BUSITEMA UNIVERSITY

FACULTY OF ENGINEERING

DEPARTMENT OF TEXTILE AND GINNING ENGINEERING

PREDICTION OF SINGLE JERSEY PLAIN COTTON KNITTED FABRIC WIDTH USING ANFIS

BY

BUSITEMA UNIVERSITY
DATE:.....
LIBRARY

NIWAGABA RONALD

BU/UG/2010/127

Email: lintroni@gmail.com

TEL: 0700264460/0775427617

MAIN SUPERVISOR: DR. NIBIKORA ILDEPHONSE

CO-SUPERVISORS: MR. EDWIN KAMALHA

MR. SSEMBATYA MARTIN

A FINAL PROJECT REPORT SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF BACHELOR OF SCIENCE IN TEXTILE ENGINEERING OF BUSITEMA UNIVERSITY

JUNE 2014

DECLARATION

I, **Niwagaba Ronald, BU/UG/2010/127**, declare that this report is mine and has never been produced by any other person for academic or any other purpose. It is my report about my final year project as a partial requirement for the fulfilment of the award of a degree of Bachelor of Science in Textile Engineering of Busitema University.

Name: NIWAGABA RONALD.

Signature: .....

Date: 13/06/2014.

BUSITEMA UNIVERSITY LIBRARY
CLASS No.:
ACCESS NO.: FF10439

APPROVAL

This report has been submitted with the approval of the following supervisors.

MAIN SUPERVISOR

Name: DR. NIBIKORA ILDEPHONSE.

Signature.....

Date: .....

CO-SUPERVISOR

Name: MR. EDWIN KAMALHA.

Signature.....

Date: .....

CO-SUPERVISOR

Name: MR. SSEMBATYA MARTIN.

Signature.....

Date: .....

ACKNOWLEDGEMENT

I would like to thank the Almighty God for life, protection, guidance and wisdom throughout my studies.

I thank so much the management of Southern Range Nyanza Limited for allowing me to carry out my research from their company. I thank so much the head of knitting section, Mr. Danstan Katungi for his dedicated consultation time towards the success of this project.

Great thanks also to my University supervisors and all teaching staff in the Department of Ginning and Textile Engineering for their continued guidance throughout my studies. A paper is not enough for me to express the support and guidance I received from you for all the time I have been at Busitema University.

My sincere gratitude goes to my loving parents for their continued parental, moral and financial support towards me during my academic journey.

I cannot forget to thank my fellow students for the cooperation they showed me during the course of study.

DEDICATION

I dedicate this report to my parents, Mr. Mutigah Denis and Mrs. Mutigah Dommitilla, my brother Kaliisa Martin and my sister Arinda Immaculate for their love and concern about my education and life.

ABSTRACT

Knitted fabric structures have considerable advantages over woven fabric structure, normally high elasticity, flexibility, easy-care property, better air permeability, etc. There is however a number of problems with single jersey knitted structures encountered at the stages of knitting make-up and of end use. The major problem is high rate of fabric width shrinkage which causes dimensional instability during the usage of the fabric.

Achieving required fabric width with an acceptable shrinkage value is always the ultimate target of a knitted fabric manufacturer. This presented study was undertaken to develop an adaptive neuro-fuzzy model for the prediction of width of single jersey plain cotton knitted fabric. Creating this model helps knit fabric manufacturers in optimizing manufacturing processes to control knitted fabric width thus improving dimensional stability.

Multiple linear regression models as well as ANN have been used in the past for the prediction of finished width of the single jersey cotton knitted fabric from the input machine and knitting parameters. Prediction by ANN was found to be more accurate than those obtained from multiple linear regression models.

The focus of this research was to develop a more reliable model to predict the fabric width of 100% single jersey plain cotton knitted fabric in wet relaxed state. Adaptive neural fuzzy inference system was used to develop an efficient model to predict the fabric width. Yarn count and stitch length were considered for input parameters. 28 fabric samples knitted with different stitch lengths and yarn counts were considered in developing the model. Model creation was done using fuzzy logic tool box of the Matrix Laboratory (MatlabR2010a) software. Microsoft excel was used for drawing graphs (data analysis).

The model was successfully created and validated. From the summary of goodness, it can be concluded that ANFIS performed better than its linear regression counterpart as it had a better R^2= 0.95 and RMSE=1.912 compared to linear regression which gave R^2=0.89and RMSE=2.765. Thus this model can be comfortably used by knit fabric manufacturers of 100% cotton knitted fabrics.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACRONYMS

ANFIS	Adaptive Neuro-Fuzzy Inference System
ANN	Artificial Neural Networks
GUI	Graphical User Interface
FIS	Fuzzy Inference System
ASTM	American Standard Testing Methods
MF	Membership Function
RMSE	Root mean square error.
MSE	Mean Square Error
SRNL	Southern Range Nyanza Limited

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background

Knitting is a process of fabric manufacturing by interlocking series of loops of one or more yarns. Its share in fabric production is about 20% and is the second most popular technique of fabric and garment formation, after weaving. It is estimated that over 7 million tonnes of knitted goods are produced annually throughout the world (**Sadhan, 2011**). Knitted fabrics are used to produce garments that cover every part of the human body, in a wide range of garment types from socks, caps, gloves and underwear to upper and lower body garments varying from T-shirts to formal jackets. The dramatic increase in the popularity of knit fabrics during the last three decades provides a vivid example of the interrelationships between lifestyle, technology and fashion. Knitted structures have considerable advantages over woven structure, normally high elasticity, flexibility, easy-care property, better air permeability, etc. There is however a number of problems with single jersey knitted structures encountered at the stages of knitting make-up and of end use. The major problem is high rate of fabric width shrinkage (**Spencer, 2000**).

