FC Portugal Coach 2004: High-Level Coaching of a Heterogeneous Team using a Low-Level Language

Luís Paulo Reis[1,3], Nuno Lau[2,4], Rui Sampaio[1,3], Hugo Marques[2,4], Rui Ferreira[1,3], Hugo Penedones[1,3]

lpreis@fe.up.pt, lau@det.ua.pt

[1]FEUP –Faculty of Engineering of the University of Porto, Portugal
[2]DET – Electronics and Telecommunications Department, University of Aveiro, Portugal
[3]LIACC – Artificial Intelligence and Computer Science Lab., University of Porto, Portugal
[4]IEETA – Institute of Electronics and Telematics Engineering of Aveiro, Portugal
http://www.ieeta.pt/robocup

1. Introduction

FC Portugal coach became RoboCup 2002 champion in its first participation in RoboCup coach competition. Unfortunately, its full potential was not really used to won that competition. Due the low-level of the coaching language selected for the 2002 competition (compared with other coaching languages available at the time, like Coach Unilang [1]), it was found that coach messages had a negative impact on teams' performance.

Last year, in order to improve the coach competition, we proposed to use a heterogeneous team, composed by players developed by different universities, as the base for the coach competition. This idea had instant support from the community and the organizing committee and was thus approved. However, only three universities' coachable players (University of Texas - Austin, Carnegie Mellon and UST of China) were selected by the organization to be used in the competition. Most of the selected players were unable to accept the few high level commands available in the coaching language – Clang – used in the competition (like home positions to define formations). However they followed most of the available low level commands (like going blindly to a given field position) quite effectively. Also some of the players seemed to "enjoy" kicking the ball backwards, independently of our coach advice and thus we had to remove these players from important positions. This way, our coach was unable to use its full potential and participated in the competition mainly by translating a high-level strategy to lower-level commands adapted for each of the coachable players' characteristics. The final result was good and FC Portugal coach achieved second place in Padova 2003 coach competition.

2. Coach Architecture

Expecting a greater variety of more capable coachable player's to compose this year's heterogeneous team, we maintain our coach architecture from 2003 (figure 1), hoping to be able to use its full potential.

The assistant coach gathers game information at different levels, while the coach uses this information to select the best formation and to fine tune its team behavior. The visualizer enables a human coach to define new tactics, formations and player types and to monitor the games and coach performance.

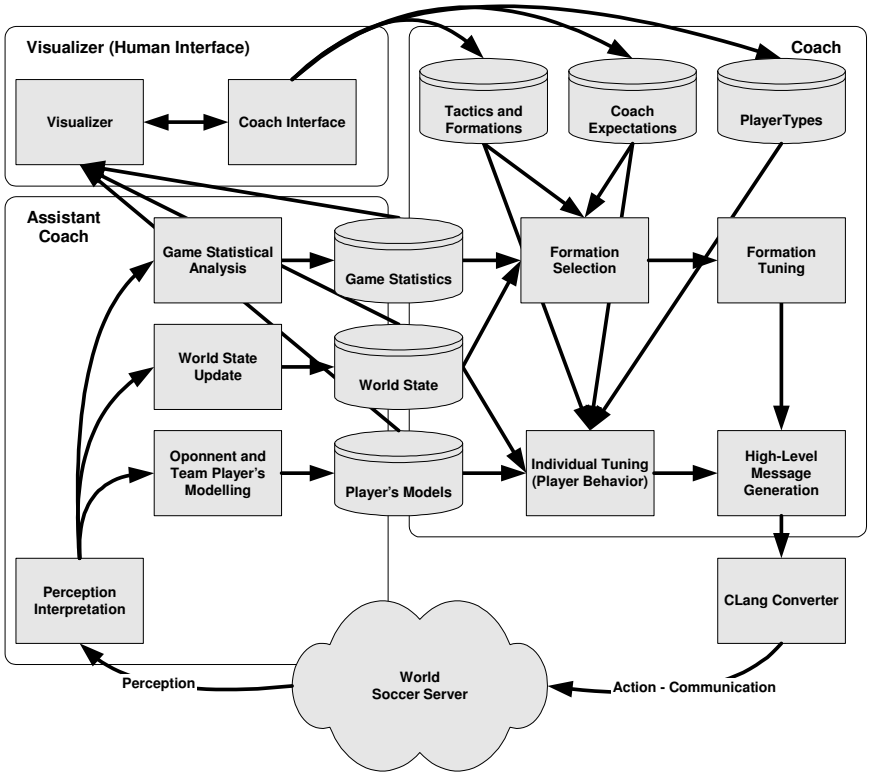

Figure 1: FC Portugal Coach Architecture for RoboCup 2003 Coach Competition.

