer, noise image layer and defect image layer (fabric patterns and colors are not considered, because they can be seen a part of texture image layer). As a result three angles could be studied that texture image layer is not the information we want in fabric defect detection, defect image layer is the true information that needs to be enhanced or completely extracted, and noise image layer should be suppressed or removed. The noise is divided into various causes and types, making it necessary to analyze the type of noise in defect detection system when the noise image layer is filtered, then the corresponding algorithm of image layered model would be selected or designed.

2 Algorithm and Implementation

According to the image layered model, the fabric defect detection algorithm flow chart (shown in Fig. 2) is designed to guide the implementation of a proposed algorithm.

In order to implement and validate the proposed algorithm, a whole software platform (shown in Fig. 3) is designed and implemented. In Fig. 3, OpenCV LIB and CPP LIB are used for algorithm implementation, and the MFC is used for GUI implementation. Some hardware drivers are used