Neural Network Algorithm Development
For Ion Sensitive Field Effect Transistor (ISFET) Sensor

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ABSTRACT

Ion Sensitive Field-Effect Transistor, which later in this paper will refer as ISFET is a kind of sensor that able to differentiate the ion by replacing the gate of the FET with electrode and the membrane. Membrane acts as selector for the ions. The sensor detects the ions and converts it into electrical signal. However the sensor has weakness to detect main ion from the interfering ion in the mixed solution when the ions have same characteristic. For this project, potassium ion (K+) and ammonium ion (NH4+) will be used as the sample as both ions have similar size. To overcome the problem, the sensor needs to be trained for pre-calibrate and pre-process by developing a model of Artificial Neural Networks (ANN). The ANN makes the model learn the pattern by the sample of inputs and outputs to estimate results or to get more accurate data. Backpropagation is used as the learning method of ANN model. The algorithm will be developed in MATLAB. The objective of this project is to develop ANN model for ISFET sensor that able to estimate the main ion in mixed solution by learning the pattern of the input and output of the sensor. The ANN model performance can be optimized by altering certain parameters in the learning algorithm. The results show that the model is able to predict with 97% accuracy and has strong and precise estimation ability with R-factor of 91.55%.

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CHAPTER 1

INTRODUCTION

1.1 PROJECT BACKGROUND

The ISFET sensor is MOSFET based sensor that detects ions by their sizes [1]. The sensor functions by sensing the ions that pass through the membrane. The ions that pass through the membrane will change the voltage threshold of the FET [2]. The output produced of this ISFET is in Drain Current value that will be converted to voltage value by readout circuit. The complications to differentiate the ions with same characteristics are the main concern and motivation to develop the learning algorithm for this ISFET. The output produced will show as the mixed ions instead of single separated ions. In order to overcome this problem, the ISFET needs to learn how to differentiate the ions with same characteristics.

The neural network is one of the artificial intelligence that able to demonstrate the learning ability same as brain [7]. The neural network will be applied as the learning algorithm to improve the selectivity of ions for this ISFET. By implementing this model to the ISFET, the sensor is expected to have better classification ability in classifying solutions of its pH value.