The development of a Coach Unilang to Clang converter enables the integration of our normal coach with the coach used in the coach competition. It is not possible to fully translate a Coach Unilang strategy into Clang, however most of Coach Unilang lower level aspects are now introduced also in Clang. This way, for example, a Coach Unilang simple formation may be translated into Clang by a set of rules, adapted to the coachable player being advised, describing the agent desired positions depending on ball position.

3. Statistics and Opponent Modeling

Statistical information is very important to coach a soccer team. The definition of the statistical information included in Coach Unilang, and used by our assistant coach module to communicate with the coach module, was based on the information used by real soccer coaches and information available in computerized video analysis soccer systems [1]:

```
# Statistical Information
<GAME_PLAYMODE> ::= playon | corner | offside | kickin | kickoff | free_kick
| goalie_free_kick | goal_kick | any
# Game Statistics Information
<STATISTICS> ::=
   (clear) |
   (game_time <TIME>) |
   (game_result <PERIOD> [integer] [integer]) |
```

```
(stopped_time <PERIOD> <TIME>) |
(game_occurence <GAME_PLAYMODE> <REGION> <TEAM> <PERIOD> <COUNT>) |
(game_playmode_count <GAME_PLAYMODE> <REGION> <TEAM> <PERIOD> <COUNT)> |
(action <ACTION> <REGION_FROM> <REGION_TO> <TEAM> <PLAYER> <PERIOD>
<ACTION_RESULT> <COUNT>) |
(recovery <RECOVERY> <REGION> <TEAM> <PLAYER> <PERIOD> <INT_RESULT>
<COUNT>) |
(ball_possession <REGION> <TEAM> <PLAYER> <PERIOD> <COUNT>) |
(player_position <REGION> <TEAM> <PLAYER> <PERIOD> <COUNT>) |
(attack <REGION_FROM> <REGION_TO> <TEAM> <PERIOD> <NPASSES>
<ACTION_RESULT> <COUNT>) |
(assist <REGION_FROM> <REGION_TO> <TEAM> <PLAYER> <PLAYER_TO> <PERIOD>
<ACTION> <ACTION_RESULT> <COUNT>) |
(ball_losses <ACTION> <REGION > <TEAM> <PLAYER> <PERIOD> <COUNT>) |
(ball_recoveries <RECOVERY> <REGION > <TEAM> <PLAYER> <PERIOD> <COUNT>) |
(action_to_player <ACTION> <REGION_FROM> <REGION_TO> <TEAM> <PLAYER>
<PLAYER_TO> <PERIOD> <ACTION_RESULT> <COUNT>)
```

Game statistics are very important to decide what is the tactic to apply. The most common items of information used by RoboCup teams to change the tactic are of course the result and time of the game. However, these two items, alone, are not sufficient to decide properly what is the best tactic to use (given the team objectives for the game). This way, our coach uses also several other game statistics (see [1] for a deeper understanding of the concepts used):

