# Cyrus Soccer 2D Simulation

## Team Description Paper 2012

Miracle Robotic Group

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**Abstract.** We made this report to consider the goals, algorithms and formations that we used in the Cyrus soccer2d simulation team and we try to introduce a full view of how our team works and what our players can do .in this report, we explain more about algorithms of direct pass , through pass , pass strategy , shoot strategy , goalie , defensive system , dynamic roles and players' dynamic movements . The base we used to make Cyrus is "agent2d-3.11".

### 1 Introduction:

Miracle Soccer 2D Simulation team was established by IT students of Shiraz university of technology 5 years ago (2008). This group has participated and qualified in competitions like "Iran Open 2012", "SharifCup 2012" and "PNU 2012" with teams named:"Nibiro ", "Miracle", "SunStorm". We achieved 5th place of "Sama robocup" and 1st place of "Fazasazan open 2012 competition". After working on Wrighteagle 3 base, we decided to make some changes on Helios base and use real soccer strategies and simulating them in 2d state and use some methods such as genetic and C.4.5 algorithms. Now we are trying to improve the team by using more advanced Artificial intelligence algorithms and optimizing current algorithms which are implemented on the team.

### 2 Dynamic Formation change:

The team's formation has been chosen dynamically according to time cycle, game situation and formation changing graph. Now ,these formations are available in Cyrus team : { 4.1.2.3 , 4.2.3.1 , 4.3.3 , 5.4.1 }

### 2.1 Formation graph:

This graph specifies what will be the next formation according to the current one.

canFAchangetoFB(FA,FB) : This is a function that returns true or false according to this structure .

Formation graph has been made according to the output of Formation Analysis software and the energy that is needed to be consumed by players to form a new formation from another.

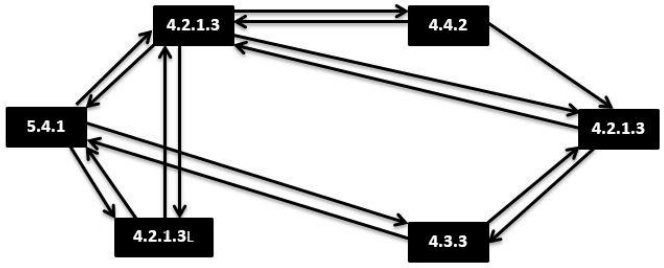



Figure 1 Formation Graph

## 3 Dynamic roles:

Each player receives a dynamic role that choose an offensive strategy by this role. The received role is based on situation, game conditions and the basic role.

- Subject ⟵ S: Group of subjects that each subject points to an agent.
- Roles ⟵ R: {GK,CB,LB,RB,DM,CM,AM,LM,RM,CF,LWF,RWF}

  A group which contains all of the player roles in the game field.

- RoleAssignment ( s , r ) RA: S ⟶ R

  Each player has only one role in the game field in each cycle.

- Assign_role ( s , r )

  Is a method which assigns a role to a player.

- UnAssign_role ( s , r )

  Is a method which unassigns a role from a player.

- Get_appropriate_role ( game Condition , game situation , game result )

  Is a method which chooses an appropriate role for a player based on situation, game conditions and the game result.

We can see the effect of the situation on the dynamic roles as follow:

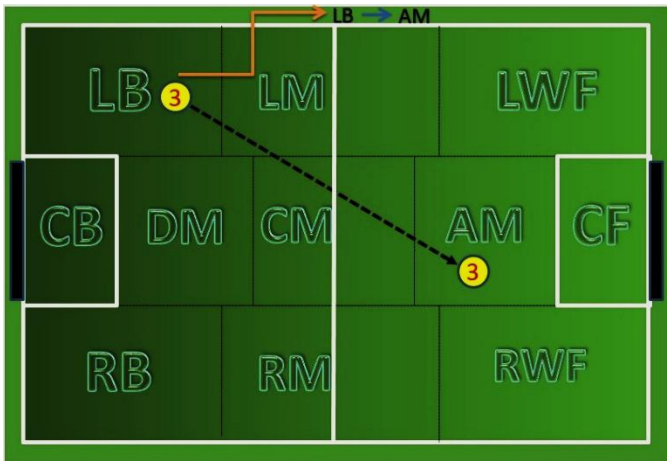



Figure 2 Dynamic Role

## 4 Intercept Simulation

Assuming the virtual kick speed for the ball and the virtual ball movement route, because of being discrete, it simulates the ball movement in future cycles .In each simulated cycle, we calculate the time for the opponents and the end players to reach the simulated ball position. If a player reaches the simulated point as soon as the ball or faster than it, it is obvious that he can be the owner of the ball.

In order to decrease the process time in simulation and in order to omit some of the players whose ball reaching statistic in the simulated cycle is 0, we omit them by the "intercept circle" algorithm described here: For instance, the player number 3 can be the owner of the ball in the second cycle however the player number 2 can't . In order to catch the ball in a specific cycle, we must be in the circle of that cycle .The existence of a player in this cycle doesn't always mean catching the ball.