The dimensional stability in form of the required fabric width of knit fabrics is an important area of the knitting industry. There are various factors influencing the dimensional stability as well as the fabric width of the knitted fabrics. Studies have been carried out over time and it was concluded that the geometry of knitted fabrics are based on two fundamental factors which are; **the different dimensionally stable states** (that is, relaxation states) to which the knitted fabrics are imposed and **the loop length,** that is, the length of yarn in the knitted loop, that is, stitch length (**Booth, 1997**). The cotton knitted fabric and garment manufacturers encounter an enormous problem of fabric width shrinkage. In spite of a fair amount of research a comprehensive solution is still elusive. The fabric undergoes relaxation as it is washed and dried causing change in dimensions. If the fabric is delivered to the garment manufacturers with a very low fabric width residual shrinkage, the perceptible shrinkage by the wearer will be negligible. Hence, the challenge before the knitter and finisher is to select appropriate knitting and relaxation combination to achieve the lowest residual fabric width shrinkage.

REFERENCES

1. Booth, J.E.: Textile Mathematis, Volume 3, 1st Edition, The Textile Institute, Manchester, U.K., 1977.
2. Charnock, I. L. A., Yarn Quality for Knitting. Text. Inst. And Ind., (1977), 15, (5), 175–7
3. Doyle P J, (1953).Fundamental aspects of the design of knitted fabrics, Journal Text.Inst, 44,561-573.
4. Engelhard, O., Warp versus Weft Knitting, Hos. Trade J., (Aug. 1967), 92–5.
5. Fuzzy Logic Toolbox™ User's Guide, MathWorks, MathWorks, Inc. ©1995-2013
6. H. Esen, M. Inalli, A.R Sengur, M. Esen. "Predicting Performance of a Ground-Source Heat Pump System using Fuzzy Weighted Pre-Processing-Based ANFIS". Building and Environment, 43(12), pp. 2178-2187, 2008.
7. Hills R L (1989), William Lee And His Knitting Machine, Journal Of Textile Institute, 80, 169–184.
8. International Journal of Engineering & Technology IJET-IJENS Vol: 11 No: 01
9. J.-S. R. Jang. "ANFIS: Adaptive-Network-based Fuzzy Inference Systems". IEEE Transactions on Systems, Man and Cybernetics, 23(3), pp. 665-685, 1993.
10. Jiang Tao et al, (1997).Effects of yarn and fabric construction on spirality of cotton single jersey fabrics, Textile research Journal, 67(1), 57-68.
11. Karba, M., Gersak, J., Stjepanovic, Z., The Influence of Knitting Parameters on Dimensional Changes of Knitted Fabrics in the Process of Relaxation, Proc. 2nd International Textile Clothing & Design Conference, 2004, pp. 200-205.
12. Knapton J J F et al, (1968).The dimensional properties of knitted wool fabrics part 1: The plain knitted structures, Textile research Journal, October, 999-1012
13. Lehmann, E. L.; Casella, George (1998). Theory of Point Estimation (2nd Edition.). New York: Springer. ISBN 0-387-98502-6. MR 1639875.
14. Majumdar A, Majumdar P K & Sarkar B, J Text Inst, 96(2005) 55
15. Majumdar A, Majumdar P K & Sarkar B,Indian J Fibre Text Res, 30(2005)19
16. Moon Won Suh, (1967).A study of the shrinkage of plain cotton fabric based on the structural changes of the loop geometry due to yarn swelling and deswelling. Textile research Journal, May, 417-431.
17. Munden D L,(1959).The geometry and dimensional properties of plain knit fabrics, Journal Text.inst,50,448-471.

18. Parmar M S and Srivastava S K, (1999).An unconventional way to incorporate comfort in knitted fabrics, Indian J Fibre Text Res, 24, 41-44.
19. Prasanta Kumar Panda and Dr Sumanta Bhattacharyya, The Indian Textile Journal, Single jersey cotton knit: Finished width prediction by ANN, published may, 2013.
20. Sadhan Chandra Ray (2011), Fundamentals and Advances in Knitting Technology, Woodhead Publishing India Pvt Ltd.
21. Sharma I C et al (1984), Dimensional stability of plain weft knitted fabrics, Indian Journal of Textile research, 9, 13-18.
22. Spencer D J (2001), Knitting Technology, Woodhead Publishing, Cambridge.