APPLICATION ANALYSIS OF DIGITAL NEURAL NETWORK-BASED DATA MINING METHOD IN MAXIMIZING THE PERFORMANCE OF SPORTS TRAINING

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ANÁLISE DE APLICAÇÃO DO MÉTODO DE MINERAÇÃO DE DADOS BASEADO EM REDE NEURAL DIGITAL NA MAXIMIZAÇÃO DO DESEMPENHO DO TREINAMENTO ESPORTIVO

ANÁLISIS DE LA APLICACIÓN DEL MÉTODO DE MINERÍA DE DATOS BASADO EN REDES NEURONALES DIGITALES PARA MAXIMIZAR EL RENDIMIENTO DEL ENTRENAMIENTO DEPORTIVO

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ABSTRACT

Introduction: In today's rapid development of science and technology, digital network data mining technology is developing as fast as the expansion of the frontiers of science and technology allows, with a very broad application level, covering most of the civilized environment. However, there is still much to explore in the application of sports training. Objective: Analyze the feasibility of data mining based on the digital network of sports training, maximizing athletes' training. Methods: This paper uses the experimental analysis of human FFT, combined with BP artificial intelligence network and deep data mining technology, to design a new sports training environment. The controlled test of this model was designed to compare advanced athletic training modalities with traditional modalities, comparing the athletes' explosive power, endurance, and fitness. Results: After 30 days of physical training, the athletic strength of athletes with advanced fitness increased by 15.33%, endurance increased by 15.85%, and fitness increased by 14.23%. Conclusion: The algorithm designed in this paper positively impacts maximizing athletes' training. It may have a favorable impact on training outcomes, as well as increase the athlete's interest in the sport. ***Level of evidence II; Therapeutic studies - investigating treatment outcomes.***

Keywords: Data Analysis; Neural Networks, Computer; Data Mining; Physical Education and Training.

RESUMO

Introdução: No rápido desenvolvimento atual de ciência e tecnologia, a tecnologia de mineração de dados de rede digital desenvolve-se tão rápido quanto a expansão das fronteiras da ciência e tecnologia permitem, com um nível de aplicação muito amplo, cobrindo a maior parte do ambiente civilizado. No entanto, ainda há muito para explorar da aplicação no treinamento esportivo. Objetivo: Análise de viabilidade da mineração de dados com base na rede digital da formação esportiva, maximizar o treinamento dos atletas. Métodos: Este trabalho utiliza a análise experimental da FFT humana, combinada com a rede de inteligência artificial da BP e tecnologia de mineração profunda de dados, para projetar um novo ambiente de treinamento esportivo. O teste controlado deste modelo foi projetado para comparar modalidades avançadas de treinamento atlético com as modalidades tradicionais, comparando o poder explosivo, resistência e condição física do atleta. Resultados: Após 30 dias de treinamento físico, a força atlética dos esportistas com aptidão física avançada aumentou 15,33%, a resistência aumentou 15,85%, e o condicionamento físico aumentou 14,23%. Conclusão: O algoritmo desenhado neste artigo tem um impacto positivo na maximização do treinamento dos atletas. Pode ter um impacto favorável nos resultados do treinamento, bem como aumentar o interesse do atleta pelo esporte. ***Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.***

Descritores: *Análise de Dados; Redes Neurais de Computação; Mineração de Dados; Educação Física e Treinamento.*

RESUMEN

Introducción: En el rápido desarrollo actual de la ciencia y la tecnología, la tecnología de extracción de datos de redes digitales se desarrolla tan rápido como lo permiten las fronteras en expansión de la ciencia y la tecnología, con un nivel de aplicación muy amplio que abarca la mayor parte del entorno civilizado. Sin embargo, aún queda mucho por explorar de la aplicación en el entrenamiento deportivo. Objetivo: Análisis de viabilidad de la minería de datos basada en la red digital de entrenamiento deportivo, maximizar la formación de los atletas. Métodos: Este trabajo utiliza el análisis experimental de la FFT humana, combinado con la red de inteligencia artificial BP y la tecnología de minería de datos profunda, para diseñar un nuevo entorno de entrenamiento deportivo. La prueba controlada de este modelo se diseñó para comparar las modalidades de entrenamiento atlético avanzado con las modalidades tradicionales, comparando la potencia explosiva, la resistencia y la forma física del atleta. Resultados: Después de 30 días de entrenamiento físico, la fuerza atlética de los atletas con un estado físico avanzado aumentó en un 15,33%, la resistencia aumentó en un 15,85% y el estado físico aumentó en un 14,23%. Conclusión: El algoritmo diseñado en

