Analysis of Power Load Prediction Model Based on Intelligent Optimization Algorithm

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Keywords: Power Load Forecasting Model, Firefly Intelligent Optimization Algorithm, Multi-Level Granularity, Simulation Experiment.

Abstract: The power load forecasting model based on intelligent optimization algorithm is based on the theory of mathematical optimization technology as a reference for design, and it is also applied to the intelligent algorithm technology and modeling technology in the field of intelligent learning of robots. We hope to improve the performance of the power load forecasting model effectively by optimizing the prediction model parameters through a series of intelligent algorithms. At present, there are three common power load forecasting models. This paper mainly discusses the construction process of power load forecasting model of firefly intelligent optimization algorithm based on evolution theory.

1. An Overview of Firefly Optimization Algorithm in Power Load Prediction Model

The research of power load forecasting model based on intelligent optimization algorithm can provide important theoretical guidance for the future construction of smart grid industry, because it realizes the optimization of various energy equipment configuration in power system, and greatly improves the economic and social benefits of power industry enterprises. At present, the construction of power load forecasting model is divided into short-term and medium-term, which can provide the most safe and reliable reference for the effective decision-making of power system.

The traditional power load forecasting uses historical data modeling, which can realize the effective prediction of future load content, but some influencing factors can not be eliminated in the process of forecasting, which leads to the inaccurate prediction results, and even seriously affects the power generation plan and maintenance plan of the power enterprise to some extent. Nowadays, in order to pursue high efficiency operation and realize all-round and reasonable prediction of power load, power enterprises have also introduced new models of power load forecasting, such as brand-new group intelligent algorithm —— firefly intelligent algorithm (Glowworm Swarm Optimization ,GSO). This algorithm mainly simulates the natural activity of firefly community gathering in nature at night, and makes a deep analysis with reference to the basic communication mode of its fluorescein and peer communication activities. Firefly algorithm has the ability of global extreme value calculation, and has been widely used in engineering industry. Multi-level particle size support vector regression machine is mainly used in the firefly algorithm, which can effectively improve the global search ability and computing ability of the firefly algorithm, realize the mixing of different algorithms in the training process of the regression machine, optimize and adjust the key parameters in the regression machine, and analyze the prediction performance of the model at the same time[1].

2. Application of Firefly Optimization Algorithm Power Load Prediction Model

In this paper, the hybrid algorithm of firefly optimization algorithm is used to construct the parameters of the optimized power load forecasting model.

2.1. Initialization Adjustment of Firefly Algorithm

In the different parameters of the firefly algorithm, the content of multi-objective optimization is

  DOI: 10.25236/cseem.2020.060

selected, and the algorithm is used to solve each of the problems, and the firefly multi-objective solution is set, which can effectively improve the efficiency of the algorithm. In this process, sampling algorithm (Latin hypercube sampling algorithm) can be used to construct the initial population, and the distribution feature content in the population can be solved, so that the optimal solution can be obtained directly.

In the process of initializing and adjusting the algorithm, it is also necessary to analyze its optimal parameters, and obtain the minimum value of model error on the verification set, set up the combination of model error minimum parameters, find the optimal solution, verify the content of the minimum value one by one and find the final function adaptation value. Then we can use firefly algorithm to carry out global search, construct global search strategy, and determine the calculation position for firefly algorithm update. The specific algorithm formula should be as follows:

$$v_i = v_i + \beta_0 e^{-\gamma r^2 ij}\left(v_j - v_i\right) + \alpha\left(rand - \frac{1}{2}\right) \tag{1}$$

$\gamma = 1$、$\beta_0 = 1$ In the formula of this algorithm, it can be set, and the random perturbation term is used to calculate, so as to avoid the algorithm falling into the precocious convergence state, so that the optimal value search for the global region can be realized based on the firefly algorithm. In the search process, the algorithm adjustment in the local search area is needed to reasonably improve the fine search ability of the individual particles. The specific operation is to set the specific search radius, write many problems to be solved into the firefly algorithm, and expand the computational search process. if the search solution found is the optimal solution, it is necessary to define the individual position of the optimal solution and reduce the radius appropriately for continuous search, and the search can be stopped after the search conditions are satisfied.

2.2. Operation of Firefly Mixed Algorithm

Firefly model is specially set up for power load forecasting model and applied to its hybrid algorithm to optimize the operation process.

First step, all the parameters in the hybrid algorithm are initialized and optimized. here we can set the population size to, set the search range radius to, set the maximum iteration value to Max, set the parameter combination solution scale parameter to. $n\ \Delta\ S_k$

In the second step, the Latin hypercube sampling algorithm is used to calculate the initial population set as follows:

$$x_i、\ i = 1、2\ldots、\ n$$

In the third step, we use the hybrid algorithm to calculate the fitness values of different individuals in the population, such as to select the best fitness function values in the population, and find the global optimal solution of the function values.

The fourth step is to calculate the value of solving the particle function and update and adjust the global optimal solution at any time.

In the fifth step, the hybrid algorithm is used to search and analyze the global optimal solution in the power load forecasting model.

