From Play Recognition to Good Plays Detection - Reviewing RoboCup 97 teams from Logfile -

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Abstract. This paper describes an attempt to review the teams participating in RoboCup simulator leagues. RoboCup simulator games are played through communication between soccer player clients and the soccer server. The server simulates the player's requirements and sends the result to the soccer monitor. We enjoy the games by seeing the players' actions and the ball's movement displayed on monitors. A method is proposed to recognize actions of a player such as shooting, kicking, etc., or the ball's movement from the log files, which are equivalent to images displayed on the monitor. Action recognition is a necessary technique for scoring, commenting and judging a game. The games in RoboCup '97 are reviewed from log files and the analysis results are discussed.

1 Introduction

RoboCup simulator games are played through communication between soccer player clients and the soccer server. The server receives the player's requirements and simulates the game. The server sends the game information to the soccer monitor. We enjoy the games by seeing the actions of the players and the ball's movement displayed on CRT monitors.

It was pointed out in RoboCup '97 workshop that other agents can join the soccer games through network without changing the simulator game frameworks. The agents are outside the field and receive the same information as displayed on CRT monitors. They score the game or comment on the plays. Their outputs indicate who passed the ball, who received the ball, and shot, or which opposing player interrupted a pass. It means that they recognize the soccer clients play as a human would see the game.

In this paper, methods of recognizing soccer actions from time sequence position data of the players and the ball are proposed. All games in RoboCup '97 are objectively reviewed using the numbers of the actions. The analysis result of all teams shows the necessary conditions for a strong team.

2 Information outside field in simulation track

Fig. 1 shows the data flows in simulation track. The data between clients agents and the soccer server is bi-directional and the flow is drawn in solid lines. Each

M. Asada and H. Kitano (Eds.): RoboCup-98, LNAI 1604, pp. 187-192, 1999.

client controls the corresponding player basically by repeating the cycles - sensing the environment around it, planning the next actions, and sending the corresponding commands to the server. The soccer server receives the requests from clients and simulates the games.

The server sends the game information to the soccer monitor periodically during the game. The data from the soccer server to the soccer monitor is unidirectional and contains the positions of all player/clients and the ball. The flow is drawn in dotted lines in the figure. Upon receiving the data, the soccer monitor displays the clients and the ball on CRTs. The clients and the soccer server are agents inside on the field and make up the game. The soccer monitor is an outside agent which does not participate in the game.

The other agents which scores the game or comment on the plays are also outside agents. They see the game by receiving the data from the soccer server.

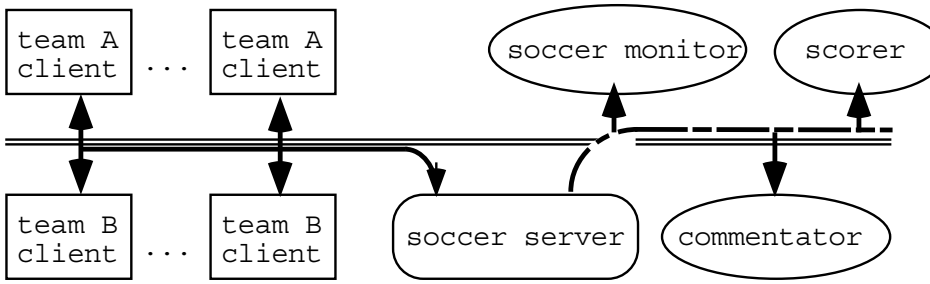

Fig. 1. data flows among agents

3 Action recognition from time sequence data

A viewer enjoy the client's plays by seeing the images displayed by the soccer monitor, and can comment on the game by indicating which agent passed the ball, whether the pass was very nice, etc. After games, the viewer becomes a programmer and improves his own client program manually by reflecting on the comments.

Our aims are to make outside agents able to detect good plays by seeing the game, and to make use of the detected plays to improve client agent ability. To do this, it is necessary to recognize the player's action and the ball movement from the time sequence data sent from the soccer server.

