Mobility in Shogi Game

Natsuhiko Nagumo (Kanagawa Univ.)

§ 1. Introduction

Shogi is Japanese representative of the family of chess games and that is extremely popular among all classes of Japanese. Today a lot of engineers and scientists are interested in Shogi. They analyze many kinds of data in Shogi and make computer programs which we can play against. At some points Shogi is looks like chess, but at other points Shogi is much different from chess. Recently mobility of shogi was recognized considerably different from chess.

§ 2. Definition of Mobility

Mobility of the stage is defined numbers of all movements per the squares. In case of chess and almost all of family of chess games, the player who has much mobility is often superior to the other player in any stage. The difference of mobility means that of the situation.

Mobility M generally defined as follows.

\[ M = \frac{\sum n \text{ of movements}}{n \text{ of squares}} \]  \hspace{1cm} (1)

Then \( p \) means Pieces, and \( n \) means Numbers.

At the beginning of chess game, for example, \( M \) is calculated as follows. Every pawn has 2 moves, every Knight has 2 moves, any other pieces have no move. Then 20 (=2x8+2x2) movements exist. Chess board has 64 (=8x8) squares. Hence \( M \) is 0.31 (=20/64).

§ 3. Mobility in Shogi

Mobility in Shogi is calculated as the sum of two factors. One of them is mobility of pieces on the board, and the other of them is mobility of captured pieces which the player can use as paratroops.
Mobility $M$ in Shogi defined as follows.

$$ M = \frac{p' + \sum n \text{ of movements} + \sum n \text{ of squares can be drop}}{n \text{ of squares}} $$  

Then $p$ means Pieces on the board, $p'$ means Pieces which were captured before, and $n$ means Numbers.

At the beginning of Shogi game, $M$ is calculated as follows. Every pawn has 1 move, every Lance has 1 move, every Knight has 0 move, every Silver has 2 moves, every Gold has 3 moves, a Bishop has 0 move, a Rook has 6 moves, a King has 3 moves and no captured pieces exist.

Then 30 ($=1x9+2x1+2x2+2x3+1x6+1x3$) movements exist. Shogi board has 81 ($=9x9$) squares. Hence $M$ is 0.37 ($=30/81$).

In last December, the 4th Computer Shogi Championship was held in Tokyo. The program called 'KIMAMI' won all 7 games and took a first place. 'KAKINIKO-SHOGI' won 5 games, lost 2 games and got the second place. I analyze the match between these two programs. 'KAKINIKO-SHOGI' got the first move, but 'KIMAMI' won the match at his 70 moves.

In this match, opening was even, but at the early stage of middle game (about his 30th move) 'KIWAMI' turned to advantage. He expanded his superiority during middle game and end game, finally won the match. It seems that it was one of very satisfying game for 'KIWAMI'. Fig.1 and Fig.2. shows mobility of each player in this match.

![Fig.1 Mobility of 'KAKINIKO-SHOGI'](image1)

![Fig.2 Mobility of 'KIWAMI'](image2)
Correlation between Mobility and situation aren't exist during all game without the last stage of end game (after 130 move). Because kinds of captured pieces extremly affect mobility in Shogi game. One kinds of captured pieces without pawn gains about 45 moves. A captured pawn gains about 8 moves.

Then mobility in Shogi is roughly estimated as follow.

\[ M' = \frac{35 + 45 \cdot c1 + 8 \cdot c2}{81} \quad (3) \]

Then \( c1 \) means kinds of captured pieces without pawn, \( c2 \) means a captured pawn or pawns. (if pawns exist, \( c2=1 \))

Broken lines on Fig.1 and Fig.2 shows <Estimated mobility \( M' \)>

§4. Summary and future problems

At the point of mobility, Shogi is much different from other family of chess games. Much mobility in Shigi don't mean superiority, but only mean a lot of captured pieces.

Captured pieces are the reserves, but aren't the regular army. 2 or more captured pieces never appear on the board at one time. So value of captured pieces ought to decrease.

[Reference]