Team Description for Harmony Co-evolutional Positioning

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Abstract. In this paper we describe our simulaltor league team "Harmony". In a multi-agent system, it is important that agnets can improve their performance autonomously.Our research focus is that agents improve their strategies by co-evolutionary procedure. In this year, we have took notice of formation and positioning of player agents. Player agents can improve their strategies autonomously by changing thier formation and positioning.

1 Introduction

Our agent team Harmony has took part in Japan Open and RoboCup International since 2000. We are interested in multi-agent system and improving agent performance by co-evolutionary procedure. In 2001, Soccer agent could improve their performance autonomously by our co-evolution procedure. As a good result of our co-evolution, we won the third place in Japan Open 2001. Our co-evolutionary procedure was effective in last year, but the evolutional object was only action selection about ball kicking.

Soccer has the problem of the high complexity - real time adaptation, cooperative behaviour, and so on. However soccer server simulator manages to keep complexity of soccer game, Soccer server simulator is a 2D simplified simulation. Formation and positioning of the 2D simulation must be more important than ones of the 3D simulation because ball cannot fly across player agent. Therefore we pay attention to formations and positionings of soccer agents. The next step of our research, we try to make soccer agent improving their strategy by co-evolution of formation and positioning.

2 Soccer Strategy - Formation and Positioning

In the soccer game both real and simulation, the positioning of players is very important. Team strategy is under the influence of positioning and formation. If agents tend to chase the ball and be near each other, team play compact soccer. On the other hand, if agents tend to be near their goal and stay their

position, maybe team is defensive. From a viewpint of cooperative behaviour, agent positioning is connected with passing the ball, getting the ball and making a score. Positioning and formation of soccer server simulation influence the team performance.

Team Harmony has parameters about formation and positioning based on FCPAgent - template of FC Portugal[Reis 2000]. Agents determine their position by parameters - tendency to chase the ball, initial position and responsible area.

3 Agent Skill

We developed agents based on FCPAgent. Player agents have some low-level skill. Therfore, our next step is to design some primitive actions such as dribble or pass by combining some low-level skill.

The decision making module adopted is based on the idea of the behavioral network. In this module, the agent senses the current status and calculates the predicted success rate to four primitive actions, and actually selects actions so as to maximize the success rate. In the module, we have a lot of parameters strongly affected the team play. For example, if the value of a parameter is very large, forward player agents are likely to choose dribble rather than pass or shoot.

The primitive actions can represent various functions by changing parameter modules in response to the action module as follows.

shoot The player kicks a ball to the goal in order to make a score under shoot action. There are some cases for shooting. For example, the player wants to shoot as soon as possible regardless of the speed of the ball or on the contrary the player wants to shoot as strongly as possible. This shoot action represents some functions like immediate-shoot or strong-shoot by changing the parameters.

dribble This action is one of the important actions in order to keep a ball and to make a score. Dribble action is performed based on a speed and a destination of player's dribbling. Speed represents the extent of time that it takes to move from a current position to the destination with a ball, and is determined according to the stamina of the player or chances to get a score. In the case of high speed, the ball is far from the player because the player kicks the ball more strongly and the risk of keeping a ball increases.

pass Generally, a pass is realized by cooperation between more than two players. Therfore, agent calculates the expected success rates of pass to other teammates, respectively, and selects the teammate maximizing the expeceted success rate of pass.

cross This action is important action to attack speedy and make a score. Agent already has ideas to attack effective and calculates the situation to kick the ball to place where teammate can get ball and shoot or can attack speedy. Nowadays most of goal keeper agent is good at playing. Therefore, cross action is important skill to make a score.

4 Co-evolution Procedure

Team Harmony has a lot of perameters related to their play style. By representing a set of these parameters as an individual (a team), we performed our co-evolutionary procedure. We especially take notice of positioning and formation this year.

The framework of our proposed co-evolutionary procedure is similar to Pollack's co-evolution model [pollack98]. In our team, since agents have developped based on the FC Portugal agent, agents already have the ability of some plays (simple dribble and kick). Individual agent positioning and formation of the team are characterized by some parameters described in section 2. The basic idea of our approach is that these parameters are tuned autonomously by using only the results of games.

We pick up one individual as a champion(use parameters of Harmony). Then, we create one individual as a challenger by adding random noise to champion, and perform the game between them in each generation. According to the result of game, the better individual is replaced to another one. A new challenger is generated by applying genetic operators to the current champion. Here we use only mutation as genetic operators, similar to [Blair 1999]. Our co-evolutionary procedure is summarized as follows.

1. Challenger is picked up in order.
2. Champion versus Challenger.
3. If Challenger beats Champion, Champion is replaced by the Challenger.
4. New Challenger is created by adding random noise to Champion's set of parameters.

The result of only one match held between champion and challenger is not enough to determine the team which is better because the match result of soccer server simulation is especially uncertain if the performance of the team is similar to the opponent. Therefore, we deal with match results statistically.Challenger must win 7 of 10 matches to replace champion. Replacing by the good challenger is to improve team performance continuously.

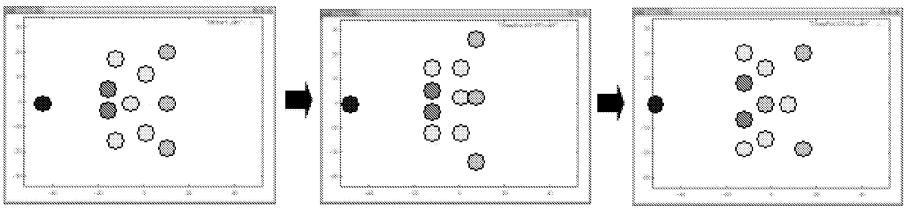

Fig. 1. Example of transformation of formation by co-evolutionary procedure.

5 Conclusion

Team Harmony can improve their strategy autonomously by transforming formation and positioning through co-evolutionary procedure. For example, the first generation is beaten by the generation of more compact formation and chasing the ball harder. Meanwhile in the other generation, counter strategy is created against the compact soccer. This team is more defensive and likely to use long pass. These adaptations for the opponent strategy are the result of co-evolutional parameter setting about the tendency to chase the ball and the initial position of player agents. Figure 1 shows the examples of formations by co-evolution.

6 Future Work

Various play style is created by co-evolution. If formation becomes broader, player agents tend to play side attack. On the other hand, if formation becomes nallower, player agents play more compact soccer. In the next step,we research how to change these formations against unknown strong team and make various co-evolutional experiments.

We have to improve basic skill of player agents. The agent of strong teams has good skills about dribble, shoot, pass, and goalie skills.

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