Team HillStone2019 in the 2DSimulation League

Team Description Paper

Taiga Ito[1], Junichiro Iseki[1], Norikazu Sato[1],Yuki Arimura[2], Norifumi Watanabe[2], Takashi Omori[1]

[1] Tamagawa University, 6-1-1 Tamagawa-gakuen,Machida-shi, TOKYO 194-8610, JAPAN

ituta6is@engs.tamagawa.ac.jp

[2] Advanced Institute of Industrial Technology, 1-10-40 Higashi Oi Shinagawa-ku Tokyo 140-0011,
JAPAN

Abstract. Team HillStone has taken part in 2D simulation league of RoboCup Japan Open Competition from 2009 in Osaka. We adopted a defensive strategy of allocating player to a ball position, and use ILP algorithm for an effective tactics searching. We discuss a possibility of the strategy and evaluation in our simulation. In the future, we will develop an attack flow from back pass.

Keywords: Inductive Logic Programming, Shoot Success Rate, Back Pass model First Section

1 Team History

Team HillStone is consisted of joint effort by Tamagawa University and Advanced Institute of Industrial Technology members. Our team has joined RoboCup Japan Competitions since 2009. They got the best result (third rank) at RoboCup Japan Competition 2014 in Fukuoka. Members are interested in a compliant human-machine interaction architecture based on human intention estimation by robots. This research is motivated by a desire to minimize the need for classical direct human machine interface and communication. We participated in the world convention for the first time in 2016.

2 Team System Development

2.1 Preivious Team Development

2.1.1 Development result in Tamagawa University

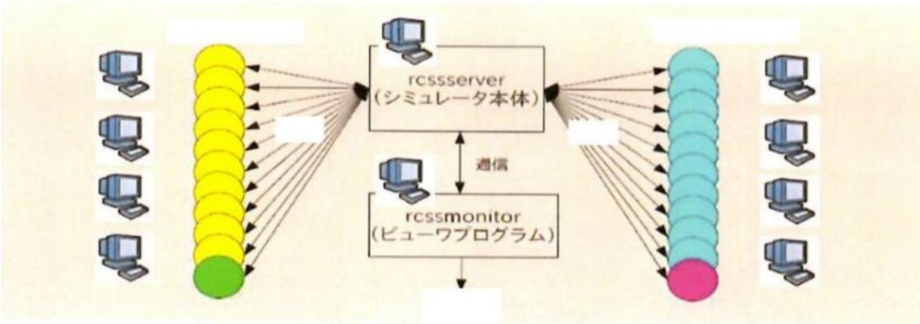

Fig. 1 System configuration diagram of soccer simulator

Fig 1 shows a system configuration of soccer simulator. Tamagawa University students were not familiar with the simulator and its programming, we began to learn about the system. Currently, we are implementing a defensive formation and developing a one-two pass behavior. We are using the fedit version 2-0.0.0 for the defensive formation development, and are creating an allocation of players for the fedit2. A sample of created allocation is shown in Fig.2 [1,2].

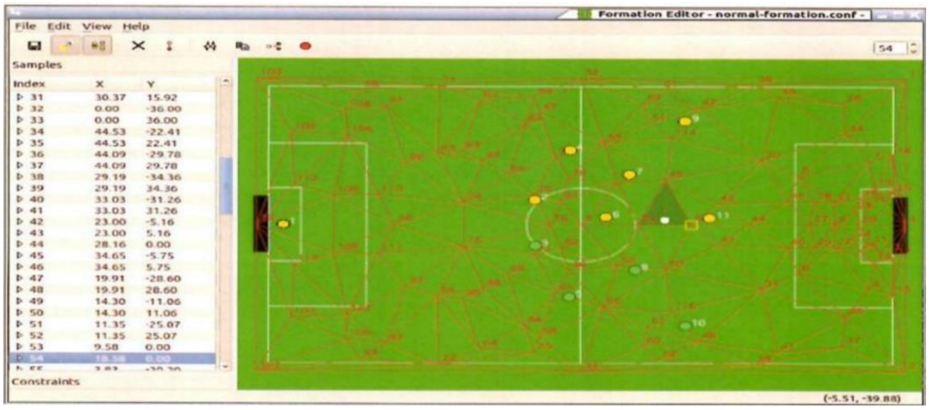

Fig.2 A sample of created player's allocation in fedit2.

