

UNIVERSITI TEKNOLOGI MARA

**A NOVEL METHOD FOR
CLASSIFICATION OF AGARWOOD
OIL USING RADIAL BASIS
FUNCTION NEURAL NETWORK**

NURUL SHAKILA BT AHMAD ZUBIR

Thesis submitted in fulfilment
of the requirements for the degree of
Master of Science

Faculty of Electrical Engineering

May 2019

ABSTRACT

Recently, there has been an increasing number in classifying the quality of Agarwood oil. Several studies have been documented for Agarwood oil applications such as aromatic oils, perfumery ingredient and medicinal practices. Furthermore, the demand of Agarwood oil is very high especially in the Middle East countries. Previously, Agarwood oil quality has been investigated based on tools or feed forward pattern classifier. The boxplot, Q-Q plot and histogram were used to visualize the statistical analysis in this study. The classification technique of Artificial Neural Network (ANN) involved the selection structure of hidden neuron that has been performed simultaneously in Scaled Conjugate Gradient (SCG) algorithm. Several criticisms have been directed towards SCG for its learning speed in selecting the optimal values of network weights. This thesis presents a new model in classifying the quality of Agarwood oil by using pattern classifier technique which is Radial Basis Function Neural Network (RBFNN). This research utilized 96 samples of Agarwood oil and 7 types of chemical compounds. The result of the study demonstrated that the RBFNN has been accurate in clarifying the quality of Agarwood oil. This study identified the 3 number of spread and 100 maximum number of hidden neuron improved the RBF network by achieving lowest mean squared error (MSE) which is 3.37×10^{-26} and 100% of accuracy, specificity, sensitivity and precision respectively for the classification of RBFNN. From the experiment show that number of variety ranged number of spread have much better performance compared to SCG technique.

ACKNOWLEDGEMENTS

In the name of Allah, Most Gracious, Most Merciful.

All Praises be to Almighty Allah, who has given me the reason and purpose to live. All knowledge, discoveries and inventions, since the first day of Prophet Adam on this small earth within the infinite galaxy are just like a drop of water from Almighty Allah's bountiful ocean of knowledge. Thereby at the end of my Master research, I witnessed that there is nothing more amazing and astounding other than the wonders of His living creatures, His creatures and His universe. May Allah mercifully forgive us all for ignorance and pride. Amin.

I wish to extend my deepest appreciation and gratitude to my supervisor Dr. Nurlaila Ismail, my main-supervisor and Prof.Ir.Dr. Mohd Nasir Taib, my Co-supervisor for their consistent efforts, guidance and countless moments of attention that they had generously spread throughout the time and the length of this course and research work. Their utmost dedication, comments and suggestions had contributed valuable assistance for this research.

I am greatly pleased and indebted to my beloved parents who give me inspirations and supports intellectually and morally to pursue my goal. I also wish to thank all members of DCS and ASP for sharing information and fruitful discussions. Special thanks to Dr Mohd Hezri Fazalul Rahiman, Dr Wan Isni Sofiah, Dr. Mohd Hezri Marzaki, Najidah Hambali, Nurul Nadia Mohammad, Siti Naimah, Khairah Jaafar and Nur Sakinah for their contributed efforts, information and valuable feedbacks which have undoubtedly inspired me to write this thesis.

TABLE OF CONTENT

	Page
CONFIRMATION OF PANEL OF EXAMINERS	ii
AUTHOR'S DECLARATION	iii
ABSTRACT	iv
ACKNOWLEDGEMENT	v
TABLE OF CONTENTS	vi
LIST OF TABLES	ix
LIST OF FIGURES	xi
LIST OF ABBREVIATIONS	xiv

CHAPTER ONE: INTRODUCTION

1.1	Research Background	1
1.2	Problem Statement	2
1.3	Objective of the study	5
1.4	Scope of study	5
1.5	Thesis Organization	6

CHAPTER TWO: LITERATURE REVIEW

2.1	Introduction	7
2.2	Agarwood oil	7
2.3	Agarwood oil quality analysis	9
2.4	The Agarwood oil classification technique	12
2.5	Intelligent Pattern Classifiers	13
	2.5.1 Radial Basis Function Neural Network (RBFNN)	14
2.6	Performance measure of classification system	15
2.7	Summary	16

CHAPTER THREE: THEORETICAL BACKGROUND

3.1	Introduction	17
3.2	Statistical Analysis	17
	3.2.1 Data distribution of agarwood oil compounds	17
3.3	Intelligent Pattern Classifier system	22
	3.3.1 Scale Conjugate Gradient (SCG)	22
	3.3.2 Radial Basis Function Neural Network (RBFNN)	23
	3.3.2.1 Radial Basis Function Neural Network (RBFNN) architecture	25
3.4	The Performance evaluation method	26
	3.4.1 Confusion Matrix Based Performance Measure	26
	3.4.2 Mean Square Error (MSE)	28

CHAPTER FOUR: METHODOLOGY

4.1	Introduction	30
	4.1.1 The model development of intelligent pattern classifier	30
4.2	Data Collection	33
4.3	Statistical Analysis	34
	4.3.1 The statistical Analysis of data distribution of Agarwood oil compounds	35
4.4	Intelligent Pattern Classifier system: Scaled Conjugate Gradient (SCG)	36
4.5	Intelligent Pattern Classifier system: RBFNN	41