

# Master-like Opening Strategy in Computer Shogi

Jun Nagashima<sup>1</sup> Tsuyoshi Hashimoto<sup>2</sup> Hiroyuki Iida<sup>3,4</sup>

<sup>1</sup>Graduate School of Science and Engineering, Shizuoka University

<sup>2</sup>Faculty of Engineering, Shizuoka University

<sup>3</sup>Department of Computer Science, Shizuoka University

<sup>4</sup>PRESTO, Japan Science and Technology Agency

## Abstract

Even masters are unable to play every opening line effortlessly which may be stored in the opening book. Each master has his preferred opening lines and attempts to lure his opponent to play into his hands. The same can be said about computer programs. In this paper, we demonstrate a method that tunes opening book through self-playing games for the purpose mentioned above. We illustrate an application of proposed method in the domain of computer shogi.

**Keywords:** computer shogi, opening game

## 1. Introduction

In the games such as othello, chess and shogi, there are standard sequence of moves that expert players execute after reaching the conclusion that those moves are the best, through their study. In those games, most human players select their moves through those sequences of moves at the opening game. Most computer players also use those sequences of moves. They have an opening database called *opening book* that there are many standard sequences of moves in.

There are some points to using opening sequence of moves. First, players have to select suitable opening lines for themselves. Expert players conclude standard sequence of moves as the best sequence since they can continue playing at high level after the moves that were led by standard sequence of moves. Therefore, if players can not continue playing well after the moves led by some opening lines, those lines are not best for them even if they are ideal for expert players. Second, the number of moves that a player have to memorize to play safely is depending on the playing strength. For safety play a player has to memorize standard sequence moves that the player can not find by oneself. If players can find correct moves in almost all opening position by themselves, they do not have to have large opening book while players that can not find correct moves by themselves have to large opening book. The third point is mainly for computer players. There are three major way to make opening book. The one is

making by hand from books about opening written by expert players or making with expert players. Inputting only suitable moves for target program, programmers can make suitable opening book, but it is difficult to make large opening book. Another way is making automatically from thousands of game records played by expert players. This way can be used if there are enough game records played by expert players. By this way programmers can easily make large opening book, but many unsuitable moves for target program can be mixed. Therefore tuning opening book for target program is very important. The third way is that program generates opening book automatically by itself. Programmers can apply this way in case there is not enough game record played by experts and make large opening book that often leads favorite position that are evaluated good by target program but it is not sure that those positions are really advantageous.

In this paper, we deal with the opening book for shogi. In making shogi opening book, there are some matters. First, opening book of shogi has not yet been established. Shogi masters sometimes play out-of-book moves even in the early opening stage. Therefore, players have to select opening line where they can play stably even if opponent player plays out-of-book moves. Second, most computer shogi programs are poor at opening play. Therefore, programmers have to support program by preparing large opening book. Fortunately, there are enough shogi game records played by expert players to make opening book. Thus tuning opening book is very important task. Third, the way of automatic tuning is required because programmers have to prepare large opening book. Tuning by hand is not practical for enough size of shogi opening book. Thus it is desirable that program tunes its opening book automatically through many games. In the case of CRAFTY [2], a computer chess program, it plays over 20,000 games per year on various Internet chess servers while we may not be able to play as much as 5,000 games on Internet server. Therefore to play enough games to tune opening book, we have to use other way such as self-playing game or playing against some commercial shogi program that can play many games automatically.

In above we notice that most of computer shogi is poor at playing in opening game. Therefore our purpose of this research is to improve play of opening game. To achieve this, we at first aim to tune opening book automatically to lead target program to favorite positions. In this paper, we try to tune opening book for our shogi program TACOS through many self-playing games.

## 2. Opening book tuning

The task of tuning opening book is too daunting to be done by hand; therefore some methods that tune or generate opening book automatically are supposed such as [2][3]. At first we explain about Extended Book of Deep Blue because the ways like that are seem to use in tuning shogi opening book. Then we explain about our method.

### 2.1. Extended book

Deep Blue is a computer chess playing system that defeated then-reigning World Chess Champion in 1997. According to [1], Deep Blue's opening book which was created by hand by Grandmasters (GMs) had only about 4,000 positions. But in addition to the opening book, Deep Blue had another opening database that was made from 700,000 game records played by GMs. Deep Blue did not use moves from that database, called extended book, as a opening standard move but instead used it as indicators to assign bonuses during search. We can consult it about what kind of moves in extended book added bonuses to decide which opening standard moves in opening book we have to select in order to lead suitable opening lines in case we make opening book from experts' game records. The factors that Deep Blue used are the number of times different moves have been played, relative number of times a move has been played and so on.

