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Sports performance prediction model based on BP neural network application research

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ABSTRACT

Olympic track and field achievements as a reference, through the use of neural network algorithm is considerable since the fault-tolerant ability and the training of the ability to learn good advantages, such as structure of the BP neural network model, specific application and validation of the model through the establishment and application of neural network to the first performance was studied. The research results show that the BP neural network can be used as a sports performance prediction, so the neural network model for performance prediction model and its broad space for development.

KEYWORDS

Neural network; Prediction model; BP algorithm; Matlab simulation.

INTRODUCTION

On the basis of the original performance forecast is going to produce results, the commonly used in large sports games, the level of sports competition for athletes to predict the future is important, therefore performance prediction of more and more important, but there are many in the modern prediction methods, including neural network in the prediction analysis of contemporary popular.

Research on various projects on sports predictions of the efforts of many people, and the results, for the social from all walks of life of scholars for its research provides favorable conditions and a prediction of scientific development. Such as: Zhong Wu etc., in 2004 by constructing special grades to predict the shot put, at the same time got the accuracy significantly higher than that of the multivariate linear regression model; Wang Zong equality, in 2006 through the neural network to man swimming is forecasted and high precision are obtained: there have been scholars in 1987 after AN N the function of the single hidden layer is N the statement for the input node number of hidden layer node number is 2 N + 1 model configurations; Cyrbenko as early as in 1988 has put forward the point of structure using S function, points out that a hidden layer is a solution to the problem of random distribution, and two hidden layers on the input graph output function. After this person again in 1989 had been put forward for any a continuous function of closed interval BP neural network model can be used for approximation.

On the basis of predecessors' research results, this paper studies the influence factors of performance, and by applying the BP neural network to forecast performance, and combined with examples to elucidate the implementation and application of the method, the result shows that to establish the forecast model of neural network in the application research on sports has a significant impact.

BP NEURAL NETWORK THEORETICAL FORMING

Achievements about sports can be divided into two categories, general grade is a kind of perceptual he focused on the overall phenotype, but his achievements is rational, he focused on the details, but in practice often score appear uneven grade and points of the status quo of the BP neural network model is required to detect the relationship between them, thus forming the neural network model after the relevant training, as long as we are going to the sports scores into the BP neural network model it will work out the public's overall, through this way to improve the accuracy of results.

Hierarchical neural network is a feedforward multilayer network model and he is one of the two connection mode, it is the smallest unit is to establish the output layer neurons to connect three modes, input layer and hidden layer of BP neural network model, its structure is shown in Figure 1.

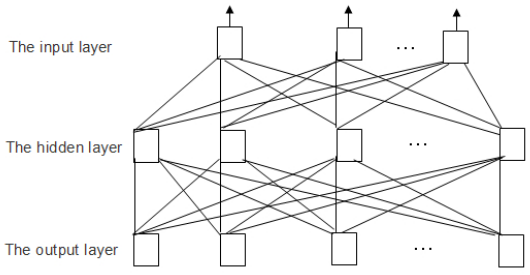

Figure 1: Neural network theory process

Though there are no any connections among them, their nerve cells are mutual correlated. The algorithm learning process is composed of two directions that are respectively forward direction process and reverse two propagation processes, from which, forward propagation is:

$$\mathbf{net}_{jk}^{l} = \sum_{j} \omega_{jk}^{l} \mathbf{o}_{jk}^{l-1} \quad \textbf{(1)}$$

In above formula, $l-1$ represents number of layers, is expressed by o_{jk}^{l-1}, and when output j pieces of units nodes, the input is the k sample, then:

$$\mathbf{o}_{jk}^{l} = \mathbf{f}(\mathbf{net}_{jk}^{l}) \quad \textbf{(2)}$$

Reverse propagation:

(1) If input unit node is j, then:

$$\mathbf{o}_{jk}^{l} = \bar{\mathbf{y}}_{jk} \quad \textbf{(3)}$$

Among them, use j as actual output unit which is expressed by $\bar{y}_{jk}$

$$\delta_{jk}^{t} = -(\mathbf{y}_{k} - \bar{\mathbf{y}}_{k})\mathbf{f}'(\mathbf{net}_{jk}^{t}) \quad \textbf{(4)}$$

