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Volleyball player technical performing influence factors research under fuzzy comprehensive evaluation

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ABSTRACT

Fuzzy comprehensive evaluation can eliminate numerous uncertain factors, and get correct score regions, volleyball player during competition and training will exist many possible events. The paper combines with fuzzy comprehensive evaluation to evaluate volleyball player, in solving process, firstly establish factor set includes technique, court awareness, physical quality and psychological quality these four main aspects, and finally it can know by weights that one volleyball achieved results located score phase after fuzzy comprehensive evaluation.

KEYWORDS

Fuzzy comprehensive evaluation; Volleyball player; Evaluation model; Physiological factor.



INTRODUCTION

In 1895, American William Morgan discovered volleyball playing method as the earliest, subsequently all places in the world started to appear volleyball such event, at that time, volleyball rules has been gradually perfected, international exchanges have gradually been increased, and then volleyball has changed from entertainment into competitiveness and come into international competitive court, while then is transformed into indoors tennis and beach tennis two kinds. Gradually domestic and abroad numerous scholars have researched on volleyball; research field distribution is widely that includes education system, training mode, biology, science, psychology and other multiple kinds of disciplines.

In 1905, volleyball was introduced to China, especially for Chinese women’s volleyball, it has achieved good results of five successive championships in Olympic Games, World Cup, World championship in 1981, so volleyball is favored by all Chinese people. Chinese volleyball research achievements main concentrate as during 1978 to 1980, it mainly researched on basic technical and tactics, competition rules, and correlation with other disciplines as well as volleyball teaching so on. During 1981 to 2002, it mainly researched on tactics, volleyball teaching sports psychology, sports training, competition rules and referee reserve talents, psychology and generalization of sports injury; during 2003 to 2008, it mainly researched on volleyball teaching coaches, reserve talents, sports training volleyball market, professional volleyball, generalization of volleyball scientific research, sports injury, competition rules and referee volleyball humanity, psychology and so on.

MODEL ESTABLISHMENTS

Fuzzy comprehensive evaluation model summary

Firstly use fuzzy comprehensive evaluation, steps are as following:

- (1) Establish factor set U ,
- (2) Establish judgment set V (evaluation set),
- (3) Define fuzzy mapping, and get fuzzy relations:

$$R = \begin{bmatrix} r_{11} & r_{12} & \cdots & r_{1n} \\ r_{21} & r_{22} & \cdots & r_{2n} \\ \vdots & \vdots & & \vdots \\ r_{m1} & r_{m2} & \cdots & r_{mn} \end{bmatrix}$$

Establish weight set, $A = (a_1, a_2, \dots, a_n)$, it meets conditions:

$$\sum_{i=1}^n a_i = 1 \quad a_i \geq 0$$

$$\sum_{i=1}^n r_{ij} \quad j = 1, 2, 3, \dots, m$$

$$B = A \cdot R$$

$$= (a_1, a_2, a_3, \dots, a_n) \cdot \begin{bmatrix} r_{11} & r_{12} & \cdots & r_{1n} \\ r_{21} & r_{22} & \cdots & r_{2n} \\ \vdots & \vdots & & \vdots \\ r_{m1} & r_{m2} & \cdots & r_{mn} \end{bmatrix}$$

$$= (b_1, b_2, b_3, \dots, b_n)$$

In V , fuzzy combination is evaluation set B . Based on above described facts, actual change model is:

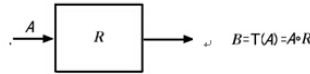


Figure 1 : Change model

As Figure 1 show, it gets fuzzy comprehensive evaluation change model, and can establish corresponding every factor grade evaluation transformation function, evaluation factors u_1, u_2, u_3, u_4, u_5 membership functions can be expressed as following:

$$u_{v1}(u_1) = \begin{cases} 0.5(1 + \frac{u_i - k_1}{u_i - k_2}), & u_i \geq k_1 \\ 0.5(1 - \frac{k_1 - u_i}{k_1 - k_2}), & k_2 \leq u_i < k_1 \\ 0, & u_i < k_2 \end{cases}$$

$$u_{v2}(u_1) = \begin{cases} 0.5(1 - \frac{u_i - k_1}{u_i - k_2}), & u_i \geq k_1 \\ 0.5(1 + \frac{k_1 - u_i}{k_1 - k_2}), & k_2 \leq u_i < k_1 \\ 0.5(1 - \frac{u_i - k_3}{k_2 - k_3}), & k_3 \leq u_i < k_2 \\ 0.5(1 - \frac{k_3 - u_i}{k_2 - u_i}), & u_i < k_3 \end{cases}$$

$$u_{v3}(u_1) = \begin{cases} 0, & u_i \geq k_2 \\ 0.5(1 - \frac{k_1 - u_i}{k_2 - k_3}), & k_3 \leq u_i < k_2 \\ 0.5(1 + \frac{k_3 - u_i}{k_2 - u_i}), & u_i < k_3 \end{cases}$$

