

Poster code:

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Rank-based Optimal Neural Network Architecture for Dissolved Oxygen Prediction in a 200L Bioreactor

Nor Hana Mamat^{1,2*}, Samsul Bahari Mohd Noor¹, Azura Che Soh¹, Farah Saleena Taip¹, Ahmad Hazri Ab. Rashid³, Nur Liyana Jufika Ahmad³, and Ishak Mohd Yusuff³.

¹Faculty of Engineering, University Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia

²Faculty of Electrical and Automation Engineering Technology, TATI University College, Teluk Kalong, 24000 Kemaman, Terengganu, Malaysia

³Industrial Biotechnology Research Centre, SIRIM Berhad, Persiaran Dato Menteri, Seksyen 2, 40700 Shah Alam, Selangor, Malaysia

*Corresponding author's e-mail: norhana.mamat @tatiuc.edu.my

Abstract. In a fermentation process, dissolved oxygen (DO) concentration is mostly affected by aeration rate, and agitation speed and temperature. Thus it is beneficial to model the relationship of DO concentration with these variables based on real process data for further use in controller design. Formulation of bioprocess model using process data or data driven technique is able to describe the true process conditions better than a model driven technique that focused on ideal steady state condition of process map the relationship of DO concentration with other physical and chemical process variable that has influence on the process. Artificial neural network (ANN) is a reliable and popular tool for approximation of nonlinear relationship between input and output data with little knowledge and no assumption of the process, also when dealing with problems involving prediction of variables. The structure of a neural network model namely input layer, hidden layer and output layers has significant effect on predicted results. While the number of neurons in input and output layers are determined based on the number of respective input and output parameters, there is no straightforward method to determine the optimal number of neurons in hidden layer. In order to select the appropriate structure, trial and error method or repeated runs are usually used to find the number of hidden neurons that gives smallest value of error and highest value of correlation coefficient. In this paper, a ranking system based on repeated runs of neural network model is used to determine the architecture with optimal number of hidden neurons for three different division of data for training and testing. The ranks are applied together for both training and testing datasets. The backpropagation neural network model with Lavenberg Marquardt learning algorithm was developed using 1476 samples real process dataset obtained from a fermentation process in a 200L bioreactor. The ranking system applied to simulation results shows that the best prediction of dissolved oxygen level was obtained for 80%/20% data division with 6 hidden neurons.

Keywords: Neural network, optimal architecture, bioreactor, dissolved oxygen