Regularity Analysis For Patterned Texture Using Bollinger Band Method

Sarojini Ganapati Naik[1], Mrs.Archana S.Futane[2]
[1, 2] Dept of E & TC
[1, 2] Pimpri Chinchwad Polytechnic

Abstract- *In Patterned texture is built on a repetitive unit of a pattern. Regularity is one of the most important features in many textures. In this paper pattern texture inspection using Bollinger Band method is introduced. The Bollinger Band method, originally used for financial technical analysis tool using moving average and standard deviation. The Bollinger band method is extended from 1-D approach to a 2-D approach for Jacquard fabric inspection. The Bollinger Band method was shift-invariant across patterned texture .*

Keywords- Bollinger Band, Defect Detection, Histogram Equalization, Moving Average, Standard Deviation.

I. INTRODUCTION

The The regularity of a patterned texture has two meanings: the spatial relationship between pixel intensities and the repeat distance of repetitive units. The spatial relationship between pixel intensities implies that one pixel in an image should have dependencies and steady changes with its surrounding neighborhoods on a patterned texture. The repeat distance of a repetitive unit is a measurement that can monitor whether the pattern distorts and overlaps within its placement rule for the construction of a whole image. This kind of regularity is related to the concept of periodicity. . Previously visual inspection by a human being was carried out, which yields error due to human fatigue and hence accuracy and efficiency was less in traditional inspection methods. To overcome above problem automatic fabric defect detection is necessary to improve quality and as well as production rate [13], which increases the efficiency of the product. There are many kinds of fabric defects like hole, broken end, multiple knitting, knot and oil strain caused due to malfunctioning of the machines or machine spoils as shown in fig 1.

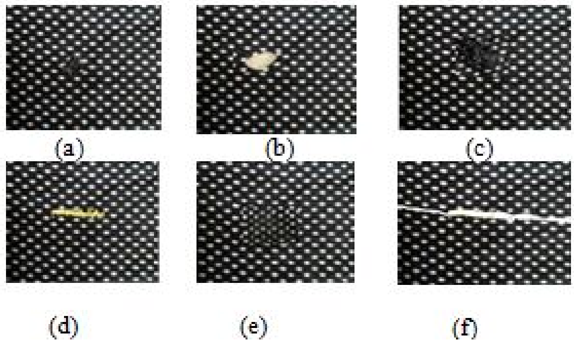


Fig 1. Different fabric defects like (a) Broken end (b) hole (c) Knot (d) Multiple thread (e) Oil strain (f) Thin Bar

Defects reduces the quality of the product and hence losses in the revenues [1][12].Fabric can be classified into patterned and non-patterned fabric. Fabric defect detection is more challenging and complex in patterned fabric compared to non-patterned fabric or plain fabric because of its complexity in repetitive pattern. Various techniques have been developed for patterned texture inspection [5].Statistical analysis indicates the spatial distributions of pixel values. Ngan [5] explained regularity analysis for patterned texture using various methods [9][10]. The relationship between the intensity of pixel values and repetitive units gives the regularity of patterned fabric. The Spatial relationship of image is the dependency and the changes of pixel with the neighboring pixel intensity value.

II. RELATED WORK

This is a natural study about the underlying patterned fabric and the geometrical defective objects in fabric images. For defect detection some previous techniques used are wavelet transform, Fourier transform which uses a simple plain twill and fabric images. But in this process having transformation and reconstruction process which is not give a correct result for dot, star, and box patterned fabric which is a complicated patterned fabric [7]. Whereas for the grey relational analysis, (DT) Direct Thresholding [16], (WGIS) Wavelet Golden Image Subtraction [2, 9, 14], (LBP) Local Binary Pattern [17], (BB) Bollinger band methods are developed for complicated pattern fabrics [2]. Out of that Direct Thresholding, and Local Binary Pattern belongs to spectral approach and Bollinger Band, Wavelet Golden Image Subs traction belongs to mixture of statistical and filtering approach. In this the BB having a regularity property in the patterned texture which is further used to detect the defects in the simple patterned texture of (p1 wallpaper group) that means all above approaches are classified under non -motif based approach which treat whole input image for fabric inspection[4].

III. PROPOSED METHODOLOGY

2.1 Bollinger Band Method

The Bollinger Bands (BB) method, originally for financial technical analysis, was based on moving average and standard deviation. The BB method was shift-invariant across patterned texture and its mathematical definition was simple. In addition, it was able to outline defective regions after detection.[7][2]
Fabric defect detection using Bollinger band consist of two stages,

1) Training Stage
2) Testing Stage

2.1 Training Stage

In training stage, non-defective patterned fabric sample is selected for the regularity analysis and using Bollinger band method normal regularity threshold values are calculated. Training of regularity analysis consists of following steps:

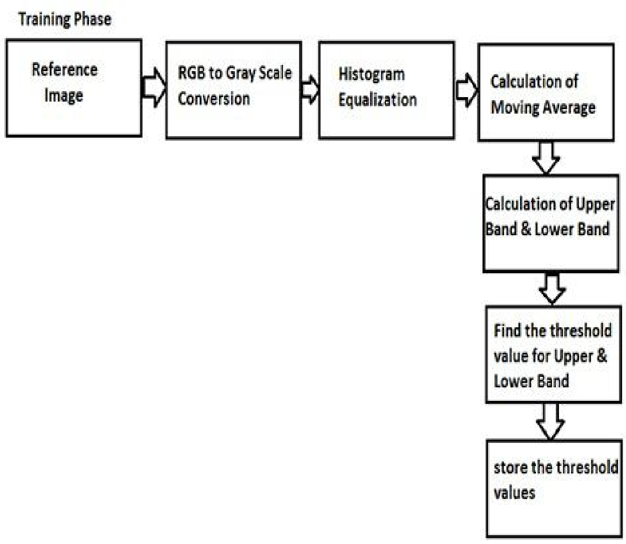


Figure 2.1: Flow diagram for training of fabric defect detection using Bollinger Band

Step 1: Image preprocessing

Fabric images are taken from the rolling texttile mill. While capturing these images they can be blurred and distrurbed by inequal light variations. Image preprocessing consists of color to gray image conversion followed by histogram equalization.Equalization process reduces any noise and blur in the image that will make thresholding most efficient. The Histogram Equalization block enhances the contrast of images by transforming the values in an intensity image so that the histogram of the output image approximately matches a specified histogram.

Step 2. Calculation of moving average or mean

The input image is first converted into the 1-d vector, then the moving average is calculated for the period of N=20 and N=40 with the help of following formula.[7][2]

$$\frac{\mathrm{Mr} = \sum_{j=1}^{n} X_j}{\mathrm{n}} \quad (2.1)$$

Where , Mr = Moving average for the input image
n= period (n=20,n=40)
X j= Value of image pixel for the given period

The moving average for the original image for n=20 is shown in the figure.2.3

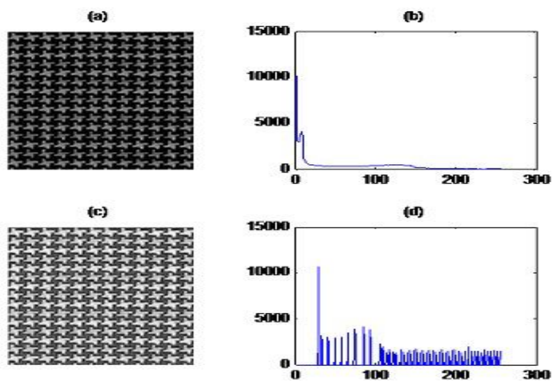


Figure 2.2: (a) Defect-free sample of star-patterned fabric without histogram equalization, (b) the histogram of (a), (c) defect-free sample of star-patterned fabric with histogram equalization, (d) the histogram of (c).

Step 3. Calculation of the Upper Band and Lower Band

For input image, calculate the upper and lower band which is depends upon the moving average and standard deviation. [2][7] The upper band and lower band is calculated by using following formulae and shown in figure 3.4 and 3.5. The upper band is defined as,

$$U_{Br}=Mr+d* \S_r \qquad \textbf{(2.2)}$$

The lower band is defined as ,

$$LBr=Mr-d* \S r \qquad \textbf{(2.3)}$$

Step 4. Obtain the threshold values.

Calculate the maximum (UBMax1) and minimum(UBMin1) value of upper band and maximum (LBMax1) and minimum (LBMin1) value of lower band

2.2 Testing Stage

Testing stage is similar to training stage as shown in Fig. 4, only difference is that we apply threshold obtained in training stage to the LRB and DRB band of testing image for the defect detection.

Step 1: Image preprocessing
Step 2: Calculation of moving average or mean
Step 3: Calculation of the Upper Band and Lower Band
Step 4: Obtain the threshold values.

The values of upper band are compared with the threshold value for upper band of training stage (refer- ence image) and the values of lower band are compared with the threshold value for lower band of training stage (reference image).

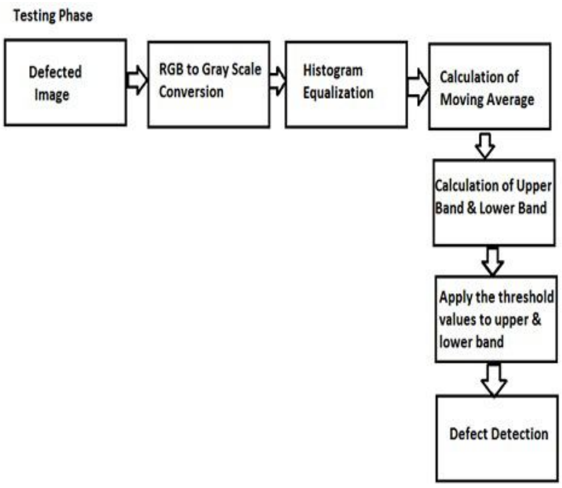


Figure 2.3: Flow diagram for testing of fabric defect detection using Bollinger Band

