Research and Analysis on Adaptive Model Identification of System Parameters Based on Sports Safety Model for Children with Different Physique

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Abstract. There are differences in the safe heart rate of children with different constitutions when exercising. To study the suitable heart rate of children with different constitutions for reasonable exercise provides scientific and effective guarantee for children. Through the establishment of model system parameter identification for children with different constitutions who exercise and keep fit, the model system parameter adaptive model identification for children with different constitutions who exercise and keep fit and other types of sports crowd parameter identification are further studied. Through the analysis of parameter adaptive model identification, the safe heart rate of children with different constitutions and genders is obviously different during sports. In order to ensure the safety and effectiveness of their sports, children with weak constitution and obese children should be treated differently in groups and genders when arranging children's sports fitness and training plans. The simulation results verify the feasibility and effectiveness of the parameter adaptive model identification method.

1. Introduction
Physical activity is decreasing day by day, and children's health will become an urgent problem to be solved in building a well-off society in an all-round way [1-18]. The existing research shows that the physical health of children and adolescents is gradually declining in today's increasingly improved living standards. The emergence of this phenomenon: on the one hand, with the development of society and the change of modern lifestyle, children and domestic activities have It doesn't matter basically. The fierce social competition makes most children spend their spare time in cram schools, special classes and homework. Therefore, in order to ensure the safety and effectiveness of children's sports, we must develop sports intensity suitable for children and adolescents with different constitutions [19-22], so as to formulate scientific and reasonable sports programs for them, thus improving their constitutions and promoting their physical and mental health development[23-26].

In this paper, the model system parameter adaptive model identification and other types of sports crowd parameter identification of children with different physical fitness have been deeply studied. Through the analysis of parameter adaptive model identification[27-29], there are obvious differences...
in safe heart rate of children with different physical fitness and gender during sports. In order to ensure the safety and effectiveness of their sports, children with weak constitution and obese children should be treated differently in groups and gender when arranging children's sports fitness and training plans. A parameter model system[30-43] is established, and the simulation results verify the feasibility and effectiveness of the parameter adaptive model identification method.

2. Identification structure model

2.1. Research object

1 research objects and methods

1.1 Research object According to the 2017 physical fitness test data of Qingyang city, 220 grade 5 primary school students aged 10-11 in a primary school in Qingyang city were selected (signed informed consent form with their parents), of whom 120 were boys and 100 were girls. According to the primary school student's height standard weight evaluation scale, students with BMI < 18 are classified as thin group (54), students with BMI > 25 are classified as obese group (66), and students with BMI between 18 and 25 are classified as normal group (100).

2.2. Research objects and methods

Pre-experiment before increasing load lactic acid threshold exercise experiment Accusporty portable blood lactic acid tester made in Germany, Jaeger-Laufergotest mobile treadmill made of blood lactic acid reagent strip and PE-4000 telemetric heart rate meter made in Finland were used for testing. Before the formal experiment in January 2018, a total of two pre-experiments were carried out. For the first time, the initial load was 7 km/h, and the load was added every two minutes, increasing by 1 km/h each time. However, due to imperfect consideration, the whole process was in a passive state, and thus the ideal results were not obtained. In the second experiment, we set the starting load of the normal group at 7km/h and the weak and obese group at 6km/h, and obtained the ideal test results.

| Group                  | Anaerobic threshold heart rate (b/min) | Anaerobic threshold heart rate (b/min) | Maximum heart rate (b/min) |
|------------------------|---------------------------------------|---------------------------------------|-----------------------------|
| Normal group(n=100)    | 175±8$                               | 86±10                                 | 201±10.8                    |
| Obesity group(n=66)    | 164±10                                | 93±11.0                               | 193±15.2                    |
| Weak group(n=54)       | 159±12 ##                            | 95±10.0                               | 188±10.5                    |

Note: # represents the difference between the data of emaciated group and normal group (P<0.01), ## represents the difference between the data of emaciated group and obesity group (P<0.05), & represents the difference between the data of obesity group and normal group (P<0.05).

3. Model system parameter identification based on the current situation

The combined effect of these factors makes the physical activity of modern children decrease day by day, which poses a serious threat to children's health. Existing research shows that exercise is the main way to improve children's health. The specific model [16]and system identification and MATLAB simulation.

