

Creating AI that behaves like a human in Universal Fighting Engine

Abstract

In recent years, the level of in-game AI has increased. Among them, the growth of AI in fighting games is remarkable. It used to be so weak that it couldn't be a practice opponent, but now it's a combo that connects the skills of strong players to attack. Even a strong player can lose. However, "human-like movement" is still impossible. For example, tensions between people fighting each other can cause them to perform better than usual. On the other hand, we may be nervous and make small mistakes that we wouldn't normally make. We believe that creating an AI that behaves like a human will be a better practice partner for this fighting game. By doing so, I thought that I could expect to improve the skills of human players. Therefore, I researched how much "human-like movement" can be achieved by recording human movements and letting AI learn. I confirmed the created AI by Turing test. The result was that about 50% of people mistakenly thought it was a human movement.

1 Introduction

The purpose of this research is to create an AI that behaves like a human in a fighting game. The fighting game has a 2D map and 1vs1 pure battle. Also, depending on the character, there are some that emit a beam from their hands. This fighting game is popular all over the world, and there is some software such as "Street Fighter" and "Tekken" that have evolved into e-sports. AI in the current fighting game has become a practice opponent such as a professional fighting game player by adjusting the strength. However, when the strength of AI and the strength of human players increase, it becomes very difficult to win. If that happens, the motivation, fun, and play skills of the human side will be lost. Also, AI that is too strong transcends the operations performed by real human players. As a result, it becomes a mechanical movement, and it is not possible to gain practical experience. Therefore, I focused on the question, "What kind of AI is an AI that can be used as a practice partner for various people?" As a result of our thinking, it is an AI called "AI that behaves like a human player". "Human-like movement" is a technique called "feint" that moves so as not to hit the opponent intentionally and induces the opponent's movement, a technique that humans tend to choose, and a change in movement due to tension. And so on. I thought that these movements

could be reproduced by learning human play data. Therefore, we collect various battle data in the fighting game and use an analysis tool called "GameViewer" to let AI learn. Then, a test called the Turing test [1] is conducted to take a questionnaire to see if it behaves like a human being.

2 Method

2.1 Fighting Game

A fighting game is a game in which players fight with each other or with players such as hitting and kicking with the player VS CPU. In fighting games, there are special moves that can be performed for each character other than operations such as punching, kicking, and throwing. For example, there is a technique to put out a fireball (Fire Ball) and a technique to punch while dashing. We need to make multiple inputs quickly to activate these Special Moves. In the case of a fireball, enter the key to move forward after crouching, and finally enter the punch for the operation. A technique that requires multiple inputs is called a "command technique". The input is called a "command". And we can give a certain amount of damage to our opponent by combining these techniques and putting them out in succession. This is called a "combo". Since each character has a different size, a large character has a wider range of attack than a small character, and it moves slowly, which is a disadvantage. Instead, it is stronger than a character with low offensive and defensive power. As we can see, the status is different for each character. As a result, fighting games are extremely competitive and various types of fighting games have become e-sports.

2.2 Universal Fighting Engine

The fighting game software used in this research is "Universal Fighting Engine 2" (Ufe2) [2]. This is the engine for creating 2D 1vs1 fighting games like the one above in Unity [3]. Ufe2 is equipped with characters, movement motion, attack motion, etc. in advance. And since it works within Unity, it's very easy to change. For example, the fighting game software used in this research is "Universal Fighting Engine 2" (Ufe2) [2]. This is the engine for creating 2D 1vs1 fighting games like the one above in Unity [3]. Ufe2 is equipped with characters, movement motion, attack motion, etc. in

advance. And since it works within Unity, it's very easy to change. For example, increase the attack pattern of the character, add or change the button to attack. Furthermore, it is possible to add characters and the like. There is an AI called "Fuzzy AI"[3] in this, and "Fuzzy logic" is used for decision making. I can change the difficulty of Fuzzy AI by adjusting various parameters of this fuzzy logic. Fuzzy AI will be explained in detail in the explanation of AI. In this experiment, a controller was adopted because it is easier to issue commands than keyboard input. Then, I use a tool called "AntiMicro" so that I can input with the controller. add or change the button to attack. Furthermore, it is possible to add characters and the like. There is an AI called "Fuzzy AI" [3] in this, and "Fuzzy logic" is used for decision making. I can change the difficulty of Fuzzy AI by adjusting various parameters of this fuzzy logic. Fuzzy AI will be explained in detail in the explanation of AI. In this experiment, a controller was adopted because it is easier to issue commands than keyboard input. Then, I use a tool called "AntiMicro" so that I can input with the controller.



