RaiC10: Analyzing the Influence and Effectiveness of One-man Agent on its Team's Performance

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Abstract. The purpose of our study is to examine the influence and effectiveness of one-man agent on its simulated soccer team based on the coordination, from the standpoint of its team's performance. The experimental results comparing teams T_{E9} and T_{E11} included the one-man agent with the team agent2d showed that the average scores of teams T_{E9} and T_{E11} were increased from 0.04 to 0.48 and from 0.04 to 0.50, respectively. Additionally, 67% and 96% of total scores of teams T_{E9} and T_{E11} are scored by the one-man agent, respectively.

1 Introduction

Our long-term objective is to realize an adaptive behavior selection between "behave by itself" and "behave cooperatively" on MAS and propose a design of MAS by using the one-man agent through a series of studies on the "one-man agent". The scientific focus of our team is to analyze the influence and effectiveness of the one-man agent on the team. The one-man agent is defined as an agent which behaves by itself without others' cooperation while the agent shares the team's goal.

Generally soccer agents are designed to make each agent collaborates with its team mates to accomplish the team's goal[1, 2]. However, getting back to completing the team's goal – to win against an opponent team –, it should not always be the best way that an agent behaves with the team mates cooperatively. It is also concerned that the agent which behaves by itself may produce good results. In fact, some of real human soccer teams are designed so that genuine talented player and his team mates can make the most of what he has. From these perspective, the one-man agent is focused on. The experiments were performed to examine the influence and effectiveness of the one-man agent on the team and improvement of the team performance. The agent2d-2.0.1[3] is used as a base code for all experimental teams. Then, the experimental results were analyzed from the standpoint of its team's performance including the number of wins and losses, scores and the number of shots. The result turned out that the team performance was improved when the one-man agent was in FW positions(See Section 3). Based on the experimental results and test games against several teams, the team RaiC10 consists of an one-man agent wearing uniform number

10 as FW and ten agents of agent2d-2.1.0 excepting the agent wearing uniform number 10. The one-man agent's base code is agent2d-2.1.0. The one-man agent and the experimental results are described as below.

2   One-man Agent

In our study, a one-man agent has been developed based on agent2d-2.0.1.

The one-man agent is defined as an agent which always takes the one-man approach and simultaneously shares the goal of its team – to win against an opponent team –. Then, the one-man approach is realized as the behavior that the agent dribbles the ball toward the opponent goal and then makes a shot without passing to its team mate.

Specifically, the one-man agent is implemented by removing "pass" from its behavior rules of the team agent2d.

3   Experimental Result

To examine the influence and effectiveness of the one-man agent in a simulated soccer team, experimentations were performed through simulated soccer games. Then, the experimental results of the teams including the one one-man agent were compared with the team's not including the one-man agent. The number of wins and losses, scores, the number of shots and trajectories of dribbling were used as analytical indicators.

3.1   Experiment Description

Simulated soccer games(eleven-on-eleven) were done as the experiments to 11 experimental teams below. Each experimental team played 50 times against the team agent2d. One game has 3000 simulation steps. An experimental team is a team that an agent in the team agent2d replaced by one one-man agent.

Fig. 1 shows the formation of the experimental teams. Each circle represents an agent. The digit in each circle is an uniform number of agent. The goal keeper wears uniform number 1.

The formation and agents' positions in the experimental teams are defined as follows.

$$T_{\mathrm{Ei}} = \{p_j | 1 \leq j \leq 11\} \tag{1}$$

Where T_{E} is an experimental team, i is a number of experimental team, p is an agent(player) and j is an uniform number of an agent. Also, the set of all experimental teams is described as follows.

$$\{T_{\mathrm{Ei}} | 0 \leq i \leq 11, i \neq 1\} \tag{2}$$

Where i is a team's identification number and is also the uniform number of the one-man agent of the team. There is no team T_{E1}, because the goal
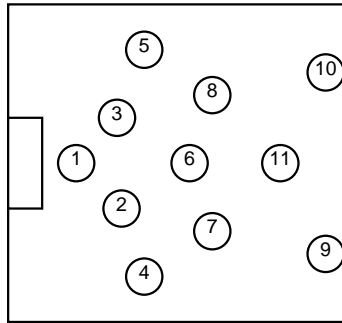
Fig. 1. Agents' positions in an experimental team(Each circle shows an agent, and inner-number is its uniform number.)