Combine with fuzzy evaluation model to evaluate volleyball player

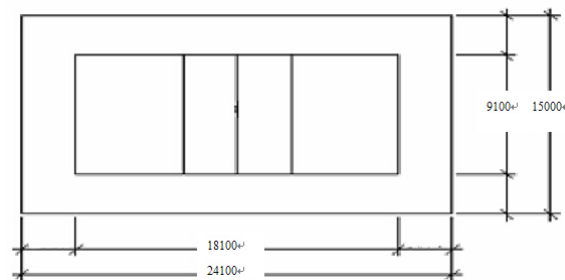


Figure 2 : Court distribution diagram

According to court distribution, the paper considers court awareness such factor, to player; to control the whole court needs well court awareness. And team cooperation is also magic weapon to win the game.

Establish factor set $U, U=(U_1 U_2 U_3 U_4)$. Among them technique U_1 , court awareness U_2 , physical quality U_3 , psychological quality U_4 , it gets TABLE 1.

TABLE 1: Volleyball player evaluation indicator system

Technique U_1 0.35	Court awareness U_2 0.3	Physical quality U_3 0.2	Psychological quality U_4 0.15
Stroke u_{11}	Tactics strategy u_{21}	Endurance u_{31}	Concentration u_{41}
Receive u_{12}	Ability of judgment u_{22}	Speed u_{32}	Self-confidence degree u_{42}
Service u_{13}	Reaction capacity u_{23}	Strength u_{33}	Individual quality u_{43}
Intercept u_{14}	Competition experience u_{24}	Sensitivity u_{34}	
Basic foot movements u_{15}			

The paper gets evaluation set:

$$U_1 = \{u_{11}, u_{12}, u_{13}, u_{14}\}$$

$$U_2 = \{u_{21}, u_{22}, u_{23}, u_{24}, u_{25}\}$$

$$U_3 = \{u_{31}, u_{32}, u_{33}\}$$

$$U_4 = \{u_{41}, u_{42}, u_{43}, u_{44}\}$$

By collecting data and analyzing, it gets four kinds of factors importance degrees ranking statistics, as TABLE 2 show.

TABLE 2 : Four kinds of factors importance degree ranking statistics

Classification	Rank 1	Rank 2	Rank 3	Rank 4
Court awareness U_1	23	7	4	0
Technique U_2	7	18	8	0
Psychological quality U_3	0	9	13	12
Physical quality U_4	3	0	9	21

But:

$$U_1 = \{23, 7, 4, 0\}$$

$$U_2 = \{7, 18, 8, 0\}$$

$$U_3 = \{0, 9, 13, 12\}$$

$$U_4 = \{3, 0, 9, 21\}$$

Obtained weighted vector from rank 1 to rank 2:

$$\beta = \{\beta_1, \beta_2, \beta_3, \beta_4\} = \{0.4, 0.3, 0.2, 0.1\}$$

$$U_i^* = U_i \cdot \beta^T$$

$$U_1^* = 12, U_2^* = 9.7, U_3^* = 6, U_4^* = 5$$

The paper takes normalization processing:

$$U_1^* = 0.35, U_2^* = 0.3, U_3^* = 0.2, U_4^* = 0.15$$

It gets:

$$\bar{A} = (0.35 \quad 0.3 \quad 0.2 \quad 0.15)$$

TABLE 3 : Remarks membership

Evaluation way	Set scores interval			
	0-60	60-80	80-90	90-100
Very good	0	0	0.05	0.95
Good	0	0.05	0.9	0.05
Normal	0.05	0.9	0.05	0
Bad	0.95	0.05	0	0

By remarks membership TABLE 3, according to one volleyball player's each kind of indicator obtained evaluation, it gets TABLE 4.

