A Turning Point in Speculative Play

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Abstract

A goal of this research is to determine the suitable timing to perform a speculative play for every kind of games. As the background, there is a speculative play that is used by a professional player to recover from a disadvantageous position. Currently, we have been trying to implement the speculative play as a strong player does. For that purpose, it is indispensable to clarify the nature of the speculative play. We selected Amazon as a testbed and obtained the data on the change of evaluation values throughout each game. Consequently, the data showed that there is an obvious win when the evaluated value is over a certain value. We defined this value as a turning point, which determines the outcome of a game. Finally, we performed the experiments of the speculative play based on the obtained turning point in 10x10 Amazon. The results showed the validity of using the turning point in Amazon.

Keywords: speculative play; turning point; value of a turn; Amazon;

1 Introduction

In the previous study, we studied the speculative play [3] compared to the semi-random self-play that is a search strategy using the random decision and the lookahead search [4]. Afterward, we have focused on two categories of timing when a speculative play should be used. One category is to use it in a disadvantageous position, while another is to use it just before the opponent has come to find the outcome of the game. Recently, the opponent-model search with probability was investigated by Donkers et al. [5]. They claimed that using the opponent-model search [2] in every position does not lead to a good result. However, there are no studies on the suitable timing to perform a speculative play in a game. Therefore, we have aimed to determine the timing by focusing on the change of the evaluation value.

2 Previous Experiments

At first, we have performed a self-play experiment in order to observe the change of the evaluation values between the players of comparable strength. We have selected Amazon and Othello as the target domains. As a result, we confirmed the some interesting features in Amazon. In addition, we focused on the amplitude of the evaluation values. The changes of the value of each turn in games of Amazon are shown in Figure 1. Consequently, we obtained the following knowledge.

- The amplitude of the evaluation values corresponds to the value of each turn.

- The value of a turn decreases as a game proceeds.

- The turning point seems to depend on the value of a turn.

Among the above features, we recognize the last one is the most important to implement the speculative play based on the turning point. Therefore, we have to determine the turning point considering the effect of the value of a turn.
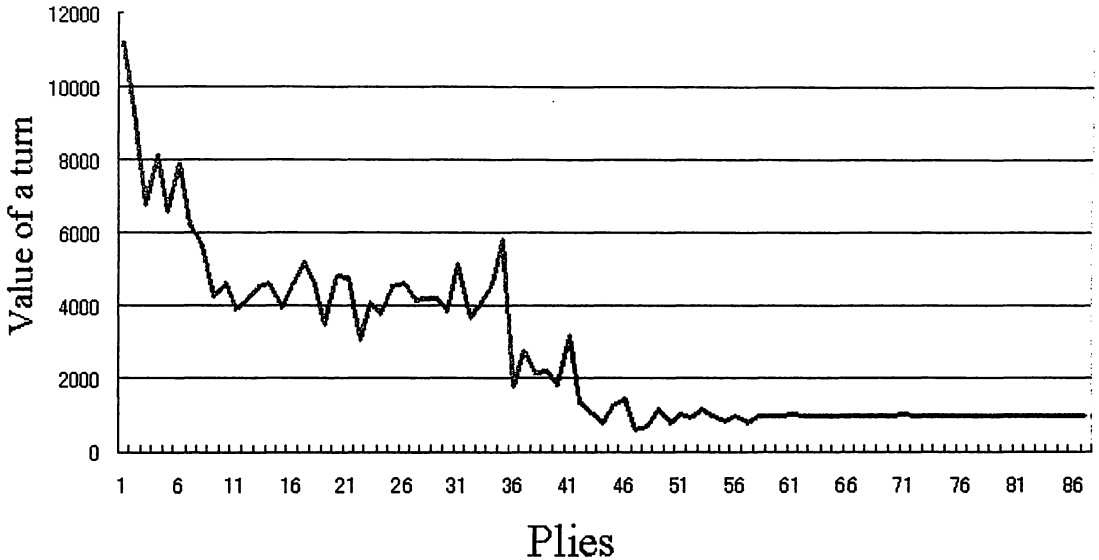
Figure 1: The changes of the value of each turn in games of Amazon

3   Definition

Before showing the experimental results, let us define several important terms: the value of a turn, the turning point and the speculative play. The turning point is calculated as the negative of the value of a turn, which seems to be independent of the characteristics of a game.

