FCP_GPR_2014 Free Challenge: Joining Setplays from FCPortugal with Reinforcement Learning from GPR2D to Improve Decision-Making in Multi-Option Setplays

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1. Introduction

FCPortugal is a research team from 3 Portugal universities (Universities of Aveiro, Minho and Porto) focused on the **development of coordination methodologies and tools** that can be **used in various** dynamic **competitive domains** such as **distinct RoboCup leagues.** The team participates in RoboCup since 2000 in various leagues (Simulation 2D, Simulation 3D, Rescue, SPL) and also collaborates with teams on several leagues that apply the coordination methodologies developed with success (mostly at SSL and MSL). Among the coordination methodologies developed by the team is a r**ecently** developed and **complete framework for the specification, execution and graphic design of Setplays** [1,2]. **Setplays** (or **Set Pieces**) are **sequences of coordinated actions** that should be **executed cooperatively** by a team in order to achieve an objective during the match (Corner Kicks, Direct Free Kicks, etc). ***GPR-2D*** is the Robotic Research Group ("***G**rupo de **P**esquisa em **R**obótica*" in portuguese) robotic soccer team, from Federal University of Technology - Paraná - UTFPR). The research objective is the development of **adaptive intelligent approaches to control mobile robots**, to cope with complex, cooperative tasks [3]. These **two research groups joined forces to** bring together the **flexibility of Setplays** with **learning capabilities**, resulting in **FCP_GPR_2014**, a team from two countries.

2. The Setplay Framework

The **Setplay Framework** is a set of **free software tools** developed by **FCPortugal**, and just recently made available. It is composed of a **library of classes (*fcportugalsetplay*)** [4], a **Graphical Specification Tool (*FCPortugal Splanner*** [5]), and a Complete Example Team that can execute Setplays (***FCPortugalSetplaysAgent2D*** [6]), **based on Agent2D** source code [7]. By using the Framework, it is possible to **graphically specify (Figure 1 – left) Setplays**, in a very intuitive and simple manner, and to test and execute them using the 2D Soccer Simulator. This framework is available to be used not only in the Simulation 2D league but also in any other RoboCup league that demands for cooperative team play.

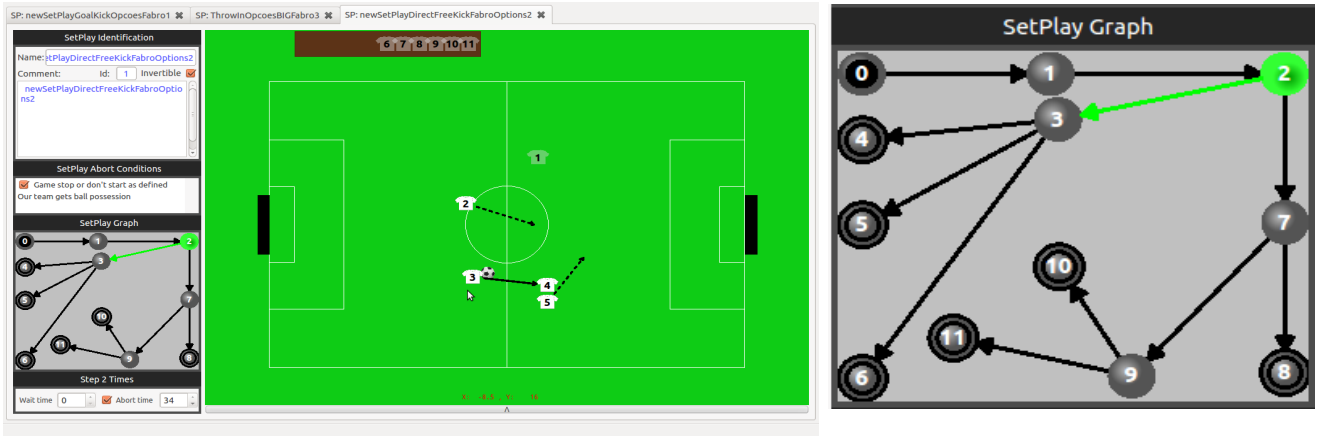

Figure 1 –FCPortugal SPlanner Specification Tool (left), and an Example of Setplay with multiple-choices (right).

3. Proposed Approach – Machine Learning to Select Actions on Multiple-choices Setplays

The methodologies developed by **GPR-2D** team for using **reinforcement learning(Q-Learning)** in the **attack decision for the player with ball possession** were **adapted** to **choose the best action in multi-choice setplays** (see Figure 1 - right). This **Setplay Graph** defines the actions of each participating player in each step of the setplay. In the example on a **Direct Kick** setplay, in **Step 2**, **Player 3** (that is in possession of the ball) has **2 options**: to **pass the ball to Player 4** (advancing the **Setplay to State 3**) or to **pass to Player 2**, that is running, and thus **advancing the setplay to Step 7**). This decision is random at first, but after several matches against any given team, the procedure adjusts, rewarding the option that works better, and lead to a better execution of the setplay. As results, this procedure resulted in a percentage of **93% of winning chance over Agent2D 3.1.1**, **75% over FCPortugal_2013**, **71% over GPR2D_2013**, **25% over Yushan2013**, and about **10% over both HELIOS2013 and WrightEagle2013** (the last 3 being respectively 3rd, 2nd and 1st place in Robocup2013).

References

[1] Mota, L.; Lau, N.; Reis, L.P.: ***Co-ordination in RoboCup's 2D Simulation League: Setplays as Flexible, Multi- Robot Plans***, 2010 IEEE Conf. on Robotics, Automation and Mechatronics, IEEE RAM 2010, pp. 362-367, 2010
[2] Mota, L.; Reis, L.P.; Lau, N.: ***Multi-Robot Coordination using Setplays in the Middle-size and Simulation Leagues***, Mechatronics, Elsevier, Vol. 21, Issue 2, pp.434-444, 2011.
[3]Neri, J.R.F.; Zatelli, M.R.; Farias dos Santos, C.H.; Fabro, J.A.: ***A Proposal of QLearning to Control the Attack of a 2D Robot Soccer Simulation Team***, 2012 Brazilian Robotics Symposium and Latin American Robotics Symposium (SBR-LARS), pp.174-178, 16-19 Oct. 2012.
[4] **http://www.sourceforge.org/projects/fcportugalsetplays**
[5] **http://www.sourceforge.org/projects/fcportugalSPlanner**
[6] **http://www.sourceforge.org/projects/fcportugalsetplaysagent2d**
[7] Akiyama, H. ***Helios RoboCup Simulation League Team***, **http://rctools.sourceforge.jp/pukiwiki/**

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