We consider that some moves that are regarded as moves that lead to even or advantageous positions by many GMs are played many times. A position led by those moves can make it even or advantageous for GMs. Note that such position will make it even or advantageous for GMs, not just any players. If a player is strong enough to continue playing after such positions, there is no problem. However, if a player is poor at playing such positions, they should avoid following such moves even if many GMs consider them to create big advantages.

### 2.2. Tuning via self-playing games

By checking whether a player is good or poor at playing the game after each position led by opening standard sequence of moves, we can tune opening book to lead suitable opening lines and avoid unsuitable opening lines. We suggest the tuning method that tunes opening book through self-playing games.

We explain our method in the following case. Each move in the opening book has weight. If a position has only one opening standard move, then that move is played. If a position has more than one opening standard moves, then the move that has the biggest weight in those moves is played. First of all, weights of all moves in the opening book are initialized to the same value. Then self-playing game is performed from the initial position. When a player is in positions which are included in opening book, one move is selected and played according to the rule. If a position has only one opening standard move, then that move is played. If a position has more than one move, then the move that has the biggest value  $v$  in those moves is played.  $v$  is calculated by the following formula:

$$v = w_m + r$$

$w_m$  is weight of opening standard move.  $r$  is random number ranges 0 to *Rand*. Self-playing game is performed until the game is over. According to the result of the game, weights of opening standard moves that are played just before in self-playing game are updated. If the opening standard move was played by the winner the weight of the move is added to  $\Delta w$  while the weight of the move is reduced from  $\Delta w$  after the loser's opening standard move. Then perform another self-playing game and update weights reducing *Rand* and  $\Delta w$  till weights of moves in opening book become stable. We prepare additional option that sometimes leads out-book position intentionally when selecting opening standard move to play in self-playing game. To do this, we can check whether target player can play strong enough in current opening line even if the opponent player leads out-book position.

Using our method, opening book is tuned for target player. Target player can lead suitable position and avoid unsuitable position using tuned opening book because weight of moves that lead suitable positions become higher and weight of moves that lead unsuitable positions become lower.

## 3. Application to TACOS

In this section, we apply our method and the other ways that were explained in section 2 to our shogi program TACOS and confirm if each method tunes opening book suitable for TACOS.

### 3.1. Opening book for experiment

At this time, we use the opening book that is automatically made from experts' game records. We prepared about 29,000 game records including about 11,000 game records played by professional players and about 18,000 game records played in Shogi Club 24, famous Internet shogi site [4]. We use the first 45 moves of each game record as an opening standard move. We regard that expert players seldom make mistakes in early stage of the game. However, as rare as they might be mistakes still do occur to players at any level. Actually, in one game record played in Shogi Club 24, first move was P-8f that is rarely played; therefore we think that black player wanted to play P-7f but misplaced it. To exclude such mistake moves, we remove moves played less than 10 times in position that appears more than 100 times. Using this rule and additional rule, we make multiple opening books that basically contain about 670,000 positions and 725,000 opening standard moves. Each move has weights and the move that has the biggest weight in those moves is played in each position.

### 3.2. Tuning

This time, we make 24 opening books. We will explain about them below.

#### Move information (Type-1)

We make opening book using only information of moves from experts' game records. Weight of all moves in the opening book is the same value (0). This opening book is named as Type-1.

#### Move and frequency information (Type-2)

We make opening book using information of moves from experts' game records and how many times those moves were played. Weights of each move in opening book are frequency of each move. This opening book is named as Type-2.

#### Move information of winner (Type-3)

We make opening book using only information of moves played by winner from experts' game records. We do not use moves played by loser in this opening book. If same moves are played by winner in a game record and also played by a loser in another game record, we use such moves. This opening book is named as Type-3 and has about 358,000 positions and 385,000 standard opening moves.

#### Move and frequency information of winner (Type-4)

We make opening book using information of moves played by winner from experts' game records and how many times those moves were played. Weights of each move in opening book are frequency of each move played by winners. This opening book is named as Type-4 and has about 358,000 positions and 385,000 standard opening moves.

#### Move, frequency and other information (Type-5a, Type-5b, Type-5c)

We make opening book using information of moves from experts' game records' frequency of those moves and results of games and whether players were professional or not. We make three opening books, Type-5a, Type-5b and Type-5c.

In Type-5a, moves played by winners add 3 points and moves played by losers add 1 point to the weight of opening standard moves in the opening book. In Type-5b, moves played by professional players add 3 point and moves played by armature players add 1 point to weight of opening standard moves in opening book. In Type-5c, moves played by professional winners add 5 points, moves played by losing professionals add 2 points, moves played by armature winners add 3 points and moves played by losing armatures add 1 point to the weight of opening standard moves in opening book.

