

The Performance of Non-Stationary Fuzzy Systems on Mackey-Glass Time-Series Prediction

S. Musikasuwan¹, S. Chuai-Aree², and N. McNeil³

Abstract: The aim of this research is to investigate the modeling performance of non-stationary fuzzy systems. An investigation was carried out in which the performances of type-1, type-2, and non-stationary fuzzy logic systems (FLSs) were compared in their ability to predict the Mackey-Glass time-series with various levels of added noise. Root Mean Square Error (RMSE) has been used for evaluating the model performance. Each of the FLSs was tuned to achieve the best possible performance. These experiments were repeated a number of times in order to establish the mean of performances for each FLS.

The data used in this research were generated by using Mackey-Glass time series method in total 1000 data series (500 for training and 500 for testing). We assign 4 antecedents for forecasting, i.e $s(t - 3)$, $s(t - 2)$, $s(t - 1)$, and $s(t)$ to predict $s(t + 1)$, we use only two membership functions for each antecedent, so there are in total $2^4 = 16$ rules. The initial locations of antecedent membership functions are based on the mean and standard deviation of the first 500 points, i.e., training data.

The results show that the best performance was achieved with a non-stationary fuzzy system with normal distribution function used as perturbation function while the centre variation has been applied with 1000 iterations. Hence, we may tentatively suggest that while type-2 fuzzy systems may not strictly be necessary in order to achieve optimal performance, their benefit may lie more in achieving good performance in a more tractable model.

^{1,2,3} Department of Mathematics and Computer Science
Faculty of Science and Technology, Prince of Songkla University
181 Charoenpradit Road, Rusamilae, Muang, Pattani, 94000 Thailand
and
Centre of Excellence in Mathematics, CHE, Si Ayutthaya Rd., Bangkok, 10400, Thailand
salang.m@psu.ac.th, somporn.c@psu.ac.th, nittaya.ch@psu.ac.th