FC Portugal Coach 2005: Soccer Intelligent Game Analysis

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1. Introduction

FC Portugal coach became RoboCup 2002 champion in its first participation in RoboCup coach competition. He also became RoboCup vice-champion in its following participations (2003 and 2004) very close in competition results (and statistically clearly better in our lab controlled experiments) to the competition champions. Unfortunately, its full potential was not really used on those three competitions. This was mainly due to the low-level characteristics of the coaching language selected for the competitions (compared with other coaching languages available at the time, like Coach Unilang [1] upon which Clang is mainly based).

2. Previous Competitions

In 2002 competition, it was found that coach messages had a negative impact on tuned teams' performance. So, the best strategy was to let the team play with few or no advice unless "things were really going wrong"! In next years' competitions, due to the fact that opponent teams used fixed tactics and were previously known, it was found that a hand-tuned fixed tactic was the best policy to win the competition (and this policy was used by the champion teams and also by the vice-champions FC Portugal).
In 2003, in order to improve the coach competition, FC Portugal 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 (Texas-Austin, CMU and UST) 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 even if it was outside of the field) 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. However, the final result was good and FC Portugal coach achieved second place in Padova 2003 coach competition.
In 2004, the competition remained mostly the same. Player's from only three universities were selected for the heterogeneous team (Texas-Austin, CMU and Caspian). However the players were much more effective in following coach higher-level advice and it was really possible to observe totally different strategies developed by the various participant coaches.

FC Portugal coach again got second place in the competition. However, the coachable team, advised by our coach, was able to dominate all the games played keeping the ball most of the time on the opponents half in all the games. However due to the poor quality of the selected goal keeper, this offensive strategy was not enough to won the competition. Very defensive strategies in which teams defended inside their penalty box most of the time, reveled to be a lot more successful and thus our team achieved only second place.
This year, the coach competition will not be a real coach competition but mainly a soccer game intelligent analysis competition. Coaches will have to analyze previously recorded games and identify team playing patterns. Although in essence the competition will not be a coaching competition, it promises to be a very interesting challenge and a lot different from previous RoboCup coach competitions.
Next year it may be possible to merge both ideas and really (and at last) have a coach competition. Generally in sports and particularly in soccer, a coach is a person who teaches and directs a team via encouragement and advice. Since our robots do not need encouragement (at least in the next years…) the coach must mainly advice the team. A soccer coach must analyze his players and the opponent team and the course of the game and decide the best strategy at each moment to win the game. This embodies two aspects: game analysis and player's advice. However these two aspects of coaching were never combined in RoboCup coach competition (and thus our disappointment comparing with the initial expectations generated by this competition). It is our belief that, in order to have a real coach competition, we have to have:

- A coachable team composed with players developed by different universities capable of understanding high-level advice (in order to be advised);
- A known opponent team that however are able to completely change the playing strategy according to the match characteristic and opponent behavior (otherwise game analysis is not needed).

Although this may seem difficult to achieve, in practice it is quite easy. It is more then sufficient to have a heterogeneous team and head-to-head matches between the participant coaches. The team may be composed by players developed by 4 or 5 different universities (even with non coachable players mixed in order to assure that the coach must be able to identify them and give appropriate advice to each player depending on its characteristics). Head-to-head matches assure that although the coach knows the opponent team (it is composed by exactly the same players as its own team) the team strategies varies during the game (it is being coached by a competing coach) and game analysis is needed in order to decide the best tactic at each moment. After this year experiment on game analysis, let's advance to a complete soccer coaching competition next year!

3. FC Portugal Coach Architecture

Our coach architecture remains unchanged since 2003 (figure 1) although only the assistant coach (mainly the game statistical analysis module) will be used for 2005 competition.
The main principle of our architecture is that 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.

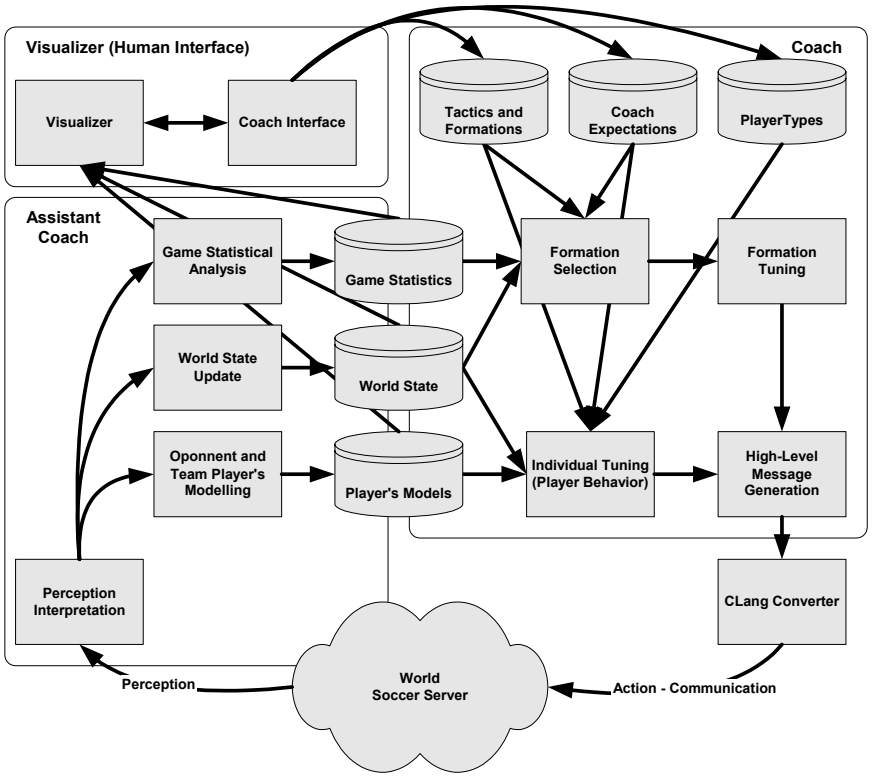

Figure 1: FC Portugal Coach Architecture.

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.

4. Game Analysis and Pattern Detection

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.
In 2005 coach competition, this statistic information will be used to identify the playing patterns. Firstly, for each known playing pattern, the information collected will be recorded. During the competition games, the playing pattern selected (and reported by our assistant coach) will be the one with a closest match with the game statistical information collected.

5. 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. The 2005 coach competition will depend only on coach game analysis capabilities and thus we believe that FC Portugal 2005 coach will be, again, capable of being very competitive at Osaka 2005 tournament.

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