Definition 3.1 (Value of a turn)
The value of a turn VT is defined as the average absolute difference between the evaluation value of a position and that of the next position through several recent plies of a game.

In this study, we have used the average absolute difference obtained from the recent 4 plies in order to guarantee the sufficient reliability of the value.

Definition 3.2 (Turning Point)
The turning point TP is defined as the point such that there is an obvious win when the evaluated value is over TP. TP is set to the negative of the value of a turn.

The speculative play has to be performed when the evaluation value of a root position is still under the turning point. However, we do not perform the speculative play at a quite disadvantageous position where the evaluation value of the position is under the turning point even if the value of a turn is added.

Definition 3.3 (Speculative Play)
The speculative play is a kind of search strategies in the disadvantageous position. It is used in order to recover the even or advantageous position somehow or other by expecting the opponent moves and playing so as to raise the winning chance against the possible opponent moves.

We have implemented the speculative play by setting the search depth deeper by one than the regular search. It is not only easy to implement but also reliable in order to develop the strong player with the full-width search [1].

4   Experimental Design

The 10x10 Amazon was chosen as a testbed. We prepared the 4 types of players: P2, P3, SP2 and RSP2, which are described below.

- P2 represents the non-speculative player with the search depth 2.

- P3 represents the non-speculative player with the search depth 3.

- SP2 represents the speculative player with the search depth 2, who uses the speculative play under a certain condition.

- RSP2 represents the speculative player with the search depth 2, who uses the speculative play at random. We set the probability of using the speculative play to 20%.

Note that the search depth of SP2 and RSP2 is 3 during the speculative play. The condition of using the speculative play in SP2 is given as follows.

$$EV \leq TP \text{ and } EV + VT > TP$$

EV, TP and VT denote the evaluation value of a root position, the turning point [Definition 3.2], and the value of a turn [Definition 3.1], respectively.

Every hundred games between P2 as the first player and one of 4 types of players, or between one of 4 types of players and P2 as the second player, have been performed. Every player has not performed any selective search in order to make the difference of strength between P2 and P3 clear.

5   Results and Discussions

The results of the experiments are shown in Table 1 and 2. Table 1 shows the results when the speculative player moved first, while Table 2 shows the results when the second player performed the speculative play. In both tables, the winning ratio against P2, the average total thinking time in a game (as an index of the search cost) and the average number of the speculative play SP are shown.

	winning ratio	time(msec)	SP
P2	50.0%	14070	—
SP2	59.0%	95111	4.30
RSP2	50.0%	78125	2.78
P3	90.0%	773167	—

Table 1: The case when the first player performed the speculative play against P2

	winning ratio	time(msec)	SP
P2	50.0%	11918	—
SP2	72.0%	50925	2.98
RSP2	58.0%	76515	2.82
P3	90.0%	701469	—

Table 2: The case when the second player performed the speculative play against P2

We have perceived the interesting effect that the second player seems to have the larger advantage than the first player when the speculative play is performed. Moreover, SP2 has the greater winning ratio than RSP2, although both players have the same opportunity to use the speculative play. This indicates the validity of performing the speculative play based on the turning point. Consequently, this method is effective in 10x10 Amazon. However, since the use of the speculative

	time(msec)	SP
1W	81157	3.10
1L	116041	6.10
2W	42447	1.84
2L	64757	4.84

Table 3: The comparison of winning cases and losing cases

play is more expensive than the normal search, it is difficult to determine the best balance between the search cost and the gain of the winning ratio.

Table 3 shows the results of comparison between winning cases and losing cases when the speculative play is performed. The win of the first player and the loss of the first player are denoted by 1W and 1L, respectively. The win and loss of the second player are denoted by 2W and 2L. The losing cases need much more search cost than the winning cases. This is probably because more disadvantageous positions appear and more speculative plays are performed in the losing games than in the winning games.

6 Concluding Remarks

We have confirmed the effectivity of performing the speculative play based on the turning point considering the value of a turn in the domain of 10x10 Amazon as one of the complicated games.

In the near future, we need to perform the experiments in other games such as Japanese chess. In order to develop a strong computer player in such a complicated game, we believe that the excellent implementation of a speculative play is necessary.

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