Improving Rule-Based Player AI in a SimpleSoccer Simulator

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Abstract

Currently, artificial intelligence in games is playing a major role in entertaining users. Also, in the case of sports games, the game may be played by people who have actually experienced the sport, so how the artificial intelligence judges the situation and acts on it will greatly affect the satisfaction of the game. And if the artificial intelligence does not look like a player in the first place, users will not be able to enjoy the game as a sports game. For example, in a soccer game, if the artificial intelligence cannot kick the ball well, or in a tennis game, if the artificial intelligence does not seem to be able to hit the ball well, the user will not feel that they are playing soccer or tennis.

In this study, we use Mat Buckland's soccer simulator [1], and we use its built-in AI for benchmarking and testing. However, the quality of this built-in AI is not good enough and has several problems. The purpose of this research is to solve some of these problems and contribute to the user's enjoyment of the game.

1 Introduction

With the spread of the Internet, we are now able to watch sporting events being held on the other side of the world. And by watching how the players play and move, many people today have become accustomed to watching the movements of professional athletes. As a result, there is a need for sports games to have artificial intelligence in their games that can replicate as much as possible the movements of the professional athletes that people have seen.

In soccer games, the trajectory of the ball kicked by the players, where the players try to move to when they don't have the ball, and even whether the players try to defend immediately when they lose the ball, all the actions of soccer players during the game are watched by many people, and with the development of social networking sites, they are even evaluated by the general public.

And for users who watch the movements of soccer players and think about and evaluate the reasons that led to their play, if the movements of the artificial intelligence in a soccer game do not look like the movements of a professional soccer player, they will not be satisfied with playing that game. And if it can't kick the ball properly, users will feel as if they are playing a completely different game that is called a soccer game.

However, in the soccer simulator that I am using in my research [1], the artificial intelligence sometimes behaves in a way that does not seem very soccer player-like. There are attempts to build a better, more human-like data-driven AI system [2], but the built-in rule-based AI is still needed as an auxiliary fail-safe module. First, the player controlled by the artificial intelligence kicks the ball forward more than necessary when dribbling. This may seem like the right thing to do in some situations, but if it happens every time the player dribbles, it will be too easy for the opposing defender intercepting the ball. Another problem is that the player receiving the pass does not move from his spot and waits until the ball reaches him. Depending on the situation, soccer players usually either approach the ball when receiving a pass or move in the same direction as the ball to receive the ball so that they can quickly move on to the next play. In this study, the goal is to reduce the possibility of losing the ball to the opposing team's defender by having the player receiving the pass approach the ball.

2 Method

2.1 Rules that determine how the artificial intelligence will play

The AI decides its behavior (move, pass, shoot at goal) based on some rules. For example, the player closest to the ball on the team that does not have the ball will chase the ball to get it. Also, the team that has the ball will look for a spot where it would be a great opportunity to score if they have the ball, and the player closest to that spot will move to it. In this way, the rules are set up so that the players can take the best action according to the situation, such as which team has the ball and where the ball is located. So, by rewriting the

rules, we can improve some of the flaws in the behavior of artificial intelligence.

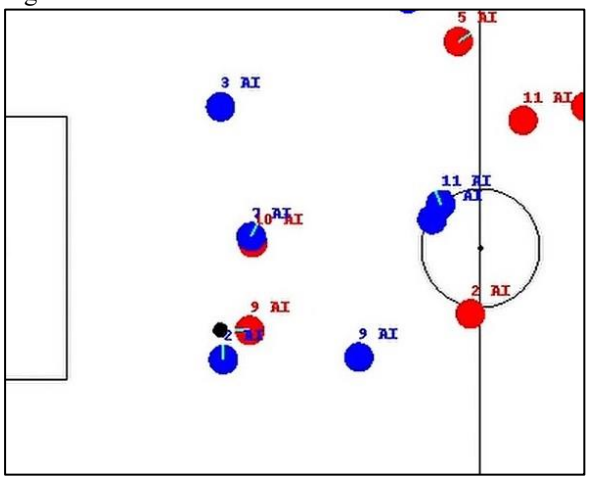
2.2 Problems of Dribbling

When an artificial intelligence tries to dribble, there are through a number of steps. First, when a player tries to dribble with the ball, he needs to face the direction of the opponent's goal line. Because he wants to get closer to the opponent's goal by dribbling in order to get a shot on goal. Next, he move the ball forward by making small kicks. And, he continue to dribble by catching up to the ball by chasing that ball and again making a small kick to the ball to move it forward. Among these steps, the one that is problematic is the step where the artificial intelligence kicks the ball forward.