este trabajo tiene un impacto positivo en la maximización del entrenamiento de los atletas. Puede tener un impacto favorable en los resultados del entrenamiento, así como aumentar el interés del atleta por el deporte. ***Nivel de evidencia II; Estudios terapéuticos - investigación de los resultados del tratamiento.***

Descriptores: *Análisis de Datos; Redes Neurales de la Computación; Minería de Datos; Educación y Entrenamiento Físico.*

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INTRODUCTION

Since the beginning of New China, the indoor sports industry has achieved rapid growth. It has hosted many successful international events such as the Beijing Games in 1990, the Beijing Olympics in 2008 and the Asian Games in Guangzhou in 2010. The 2022 Winter Olympics will take place soon. Indoor athletes have also overcome difficulties in world-class competitions, often winning gold and silver, and China is already an undisputed force. However, it is also an indisputable fact that China does not yet have the power to play sports. The sport of team sports in particular also has a huge gap compared to the developed countries of Europe and America. How fast the promotion of athlete sports has become an issue that Chinese athletes need to study seriously.

To perform controlled physical training, specific changes will be induced in the peripheral vasculature and can lead to positive changes in vascular perfusion in the lower extremities. The objective of the Jurczak I study was to quantify changes in the peripheral circulation of the lower leg in patients with acute coronary heart disease (ACD) undergoing body control training. During training, resistance demographics are used to monitor peripheral circulation.[1] To improve physical and functional performance, Orr RM uses computer equipment and/or nightly group training to monitor general and functional training, which can improve compliance and motivation.[2] Lu H proposed a method to study the naming rules of symbols using neural networks. Using the proposed method, it is possible to remove high-accuracy short-sighted rules from neural networks.[3] Based on the Asynchronous Advantage Actor-Critic Network (A3C), Helma C created a game environment similar to the OpenAI platform using Fighter 2 (LF2) and designed a new A3C+ network to create RL agents.[4] It can be found through relevant research that data mining techniques are used to protect privacy, but this paper specifically seeks to explore scientific methods of sports training through data mining.

The purpose of this paper is to design a good model of athletic training for athletes through the testing of human FFT technology and data mining of neural networks. This model can be effective in improving the explosive strength, endurance and fitness of the athlete.

METHODS

Data Mining Technology Method Based on Digital Neural Network

The BP network[5,6] is a multi-level power supply network[7,8], the main function of the network is signal transmission. In the adaptation, the input signal passes through the input layer through the hidden layer to the output layer and is processed through the layer. The state of neurons in each layer can affect the state of neurons in the next layer. If you can not get the result of the expected output level, go to the background and adjust the weight[9] and the limit[10] according to the forecast error. Therefore, the prognostic effect of the BP neural network is always close to the expected result. The topological structure of the BP basal neural network is shown in Figure 1.

Between A1, A2, ..., we have the input values of the neural network BP. B1, B2 ..., Bm are the predictive values of the neural network BP. ωxy and ωyz are the densities of the neural network BP. You can see from the figure that the BP neural network can be perceived as a non-linear function and the input and output values of the network are independent variables and function-dependent variables, respectively.[11,12]

