ISSN : 0974 - 7435 Volume 10 Issue 6

BioTechnology

An Indian Journal

FULL PAPER

BTAIJ, 10(6), 2014 [1486-1490]

The study on the impact of basketball technical and tactical training based on the inverse eigenvalue problems for jacob matrix

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ABSTRACT

A high level basketball team is closely connectedly with basketball players training. Basketball training is complex, including basic skills, physical fitness, coordination, practice. It is an effective way to find out the specific contribution for each training factor for the purpose of improving the level of athletes so as, to carry out targeted training. For this, combining the Jacobi matrix inverse eigenvalue problem, this paper conducts the research on the basketball training factors. Firstly, the inverse eigenvalue problems for Jacobi matrix are introduced and improved. Then, the Jacobi matrix inverse eigenvalue problems are applied to the specific problems of basketball training, and basketball training factors into matrix form are analyzed, from which the contribution can be turned out on how the training of various factors influence on improving the level of athletes. This way also will make contributions to promote the basketball level in china.

KEYWORDS

Basketball fitness training;
Jacobi matrix;
Inverse eigenvalue;
Sub cycle;
Mathematical model.

INTRODUCTION

Basketball training factors is complex and various, mainly including basic skills training, physical quality training, coordination training, practical training, and personal orientation training. The basic skill training can be divided into dribbling, Lay-up shot, defense, layup, dribbling, crossover, passing. Physical quality training mainly includes bouncing exercise, endurance exercise, folding back, strength training and sprint. The coordination training includes the pick and roll, two pass, three people pass, multi- people pass; situation drill includes combats of one VS one, one VS two, two VS two, three VS three, five and VS five. Personal orientation training includes a variety of trainings according to different positions of different players. So many training contents make players feel confused so that they don't know how to improve the highly-efficient level of the whole team. Based on this, this paper employs inverse eigenvalue problems on Jacobi matrix in linear algebra to solve the problem.

For the level of basketball training, many previous specialists made its own research and proposals. It is their constant effort and athletes' hard training that makes the steady development of basketball in china. Ye Peng (2008), in the article *Discussion on the physical fitness training of Chinese basketball*, pointed out that our nation lacks physical fitness training organizations, that there are many unscientific problems about basketball training in our country, and he gave some suggestions for studying more on the scientific method of the physical training, correctly grasping the laws of winning, and adopting advanced technology and equipment to conduct physical science training and monitoring[1]. Liu Xinzheng (2006), in the article *Present physical fitness training problems and solutions of the Chinese basketball* in the article, points out that Chinese coaches and athletes generally lack deep understanding of the basketball competition rules and characteristics and the training means and methods are simple. Therefore, it is suggested that the law of winning in basketball sports events should be emphasized. What's more, it is a must to strengthen the scientific training of the strength quality for special event, speed quality, endurance quality, flexibility quality, as well as the research on the scientific methods of the physical training, and to adopt advanced technology and equipment to monitor physical fitness training[2].

The article studies basketball training factors combing the inverse eigenvalue problems for Jacobi matrix. It firstly introduces and improves the inverse eigenvalue problems for Jacobi matrix. And next, the inverse eigenvalue problems for Jacobi matrix are applied to special problems, which contribute to the basketball career in our nation.

THE INVERSE EIGENVALUE PROBLEMS FOR JACOBI MATRIX

As is shown in TABLE 1, in numerical algebra, according to a known feature matrix, ask the eigenvectors and the problem called the matrix eigenvalue. Eigenvalue is often some general, practical problems, which reflects laws and key points of the practical problems. So, the study on the characteristic value is of great significance, and the inverse eigenvalue problem is a kind of matrix problem in the original system, which is the given spectrum data. This paper focuses on the inverse eigenvalue problems on Jacobi matrix. Sub periodic Jacobi matrix is a special symmetric tridiagonal matrix, whose specific form as shown in formula 1:

$$S_n = \begin{pmatrix} a_1 & b_1 & 0 & \cdots & b_n^{(k)} & \cdots & 0 \\ b_1 & a_2 & b_2 & & \cdots & & 0 \\ 0 & & & \ddots & & & \\ \vdots & & \ddots & \ddots & & & \vdots \\ b_n^{(k)} & & & \ddots & \ddots & \ddots & \\ \vdots & & & & & a_{n-1} & b_{n-1} \\ 0 & & & \cdots & & b_{n-1} & a_n \end{pmatrix} \quad (1)$$

