Warthog Robotics
Team Description Paper 2012

Pedro Carlson[1]

[1] Av. Trabalhador Sancarlense, 400, 13566-590, São Carlos
University of São Paulo, School of Engineering of São Carlos, Department of Electrical Engineering
São Carlos, São Paulo, Brazil
{ pedrocarlson@usp.br , carlson.pedro@gmail.com }

Abstract. This paper describes the Warthog Robotics 2D soccer simulation team. The team was runner-up at the Brazilian Robotics Competition (CBR) 2011 and, previously under the name of GEARSIM, won the CBR 2009 and the Latin American Robotics Competition (LARC) 2010. In this paper is presented the current team research focus, which has been designed and implemented within this last year.

1 Introduction

The Warthog Robotics 2D soccer simulation team is a branch of the Warthog Robotics Team [1], which was created in 2011, after the merge of two previous robotics groups, GEAR and USPDroids, both competitors at the Brazilian Robotics Competition during several years. Besides the 2D simulation league, the team also participates in two other categories of the Robocup, the 3D simulation league and the SSL.

Our approach to the simulation 2D league is the research of decision making in dynamic multi-agent systems. Based on the uncertainty and the subjective character of each simulation 2D game, and on [2], [3], [4], [6], [7], we have chosen a fuzzy system technique to determine the team formation, merging both previous works [6], [7], so that both behavior and positioning of each agents were affected. This method will be presented further on this paper.

The Warthog 2D Team is based on Agent2D base source code [5], due its nice and clear implementation of the low-level layer, and its easiness in developing intelligent approaches in the high-level layer.

2 Fuzzy System Formation Chooser

In our previous works, fuzzy systems were implemented on the coach, and they could alter either the positioning of the agents [7], or its behavior [6]. In this new approach, the coach calculates both fuzzy systems, generating two different outputs, one for the positioning, and the other for the behavior of each agent. Using these outputs the new formation is chosen according to Table 1.

This new fuzzy set, which contains both fuzzy systems for positioning and behavior, has four inputs and two outputs. These parameters are, respectively:

- Time - Number of game cycles (Figure 1);
- Successful Attacks - Value in percentage (%) (Figure 2);
- Successful Defenses - Value in percentage (%) (Figure 3);
- Ball position – Average value of the *X* coordinate, where the value 0 is the minimum value, and 105 the maximum value (Figure 4);
- Stress Level – Represents the behavior to be adopted (Figure 5);
- Tactical Formation – Represents the position to be adopted (Figure 6).

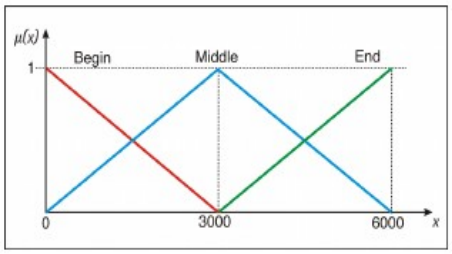

Fig. 1 – Total game time [6].

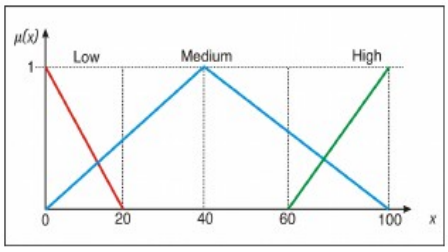

Fig. 2 – % Successful Attacks [6].

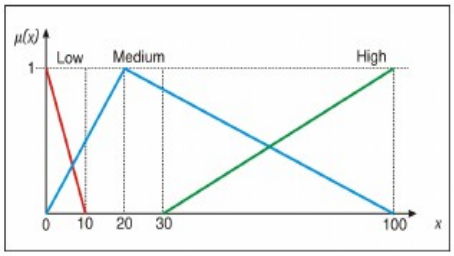

Fig. 3 – % Successful Defenses [6].

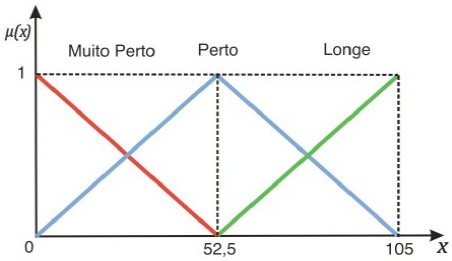

Fig. 4 – Ball Position [7]*.

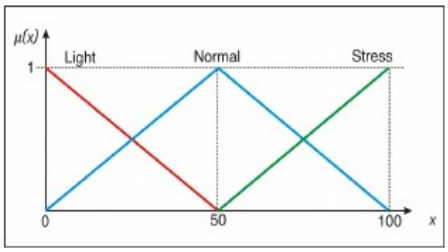

Fig. 5 – Stress Level [6].

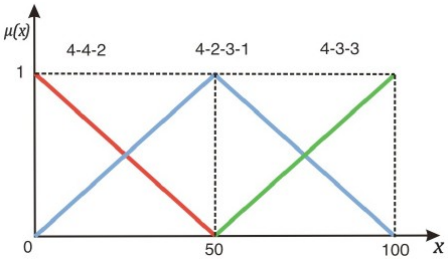

Fig. 6 – Tactical Formations [7].

*some parameters are not in English:

”Muito perto” stands for “Too close”;

“Perto” stands for “close”;

“Longe” stands for “Far away”.

At every 250 cycles of the game time, both fuzzy systems are evaluated by the coach, generating one stress level and one tactical formation. Combining these results, as shown in Table 1, the new formation is chosen, and the couch announces to each agent their new role and behavior.