If a player kicks the ball very lightly, he will kick the ball more often. Then the player will not be able to run as fast as he can and will be dribbling at a very low speed. If the player controlled by artificial intelligence can only dribble at a very slow speed, users will not find the game fun. On the other hand, If a player strong kicks the ball, he can run as fast as he can, which allows him to dribble at a high speed. However, because they have to kick the ball forward in a big way, there is a greater chance that the ball will be stolen by the other team.

Also, there is a problem with the step where the artificial intelligence faces the direction of the opponent's goal line when dribbling. This is fine if the player is in the middle of the pitch, but if he is at the edge of the pitch, he will dribble towards the corner flag.

Figure 1



Let us look at the above Figure 1 and consider the problem of artificial intelligence dribbling:
Player (9AI) of team Red is dribbling. The ball is kicked forward far away that nearby opponents can easily get the ball. As a result, Player (2AI) of team Blue intercepts the ball.

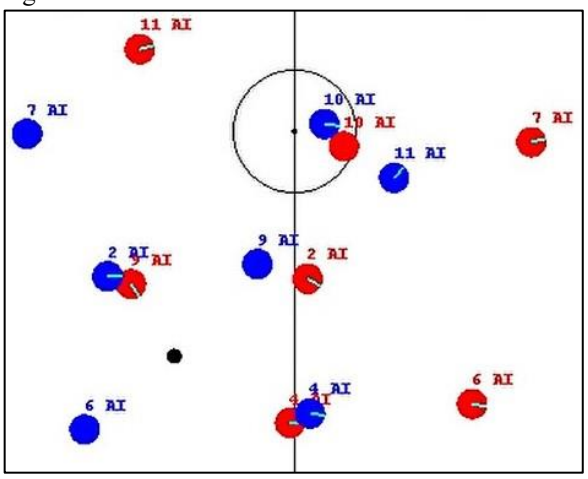
2.3 Solutions to problems of Dribbling

We suggest to solve the above-stated problems as follows. First, modify the ball so that it is always placed at the player's feet as the player dribbles. Instead of the players kicking the ball, change it so that when the players are running, the ball follows at their feet. Also, to prevent players from dribbling towards the corner flag, modify them to dribble with the opponent's goal as their destination. This will be implemented in the same way as when a player goes for the ball. When players are chasing the ball, they always use the location of the ball as their destination to activate their search behavior. This time, by activating the search behavior with the location information of the opponent's goal as the destination, the artificial intelligence will dribble toward the opponent's goal.

2.4 Problems of Passing

The player who receives the pass can act in two ways, depending on the situation. One is that the player receiving the pass waits for the ball to arrive at the place where the pass will arrive. The second is to move closer to the ball and receive the pass only if there is an opponent nearby and there is a chance that the ball will be taken away. Of these two ways of receiving the ball, there is a problem with the first, waiting for the ball to arrive on the spot. Even if the opposing team's player is not nearby at the moment of the pass, by the time the ball reaches the player receiving the pass, the opposing player will be nearby, and the ball can be stolen soon after.

Figure 2



Next, let us look at Figure 2 and consider the problem when the artificial intelligence receives a pass:
Player (9AI) from the blue team passes to a player (6AI). There is a wide space in front of the player (6AI), but he stops and waits for the pass to come. The player from the red team (9AI), who is near the player from the blue team (2AI), is coming towards the player from the blue team (6AI), so by the time the pass arrives, the space in front of him will be gone.

2.5 Solutions to problems of Passing

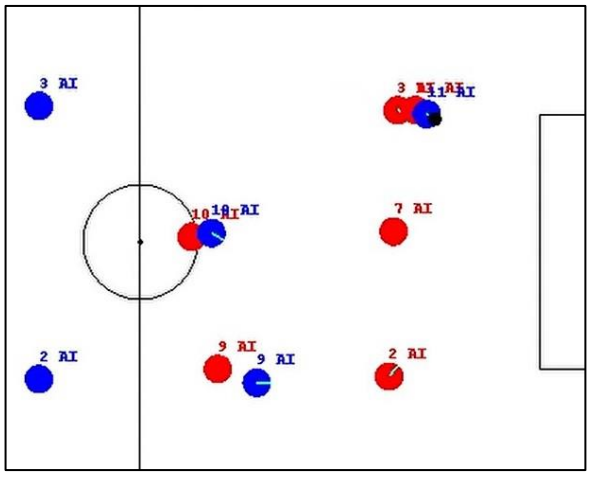
In this study, the player receiving the pass should always be approaching towards the ball to receive the pass. To achieve this, I apply the exploratory behavior that I use to go for the ball, which we mentioned earlier as being used to improve dribbling. When the passer makes a pass, the receiver activates a search behavior using the location of the ball as the destination and follows the ball. Since the ball is moving towards that player, it will actually look more like the player is approaching and receiving it, rather than the player chasing the ball.