Among which, $b_{i>0}$, $i=1,2,\cdots n-1, b_n^{(k)} > 0$ 0Suppose S_{n-1} expresses order principal sub matrix of $n-1$ rank, namely,

$$S_{n-1} = \begin{pmatrix} a_1 & b_1 & 0 & \cdots & b_n^{(k)} & \cdots & 0 \\ b_1 & a_2 & b_2 & & \cdots & & 0 \\ 0 & & & \ddots & & & \\ \vdots & & \ddots & \ddots & & & \vdots \\ b_n^{(k)} & & & \ddots & \ddots & \ddots & \\ \vdots & & & & & a_{n-2} & b_{n-2} \\ 0 & & & \cdots & & b_{n-2} & a_{n-1} \end{pmatrix} \quad (2)$$

If giving two groups of real num-

TABLE 1 : Symbol meanings in the article

$R^{m\times n}$	All $m\times n$ rank real matrix sets	$\text{order}(A)$	rank of Matrix A
$C^{n\times n}$	all $n\times n$ rank complex matrix sets	$\|A\|F$	Erogenous norm of Matrix A
R^n	All n rank real Vector sets	$\|b\|_2$	Norm2 of vector b
I_n	$n\times n$ rank unit matrix	A^*	associate of Matrix A
$\det(A)$	determinant of Matrix A	A^{-1}	inversion of Matrix A
$rank(A)$	rank of Matrix A	A^-	generalized inverse of Matrix A
$tr(A)$	trace of Matrix A	$\sigma(A)$	All eigenvalue of Matrix A

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bers, $\lambda = \{\lambda_1 \ \lambda_2 \ ;\cdots \lambda_n\}$, $\mu = \{\mu_1 \ \mu_2 \ ;\cdots \mu_{n-1}\}$, and meet the following condition:

$$\lambda_1 < \mu_1 < \lambda_2 < \cdots < \lambda_{n-1} < \mu_{n-1} < \lambda_n \quad (3)$$

Give the parameter β, then, the Sub periodic Jacobi matrix S_n can be obtained, so:

$$\begin{cases} \sigma(S_n) = \{\lambda_1, \lambda_2 \cdots \lambda_n\} \\ \sigma(S_{n-1}) = \{\mu_1, \mu_2 \cdots \mu_{n-1}\} \\ b_1 b_2 \cdots b_{k-1} b_n^{(k)} = \beta \end{cases} \quad (4)$$

In Formula (1), if $b_n^{(k)} - 0$, then, S_n can be called Jacobi matrix, so, Jacobi matrix has following characters:

First, for Jacobi matrix J_n of n ranks, suppose $\varphi_n(\lambda), \varphi_{n-1}(\lambda), \varphi_{n-2}(\lambda)$ are respectively characteristic polynomials of J_n order principal sub matrix, so:

$$\varphi_n(\lambda) = (\lambda - a_n)\varphi_{n-1}(\lambda) - b_n^2 \varphi_{n-2}(\lambda) \quad (5)$$

Secondly, suppose S_i is i rank order principal sub matrix of S_n, $\varphi_i(\lambda) = \det(\lambda I - S_i)$ is the characteristic polynomials of S_i, then, when $k+1 \le i \le n$, then:

$$\varphi_i(\lambda) = (\lambda - a_i)\varphi_{i-1}(\lambda) - b_i^2 \varphi_{i-2}(\lambda) \quad (6)$$

Principle: if $i = k+1, k+2, \cdots, n$, according to the definition:

$$\varphi_i(\lambda) = \det(\lambda I - S_i) = \begin{vmatrix} \lambda - a_1 & -b & 0 & \cdots & -b_n^{(k)} & \cdots & 0 \\ -b_1 & \lambda - a_2 & -b_2 & & \cdots & & 0 \\ 0 & & & \ddots & & & \\ \vdots & & \ddots & \ddots & & & \\ -b_n^{(k)} & & & \ddots & \ddots & \ddots & \\ \vdots & & & & & \lambda - a_{i-1} & -b_{i-1} \\ 0 & & & \cdots & & -b_{i-1} & \lambda - a_i \end{vmatrix} \quad (7)$$

