Journal of Fiber Bioengineering and Informatics 7:4 (2014) 561–571
doi:10.3993/jfbi12201409

Regression Analysis on Tie-dye Technique and Pattern Feature ⋆

Suqiong Liu [a,b,*], Huie Liang [a,*], Weidong Gao [a], Wei Xue [c], Ming Gu [d]

[a] *School of Textile and Garment, Jiangnan University, Wuxi 214122, China*

[b] *Art College, Jinling Institute of Technology, Nanjing 211169, China*

[c] *College of Information Science and Technology, Nanjing Agricultural University Nanjing 210002, China*

[d] *Jiangsu Huayi Group, Haian 226600, China*

Received 25 April 2014; accepted (in revised version) 21 November 2014; available online 17 December 2014

Abstract

Based on computer vision technology, we studied predictive method of tie-dye pattern information. We extracted the average value of HSV (hue, saturation, value) tri-component of valid tie-dye area, proportion of tie-dye white area and coarseness as pattern feature, and designed correlation analysis on tie-dye production process and pattern feature accordingly. The results showed that dye concentration and pattern feature are highly correlated and the speed is also an important indicator of the effect of tie-dye pattern. In view of tie-dye production speed, concentration process parameters and pattern feature linear regression analysis, the findings are as follows: there is a positive correlation between process parameters and H, S component mean; process parameters negatively correlate with V component mean and proportion of tie-dye white area and coarseness; R-Squared values of prediction model are greater than 0.5. The linear regression models can be used to predict tie-dye image pattern effects.

Keywords: Tie-dye; Image Processing; HSV; Regression Analysis

1 Introduction

The pattern of tie-die is a crucial factor for evaluating the effect of tie-die technique [1]. If the mapping between production technique and pattern is established, then prediction of the effect of the pattern can be made on the basis of used technique. This will significantly shorten production cycle and reduce screening cost. This paper focuses on the visual features of digital

⋆Project supported by National-sponsored Social Sciences Funding Program of China (No. 12BMZ049), the Ministry of education for New Century Excellent Tal ents Project of China (No. NCET-10-0454), and Jiangsu Natural Science Foundation of China (No. BK2012363).

*Corresponding author.
Email addresses: liuliu-qiong@163.com (Suqiong Liu), lianghe@jiangnan.edu.cn (Huie Liang).

image processing by examining extracted pattern characteristics of printed color and textures. A mathematical model is established to estimate the pattern effect by regressional analysis of tie-dye technique and pattern characteristics.

Subjective human evaluation is based on examining color and texture of the tie-dye pattern. Color is an important visual feature of the image. So the method of using color to identify image has been widely applied. The extraction of color information should use appropriate color space. There are a lot of applications of extracting characteristics from color space for relevant analysis within the field of facial recognition, remote sensing analysis and traffic management.

Lachkar [2] realized a system for textile design patterns retrieval by proposing an adaptive and efficient unsupervised color image segmentation method. Sheng [3] took (S+V)/H as the base value to characterize skin color, which could enhance the recognition capacity of HSV space for human skin. Guo [4] developed a fabric image retrieval system. He presented a method of color extraction and used HSV color space to handle color data which could be inputted into database. Amine [5] sumed up the Gaussian distribution in pure-color space YCrCb to classify the pixels. Wei Li [6] introduced the hue component of HSV color space to the cloud test system. Martel [7] raised the method to cut shadows of moving vehicle on the edge of HSV color space. Cucchiara [8] firstly adopted the middle-value filtering to obtain the background model and then utilized the similarity of hue and saturation as well as the difference of lightness between shadows of moving vehicles and the background pixels within HSV color space to identify and separate the shadow of moving vehicle. Hong-yin Yang [9] proposed an image indexing method on the basis of HSV space color edge histogram.

Compared with the models of RGB and YCrCb, HSV color space is better in color description. HSV color space has two important features: V component is not related to color information; H and S components closely imitate colour observation by human naked eyes. These features make the HSV color space suitable for digital image processing. So we chose to analyze tie-dye image within HSV color space.

Texture is a key component of human visual perception. It describes the homogeneity of image surface and the spatial distribution of different elements without color and brightness information dependency. There are many texture feature extraction methods, including wavelet-based texture feature, Tamura feature, feature Gray-Level Co-occurrence Matrix and so on [10]. Kuo [11] proposed an approach for texture analysis to recognize the fabric nature and type of the main weaving texture by learning vector quantization networks. First, the color 2D scanner captures the fabric image and then the wavelet transformation is used to display image texture. The co-occurrence matrix is then applied to calculate the texture characteristics. Alper Selver [12] proposed a texture analysis method to realize the inspection of fabric defects which uses sum and difference histograms conjointly with co-occurrence matrices.

In this paper we focused on coarseness [13], one of the textural properties mostly used in literature for differentiation between fine and coarse textures. In fact, the concept of texture is usually associated with the presence of fineness. A fine texture can be considered as small texture primitives with big gray tone differences between neighbor primitives. On the contrary, if texture primitives are bigger and formed by several pixels, it is a coarse texture.

Based on digital image processing technology, this paper extracted the average value of HSV (hue, saturation, value) tri-component of the valid tie-dye area, the proportion of tie-dye white area and coarseness as pattern feature. A set of correlation analysis was designed to validate the strong relationship between the tie-dye technique and the characteristic quantity of color and