International Journal of Applied Engineering and Technology ISSN: 2277-212X (Online)
An Open Access, Online International Journal Available at http://www.cibtech.org/jet.htm
2015 Vol. 5 (1) January-March, pp.1-5/Singh and Singh
Research Article

TEXTURE ANALYSIS IN FABRIC MATERIAL FOR QUALITY EVALUATION USING GLCM MATRIX

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ABSTRACT
Online visual inspection of fabric quality is an important activity that is required for quality production of fabrics in textile mills. Automated visual inspection of fabrics produces uniform quality fabrics over the entire production period. Further, the same is independent of the variation in quality evaluation due to different human personnel. In the presented algorithm, the fabrics quality is adjudged by analyzing the gray level co-occurrence matrix (GLCM) parameters. The GLCM parameters include contrast, energy, homogeneity and correlation. Other than the GLCM parameters, entropy, standard deviation of image intensity and mean intensity are the parameters that contribute in uniquely identifying the fabrics quality and show potential variation in numerical values when the fabric under study show a deviation in quality with respect to standard or acceptable fabrics quality.

Keywords: *Textile Imaging, Segmentation, Gray Level Co-occurrence Matrix*

INTRODUCTION
The textile quality can be determined by inspecting the texture in a cloth material. And thereby, this problem comes under the preview of texture analysis in machine vision system. Fabric defect detection plays an important role in automated inspection of fabric quality based on computer vision, which aims at locating defect regions accurately. The fabric defect detection is of vital importance in the textile industry. Currently, automated inspection of the fabric defects based on computer vision, which can meet the requirements of practical products, has the advantages of high precision and efficiency over the traditional human visual inspection. There are two main directions for the detection techniques of fabric defects. One is using transform domain-based features, e.g. Gabor transform and Wavelet transform. The other is statistical texture analysis, e.g. the gray level co-occurrence matrices (GLCM) describes texture feature of the fabrics by combining with gray level distribution and spatial relations, who is recognized to be of highly value to fabric defect detection. Each texture analysis method presents a different potential for analysis of textured textile images. By considering their advantages and potential for successful flaw detection performance in homogeneous and jacquard textiles, machine vision system comes out to be a very handy method while determining the textile quality. Texture analysis refers to the characterization of regions in an image by their texture content. Texture analysis attempts to quantify intuitive qualities described by terms such as rough, smooth, silky, or bumpy as a function of the spatial variation in pixel intensities. In this sense, the roughness or bumpiness refers to variations in the intensity values, or gray levels.

Related Works
Escofet *et al.,* (2001) discussed the image processing based application in textile industries. Machine vision system is very useful tool in identifying online fabric material at fast speed and that too at high repeatability (Escofet *et al.,* 2001). Hu *et al.,* discussed the wavelet approach in decomposing the fabric image and then analysis in HH-band. The maximum information is available in LL-sub-band and if some texture is present that can be analyzed in other bands (Hu and Tsai, 2000). Tsai *et al.,* research about Wrinkle Assessment of Fabric A light profile based analysis is proposed in this work. The light profile's height is the main informative parameter in this study (Tsai and Hu, 1996).

Portilla *et al.,* (1996) researched about automated textile defect recognition system using computer vision and artificial neural networks according their study Inspection processes done on these industries are mostly manual and time consuming (Portilla *et al.,* 1996).

Randen and Hakon-Husoy (1994) discussed the wavelet approach in fabric quality defects and their identification. The fabric defects many a times are analyzed quantitatively or qualitatively. In case of quantitative analysis, the defects size, location and type is of prime importance. Normally haar wavelet is employed for decomposition of the fabric image area and analyzed in different sub bands of the wavelet decomposed image (Randen and Hakon-Husoy, 1994).

Hosseini *et al.*, (1995) studied the digital aspects of the fabric defects from statistical point of view. The presented approach was real time analysis of the fabric material on shop floor. The image decomposition for analysis is decomposed into bit planes. Bit planes depict fair idea about the location and size of the textile defects (Hosseini, 1995).

Hu and Tsai (2000) discussed the defects identification in fabric material like lines, tears, and spots. A furrier analysis of the fabric image in frequency domain is suggested here. As the fabric design mostly contains different design patches or blocks, frequency domain approach is very useful in segmenting the fabric design from that of the similar kind of defects (Hu and Tsai, 2000).

