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Fabric Defect Detection Algorithm Based on Local Neighborhood Analysis

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***Abstract*— Fabric defect detection algorithm based on local neighborhood is proposed to improve the accuracy and real-time of Fabric defect detection. A local neighborhood window slides over the entire inspection image. The coefficient of variation is used as a homogeneity measure. A defect-free region will generate a smaller value of Variation Coefficient than that of a defective region. To extract and segment the defective regions a simple threshold can be used and to increase the computational efficiency the integral image is introduced. The proposed algorithm is used to detecting only one single discrimination feature. It could avoid complicated Spectral decomposition and sample learning. Experimental results from fabric detection in the industry, has shown the feasibility and effectiveness.**

Keywords*— Local Neighborhood Analysis, fabric defect detection, coefficient of variation, homogeneity

I. INTRODUCTION

Quality inspection of fabric is very important in textile industry. The minor defect in fabric reduces its cost by 65 to 70%. Hence automated inspection becomes essential to improve quality of fabric and reduce labor costs. Defects caused due to machine faults, yarn problems, poor finishing, and excessive stretching among others. There are many types of defects like broken end, thin bar, thick bar, hole, stain, loose pick, multiple netting and knot. The defects in fabric are generally classified into three sub-divisions according to their occurrence in the fabric. They are, (i) weft-way defects (ii) warp-way defects and (iii) defects with no directional dependence. There are about twenty-two types of defects usually associated with woven fabric due to various processing irregularities. Out of these twenty-two, only few are severe defects and need elimination by rejection at the production stages. These are pick defects, slub or fly, knot, snarl and snug, reed mark or crack and thin place. Apart from the above-mentioned major defects, mechanical defects such as hole, piling, oil marks and other anomalies manifest themselves as defects in woven fabric. Numerous approaches were proposed to address the problem of detecting defects in woven fabrics, which can be broadly categorized into three classes: statistical, spectral and model based Compared with traditional methods,

Machine vision inspection technology has non-contact, high speed, high precision, low cost advantages [1, 2]. In machine vision systems, fabric defect detection is very important, it is widely used in steel balls surface defect detection [3], the rail surface detection [4], the bottle caps surface inspection [5], the slab surface defect detection [6] and solar wafer surface detection [7] and many other fields. In recent years, fabric defect detection technology has developed. There are many algorithms, such as histogram statistics, autocorrelation, Fourier transform, co-occurrence matrices and Gabor filtering [8].

In this study, we propose a simple and rapid detection method based on local neighborhood. The coefficient of variation is used as defect detection and localization of homogeneity measure. To reduce computing time the integral image technology is used. The proposed measure has high inspection speed and high accuracy, and insensitive to uneven illumination.

I. FABRIC DEFECT DETECTION ALGORITHM BASED ON LOCAL NEIGHBORHOOD ANALYSIS

The block diagram of proposed system is shown in figure 1.

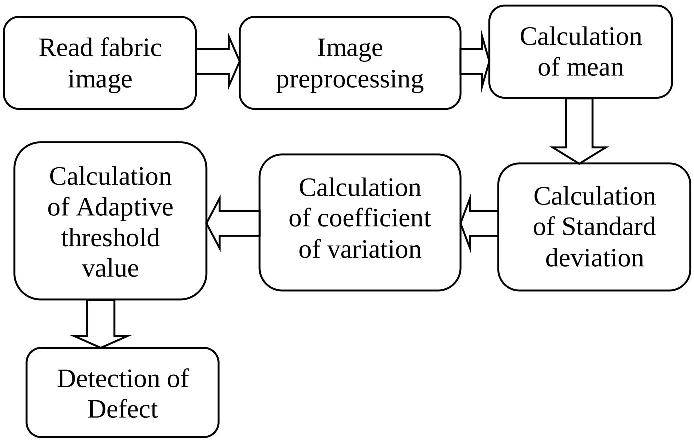

Figure1. Block diagram of proposed system

Image preprocessing consists of histogram equalization for blur, shadow and light. In equal distribution removal along with median filtering for noise removal. Post processing includes morphological filtering on defect segmented image to enhance the defected region.

A. The Coefficient of Variation

The coefficient of variation is also known as dispersion coefficient. It is used to measure homogeneity. The coefficient of variation is the ratio of the standard deviation of the mean. It is a reflection of a statistical distribution of the amount of data, which reflects the degree of variation of a set of observed data. The coefficient of variation is given by

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$$C_v = \frac{\sigma}{\mu} \times 100\% \qquad (1)$$

Where, σ is standard deviation and μ is mean.

If the variation coefficient of a group of data is larger, it means that the group data relative to the distribution of discrete, density change is bigger, non uniform distribution of data. On the contrary, if a group of data of variation coefficient is small, then the group data density change is not big, the data distribution is relatively uniform.