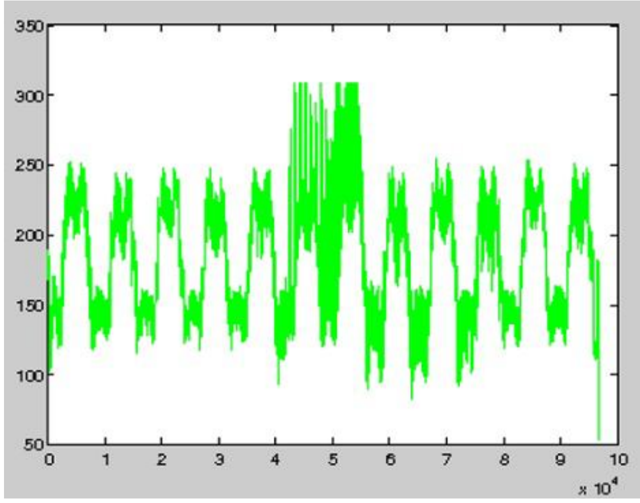


Figure 2.4: Upper Band for defected testing image

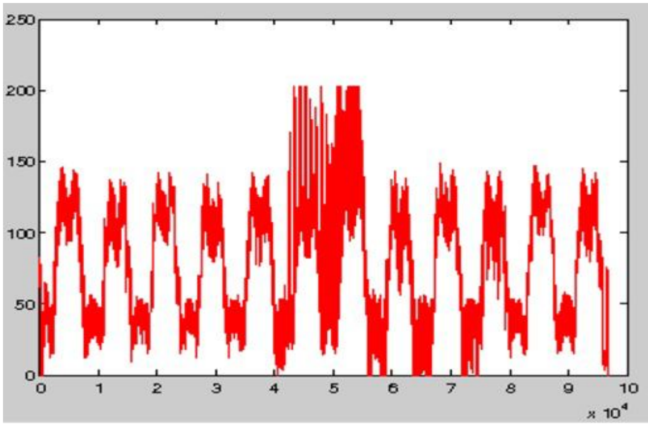


Figure 2.5 Lower Band for testing image (defected image)

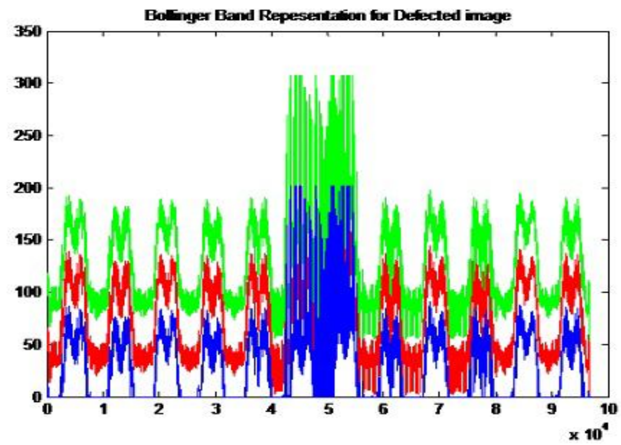
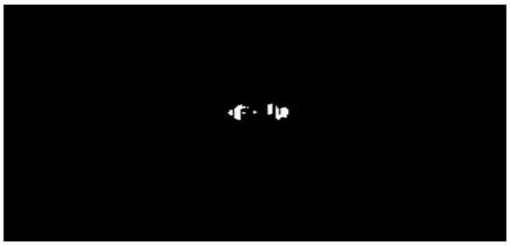


Figure 2.6 Bollinger Band representation for defected image,

Upper Band in green color, Mid band in red color, and Lower Band in blue color and Lower Band with the corresponding threshold values determined during the training stage as shown in figure 2.12.

Step 5. Detect the defect in defected image using the threshold values



IV. CONCLUSION

Bollinger band method used for patterned fabric defect detection is very effective and robust for regular patterned fabric. Its strength is periodic in nature and any change in the periodic signal will affect the output. As compared to other patterned fabric defect detection methods. Its 1-D approach is suitable to optimizing the period lengths (that is n) if it select a larger than repetitive unit. By using BB the alignment problem occurred in wavelet Subtraction method is solved. It require less computation time. BB method is simple to implement and the mathematical definition was very simple. Its efficiency is also high as compared to DT and WGIS. While using BB method light color differences such as light shade not detected by the Bollinger Band method because it is only applicable for gray scaled images not to the RGB scaled images but it gives clean and clear shape of the defect

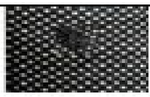
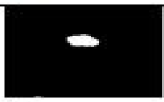
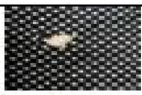
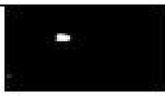
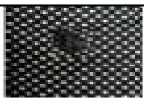
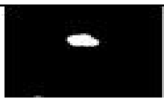
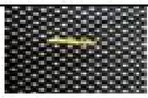
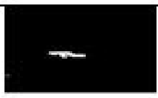
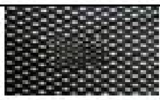
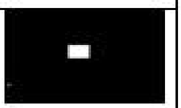
Type of Defect	Image	Bollinger Band Method
Broken end		
hole		
Knot		
Multiple thread		
Oil strain		

Fig 6. Defects on patterned fabric detected using implemented method

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