Set the system reference model [16] as:
\[ y^m_m(k) = \sum_{i=1}^{n} a^m_i \cdot y^m_m(k-i) + \sum_{i=1}^{m} b^m_i \cdot y^r_m(k-i) = \theta^T_m \cdot x^m_m(k-1) \] (1)

In the formula (2), \( x^m_m(k-1) \) can be written as:
\[
\begin{align*}
\theta^m_m & = [a^m_{m}, \ldots, a^m_{1}, b^m_{m}, \ldots, b^m_{1}]^T \in \mathbb{R}^{(m+1) \times 1} \\
x^m_m(k-1) & = [y^m_m(k-1), \ldots, y^m_m(k-n), y^r_m(k), \ldots, y^r_m(k-m)]^T \in \mathbb{R}^{(n+m+1) \times 1}
\end{align*}
\] (2)

In the formula:
\( \theta^m_m \) and \( x^m_m(k-1) \) are respectively the parameter vector and input/output data vector of the reference model, and \( y^m_m(k) \) and \( y^r_m(k) \) are respectively the output and input of the reference model.

Supposed
\[
\begin{align*}
y^p_p(k) & = \sum_{i=1}^{n} a^p_i \cdot y^p_p(k-i) + \sum_{i=0}^{m} b^p_i \cdot y^r_p(k-i) = \theta^T_p(k) \cdot x^p_p(k-i) \\
y^p_p(k) & = \theta^T_p(k-1) \cdot x^p_p(k-i)
\end{align*}
\] (3)

\[
\begin{align*}
\theta^p_p(k) & = [a^p_{p}, \ldots, a^p_{1}, b^p_{p}, \ldots, b^p_{1}]^T \in \mathbb{R}^{(p+1) \times 1} \\
x^p_p(k-1) & = [y^p_p(k-1), \ldots, y^p_p(k-n), y^r_p(k), \ldots, y^r_p(k-m)]^T \in \mathbb{R}^{(n+m+1) \times 1}
\end{align*}
\] (4)

In the formula:
\( \theta^p_p(k) \) and \( x^p_p(k-1) \) are respectively adjustable parameter vectors and input and output data vectors of the adjustable system, and \( y^0_p(k) \) and \( y^p_p(k) \) are respectively a priori output and a posteriori output of the adjustable system.

Using the formula (4) iteration, the model parameter estimate can be obtained.

4. Experimental analysis and research
There are differences in the safe heart rate of children with different constitutions when exercising. To study the suitable heart rate of children with different constitutions for reasonable exercise provides scientific and effective guarantee for children. Through the establishment of model system parameter identification for children with different constitutions who exercise and keep fit, the model system parameter adaptive model identification for children with different constitutions who exercise and keep fit and other types of sports crowd parameter identification are further studied, and through the analysis of parameter adaptive model identification. Model system parameter identification laboratory, as is shown in Fig.2. Sports Population and other sports population, and uses MATLAB software to simulate and analyze the identification mode.
Fig 1. Model system parameter identification laboratory.

Gymnastics Sports Population and other sports population, and uses MATLAB software to simulate and analyze the identification mode, as shown in Fig. 3, 4 and 5.
Fig 2. Anaerobic threshold heart rate identification (a) (b) (c) (d).

Fig 3. Gymnastics class Sports population identification.
In Figure 2, 3 and 4, through the analysis of parameter adaptive model identification, there are obvious differences in safe heart rate of children with different physical fitness and gender during sports. The simulation results verify the feasibility and effectiveness of the parameter adaptive model identification method.

5. Summary
Through the analysis of parameter adaptive model identification, there are obvious differences in safe heart rate of children with different physical fitness and gender during sports. In order to ensure the safety and effectiveness of their sports, children with weak constitution and obese children should be treated differently in groups and gender when arranging children's sports fitness and training plans. A parameter model system is established, and the simulation results verify the feasibility and effectiveness of the parameter adaptive model identification method.

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Reference
[1] Sijie Tan, Chunhua Yang. Physical Training of 9-to 10-Year-Old Children With Obesity to Lactate Threshold Intensity[J]. Pediatric Exercise Science, 2010, 22, 477-485.
[2] Stegmann H, W Kinderman, A Schnabel lactate kinetics and individual anaerobic threshold. J Sports medicine, 1981, 2 (3) :160-165.
[3] Xiao Huanyu, Fang Li. Comparative analysis of sports population between China and developed countries [J]. Journal of Shanghai Institute of physical education, 2004 (3): 7-12.
[4] Zhang Wanjun, Zhang Feng, Zhang Jingxuan, et al. Curved Measurement Theory of Honing Pneum
atic Measurement System and Optimization of Measurement Parameters[J]. Journal of Physics, 2018, 8. Vol. 1064. 012028:1-14.

[5] Zhang Wanjun, Zhang Feng, Zhang Jingxuan, et al. Flow field analysis and parameter optimization of main and measured nozzles of differential pressure type gas momentum instrument based on CFD[J]. Journal of Physics, 2018, 8. Vol. 1064. 012028:1-12.