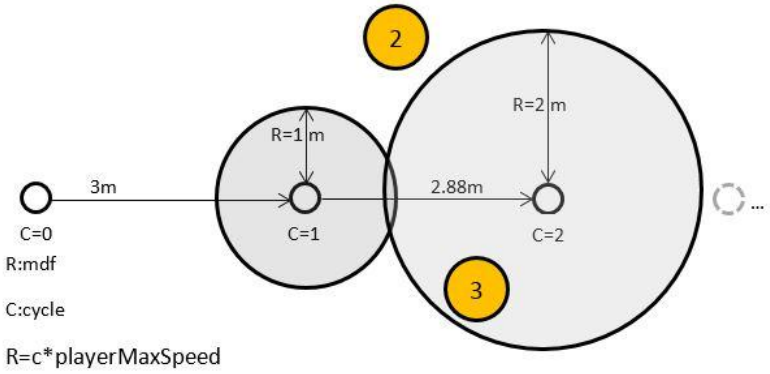



Figure 3 Circle Cycle Intercept

## 5 Pass:

Cyrus Pass has three main parts as we described here:

- Update Database
- Sort Database
- Select Best Pass

### 5.1 Update Database:

This method shows all the passes that the ball owner player can send to his teammates via them, and also this method divides and categorizes the passes based on the end player dynamic role. In this method, possible passes will be saved in a list by calling “LeadPass” and “throughPass” methods.

#### 5.1.1 LeadPass:

In this pass, the end player, catches the ball in its neighboring distances. In this algorithm, the ball routes are the end player’s close angles, then all the possible and critical speeds will be checked and by using ball catch simulator, the exact point in which the ball will be cached by the end player will be shown .Then by using the simulation for the opponent players, it will be understood whether the ball reaches to the end point or not , according to the safety. If a teammate catches the ball, this pass will be considered as a possible pass.

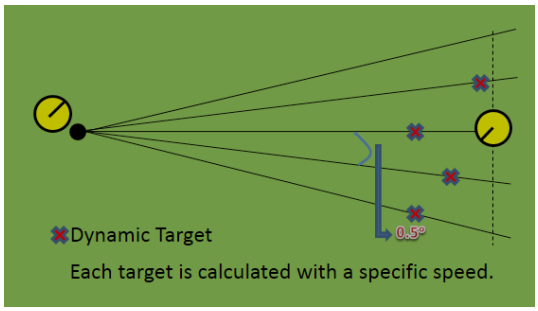



Figure 4 Lead Pass Dynamic Target

#### 5.1.2 Throuth Pass:

It is a kind of pass in which the end player catches the ball in front of him. In this algorithm, the various angles are also the virtual route of the ball movement ,then by considering the various kicking speeds, by using the simulation, the calculated position is set for the end position. By using simulation for opponent players, if the ball reaches the end point by considering the safety in its high level or medium level, this pass will be in the possible passes list.

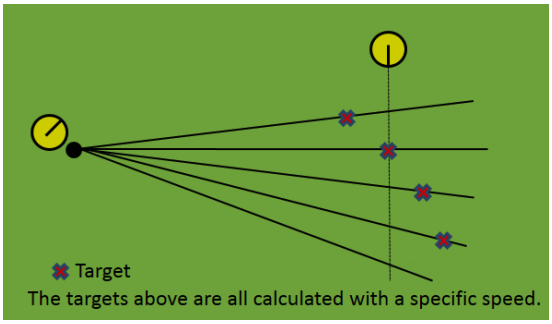
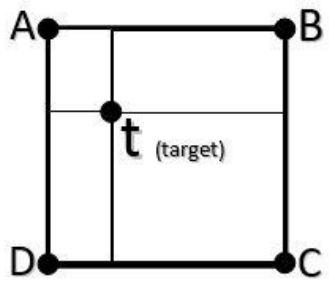



Figure 5 Throuth Pass Dynamic Target

### 5.2 Pass Evaluator:

Pass evaluating method, evaluates passes based on the different parts of the game field , which is calculated by "C4.5" tool , genetic artificial intelligence based on reaching the ball to the opponent danger area side and score . By using this formula we can convert the discrete points to continuous points.




$$S_1 = (t.x - A.x) \times (t.y - A.y)$$

$$S_2 = (B.x - t.x) \times (t.y - B.y)$$

$$S_3 = (C.x - t.x) \times (C.y - t.y)$$

$$S_4 = (t.x - D.x) \times (D.y - t.y)$$

$$\forall\, i \in \{A, B, C, D, t\}\; i.e : evaluate\ of\ i$$

$$t.e = A.e \times S_3 + B.e \times S_4 + C.e \times S_1 + D.e \times S_2$$

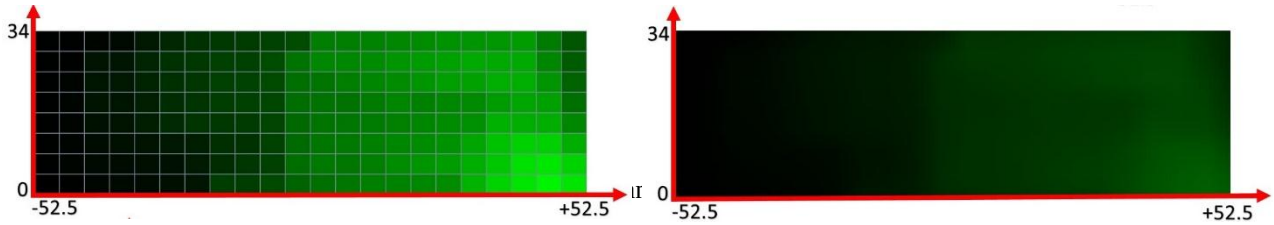



Figure 6 discrete points to continuous points

This method chooses the best pass that has a value of "Dif" in excess of the other values and based on the safety degree, which is shown by "Conf" , then runs it.