Figure 1. Ufe2 game screen

2.3 AntiMicro

AntiMicro [4] is software that allows us to set gamepad buttons as shortcut keys or keyboard buttons. In addition, AntiMicro can set multiple buttons on the keyboard to be pressed simultaneously as one button (ex. AIZU and FUKUSHIMA can be input with one button). Furthermore, AntiMicro can set the launch of the application. Highly extensible software that can also be used. In this research, the movement keys on the keyboard were ported to the joystick of the controller, and the other buttons were set as attack buttons.

2.4 AI

This study uses "Fuzzy AI" and "Artificial contender AI" (ACAI) [5].

• Fuzzy AI

This AI is an AI implemented in Ufe2 that allows us to easily adjust the difficulty level. Adjustable parameters are "time to decision", "time between actions", "rule compliance", "aggression" (weight of attack movement), "combo efficiency" (probability of attempting combo action) There are 5 of them. Each of these can be adjusted with a maximum value of 1. This time, I set 5 of very easy, easy, normal, hard, and very hard. Each adjusted value is in Table 1.

	Very easy	Easy
Time between decisions	0.4	0.3
Time between actions	0.1	0.1
Rule compliance	0.9	0.9
Aggressiveness	0.1	0.3
Combo efficiency	0.1	0.2

Table 1. Fuzzy AI's 2 difficulty setting values

	Normal	Hard	Very hard
Time between decisions	0	0.1	0
Time between actions	0.05	0.05	0.05
Rule compliance	0.9	0.9	0.9
Aggressiveness	0.5	0.6	0.6
Combo efficiency	1	1	1

Table 2. Fuzzy AI's 3 difficulty setting values

• Artificial contender AI (ACAI)

In this research, we will build using the AI learning method called Markov decision processes [6] from among many types of AI construction. This learning method observes and learns human movements and acts on the knowledge base formed after that. Therefore, the AI uses the situation in the game and the knowledge base to determine the action to be performed. TruSoft's artificial intelligence middleware "Artificial Contender" [5] was used to build this AI. Follow the steps below to create a knowledge base to be used for learning.

1. Record a match in which a human player is fighting in Ufe2 (.fgr file)
2. Load the recorded data with "Game Viewer"
3. Convert to a knowledge base file for AI (.ack file)

The contents in the log file are as follows

currentState	The current posture and movement are stored ex. Stand, Jump
currentSubstate	Postures and movements other than currentState are saved ex. Idle, Stunned
currentBasicMove	Stores the current basic movement Example: MovingJump, MovingForward
currentMoveName	Stores the current attack Example: Punch, Kick
Coordinate	x, y, z are stored
isBlocking	Stores whether or not the attack has been successfully defended. Success: True Failure: False
characterHealthSelf	Hit point
characterDistanceSelf	Distance from enemy
characterJumpArcSelf	Jump power

Table 3. Elements of battle data

2.5 Game Viewer

Game Viewer is a tool for changing recorded battle data into a knowledge base for AI. By loading the battle data into Game Viewer, stick figures and remaining physical strength will be displayed. In addition, the current movement and posture are also displayed for each frame. Create an ack file that saves this in-game situation and the movements that human players are doing in the knowledge base.

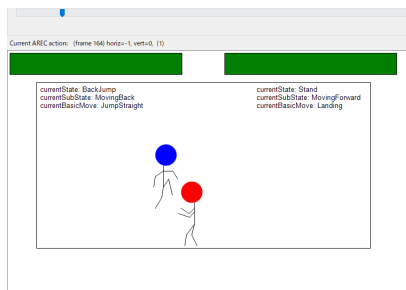


Figure 2. Game Viewer

2.6 AI movement

ACAI will determine the best action based on the current game situation and knowledge base. The "GameSituation, Action" pair is saved in the knowledge base, and if there is the same "GameSituation" as the actual game situation, select the paired "Action". If the AI does not find the same "GameSituation" in the game, select the most similar pair. Also, if a pair that matches the current Game Situation is not found, the attribute set is reduced, the search conditions are changed, and the search is performed again. In some cases, instead of selecting only based on the current in-game situation, a pair of "Game Situation" that reproduces the "combo" often used by the human player used for learning may be selected. When selecting "Combo", there may be multiple attacks in succession. In that case, it is determined based on a weighted random selection from the options. In addition to the pair, the knowledge base stores how many times the same pair was recorded. Therefore, the basis for this weighted random selection depends on the number of times the same "GameSituation, Action" pair is recorded.

