# PATTERNED FABRIC DEFECT DETECTION USING BOLLINGER BAND METHOD

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## ABSTRACT

*This paper analyses how the Bollinger Band method is used to represent defective objects and repeated patterns in fabric images. Regularity is one of the main features for many Patterned texture material inspection. This study shows the new approach called Bollinger Band (BB) method which is used to outline the shape of the defective region. In the proposed method the Bollinger Band is calculated based on standard deviation and moving average. The Bollinger Band method is shift invariant approach and hence immune of the alignment. In this paper the upper Bollinger band and lower Bollinger bands are developed to indicate defective areas in patterned fabric. Abnormal changes in the pattern lead to large variation in the standard deviation. Its mathematical definition was simple. For defect detection on patterned texture application of Bollinger Band is divided into training stage and testing stage.*

***Keywords : Bollinger Band, Defect Detection, Histogram Equalization, Moving Average, Patterned Fabric, Standard Deviation.***

## I INTRODUCTION

Nowadays automated fabric inspection is a more effective technique in the production of automation. In automated industry defect inspection is the most effective technique because on-loom machine material will move around a speed of 200dpi/ meter so human inspection is not possible with this speed. Errors are caused by human fatigue. Quality assurance and quality control is necessary to retain the stability in the market and maintain the quality. Quality control is nothing but the manufacturing the fabric without defect. Defect is nothing but the flaw on the fabric. So due to automated inspection human errors are minimized and increase the efficiency, reduce the labor cost and computational time which is most effective measures for the improvement of fabric quality. Textures are broadly classified into patterned regular textures and irregular textures. This paper analyses the patterned texture inspection. Fabric is a 2-D pattern texture and is underlined lattice with its symmetry properties governed by its 17 wallpaper groups. In mathematical algebra the wallpaper groups also known as the crystallographic groups. Pattern texture of such a wallpaper group can be generated by at least one of its symmetry rules on lattice among translational, rotational, reflectional and glide reflectional symmetries [1]. These 17 wallpaper groups are named as p1, p2, pm, pg, cm, pmm, pmg , pgg, cmm, p4, p4m, p4g, p3, p3m1, p3mp6, and p6 while letter p refers to primitive and c is a centered cell. The integer that follows p or c denotes the highest order of symmetry that is 1-fold, 2-fold, 3-fold, 4-fold, or 6-fold. Where symbol m indicates a reflectional symmetry and g is a glide reflectional symmetry. Generally the patterned fabric inspection methods depend upon the spectral, statistical, model based, learning and structural. This is a natural study about the underlying patterned fabric and the geometrical defective objects in fabric images. For defect detection some previous methods will not give 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, (WGIS) Wavelet Golden Image Subtraction [2], (LBP) Local Binary Pattern, (BB) Bollinger band methods are developed for complicated pattern fabrics. 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. Bollinger Band consists of Lower Band, Upper Band, and Middle band. By the principle of the Bollinger Band method that is the patterned rows (columns) will generate periodic upper and lower bands. Any defective region in patterned fabric means that there would be break of periodicity in the pattern. Abnormal changes in the Upper Band and Lower Band leads to large variation in standard deviation.

## II PROPOSED METHOD

### 2.1 Bollinger Band Method

Mostly it is used for financial technical analysis based on moving average and standard deviation. It provides a relative definition of high and low prices mainly in stock market for oversold and over brought shares.[8]. Bollinger band consists of Middle band with only moving average, lower band and upper band having moving average and standard deviation. It was extended from 1-D approach to 2-D approach for jacquard fabric inspection. The detection accuracy achieved is 98.59% in good quality from three groups (pmm, p2 and p4m). Bollinger band method was shift invariant across patterned fabric material in addition it was able to outline the shape of defects [3]. [4].

Fabric defect detection Bollinger Band mainly consists of two stages:-

1) Training stage 2) Testing stage

#### 2.1.1 Training Stage

Training stage consists of defect free image the threshold values are determined from the Bollinger band of the reference defect free image. The flow diagram for training for reference free image is shown in Fig1.

**Step1.** Histogram equalization helps in reducing the noise on the images and makes the later threshold process more reliable. Mainly this block is used for contrast enhancement to show equalization of the signal. Which is shown in Fig 2 (a) Defect-free sample of star-patterned fabric without histogram equalization, (c) the histogram of (a), (b) defect-free sample of Star- patterned fabric with histogram equalization, (d) the histogram of (b). it shows a comparison of two defective samples with and without histogram equalization as a preprocessing step. The resultant image show better results with histogram equalized preprocessing than those without histogram equalization. Defect on the fabric is usually characterized by high frequency changes in pixel intensities within an image.