(2) If input unit node is not j, then:

$$\delta_{jk}^{t} = \sum_{m} \delta_{mk}^{l+1} \omega_{mj}^{l+1} \mathbf{f}'(\mathbf{net}_{jk}^{t}) \quad \textbf{(5)}$$

$$\frac{\partial \mathbf{E}_{k}}{\partial \omega_{ij}} = \delta_{jk}^{l} \mathbf{o}_{jk}^{l-1} \quad \textbf{(6)}$$

Revise weight:

$$\omega_{ij} = \omega_{IJ} - \mu \frac{\partial E}{\partial \omega_{ij}}, \mu \succ 0$$

Here:

$$\frac{\partial \mathbf{E}}{\partial \omega_{ij}} = \sum_{K=1}^{N} \frac{\partial \mathbf{E}}{\partial \omega_{ij}} \quad \textbf{(7)}$$

Among them, the process from input layer to hidden layer and then transfer to output layer is information forward direction propagation, but once end cannot get corresponding output result, it will automatically turn to reverse propagation, one nerve cell k is expressed by following formula:

$$\mathbf{u}_{k} = \sum_{t=1}^{m} \mathbf{w}_{ik} \mathbf{x}_{t} \quad \textbf{(8)}$$

$$\mathbf{y}_{k} = \mathbf{f}(\mathbf{u}_{k} + \mathbf{b}_{k}) \quad \textbf{(9)}$$

In above formula, nerve cell unit threshold value is b_k, in linear combination, input signal output is u_k, output signal is y_k, protruded weight is w_{ik}, input signal is x_k, and meanwhile activated function is $F()$, corresponding function formula is as following:

$$\mathbf{f(v)=\frac{1}{1+e^{-v}}} \quad \textbf{(10)}$$

Due to BP neural network nerve cell does not change; corresponding model is as Figure 2.

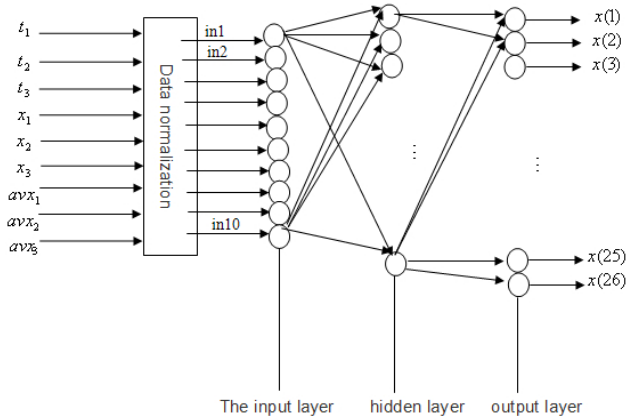

Figure 2 : Neural network operation process

For BP nerve cell, its input end is:

$$\mathbf{net=x_1w_1+x_2w_2+\cdots+x_nw_n} \quad \textbf{(11)}$$

In above formula, connection weight value: $w_1, w_2, \cdots, w_n$, input value: $x_1, x_2, \cdots, x_n$, these nerve cells all activated functions use S type function; the function not only is continuous but also can derive.

BP NEURAL NETWORK LEARNING

Neural network is mainly up to two aspects: model parameters, features, from which parameters include stopping, hidden layer, learning rate and other criterions, and the learning process is as Figure 3 show:

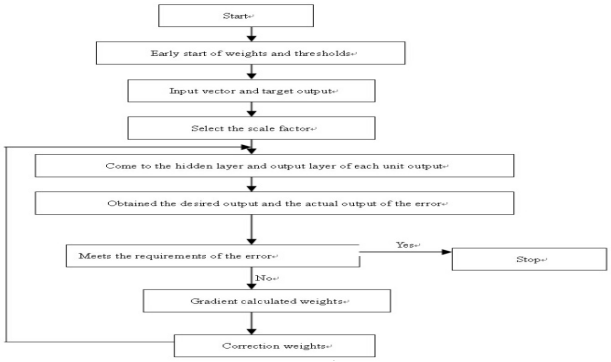

Figure 3 : Learning neural network model

Neural network learning process starts implementing form initialized network, and then inputs the input layer into a training corresponding mode, after network transitive signal recognition, it defines output value size and automatically sets a matching minimum value, if error is out of the value, and then system will automatically circulate the function till error reduces to range.

