CHAPTER 5

DEFECT DETECTION IN TEXTILE FABRIC
USING MRCSF

5.1 ABSTRACT

In textile industry, reliable and accurate quality control and inspection becomes an important element. Presently, this is still accomplished by human experience, which is very time consuming and prone to errors. Hence automated visual inspection systems become mandatory in textile industries. Here the automatic fabric defect detection using Multi Resolution Combined Statistical and spatial Frequency method is proposed. Defect detection consists of two phases, first is the training and next is the testing phase. In the training phase the reference fabric images are cropped into non-overlapping sub-windows and the features of the textile fabrics are extracted by applying MRCSF, and stored in the database. During the testing phase the same procedure is applied for test fabric and the features are compared with database information. Based on the comparison results each sub-window is categorized as defective or non-defective. The objective of the proposed work is to identify whether the fabric is defective or not. If it is defective then the location and the type of the defect is indicated.

5.2 TEXTILE FABRICS

Textile Fabric (Wood 1990) materials are used to prepare different categories and types of Fabric products in the textile industry. Natural fabric
and synthetic fabric are the two different classification of textile fabric. Synthetic fabrics are fairly new and have evolved with the continuous growth in textile industry. According to the need and constant innovation in textile industry water proof, oil resistant, UV resistant and abrasive resistant fabrics are also available.

5.3 NATURAL FABRICS

Natural fabrics make use of animal’s coats, the cocoons of silkworms, plants seeds, leaves and stems. It is breathable, does not cause rashes and are also soft and durable. Natural fabric is the best choice for everyone. It does not change color due to UV light and there is no warming effect to the user until the material looses its tensile strength. The various types of natural fabrics are cotton fabric, silk fabric, wool fabric, leather fabric, hemp fabric, coir fabric and linen fabric (Wood 1990).

5.4 FABRIC TEXTURES

Fabric texture is the feel of the fabric (Escofet et al 2001). It is smooth, rough, soft, velvety, silky, lustrous, and so on. The different textures of the fabric depend upon the types of weaves used. Textures are given to all types of fabrics, cotton, silk, wool, leather, and also to linen. Few of the famous fabric textures are flannel, velvet, organdy, chintz, crepe, damask, challis, venise, suede and embossed leather. Different types of fabric textures are cotton fabric textures, silk fabric textures, wool fabric textures, linen fabric and leather fabric.
5.5 TEXTILE DEFECTS

A portion of the textile fabric (Arivazhagan et al. 2006) that has not met the requirement or an attribute of a fabric that is not in the statement of requirement is said to be a defect which leads to customer dissatisfaction.

The various types of defects detected (Ganesh Kumar Gupta 2002) during quality controls are broadly classified as follows.

**Critical Defects** - Defects which are likely to result hazardous to the health of individuals using it.

**Major Defects** - More serious defects which are likely to comprise the purchase of the product.

**Minor Defects** - Include small faults which have no effects on the purchase of the product.

Some of the commonly occurring fabric defects are as follows.

5.5.1 Yarn Defects

The defects originating from the spinning stage or winding stage. Different types of yarn defects are shown in Figure 5.1.

- **Broken Filaments** - Occurs when the individual filaments constituting the main yarn are broken.

- **Colored Flecks** - Presence of colored foreign matter in the yarn.

- **Knots** - Occurs when broken threads are pieced together by improper knotting.
• **Slub**- A Slub is a bunch of fibers having less twist or no twist and has a wider diameter compared to normal spun yarn.

![Broken Filament, Colored Flecks, Knots, Slub](image)

**Figure 5.1 Yarn Defects**

5.5.2 **Weaving Defects**

The defects which originate during the process of weaving. The different types of weaving defects are shown in Figure 5.2.

• **Broken Ends**- This defect is caused by a bunch of broken ends woven in the fabric.

• **Broken Pattern**- A broken pattern is the non continuity of a weave/design/pattern.

• **Double End**- When two or more ends unintentionally get woven as one. This defect is characterized by a thick bar running parallel to the warp.

• **Float**- A float is the improper interlacement of warp and weft threads in the fabric over a certain area.

• **Gout**- A gout is a foreign matter usually lint or waste accidentally woven into the fabric.
Figure 5.2 Weaving defects
- **Hole, Cut or Tear** - The occurrence of hole, cut or tear which is self explanatory.

- **Lashing-In** - An extra piece of yarn woven into the fabric in the vicinity of the selvedge.

- **Local Distortion** - Distortion occurs when there is displacement of warp and/or weft threads from their normal position.

- **Missing Ends** - The fabric is characterized by a gap parallel to the warp. The no of ends missing may be one or more.

- **Oil or Other Stain** - These are spot defects of oil, rust, grease or other stains found in the fabric.

- **Oily or Soiled Ends** - These are oily or soiled warp threads.

- **Oily Weft** - Streaks of dirty and oily weft appearing across the width of the cloth.

- **Reed Marks** - A pronounced warp way crack caused by a damaged or defective reed.

- **Selvedge Defect** - These are different defects appearing at the selvedge.

- **Slough Off** - A slough-off is a bunch of weft woven into the fabric.

- **Smash** - Ruptured cloth structure characterized by many broken warp ends and floating picks.

- **Snarls** - A short length of yarn, mainly the weft which has spontaneously doubled back on itself results in snarls.

- **Stitches** - A single thread float either in the warp or weft way. It is very prominent in case of different colors of warp and weft.
• **Untrimmed Loose Threads** - Any hanging threads on the face of the fabrics are termed as loose threads.