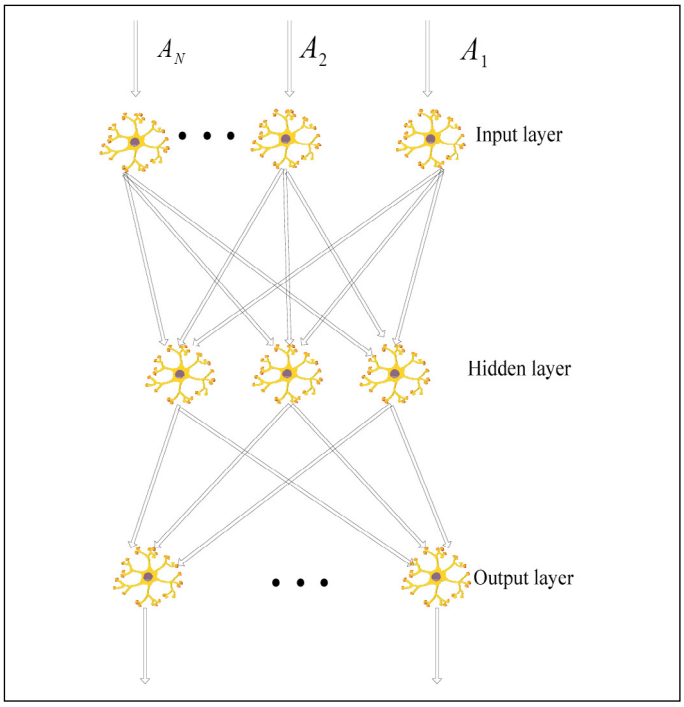

Figure 1. Figure 3-2 BP network topology structure diagram.

$$H_y = f\left(\sum_{x=1}^{n} \omega_y a_x - i_y\right), y = 1,2,...,l \quad (1)$$

1. Step function

$$b = \varphi(a) = \begin{cases} 1, & a \geq 0 \\ -1, & a < 0 \end{cases} \quad (2)$$

2. Piecewise linear function

$$b = \varphi(a) = \begin{cases} 1, & a \geq 1 \\ 0.5(1+a), & -1 < a < 1 \\ -1, & a \leq -1 \end{cases} \quad (3)$$

3. Sigmoid type function

The most common sigmoid function[13,14] is formula (4), and the most common asymmetric tangent hyperfunctions are also available as formula (5).

$$\varphi(a) = \frac{1}{1+\exp(-\dot{u})} \quad (4)$$

The parameter i is the controllable slope.

$$\varphi(a)=\tanh(0.5a)=\frac{1-\exp(-a)}{1+\exp(-a)} \quad (5)$$

Step 3: Calculate the output of the output level. Like the layer H of the layer, the density ωyz is connected to the surface j and the network density BP is calculated.[15,16]

$$O_z=\sum_{y=1}^{l} H_y\omega_{\#}-j_z, \quad z=1,2,...,m \quad (6)$$

Step 4: Error calculation. As a result of the network prediction O and the expected result B, the network prediction error e is statistical.

$$e_z=B_z-O_z, \quad z=1,2,...,m \quad (7)$$

Step 5: Weight update. Asopọxy network connection density, ωyz has been updated according to the network prediction error e.

$$\omega_{xy}=\omega_{xy}+\eta H_y(1-H_y)a(x)\sum_{z=1}^{m}\omega_{yz}e_z, \quad x=1,2,...,n; y=1,2,...,l \quad (8)$$

$$\omega_{yz}=\omega_{yz}+\eta H_y e_z, \quad y=1,2,...,l; z=1,2,...,m \quad (9)$$

In the formula, η is the learning rate.

$$i_y=i_y+\eta H_y(1-H_y)\sum_{z=1}^{m}\omega_{yz}e_z, \quad y=1,2,...,l \quad (10)$$

$$j_z=j_z+e_z, \quad z=1,2,...,m \quad (11)$$

Predicting trend behavior: In large databases, data mining technology will automatically search for predictive information. In the past, the person in charge of data mining needed to manually analyze the data, but now it can go directly through the final stage of data acquisition. The most representative example is the problem of market forecasting.[17,18] Data mining is to analyze sales promotion data and find that consumers can generate the greatest profitability in future commercial and production activities, and their connotations are shown in Figure 2. The study and all the participants were reviewed and approved by Ethics Committee (NO. 2021JU718)

