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Multi-Venue Basketball Match Scheduling Based on Simulated Annealing Algorithm

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ABSTRACT

This work studies the multi-venue basketball event scheduling plan based on a simulated annealing algorithm, aiming to improve the stability and fairness of event scheduling. By reviewing the application advantages and disadvantages of traditional intelligent algorithms in basketball event scheduling, this paper introduces the principle of simulated annealing algorithm and its application in basketball event scheduling. A basketball tournament scheduling plan based on a simulated annealing algorithm was designed and implemented for multiple competition venues, and its effectiveness was verified through experiments. The experimental results show that compared with traditional intelligent algorithms, the plan exhibits better performance in terms of stability and fairness.

Subject Categories and Descriptors: [B.5.2 Design Aids]; Simulation: [F.2.1] Numerical Algorithms and Problems; [I.6 SIMULATION AND MODELING]; Discrete event

General Terms: Simulation and Modeling, Optimization Algorithms, Event Modeling, Event Design

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1. Introduction

Basketball is a popular sport with a large number of enthusiasts worldwide. With the popularization and development of basketball, competitions are also constantly increasing [1]. Therefore, how to make reasonable

arrangements for basketball matches with multiple venues to ensure fairness and stability has become an important issue. In traditional basketball tournament planning, experience or simple rules are usually used to allocate venues and schedule matches [2]. However, with increased competition venues and the number of matches, this traditional manual method can no longer meet the demand. It is prone to omissions and unreasonable situations. Therefore, using intelligent algorithms to arrange and plan basketball matches in multiple venues has become a research hotspot [3]. Intelligent algorithms can automatically arrange events based on factors such as venue constraints and team capabilities and can consider various complex situations to find the optimal or approximate solution. However, traditional intelligent algorithms also have limitations when scheduling basketball matches on multiple playing fields. For example, it is easy to fall into local optima, take a long calculation time, and be sensitive to initial values [4]. Therefore, this study introduces a simulated annealing algorithm to optimize basketball match scheduling on multiple playing fields [5].

The simulated annealing algorithm is a heuristic search algorithm based on the principle of the solid-state annealing process. This algorithm introduces randomness and gradually reduces the search temperature, enabling the algorithm to jump out of the local optimal solution and find the global optimal solution during the search process. In the arrangement plan of basketball matches on multiple playing fields, a simulated annealing algorithm can effectively handle the constraints of the playing field and find a reasonable match arrangement plan [6]. This study aims to explore a multi-venue basketball tournament scheduling plan based on a simulated annealing algorithm, aiming to improve the stability and fairness of tournament scheduling. By reviewing the application advantages and disadvantages of traditional intelligent algorithms in basketball event scheduling, this paper introduces the principle of simulated annealing algorithm and its application in basketball event scheduling. A basketball tournament scheduling plan based on a simulated annealing algorithm was designed and implemented for multiple competition venues, and its effectiveness was verified through experiments [7].

2. Related Work

The role of sports in the development of today's time is becoming increasingly important. It can positively affect people's physical quality and mental health, and sports also play an auxiliary role in international communication[8]. Many countries and regions have begun to show their comprehensive strength through sports and sports. With the increasing number of sports events, many countries rely on this form to complete their political and economic exchanges[9]. In today's times, many countries have been relying on their physical strength to enhance their overall national strength. With the recognition of the importance of sports, diversified forms of sports have begun to appear in the eyes of the people[10]. Basketball is an influential form of sports in the development of the times. Basketball has been introduced in many countries, and many basketball games have gradually aroused people's attention, such as the NBA, Olympic basketball and so on[11]. However, some basketball researchers believe that the home and away mode impacts the winning and losing of team matches when holding basketball events. It may affect the player's mood or physical strength to a certain extent and may be a key factor in the game[12]. Therefore, a more reasonable management mode for the main and the guest fields of the basketball match is essential for the fairness of the whole competition[13]. Some scholars put forward the application of the more popular simulated annealing algorithm in managing the basketball tournament's host and guest mode. By applying the model, the arrangement and management of the main road are more reliable, providing a theoretical basis for the fairness of competitive basketball [14].