According to last line, the following can be obtained:

$$\varphi_i(\lambda) = (\lambda - a_i)\varphi_{i-1}(\lambda) + b_{i-1} \begin{vmatrix} \lambda - a_1 & -b & 0 & \cdots & -b_n^{(k)} & \cdots & 0 \\ -b_1 & \lambda - a_2 & -b_2 & & \cdots & & 0 \\ 0 & & & \ddots & & & \\ \vdots & & \ddots & \ddots & & & \\ -b_n^{(k)} & & & \ddots & \ddots & -b_{i-3} & 0 \\ \vdots & & & & -b_{i-3} & \lambda - a_{i-2} & 0 \\ 0 & & & \cdots & & -b_{i-2} & -b_{i-1} \end{vmatrix} \quad (8)$$

$$= (\lambda - a_i)\varphi_{i-1}(\lambda) - b_{i-1}^2 \varphi_{i-1}(\lambda)$$

For Formula (6), as long as $i \ne k$, Formula (6) holds. While, if $i = k$:

$$S_k = \begin{pmatrix} a_1 & b_1 & 0 & \cdots & b_n^{(k)} \\ b_1 & a_2 & b_2 & \cdots & 0 \\ 0 & \ddots & \ddots & \ddots & \vdots \\ \vdots & & & a_{k-1} & b_{k-1} \\ b_n^{(k)} & \cdots & & b_{k-1} & a_k \end{pmatrix} \quad (9)$$

Formula (9) is called periodic Jacobi matrix, the periodic Jacobi matrix J_n is obtained, thus,

$$\begin{cases} \sigma(J_n) = \{\lambda_1, \lambda_2, \cdots \lambda_n\}, \\ \sigma(J_{n-1}) = \{\mu_1, \mu_2, \cdots, \mu_{n-1}\} \\ \prod_{i=1}^{n} b_i = \beta \end{cases} \quad (10)$$

Among which, $\{\lambda_i\}$, $\{\mu_i\}$ meet the following formula:

$$\begin{cases} \lambda_i \le \mu_i \le \lambda_{i+1} \\ \mu_i < \mu_{i+1} \end{cases} \quad (11)$$

Therefore, J_{n-1} is $n-1$ order principal sub matrix of J_n, β is arbitrarily positive real number.

For n rank Sub periodic Jacobi matrix, zero points of $\varphi_i(\lambda)(i = 1,2,\cdots,n)$ and $\varphi_{i-1}(\lambda)$ has the following chanters:

$$\lambda_1^i < \lambda_1^{i-1} < \cdots < \lambda_{i-1}^i < \lambda_{i-1}^{i-1} < \lambda_i^i \quad (12)$$

The principle: first consider $i = n, n-1, \cdots, k+1, k$. combine Formula (6), the following can be obtained:

$$\varphi_n(\lambda) = (\lambda - a_n)\varphi_{n-1}(\lambda) - b_{n-1}^2 \varphi_{n-2}(\lambda) \quad (13)$$

Substitute μ_j, $j = 1, 2, \cdots, n-1$, then:

$$\varphi_n(\mu_j) = (\lambda - a_n)\varphi_{n-1}(\mu_j) - b_{n-1}^2 \varphi_{n-2}(\mu_j) = -b_{n-1}^2 \varphi_{n-2}(\mu_j) \quad (14)$$

Therefore:

$$\mathrm{Sign}(\varphi_{n-2}(\mu_j)) = -\mathrm{Sign}(\varphi_n(\mu_j)) = (-1)^{n-j+1}, j = 1, 2, \cdots, n-1 \quad (15)$$

According to mean value theorem, it can be known that at leas t there is a zero point λ_j^{n-2} for $\varphi_{n-2}(\lambda)$ between the arbitrary μ_j and μ_{j+1}, thus:

$$\lambda_j^{n-1} = \mu_j < \lambda_j^{n-2} < \mu_{j+1} = \lambda_{j+1}^{n-1} \quad , j = 1, 2, \cdots, n-2 \quad (16)$$

So, Formula (12) holds.

From the analysis above, the eigenvalue for Jacobi matrix has these chanters; the following will focus on the promotion of Jacobi matrix combining basketball training so as to schematically solve the problems in basketball.

THE APPLICATION OF THE INVERSE EIGENVALUE PROBLEMS FOR JACOBI MATRIX IN BASKETBALL TRAINING

Basketball training factors are various and complex, and the relationship between level of sports training of the whole team and each training factor is not clear, so it is the key of improving training efficiency to analyze the contribution made by each factor to the whole team so as to conduct targeted training. Basketball training contents are mainly as shown in Figure 1, TABLE 2, and Figure 2.