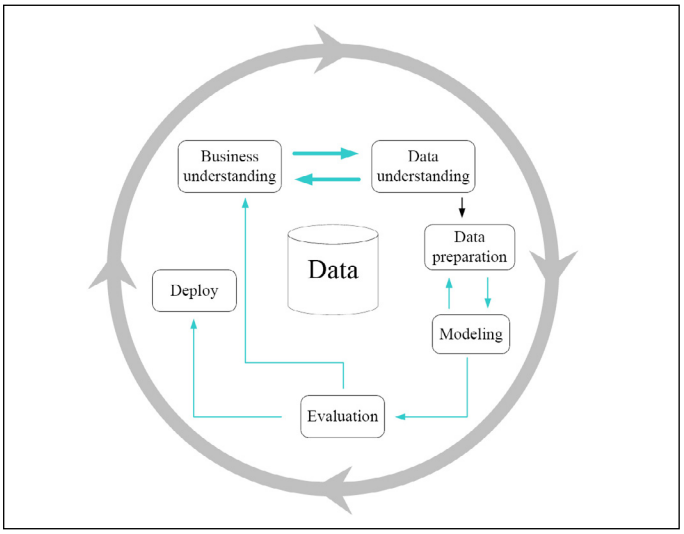

Figure 2. The connotation of data mining.

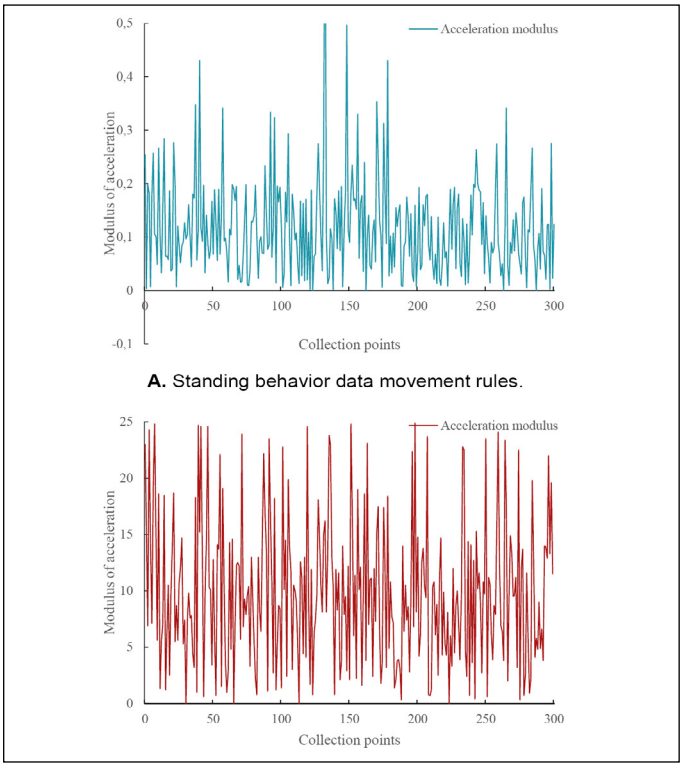

Figure 3. Movement patterns of standing and walking state.

Human Motion Pattern Recognition Process and Experimental Results

Use Matlab software to calculate and draw two-dimensional images, as shown in Figure 3, so that the data transfer rule is more obvious.[19,20]

After extracting the selected data and continuing to calculate the measure, we can determine that the overall acceleration coefficient changes by about 0.1 / 2ms while the human body maintains a stable position.

Figure 4 shows the results of the FFT change of posture and walking positions of the human body. Diagram:

It can be seen from the figure that the FFT of the human body is maintained at about 0.002 when standing, and the FFT of the human body is basically around 0.2 when walking. Therefore, this experiment can design a training mode that n strengthen the human body based on the FFT of human body changes. Through the iterative training of artificial neural network, coupled with data mining capabilities, a sports analysis based on data mining technology is designed.

Sports Training Model Based on Digital Neural Network Data Mining Technology Design

In this paper, a sports training model is designed by establishing the FFT value of the human body. The experimental results are as follows

Through 30 days of physical training, the explosive power of the members is shown in Table 1:

The maximum explosive power of the experimental group reached 99, and the average energy was as high as 92.5, which was an increase of 15.33% compared to the previous one. This shows that the improved sports training can greatly improve the explosive power of the athletes, which is very effective for sprinters.