Our strategy of defensive formation is to locate a player at a ball position where an opponent player must be there. By doing so, at least one player can press and defense to the opponent to prevent making effective pass or shoot.

But, the drawback also exists. A large stamina consumption occurs because the defense player has to run quickly toward the ball position when an opponent team player come into the defense zone. The other is a higher risk of foul because the running action is almost same as a tackling action. To avoid these drawbacks, as a future challenge, we must create a chain of cooperative actions program for the defenders before we join RoboCup World Championship [3]. The program works as follows. In a case of opponent player carrying a ball into the defense zone, we plan our defenders come and enclose the ball holder from multiple direction to block all effective pass courses.

2.1.2 Development result in Advanced Institute of Industrial Technology

Effective strategic patterns in RoboCup2D simulation are extracted using the inductive logic programming system Aleph [4,5,6]. Due to the dynamic changes of the offensive and defensive behaviors, strategic pattern extraction in real soccer is difficult. Therefore, a behavioral model is constructed using J-league soccer player data based on the analysis of behaviors in scenes of mutual intention inference, and implemented the model to the RoboCup2D agents. Then, we extracted effective strategic patterns from log data of the soccer simulation with Aleph and verify the validity of the patterns comparing to the previous studies. Fig.3 shows an extraction result using the Aleph. As a result, a side-pass from the center area could be effective. [7,8]

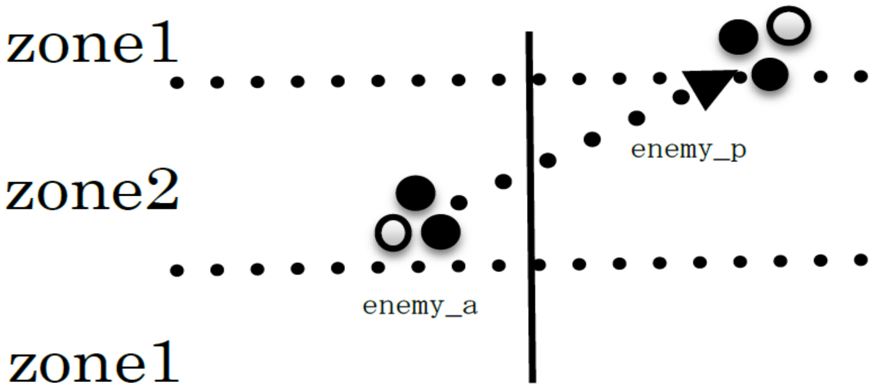

Fig.3. Examples of action chain extracted by a predicate logic

We will make a new definition of the Aleph and try it for future developments .

2.2 Team Development

2.2.1 Back Pass Model by Path Evaluation

In the future we will develop about exploration of paths.

Currently, when HillStone is attacking from the side towards the opponent goal, if the agent is surrounded by the opponent team player, the agent is trying to forcibly break through forcibly by dribbling or pass. However, in that case, problems such as taking the ball by the opponent, getting a foul, and finally there is no shoot course come out. Therefore, using the shoot success rate and back pass, we aim to pass that it is hard to be stolen by the opponent and leads to the score. First, the whole path is searched for three steps. When searching up to three steps, if an ally is in the goal area within three steps, the path is evaluated using the shoot success rate. If the evaluation value of the path is less than a certain threshold when three step search is done, the ball will be stolen by the opponent without succeeding even if we pass before, so after going back pass and attack again.