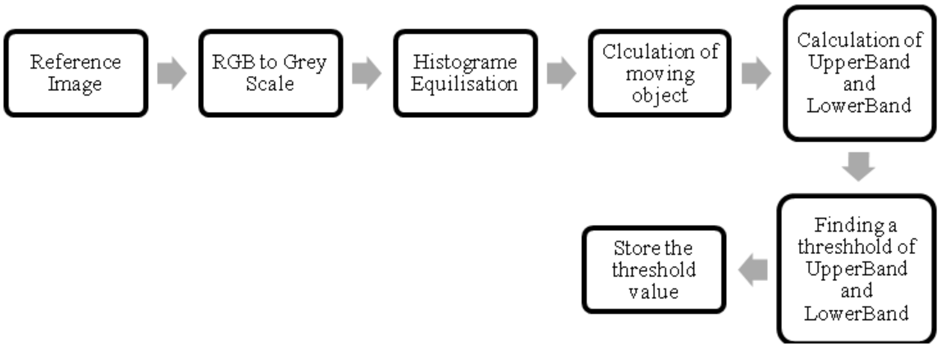



**Fig1. Flow diagram for training of fabric defect detection using Bollinger Band**

## Step2. 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 where n denotes the row dimension of repetitive unit.

$$\mathbf{M_r} = \frac{\sum_{j=r1}^{rn} x_j}{n}$$

Where Mr= is moving average for input image, n=period, $x_j$ = Value of image pixel for the given period. The moving average for n=20 is shown in Fig.2(e).

### Step3. Calculation of Upper band and Lower band

For input image calculation of Upper band and Lower band depends upon the moving average and standard deviation which is calculated by following formula and shown in Fig .2(f) and (g)

Upper band is defined as

$$\mathbf{UB_r = M_r + d * \delta_r}$$

Lower band is defined as

$$\mathbf{LB_r = M_r - d * \delta_r}$$

The standard deviation is defined as

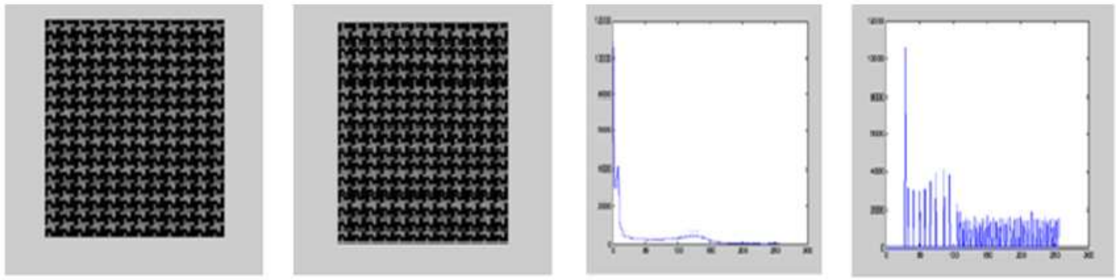
$$\delta_r = \sqrt{\frac{\sum_{j=r1}^{rn}(X_j - M_r)^2}{n}}$$

### Step 4: Obtained the threshold values

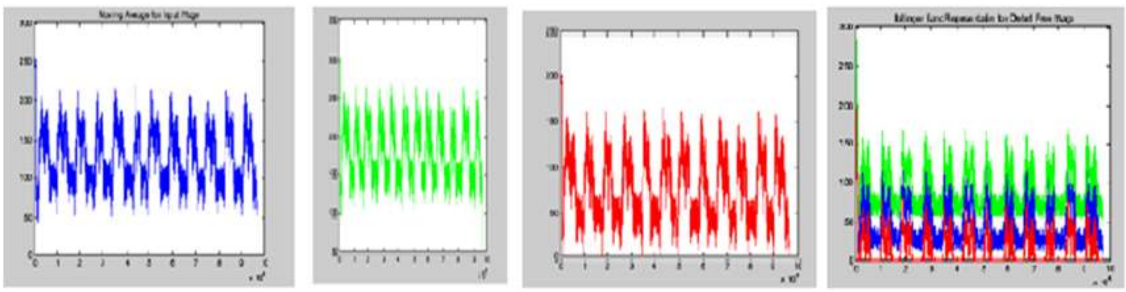
In this calculation of Upper band is maximum (UBmax1) and Minimum of (UBMin1), and for lower band is Maximum of (LBMax1) and Minimum of (LBMin1). Combination of Upper Band, Lower Band and Moving average is shown in Fig.2 (h) which is computation of all.

