Research and Analysis on the Identification Algorithm Based On the Random Near Parameter Estimation of Children's Running

Qiurong Guo¹, Wanjun Zhang²*, Feng Zhang¹, Xiaoping Gou¹, Bingze Li³ & Chunhua Yang¹, Aihong Yang¹

¹School of Physical Education, Longdong University, Qingyang 745000, China
²Gansu ZeDe Electronic Technology Company Limited, Gansu 741003, China
³School of Graduate, Northwest Normal University, Gansu 730050, China.

*Corresponding author e-mail: gansu_zwj@163.com

Abstract. To study the suitable heart rate of obese children with different physique in weight-loss exercise, so as to provide scientific and effective exercise for children. In this paper, a stochastic near parameter estimation and identification algorithm based on running of obese children is proposed. Based on the obese children's weight-loss exercise, a system of random near parameter estimation and identification is established. Finally, through the MATLAB simulation analysis, the results show that the method is suitable for children's running safety heart rate and physical quality. The simulation results verify the feasibility and effectiveness of the method. The obese children's weight-loss children's running exercise has a strong reference in physical exercise.

Keywords: Stochastic near parameter estimation; nonlinear model; identification algorithm; research and analysis.

1. Introduction

Exercise is the main way to improve children's health. For children of different physique in the growth and development period, scientific and reasonable exercise is an important means to promote their health [1-3]. The key of children's and adolescents' exercise is also the control of exercise intensity. For children of different physique types in the same age group with vigorous growth and development, there are differences in their development degree [4-6]. The method of calculating relative intensity by limit heart rate was used to measure the suitable exercise intensity of children and adolescents with different physique [23-36]. 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 physiques[8], so as to make scientific and reasonable sports programs for them, so as to improve their physique and promote their physical and mental health development [7-9].

In the case of unknown parameters, we need to carry out parameter identification, and estimate the parameter system identification of the system model [10-13]. These two kinds of algorithms have developed maturely, and have been applied to many fields of adaptive control.
In this paper, a stochastic near parameter estimation and identification algorithm based on running of obese children is proposed. Based on the obese children's weight-loss exercise, a system of random near parameter estimation and identification is established. Finally, through the MATLAB simulation analysis, the results show that the method is suitable for children's running safety heart rate and physical quality. The simulation results verify the feasibility and effectiveness of the method. The obese children's weight-loss children's running exercise has a strong reference in physical exercise.

2. Research object and method

2.1. Research object
There are 26 children in the kindergarten, 8 of whom are 4 years old (Male 5, Female 3), 12 of whom are 5 years old (Male 5, Female 7), and 6 of whom are 6 years old (Male 3, Female 3). Their weight is more than 2sd of the height standard weight recommended by who. According to the height and weight value of who, they were evaluated. Among them, 4 were slightly obese (more than 20%~29% of the standard weight), 21 were moderately obese (more than 30%~49% of the standard weight), and 1 was severely obese (more than 50% of the standard weight).

2.2. Research methods
900 questionnaires were sent out, 875 were recovered, 27 invalid questionnaires were eliminated, 848 were valid, the effective rate was 96.91%. In this paper, the author also conducted a field survey on the leaders, social counselors, community and street offices in the three regions with high, medium and low proportion of sports population by means of visits and telephone interviews.

3. Random near parameter estimation method

Consider the model:

\[ A(z^{-1})y(k) = B(z^{-1})u(k) + v(k) \]  

(1)

In the formula: \( v(k) \) is the uncorrelated noise with the mean value of zero and the variance of \( \sigma_v^2 \); the measurement value corresponding to the input and output data is:

\[
\begin{cases}
  x(k) = u(k) + s(k) \\
  z(k) = y(k) + w(k)
\end{cases}
\]  

(2)