Jasper *et al.*, (1996) studied about the neural approach in textile/fabric defects identification. However, this approach requires a large no. of training samples and a validation is required for real test on shop floor. Neural approach is good if similar kind of defects is observed in a fabric material (Jasper *et al.*, 1996).

Jasper *et al.*, (1996) studied discrete cosine transform and artificial neural network system for defect identification about Characterization and classification of fabric defects using discrete cosine transformation and artificial neural network this technique shows how fabric defects can be detected using DCT coefficients neural network using back propagation algorithm helps in finding defects in fabric (Jasper and Potlapalli, 1995).

Kang *et al.*, (1999) studied about Fabric Defect Detection Using Auto-Correlation Function which introduces a new fabric segmentation approach for detecting fabric defects using auto-correlation Function. Banumathi and Nasira (2012) researched on neural approach of fabric material analysis. They used a back propagation neural network by taking nine input neurons and three hidden neurons in one hidden layer. The output quality is suggested at one output (Kang *et al.*, 1999).

Kang *et al.*, (2001) researched about AUTOMATIC FABRICS FAULT PROCESSING USING IMAGE PROCESSING TECHNIQUE IN MATLAB according which defective fabric parts can be processed using Matlab with image processing techniques. In developing countries like India especially in Tamilnadu, Tirupur the Knitwear capital of the country in three decades yields a major income for the country. To upgrade this process the fabrics when processed in textiles the fault present on the fabrics can be identified using Matlab with Image processing techniques (Kang *et al.*, 2001).

Mallat (1998) studied about BAYESIAN CLASSIFICATION OF FABRICS USING BINARY CO-OCCURRENCE MATRIX according to their research Classification of fabrics is usually performed manually which requires considerable human efforts. The Co-occurrence matrices functions characterize the texture of an image by calculating how often pairs of pixel with specific values and in a specified spatial relationship occur in an image, and then extracting statistical measures from this matrix. The extracted features from GLCM and BLCM are used to classify the texture by Bayesian classifier to compare their effectiveness (Mallat, 1998).

Marcelja (1980) studied about fabric defect detection in spatial domain. A survey of existing techniques for fabric defect identification and analysis is discussed in length. The prime domain of survey was in frequency, spatial and statistical approach (Marcelja, 1980).

Millán *et al.*, It has been observed that low bit plane contains more information as that of the higher bit plane. If the camera for imaging is brought close or far from the actual scene, then the analysis value varies Millán *et al.*, again discussed the image analysis in wavelet domain using haar wavelet. An entropy based analysis is also discussed here using the genetic algorithm (Millán and Escofet, 1996).

MATERIALS AND METHODS

Algorithm

The fabrics quality visual inspection system includes the following steps:

❖Image Acquisition
❖GLCM matrix extraction
❖Contrast, Energy, Correlation and Homogeneity Extraction
❖Entropy Extraction
❖Mean Intensity and standard deviation of intensity computation

The fabrics image is acquired using the digital camera installed at a fixed location so that the quality measurement is independent of illumination and camera position. In the presented case, a Nikon Cool-Pix camera with 14 MPixel camera is used for image acquisition.

The acquired image is in jpeg format (24-bit color format) and is converted to gray scale format i.e. 8-bit color format having gray shades form black (=0) to white (=255).

A glcm matrix is extracted from the gray scale image using the matlab tool. A GLCM matrix is the mapping of pixels arranged in a special format. The property of GLCM matrix is very useful in differentiating the different texture from each other. The GLCM property includes contrast, energy, homogeneity and correlation. These properties are summarized in the table below:

Contrast	$\sum_i \sum_j (i-j)^2 P_{\mathbf{d}}(i,j)$
Energy	$\sum_i \sum_j P_{\mathbf{d}}^2(i,j)$
Homogeneity	$\sum_i \sum_j \frac{P_{\mathbf{d}}(i,j)}{1+\lvert i-j \rvert}$
Correlation	$\frac{\sum_i \sum_j (i-\mu_x)(j-\mu_y)P_{\mathbf{d}}(i,j)}{\sigma_x \sigma_y}$

Entropy, mean intensity ad standard deviation are computed by using the following method:

Entropy = $-\sum_{i=0}^{L-1} P_i . \log P_i$

Where Pi is the probability distribution function of the image under study.

The mean intensity I_{mean} is given by:

$I_{mean}\ (\mu) = \frac{1}{N}\sum_{r=1}^{row} \sum_{c=1}^{col} I_{(r,c)}$

Where I(r,c) is the gray level intensity at location (r,c).

