Analysis of Isolation Heuristic Functions

Description of Heuristic Functions

Baseline – AB_Improved:
This function calculates the difference between the available moves for the active player and for the opponent. It rewards moves that allow the active player to have more options to occupy the board, and penalizes moves otherwise.

AB_Custom:
Instead of using L1 distance in the AB_Improved, this heuristic uses L2 distance between the available moves of the player and her opponent.

AB_Custom_2:
Similar to AB_Improved, this heuristic penalizes a player's move that would increase her opponent's number of moves. However, the penalty coefficient gradually increases from 1 as the board get more crowded and is capped at 3.

AB_Custom_3:
In addition to AB_Improved, this heuristic also rewards a player's move that position herself closer to the center of the board, and penalizes a move that would allow her opponent to do so.

Results

The three customized heuristic functions are competed against the baseline improved function in a tournament format over 200 games for each cpu agent. The results are shown in the table below.

	AB_Improved	AB_Custom	AB_Custom_2	AB_Custom_3
Random	93%	94%	95%	94%
MM_Open	73%	79%	76%	73%
MM_Center	84%	85%	87%	89%
MM_Improved	68%	78%	75%	69%
AB_Open	53%	51%	50%	51%
AB_Center	52%	56%	50%	56%
AB_Improved	52%	44%	47%	50%
Avg. Winning Pct	67.4%	69.4%	68.1%	68.6%
Std. Deviation	16.5%	19.0%	19.6%	17.9%
Ratio	4.07	3.65	3.47	3.83

All three heuristics have a few percentages of improvements over AB_Improved, with AB_Custom has the highest average winning percentage 69.4%, an improvement of 2%.
AB_Custom is particularly good at competing against MM_Open and MM_Improved because it penalizes moves that favor the opponent and it uses alpha-beta pruning.
I'm a little surprised that the AB_Custom_2 has an overall lower winning percentage than that of AB_Custom. Probably because the decaying factor needs to be fine-tuned.

The standard deviations are also compared, it appears that all heuristics have higher variances than AB_Improved, and hence lower Winning Percetage/S.D. ratios. Though, more games might be needed for the variance analysis.
AB_Custom_3 has the best ratio among the three. It is particularly good at competing against MM_CENTER and AB_CENTER because it penalizes moves that favor the opponent and it also combines with the improved_score heuristic.

Recommendations

AB_Custom_3 is the best option from the three heuristics.

1. It has substantial improvement over AB_Improved, 1.2%.
2. It has at least 50% winning probability against any of the competing strategies.
3. It's particularly great competing against MM_CENTER, AB_CENTER.