Journal of Fiber Bioengineering and Informatics 8:2 (2015) 241–248
doi:10.3993/jfbim00108

Fabric Color Difference Detection Based on SVM of Multi-dimension Features with Wavelet Kernel ⋆

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Abstract

Traditionally dyed fabric color difference detection is based on the image color characteristics in textile industry. However, relying solely on the single image color features can't effectively identify dyed fabric color difference with rich texture characteristics. In order to solve this problem, a new efficient color difference detection method based on multi-dimensional characteristics of Morlet Wavelet Kernel Support Vector Machine (MWSVM) is proposed in this paper. Firstly the dyed fabric image to be detected is divided into some appropriate sub-blocks in the LAB color space. The LAB histograms of the image in those sub-blocks are extracted. In addition, the Local Binary Pattern (LBP) algorithm is applied to extract the image texture features in those different divided regions. Then the Grey Relational Grade (GRG) between the sample image and the detected image is calculated. Finally the LAB histograms, the LBP features and the GRG are used as the input image data for the MWSVM algorithm to detect color difference of dyed fabrics. The experimental results show that the proposed method can detect dyed fabric color difference more efficiently and accurately. The classification accuracy rate as high as 87.5%.

Keywords: LAB Color Space; LBP; Grey Relational Grade (GRG); SVM; Morlet Wavelet Kernel; Color Difference Detection

1 Introduction

The fabric quality detection has been widely studied in realistic environment [1, 2]. Dyed fabric color difference is a very important evaluation parameter in the fabric quality inspection process.

⋆This work is funded by Zhejiang Top Priority Discipline of Textile Science and Engineering. And it is also supported by Zhejiang Provincial Natural Science Foundation of China (No. LY13F030013).

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At present, the color difference evaluation of dyed fabrics in many dyeing factories is mostly done by professionals. This way of color difference detecting relies heavily on the human eye and has many deficiencies, e.g., high misjudgment rate, high cost and etc. Therefore, it is important to introduce computer vision based color difference evaluation system into the dyeing industry, which can overcome the subjective influence of human beings, making the evaluation results more efficiently and accurately.

Over decades many color difference detection algorithms have been proposed. For example, Wan [3] proposed a fabric color difference detection method based on flexible neural network. Li [4] designed an on-line color detection system based on machine vision, which has been applied in practice. To improve the method in [4], Li [5] takes the RGB values as the input of BP neural network and selects the suitable calculation formula to calculate the color difference [4, 5] just use the color characteristics of the image and apply only to those solid fabrics. In [6] Liu classifies the color difference of dyed fabrics based on fuzzy artificial neural network. However, those neural network algorithms usually take a lot of training time. Shams-Nateri [7] converts the images from the RGB color space to CIEXYZ color space and adopts the SRGB formula to evaluate color difference. Liu [8] detects the color difference of two kinds of fabric samples in L*a*b color space and achieves a better performance in those rich color fabrics. Jin [9] proposed the general rules of the color difference formula selection by analyzing the advantages and disadvantages of various types of color formulas.

Color difference detection should not only consider the color characteristics of dyed fabrics, but also cannot ignore the texture characteristics. In addition, the grey relational grade between the sample image and the detected image is also an important evaluation index. Since the Support Vector Machine (SVM) has many unique advantages in solving the small sample, nonlinear and high dimensional pattern recognition problems, we proposed a new automatic classification method based on Morlet wavelet kernel support vector machine, which combines the color characteristics and the texture characteristics of dyed fabrics.

2 Feature Model of Dyeing Product

For those single color fabrics, color is the main feature. Their texture feature is relatively simple. While for the fabrics with rich texture, their main features include both color and texture. In this paper, with the combination of color space, local texture features and hierarchic grey relational grade, the color difference of dyed fabrics will be easily recognized.

In order to characterize color spatial relationship of dyeing products with inner graphic, this paper presents a data model with the fusion of histogram and grey relevance based on the blocking idea. Firstly, image should be divided into appropriate sub blocks (e.g., 4×4). Color is intuitive property of object surface. Color histogram describes the different color proportion without any information of spatial position, which has been widely used in multiple color description system [10]. To facilitate the measurement and calculation, color histogram can be composed by different color spaces and coordinate systems. In this paper, we use the LAB color space. The adjustment will be simple and the calculation speed will be fast with a wide color gamut because the chromaticity and the brightness are separated in the Lab color space. All the colors that human being can perceive could be expressed by LAB color space.