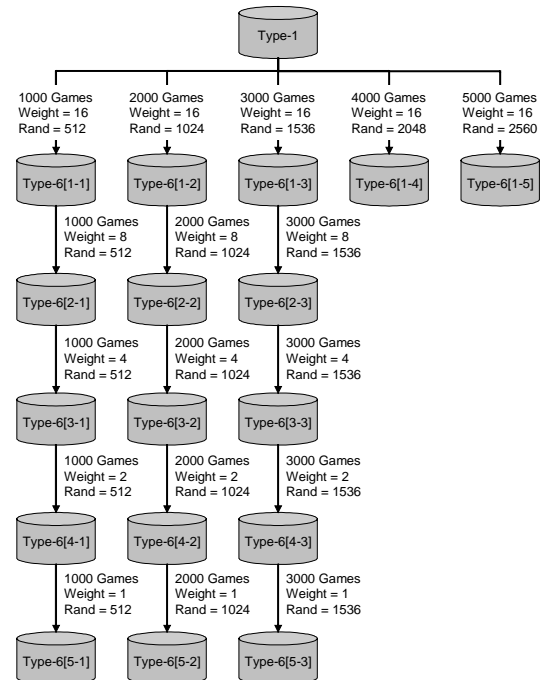


Figure 1 Process of making Type-6 opening books.

### Tuning through self-playing games

#### (Type-6[1-1], Type-6[1-2], ..., Type-6[5-3])

We tune Type-1 through self-playing game and make 17 opening books. Figure 1 shows a process of these operations. The first, we tune Type-1 through 1,000 self-playing games with tuning parameter of  $\Delta w = 16$  and make Type-6[1-1]. In the same way, we make Type-6[1-2], Type-6[1-3], Type-6[1-4] and Type-6[1-5] from Type-1. Then we tune Type-6[1-1] through 1,000 self-playing games with tuning parameter of  $\Delta w = 8$  and make Type-6[2-1]. In the same way, we make other opening books such as Type-6[5-1], Type-6[5-2] and Type-6[5-3].

During self-playing games, we lead out-book position intentionally with 0.8% probability. Under this condition, about 70% games were lead to positions after 45 opening standard moves from the initial position. And we used tuning parameter Rand as 512 for Type-6[x-1], 1024 for Type-6[x-2] and 1536 for Type-6[x-3]. We did not use some game records that became draw by repetition of moves or that had over 300 moves.

## 4. Experiment

To compare effectiveness of each tuning, we performed self-playing experiment played by TACOS with Type-1 opening book against TACOS with other opening books. In case that both of player used opening books, opening book always leads positions after 45 moves from the initial position. But in a real game, the opponent player sometimes leads out-book position; therefore, in this experiment we also lead out-book position intentionally with 0.8% probability. Each game of this self-playing experiment started from the initial position. TACOS with an opening

book plays 50 games as black and 50 games as white against TACOS with Type-1.

The result of this experiment is shown in Table 1. We treated games that became draw by repetition of moves or that became over 300 moves as 0.5 win and 0.5 loss. The results of Type-2, Type-3, Type-4 and Type-5 show that those opening books are not suitably tuned for TACOS. This means that some opening lines are not suitable for TACOS even if those opening lines are often played by expert players. On the other hand, TACOS with Type-6 opening book beat TACOS with Type-1 opening book. This means that tuning through self-playing games we can make suitable opening book for a target program.

## 5. Conclusion and Future Work

In this paper, we aim to tune an opening book for a target program. To apply to any game, our method tunes weight of moves in opening books through self-playing games. Using this method, we tune the opening book that is made from experts' game records for TACOS and using that opening book TACOS can select suitable opening lines and avoid unsuitable lines.

In this case, we tune weight of moves in opening book through self-playing games. We can easily perform many games under the condition of self-playing games, but under this condition opening book can be tuned bias. One way to avoid this is to tune through games against various opponents. And as another way, now we are analyzing game records of self-playing game paying attention to the change of evaluation value. That is the future work.

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Table 1 Result of self-playing experiment.

Type-1 vs.	Wining point	Type-1 vs.	Wining point
Type-2	61	Type-6[2-2]	61
Type-3	56	Type-6[2-3]	61
Type-4	50	Type-6[3-1]	55
Type-5a	47	Type-6[3-2]	61.5
Type-5b	54	Type-6[3-3]	60
Type-5c	53	Type-6[4-1]	70.5
Type-6[1-2]	57	Type-6[4-2]	63
Type-6[1-2]	60.5	Type-6[4-3]	73
Type-6[1-3]	56.5	Type-6[5-1]	62.5
Type-6[1-4]	62	Type-6[5-2]	65
Type-6[1-5]	67.5	Type-6[5-3]	61.5
Type-6[2-1]	51		