The issues in recognizing the player's actions and the ball movements are (1) detection of changes in games, and (2) which agent causes the changes. To make use of them as learning data, (3) division of the games into parts which

are sufficient to replay the changes is necessary, (4) as well as transforming them into symbols. The ideal set of actions recognized by agents is the same one as the humans recognize by seeing the game.

We assume that the outside agents receive the same data as the soccer monitor receives them from the soccer server. The following is the data format sent to the soccer monitor. `showinfo_t` contains the positions of 22 players and the ball at time t which is represented by $\boldsymbol{p}_t$ and $\boldsymbol{b}_t$ respectively. `msginfo_t` contains the referee's command.

```
typedef struct {
   short enable;
   short side;
   short unum;
   short angle;
   short x;
   short y;
 } pos_t;

typedef struct {
   short  board;
   char   message[2048];
 } msginfo_t;
```

```
typedef struct {
   char  name[16];
   short score;
 } team_t;
```

```
typedef struct {
   char   pmode;
   team_t team[2];
   pos_t  pos[23];
   short  time;
 } showinfo_t;

typedef struct {
   short mode;
   union {
      showinfo_t  show;
      msginfo_t   msg;
   } body;
 } dispinfo_t;
```

(from sserver-3.28[1]/server/type.h)

The actions recognized at present are *kick* and *shoot*. The recognized ball movements are *goal*, *own-goal* and the player who *assist*ed the goal is recognized. The followings are the methods used to recognize actions using a time sequence of $\boldsymbol{p}_t$ and $\boldsymbol{b}_t$.

kick:
1. the ball direction is changed.
   (the angle between $\boldsymbol{b}_{t_i} - \boldsymbol{b}_{t_{i-1}}$ and $\boldsymbol{b}_{t_{i-1}} - \boldsymbol{b}_{t_{i-2}}$ is larger than a specified value.)
2. the ball speed is increased.
   ($|\boldsymbol{b}_{t_i} - \boldsymbol{b}_{t_{i-1}}|$ is larger than $|\boldsymbol{b}_{t_{i-1}} - \boldsymbol{b}_{t_{i-2}}|$.)
3. at least one player is within kickable area when the 1st condition or 2nd one is satisfied.

shoot:
1. the ball moves to the goal.
2. the ball speed is sufficient to reach the goal.
   (the distance of a ball is estimated using $|\boldsymbol{b}_{t_i} - \boldsymbol{b}_{t_{i-1}}|$.)
3. the goal's team is different from the team of a player who kicked the ball.

goal:
1. the ball reached the goal.
2. the same as the 3rd condition in shoot.

the last player who kicked the ball is the goal player.

[1] http://ci.etl.go.jp/~noda/soccer/server.html

own-goal: 1. the same as the 1st condition in goal.
2. the opposite one to the 3rd condition in shoot.

assist: 1. goal occurred.
2. the player who kicked the ball before the shooter and was the same team of the shooter is assigned as an assist player.

4 Analysis of RoboCup 97's teams

We see soccer games implicitly on assumptions that:

1. players of a strong team move more actively than players of a weak team,
2. a team which controls a game kicks the ball more times than the other team.

We checked to see if these assumptions held true in soccer simulation games. 29 teams participated in RoboCup '97. The data sent from the soccer server during a game was stored as a Logfile. The Logfiles have been made public through the internet.

Table 1 shows the result of comparing teams by seven items - score, distances, kick, shoot, goal, own-goal and assist -. The first column contains the team names who participated in RoboCup '97. The second column contains game numbers that a team played. "Score" is the points the team gained in RoboCup. The others are recognized items. "Distance" is the sum of distance all players moved in a game. The numbers are the average per game. The numbers in parentheses show the order in each item.