- **Stopped game time** (time in which the ball is out of bounds);
- **Game occurrences** (like corners, offsides, etc) their count and number of cycles. This information may be given by field region and team. For example (game_occurrence offside their_penalty_box our first_half 3) states that 3 offsides of our team occurred in the first half of the game inside the opponent's penalty area.
- **Action number and results**. This concerns the number of actions (by region, team, player and period) and their results. For example (action pass field field our any game success 20) states that our team did 20 successful passes in the game).
- **Recovery actions number and results**. This concerns the number of ball recovery actions (by region, team, player and period) and their results. For example (recovery interception their_middle_field our 10 last_300 fail 4) states that player 10 of our team failed 4 interceptions in the opponent's half in the last 300 cycles).
- **Ball possession**. This gives the ball possession statistics (in terms of number of cycles) of each team and player in each region and period. The sentence (ball_possession their_left_wing our any game 250) states that our team had 250 cycles of ball possession in the offensive left_wing in the game.
- **Player positions in the game**. This information regards player's positions in the defined regions throughout the game. We may state, for example, that our number 9 player stayed for 340 cycles in the opponent's area throughout the game (player_position their_penalty_box our 9 game 340).
- **Number of attacks by type and result**. This enables to give information about the attacks of each of the teams, their initial and final regions, their type (in terms of the number of passes performed) and their results. For example (attack field field our game 3 opp_goalie_catch 4). States that our team did 4 attacks in the game that took 3 passes and resulted on an opponent's goalie catch.
- **Assistances to shoots on goal**. This is a very important but often-neglected soccer concept. This enables the assistant coach to give information about the number of assistances made by each player to each player by regions and time periods. It also enables the inclusion of

the action that was performed by the assisting player to perform the assistance and the result of the shoot action. For example (assist their_left_wing their_penalty_box any any game pass goal 3) states that their were 3 assistances to goal made using passes from the left_wing.

- **Ball losses**. This information concerns ball losses from each team and player by field region and time period. It also includes the possibility of stating the action performed prior to lose the ball. This way, (ball_losses pass their_middle_field our any last_1000 10) states that 10 balls were lost by our team in the opponent's half of the field while making passes in the last 1000 cycles.
- **Ball recoveries**. Ball recovery information is concerned with the way the ball was recovered by each team. It enables the inclusion of information regarding the recovery action, region, team and player and time period. For example (ball_recoveries tackle our_middle opponent any game 10) states that the opponent team recovered 10 balls using the tackling recovery action (win a divided ball) in the our_middle region during the game.
- **Ball circulation**. We may also state the actions performed by each player to each player in the game and their region and results. For example (action_to_player pass field field our 8 9 second_half successful 10) states that 10 successful passes wer made from player 8 to player 9 of our team in the second half of the game.

Statistical information is used together with opponent modeling information and own team player's information to decide the best tactic to be used at each moment.

4. Conclusions

FC Portugal coach architecture is intended for high-level player coaching based on several types of statistics and opponent players' models. The coach was conceived to coach FC Portugal team players [2, 3, 4] that are able to follow high-level instructions like tactics and formations. However, the coach possesses a great game analysis potential and is able to adapt his advice to other coachable players. Since we believe that the 2004 coach competition rules will allow for a better coach competition in which coach analysis of the game will be decisive, FC Portugal 2004 coach is, again, capable of being very competitive at Lisbon 2004 tournament.

Acknowledgements

This work is partially supported by the Portuguese National Foundation for Science and Technology FCT-POSI/ROBO/43910/2002 Project - "FC Portugal – New Coordination Methodologies applied to the Simulation League".

References

1. Luis Paulo Reis and Nuno Lau, *COACH UNILANG - A Standard Language for Coaching a (Robo)Soccer Team*, In Andreas Birk, Silvia Coradeshi, Satoshi Tadokoro editors, RoboCup-2001: Robot Soccer World Cup V, LNAI 2377, pp 183-192, Springer Verlag, Berlin, 2002
2. Luis Paulo Reis and Nuno Lau, *FC Portugal Team Description: RoboCup 2000 Simulation League Champion*, In Peter Stone, Tucker Balch and Gerhard Kraetzschmar editors, RoboCup-2000: Robot Soccer World Cup IV, LNAI 2019, pp 29-40, Springer Verlag, Berlin, 2001
3. Nuno Lau and Luis Paulo Reis, *FC Portugal Homepage*, Http://www.ieeta.pt/robocup
4. Luis Paulo Reis, Nuno Lau and Eugénio Oliveira. *Situation Based Strategic Positioning for Coordinating a Simulated RoboSoccer Team,* in M. Hannebauer, J. Wendler and E. Pagello eds, Balancing React. and Social Deliberation in MAS, Springer, LNAI, Vol. 2103, pp.175-197, Berlin, 2001