Imitating the Behavior of Human Players in Action Games

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Abstract. In action games, the computer's behavior lacks diversity and human players are able to learn how the computer behaves by playing the same game over and over again. As a result, human players eventually grow tired of the game. Therefore, this paper proposes a method of imitating the behavior of human players by creating profiles of players from their play data. By imitating what many different players do, a greater variety of actions can be created.

1 Introduction

In many action games, a human player manages different behavior every time he/she faces a different opponent. However, when the player faces a computer as an opponent, its behavior is limited in variety since its behavioral patterns are restricted by a finite-state machine or by scripts programmed in advance [1]. Because of this limitation in behavior, a human player can play the same game repeatedly, learn the behavior of the computer-controlled game character, and win easily. This is one major reason why human players soon grow tired of "fighting with a computer." Thus, many players prefer playing with another human player to playing with a computer. Yet this human-to-human play has a major drawback, as there is no guarantee that a player can find a human opponent when he/she wants to "fight."

Recently, it has become easier to find a human opponent over the Internet or other networks, which has alleviated this problem by connecting two human players across a long distance. Still, it remains difficult to find a human opponent with a similar degree of proficiency and/or a similar preference in style of play. Therefore, game players demand computer-controlled characters with many different behavioral patterns, which they can fight at anytime. However, many researchers in this field are focusing on making the computer's artificial intelligence for fighting human players as "tough" as humans. Furthermore, researchers are striving to develop artificial intelligence that is closer to human intelligence. However, such research is not focusing on imitating the behavior of a player that a human player wants to fight.

This paper proposes a system that imitates a player's actions by creating a profile of the player. The profile incorporates the player's tactics and strategies based on play data for that particular player and controls the computer character's behavior by referring to the profile. By changing the player profile for the computer, a human player can face computer-controlled characters with many different behavioral patterns. The

human player can also fight a computer-controlled opponent that matches his/her preference simply by choosing the player profile he/she prefers.

As shown in Fig. 1, the proposed system records the moment-to-moment actions that a game player takes and the timing of interactions between game players as the play data. From these play data, the system calculates correlations of situations and tactics to the actions taken by the player in such situations. In addition, the system acquires from the play data the strategies (tactic sequences) of the player, which are represented by a sequence of tactics. The acquired tactics and tactic sequences are stored as the player profile of the particular player to be imitated. Then, the system creates imitated actions of the player based on this player profile. The computer evaluates the distance between the situation in the game and the strategy selection criteria in order to create the imitated behavior of the player by choosing and carrying out and carrying out the strategy in the player profile that the imitated player would most likely take.

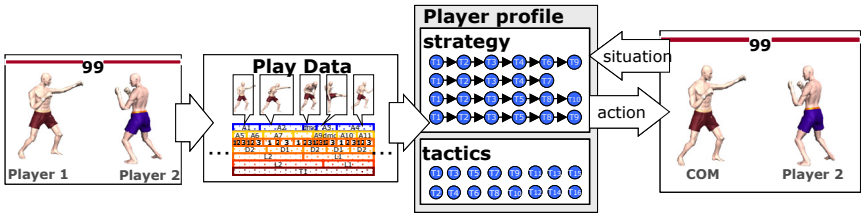


Fig. 1. Outline of the proposed system

2 Player profile system

Our proposed system records characteristics of the imitated player in his/her play data as the player's profile and creates actions that imitate the player. This system chooses the actions to take based on the sequence of actions recorded in the profile and reproduces the sequencing of actions. Out of these recorded sequences, a sequence is chosen probabilistically according to the frequency of its appearance. This allows the reproduction of the player's tendency in action as well as the diversity of actions the player could take. In this paper, the correlation between a given situation and the actions taken by the imitated player in that situation, which are observed in the play data, are referred to as tactics. A strategy combining such tactics is called a "tactic sequence", which is a series of tactics. The appearance frequency of each tactic sequence is also obtained from the play data. The player's profile consists of these sequences and their frequencies. The computer character creates the actions of the imitated player by choosing what actions to take based on this player profile.