3 Evaluate AI

The Turing test is used to evaluate AI. The Turing test is one of the ways to consider the intelligence of a computer. A test that confirms whether an objectively created AI actually behaves like a human being. In this test, we'll ask multiple people to watch three battle videos to see how many people can tell if they're AI and human players. In the battle video, each (Fuzzy AI, ACAI, human player) fights against the same opponent (Fuzzy AI). The difficulty level of the opponent's Fuzzy AI is Normal. As for the human player, the player who actually learned ACAI plays the game. There are three questions to ask.

Q1. "Have you ever experienced a fighting game?"

Q2. "Is it AI or a human being operated in the video?" (Every 3 videos)

Q3. "Is it easy to judge whether it is AI or human?"

Use the same character for each video so that there is no difference other than operation. I survey people in different categories, from experienced fighting game players to those who have little experience or who have never played fighting games. For the question "Is it AI or human?", Watch the video and select the person who is operating the target character. There are two choices, "AI" and "Human", and respondents can answer correctly with a 50%

probability even if they do not know. Then, ask the question "Is it easy to judge whether it is AI or human?" To confirm how confident you are in your answer. The questionnaire is created using Google Form, and 40 acquaintances are asked to take the questionnaire.

4 Result

The results of the survey are represented by the table below. There are three videos from A to C, A is operated by ACAI, B is operated by humans, and C is operated by Fuzzy AI. Opponents are Fuzzy AI (normal) in all three games.

Q1. Have you ever played a fighting game?

Selection	Percent (%)
Yes(little)	70
Yes(long)	10
No	20

Table 4. Result of Q1

Q2. "Is robot character controlled by"

Video-A is ACAI

Choice	Percent (%)
AI	55
Human	45

Table 5. Result of Q2 (video A)

Video-B is human

Choice	Percent (%)
AI	62.5
Human	37.5

Table 6. Result of Q2 (video B)

Video-C is Fuzzy AI

Choice	Percent (%)
AI	60
Human	40

Table 7. Result of Q2 (video C)

Q3. Watch each video and select the item that applies to AI

Choice	Percent (%)
Easy	7.5
understand	7.5
difficult	20
didn't understand	20
Intuition	45

Table 8. Result of Q3

5 Discussion

Of the people who participated in this survey, 32 out of 40 (80%) experienced fighting games before the survey. Since many people understand fighting games, the answer results are likely to be close to accurate. In Q2 video-A, ACAI controlled the robot. According to the survey results, 45% of people answered that they are operated by humans. Almost half of the people were deceived. This result suggests that ACAI was able to move very close to humans. Also, in video-B, I found out that many people are operating it. In this questionnaire, video-C operated by Fuzzy AI was able to deceive the respondents most. It turns out that it is possible to resemble a human movement just by adjusting the difficulty level. In the self-confidence question for Q3's answer, the majority of the three negative answers were "difficult", "didn't understand", and "intuition", and it was found that many respondents were worried. Among those who answered the other "easy" and "understand" options, 2 out of 6 people answered all. The ratio of all the videos (A to C) was close to 5: 5. From this, it is considered that the ACAI and Fuzzy AI created this time are able to move very close to humans.

6 Conclusion and Future work

In this research, we have been researching on the theme of "creating a fighting game AI that can be operated by humans". With this result, we were able to make AI move like a human from an objective point of view. In the future, how much will AI objectively approach human movements when a higher-level player becomes a learning source or a lower-level player becomes a learning source? How close is the AI created based on the created AI to the human player who was the learning source at the beginning? What is the result if the respondents actually fight and decide whether it is AI or human? The future work is to create a game AI that behaves like a human by changing the viewpoint.

7 References

- [1] Livingstone, D. (2006): Turing's Test and Believable AI in Games. In *Computers in Entertainment* 4 (1), pp. 6–18.
- [2] Mistermind [Handle], Ufe2 source in Unity Asset Store, (2017) [online] Available:<https://assetstore.unity.com/packages/templates/systems/ufe-2-source-126124>

- [3] Unity.com “Unity” [online] Available:
<https://unity.com/ja>
- [4] Travis Nickles and the Antimicro Organization
“AntiMicro”,(2021) [online]
Available:https://www.microsoft.com/ja-jp/p/antimicro/9n1fcfq6p5lw?cid=msft_web_chat&activetab=pivot:overviewtab
- [5] Tutorialspoint, “Artificial Intelligence - Fuzzy Logic Systems”, [online]
Available:https://www.tutorialspoint.com/artificial_intelligence/artificial_intelligence_fuzzy_logic_systems.htm
- [6] TruSoft International Inc. “Artificial Contender” [online]
Available: <http://www.trusoft.com/>
- [7] Even-Dar, E., Kakade, S., & Mansour, Y. (2004). Experts in a Markov Decision Process. Advances in Neural Information Processing Systems, 17, pp. 401-408