From Table 1, the followings are shown,

1. The top four teams, andhill, AT_Humbolt, CMUnited, ISIS, happen to be in the middle in distance ranking from 16 to 19.
2. The top two teams, andhill, AT_Humbolt, are highly ranked in kick and shoot.
3. Team C4 is the highest ranked in score, goal and assist. However, it is also the lowest ranked in own-goal.

Table 2 shows the result of the game between andhills vs. Kasugabito in preliminary league Group D. The score was 23 to 0 and andhills won. The rows data are each player's data. In looking at the activity of a player, distance ranking and shoot ranking seems to be related.

From these, conditions of strong teams are (1) numbers of kicks or shots are numerous, (2) number of own-goal is small. These conditions match our human assumptions.

The score is the sum of its goal and the opponent's own goal. However, in Table 1, the score is not equal to the goal. The reason is that the number is an average over different opponents.

Table 1. Comparison among RoboCup'97 teams

	teamname	game	score	distance	kick	shoot	goal	own-goal	assist
1	andhill(2)	7	12.7 (3)	11330 (17)	191.7 (3)	30.5 (1)	8.1 (2)	0.5 (4)	3.2 (2)
2	AT_Humboldt(1)	7	13.2 (2)	11315 (18)	204.5 (2)	25.7 (2)	8.0 (3)	0.8 (6)	3.0 (3)
3	C4	5	14.4 (1)	12291 (15)	166.2 (6)	0.0 (4)	10.6 (1)	3.8 (22)	4.8 (1)
4	CAT_Finland	5	2.8 (16)	9351 (23)	142.8 (13)	3.8 (20)	1.8 (15)	1.8 (13)	1.0 (11)
5	CMUnited(4)	7	8.8 (4)	11852 (16)	160.5 (7)	13.7 (9)	5.8 (5)	1.4 (10)	1.8 (7)
6	CTH	3	4.0 (13)	7581 (26)	133.3 (16)	16.3 (6)	3.0 (12)	1.3 (9)	1.3 (10)
7	FCMellon	6	8.8 (5)	8691 (25)	142.5 (14)	14.1 (8)	5.6 (6)	0.6 (5)	1.5 (8)
8	gamma	2	0.0 (26)	13475 (10)	136.0 (15)	0.5 (28)	0.0 (24)	6.5 (29)	0.0 (22)
9	Georgia_Tech	3	1.0 (23)	17037 (4)	104.0 (23)	4.3 (18)	0.3 (23)	3.3 (21)	0.0 (22)
10	HAARLEM	3	2.0 (17)	18019 (2)	124.0 (19)	7.6 (14)	1.3 (18)	1.6 (12)	0.3 (19)
11	HChick	3	1.6 (18)	12916 (12)	93.6 (27)	2.6 (22)	0.6 (20)	2.3 (14)	0.0 (22)
12	Inoue &Wilkin	2	0.0 (26)	9614 (22)	52.5 (29)	1.0 (25)	0.0 (24)	2.5 (18)	0.0 (22)
13	ISIS(3)	6	6.0 (11)	10664 (21)	147.6 (9)	13.3 (12)	3.5 (10)	2.6 (19)	0.8 (12)
14	kasuga-bito	3	1.3 (21)	15113 (8)	149.3 (8)	3.6 (21)	1.0 (19)	6.0 (27)	0.6 (13)
15	Maryland	4	6.7 (10)	15691 (6)	175.7 (4)	18.2 (5)	3.5 (10)	2.2 (14)	0.5 (16)
16	MICROB	3	7.0 (8)	12452 (14)	120.6 (21)	23.6 (3)	2.3 (13)	2.3 (14)	0.6 (13)
17	miya	4	8.7 (5)	11200 (19)	144.7 (11)	13.5 (11)	4.5 (7)	0.2 (2)	2.7 (4)
18	NIKEN	4	7.0 (8)	16326 (5)	120.0 (22)	7.0 (15)	3.7 (9)	1.0 (7)	1.5 (9)
19	NIT-stones	3	0.3 (24)	13464 (11)	78.6 (28)	1.0 (25)	0.0 (24)	4.6 (24)	0.0 (22)
20	Ogalets	4	8.5 (7)	17065 (3)	128.5 (17)	16.3 (6)	6.0 (4)	0.5 (3)	2.5 (5)
21	Orient	6	6.1 (19)	13478 (29)	117.3 (24)	12.1 (19)	4.5 (17)	0.33 (1)	1.8 (16)
22	PaSo	3	3.6 (14)	13776 (9)	173.6 (5)	6.0 (17)	2.3 (13)	1.0 (7)	0.3 (19)
23	ProjectMAGI	5	6.0 (11)	10993 (20)	144.6 (12)	8.6 (13)	4.2 (8)	3.0 (20)	2.0 (6)
24	R.M.Knights	3	0.0 (26)	6924 (28)	124.6 (18)	1.0 (25)	0.0 (24)	4.3 (23)	0.0 (22)
25	sicily	3	0.3 (24)	9153 (24)	94.3 (25)	1.3 (24)	0.0 (24)	5.6 (26)	0.0 (22)
26	TeamGC	3	1.3 (21)	12666 (13)	216.3 (1)	1.6 (23)	0.6 (20)	5.6 (25)	0.6 (13)
27	TUT11	2	0.0 (26)	7427 (27)	123.0 (20)	0.5 (28)	0.0 (24)	6.0 (27)	0.0 (22)
28	UBC_Dynamo	2	1.5 (20)	15446 (7)	94.0 (26)	6.5 (16)	0.5 (22)	1.5 (11)	0.5 (16)
29	uc3m	3	3.6 (14)	18374 (1)	146.6 (10)	13.6 (9)	1.6 (16)	2.3 (14)	0.3 (19)