In the formula: \( s(k) \) and \( w(k) \) are uncorrelated random noises with mean value of zero and variance of \( \sigma_s^2 \) and \( \sigma_w^2 \) respectively, and \( v(k), s(k), w(k) \) and \( u(k) \) are statistically, uncorrelated:

\[
\begin{cases}
  A(z^{-1}) = 1 + a_1 z^{-1} + a_2 z^{-2} + \cdots + a_{n_s} z^{-n_s} \\
  B(z^{-1}) = b_1 z^{-1} + b_2 z^{-2} + \cdots + b_{n_s} z^{-n_s}
\end{cases}
\]  

(3)

The model (4) can be transformed into the least square format:

\[ z(k) = h^T(k) \cdot \theta + e(k) \]  

(4)

In the formula:
\[
\begin{align*}
\mathbf{h}(k) &= \left[ -z(k-1), \ldots, -z(k-n_z), x(k-1), \ldots, x(k-n_x) \right]^T \\
\mathbf{\theta} &= \left[ a_1, a_2, \ldots, a_n, b_1, b_2, \ldots, b_{n_b} \right]^T \\
e(k) &= A(z^{-1})\omega(k) - B(z^{-1})x(k) + v(k)
\end{align*}
\] (5)

Obviously, noise \(e(k)\) has the following characteristics:

\[
\begin{align*}
E[e(k)] &= 0 \\
E[h(k) \cdot e(k)] &= \begin{cases} 
\text{[other]}, & |k-j| \leq n \\
0, & |k-j| > n, n = \max(n_x, n_z) 
\end{cases} \\
E[h(k) \cdot e(k)] &= 0
\end{align*}
\] (6)

According to Equation (7), the criterion function is:

\[
J(\mathbf{\theta}) = \frac{1}{2} E\left[ z(k+n) - h^T(k+n) \cdot \mathbf{\theta} \right]^2
\] (7)

Isermann's random approximation algorithm for parameter \(\mathbf{\theta}\) estimation by using the principle of random approximation:

\[
\begin{align*}
\hat{\mathbf{\theta}}(k+n) &= \hat{\mathbf{\theta}}(k-1) + \rho(l) h(k+n) \left[ z(k+n) - h^T(k+n) \hat{\mathbf{\theta}}(k-1) \right] \\
k &= 1, n+2, 2n+3, \ldots
\end{align*}
\] (8)

This formula is the basic formula to solve the identification problem of model (5) by using random approximation method. Next, the parameter identification of the difference equation is discussed in detail.

4. Introduction of Test Platform

The purpose of this test is to test and verify the above control method, and compare it with the theoretical gait trajectory and analyze the error. The test platform is shown in Fig. 1.

![Fig.1. Test platform.](image)
Through the MATLAB simulation analysis, the results show that the method is suitable for children's running safety heart rate and physical quality. The simulation results verify the feasibility and effectiveness of the method. The obese children's weight-loss children's running exercise has a strong reference in physical exercise.

5. Results and analysis
In this study, two sets of data were obtained by real-time measurement of the motion angle at the knee joint of the robot with motion capture instruments, the dotted line represents the planned gait trajectory and the solid line represents the measured gait trajectory.

Test experiment simulation diagram 1, 2, 3 and 4, As is shown in Fig.2, Fig.3, Fig.4 and Fig.5.

Fig. 2 Test experiment simulation diagram 1.

Fig. 3 Test experiment simulation diagram 2.
Through the MATLAB simulation analysis, the results show that the method is suitable for children's running safety heart rate and physical quality. The simulation results verify the feasibility and effectiveness of the method. The obese children's weight-loss children's running exercise has a strong reference in physical exercise.

6. Summary
In this paper, a stochastic near parameter estimation and identification algorithm based on running of obese children is proposed. Based on the obese children's weight-loss exercise, a system of random near parameter estimation and identification is established. Finally, through the MATLAB simulation analysis, the results show that the method is suitable for children's running safety heart rate and physical quality. The simulation results verify the feasibility and effectiveness of the method. The obese children's weight-loss children's running exercise has a strong reference in physical exercise.

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