keeper(uniform number 1) is not replaced by the one-man agent. When $i = 0$, T_{E0} is the same team as the team agent2d. The experimental results of team T_{E0} were utilized as the basis of analysis.
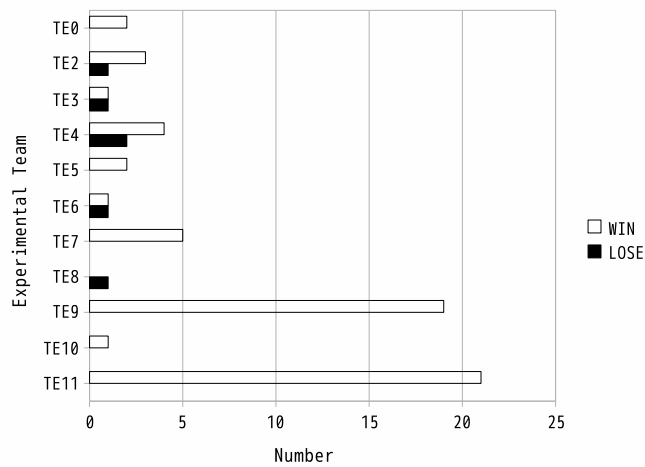
3.2 Experimental Results

Fig. 2. Win-lose results of experimental teams against the team agent2d (50 games per an experimental team)

The bar chart in Fig. 2 shows the results of simulated soccer games per 50 games for each experimental team. Team T_{E9} had 19 wins, 0 loss and 31 draws and team T_{E11} had 21 wins, 0 loss and 20 draws. These teams won better than

the others. Comparing teams T_{E9} and T_{E11} to team T_{E0} which has no one-man agent.The results have great advantage of the number of win games.
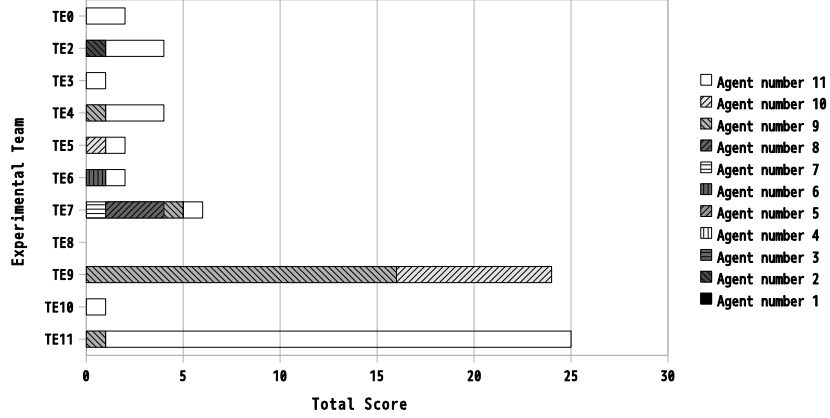

Fig. 3. Total scores of experimental teams and agents against the team agent2d(50 games per an experimental team)

The bar chart in Fig. 3 shows the total scores of each experimental team and scores obtained by each agent. The graph legends show agents which score. Teams T_{E9} and T_{E11} score 24 and 25, respectively. It shows the great advantage of scoring from other teams.

Table 1. Comparison of Experimental Results(Number of Shots and Scores) between teams T_{E0} and T_{E9}

	Number of Shots		Scores	
	Avg.	SD	Avg.	SD
T_{E0}	0.08	0.27	0.04	0.20
	(0.04)	(0.20)	(0.00)	(0.00)
T_{E9}	1.02	1.02	0.48	0.68
	(0.40)	(0.61)	(0.32)	(0.51)
t-value	0.00		0.00	

Values in parentheses are the results of the agent wearing uniform number 9.

Table 2. Comparison of Experimental Results(Number of Shots and Scores) between teams T_{E0} and T_{E11}

	Number of Shots		Scores	
	Avg.	SD	Avg.	SD
T_{E0}	0.08	0.27	0.04	0.20
	(0.04)	(0.20)	(0.04)	(0.20)
T_{E11}	0.64	0.72	0.50	0.68
	(0.56)	(0.70)	(0.48)	(0.68)
t-value	0.00		0.00	

Values in parentheses are the results of the agent wearing uniform number 11.

Table 1 and Table 2 show the results comparing Number of Shots and Scores of team T_{E9} and T_{E11} with them of team T_{E0}, respectively. Teams T_{E9} and T_{E11} had average score of Number of Shots and Scores more than team T_{E0},

respectively. The t-test results of team T_{E9} and T_{E11} based on team T_{E0} are significantly different, respectively. The one-man agents of teams T_{E9} and T_{E11} also had them more than agents in the same positions, respectively.