The standard deviation (σ) of the gray level intensity is given by:

$\sigma = \frac{1}{N}\sum_{r=1,c=1}^{row,col} (\mu - I_{(r,c)})^2$

RESULTS AND DISCUSSION

Results

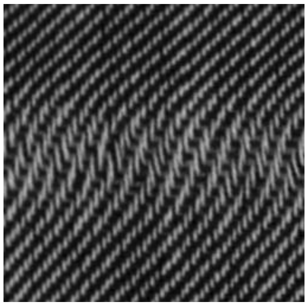

Figure 1 (Standard)

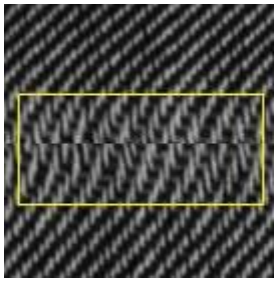

Figure 2 (Deviated Quality)

The presented algorithm has been tested on the following images taken by using the Nikon CoolPi 14MP digital camera.

As can be seen from figure 1 and 2, in figure 2 there is an offset in the texture or design pattern. On careful observation of figure 2, it is observed that the black lining is coming on white lining as shown in yellow region. This type of defect however cannot be picked in normal inspection but comes on surface when the design pattern is coarse enough. In that case, the entire product quality suffers. This deviation in quality can be observed in the result table as shown below:

Below table shows the GLCM and other parameters for the acceptable fabric quality and downgraded fabric quality. It is clear from the example that the quality parameters vary in their numerical values as the fabric deviates from the standard or predefined quality.

S. No.	Parameter	Standard Quality	Defected Quality
1	Contrast	5.067	4.854
2	Energy	0.021	0.128
3	Correlation	0.426	0.987
4	Homogeneity	0.507	0.765
5	Entropy	5.984	5.980
6	Mean Intensity	0.039	0.036
7	Standard Deviation	77.00	75.78

Conclusion

It may be observed from the result table as shown above that the quality parameters get a shift when the fabric quality gets offset from the standard image. This variation may be higher if the variation or deviation is in either side of the design. Therefore, a very well fabric quality can be estimated by analyzing the above parameters. A fine tuning of the same may be used to accurately distinguish the minor offset in design pattern.

REFERENCES

Escofet J, Millán MS, Ralló M (2001). Modeling of woven fabric structures based on Fourier image analysis, *Applied Optics* **40**(34) 6170-6176.

Hu MC and Tsai IS (2000). Fabric Inspection Based on best Wavelet Packet Bases, *Textile Research Journal* **70**(8) 662-670.

Tsai IS and Hu MC (1996). Automatic Inspection of Fabric Defects Using an Artificial Neural Network Technique, *Textile Research Journal* **66**(7) 474-482.

Portilla J, Navarro R, Nestares O (1996). Texture synthesis- by-analysis method based on a multiscale early-vision model, *Optical Engineering* **35**(8) 2403-2417.

Randen T and Hakon-Husoy J (1994). Multichannel filtering for image texture segmentation, *Optical Engineering* **33**(8) 2617-2625.

Hosseini RSA (1995). Fourier transform analysis of plain weave fabric appearance, *Textile Research Journal* **65**(11) 676-683.

Hu MC and Tsai IS (2000). Fabric Inspection based on best Wavelet Packet Bases, *Textile Research Journal* **70**(8) 662-670.

Jasper WJ, Garnier SJ and Potlapalli H (1996). Texture characterization and defect detection using adaptive wavelets, *Optical Engineering* **35**(11) 3140-3149.

Jasper WJ and Potlapalli H (1995). Image analysis of mispicks in woven fabric, *Textile Research Journal* **65**(1) 683-692.

Kang TJ *et al.*, (1999). Automatic Recognition of Fabric Weave Patterns by Digital Image Analysis, *Textile Research Journal* **69**(2) 77-83.

Kang TJ *et al.*, (2001). Automatic Structure Analysis and Objective Evaluation of Woven Fabric Using Image Analysis, *Textile Research Journal* **71**(3) 261-270.

Mallat S (1998). *A Wavelet Tour of Signal Processing* (Academic Press).

Marcelja S (1980). Mathematical description of the response of simple cortical cells, *Journal of the Optical Society of America A* **70** 1297-1300.

Millán MS and Escofet J (1996). Fourier domain based angular correlation for quasiperiodic pattern recognition. Applications to web inspection, *Applied Optics* **35**(31) 6253-6260.

