

The impact of consensus on the selection of the attacker role on the reduction in the number of fouls committed

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I. INTRODUCTION

Bahia Robotics Team (BahiaRT) has been using an algorithm to select the best player for the Attacker role during a match based on the estimated ball trajectory. As the Attacker, we consider the player in the best condition to carry the ball, perform a kick (pass or kick to goal) or try to intercept the ball if it is in the opponent's possession. Our legacy algorithm is obsolete since the estimation of ball trajectory was based on the gameplay of teams back in 2013 when most of them used to dribble the ball almost all the time. In the current status of the league, the gameplay is more dynamic, with passes and kicks to the goal from a variety of distances.

We decided to create a new algorithm to select the Attacker role, and in this paper, we present the new algorithm, the consensus protocol we developed, and its impact on the team's committed fouls.

II. ATTACKER ROLE SELECTION ALGORITHM

The new algorithm is based on two main concepts: *Fastest Carrier* and *Fastest Blocker*. The Fastest Carrier is the player of our team closest to the ball whose orientation is aligned both to the ball and the opponent's goal line. The Fastest Blocker is the player of our team closest to the ball with no obstacles between them.

The algorithm's main bias is prioritizing the Fastest Carrier to be an Attacker when the ball possession is clearly of our team. And when the ball possession is of the opponent or imprecise, the priority goes to the Fastest Blocker as the best candidate for Attacker.

The first results of the new algorithm were worse than the legacy solution because many times, more than one player elected himself as the Attacker, and both went to the ball, creating scenarios that were favorable to the opponents. To solve this problem, we created a consensus protocol to ensure that only one player will act as an Attacker at a time. This protocol is described in the following section.

III. CONSENSUS PROTOCOL

The BahiaRT team uses a coordinated message system that enables players to communicate with the team on a round-robin basis. We created an election system using the existing message protocol. The idea is that when a player evaluates that someone should be an Attacker, according to

the algorithm described in section II, he will post a vote in the message system. All players consider the vote of the goalie (player number 1) as the start of a new voting round. When we collect 11 votes, all players agree that the most voted player is the one who should be the Attacker.

This consensus protocol eliminated the previous situation where more than one player goes to the ball and also makes a better choice for the Attacker role. In the following section, we present the main results of the new solution.

IV. RESULTS

To assess the algorithm of Attacker role selection and the consensus protocol, we ran 100 matches of each BahiaRT version (legacy, no consensus, consensus) against some opponents. The results are shown in Table I.

TABLE I: Results of 100 matches using each algorithm version against four opponents.

	Code Version	ITAndroids	MIRG	magma	Apollo
Wins	Legacy	16	96	0	0
	No Consensus	9	83	0	0
	Consensus	19	97	0	0
Draws	Legacy	58	4	0	4
	No Consensus	56	17	0	2
	Consensus	49	3	0	0
Loss	Legacy	26	0	100	96
	No Consensus	35	0	100	98
	Consensus	32	0	100	100
Mean Fouls	Legacy	18.45	12.26	16.05	20.49
	No Consensus	17.06	11.34	13.87	18.40
	Consensus	9.51	8.65	6.87	10.74

The new algorithm with consensus has a similar overall performance to the legacy algorithm. But it overcomes the new algorithm without consensus in most of the clashes. The main result is related to the Mean charging fouls committed. We can see that the new algorithm with consensus reduces the number of fouls by approximately 50%.

V. CONCLUSIONS

The results present evidence that the consensus about role assignment is an important requirement for robot soccer teams. In particular, when the role is the Attacker, it can reduce the number of committed fouls. Reducing fouls is an important requirement for further development to enhance team performance.

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