

**DETECTION OF DEFECTS ON
WARP KNITTED FABRIC SURFACES**

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Department of Mechanical Engineering

University of Moratuwa

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DECLARATION

I declare that this is my own work and this thesis/dissertation does not incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any other University or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in text.

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The above candidate has carried out research for Master's thesis under my supervision.

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Abstract

This thesis is concerned with the development of a novel learning algorithm based method for detection of defects on patterned, textured surfaces of warp knitted fabric surfaces using neural networks. The acquired images were subjected to several filtering processes and morphological operations to improve the state of the image and enhance texture details.

The proposed method was developed by considering textural abnormality as a defect. Since the warp knitted fabric surface is a repetitive patterned texture the image was splitted into windows prior to analysis in order to enhance detectability of defects. Also, gray level co-occurrence matrix and local binary pattern were used as the texture models of an image window. Selected set of statistical measurements were used to extract the texture from gray level co-occurrence matrix. Since detection of defects on an image is a binary classification problem an anomaly detection scheme was proposed. This enabled the development of the detection model by learning the feature space of one particular class of problem. A self-organizing map was used to learn the texture patterns on images of the non defective fabric samples. The resultant Euclidian distance of a window from the self-organizing map was used as the measure of similarity to non-defective windows while thresholding the similarity measure by using the maximum value similarity of non-defective windows as the threshold. The proposed anomaly detection scheme enabled detection of defects on particular type of texture.

There were different surface types associated with warp knitted fabrics. Self-organizing map based clustering approach was used to discretize the detection problem according to surface texture type and the intention was to simplify the detection problem and solve it with respect to specific texture. Furthermore, the histogram of the local binary pattern was used for development of compressed self-organizing map to represent the local texture of a window of different surface types.

All the calculations, analysis tasks and development of mathematical models were performed in a matlab environment. The appropriate graphical user interfaces were also developed with the proposed method been applied on images with seven different types of defects on seven surface types. The quality percentage was calculated based on the number of false positives/false negatives of the detection results for the image windows in order to evaluate the validity of the proposed method. The method results quality percentage was in the 80% range during the detection of defects.

Key words : Intelligent learning algorithms, Self-organizing neural networks, defect detection, Statistical texture analysis, Fabrics

TABLE OF CONTENTS

DECLARATION	i
Acknowledgements	ii
Abstract	iii
TABLE OF CONTENT	iv
LIST OF FIGURES	vi
LIST OF TABLES	vii
LIST OF ABBREVIATIONS	viii
1 CHAPTER 1 INTRODUCTION	1
1.1. Related work	2
1.1.1. k - nearest neighbor classifier	3
1.1.2. Multi layer perceptron	5
1.1.3. Kohonen self-organizing map	6
1.2. Overview of the thesis	9
1.3. Organization of the thesis	11
2 CHAPTER 2 OVERVIEW OF THE METHODOLOGY	12
2.1. Warp knitted fabrics: An overview	12
2.2. Defect types on warp knited fabrics	13
2.3. The problem definition and objectives	15
2.4. The proposed solution and implementation	17
3 CHAPTER 3 PRE PROCESSES FOR IMAGE ENHANCEMENT	19
3.1. Gama transformation	20
3.2. Homomorphic filter	21
3.3. High-pass filter	22
3.4. Morphological operations	23
3.5. Histogram equalization	24
4 CHAPTER 4 EXTRACTION OF TEXTURE FEATURES	25
4.1. Global texture model: Gray level co-occurrence matrix	26
4.2. Local texture model: Local binary pattern	36
5 CHAPTER 5 SURFACE TYPE IDENTIFICATION	40

5.1.	Kohonen self-organizing model -----	41
6	CHAPTER 6 DETECTION OF DEFECTS -----	49
6.1.	The KSOM Model -----	51
6.2.	The method for detection of defects and implementation -----	52
7	CHAPTER 7 CONCLUSIONS -----	61
	REFERENCES -----	62
	APPENDIX A: MATLAB SCRIPTS -----	65

LIST OF FIGURES

Figure 2.1: Example surface types -----	12
Figure 2.2: Example defect types -----	13
Figure 2.3: Knitting machine faults-----	14
Figure 2.4: Defects associated with yarn faults -----	14
Figure 2.5: Defects associated with chemical processes-----	15
Figure 2.6: Schematic for implementation of the proposed solution -----	17
Figure 2.8: Set-up for image capturing-----	24
Figure 3.1: Images of defective fabric samples -----	20
Figure 3.2: Green channel of defective samples -----	20
Figure 3.3: Gama transformed images -----	21
Figure 3.4: Corrected images for illumination -----	22
Figure 3.5: High-pass filtered images -----	22
Figure 3.6: Morphologically processed images -----	24
Figure 3.7: Histogram equalized images-----	24
Figure 4.1: Original and pre-processed images -----	34
Figure 4.2: Local binary pattern-----	52
Figure 5.1: Catalogue of fabric types-----	40
Figure 5.2: GUI for feature extraction stage-----	41
Figure 5.3: Flow diagram for of KSOM training related processes-----	43
Figure 5.4: GUI for training of KSOM-----	43
Figure 5.5: Activated regions in KSOM lattice -----	44
Figure 5.6: Labeled KSOM on GUI -----	45
Figure 5.7: Flow diagram of proposed scheme for fabric type identification -----	46
Figure 6.1: Flow diagram of initially developed detection scheme -----	48
Figure 6.2: Flow diagram of final detection scheme -----	49
Figure 6.3: Flow diagram for associated processes of KSOM training-----	50
Figure 6.4: Flow diagram for Defect detection strategy -----	51
Figure 6.5: GUI for implementation of defect detection scheme-----	52
Figure 6.6: Presentation of final detection results on GUI -----	53

LIST OF TABLES

TABLE 4.1: RESULTS OF EXPERIMENT -----34
TABLE 6.1: GENERATION OF DETECTION RESULTS -----53
TABLE 6.2: DETECTION RESULTS OF THE EXPERIMENT -----54
TABLE 6.3: RESULTS OF ACCURACY ASSESMENT -----59

LIST OF ABBREVIATIONS

Abbreviation	Description
ANN	Artificial neural networks
BMU	Best matching unit
BP	Back propagation algorithm
GD	Gradient descent method
GLCM	Gray level co-occurrence matrix
GUI	Graphical user interface
<i>k</i> -NN	<i>k</i> - nearest neighbor algorithm
KSOM	Kohonen self-organizing map
LBP	Local binary pattern
PC	Personal computer
PCA	Principle component analysis
MLP	Multi-layer perceptron
USB	Universal Serial Bus
W.R.T.	With respect to

