Electricity Consumption Forecasting Using Adaptive Neuro-Fuzzy Inference System (ANFIS)

K. G. Tay[1,*], Hassan Muwafaq[1], W. K. Tiong[2], Y. Y. Choy[3]

[1]Faculty of Electrical and Electronics Engineering, Universiti Tun Hussein Onn Malaysia, Malaysia
[2]Faculty of Computer Science and Information, Universiti Malaysia Sarawak, Malaysia
[3]Faculty of Applied Science and Technology, Universiti Tun Hussein Onn Malaysia, Malaysia

Abstract Universiti Tun Hussein Onn Malaysia (UTHM) is a developing Malaysian Technical University. There is a great development of UTHM since its formation in 1993. Therefore, it is crucial to have accurate future electricity consumption forecasting for its future energy management and saving. Even though there are previous works of electricity consumption forecasting using Adaptive Neuro-Fuzzy Inference System (ANFIS), but most of their data are multivariate data. In this study, we have only univariate data of UTHM electricity consumption from January 2009 to December 2018 and wish to forecast 2019 consumption. The univariate data was converted to multivariate and ANFIS was chosen as it carries both advantages of Artificial Neural Network (ANN) and Fuzzy Inference System (FIS). ANFIS yields the MAPE between actual and predicted electricity consumption of 0.4002% which is relatively low if compared to previous works of UTHM electricity forecasting using time series model (11.14%), and first-order fuzzy time series (5.74%), and multiple linear regression (10.62%).

Keywords ANN, FIS, ANFIS, Electricity Consumption, Forecasting, UTHM

1. Introduction

Overestimation of electricity demand will cause the wasting of resources as electricity cannot be stored, while underestimation will lead to higher operation cost [1]. Reliable and accurate prediction of electricity consumption is therefore vital for Utilities Company to plan for future power generation and distribution. Load forecasting can be classified into short-term load forecasting (STLF), medium-term load forecasting (MTLF) and long-term load forecasting (LTLF). STLF forecasts load from one day or one week at most, MTF forecasts load one day to several months while LTF predicts more than a year ahead [2]. STLF plays role for scheduling the generation and transmission of electricity, MTLF tries to plan the fuel purchases, whereas LTLF is aimed to develop the power supply and delivery system (generation units, transmission system, and distribution system) [3].

Universiti Tun Hussein Onn Malaysia (UTHM) is a developing Malaysian Technical university which is located in Johor state in south Peninsular Malaysia. UTHM has two campuses. The main campus is in Parit Raja, Batu Pahat, Johor, while another campus is in Pagoh, Johor.

UTHM electricity consumption forecasting has been forecasted by using time series models [4], first-order fuzzy time series [5] and multiple linear regression [6] with MAPE of 11.14%, 5.74% and 10.62% respectively. We believe the prediction accuracy of the studies [4-6] still can be improved by employing other techniques such as autoregressive integrated moving average (ARIMA) [7], seasonal ARIMA (SARIMA) [8], artificial neural network (ANN) [8-12], support vector machine (SVM) [12], Least-square SVM (LSSVM) [1], support vector regression [9], ANFIS[13-15], ARIMA-ANFIS [16] etc.

Research in [13] applied pre-processing to improve noisy and missing data. They then considered the time of day, the day of the week, the heating degree of the day (HDD) and cooling degree of the day (CDD) as ANFIS inputs, whereas historical electricity load was target and output was the forecasted load to predict STLF.

Mordjaoui [14] forecasted STL using half-hour weekly load data rearranged in multi-input single output by ANFIS. Their ANFIS input and output structures are shown in Figure 1 below: