The Game Model And The Probability Algorithm of Einstein Chess

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Abstract: Einstein Chess is one of the Olympic computer game competition items. It is obviously different from the other games. Players throw the dice, then according to the dice's point number, the player decide to move the chess piece. The dice's point number is random. Therefore, Einstein chess is a random game of complete information. Research on random game is still in the exploration stage. This paper analyzes the game model of Einstein chess. Chess strategy optimization algorithm is designed based on the position and the probability. Through a lot of simulation experiments prove that, the algorithm is effective and practical.

Key Words: Random Game; Game Model; Einstein Chess

1 INTRODUCTION

Einstein chess is invented in 2004,[1] which needs two game players. It is one of the Olympic computer game of competitive games.[2] Obviously, It is different from the other games. Game players throw the dice, according to the number of dice , and determine the number of moving pieces. The dice keeps random. And, it is because that the position of the pieces of the both sides know,it is a game of complete information.[3] However, in the process of throwing the dice, the number of points that appear is uncertain, so there are random. Therefore, Einstein chess is a stochastic game of complete information. Now the research on random game is still in the early exploratory stage. Stochastic game is a dynamic game process that has one or more participants and the state transition probability. Random game consists of multiple game stage[4]. At the beginning of the game, it is in a certain state. Participants choose their own strategies and receive the appropriate remuneration that is determined by the current state and strategy. Afterwords, the game will random transition to the next stage in accordance with distribution of probability and the participants' strategy. In the new stage, fist repeat last strategy selection process, then the game continues. All participants received remuneration in a stochastic game. In general, the discounted value of each stage is calculated, or use of the average value of the various stages of the assembly line to calculate the average. If the number of participants and the number of states in each game may be limited, there will be a Nash equilibrium problem in stochastic game which has a finite game.

Similarly, for an infinite stage stochastic game, if the discounted value of each stage is used to calculate the whole stage of the game rewards, there also will be a Nash equilibrium of the stochastic game.[5]

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It is proved that if the reward of the game process is paid by the lower limit of the average value of each stage, stochastic game that is a game with two players having finite stage and finite state will approximate Nash equilibrium theory in Venice. [6]

2 EINSTEIN CHESS'S RULE

Einstein chess is made up of chessboard, chess pieces and dice.

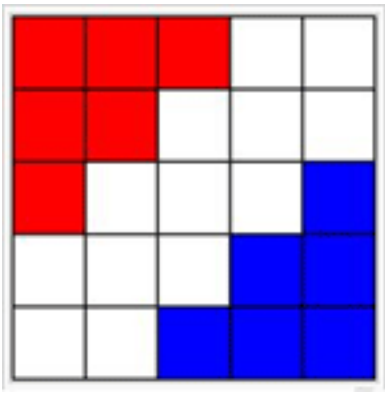

Fig 1. Einstein chess board

The checker board is a grid which have 5 rows and 5 columns, as shown in Fig.1. In order to facilitate the identification of the initial position of the pieces, we fill opex 6 lattice board with red and blue in the vicinity. Both red and blue in the game of each of the 6 pieces are sequentially numbered 1, 2, 3, 4, 5, 6. In the game, any triangle color regions exist the pieces which could be placed arbitrarily at will before the start of the pieces's place are changed. In the course of the game, the two sides take turns to roll the dice, and then dice and more the corresponding pieces the digital displaied the corresponding pieces. If the corresponding pieces from the board removed, the chess can be moved more or less than

this number and the number is closest to; The red side pieces walk right, down, right, every move; The blue side pieces walk left, up, left, each about one; If the pawn move chess pieces on a target, we will remove the piece from the chess board[7]. Sometimes eat this piece is also a kind of strategy, because it can increase flexibility and opportunities which other chess pieces win fastly; The first to reach the other side of or eat up will win ;

3 RANDOM GAME MODEL OF EINSTEIN CHESS

We analyzed at 6 aspects of chess game elements Einstein Chess. They are the set of participants, the process history, participants function, information space, natural probability, participants revenue function.

$$\Gamma = \{N, H, P, I, p, u\} \tag{1}$$

A. Set of Participants

Einstein has red and blue two kinds of chess . Collection of N participants.

$$N = \{1,2\} \tag{2}$$

The red player is called 1. And the blue player is called 2.

B. The Process History

Einstein chess has two stages.

They are pieces of layout and move the pieces

$$H = \{ArrayR_1R_2...R_k\} \tag{3}$$

Array piece layout process. Each participant will be their pieces in the starting area.

Li is my round of mobile chess.

C. Participants Function

Function description of participants in each historical stage, participants' decision-making ability.

$$P(\phi) = 0 \tag{4}$$

$$P(Array) = 1 \tag{5}$$

$$P(ArrayR_1) = 2 \tag{6}$$

$$P(ArrayR_1R_2...R_k) = \begin{cases} 1, kMod2 = 0 \\ 2, kMod2 = 1 \end{cases} \tag{7}$$

D. Information Space

Einstein Chess is a game of complete information.

$$I = I_0 \bigcup I_1 \bigcup ... \bigcup I_k \tag{8}$$

I_0 said the two sides know the layout of the stage all the pieces of the starting position.

I_1 said the first round game played all the pieces move the pieces to the location of the I_{ke} said the K rounds all the pieces move the pieces to the position of the game player.

E. Natural Probability

Einstein chess according to dice decided to move the pieces.

The dice be random.

$$p(k) = \frac{1}{6} \tag{9}$$

The probability for each 1/6.

When there are no pieces missing, probability of moving pieces of each is 1/6.

Along with the continuously removed from the pawn, pawn to get near the moving ability of adjacent pieces.

If a piece of M adjacent pieces are removed from the board, the probability of its access to mobile ability to the (m+1) /6.

F. Participants Revenue Function

The first will be moved to the other vertex position chess game player to win.

In the game, the game player to win 2 points, 0 points of the game player failed.

$$u_i = \begin{cases} 2, Chess_i ArrivedEnd \\ 0, Chess_{(3-i)} ArrivedEnd \end{cases} \tag{10}$$

Us means the game player gains

4 EINSTEIN CHESS ALGORITHM

A. Array Chess Pieces

Pieces have been removed, adjacent pieces action probability will increase. In the layout phase, players need to arrange different numbering the position of the pieces. In the first few steps, the more concentrated pieces. Players have the opportunity to eat their own pieces, improve the probability of other pieces of mobile. Such as Fig.2 and Fig.3. The layout of the common method has the following graph.

3	5	6		
4	1			
2				

Fig 2. one of bad array maps

1	6	5		
2	4			
3				

Fig 3. one of good array maps

B. Pieces of mobile computing ability of probabilistic algorithm

When there are no pieces missing, probability of moving pieces of each is 1/6. Along with the continuously removed from the pawn, the pawn to get near the moving ability of adjacent pieces. If a piece of my adjacent pieces are removed from the board, the probability of dMPro is its ability to obtain mobile (i) as (m+1)/6.

For example, No.5 chess pieces are moved out board. Then the No.4 and No.6 chess pieces all have 1/6 + 1/6 move probability. Such as Fig.4.

1		6		
2				
	3	4		

Fig 4. No.5 chess pieces are moved out board

If No.6 chess pieces are moved out board. Only No.5 chess pieces have 1/6 + 1/6 move probability. Such as Fig.5.

	1	5		
2				
	3	4		

Fig 5. No.6 chess pieces are moved out board

The following is the implementation of the relevant algorithm model.

```
dMPro(i) = 1 / 6
For j = i - 1 To 1 Step -1
   If iChess(j) < 0 Then
      dMPro(i) = dMPro(i) + 1 / 6
   Else
      Exit For
   End If
Next j
For j = i + 1 To 6
   If iChess(j) < 0 Then
      dMPro(i) = dMPro(i) + 1 / 6
   Else
      Exit For
   End If
Next j
```

C. Pieces to reach the end of the shortest remaining steps

A piece of line numbers were m and n.

Calculation method of it reaches the end of the shortest remaining step number for iRemainSteps

```
If m < n Then
   iRemainSteps = 4 - m
Else
   iRemainSteps = 4 - n
End If
```

Phase evaluation function

Considering the probability of action should be the chess pieces in the process, the remaining number of steps and the defense attack effect coefficient.

dSum says the situation value.

dMpro (i) represents the action probability my pieces.

iSteps (i) said the number of pieces remaining step attacks effect.

iAgainst (i) said the defense factors my pieces in the traveling area the enemy pawn.

```
dSum = 0
For  i = 1 to 6
   dSum = dSum + dMPro(i) * iSteps(i) * iAgainst(i)
Next i
```

5 Conclusion

Einstein Chess is a random game with complete information. The player, who first move the chess to another player's top corner, will win the game. The location of chess pieces, moving stochastic and defend of opponent is the main factors of the situation assessment. In this paper, the game model of Einstein chess is analyzed. The effect of random number key calculation to the dice on pawn move probability. Based on location and the probability, the optimization algorithm is designed for the chess strategy. Additionally, a lot of simulation experiments prove the algorithm is effective and practical.

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