Monte-Carlo Tree Search for Implementation of Dynamic Difficulty Adjustment Fighting Game AIs Having Believable Behaviors

Author: Makoto Ishihara , Suguru Ito , Ryota Ishii, Tomohiro Harada, Ruck Thawonmas

Abstruct

- **The purpose is to create an AI that can adjust the difficulty of fighting games with Monte Carlo Tree Search (MCTS).**

- **Difficulty levels are for beginner and intermediate levels.**

- **This AI is Dynamic Difficulty Adjustment (DDA) AI.**

What are beginner and intermediate levels?

Intended for beginner and intermediate human players in fighting games.

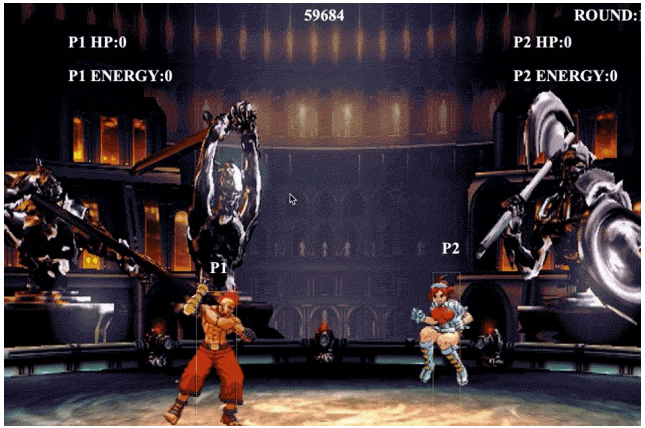
Do not fully understand the game information.

- **Main features of beginners and intermediates**
- **Character operation**
- **Available actions**
- **Combat style and tactics**

Game &DDA-AI

- **The game used is Fighting ICE**

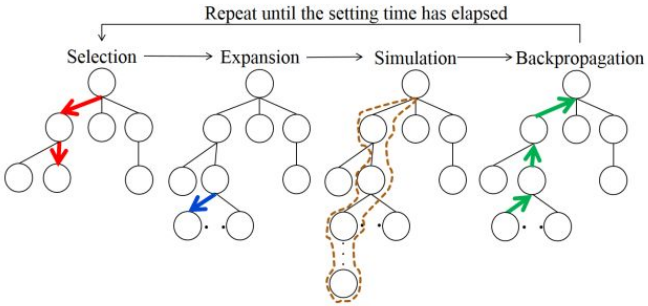
- **DDA-AI fights evenly with opponents**
  - This AI can win or lose
  - The evaluation criteria use only the difference in HP



MCTS

- **Tree search using the Monte Carlo method**

Often used in games to determine the next move



- **The root node contains current game information**
  - The character's hit points (HP)
  - Energy
  - Position
  - Actions in progress
  - Time remaining in the game.

AHDTG
(Average HP Difference Throughout the Game)

- **Evaluation method for AI to fight in a balanced manner**
- **Get the HP of me and my opponent for each frame and calculate the value.**

  If fight evenly, the value of AHDTG will be smaller.

$$AHDTG = \frac{\sum_{i=1}^{F_{total}} |HP_i^{my} - HP_i^{opp}|}{F_{total}},$$

Test

- **Ask multiple people to fight the three AIs and then answer the questionnaire. (eAI, TPOSAS, BEAI)**

- **Ask multiple people to fight the three AIs and then answer the questionnaire.**

The questionnaire will fight each AI and answer the elements called positive effects (fun, strength, unnaturalness) on a 5-point scale.

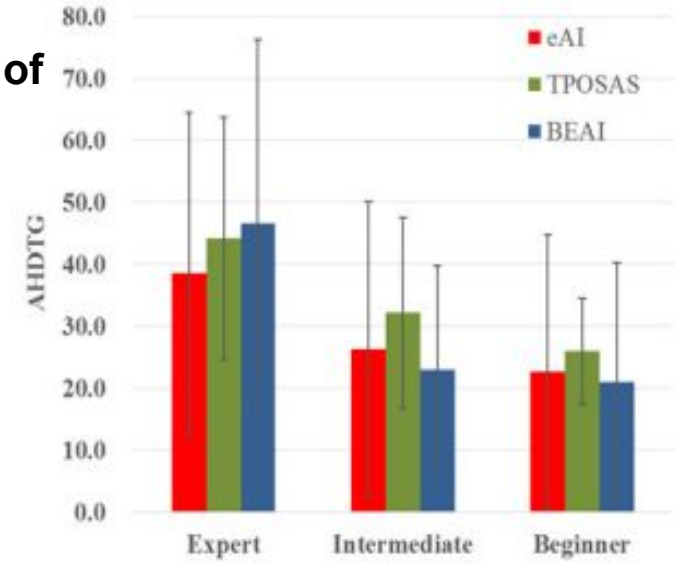
- **Find the AHDTG value for each AI match record**

