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Abstract

Artificial Neural Network Short-term Electrical Load Forecasting Techniques

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This thesis presents some practical techniques for short-term electrical load forecasting problem using artificial neural networks. The model described in this thesis is back-propagation based multi-layer perceptron including temperature factor. This thesis attempts to solve three main problems, local minimum, slow convergence process, and forecasting accuracy.

Local minimum problem is a fetter to most of artificial neural network systems, especially for those based on back-propagation. Noise method is considered regarding this problem first. Then another method, which repeats the training process for several times and selects the weights and biases with the best performance, is employed and compared with the noise method.

Generally, neural network systems based on BP are performed with method of steepest descent, which is a first-order cost function minimization method. In order to expedite the training process, variable learning rate method and Quasi-Newton method are introduced. These two methods expedite the training process substantially, especially for the Quasi-Newton method (second-order method). Quasi-Newton method reduces the training time to only one fourth of the method of steepest descent, which makes the training time not the main consideration any more.

Accuracy is definitely the most important problem for STLF. This thesis contributes

three new ideas, i.e., intelligent treatment of holidays and weekends, Chinese New Year problem and intelligent data preprocessing, in order to improve the forecasting accuracy. Holiday and weekend problem affects the forecasting accuracy greatly. After the intelligent treatment of holidays and weekends, the forecasting performance is prominently improved. Chinese New Year is a special holiday. The intelligent treatment of holidays and weekends is not applicable for the Chinese New Year period. Method of yearly displacement compensation reduces its influence and improves the forecasting accuracy for the Chinese New Year period. Intelligent historical data preprocessing is to detect the abnormal data in the data files. This procedure is also very important since existence of abnormal data is very harmful to the forecasting.

As a result, the average forecasting error for 1996 in Macao is 2.979 %, which surpasses the world leading level of 1995 and is very close to world leading level of 1997 and 1998.