DETECTION OF DEFECTS ON

WARP KNITTED FABRIC SURFACES

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Degree of Master of Engineering

Department of Mechanical Engineering

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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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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

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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
k-NN	*k* - 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