3. Methodology

Since China has entered a new period, the state has gradually realized that the national physical quality level will directly affect our country's prosperity. Along with developing our country's economy, the state has also started to advocate strengthening the national physical quality in the present era to enable people to meet their material and cultural life and simultaneously enhance their comprehensive level. Therefore, in this era, our country began to strengthen the development of the sports industry. Sports development makes our national physical fitness a growing trend, and to a certain extent, our country's overall national strength and international influence incredibly. With the gradual increase of communication between our country and the developed countries in the world, the development of China's sports industry has become more diversified, and the number of sports activities has also increased. In the development of the times, basketball has become an important sport, and its influence on our country is beyond doubt (As shown in Figure 1). In a basketball game, the victory of a game may be influenced by many factors. The management mode of home and away matches remarkably impacts basketball players' physical strength and psychology. Therefore, a reasonable arrangement of home and away basketball games is necessary. Although the communication between our country and the world's most advanced sporting power countries has made the management of our country's basketball events more perfect, there still exists a series of shortcomings and deficiencies in managing the host-guest field in China's basketball matches. As a mathematical model that greatly influences some industries in the current era, discrete-time differential algorithms can determine the best industrial development plan by analyzing many elements. Combining this kind of model with computer technology, which is rapidly developing nowadays, can make a great deal of data and information begin to be used in the analysis of the model and finally make the analysis result more accurate and reliable. Therefore, the algorithm was gradually applied to the actual development of the industry. Through the analysis of the deficiencies of the host-field management mode of basketball matches in China, some researchers combine the discrete-difference algorithm with the host-guest field management mode of basketball matches in China to help basketball matches reasonably divide the home and away games to ensure that the participating teams' fairness, and eventually brought a more fair and enjoyable basketball game to the audience. However, due to the lack of recognition of algorithm theory in related industries, there are still drawbacks to introducing and applying the algorithm in actual basketball matches. Therefore, in this study, the author will analyze the current situation of unreasonable arrangements of the host-guest game in China's basketball matches, as well as the insufficient application of the discrete-difference algorithm. Then, through the combination of theory and practice, the author discusses the application of the discrete-time differential algorithm in managing the host-guest field in basketball matches. This study aims to provide a reference for the further development of basketball in China.

To better promote the application of the discrete-difference algorithm in managing the home-away-match pattern of basketball matches in China, the author applies the discrete-time differential algorithm to the actual pattern management of the home-away match of basketball matches based on the description of relevant theories. Thus, the research results have greater credibility. The detailed research plan of this study is as follows:

(1) First, the author inquires about the relevant information and visits some professional basketball athletes to discuss and analyze the current development of the basketball industry in our country and the deficiencies in managing the home-away-match mode. Furthermore, the author discusses the necessity of improving the management of the home-away-match mode in China's basketball matches. On this basis, the author determines

the specific direction of this study, which gives this study some research basis.

(2) Based on the reading of the relevant data, the author further introduces the discrete-time differential algorithm and applies it to the management of the host-away mode of the actual basketball events. The model of the discrete-time differential algorithm is shown in formula (1) and formula (2)[15].

$$\frac{\partial \mathrm{u}}{\partial \mathrm{t}} = s - \mu u(x,t) - \frac{\beta u(x,t) v(x,t)}{1+\alpha v(x,t)} \quad (1)$$

Among them, s, μ, α and β are the numerical values of the simulated annealing algorithm formula values, and their values are 10^7, 0.1, 0.002 and $5/10^{10}$, respectively; $\frac{\partial u}{\partial t}$ represents the result of all home arrangements for a team in a basketball game; u(x, t), the probability value that a team's game is scheduled to be home; v(x, t) represents the probability of a team participating in the game.

$$\frac{\partial \mathrm{w}}{\partial \mathrm{t}} = \frac{\beta u(x,t-\tau) v(x,t-\tau)}{1+\alpha v(x,t-\tau)} - \delta w(x,t) \quad (2)$$

Among them, δ, τ, α and β are the formula parameters of the simulated annealing algorithm, and their values are 0.1, 7.8, 0.002 and $5/10^{10}$, respectively; $\frac{\partial w}{\partial t}$ represents the result of all road arrangements of a specific team in a basketball match; $u(x, t-\tau)$ represents the probability that a particular team is on the road for a match; w(x, t) is the probability of a team participating in the match(As shown in table 1).

After applying the simulated annealing algorithm to the management of the basketball game's host and guest mode, the author analyses the rationality of the basketball match before and after the model's application to determine the algorithm application's feasibility. On this basis, the author summarizes and analyses the advantages of the simulated annealing algorithm in applying the basketball game's primary and guest field modes. Todetermine the correct management process for our basketball game's host and guest mode, we will provide a reference for the comprehensive development of the basketball industry in China.