[6] Zhang Wanjun, Zhang Feng, Zhang Guohua. Research on a algorithm of adaptive interpolation for NURBS curve[J]. Applied Mechanics and Materials, Vol. 687-691, pp. 1600-1603, December 2014.

[7] Zhang Wanjun, Zhang Feng, Zhang Guohua. Research on modification algorithm of Cubic B-spline curve interpolation technology[J]. Applied Mechanics and Materials, Vol. 687-691:1596-1599. December 2014.

[8] Zhang Wanjun, Zhang, Gao Shanping, Zhang Sujia. A improved algorithm of three B-spline curve interpolation and simulation[J]. Advances in Materials, materials, Machinery, Electronics I, 2017, 2. Vol. 1820. 080004-1-080004-6.

[9] Zhang Wanjun, Zhang Feng, Zhang Jingxuan, et al. Modeling and identification of system model parameters based on information granularity method[C]//Proceedings of the IEEE International Conference on Computers, Signals and systems. Dalian, 2018: 114–118.

[10] Zhang Wanjun, Zhang Feng, Zhang Jingxuan, et al. Optimization of identification structure parameters based on recursive maximum likelihood iteration[C]//Proceedings of the IEEE International Conference on Computers, Signals and systems. Dalian, 2018: 119–124.

[11] Zhang Wanjun, Zhang Feng, Zhang Jingxuan, et al. Parameter optimization and model identification of identification model control based on improved generalized predictive control[C]//Proceedings of the IEEE International Conference on Computers, Signals and systems. Dalian, 2018: 125–129.

[12] Zhang Wanjun, Zhang Feng, Zhang Jingxuan, et al. Study on System Recognition Method for Newton-Raphson Iterations[C]//Proceedings of the IEEE International Conference on Computers, Signals and systems. Dalian, 2018: 130–135.

[13] Zhang Wanjun, Zhang, Gao Shanping, Zhang Sujia. A improved algorithm of three B-spline curve interpolation and simulation[J]. Advances in Materials, materials, Machinery, Electronics I, 2017, 2. Vol. 1820. 080004-1-080004-6.

[14] Zhang Wanjun, Zhang Feng, Zhang Jingxuan, et al. Research on a Kind of Adaptive Fuzzy Control Method and Its Application in Feeding System of CNC Honing Machine[J]. Materials Science and Engineering, 2018, 8. Vol. 452. 042076:1-8.

[15] Zhang Wanjun, Zhang Feng, Zhang Jingxuan, et al. Application of PLC in Pneumatic Measurement Control System[J]. Materials Science and Engineering, 2018, 8. Vol. 402074:1-11.

[16] Zhang Wanjun, Zhang Jingxuan, et al. Research and Analysis on the Identification Model of Multivariate Economic System[J]. Materials Science and Engineering, 2018, 8. Vol. 452. 022061:1-11.

[17] Zhang Wanjun, Zhang Feng, Zhang Jingxuan, et al. Identification and Analysis of Economic Model Based on Longnan Southeast[J]. Materials Science and Engineering, 2018, 8. Vol. 452. 032058:1-8.

[18] Zhu Chuangeng, Wang Kai, Ding Yongliang, et al. Response and Prospect of China's sports policy to the evolution of development concept in the past 40 years of reform and opening up [J]. Sports research, 2018, 1(6):1-11.

[19] Zhang Wanjun, Zhang Feng, Zhang Jingxuan, et al. Application of digital image processing technology in polyaniline deposition on the surface of carbonyl iron powder [J]. Earth and Environmental Science, 2018, 12. Vol. 252:491-500.

[20] Zhang Wanjun, Zhang Feng, Zhang Jingxuan, et al. Effect of space stabilizer on in-situ deposition of polyaniline on carbonyl iron powder [J]. Earth and Environmental Science, 2018, 12. Vol. 2 52:501-509.

[21] Zhang Wanjun, Zhang Feng, Zhang Jingxuan, et al. One-dimensional mathematical model of coal
combustion in furnace and its simulation [J]. Earth and Environmental Science, 2018, 12, Vol. 252: 1822-1833.

[22] Zhang Wanjun, Zhang Feng, Zhang Jingxuan, et al. Research on Fuzzy Control Based on Directional Power Conversion of Wind Generator [J]. Earth and Environmental Science, 2018, 12, Vol. 252: 1912-1923.

[23] Gou Xiaoping, Zhang Wanjun, Zhang Feng, et al. Study on the Structure Design and Feasibility Analysis of Apple Inhaled Box Bags Based on Hailproof [J]. Earth and Environmental Science, 2018, 12, Vol. 252: 3826-3837.