Change the training events into data forms and combine eigenvalue calculation for Jacobi matrix; the following calculation procedures can be obtained:

Combine basket training and transform each train-

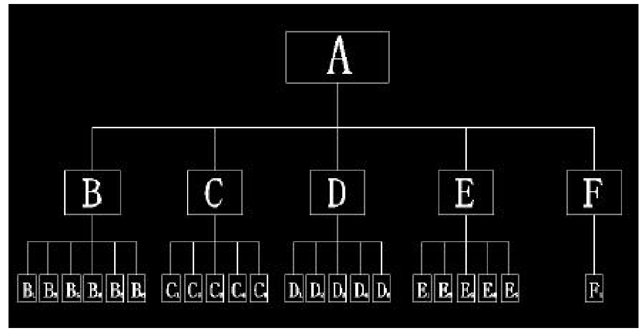

Figure1 : Basketball training factors relationship

TABLE 2 : The symbol meaning for Figure1 above

A	General level of basket team	D	Cooperation practice
B	The training of basic skill	D_1	Two persons pass
B_1	dribble	D_2	three persons pass
B_2	lay-up	D_3	Multi-persons pass
B_3	crossover	D_4	The pick and roll practice
B_4	pass	D_5	Drive and pass
B_5	shot	E	situation drill
B_6	defense	E_1	one VS one
C	Physical quality training	E_2	one VS two 二
C_1	Bounce practice	E_3	two VS two
C_2	shuttle running	E_4	three VS three
C_3	endurance training	E_5	five and VS five
C_4	dash	F	Personal orientation training
C_5	Strength practice	F_1	Different positions of different players.

Figure 2 : Athletes' sports events

ing event into dada analysis form, then, $\lambda = \{-0.7788, 0.9196, 1.6669, 2.3331, 3.0804, 4.7788\}$, $\mu = \{-0.7578, 1.3719\ \ 2.0000\ \ 2.6281, 4.7578\ \}$ and $\beta = 2$, based on the calculation procedures in the second section, the result, the result can be obtained as follows:

$$S_6^1 = \begin{pmatrix} 2.0000 & 1.0001 & 0 & 1.0006 & 0 & 0 \\ 1.0001 & 2.0000 & 0.9994 & 0 & 0 & 0 \\ 0 & 0.9994 & 2.0000 & 1.9998 & 0 & 0 \\ 1.0006 & 0 & 1.9998 & 2.0000 & 1.0003 & 0 \\ 0 & 0 & 0 & 1.0003 & 2.0000 & 1.0000 \\ 0 & 0 & 0 & 0 & 1.0000 & 2 \end{pmatrix} \quad (16)$$

$$S_6^2 = \begin{pmatrix} 2.6048 & 1.0303 & 0 & 1.3228 & 0 & 0 \\ 1.0304 & 1.7207 & 0.8139 & 0 & 0 & 0 \\ 0 & 0.8139 & 1.6744 & 1.8029 & 0 & 0 \\ 1.3228 & 0 & 1.8029 & 2.0000 & 1.0003 & 0 \\ 0 & 0 & 0 & 1.0003 & 2.0000 & 1.0000 \\ 0 & 0 & 0 & 0 & 1.0000 & 2 \end{pmatrix} \quad (17)$$

$$S_6^3 = \begin{pmatrix} 2.0000 & 0.6327 & 0 & 1.5818 & 0 & 0 \\ 0.6327 & 2.0000 & 1.2644 & 0 & 0 & 0 \\ 0 & 1.2644 & 2.0000 & 1.5806 & 0 & 0 \\ 1.5818 & 0 & 1.5806 & 2.0000 & 1.0003 & 0 \\ 0 & 0 & 0 & 1.0003 & 2.0000 & 1.0000 \\ 0 & 0 & 0 & 0 & 1.0000 & 2 \end{pmatrix} \quad (18)$$

$$S_6^4 = \begin{pmatrix} 2.3256 & 0.8139 & 0 & 1.8029 & 0 & 0 \\ 0.8139 & 2.2793 & 1.0304 & 0 & 0 & 0 \\ 0 & 1.0304 & 1.3952 & 1.3288 & 0 & 0 \\ 1.8029 & 0 & 1.3228 & 2.0000 & 1.0003 & 0 \\ 0 & 0 & 0 & 1.0003 & 2.0000 & 1.0000 \\ 0 & 0 & 0 & 0 & 1.0000 & 2 \end{pmatrix} \quad (19)$$

According to the results in (16)(17)(18)(19), it can be known that situation drill and basic skill practice dominate in improving general level, so, both should be strengthened In routine training.

CONCLUSION

This paper firstly introduces the inverse eigenvalue problems for Jacobi matrix and improves it. Combed the practical problems well, the practical solution is obtained. The inverse eigenvalue problems for Jacobi matrix are improved and promoted, meanwhile, which provides new ideas for the research on: level of competitive sports. Through the analysis on basketball training events and the combination of calculation for Jacobi matrix, it can be seen that as for the basketball players in our country, they must attach much importance to situation drill and basic skill practice which is a training method for improve the highest efficiency of the whole basketball team.

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