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OPTIMIZATION OF MULTILAYER PERCEPTRON (MLP) NETWORK TRAINING ALGORITHMS FOR AGRWOOD OIL QUALITY SEPARATION

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ABSTRACT

As a part of on-going research in classifying the agarwood oil quality, this research presented the optimization of the Multilayer Perceptron (MLP) network with the three different training data network algorithms; Scaled-Conjugate Gradient (SCG), Levenberg Marquardt (LM), and Resilient-Backpropagation (RBP). The work was done by using MATLAB version 2017a. The training algorithms were applied to agarwood oil data to classify its compounds to the different quality either in high or low. The data collection consists of 96 inputs of the abundances (%) of agarwood oil compounds and the output was the quality of the oil (high=2 and low=1). The process involved in data pre-processing; data normalization, data randomization, and data division. The data is divided into three groups with a ratio of 70%: 15%: 15% for training, validation, and testing respectively. The performance criteria were taken as a consideration which includes confusion matrix, accuracy, sensitivity, specificity and precision also mean square error (MSE). It was found that Levenberg-Marquardt (LM) presented the highest accuracy which was 100% for all training, validation and testing dataset with the lowest MSE. This research is important and contributed as additional research findings especially in the classification of agarwood oil area.

Keywords: agarwood oil, MLP, training algorithms, confusion matrix and MSE

1. INTRODUCTION

Agarwood oil is a well-known essential oil extracted by agarwood trees which belong to genus *Aquilaria Malaccensis* of plant family *Thymelaeaceae*. Agarwood is resin-impregnated heartwood which all parts of the agarwood plant have its purpose such as tree trunks and branches can produce a quality powder or essential oils and the stem part can be extracted to form agarwood oil. Generally, agarwood has been used in incense, perfumery, medicine and ceremonies by different cultures and religious. It is crucial to grade agarwood oil into their quality because high quality and low quality of agarwood oil have the differences in terms of price, usability and others [1][2]. Currently, the MLP network has widely used among the researcher in any areas of studies such as in grading the essential oil, pattern recognition, oil industry and many others. MLP successfully implement in estimating the extraction yield on *Oregano* and *Valerian* essential oil [3], [4]. Researcher [4] used training algorithms; SCG, RBP, LM and Gradient Descent, while researcher [3] only used LM algorithm. The only similarities in both research studies are the results obtained showed that LM algorithm performed good accuracy and lowest error. Researcher [5] successfully implemented MLP to detect infant hypothyroidism using cry signal that extracts using MFCC analysis.

Different number of hidden neurons and the number of coefficients are varied in this experiment as well as a Scaled conjugate gradient (SCG) used as training algorithm.

The output obtained concluded that the lowest MSE and highest accuracy performed at hidden neurons 15 with the 20 feature that the lowest MSE and highest accuracy performed at hidden neurons 15 with the 20 feature coefficients [5].

1.1 Objectives

This work embarks the following objectives:

- i. To employ Multilayer Perceptron (MLP) network techniques with the optimization of three training algorithms; Scale Conjugate Gradient (SCG), Levenberg Marquardt (LM) and Resilient Backpropagation (RBP) for agarwood oil quality classification.
- ii. To evaluate the MLP performance so that they pass the agarwood oil quality grading.

2. METHODOLOGY

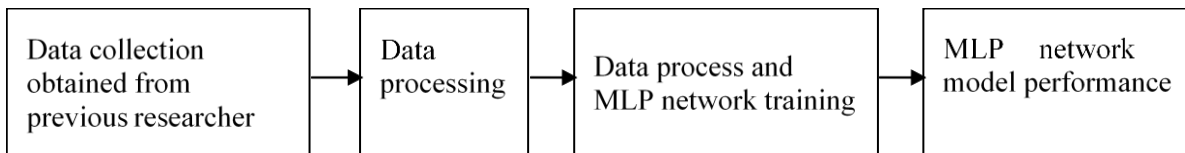


Figure 1. Block Diagram of Experimental Work.

3. RESULTS

Table 1 Final Design Parameter of Each MLP Training Algorithms.

Parameter	Training Algorithms		
	SCG	*LM	RBP
Number of Input neurons	7	7	7
Number of Hidden neurons	2	6	9
Number of Output neurons	1	1	1
Training	100%	100%	100%
Validation	100%	100%	100%
Testing	100%	100%	100%
Mean Square Error (MSE)	1.35×10^{-2}	1.39×10^{-9}	1.91×10^{-8}

*The best training algorithms

CONCLUSION

The study in this research has successfully classified the agarwood oil into high and low quality using MLP network with training algorithms. It was showed that LM outperforms others. The results of this research were supported by the accuracy yield by LM for training, validation and testing that obtained 100%. Besides that, the value of mean squared error in LM shows the lowest among other algorithms. This technique will give benefits to the agarwood oil industry especially to its grading system.

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2. Pihak Perpustakaan ingin memohon kelulusan YBhg. Profesor untuk membuat imbasan (*digitize*) dan memuat naik semua jenis penerbitan di bawah UiTM Cawangan Perak melalui Repositori Institusi UiTM, PTAR.
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Kelulusan daripada pihak YBhg. Profesor dalam perkara ini amat dihargai.

Sekian, terima kasih.

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