[24] Zhang Wanjun, Zhang Feng, Zhang Wan-liang. Research on high-grade CNC machines tools CNC system for B-Spline curve method of High-speed real-time interpolation arithmetic [J]. Chinese Journal of Manufacturing Technology & Machine Tool, 8(8), pp.172-176, August 2015.

[25] Zhang Wanjun, Zhang, Gao Shanping, Zhang Sujia. Modification algorithm of NURBS curve interpolation. [J]. Advances in Engineering Research, 2016, 12, Vol. 83. 507-512.

[26] Zhang Wanjun, Zhang, Gao Shanping, Zhang Sujia. Modification algorithm of Cubic B-spline curve interpolation. [J]. Advances in Engineering Research, 2016, 12, Vol. 83. 513-518.

[27] Han Dan. Questioning "sports population". Sports and science, 2004 (3): 1-4.

[28] Li Hong, Xue Haihong, Feng Wulong. Sociological analysis of the comparison between Chinese population and Chinese sports population [J]. Journal of Xi'an Institute of physical education, 2007 (4): 2528.

[29] Miao Zhiwen, Qin Chunlin. Sociological analysis of sports population structure in contemporary China [J]. Journal of sports, 2006 (1): 119-121.

[30] Huang Y C, Malina R M. BMI and the health-related physical fitness in Taiwanese youth 9-18 years [J]. Med Sci Sports Exerc, 2007, 399(4): 701-708.

[31] KESSLER H S, SISSON S B, SHORT K R. The potential for high-intensity interval training to reduce cardiometabolism disease risk [J]. Sports Med, 2012, 42(6): 489-509.

[32] Zhang Wanjun, Zhang, Gao Shanping, Zhang Sujia. Modification algorithm of NURBS curve interpolation. [J]. Advances in Engineering Research, 2016, 12, Vol. 83. 507-512.

[33] Zhang Wanjun, Zhang, Gao Shanping, Zhang Sujia. Modification algorithm of Cubic B-spline curve interpolation. [J]. Advances in Engineering Research, 2016, 12, Vol. 83. 513-518.

[34] Zhang Wanjun, Zhang, Gao Shanping, Zhang Sujia. Modification algorithm of NURBS curve interpolation. [J]. 2016 4th International conference on Machinery, materials and Information Technology Applications, 2016, 12, Vol. 71. 507-512.

[35] Zhang Wanjun, Zhang, Gao Shanping, Zhang Sujia. Modification algorithm of Cubic B-spline curve interpolation. [J]. 2016 4th International conference on Machinery, materials and Information Technology Applications, 2016, 12, Vol. 71. 513-518.

[36] Gou Xiaoping, Zhang Wanjun, Zhang Feng, et al. Based on the Physiological Performance Test of Sprinters Through Indoor Treadmill [J]. Materials Science and Engineering, 2019, 11, Vol. 612: 3826-3837.

[37] Gou Xiaoping, Zhang Wanjun, Zhang Feng, et al. Research on Simulation and Analysis of Monitoring Process of Hail-proof Apple Bagging Four-rotor Aircraft [J]. Materials Science and Engineering, 2019, 11, Vol. 612: 3826-3837.

[38] Gou Xiaoping, Zhang Wanjun, Zhang Feng, et al. Based on The Physiological Performance Test of Sprinters Through Indoor Treadmill [J]. Materials Science and Engineering, 2019, 8, Vol. 612: 2052-2062.

[39] Gou Xiaoping, Zhang Wanjun, Zhang Feng, et al. Feasibility Analysis of Auxiliary Training Device for Backhand Turnover Based on Middle School Tumblers [J]. Advances in Computer, Signals and Systems, 2019, 9, Vol. 10: 252-260.

[40] Gou Xiaoping, Zhang Wanjun, Zhang Feng, et al. Research and Simulation of Table Tennis Track Prediction Based on Double Concave Round Table Tennis [J]. Advances in Computer, Signals
and Systems, 2019,9, Vol.10:261-270.

[41] Gou xiaoping, Zhang Wanjun, Zhang Feng, et al. Research and analysis on parameter identification of model system based on running, gymnastics and other physical exercise population [J]. Earth and Environmental Science, 2020, 3, Vol. 612: 2048-2058.

[42] Gou xiaoping, Zhang Wanjun, Zhang Feng, et al. Study on the Structure Design and Feasibility Analysis of Apple Inhaled Box Bags Based on Hailproof [J]. Earth and Environmental Science, 2018, 12, Vol. 252: 3826-3837.

[43] Gou Xiaoping, Zhang Wanjun, Zhang Feng, et al. Study on Quality Characteristics and Feasibility Analysis of Hail-proof Plastic Bagging of 5000 Mu in Gansu [J]. Earth and Environmental Science, 2020, 3, Vol. 612: 2048-2058