4. Analysis and Discussion

4.1 Insufficiency of the Management of the Main and the Guest Field Patterns in China's Basketball Games

Since the 90s of last century, the exchange of sports industry between the state and the developed countries in the West has been strengthened continuously, and the basketball cause has been greatly expanded. So, basketball in our country began to grow from being popular to being professional. A large number of excellent basketball players have been sent to the United States for training, which, to a certain extent, has promoted the development of basketball culture in China. With the importance of basketball in China, basketball games are becoming more formal, and the number of basketball events is increasing. However, fairness is an essential factor in basketball games, which may be affected by several factors. The arrangement for the basketball game's main stadium dramatically influences the game's loss and win. A team that has long participated in the

Evaluation project	Number of specific projects	Score (full score is 6 points)	Remarks
1. Contention for the right of the ball	4	3	Reasonable home and away arrangements, and it can be increased to 4
2. Passing	11	3	Reasonable home and away arrangements, and it can be increased to 4
3. Dribble	9	3,4	Reasonable home and away arrangements, and it can be stabilized to 4
4. Catching	7	3,2	Reasonable home and away arrangements, and it can be stabilized to 3
5. Shooting	15	3,4	Reasonable arrangements of home and away and it can increase the intensity
6. Defending	27	4,5	Reasonable home and away arrangements, and it can be stabilized to 5
7. Rebound	8	2	With reasonable home and away arrangements, there is much room for improvement
8. Physical fitness	5	4	Reasonable home and away arrangements, and it can be increased to 5
9. Tactical effectiveness	22	4	Reasonable home and away arrangements, and it can be increased to 5
10. Psychological control ability	12	3,2	With reasonable home and away arrangements, there is much room for improvement

Table 1. The Content and Result of Post-Game Evaluation of Basketball Match

guest field may have a physical decline, and the influence of the fans on the players' mentality cannot be ignored. Therefore, China has begun to strengthen the management of the leading basketball games. Although many advanced basketball management theories have been gradually introduced into the management of basketball competitions in China, there are still significant loopholes in the management mode of basketball matches in China. In this study, the author interviews with relevant information and interviews with professional basketball knowledge to determine the defects of the management mode of basketball tournaments in China. This is mainly because there are many defects in the actual competition, such as the combination of theory and

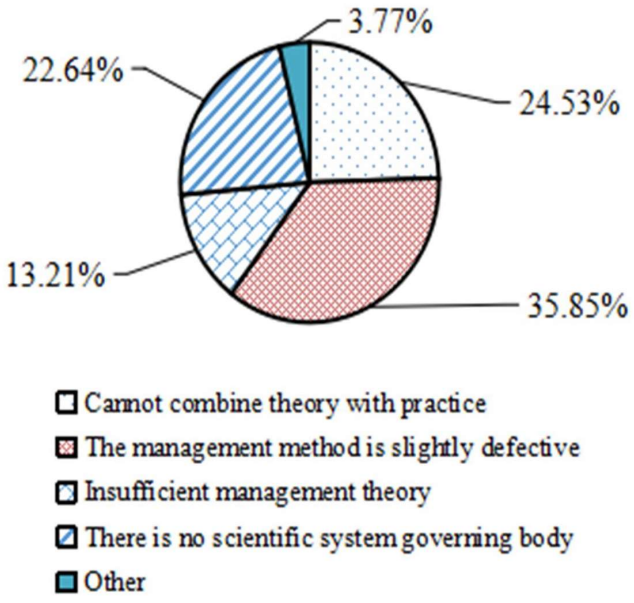

Figure 1. Results of the insufficient management of home and away mode of basketball matches in China

practice, lack of management methods, lack of scientific management theory, etc. (Figure 2). Only given the deficiency of this series, can we provide some references for the further development and improvement of basketball in China.

4.2 Arrangement Result of Home and Away Basketball Match Based on Simulated annealing algorithm in China Basketball Warm-up Match

Based on analyzing the management of the host and guest mode of basketball matches in China, the author chose the 14 main events of our men's basketball tournament. In this competition, 4 Asian regions were arranged as opponents of the Chinese men's basketball match. Then, based on location and time, the author used a simulated annealing algorithm to organize each match's main and away games. The final arrangement result is shown in Table 2. As we can see from the table, the author arranges the match between the host and the guest field and does not enter the national route for the warm-up game but also arranges the match days. So that the final arrangement can be carried out according to the most economical route practice; therefore, this arrangement can ensure the athletes get more adequate rest time. Finally, we realize the more practical effect of training.