These results suggest that the one-man agents in teams T_{E9} and T_{E11} contribute to the improvement of the teams' performance, respectively.
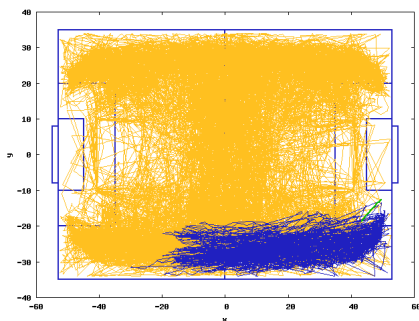

Fig. 4. Ball trajectory(team T_{E0} vs. the team agent2d, 50 games total). Light gray lines is the whole trajectory of the ball. Black lines is the dribbling trajectory by the agent wearing uniform number 9 of team T_{E0}. Only dribbling play was extracted from the other behavior including a passing. Dark gray line is the shot trajectory by the agent wearing uniform number 9 of team T_{E0}.
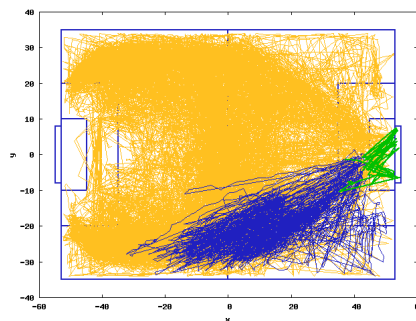

Fig. 5. Ball trajectory(team T_{E9} vs. the team agent2d, 50 games total). Light gray lines is the whole trajectory of the ball. Black lines is the dribbling trajectory by the agent wearing uniform number 9 of team T_{E9}. Dark gray line is the shot trajectory by the agent wearing uniform number 9 of team T_{E9}.

At the end, these teams' trajectories of the ball are shown in Fig.s 4, 5, 6 and 7.

Comparing team T_{E0} in Fig. 4 with team T_{E9} in Fig. 5, the whole trajectory of the ball(light gray lines) of team T_{E9} was changed clearly.

Also, comparing the dribbling trajectory(black lines in Fig. 5) of the one-man agent(the uniform number 9) of team T_{E9} with the trajectory(black line in Fig. 4) of the agent in the same position in team T_{E0}(=agent2d), the trajectory of the one-man agent of team T_{E9} shows that the one-man agent headed to the opponent goal rather than the agent of team T_{E0}. It leads that the team T_{E9}'s chances of shots(dark gray lines) increased rather than team T_{E0}

The same tendency can been seen between the one-man agent of team T_{E11} in Fig. 7 and the agent(the uniform number 11) of team T_{E0}.
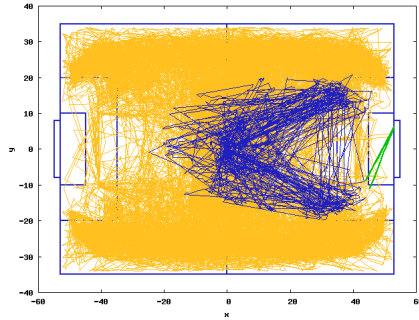
Fig. 6. Ball trajectory(team T_{E0} vs. the team agent2d, 50 games total). Light gray lines is the whole trajectory of the ball. Black lines is the dribbling trajectory by the agent wearing uniform number 11 of team T_{E0}. Only dribbling play was extracted from the other behavior including a passing. Dark gray line is the shot trajectory by the agent wearing uniform number 11 of team T_{E0}.
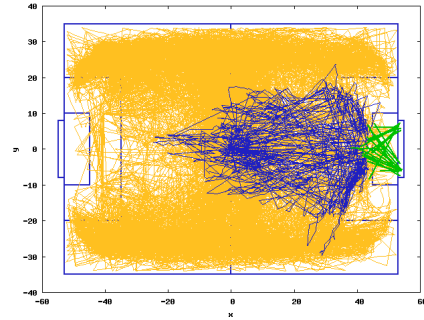

Fig. 7. Ball trajectory(team T_{E11} vs. the team agent2d, 50 games total). Light gray lines is the whole trajectory of the ball. Black lines is the dribbling trajectory by the agent wearing uniform number 11 of team T_{E11}. Dark gray line is the shot trajectory by the agent wearing uniform number 11 of team T_{E11}.

4 Summary

The team RaiC10 consists of an one-man agent wearing uniform number 10 as FW and ten agents of agent2d-2.1.0 excepting the agent wearing uniform number 10. The one-man agent's base code is agent2d-2.1.0. The one-man agent was described and the experimental results indicated that the one-man agent is effective when it was in FW positions.

References

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