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Fuzzy logic load forecasting with genetic algorithm parameter adjustment

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Abstract

World-wide pressure on existing power distribution systems calls for action to be taken in order to curb the energy deficit. The concept of a smart grid can assist since a significant function is the improvement of energy efficiency in transmission and usage. This is also known as energy management. Load forecasting can indirectly aid energy management by raising user awareness to reduce the peak and total power usage. Load forecasting has been implemented using many different methods over the years, from statistical methods to computational intelligence methods. Combinations of methods also exist to enhance the forecasting capabilities. Following from observations made, it was hypothesised that a fuzzy logic load forecasting algorithm could be improved by incorporating an optimisation technique such as genetic algorithms.

In order to observe the effects of a genetic algorithm on a fuzzy logic load forecasting system, MATLAB® was used to implement a load forecasting algorithm using fuzzy logic systems and genetic algorithms. The fuzzy logic systems used the day (week or weekend), the time of day and the historic power usage to perform the forecasting. The genetic algorithm adjusted the fuzzy logic parameters to minimise the peak and total energy errors in a 24 hour period.

Using data from one week prior to the test yielded the most accurate results after considering varying quantities of input data. The results obtained from five case studies indicated a good correlation between the forecast and measured values. Initial results were obtained using *a priori* knowledge of the behaviour of the system, then the genetic algorithm was implemented. The full week forecast results showed an average improvement, for the five cases, of 4.32 and 18.95 times for the peak energy error and the total energy error respectively. This indicates that the dissertation hypothesis was proven to be correct.