4.3 The Correlation Analysis of the Influence Factors of the Home and Away Mode Arrangement of Basketball Games based on the simulated annealing algorithm

The management of the home-away-match mode of a basketball game may influencethe athlete's technical actions, the control of the entire basketball game, tactical effectiveness, and the player's physical and mental control ability. Therefore, the author analyzes the relevance of the main difference between the basketball game's home and away pattern management based on a simulated annealing algorithm and the basketball game. Analysis results are shown in Figure 3. The results show that with the improvement of home and away mode and the improvement of the strength, the effective management of home and away mode enhances the player's psychological control ability more effectively.

Warm-up time	Place	Opponent	The days from the first game	Home and away
June 7th	QingDao	Australia	55	Home court
June 9th	BeiJing	Australia	53	Home court
June 12th	Sydney	Australia	50	Away
June 14th	Melbourne	Australia	48	Away
June 23rd	Tainan	Chinese Taipei	39	Away
June 25th	Gaoxiong	Chinese Taipei	37	Away
July 6th	HaiNan	Chinese Taipei	26	Home court
July 7th	ZhouShan	Chinese Taipei	25	Home court
July 9th	HaiNan	Japan	23	Home court
July 19th	Guangzhou	Japan	13	Home court
July 20th	Tokyo	Japan	12	Away
July 21st	Nagoya	Japan	11	Away
July 24th	Busan	Korea	8	Away
July 26th	Seoul	Korea	6	Away
July 29th	QingDao	Korea	5	Home court
August 2nd	Tianjin	Korea	4	Home court

Table 2. Arrangement Results of Home and Away Basketball Match Based on Simulated annealing Basketball Warm-up Match

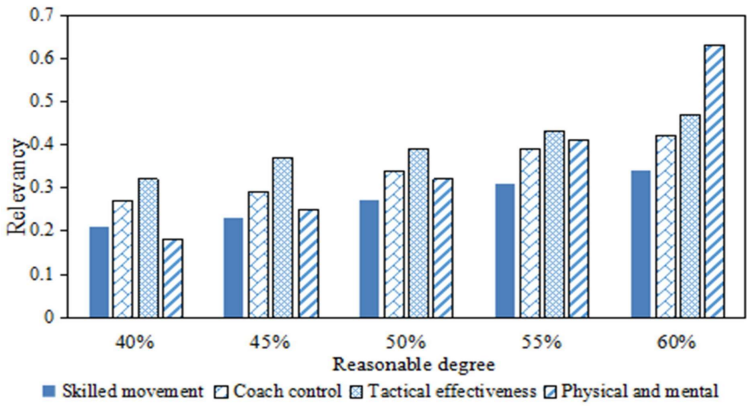

Figure 3. The Correlation Analysis of the Influence Factors of the Home and Away Mode Arrangement of Basketball Games based on the simulated annealing algorithm

4.4 Comparison Results of Players' Competition Effect Based on Discrete Differential and Traditional Methods for Warm-up and Basketball Matches

After using the simulated annealing algorithm to arrange home-away tournament matches, the authors conducted a comparative analysis of the effects of the warm-up game. The results are shown in Table 3. The results show that after the discrete-time differential algorithm is used for home-away match arrangement in warm-up matches, the team's effect is significantly higher than that of the traditional home-away-match arrangement. This may be due to the reasonable arrangement of the simulated annealing algorithm to effectively save the physical strength of the players and make the player's mentality relatively calm to obtain better race results.

Evaluation item	Simulated annealing algorithm	Traditional algorithm	Score difference
1. Competition for the ball	4	3	+1
2. Passing	5	3	+2
3. Dribble	4	3	+1
4. Catching	3	2	+1
5. Shooting	4	2	+2
6. Defending	5	3	+2
7. Rebound	4	2	+2
8. Physical fitness	5	3	+2
9. Tactical effectiveness	5	4	+1
10. Psychological control ability	5	2	+3
Total	**44**	**27**	**+17**

Table 3. Comparison Results of Players' Competition Effect Based on Discrete Differential and Traditional Methods for Warm-up and Basketball Matches

5. Conclusion

This article studies the multi-venue basketball tournament scheduling based on a simulated annealing algorithm and verifies the advantages of this method in terms of stability and fairness through experiments. However, this study still has some shortcomings, such as not considering the competition team's home factors and the limited amount of data. Future research directions can include improving data processing methods, considering

more influencing factors, and optimizing algorithm implementation. At the same time, it is possible to consider applying this method to other sports events or fields to expand its application scope. In summary, the simulated annealing algorithm-based multi-venue basketball event arrangement plan has specific practical value and development potential. It has a positive significance in promoting improving the basketball management level.

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