The stress level output determines which behavior the agent will have. Its inputs are time, percentage of successful attacks and defenses. It affects both the actions that each agent will perform, such as offensives or defensive passes, and the intensity of dashes or tackles. If a light behavior is calculated, the agent will be cautious in his actions, only executing passes that are safe, avoiding any kind of risks. This leads to almost no attacks during this behavior, but at the same time guarantees a huge ball possession, and therefore no pressure from the opponent. The intensity of the actions will be the minimum necessary to successfully execute each action, which saves stamina, a powerful player resource in the end of the match. This behavior is selected when the percentage of successful attacks or defenses are high, usually representing a winning situation. With this behavior very few goals are scored, but almost none goals are suffered, maintaining the game score.

When the normal behavior is chosen, each agent performs its action balancing two parameters: energy saving and small execution time. The result is a faster and more aggressive team than with a light behavior. The actions becomes more offensive, with through passes, offside and a stronger marking of the opponent. This behavior is usually chosen when the game is balanced or tied, with equal winning chances for both teams.

The stressed behavior represents a situation of despair, anger or frustration of the team. It is chosen when the percentages of successful attacks or defenses are low, or when the game is reaching its end and the team is losing. With this behavior, the team is only interested in scoring at any cost. Every action is performed with the maximum intensity possible. When a teammate has the ball possession, it starts moving forward, dribbling or doing long passes, quickly trying to reach the opponents goal, in a

reckless offensive move. When defending, the agent tries at all cost to stop the advance of the opponent, doing a strong marking, which results in a high number of fouls. This behavior has the higher percentage of goals scored and suffered among all of the behaviors.

The other output that is evaluated in the fuzzy set is the tactical formation. Its inputs are time and average ball position. There are three different tactical formation available, each one with its own roles and positioning.

In order to avoid errors during the fuzzy calculation, the ball position runs from 0 (own goalie) to 100, instead of -52.5 (own goalie) to 52.5. When the ball position is elevated, the team is attacking, so an offensive positioning is chosen (433). This tactical formation has three attackers and two offensive midfielders. The defenders are advanced in the field, supporting the midfielders and performing long through passes.

When the game is balanced, the average ball position tends to be close to the center field line. As an attempt to occupy the midfield preventing the opponent attack, the 4231 tactical formation is chosen. With its five midfielders, this tactical formation allows a good defense system and yet openings for counter-attacks.

In a defensive situation, where the average ball position is too close to the goalie, the 442 tactical formation is chosen. With four defenders and two defensive midfielders, it blocks the opponents attempts of through passes and offensive plays.

The thresholds of each membership function were defined using both statistics and analysis of real soccer matches. After watching several matches, commentators analysis, and comparing the comments with the statistics, the thresholds were arbitrarily defined.

Compared with the previous works, instead of having only three behaviors with one positioning, or three different positioning with only one behavior, there are nine possible combinations of formations, as represented on table 1.

Behavior\Formation	4-4-2	4-2-3-1	4-3-3
Stressed	442_S	4231_S	433_S
Normal	442_N	4231_N	433_N
Light	442_L	4231_L	433_L

Table 1 – Possible combinations of formations and behaviors.

It is interesting to point out that both fuzzy systems shares one input (time), and they are influenced by each other. When the formation chosen is the offensive (433), the team tends to attack more, make more shots at goal. This affects the percentage of

successful attacks, which affects the choice of the behavior. With more attacks, the behavior chosen tends to be light, which prioritizes a more cautious behavior, with less wrong passes. This generates a more defensive behavior, which causes the ball position (*x* coordinate) to be smaller, influencing the choice of the formation.

3 Results

Tests were performed against three different teams, in order to evaluate the effectiveness of the fuzzy system. The teams are: Marlik (3rd place at Robocup 2011), NADCO (6th place at Robocup 2011) and agent2D (the base code of our team). Ten matches were played against each team. The results obtained are displayed in table 2.

	Warthog	*Marlik*	*Warthog*	*NADCO*	*Warthog*	*Agent2d*
1	1	2	1	1	2	0
2	0	0	2	0	4	0
3	0	3	4	0	4	0
4	1	2	2	2	5	0
5	1	3	3	1	2	1
6	0	1	2	1	3	0
7	0	0	3	0	5	0
8	0	2	1	2	4	1
9	0	2	0	0	3	0
10	1	1	1	0	3	0

Table 2 – Results of test matches.

Against a strong team as Marlik, no victories were obtained, three games ended tied, and there were seven losses, but the goal difference in each game is not big, only a couple of goals. The formation that prevailed during the matches was 442_S, since the team was in a defensive situation, and always in pressure (goal kicks from opponent). The least used formation was 433_L, since the team didn't attack very much, and was in constant pressure.

On the other hand, against NADCO (medium team) and Agent2D (weak team), there were sixteen victories, three ties and only one loss. The goal difference in the matches is not very wide, because the main behavior in those games was light, where the ball possession is more important than reckless offensive moves. The formation that was most used was 4231_L, which represents a huge ball possession and very few, yet successful attacks.

These results were obtained without changing the threshold values of the membership functions. An adaptive approach to change the thresholds during the game is planned to be developed in our future works.

4 Conclusion and Future Plans

This paper briefly describes the Warthog Robotics 2D Simulation Team, its current efforts and research areas. We have merged two previous researches in a new fuzzy system that affects both behavior and positioning of the agents. Improvements are still being performed, since the amount of coding needed to implement all the new behaviors were considerably high.

Our plans for the future includes some reinforcement learning techniques applied to the goalie, adaptive thresholds for the fuzzy system and a swarm approach for the agents navigation.

References

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