Step 6, stop the algorithm immediately after the hybrid calculation satisfies the termination condition, if the termination condition is not satisfied, the calculation needs to be re-expanded in step 4.

Based on the above algorithm, the hybrid algorithm model of firefly can be constructed, combined with global spatial search to find the optimal solution of the algorithm, which is mainly based on the local region to analyze the individual data content, so it can also effectively improve the convergence speed of the model calculation. In this process, we need to calculate the numerical size and local search, as follows: $pl(x_k)$

$$pl(x_k) = \frac{f_{\max}(P) - f(x)}{\sum_{y \in P}\left(f_{\max}(P) - f(y)\right)} \tag{2}$$

$pl(x_k)$ If the result is larger, the higher probability of local fine search can be obtained by firefly hybrid algorithm, and the process and details of the algorithm need to be reasonably grasped[2].

3. Analysis of Simulation Experimental Results of Firefly Optimization Algorithm in Power Load Prediction Model

After using the firefly hybrid algorithm to calculate the power load forecasting model, it is necessary to analyze the simulation results of the hybrid algorithm simulation experiment, to effectively plan the load data per hour in the model, to establish the prediction model and the data content, and to establish the simulation experiment result data type analysis system, such as table 1.

Table 1 Classification of computational data set based on firefly mixed algorithm

Mixed algorithm computes data types	Calculation time of hybrid algorithm	Sample
Training set	2018/1/1~201812/31	365*24
Verification set	2019/1/1~2019/6/1	365*24
Test set	2019/6/1~2019/12/31	365*24

Combined with the above hybrid algorithms to calculate the data types, it can effectively judge the ability of firefly hybrid algorithm to optimize the power load prediction model. In order to verify this point, other algorithms such as simulated annealing algorithm, particle swarm optimization algorithm and so on can be used actively.

In the analysis of simulation results, it is necessary to further analyze the efficiency of the algorithm from different calculation time of different algorithms, for example, the firefly hybrid algorithm will consume more time than other algorithms, which is mainly due to the addition of multi-mode search algorithm content in the firefly hybrid algorithm, which realizes the fine adjustment of the algorithm, so it consumes more time. but based on this hybrid algorithm can realize the optimization adjustment of the power load prediction model. the consumption time of finding the optimal parameters for different algorithms is given below, as shown in table 2.

Table 2 Parameter optimization time of different algorithms in power load prediction model

Algorithm	Firefly Hybrid Algorithm	Firefly algorithm	GA algorithm	PSO algorithm	SA algorithm
CPU(m)	34	25	28	29	27

As shown in table 2, it can be seen that the firefly hybrid algorithm is relatively dominant in the time taken to find the optimal parameters. Therefore, this algorithm can be used to predict the actual performance of the power load forecasting model, to clarify the final real power load data content of the equipment, and to obtain the optimal calculation results. In addition, the simulation results are proved to be correct. In addition, it is necessary to prove the advantages of firefly hybrid algorithm in optimizing and adjusting power load forecasting model. First, the firefly hybrid algorithm directly improves the local data parameter searching ability of the power load forecasting model, and is in place and intuitive in improving the performance of the model. Furthermore, the local solution obtained by using the method of roulette is better, which can balance global and local capability calculation and better reflect the forecasting performance of hybrid algorithm to power load budget model.

In conclusion, after adopting the firefly hybrid algorithm, the performance index optimization ability of the power load forecasting model is stronger, and some key parameters in the model can be excavated, and the best prediction results can be obtained. In order to further verify the prediction ability of the model, it is necessary to infer the simulation results, and it is found from this paper that the hybrid algorithm of firefly still has the best ability to optimize the prediction model data.[3].

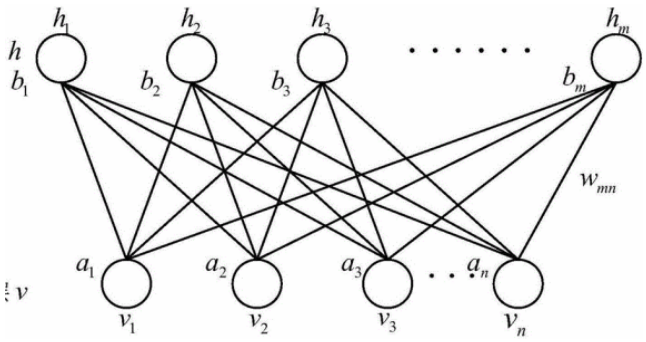

Figure 1 Power load prediction model

4. Summary

At present, it is quite common to optimize and adjust power system for power load model in power enterprises. After using intelligent algorithm such as firefly hybrid algorithm, the optimization prediction of power load model data content is more accurate and effective, which basically realizes the effective adjustment and dispatch of power system content, meets its power supply planning requirements, and improves the Gongshu store ability of different projects in power system. The local search algorithm system based on fire worm algorithm is also established for the power load forecasting ability of the constructed model. The hybrid algorithm can effectively analyze the power load forecasting model, extract many key parameters, find the optimal value of different data indexes under different index system, and then analyze the power load forecasting model again with the actual data content, verify its scientific rationality and improve the power supply and distribution ability of power enterprise.

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