According to this process, the computer character that is equipped with the player profile of the imitated player makes actions that imitate the player. In addition, by changing the player profile for the computer to use, a human player can "fight" many different opponents with many different behavioral patterns. With our proposed sys-

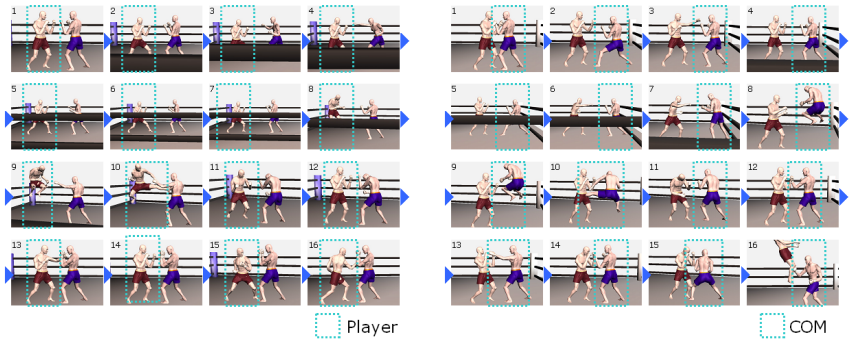
tem, a human player can play a game with his/her friend and obtain the friend's play data. Then, the friend's profile can be created. With this profile, the human player can fight with a computer character that imitates the friend's behavioral patterns, even when the friend is not present. The human player can also analyze the behavioral patterns in order to defeat the friend in their next fight. In addition, a player can download other profiles. For instance, the profile of the champion of a game competition can be downloaded and a player can fight the champion.

3 Evaluation experiment

To verify the effectiveness of the system proposed herein, we implemented the system in an experiment. For the experiment, a PC (Intel ® Xeon ™ CPU 2.80GHz, 1.00GB RAM, ELSA Gloria4 900 XGL) and a "joy pad" (Xbox controller) were used. The game used in the experiment was similar to many fighting games. The player who has done more damage to the opponent or brought the opponent's power down to 0 within a certain period of time is the winner.

In the experiment, human test subjects played ten matches between themselves during which play data were collected. Then, using the play data a player profile was created for each of the human test subjects. These profiles were then loaded into the computer. Next, each of the human subjects "fought" a computer character controlled according to the player profile of the opponent he/she fought when the play data were being collected. Then, each of the human players fought a computer character containing his/her own player profile, in order to confirm whether or not the character imitates the player's strategies.

We observed and compared the human players fighting another human player while collecting play data and while the human players were fighting the computer character controlled with the player profile of their respective human opponents. For example, Subject A in red trunks adjusted the timing while fending off the opponent's attacks by dashing backwards(Fig. 2(a)). Then, when the attacking opponent was momentarily vulnerable, Subject A moved closer to the opponent by attacking the opponent with continuous jump kicks. When the opponent fought back, Subject A adjusted the timing again. This was the subject's strategy. When we applied the player profile of Subject A to the computer, we observed that the computer character followed a similar strategy. As shown in Fig. 2(b), the computer character in blue trunks dashed backwards to fend off the opponent's attacks and to adjust the timing (Frames 1 through 6 in Fig. 2(b)), then, when the attacking opponent became vulnerable, just like Subject A, the character got closer to the opponent by attacking the opponent with jump kicks (Frames 7 through 12 in Fig. 2(b)) and continued the attacks (Frames 12 through 16 in Fig. 2(b)).



(a) Human's play data (b) Imitative behavior

Fig. 2. Experiment results

4 Conclusion

This paper proposed a system that enables a computer character to imitate a human player. To do so, the system first acquires tactics and tactic sequences from play data of a player. Then, from the tactic sequences collected it creates tactic graphs that represent the strategic actions of the player. From these graphs, the system selects tactics that suit different situations. We also demonstrated the effectiveness of the system in an evaluation experiment. Furthermore, we created many different behavioral patterns for the computer by changing player profiles, which are the collections of tactic sequences and tactic graphs of the particular players.

Although we tried to obtain a diverse range of behaviors by probabilistically choosing from multiple candidate tactics, such diversity was not actually obtained because of insufficient play data. One solution to this problem could be to create as many player profiles from as much play data as possible, so that more tactics can be acquired. However, the more tactics we have, the more strategies are developed and the more computation is required in order to choose a strategy. Therefore, in order to manage more strategies, it is necessary to employ a more efficient method of choosing strategies, such as clustering strategies depending on the situation.

References

1. Brian Schwab. "AI GAME ENGINE PROGRAMMING", Charles River Media, pp.203-210 (2004)