Advanced Science and Technology Letters
Vol.31 (MulGraB 2013), pp.130-133
http://dx.doi.org/10.14257/astl.2013.31.29

RBF Neural Network Controller Research Based on AFSA algorithm

Qing-kunSong, Meng-meng Xu, Yi Liu

School of Automation
Harbin University Of Science And Technology
Control theory and control engineering
sqk@hrbust.edu.cn, xumm_1988@163.com, 459033664@qq.com,

Abstract. Artificial fish-swarm algorithm is proposed recently by Li Xiaolei and Shao Zhijiang which is a realization model of the swarm intelligence optimization algorithm.This design uses second-order pendulum as a controlled object, using artificial fish swarm algorithm applied to the neural network training algorithms, building design of RBF Neural networks control module, verifing by Matlab simulation of actual control controller performance.

Keywords: RBF neural network; artificial fish-swarm algorithm; Double inverted pendulum

1 Introduction

Artificial neural networks [1] are nonlinear system of massively parallel distributed processing, application of neural network theory has penetrated into all areas. Artificial fish-swarm algorithm is a organic search optimization algorithm based on simulation of fish behavior, it makes use of fish feeding, clusters and rear, from the structural behavior of a single fish up, by individual fish local optimization purposes of global optimization. Algorithm has the ability to overcome the local extreme values, access to global extremism. This article for double inverted pendulum control model, the introduction of artificial fish-swarm algorithm in optimization of radial basis function neural network training, the establishment of a training model of neural network controller based on the algorithm and has a better performance simulation controller.

2 The Basic Theory

Gaussian function[2] is often used as the commonly used activation function in radial basis function can be expressed as:

$$\Phi_j(x) = \exp\left(-\frac{\| x - c_j \|^2}{2\delta_j^2}\right) \quad (1)$$

ISSN: 2287-1233 ASTL

Where $^{TM}_{j}$ is Gaussian function of variance. ||x □ c_j|| is European norm, C_j said that the center of the Gaussian function. The δ_j smaller, the smaller the width of the radial basis function, and basis function will hold the stronger selective.

Then the k-th output of the RBF network can be expressed as:

$$y_k = \sum_{j\delta 1}^{n} w_{kj}(x)\sqrt{} \quad (2)$$

w_{kj} is weights value between layer neurons and output layer neurons, y_k is actual output.

3 RBF Neural Network Artificial Fish Swarm Algorithm:

Artificial fish swarm algorithm which based on research in intelligent behavior of animal groups is a new bionic optimization algorithm LI Xiao-lei [3] in 2002. Upon this algorithm, in this paper get an algorithm which is RBF Neural network artificial fish swarm algorithm. This algorithm is mainly used to optimize the RBFNN [4] in hidden layer node position and width value, this artificial fish need to determine the encoding and initialed, calculated to determine the fitness value of artificial fish behaviour, calculate the hidden layer to the output layer weights to determine RBFNN output error, the paper is divided into steps to address these issues.

The minimum value of the i-th column may be expressed as:

$$hid_{ji} += X_{i\min} rand(0, \square M),(i/M) \quad (3)$$

The value of the width of the i-th hidden unit can be expressed as:

$$\int_i = \int_{\min} + rand(0,M).(\square \int /M) \quad (4)$$

4 Experimental Results and Simulation:

Parameters for double inverted pendulum: the quality of car M =1.32kg , the quality of hem m_1 =0.04kg , On the pendulum mass m_2=0.132kg , the quality of the mass on the pendulum and hem is $_{0.208kg}$, Hem lever rotation center to the rod and the distance of the centroid l_1= 0.09m , On the swing lever rotation center to the rod and the distance of the centroid l_2 =0.27m . F is the external force acting on the system, F that is, the amount of control in the system state space u ,and $u = F$.

The populations number is 50, the initial range is set to [-1,1], the sample data is 55 group. Network of hidden nodes is 6. When the error of the network is no longer the obvious changes, the application change to stop the iteration until the error reached 0.00005. The results obtained is shown in Figure 1:

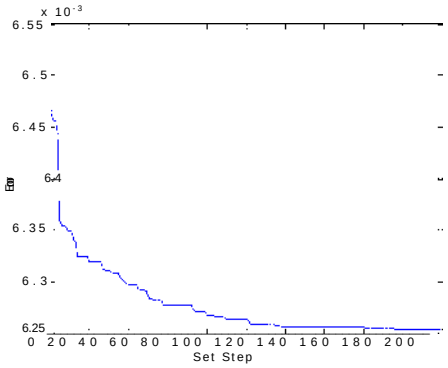

Fig.1. Figure of the error trend in the training of SFSA

Data after 55 sets of data extracted through the use of optimization algorithms to optimize neural network controller to complete the fitting with the source data, proved the robustness of the controller and optimize the effect.

Artificial fish swarm algorithm applied directly to the RBF neural network, network error0.00005 no longer change after 200 steps to reach the error requirement. This shows that the artificial fish swarm algorithm enables the RBF neural network initial value select appropriate, overcome the genetic algorithm to search a long time, and the slow shortcomings, is a fast and reliable optimization of RBF neural network method. The results obtained is shown in Figure 2:

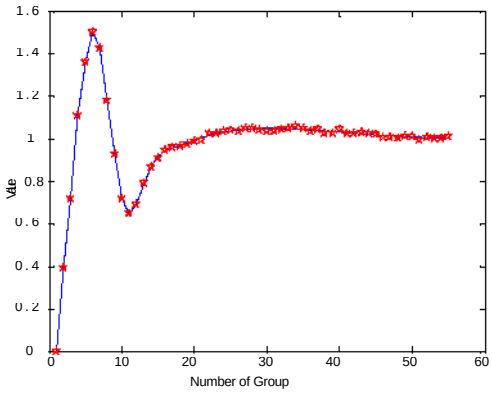

Fig.2. training data fitting results

5 Conclusion

In this paper, the simulation results can be seen, the controller designed in this paper can be stable control of double inverted pendulum system, and has a good anti-jamming capability. From the actual control curve to be seen, this paper, the design of the RBF neural network controller based on artificial fish swarm algorithm is effective.

References

1. YAN F. Artificial neural networks and evolutionary computing[C]. 2nd edn. Tsinghua University Publishing House, 2005: 101-105.
2. Salahshoor Karim, Salahshoor Karim. Online Identification of nonlinear multivariable processes using
self-generating RBF neural networks[J]. Asian Journal of Control, 2010, 9: 626-639.
3. LI Xiao-Lei, Xue Yun-can, Lu Fei, et,al. Parameter Estimation Method Based-on ArtificialschoolAlgorithm[J], Journal of Shandong University: Engineering Science,2004,34(3):84-87.
4. LIU Yao-nian,LI Ying-hong,, LIU Jun-feng et,al. RBF neural Network Based on Artifical Fish Swarm Algorithm[J], Journal of Northeast Dianli University: Natural Science Edition, 2006,26(4):23-27.

