Titãs Da Robótica Team Description Paper 2025

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Abstract. This document describes the core of the Soccer 2D team code of the Titãs da Robótica team. Titãs da Robótica is a robotics team from the Federal Institute of Espírito Santo - Colatina Campus (Brazil). In the past year, the team underwent a major code restructuring. There was a change in the base team and the addition of new techniques and algorithms. The main goal of this document is to describe the team development while presenting the methods and technologies which were applied, as well as the results from past competitions.

Keywords: RoboCup, Soccer Simulation 2D, Marking, Hungarian Algorithm.

1 Introduction

The Robotics Team of the Federal Institute of Espírito Santo – Colatina Campus was created in 2015 under the name Asimov, competing in the Standard Educational Kit (SEK) category in Latin American Robotics Championship (LARC). In 2016 it started to compete in the Soccer 2D, Practical and Theoretical in Brazilian Robotics Olympics (OBR). In 2018 the team was renamed Titãs da Robótica.

In 2016 the team started competing in the 2D Soccer category at the initiative of the students of the Information Systems course. The main goal of the students was to apply the knowledge acquired during the classes in the development of the robots. Programming techniques, game observation, code study and application of conventional soccer techniques were applied in order to improve accuracy in kicking, passing, tight marking, choice of the best moves and other characteristics of the team.

The team competed for the first time in LARC in October 2016, and won first place. Our team maintained the results in 2017, 2018 and 2020, becoming four-time champions in the competition.

A restructuring of the team took place in 2023, as a result, the team did not participate in championships that year. However, it resumed activities in 2024, securing second place in Brazilian Robotics Competition (CBR). In this context, the team's code underwent several changes to regain competitiveness after a period without significant modifications or additions.

The team code was based on Gliders2D [1], and all development efforts were focused on improving mechanisms already present in the structure of Gliders2D. Additionally, many ideas were inspired by the work of other teams, especially MarliK

[2]. However, with the team's restructuring in 2023, its features were incorporated into Cyrus2D [3] to restore the team's competitiveness.

Furthermore, in an effort to implement new behaviors for the team, a dynamic player marking algorithm was introduced, inspired by the RobôCIn Team Description Paper 2023 [4]. This algorithm utilizes the Hungarian algorithm for assigning player positioning.

2 Team Rebase

In 2023, the team remained inactive and, after this period, underwent a complete restructuring of its members. Thus, it became necessary to implement changes and additions that restored the team's competitiveness, while the new members needed to learn and familiarize themselves with the source code and infrastructure of Soccer Simulation 2D.

To achieve this, we decided to integrate our team's features into the Cyrus2D base to maintain our playing style, which is based on characteristics from MarliK, Gliders2D, and our own adjustments, combined with new features from this base.

The choice of Cyrus2D was due to the good results that this new base presented against other teams and bases, in addition to possessing new blocking and marking strategies, which our old team did not have. Another decisive factor was that Cyrus2D is based on Gliders2D and Helios base [5], which were the bases used by the team, making the code integration easier.

Another change resulting from the base switch was the update of the librcsc [5] from version 4.1.0 to support-v18. This may have been one of the factors contributing to the team's improved performance, as analyzed by the ITAndroids team in their 2024 TDP [6].

One issue caused by this update was incompatibility with old team formations. To resolve this problem, we created a converter that updated the formatting of the old formations, making them usable with the new base.

These changes had a rapid impact, as in February 2024, we achieved third place in the Inatel Robotics National Cup (IRONCup), a feat that would not have been possible with our team before the changes were implemented.

3 Dynamic Marking

At IRONCup 2024, we competed against the RoboCIn and ThunderLeague teams and observed their players behavior in set-piece situations. While our team adopted a static positioning based on formation files, these teams employed a dynamic approach: their players strategically positioned themselves in front of opponents, blocking potential passing lanes. Given the effectiveness of this strategy, we decided to implement it in our team.

Regarding marking, each player should position themselves near the closest opponent. However, this simple approach can lead to multiple players marking the same opponent. To avoid this issue, inspired by RoboCIn’s methodology [4], we adopted the Hungarian algorithm [7], ensuring that each player is assigned a different

opponent. Additionally, only opponents near the ball should be marked. If a player is assigned to mark an opponent who is far from the ball, they will remain in their static positioning.

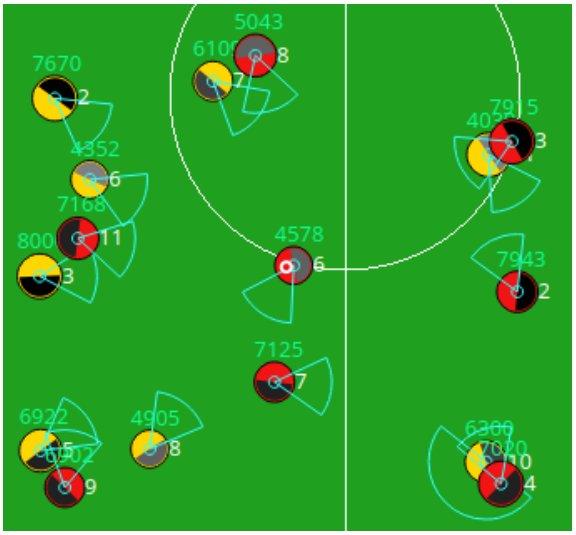

Fig. 1. Dynamic Marking

The implementation requires fine-tuning to enhance its effectiveness. Additionally, we are exploring ways to use this marking system in other game situations.

4 Results

To validate the above-mentioned modifications, approximately 1,500 matches were played against some teams from the competitions we participated in during 2024 (IRONCup and CBR): ITAndroids, ThunderLeague, Reddragons, and RoboCIn. From the results, the percentage of wins, losses, and draws was calculated.

Table 1. Comparison against teams

	old team	cyrus based team	dynamic marking
Victories	9.8%	37.8%	37.8%
Defeat	75.2%	45.2%	41.0%
Draw	15%	17%	21.2%

5 Conclusions

This paper presents the implementations developed during 2024 and early 2025. Some of these are fully implemented and tested, while others remain in development. The analysis of the results confirms that the new implementations – especially dynamic marking and the base change – have provided significant improvements in

the team's performance compared to previous versions. The statistics demonstrate a notable reduction in losses and a substantial increase in wins. Thus, it is concluded that as the functionalities planned in Future Works are consolidated, the team tends to become even more competitive, achieving increasingly significant results in future competitions.

6 Future Works

As mentioned above, we are analyzing a way to apply the dynamic marking in non set-piece situations.

In addition, we are studying how different formations, such as 5-3-2 and 4-4-2, can impact our playing style, and whether switching between these formations in different situations can improve the team's performance.

Another work we are developing is an analysis of the players attributes, focusing on the improvement of the selection made by the coach.

We hope that through these studies we can enhance the team's performance and become more competitive in the coming years.

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