Through 30 days of physical training, the endurance of the members is shown in Table 2:

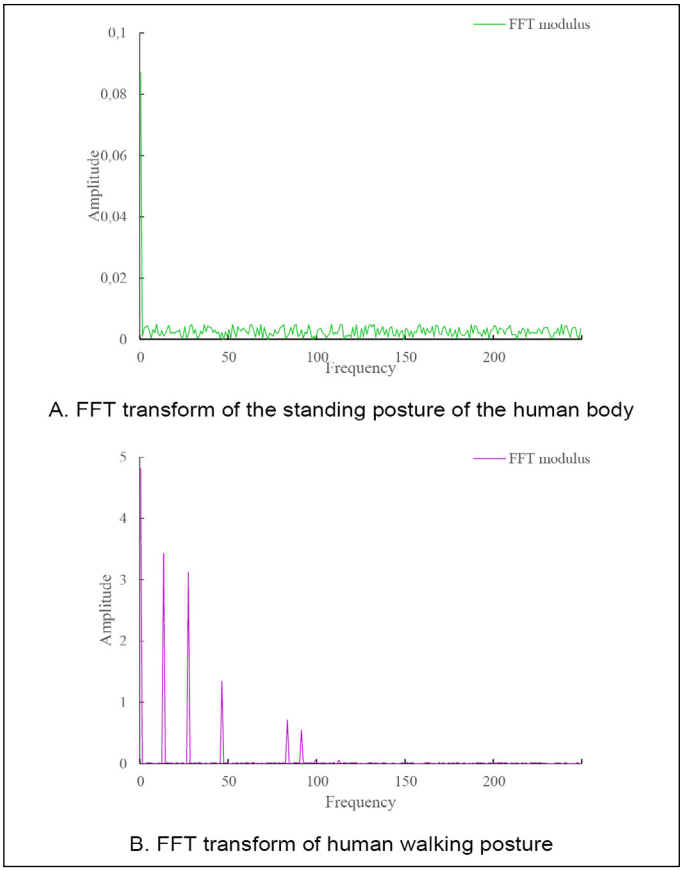

Figure 4. FFT changes of standing and walking.

Table 1. Athlete's explosive power score after sports training.

	Max	Minimum	Average value	Degree of improvement
Test group	99	87	92.5	15.33%
Control group	85	71	80.2	

Table 2. Endurance scores of athletes after sports training.

	Max	Minimum	Average value	Degree of improvement
Test group	97	85	90.6	15.85%
Control group	84	70	78.5	

There is a big difference between the control group and the experimental group. The endurance of the experimental group has increased by 15.85%, which is very helpful for long-distance runners. Through the improved physical training, the endurance of the athletes Maintained around 90.6, nearly 12.4 higher than 78.5 in the control group, which is a very representative data.

Physical fitness is also an indispensable part of athletes, not only to have good results, but also to have a good physical fitness. For this, as shown in Table 3, the physical fitness of the experimental group and the control group after 30 days of physical training:

It can be seen from the table that the improved physical training can effectively improve the physical fitness of athletes, at least 14.23%, and the physical fitness has been maintained above 90.

In summary, the sports training model designed under neural network-based data mining technology can effectively improve the athlete's explosive power, endurance and physical fitness. For a long time, it has been very good for athletes' training. It can not only improve the athletes' various indicators, but also maintain a good physical condition.

Table 3. Athletes' physical fitness scores after sports training.

	Max	Minimum	Average value	Degree of improvement
Test group	98	90	95.5	14.23%
Control group	90	75	83.6	

CONCLUSIONS

The purpose of this article is to explore the application of digital network-based data mining technology in sports training. This course understands the application of artificial intelligence network and data mining technology and conducts retraining based on the BP network, through the FFT of human posture and gait. designed. Through the control test of this model, you can see through the test that the advanced training model improved the athlete's muscle strength by 15.33%, endurance by 15.85% and fitness by 14.23% . Research shows that a digital training data model based on digital data mining technology can increase efficiency in athletic performance, endurance and fitness.

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AUTHORS' CONTRIBUTIONS: Every author has made an important contribution to this manuscript. KC: writing; FC: execution; LH, MX and MMK: editing.