note: The numbers are rounded at first decimal points.
So, the ranks are different for the same score.

5 Discussion and Summary

The methods to recognize the player's action and events related to goal are described. The games in RoboCup '97 were reviewed and the teams were analyzed quantitatively.

The analysis shows that the necessary conditions to be a strong team are to increase the number of kicks, and not to do the own-goal.

This paper is a step to make agents who can score or comment on the game. The next steps are (1) to segment data record into a sequence of a player's

Table 2. Comparison between Andhills and Kasuga-bito

	andhil:23						Kasuga-bito:0					
player	distance	kick	shoot	goal	own-goal	assist	distance	kick	shoot	goal	own-goal	assist
1	223	8	0	0	0	0	500	22	0	0	7	0
2	1276	27	0	0	0	1	1030	11	0	0	1	0
3	785	9	0	0	0	0	1201	10	0	0	0	0
4	641	12	0	0	0	0	920	13	0	0	0	0
5	502	7	0	0	0	0	823	9	0	0	0	0
6	1022	24	1	0	0	0	806	8	0	0	0	0
7	991	17	1	0	0	2	1174	55	3	0	0	0
8	1392	13	5	1	0	2	713	1	0	0	0	0
9	1516	21	4	1	0	1	732	5	0	0	0	0
10	1918	23	13	7	0	0	881	6	0	0	0	0
11	1871	16	7	6	0	0	953	9	0	0	0	0
Total	12144	177	31	15	0	6	9738	149	3	0	8	0

actions, (2) relate the actions between and among players, (3) estimate them from the viewpoint of using learning samples. In RoboCup '98, a special session was held to evaluate simulation teams year by year. Quantitative game scores are one of fundumentals for evaulations.

The program which analyzes the logfiles is in http://www.bais.chubu.ac.jp/~ttaka/.

References

1. http://ci.etl.go.jp/~noda/soccer/client.html
2. Noda Itsuki, Kuniyoshi Yasuo. *Simulator track and Soccer Server.* bit (in Japanese), Vol.28, No.5, pp.28-34.