### 5.5.3 Piling and Raising Defects

The defects occurring in pile fabrics during the process of weaving. Different types of piling and raising defects are shown in Figure 5.3.

- **Broken Pattern Due To Defective Piles** - A broken pattern is the result of non-continuity of the design/pattern in the pile fabric.
- **Pile less Spot** - A pile less spot is a spot without the pile where it should have been.
- **Uneven Piles** - In case of raised fabric, if the raising is uneven on certain spots it shows a patch.

![Broken Pattern](image1)
![Pile less Spot](image2)
![Uneven Piles](image3)

**Figure 5.3 Piling and Raising Defects**

### 5.5.4 Milling Defects

The defects which are caused during the process of milling of woolen fabrics. It is shown in Figure 5.4.
- **Mill Rigs**- The creases produced in the milling are known as mill rigs.

- **Uneven Milling**- Uneven matting together of fibers results in uneven milling.

![Figure 5.4 Milling defects](image)

**5.5.5 Embroidery Defects**

The defects which are caused during the process of embroidery. It is shown in Figure 5.5.

**Embroidery Defects** - Defective or absence of embroidery.

![Figure 5.5 Uneven embroidery defects](image)
5.6 TEXTILE DEFECT DETECTION

Inspection is the process of determining whether a product has deviated from a given set of specifications. Texture defect detection (Tamnun et al 2008) can be defined as the process of determining the location and/or extend of a collection of pixels in a textured image with remarkable deviation in their intensity values or spatial arrangement with respect to the background texture.

5.6.1 Manual Defect Detection

In the textile industry, inspection (Arivazhagan et al 2006), is needed to assure the fabric quality before any shipments are sent to customers, because defects in fabrics can reduce the price of a product by 45% to 65%. Currently, the quality assurance of web processing is mainly carried out by manual inspection. However, the reliability of manual inspection is limited by ensuing fatigue and inattentiveness. Indeed, only about 70% of defects can be detected by the most highly trained inspectors.

5.6.2 Automated Defect Detection

Textile industries are facing increasing pressure to be more efficient and competitive by reducing costs. Therefore, automated detection of defects in textile fabrics (Arivazhagan et al 2006), which results in high-quality products and high-speed production, is definitely needed.

Some of the advantages of automated detection (Tamnun et al 2008) of defects are:

- 100% inspection can be conducted
- It is a more consistent process when compared with manual inspection
It is a non-contact inspection, thus avoiding problems that arise as a result of using some contact inspection devices.

It can usually result in:
- lower labor costs
- improved quality
- faster inspection
- increased reliability

5.7 DEFECT DETECTION SYSTEM

The defect detection system is shown in Figure 5.6. This setup uses computer vision and intelligence which controls the other peripherals such as motor, printer, etc. The test fabric is placed in such a way that, it is suitable for the camera to capture the image.

The digital camera is made mobile by using the motor which controls the shaft movement which in turn is controlled by the computer. The camera is interfaced to the computer. The image samples are collected using the Data acquisition toolbox of the MATLAB software. The collected image samples are then given to the image processing algorithm, which classifies the test sample as defective or non-defective after comparing the test image features with the database. If a defective sample is detected, the location and the type of defect is printed on the screen for the user.

The entire process can be summarized as follows:

1. Feature Extraction of the original image using MRCSF
2. Capturing and Feature extraction of the test sample
3. Comparison with Library
4. Indication of the Defects
The above steps are explained as follows:

1. **Feature Extraction of original image**: This is the initial task in which the original non-defective reference samples are collected and their features are extracted using appropriate algorithm and stored in a database.
Before feature extraction the sample images are wavelet transformed so that the samples are localized in both time and frequency. MRCSF Features like mean, standard deviation, energy, entropy, spatial frequency, Multi Resolution Markov Random Field Matrix and Gray Level Co occurrence Matrix (GLCM) for both the reference fabric and the fabric to be tested were extracted using Matlab 7.5 and hence compared for classification.

All the above mentioned steps are done using MATLAB Image Processing toolbox and Database Toolbox.

2. Capturing and Feature extraction of test sample: This part comes under the classification stage where the test samples are captured using a digital camera which is attached to a shaft which moves over the entire sample. The movement of the shaft is controlled by embedded system which employs a microcontroller. After capturing the sample images the feature are extracted in the same way as in the case of original image and stored in the library.

3. Comparison with Library: In this stage the stored features of the original image and the test sample are compared using the nearest neighborhood algorithm. The test samples are classified as defective or non-defective based on the comparison results.

4. Indication of the Defects: The obtained defect is analyzed for its type using the available database of defects and hence the defect type is displayed on the screen. The location of the defect is also displayed on the screen for the ease of the user.

The Computation time of the proposed algorithm for Fabric defect detection system is shown in Table 5.1.
### Table 5.1 Computation Time of the MRCSF in Textile Fabric

<table>
<thead>
<tr>
<th>S.No</th>
<th>Item</th>
<th>Subjective Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Training Phase</td>
<td>2.5 to 3 Sec</td>
</tr>
<tr>
<td>2</td>
<td>Defect Detection and Location of the Defect Indication Phase</td>
<td>2 Sec</td>
</tr>
<tr>
<td>3</td>
<td>Type of the Defect</td>
<td>7 Sec</td>
</tr>
</tbody>
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PC Configuration of the proposed algorithm:

- Intel(R) Core (TM) 2 CPU
- Model T 5600
- Processor Speed 2 GHZ
- Bus Speed 987 MHZ
- 512 MB RAM
- 40 GB HDD