Original data standardization process

Define that between 0 and 1 is BP neural network node value, if input information hasn't arrived at hidden layer, then the node is 0, therefore to avoid the fault status, we adopt standardization handling with these original data, adopt:

$$1 = \sqrt{m = n} + a \tag{12}$$

Hidden point initial number values can be defined by formula (2), that is:

$$1 = \sqrt{0.43nm + 0.12n^2 + 2.54m + 0.77n + 0.35 + 0.51} \tag{13}$$

Among them, in above two formulas, a is a constant, and is a number between 1and 10, n, m are the number of output and input nodes. We work out an initial value by formula (1), and then solve it gradually[7].

Define error

Assume when outputs network, error value is:

$$E_K = \frac{1}{2}\sum_J (y_{jk} - o_{jk})^2 \tag{14}$$

We assume that $E = \sum E_K$ is the sum of the model whole process generated output errors, and in above formula, actual output value is o_{jlk}, ideal output value is y_{jk}.

APPLY NEURAL NETWORK INTO SPORTS PERFORMANCE PREDICTION THEORETICAL RESEARCH MODEL

The paper selects 24th to 30th Olympic Games 1000、50000、1500、800、400、200、$100m$ men's competitions each event champions sports performances as training samples, and testing samples adopt 26th to 30th sports performance, checking samples adopt 25th to 29th sports performance, we let matrix column to be every session different event performance value, and line to be an event different number of sessions, so that fulfill the matrix.

Parameters defining and data handling

The paper defines output layer activated function as $purelin(x) = x$, from which network learning precise is set as 0.00005, iteration times are 10000times, implicit function corresponding activated function is defined as hyperbolic tangent $(\tan sigx)\ S$ type transmission function:

$$\tan sig(x)\frac{\sigma - \sigma}{\sigma^2 + \sigma^{-2}} \tag{17}$$

In addition, it should ensure that input data is between 0-1, by converting p, that:

$$p=\begin{vmatrix} 9.98 & 9.96 & 9.97 & 9.84 & 9.87 & 9.86 & 969 \\ 19.80 & 19.75 & 20.01 & 19.30 & 20.09 & 19.79 & 19.30 \\ 44.27 & 43.87 & 43.50 & 43.49 & 43.84 & 44.00 & 43.75 \\ 103.00 & 103.45 & 403.66 & 102.58 & 105.08 & 104.45 & 104.46 \\ 212.53 & 215.96 & 220.12 & 215.78 & 212.07 & 214.18 & 213.94 \\ 783.59 & 791.70 & 792.52 & 787.96 & 822.49 & 749.39 & 777.82 \\ 1667.57 & 1641.46 & 1647.72 & 1627.34 & 1638.20 & 1625.10 & 1621.17 \end{vmatrix}$$

After that, divide by every column found corresponding maximum value and then get p_1, that:

$$p1=\begin{vmatrix} 1.0000 & 0.9857 & 1.0000 & 0.9803 & 0.9655 & 0.9527 & 1.0000 \\ 0.9801 & 0.9831 & 0.9910 & 0.9845 & 0.9811 & 0.9626 & 0.9844 \\ 0.9970 & 0.9960 & 0.9826 & 0.9865 & 1.0000 & 0.9636 & 0.9881 \\ 0.9850 & 0.9607 & 0.9824 & 0.9762 & 0.9803 & 0.9580 & 0.9759 \\ 0.9880 & 1.0000 & 0.9903 & 1.0000 & 0.9634 & 1.0000 & 0.9824 \\ 0.9860 & 0.9851 & 0.9939 & 0.9940 & 0.9730 & 0.9658 & 0.9745 \\ 0.9701 & 0.9607 & 0.9883 & 0.9719 & 0.9457 & 0.9457 & 0.9721 \end{vmatrix}$$

In the following take p_1 line three to line seven as testing sample $p30$, line two to line six as checking sample $p20$, top five lines as training sample $p10$, on the condition that hidden layer node number meets that hidden layer and input as well as output layer number should be less than $N-1$, samples output is 3 number of nodes is 3, input is 5, from which N is the number of samples.

BP neural network training process

The paper using created BP neural network to predict the 31st Tokyo Olympic Games 1000m 5000m 1500m 800m 400m 200m 100m, prediction way is rolling type alternate training until prediction precise conforms to requirement, the performance is predicted performance.

