RaiC02 : Adaptive Selection of a Shooter Using a Team mate's Behavior Model on Real-time

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Abstract. The teammates' behavior models are applied to Team RaiC02 soccer agents to realize adaptive cooperative behavior during a game. This paper focuses on a last pass for a shot as a cooperative behavior. The passer adopts a model of receiver's shooting space recognition as a team mate's behavior model. The teammates behavior models will enable the passer to take account of not only positions of opponents and teammates but also whether receivers will be able to shoot.
The effectiveness of this model was showed through some experiments under a certain situation in front of the goal.

1 Introduction

We have been investigating real-time adaptation of RoboCup soccer agents on the RoboCup official Server System. Real-time adaptation is a significant issue in simulated soccer games as a dynamic multi-agent systems. A soccer agent has to adapt to its opponents as well as its teammates for cooperative behaviors during a game. To adapt the agent behavior to their opponents during a game, The "Observation Learning" method we have proposed is installed to Team RaiC02 soccer agents[1].

In this paper, adaption to teammates for cooperative behavior using teammates' behaviors models[2] is described. This paper focuses on a last pass for a shot as a cooperative behavior.

A pass is one of the most important cooperative behavior in soccer. A passer has to consider receivers' next behaviors and who is the best receiver. In case of a last pass, a passer has to pass a ball to the best receiver who can shoot. The passer employs a model of receiver's shooting space recognition as a team mate's behavior model. The model includes a parameter which represents opponents' interception ability for the receiver. The passer tries to estimate the parameter by learning on real-time. The teammmate's behavior model will enable the passer to take account of not only positions of opponents and teammates but also whether receivers can shoot. The effectiveness of the model was showed through some experiments under a certain situation vicinity of the goal.

2 Team RaiC02 Agents Architecture

The agent architecture consists of a “Decision Making System” and a “Learning System”. The “Decision Making System” is based on a three layered control model [3]; the “Strategic Layer”, the “Behavior Selection Layer” and the “Executing Action Layer”. The “Behavior Selection Layer” selects a particular behavior such as a pass or a shot. The “Behavior Selection Module” resolves matched rules obtained from the “Behavior Rules”. A “Behavior Rule” may be represented as follows:

$$\mathbf{IF}(Situation_1 \mathbf{AND} Situation_2 \mathbf{AND} ... Situation_N)\mathbf{THEN}(Behavior_1)$$

The “Learning System” contains two modules; “Self-Behavior Learning Module” and “Observation Learning Module”. The agent uses only “Self-Behavior Learning Module” to adapt a “Situation” in the “Last Pass Behavior Rule”. While the agent uses both modules to adapt a “Situation” in the “Shoot Behavior Rule”[1]. Team RaiC Agents are implemented using CMUnited99[4] source code as the library.

3 Adapting Shooting Space Recognition

A “Situation”, a space for a shot is declared by the “Shoot Behavior Rule”. A shootable direction region is an area that partially covers the goal and falls outside the opponents’ intercept-able sectors. The Shooter selects the “Shoot Behavior Rule” by recognizing the space through this process. The blocking region is described by a parameter α which represents opponents’ interception ability. The shooter learns the ability by increasing or decreeing α by a parameter δ according to the results of its own shots and teammates’ shots by monitoring (see [1]). If the shooter recognizes α is large, then the opponents’ intercept-able region is large and that ability is hight too, and vice versa.

4 Adaptive Selection of a Shooter

If the passer can find receivers who a pass will reach to and choose the best shooter among them, the passer executes a last pass. The “Last Pass Rule” is expressed as follows:

IF (*I hold a ball* **AND** *One or more recivers exist within a shootable distance* **AND** *A pass spase for each recivers* **AND** *A shooting spase for each recivers*) **THEN** (*Pass a ball to a receiver*)

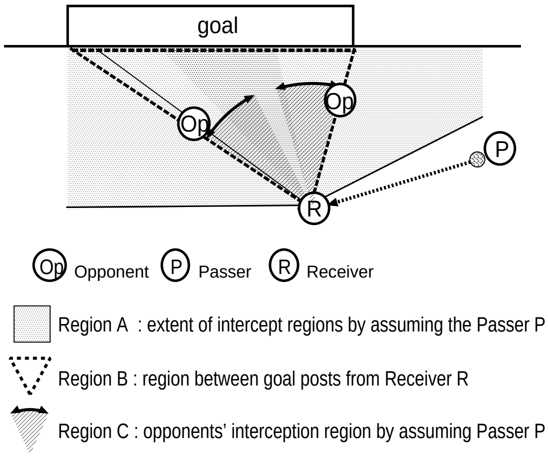

Fig. 1. A Last Pass Situation

When more than one receiver candidate is found, the passer chooses the one whose shooting space is the largest. Fig.1 indicates a last pass situation. When a Receiver R is in a scoring position and within a distance to receive a pass, a Passer P calculates an extent of opponents' interception area (Region A) from a position of Receiver R. When the Region A completely covers a area between goal posts from receiver R (Region B), if the Region B is smaller than a total area of "opponent's interception sector for the Receiver R assumed by the Passer P" (Region C), "Shooting Space for Receiver R" is recognized by the Passer P. The "opponents' interception ability for the receiver by assuming the passer " is described by a parameter β. Region C is represented by β. β is the same type as parameter α(Sec.3) and the passer has β for each receiver. When the receiver made a success of the shot, the β is decreased by the positive constant δ. While the receiver didn't try to shoot or couldn't score, the β is increased by δ.

5 Experimental Result and Conclusion

Experiments under a certain last pass situation were performed to evaluate the proposed adaptive selection of a shooter. Each 10 sets of experiment were done for three methods respectively. 50 times last passes is executed in one set of experiment. A agent learn consecutively in one set of experiment. Method 1 is the proposed method by considering not only locations of shooters and a defender but also shooters' shooting space recognition models. Method 2 is a method by considering only locations of agents. Method 3 is a method by selecting shooters at random. One passer, three shooters and one defender are placed in front of the goal. They are set at the inial positions every last pass trial. Shooter A learns the defender's interception ability and is in a good position for a shot. Shooter B learns the defender's interception ability and is in a bad position. Shooter

C don't learn and is a negative for a shot. However, C is in a good position as same as Shooter A. Table 1 shows the experimental results. Score and Last pass to receivers present the average of 10 sets trials. Method 1 obtained the

Table 1. Scores and last passes to receivers A, B, C(average of 10 sets)

	Score	Last passes		
		Receiver A	Receiver B	Receiver C
Method 1	22.3	25.3	11.2	12.9
Method 2	16.9	23.5	2.8	23.5
Method 3	19.7	16.3	16.5	16.9

highest score among three methods. It shows the effective of using teammates' recognition models and learnt parameters estimating by a passer. The difference in last passes to Receiver C between Methods 1 and 2 indicates that Method 1 enable the passer to reduce last passes to a negative shooter such a Receiver C. It means that the proposed Method 1 works adaptively on real-time and will be useful in case that a teammate doesn't work in a game. The difference in last passes to Receivers B and C between Methods 1 and 2 represents that Methods 1 pass to a shooter who is in a bad position but positive for a shoot, and then gained better result than Method 2.

Using teammates' recognition model and learning the "opponents intercept ability for the shooter "is effective for realizing adaptive selection of a shooter. This method will be examined during a game.

References

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