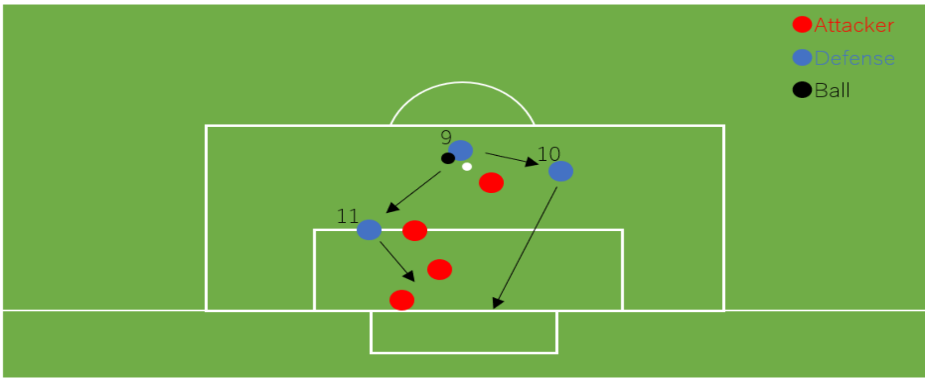

Fig.4. Pass movement before the goal

In Fig.4, No. 9 is the scene where the pass is to be issued to No. 10 or No. 11 so that the opponent team player can not take a ball. Currently HillStone does not search until the next shoot when searching for a pass. Therefore, No. 9 will pass to No. 11 which is closest to the goal. Therefore, by evaluating the pass using the shoot success rate, we make a pass that is easy to lead to the shoot.

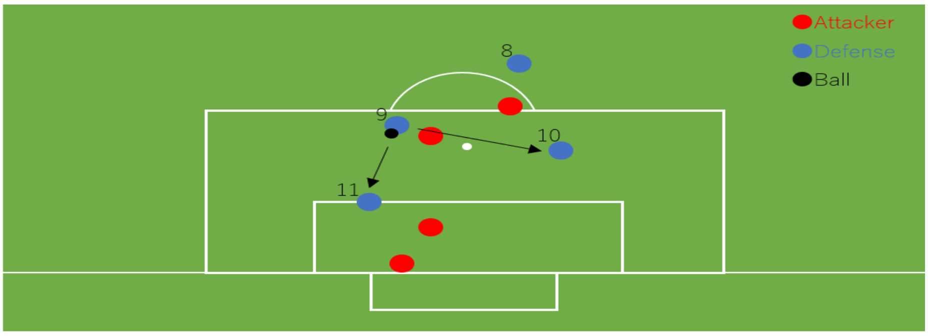

Fig.5. Path search when opponent team is in front of goal

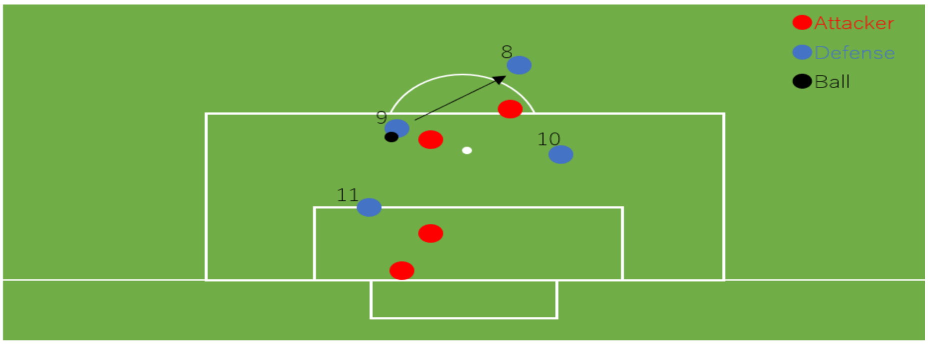

Fig.6. A diagram of the back pass when there is an opponent team before the goal and the shoot success rate is low