Neural network about Matlab application program

Input matrix p, and input:

$p=p'; po=\max(p); p00=ones(7,1)*p0=p./p00; p10=p1(1:5,:); p11=p1(6,:);$
$p20=p1(2:6,:); p21=p1(7,:); p30=p1(3:7,:);$
$net=newff(\min\max(p10),[31],\{'tan sig','purelin',\});$
$net.trainParam.epochs=10000; net.train\Pr arm.goal=0.00005; net.trainParam.show=500;$
$net=train(net,p10,p11); y1=sim(net,p10);$
$y10=y1.*p0;$

Trained the 29th performance $E1=P11-y1; MASE1=mse(E1)$. Training error rate $y2=sim(net,p20);$ $y20=y2.*p0;$ trained the 30th performance $E2=P21-y2\ MASE2=mse(E2);$ checking samples' error rate $y3=sim(net,p30);$ $y30=y3.*p0;$ make prediction on the 31st Olympic Games performance.

Training result analysis

$MSE1=4.9198e-5 \quad MSE2=1.7114e-4$

$$y_1 10 = 1.0e+3*[0.0097 \quad 0.0196 \quad 0.0441 \quad 0.1036 \quad 0.2139 \quad 0.8044 \quad 1.6365]$$
$$y_1 20 = 1.0e+3*[0.0098 \quad 0.0199 \quad 0.0440 \quad 0.1049 \quad 0.2139 \quad 0.7793 \quad 1.6289]$$
$$y_1 30 = 1.0e+3*[0.0097 \quad 0.0195 \quad 0.0434 \quad 0.1030 \quad 0.2178 \quad 0.7998 \quad 1.6248]$$

CONCLUSIONS

This article through to the sports contest the grade of the athlete of BP neural network prediction, obtained the feasibility of the proposed model, it launched for the forecast of the project in the future to an indelible contribution. Athletes performance prediction is affected by many factors, the method of using BP neural network to evaluate a prediction shows that it has obvious advantages. This paper not only introduces the prediction to the result of the BP neural network algorithm, but also application specific example verification, the result display the rationality of the structure of the model. According to the characteristic matrix of the array, to obtain the good prediction of BP neural network algorithm. Because the number of applications of successive athletics finiteness, adopted the way of training in turn, makes the result more reliable and accurate.

REFERENCES

[1] Zhu Hong-bing, Liu Jian-tong, Wang Gang; Journal of Capital College of Physical Education, **15(1)**, 118-121 **(2003)**.
[2] Wang Wei; Journal of Nanjing Institute of Physical Education, **18(6)**, 85-87 **(2004)**.
[3] Zhao Yun hong, Zhou Yao; China Sport Science and Technology, **38(2)**, 39-40 **(2002)**.
[4] Chen Liang, Sai Qing-bin; Journal of Capital College of Physical Education, **18(5)**, 85-88 **(2006)**.
[5] Song Ai-Ling, Chen Kai; Journal of Capital College of Physical Education, **15(4)**, 68-69, 116 **(2003)**.
[6] Chen Liang, Tian De-bao; Journal of Capital College of Physical Education, **18(6)**, 127-128 **(2006)**.
[7] Tong Liping, Yuan Jianguo; Journal of Shanghai Physical Education Institute, **25(2)**, 44-47 **(2001)**.
[8] Liu Jia-jin; Journal of Guangzhou Physical Education Institute, **26(2)**, 54-56 **(2006)**.
[9] Liu Jia-jin et al.; Zhejiang Sport Science, **21(1)**, 60-64 **(1999)**.
[10] B.Zhang; S.Zhang, G.Lu; Journal of Chemical and Pharmaceutical Research, **5(9)**, 256-262 **(2013)**.
[11] B.Zhang; International Journal of Applied Mathematics and Statistics, **44(14)**, 422-430 **(2013)**.
[12] B.Zhang, H.Yue; International Journal of Applied Mathematics and Statistics, **40(10)**, 469-476 **(2013)**.
[13] B.Zhang, Y.Feng; International Journal of Applied Mathematics and Statistics, **40(10)**, 136-143 **(2013)**.
[14] Bing Zhang; Journal of Chemical and Pharmaceutical Research, **5(2)**, 649-659 **(2014)**.