3 Results

3.1 Improved dribbling results

First, I adjusted the algorithms so that the player with the ball heads for the opponent's goal and not for the corner flag. Also, I have improved the algorithm so that the ball is not too far away from the dribbling players. Specifically, rather than having the player kick the ball forward, we made it so that the ball is slightly in front of the player while the player is running at a certain speed, so that the player and the ball can dribble while maintaining a certain distance (this distance is very short) by constantly updating the ball's position information.

Figure 3

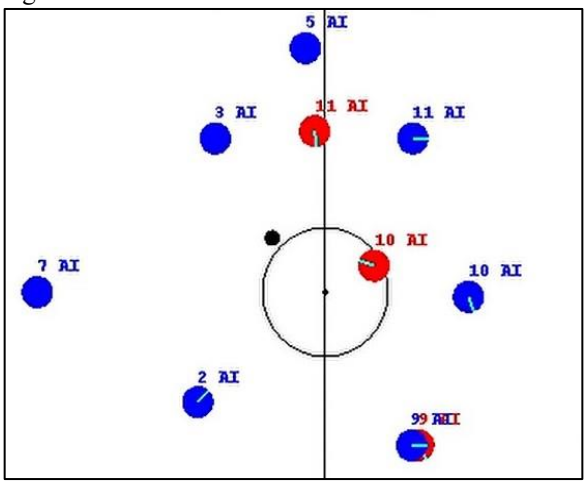


Let us see how the AI dribbles with improved algorithms:
Player (11AI) of team Blue is dribbling. Two players from the opposing team are chasing him, and another player (7AI) from the red team is nearby, but the ball is always at the dribbler's feet, so he is able to keep dribbling without losing the ball.

3.2 Improved passing results

As a result of the improved algorithm, the player is always closer to the ball and receives the pass. Also, since players no longer wait for a pass to come to them on the spot, the time it took to receive the ball became shorter. And, player's movement become more natural.

Figure 4



Let us see how an AI with an improved algorithm works when it receives a pass:
Player (5AI) of team Blue pass to another player (2AI). The receiver receives the pass while moving toward the ball, which reduces the time it takes to make the next play. It also makes the players appear to move more naturally to the user playing the game.

4 Discussions

Regarding the improvement of the dribbling, by continuously updating the location of the ball, the possibility of losing the ball to the players of the opposing team was reduced. However, keeping the ball at the dribbler's feet at all times means that he has to keep updating the position of the ball. The ball is transferred repeatedly, and as a result, the movement of the ball does not look smooth. I also thought that the

dribbling would look even more natural if the artificial intelligence could adjust the amount of force with which the player kicked the ball while dribbling according to the situation. I would like to consider what rules could be added or changed to allow the artificial intelligence to make better decisions, such as whether there are players from the opposing team in front of the dribbler, and if so, how far away they are from the dribbler.

As for the movement of the players when they receive a pass, at the moment they can only receive a pass while approaching the ball. In the future, if players controlled by artificial intelligence can receive a pass while moving in the same direction as the ball, depending on the situation, it will look even more like a real soccer player. Also, the player who makes the pass can't play a through ball like a passer who makes a pass into an open space and the receiver moves wide to receive the pass. If the passer can produce a through ball, the movement of the receiver of the pass will need to be further improved, so I would first like to think about improving the algorithm so that the artificial intelligence can produce a through ball according to the situation.

5 Conclusions

In this research, we have been improving the algorithm of the soccer game so that the movements of the players controlled by the artificial intelligence look as much as possible like the real players, so that users can get high satisfaction from playing the game.

The problem of players kicking the ball too far when dribbling was solved by updating the position information so that the ball is always at the dribbler's feet instead of the player kicking the ball. As for the movement of the player receiving a pass, we made it so that the player is always closer to the ball when receiving a pass, which makes the player's movement look more natural.

I think the point at which users play soccer games and feel that the movements of the soccer players in the game are realistic is in every part of the game, not just dribbling and passing. The speed at which players run, whether the player furthest away from the ball is walking slowly back to his position, etc. If we can recreate the fun and frustration that people who watch soccer on a daily basis feel in a soccer game, users will feel very satisfied when they play the game. In this research, we have tried to improve the major discomforts that are easily noticeable, such as passing and dribbling, but I think it would be great if we could think of ways to make artificial intelligence show the players that actual soccer players have.

References

[1] M. Buckland. Sports Simulation – Simple Soccer. Programming Game AI by Example, Jones & Bartlett Learning, USA, 2004, pp. 133-191

[2] V. Khaustov, M. Mozgovoy. Learning Believable Player Movement Patterns from Human Data in a Soccer Game. Proceedings of the 22nd International Conference on Advanced Communications Technology (IEEE/ICACT 2020), Pyeongchang, Korea, 2020, pp. 91-93