In Fig.5, when No. 9（which had been attacking from the side）passes a path to No. 11, No. 11 receives a pass, and even if it shoots because there is no shoot course, it is catched to an opponent team player GK. At this time, No.9 pass the better ally using the shoot success rate. However, in Fig.6, the path does not pass through to the No.10 and No.11 ally in front, or even if it passes, the shoot does not succeed. Therefore, as shown in Fig. 6, make a back pass, regain the system once and attack again. The condition for back pass is to do back pass when the evaluation value of the pass is equal to or less than a certain value between 3 steps of searching for a pass.

2.2.2 Shoot Success Rate

The shoot success rate is obtained as follows

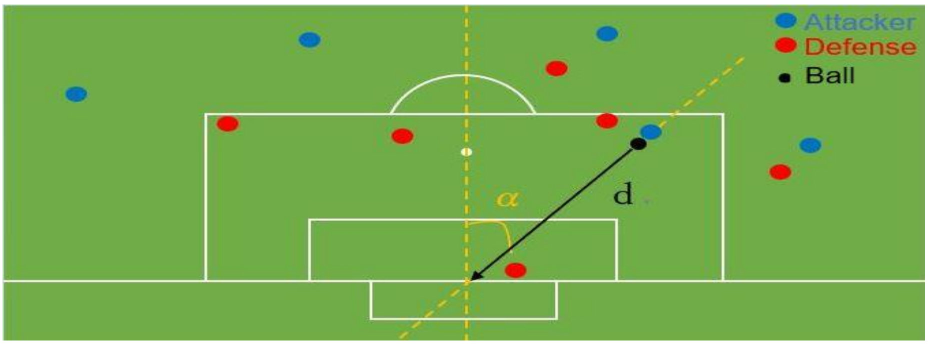

Fig.7. Example of positional relationship between ball holder and goal

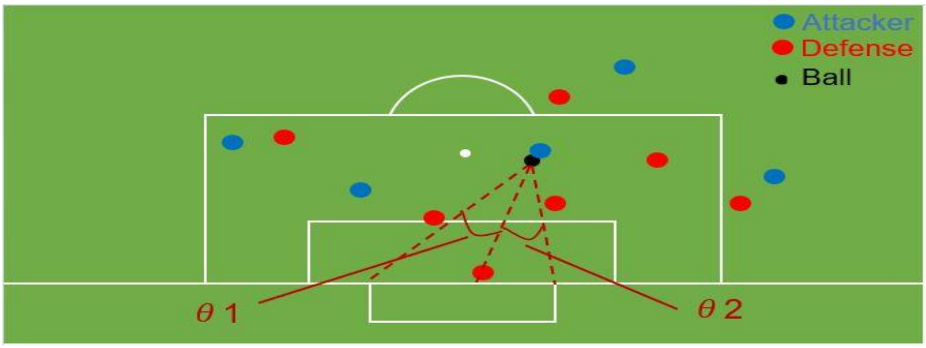

Fig.8. Example of free space when shooting

The parameters referred to above for finding the shoot success rate are the shoot's angle α from the goal center in Fig.7, the shoot's distance d to the goal center, the empty goal course θ1 on the left side as viewed from GK in Fig.8, the empty goal course θ2 on the right side. At this time, the opponent team's player shall not move, and only the GK is placed between the goal and the ball holder. Consider the best situation for each parameter and obtain the shoot success rate P based on it. The angle of the shoot is harder to shoot with no angle, so the shoot success rate increases as α approaches 0. Since shorter distance of shoot is better, shoot success rate increases as d approaches 0. Since θ is better to have a large target course, the numerical value haves to be large. Therefore, the one with the higher numerical value is selected from θ 1 and θ 2 and used. The shoot success rate is determined by $S = A / \alpha + B / d + C * \theta$ (A, B, C are coefficients) from the above three parameters.

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