REFERENCES

1. Jurczak I, Jurczak K, Irzmański R. The Effects of Controlled Physical Training on Peripheral Circulation Following Interventional Treatment of Coronary Artery Disease. Adv Clin Exp Med. 2016;25(5):851-9.
2. Orr RM, Pope RP, Knapik JJ. A Physical Training Framework for Reserve Personnel: A Rationalization and Recommendations. Strength Cond J. 2016;38(4):36-41.
3. Lu H, Setiono R, Liu H. Effective data mining using neural networks. IEEE Trans Knowl Data Eng. 2016;8(6):957-61.
4. Helma C, Cramer T, Kramer S, Raedt L. Data mining and machine learning techniques for the identification of mutagenicity inducing substructures and structure activity relationships of noncongeneric compounds. J Chem Inf Comput. 2018;35(4):1402-11.
5. Buczak A, Guven E. A Survey of Data Mining and Machine Learning Methods for Cyber Security Intrusion Detection. IEEE Comm Surv Tutor. 2017;18(2):1153-76.
6. Skuratov V, Kuzmin K, Nelin I, Sedankin M. Creation of A Neural Network Algorithm for Automated Collection and Analysis of Statistics of Exchange Quotes Graphics. EUREKA Phys Eng. 2020;3(3):22-9.
7. Gomn W, Holt K, Thomé F, Broich K, Maier W, Fink A, et al. Association of Proton Pump Inhibitors with Risk of Dementia: A Pharmacoepidemiological Claims Data Analysis. JAMA Neurol. 2016;73(4):410-6.
8. Xu L, Jiang C, Wang J, Yuan J, Ren Y. Information Security in Big Data: Privacy and Data Mining. IEEE Access. 2017;2(2):1149-76.
9. Olsen A, Key RM, Heuven SV, Lauvset SK, Velo A, Lin X, et al. The Global Ocean Data Analysis Project version 2 (GLODAPv2) – an internally consistent data product for the world ocean. Earth Syst Sci Data. 2016;71(3):300-8.
10. Koymans MR, Langereis CG, Pastor-Galán D, Hinsbergen DJJ. Paleomagnetism.org: An online multi-platform open source environment for paleomagnetic data analysis. Comput Geosci. 2016;93:127-37.
11. Liu XH, Shan MY, Zhang LH. Low-carbon supply chain resources allocation based on quantum chaos neural network algorithm and learning effect. Nat Hazards. 2016;83(1):389-409.
12. Mazimpaka JD, Timpf S. Trajectory data mining: A review of methods and applications. J Spat Inf Sci. 2016;13:61-99.
13. Kavakiotis I, Tsave O, Salifoglou A, Maglaveras N, Vlahavas I, Chouvarda I. Machine Learning and Data Mining Methods in Diabetes Research. Comput Struct Biotechnol J. 2017;15:104-16.
14. Garcia S, Luengo J, Herrera F. Tutorial on practical tips of the most influential data preprocessing algorithms in data mining. Knowl-Based Syst. 2016;98:1-29.
15. Hong H, Pourghasemi HR, Pourtaghi ZS. Landslide susceptibility assessment in Lianhua County (China): A comparison between a random forest data mining technique and bivariate and multivariate statistical models. Geomorphology. 2016;259:105-18.
16. Jain A, Hautier G, Ong SP, Persson K. New opportunities for materials informatics: Resources and data mining techniques for uncovering hidden relationships. J Mater Res. 2016;31(8):977-94.
17. Yan XS, Zheng L. Fundamental Analysis and the Cross-Section of Stock Returns: A Data-Mining Approach. Rev Financ Stud. 2017;30(4):1382-423.
18. Jain A, Hautier G, Ong SP, Persson K. New opportunities for materials informatics: Resources and data mining techniques for uncovering hidden relationships. J Mater Res. 2016;31(8):977-94.
19. Bui DT, Ho TC, Pradhan B, Pham BT, Nhu VH, Revhaug I. GIS-based modeling of rainfall-induced landslides using data mining-based functional trees classifier with AdaBoost, Bagging, and MultiBoost ensemble frameworks. Environ Earth Sci. 2016;75(14):1-22.
20. Emoto T, Yamashita T, Kobayashi T, Sasaki N, Hirota Y, Hayashi T, et al. Characterization of gut microbiota profiles in coronary artery disease patients using data mining analysis of terminal restriction fragment length polymorphism: gut microbiota could be a diagnostic marker of coronary artery disease. Heart Vessels. 2017;32(1):39-46.