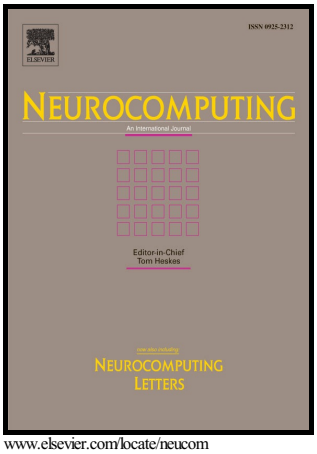

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A Short-Term Power Load Forecasting Model Based on the Generalized Regression Neural Network with Decreasing Step Fruit Fly Optimization Algorithm

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Abstract

Short term power load forecasting plays an important role in the security of power system. In the past few years, application of artificial neural network (ANN) for short-term load forecasting (STLF) has become a research hotspots. Generalized regression neural network (GRNN) has been proved to be suitable for solving the non-linear problems. And according to the historical load curve, it can be known that STLF is a non-linear problem. Thus, the GRNN was used for STLF in this paper. However, the value of spread parameter σ determines the performance of the GRNN. The fruit fly optimization algorithm with decreasing step size (SFOA) is introduced to select an appropriate spread parameter σ. Combined with the weather factors and the periodicity of short-term load, an effective STLF model based on the GRNN with decreasing step FOA was proposed. Performance of the proposed SFOA-GRNN model is compared with other ANN on the basis of prediction error.

Keywords: Short term power load forecasting, Generalized regression neural network, Fruit fly optimization algorithm, Decreasing step size

1. Introduction

With the development of agriculture, industry and the improvement of living standards, the quality of power supply has been put forward higher requirements. Power system consists of power grid and power users, its role is to provide an economical and reliable electric energy for all kinds of users. The generating capacity and electricity consumption are changing all the time, however, electricity is not easy to store, the generating capacity must follow the change of the electricity consumption, thus dynamic balance can be achieved, otherwise it will affect the quality of power supply, and even endanger the safety and stability of the power system.

Short term load forecasting, mainly refers to the power load forecasting for the next few hours, one day to several days. According to the load forecasting, the system can optimize operation time of generating units, determine the start and stop time of the generating units and its output. Accurate load forecasting can minimize the total consumption of the whole generating units. Therefore, short term load forecasting plays an important role in power system. The accuracy of prediction has a direct impact on the security, economy and quality of the power system. To improve the accuracy has become an important research field in the operation and management of the modern power system [1].

The research on short term load forecasting has a long history. It has been studied since 1950s. Classical methods include regression analysis, time series method, Kalman filter method and other traditional mathematical statistics method [2-8]. In early 1990s, with the development of artificial intelligence technology, artificial intelligence has been gradually introduced into the short-term load forecasting, such as expert system approach, fuzzy prediction method, wavelet analysis method, chaos theory method and SVM method [9-13]. But there are still shortcomings among them, such as complex procedures, low precision, slow convergence speed, poor stability and so on.

So far, the neural network theory has gradually become mature [14-19], application of artificial neural network (ANN) for short-term load forecasting has emerged, and many papers have reported successful experiments and practical tests with ANN [20]. Classical BP neural network can fit the high dimension and nonlinear mapping between the input and output from the complex sampled data, thus it can make forecast with high precision. But the method can not clearly distinguish the impact factors on the load data, the network structure is not able to be determined automatically, and the forecasting results are easy to fall into the local optimum [21].

The generalized regression neural network (GRNN) which was developed by Specht [22] is a kind of radial basis function neural network. Due to its good nonlinear approximation ability, excellent performance of anti-interference, the ability of autonomous learning and fast convergence speed, it is widely used in various disciplines and engineering fields [23]. There are several applications of short term load forecasting as well [24-26]. GRNN does not need to set the model form, but there is spread parameter in the kernel function of the implicit regression unit, and its value has a great influence on the prediction

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