### 2.1.2 Testing Stage

The testing stage consists of similar stages of training stage. Here for the calculation of Bollinger band, the threshold values of Upper band of testing stage are compared with the threshold values of upper band of training stage(reference image) and the testing stage threshold values of lower band are compared with threshold values of lower band of training stage(reference image). But for testing take a defected image. The flow diagram for testing stage is shown in Fig.3.



*(a) Original image* *(b) RGB to Grey* *(c) Histogram* *(d) Equilize Histogram*



*(e) Moving Average* *(f) Upper Band* *(g) Lower Band* *(h) Computation of all*

**Fig2. Training stage Results**

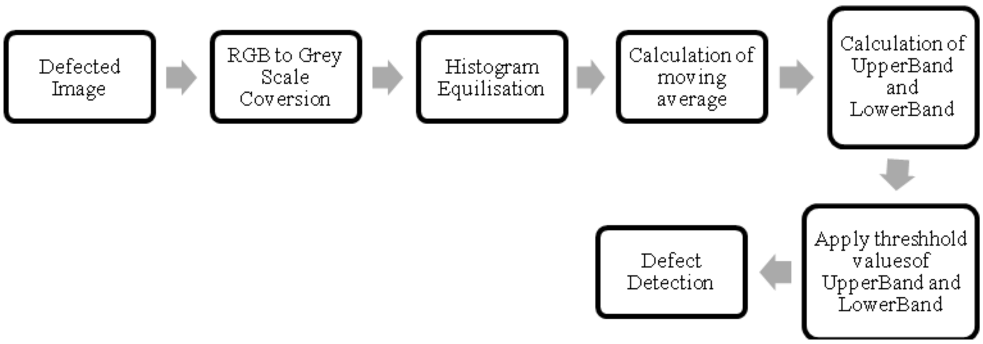



**Fig 3: Flow diagram of testing stage of defected image for the representation of Bollinger Band.**

### Step1:-Histogram equalization of input images

The defected images with hole or any defect take its histogram, the histogram equalized image and its histogram is given in Fig.4. **(**a)Defected sample of star-patterned fabric without histogram equalization, (c) the histogram of (a), (b) Defected sample of Star-patterned fabric with histogram equalization, (d) the histogram of (b).

**Step2. Calculation of moving average or mean is shown in Fig.4 (e).**

**Step3.** Calculation of the upper band and lower band is shown in Fig.4. (f) and (g). In this the value of upper band and lower band of the Bollinger band representation of the defected image is shown. In this the value of upper band and lower band will cross the threshold value (determined in training stage) at the position of defect.

Step4. Threshold the Upper band and Lower band with corresponding threshold values determined during testing stage as shown in Fig.4 (h).

**f (x) = 1 UB Max1 > UB Max**

Step5. Detect the defect in defected image using comparison of threshold values in the testing stage and training stage.