B. *The Description of the Local Neighborhood Algorithm*

A defect images consists of defective region and defect-free region. The defective region is abnormal region, its presence pixel gray mutation or unevenly distributed. Homogeneity, also known as homogeneousness, it is largely associated with the image of local information, it reflects the distribution of gray scale [9]. The coefficient of variation described above can be very good reflection of the distribution of data. Therefore, the coefficient of variation can be used to test whether there are defects in the image. For an image I of size M × N, it can be seen as an image matrix of N rows and M columns. I (x, y) is a corresponding gray value at the coordinates (x, y), where x = 1, 2, . . . , M, y = 1, 2, . . . N. Define local homogeneity measure (LHM) of the pixel P(x, y). Let W × W be the neighborhood window size centering on the pixel P(x, y), where W = 2w + 1 for some integer w, calculate coefficient of variation of pixel gray value in this neighborhood $C_v(x, y)$ which is given by

$$\mu_{xy} = \frac{\sum_{i=w}^{w} \sum_{j=-w}^{w} I(x+i, y+j)}{W \times W} \qquad (2)$$

$$\sigma_{X,Y} = \sqrt{\frac{\sum_{i=-w}^{w} \sum_{j=-w}^{w} (I(x,y) - \mu_{x,y})^2}{W \times W}} \qquad (3)$$

$$C_v(x, y) = \frac{\sigma_{x,y}}{\mu_{x,y}} \times 100\% \qquad (4)$$

Where, $\mu_{x,y}$ is the gray value of pixels which within the neighborhood window, $\sigma_{x,y}$ is standard deviation, $C_v(x, y)$ is the local homogeneity measure value. For a homogeneously textured or uniformly non-textured Fabric image, gray distribution on any local neighborhood uniform, its LHM value will be relatively small. In the image which contains defects, the gray distribution of defective region not uniform, its LHM value will be relatively large and the LHM of defect-free region is small. Using neighborhood window of size 25 × 25, the LHM value of each pixel can be calculated according to Eq. (4). Figure 2 shows a fabric image which contains the hole defect. Figure 3 shows the distribution of LHM, the large value of LHM at two peaks represents defective region and small value of LHM at flat area represents defect free region. So LHM value is as discriminating feature to distinguish the defect region and the defect-free region. The greater the LHM values of pixels, it means defective region is larger. When LHM value of a pixel is above the threshold, the region belongs to the defective region. If LHM value is less than the threshold value, then that it is defect-free region. The threshold is given by

$$T_{Cv} = \mu_{cv} + w \qquad (5)$$

Where μ_{cv} is the mean of LHM values of all the pixels in an image, w is the control variable. Different images have different thresholds(T_{Cv}). It is self-adaptive variable with different images. Control variable is usually according to different object detection and takes different values.

Fig. 2 Defected Fabric image

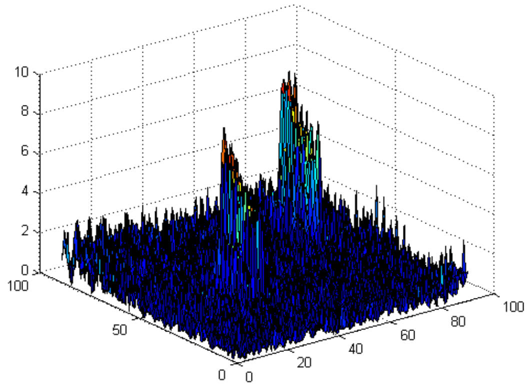
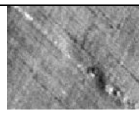
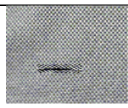
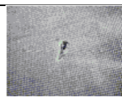
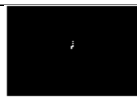
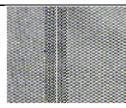


Fig3. Surface plot for distribution of LHM

III . EXPERIMENTAL RESULTS

Broken end, multiple netting defects, holes, thick bar. Detection results for various types of defect detection are given in following table. .

TABLE I. EXPERIMENTAL RESULT

Type of defect	Defected image	Detected defect
Broken end		
Multiple netting defect		
Hole defect		
Yarn removal(Thick bar)		

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The effectiveness of algorithm is measured on basis of detection success rate, also known as detection accuracy, is given as,

$$\text{Accuracy} = \frac{\text{Number of samples correctly detected}}{\text{Total number of samples}} * 100\ \%$$

IV. CONCLUSION AND FUTURE SCOPE

In this paper, local neighborhood analysis algorithm is demonstrated to fabric defect detection. This method is simple, effective, less time consuming unlike spectral decomposition techniques and learning methods. This algorithm captures the irregularities caused by defect in local homogeneous region of fabric material. The experiments conducted on different types of defects and different kinds of fabrics have yielded promising results, which have shown that this method achieves great detection accuracy and a low cost for fabric inspection successfully.

This algorithm still faces challenges in detecting defects in pattern fabrics and motif based fabrics due to lots of variations in texture.

REFERENCES

[1] Yadong L, Peihua G (2004) Free-form Surface inspection techniques state of the art review.Comput-Aid Des 36(13):1395–1417

[2] Xianghua X (2008) A review of recent advances in Fabric defect detection using texture analysis techniques. Electron Lett Comput Vis Image Anal 7(3):1–22

[3] Yuzhen M, Guoping L (2012) Detection on Surface defect of large length scale steel balls. Transducer Microsyst Technol 31(8):144–146

[4] Qingyong L, Shengwei R (2012) A visual detection system for rail Surface defects. IEEE Trans Syst Man Cybern: Part Appl Rev 42(6):1531–1542

[5] Wenju Z, Minrui F, Huiyu Z et al (2014) A sparse representation based fast detection method for surface defect detection of bottle caps. Neuro Comput 123:406–414

[6] Jiawei W, Jingqi Y, Zhihong F et al (2012) Surface defect detection of slab based on the improved Adaboost algorithm. J Iron Steel Res 24(9):59–62

[7] Li WC, Tsai DM (2012) Wavelet-based defect detection in solar wafer images with inhomogeneous texture. Pattern Recogn 45(2):742–756

[8] Jing L, Tingting D, Dan S et al (2014) A review on surface defect detection. J Front Comput Sci Technol 8(9):1041–1048

[9] Cheng HD, Sun Y (2000) A hierarchical approach to color image segmentation using homogeneity. IEEE Trans Image Process 9(12):2071C2082