Keeping track of pieces in Invisible Chess

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Abstract. Invisible Chess ([1],[2],[3]) is a variation of Chess where some of the pieces are invisible to the opponent. It is related to Kriegspiel [4] where all the pieces are invisible. However, in the variant of Invisible Chess that we investigated in this paper there are some significant differences in the rules from Kriegspiel.

1. The King is always visible.
2. Invisible pieces are revealed when they cause or block check, and when they capture or are captured.
3. If an invisible piece is moved the opponent is informed which piece has moved.
4. A player of Invisible Chess misses a turn if they perform an impossible move.
5. There is no 'any' type move like in Kriegspiel.

It has been demonstrated ([2],[3]) that the strategies of hiding a player's invisible pieces from their opponent, and seeking the opponents invisible pieces, increases the likelihood of a player winning Invisible Chess. Therefore it follows that in order for a player to play well in Invisible Chess they need to maintain in an efficient manner the probability distribution of the possible positions of the opponent's invisible pieces.

Bayesian Networks provide a framework to maintain the probability distribution of invisible pieces and to incorporate information gained in the process of playing the game. In this paper we will discuss the various issues that need to be handled in using Bayesian networks to keep track of invisible pieces in Invisible Chess. In particular the exponential increasing size of the conditional probability tables as the number of invisible pieces increase, the modeling of both static constraints, (i.e., only one piece on each square), and dynamic constraints, (i.e., no piece is allowed to move through another piece), and the handling of information gained by the player during the game (i.e., when a player is able to move a piece, such as a rook, they learn that there are no invisible pieces on the intervening squares). Also, we will show that the rules for Invisible Chess allows for the possibility of decomposing the Bayesian Network into small subnets corresponding to the movement of different types of pieces. Finally, we will discuss how the relaxing certain constraints enables the rolling up parts of the network, and this leads to considerable simplification of the network and the updating procedure.

References

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