Result

It is a graph that calculated the average of AHDTG with each opponent

BEAI was able to fight the most evenly

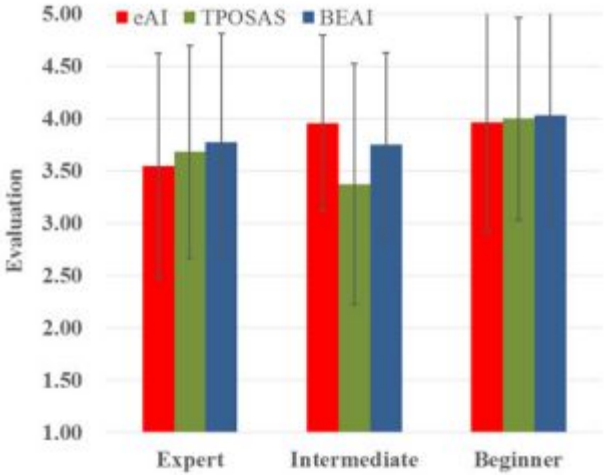
The value was the highest in Expert



Result

Evaluation of fun by the subject

BEAI gave a high number

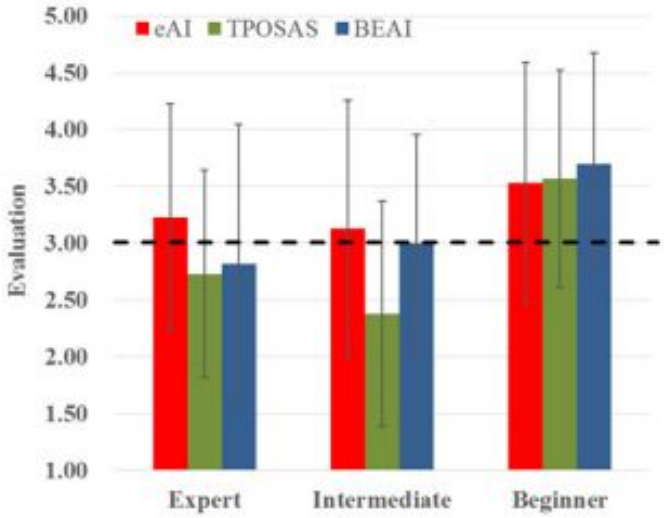


Result

Evaluation of strength by the subject

In the evaluation here, it can be said that 3.0 maintains the best strength.

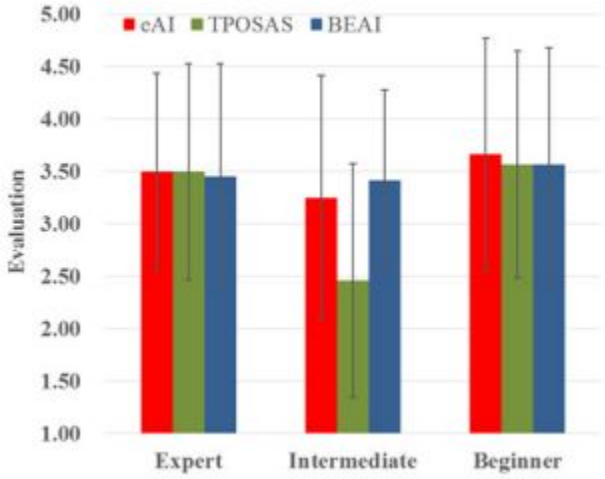
Best value for Expert and Intermediate



Result

Evaluation of unnatural by the subject

BEAI was rated higher overall than other AIs



Thank you for listening