



## Editorial

## Strategy planner: Graphical definition of soccer set-plays



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## ABSTRACT

One of the research topics on multi-agent systems focuses on the development of mechanisms such as plans to empower a team of agents to cooperate in order to perform complex tasks. In many cases, the definition of these plans are based on a specific and rather complex grammar and stored in structured text files.

In the context of the 2D simulated Robotic Soccer domain, a set-play language was proposed to coordinate the execution of teammates' behaviors to improve a team's overall performance. The process of manually writing set-play definitions is hazardous and can benefit from the use of a graphical tool to reach new users and allow typical users to become more productive.

This work presents such a tool for which several experiments were run to measure its usability with forty two users by having them perform a set of tasks for which their execution time, number errors and satisfaction were recorded.

The tool reduced the previous average time required to completely define a set-play by 90% and enabled even non-expert users to use it. Moreover, users were on average satisfied with SPlanner having ranked it with a score of 77 (out of 100) using a System Usability Scale questionnaire.

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## 1. Introduction

Artificial Intelligence and Robotics have been two areas of research which have received a great deal of attention over the past few years.

These areas of research have been fostered particularly by international initiatives like RoboCup which accommodates many challenging competitions. From these competitions the one with the most fans is undoubtedly the soccer competition due to its wide acceptance over the world. This competition places two teams of robotic agents up against each other to dispute victory in a soccer match. Teams have been improving performance by creating new strategies that currently consider the definition of strategic positioning [1–6] based on formations, tactics and set-plays [7–9].

A set-play can be part of a team's strategy and is a widely known concept in real soccer as well as in other cooperative sports to leverage a competitive advantage against an opposing team. A set-play can be described as a structured plan that describes courses of actions that a subset of players in a team should take based on the current state of a game. Some attempts to make use of set-

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plays have already been made in the robotic soccer domain, however the knowledge for their definition and execution is tightly coupled (hard-coded) with the soccer player agent internal implementation. A framework that promotes the decoupling of the knowledge of set-plays from the soccer player agents internal implementation using a s-expression language has recently been developed [9]. However, writing set-play definitions manually is a harsh, error-prone and time consuming process. For these reasons, a graphical tool, named Strategy Planner (SPlanner), is proposed to speed-up the definition of set-plays and reduce the amount of errors committed by abstracting the complexity of the grammar from the end users.

The rest of this article is organized in the following manner. Section 2 describes some of the related work done in the context of strategy definition, with a particular emphasis on the definition of set-plays. Section 3 describes the functionality and some usage examples of the Set-play framework used as the basis of this work. Section 4 presents the developed graphical user interface (GUI) of the SPlanner tool, focusing on its integration with the Set-play framework. Section 6 describes the methodology used to perform experiments in order to validate the usefulness of the developed tool. Section 7 presents an analysis of the results obtained from the experiments performed to assess the usefulness of SPlanner. Section 8 draws the main conclusions from the developed work and establishes some pointers for future work.

## 2. Related work

The general concept of strategy can be described as a previously planned and typically complex behavior whose goal is to make use of available resources in the most efficient and effective way [10]. The concept of strategy has been widely adopted in several domains and its definition has evolved to match the specificities of each domain. In collective sports, particularly in the soccer domain, the concept of strategy has been the main driver for the improvement of the game quality of teams over the years.

The use of technologies plays an important role in the improvement of strategies. They allow for games to be recorded and afterwards analyzed. Using tailored softwares (e.g. simulators, tactical panels, analyzer) the specification of strategies and their communication to the interested parties (coaches and players) is eased.

In the human soccer domain, strategy is considered to be a key point for the difference between two teams. Concepts such as game rules (how the game must be played), player roles (what type of behavior is expected from a player), coach instructions (advice given to players to adjust their behavior to become more adequate in a match), formations (players positioning in the field) and set-plays (predefined plans of action used to gain advantage over an opponent) can all play a part in a team's strategy.

In the robotic soccer domain, particularly in the RoboCup competition, the previous concepts have already been researched and experimented in different teams [11] of different leagues mainly with the goal to build better coordination mechanisms that will allow teams to improve their performance and have an advantage over their opponents. Some exemplar instances of the implementation of such strategic concepts include: general dynamic positioning [1–4], coaching [12,13], defensive positioning [6], set-plays [9,7,8] and offensive positioning [5]. As corroborated by the previous citations, these concepts have been mostly tested in the 2D soccer simulation league, in particular because it provides a standardized and robust platform around which several community open-source tools have been developed that ease the development of new ideas.

Several tools have been developed with the goal of assisting the definition of strategies in real soccer (e.g. Coach-Helper, Academy Soccer Coach, ForCoach Tactics, ForCoach of Soccer, Tactics Manager). These software applications are commercial and its functionality is mainly focused on the use of soccer tactical panels for the definition of team formations. In order to assess the usability of the tools some user tests and a heuristic evaluation [14] based on the following set of heuristics [15] was conducted:

- Ensure the visibility of system status;
- Adequately match system to real world concepts whenever possible;
- Provide the user control and freedom;
- Make use of standards and be consistent;
- Prevent user errors;
- Favor recognition rather than recall when using dialogs;
- Provide flexibility and efficiency of use;
- Develop esthetic and minimalist designs for dialogs;
- Help users recognize, diagnose, and recover from errors;
- Provide concise and step-oriented documentation focused on user tasks.

The results of the heuristic evaluation led to several conclusions, from which the most important will be highlighted. The tool that was easier to use was ForCoach Soccer which when combined with ForCoach Tactics became more suitable for defining team's tactics and formations. Although these tools use the set-play concept, none of them allow to graphically or formal define set-plays or even store the set-plays created.

The video-games industry has registered a trend of growth over the last few years, mostly due to the high level of realism that creators were able to imprint in their games. In this industry, there are many examples of soccer games (e.g. Hatrick, Online Football Manager, Virtual Manager, FIFA Soccer 2011, Pro Evolution Soccer 2011, Championship Manager 2010, Football Manager 2011, FIFA Manager 2011) made available to users in different platforms (e.g. online web-based, game consoles, PC) that empower them to define some kind of strategies. Once again, the video-games reality presented the same drawbacks exposed in the human soccer scenario. The online games that use web browsers are too simplistic and offer few tools for the definition of strategy. The soccer

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