HOW SPIRITUAL MACHINE WORKS

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ABSTRACT

The Spiritual Machine Team was developed in a non – academical environment motivated by the challenge of solving a simple comprehension problem and complex resolution. In every moment, we tried to raise the problem on simple, modular concepts and great adaptability to a high dynamical environment.

Spiritual machine is a team that looks forward to create a game philosophy and mobility far from the physical environment, dimensions and field shape, from the capacity and time given, in a way that could be easily extrapolated to other application environments (either real or virtual ones).

We dispose of several ways of playing that the team may choose during the match, so as to all players may be part in the defence, attack or steady positions to get a defendant and more accurate behavior. These possibilities give to the team a great flexibility and adaptability to the opponent.

Its first participation was in CAFR2004 (Argentine Championship of RoboSoccer 2004) where it won the Second Prize in the Simurosot category. Then it participated in FIRA World Cups (2004 and 2006) and CAFR2005, where it won the 2do Prize again. Finally in CAFR2006 it won 1st Prize.

1. INTRODUCTION

The general development concept was to achieve that the robots move quickly, in a precise way and with the minor quantity of possible corrections in its path. This tries to reserve execution time to process the strategy. On this base, we prefer that the players are in continual movement instead of being quiet or spinning in itself.

We define two navigation methods, one that guaranties an angle of destination reach and another that not. By means of these two movements we get the navigation of all players. The result of this is a team that moves quickly and kicks the ball in the right direction, to achieve this; we should work a lot with a very dynamical navigation which describes the curves to avoid the robot stops when changes the path and a good manage of the inertia provoked by the continual change of directions. This navigation is divided into two great groups of routines, ones are applied to large distances to the ball (macro- environment) and others are in charge of short distances navigation (micro-environment), this experience showed us that in cases applied to the first group, they did not work well being next to the ball, because of a simple movement in it provoked a sudden change of situation that in a macro environment do not occur easily. Another main tool to be able to work with this so dynamical plan was the development of a good routine of predicting the ball which gets to transform all this dynamism in a situation of ecstatic analysis of the ball to future letting to the robots carry out the navigation to an affective target and so be able to create plays. This prediction takes into account rebounds and changes of path provoked by own players as opponent ones.

2. TEAM DEVELOPMENTE STRUCTURE

We define the team structure through the following modules:

Environment: check data that would be used for the rest of the modules. Some of these data are the position of the contrary team, statistics about ball possession, past, present & future ball positions and the robots.

Prediction: Evaluate the future position of the ball and robots taking into account their paths. This calculation is made to each robot in particular according to its velocity and distance to the ball, giving as a result the future position respect to the ball in the field, and a t value that represents the time that the robot will need to reach the ball. As the ball is a mobile object, which has velocity, acceleration and direction, this value is calculated by means of an iterative algorithm which pretends to get a coincidence between the ball position and the robot one,

taking into account their paths, in a certain time. The iteration not always reaches an exact result and is stopped when it achieves the accuracy you want.

Strategy: gives roles to the players and orders their movements. The roles are not static, these go interchanging in order to the position of the robots (either own ones or contrary ones) and to the ball.

Navigation: is responsible for the transfer of that robot to the specifical destination by the strategy. It uses two basic functions that coordinated ensures the final reach with an accurate angle at a maximum velocity.

Kicking: Define a play when the ball is in the micro-environment of the robot. There are three kinds of kicking depending on the angle of the robot to the objective, this could be straight, gyratory or by the side, thus we may get to optimize the chances of kicking at an objective in case of reaching the ball with a no-ever ideal orientation.

Log: A very important module, who is in charge of the LOG, made possible the well development and the constant improvement of the team. The function of this module is registering the development of the match. As a result of this, we get the following possibilities:
- Have a Backup of the played matches for a posterior analysis, in which, in general, we may get improvements.
-Evaluate how our own team works, detecting development mistakes.

This module give us as a result a file that in a posterior step is analysed by a soft developed by us which let us watch the replay, watch and analyse the paths, real objectives and predicted ones. Besides, let you make numerical velocities analysis, accelerations and distances to the robots and to the ball.

3. ROLES

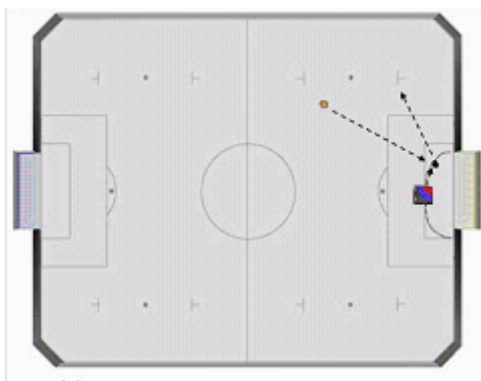We define as role to the different behaviors that may take a player in the development of the play. As follows,

Figure 1: Goalkeeper

The goalkeeper: It develops a **circular path** which results very effective to reduce the projection field of contrary shoots to our goal. Besides, it results very good to clear away balls which come from the lateral sides, clearing away the ball to the centre of the field, as avoids too and resolves the problems caused by contraries who intend to make goals using the brute force by the lateral sides by the bottom line of the field. This technique has its roots in the philosophy used in any martial arts, especially **AIKIDO**, in which you try to make use of the rival strength to become it in a favourable factor for you and so you win. The goalkeeper, taking into account this concept, does not try to restrain the opponents which are trying to make goals using the add up of the strength of many of them, because it would be impossible to him just doing it by physical matters, but he make use of it and with a simple revolving movement he move them to the centre of the field, making fail their targets.
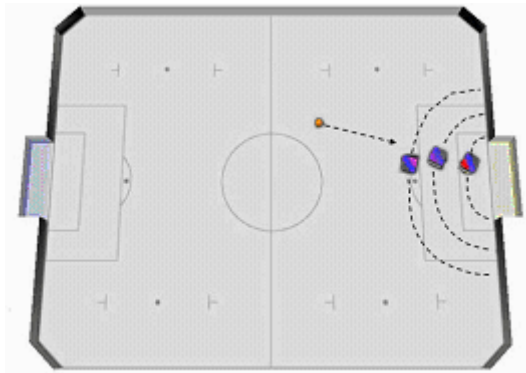

Figure 2: Defenders

The defender: It develops too a circular path with a major radio than the goalkeeper, but with a minor passive attitude in certain occasions, but with riskier kicking and clearing away features.
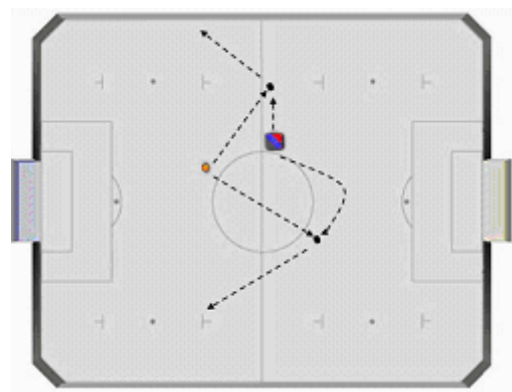

Figure 3: Middle field player

Middle field player: It develops its game in the middle field line and its main function is catching all balls which try to return to our field and send them to the contrary field. Thus, he achieve to get a great quantity of attacks of the opponent, keeping the play the contrary field which increases the chances to get more goals from the forward players and the others.
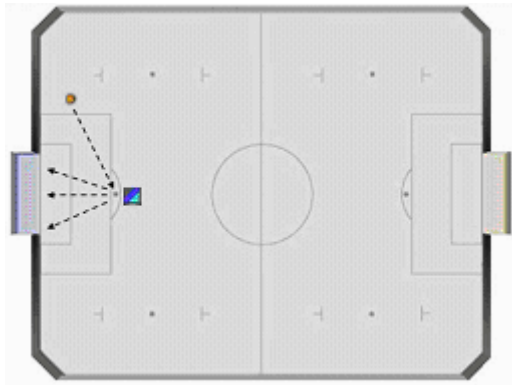

Figure 4: Forward player

The forward player: It tries to focus its radio of action in the third offensive part of the field. He counts on a feature of receiving the passes very well and executes shoots to the goal with many objectives in order to the position of the contrary team. This evaluates time by time the ball path, and it sets close, so it tries to be always good positioned to receive a pass or a clearing of the opposite team, increasing its possibilities of achieving a goal.
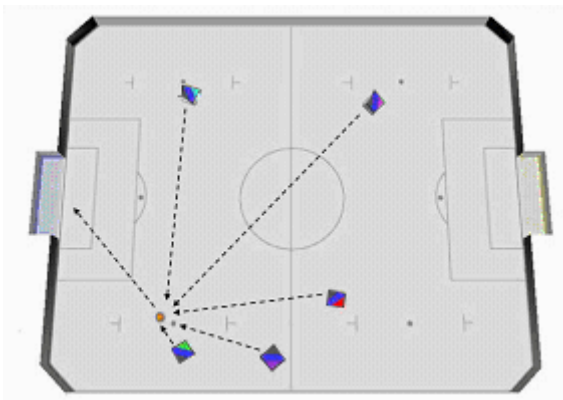

Figure 5: Whole field player

The whole field player: It presents the more complex features and tries to give dynamism to the play contributing with the whole roles and making circulate the ball to the contrary goal.
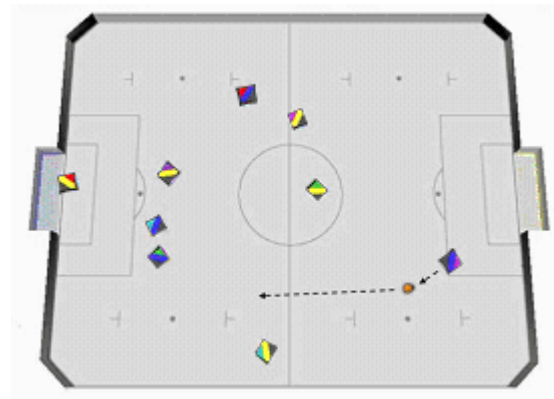

Figure 6: Clearing player

Clearing player: This role is taken when, after evaluating that the conditions are appropriated and secure, the player abandon its position and risk itself, searching the shorter path to the ball and trying to touch the ball to clear it. This role is used mainly in the defence, although in many situations is used too in the middle field. To ensure that a situation is secure to clear the ball, we evaluate the time that all the players take to reach the ball (either own or opposite ones) and if the one who has the minor time is own and there is a certain margin with the minor time of the contrary, so it takes that role. The result is the creation of situations in which the team pass of an unfavourable situation to a very favourable one, with great possibilities to escape alone to the opposite goal.
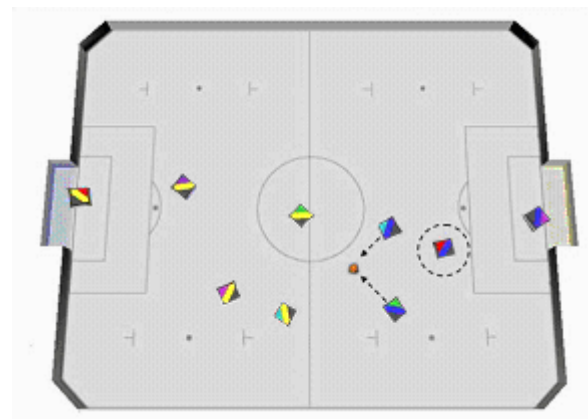

Figure 7: Ball waiter

Ball waiter: With this role we try to distribute the team position in a more accurate way in the field. This role is taken in those occasions in which many own players go to the ball, so one or many of them (depending on the quantity) is chosen to be positioned in a place more behind the ball, between it and the own goal. This is made for the following reason: to avoid that everyone run behind the ball and give a major security, having the chance to

recover the ball supposing that who go to catch it do not reach it, either because an opposite player have stolen it or because there was a mistake in the calculation of the prediction.
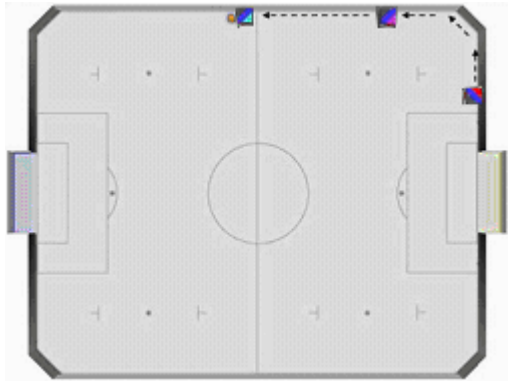

Figure 8: Perimeter line player

Perimeter Line Player: This player presents the necessary features to be able to develop the game against the field edges. Its unique function is to push the ball or an own player, with the objective of restrain an attack and make goals in the bottom line of the opposite goal.

4. STRATEGY

We have decided to give non-static, interchanging roles to the players, this allows, sometimes, to resolve a situation, in minor time, when distribute the roles, as better as could, in order to times & distances, mainly in those critical situations when it is necessary to clear away a ball or define a play.

In the normal formation, where each robot is assigned to a sector of the playground, the robot is responsible for the ball in its sector. If necessary, two or more robots can cooperate to deal with the ball against opponent robots in one sector.

Neither the kinds of roles are not distributed in a uniform way nor are given depending on the defensive or attack attitude that the team may take. This means that, for instance, that in a certain situation the team may defend with 3 players, or perhaps attack with all of them.

The strategic module feeds constantly from the information generated by the environment which may provoke the sudden change of a defensive attitude to a very aggressive in order to the time, result or making use of any weakness detected by the contrary team. This information is composed by ball time posession for each team, the parcial score and the contrary team formation.

Nowadays, we are working on neuronal networks in the decision making process because we think that as the concept of robosoccer is the same as that of the human soccer, we expect advanced strategies for simurosot will appear in the very near future following the strategies of human soccer. For this end, we will have to improve the related technology for pass behavior among robots.

5. CONCLUSION

The participation in the CAFR 2004, 2005 and 2006, FIRA 2004 and 2006 enriched us thanks to the contact with other teams; let us measure our concepts and the way in which we have applied it.

We think that be part in these championships has helped us to test our concepts in a more demanding level and so we could see our weakness and strongness, which will help that our team keep growing.

The key to continue developing our team was not be afraid of discard and redesign old concepts because of new ideas.

Our target to future is that some of these concepts be applied in our own real robots.

6. REFERENCES

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