TABLE 4: Volleyball player all kinds of indicators obtained evaluation value

Each layer indicator	Evaluation value	Each layer indicator	Evaluation value
Stroke u_{11}	Very good	Endurance u_{31}	Very good
Receive u_{12}	Very good	Speed u_{32}	Good
Service u_{13}	Normal	Strength u_{33}	Good
Intercept u_{14}	Normal	Sensitivity u_{34}	Normal
Basic foot movements u_{15}	Normal	Concentration u_{41}	Good
Tactics strategy u_{21}	Very good	Self-confidence degree u_{42}	Very good
Ability of judgment u_{22}	Very good	Individual quality u_{43}	Normal
Reaction capacity u_{23}	Very good		
Competition experience u_{24}	Good		

By above model, it gets single layer indicator weight factor fuzzy set is:

$$U_1^* = \{U_{11}, U_{12}, U_{13}, U_{14}, U_{15}\} = \{0.25 \ 0.25 \ 0.2 \ 0.15 \ 0.15\}$$

$$U_2^* = \{U_{21}, U_{22}, U_{23}, U_{24}\} = \{0.54 \ 0.1 \ 0.24 \ 0.14\}$$

$$U_3^* = \{U_{31}, U_{32}, U_{33}, U_{34}\} = \{0.4 \ 0.3 \ 0.1 \ 0.2\}$$

$$U_1^* = \{U_{41}, U_{42}, U_{43}\} = \{0.3 \ 0.4 \ 0.3\}$$

By TABLE 4, and combine with TABLE 3 evaluation remarks membership, the paper gets technique, court awareness, physical quality and psychology each aspect evaluation set:

$$\text{Technique: } U_1 = \begin{pmatrix} 0 & 0 & 0.05 & 0.95 \\ 0 & 0 & 0.05 & 0.95 \\ 0 & 0.05 & 0.95 & 0.05 \\ 0 & 0.05 & 0.95 & 0.05 \\ 0 & 0.05 & 0.95 & 0.05 \end{pmatrix}$$

$$\text{Court awareness: } U_2 = \begin{pmatrix} 0 & 0 & 0.05 & 0.95 \\ 0 & 0 & 0.05 & 0.95 \\ 0 & 0 & 0.05 & 0.95 \\ 0 & 0.05 & 0.9 & 0.05 \end{pmatrix}$$

$$\text{Physical quality: } U_3 = \begin{pmatrix} 0 & 0 & 0.05 & 0.95 \\ 0 & 0.05 & 0.9 & 0.05 \\ 0 & 0.05 & 0.9 & 0.05 \\ 0.05 & 0.9 & 0.05 & 0 \end{pmatrix}$$

$$\text{Psychological quality: } U_4 = \begin{pmatrix} 0 & 0 & 0.05 & 0.95 \\ 0 & 0.05 & 0.9 & 0.05 \\ 0 & 0.05 & 0.9 & 0.05 \end{pmatrix}$$

$$B_i = A_i \cdot R_i$$

Make normalization processing with obtained B_i , it gets the second layer fuzzy evaluation matrix.

$$\bar{B} = \begin{pmatrix} B_1 \\ B_2 \\ B_3 \\ B_4 \end{pmatrix} = \begin{pmatrix} 0.07 & 0.27 & 0.13 & 0.53 \\ 0 & 0.1 & 0.4 & 0.5 \\ 0.08 & 0.46 & 0.38 & 0.08 \\ 0.14 & 0.2 & 0.3 & 0.36 \end{pmatrix}$$

$$Z = U^* \cdot B = (0.2 \ 0.24 \ 0.25 \ 0.31)$$

Because $0.31 > 0.25 > 0.24 > 0.2$, the volleyball gets excellent results, his score phase after fuzzy comprehensive evaluation is in the interval between 90 to 100 scores.

CONCLUSION

Fuzzy comprehensive evaluation can eliminate numerous uncertain factors, and get correct score regions, volleyball player during competition and training will exist many possible events, based on the purpose, the paper combines with fuzzy comprehensive evaluation to evaluate volleyball player, in solving process, firstly establish factor set $U, U=(U_1 \ U_2 \ U_3 \ U_4)$. It includes technique U_1 , court awareness U_2 , physical quality U_3 , psychological quality U_4 these four main aspects. And get technique, court awareness, physical quality and psychological quality each aspect evaluation set, and

finally it can know by weights that one volleyball achieved results located score phase after fuzzy comprehensive evaluation.

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