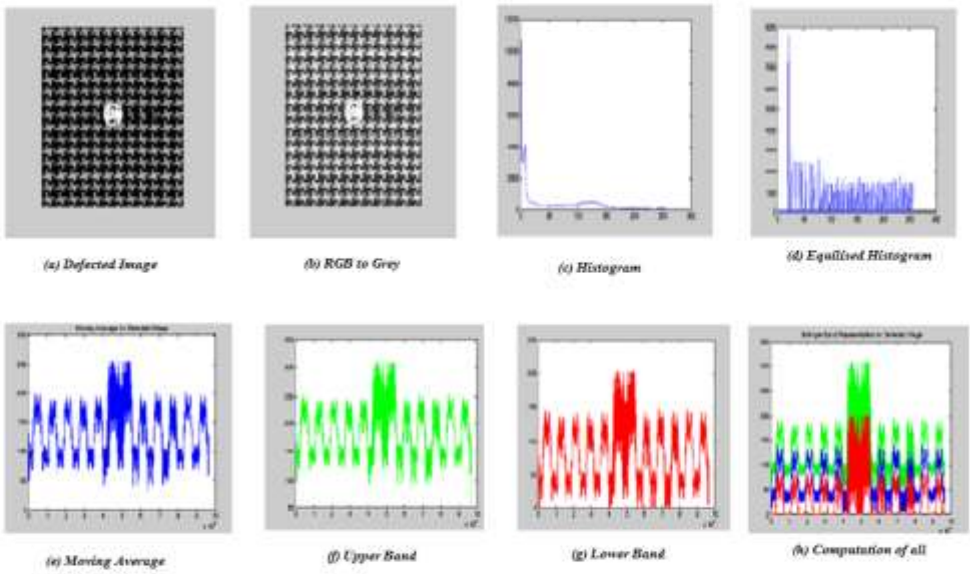
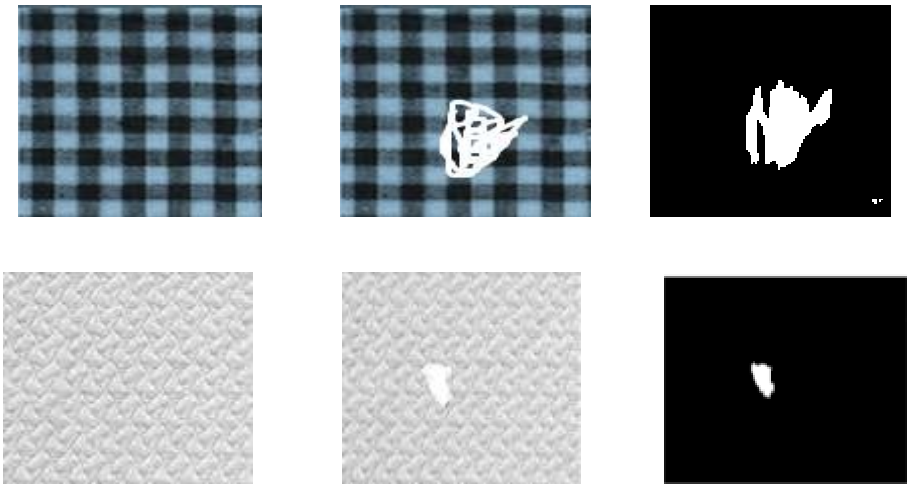
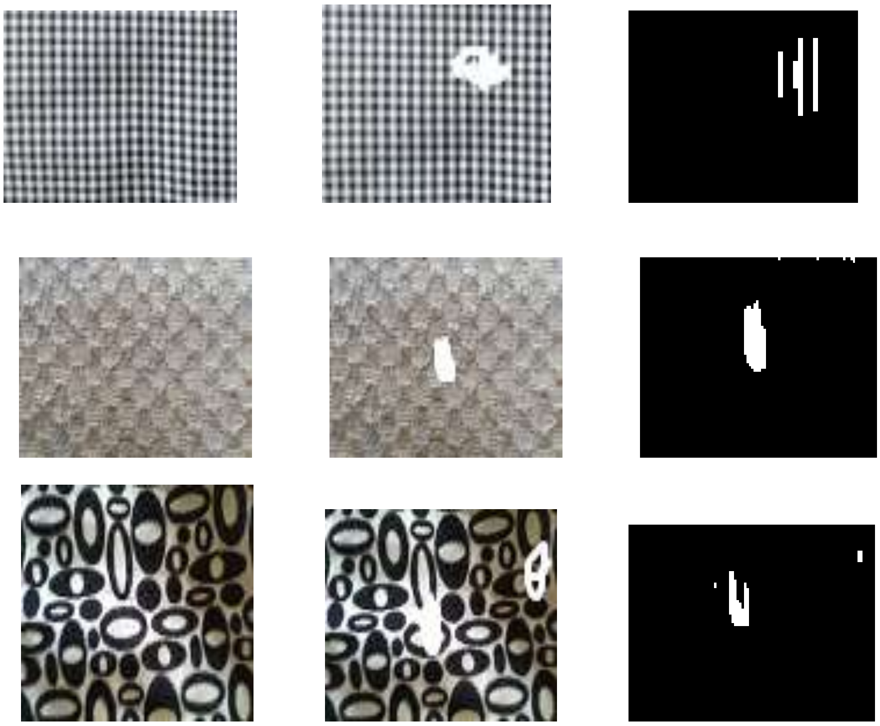



**Fig 4: Testing Stage Results**

## III EXPERIMENTAL RESULTS





**(a)** **(b)** **(c)**

**Fig5. (a) Original Image (b) Defected Image (c) Detected defect.**

## IV CONCLUSION

In this paper the 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. It 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.

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