#### 5.3.2 DangerPass (bool Conf)

This method chooses the best pass based on the safety, in the way that we become able to reach the ball at the end point by one kick, and then runs it.

#### 5.3.3 Pass2Role (bool role , double Dif, bool Conf):

In this method, we choose the best pass by considering the array of the roles we want to pass to, "Conf" variable which shows the safety and the "Dif" variable, which has the "being better" amount.

## 7 Shoot:

The most effective behavior in order to win the game is shoot behavior. We divided shoot in three parts:

- Defining the goal range
- Finding the safe points
- Choosing the best goal

### 7.1 Defining the goal range:

The goal of shoot kicks, are the points between ( 52.5,-7 ) and ( 52.5,7 ), but we consider it in a shorter range in order to decrease the number of outgoing shoots because of the slip in kicking. In Cyrus team we have defined a variable named "AngleSlip" which is calculated by considering kick speed, the difference between body angle and goal angle and the ball owner player speed .instead of a static variable. So the goal range decreases as the agent distances from the goal .

$$AngleSlip \quad \alpha \quad PlayerSpeed \quad [0,1]$$

$$AngleSlip \quad \alpha \quad DifAngle \quad [0,180]$$

$$AngleSlip \quad \alpha \quad BallSpeedKick^2 \quad [0,3]$$

$$AngleSlip = \frac{PlayerSpeed}{1} \times \frac{2 \times DifAngle}{180} \times \left(\frac{BallSpeedKick}{3}\right)^2 + 2.75$$

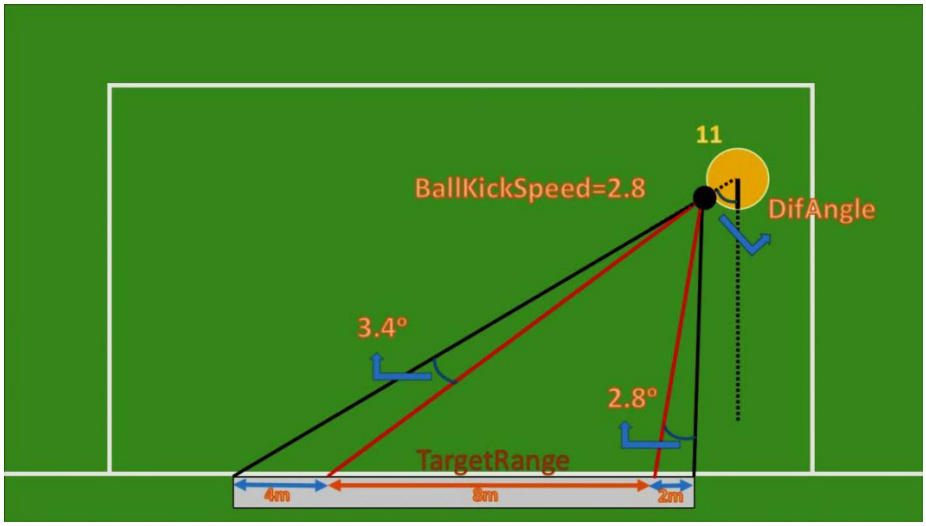



Figure 7 Shoot Target

### 7.2 Finding safe points:

One point is defined as a safe point if the shoot from that point makes goal score for us .in order to know the safe point, we use the ball movement simulation discussed above. The point is safe if the ball won't be catched by the opponents before passing the goal line .

### 7.3 Choosing the best target :

In order to choose the best target between some safe points, we calculate the least time for each point in which the opponents can reach that point, then the calculated time in numbers will be the value of that point, so the point with higher value is the target.

## 8 Defensive Movement System ( DMS )

Get Ball Action (GBA) is what an Agent does for catching the ball in any part of match field and there are many different ways of how to drive an action, in all cases the basic for the best decision is the knowledge that Agent gets them from World Model.

So the best action is which take few cycles for Agent to reach best point for receiving ball or make opponent player lose control of ball, therefore first off all ,agent finds the best direction and then does the fastest action [ Pressing ,Blocking ,Marking ] to reach to the target .

We define game situation as vector $S_i$ = (R , B ) where B is the position of the ball and R = { $pos_1$ , … , $pos_{N_R}, pos_1'$ , … , $pos_{N_R}'$ } is a vector containing the estimated poses of all agents [$N_R$ number of all agents per teams] then according to ball state choose the right action for example if ball is far from our goal we must press opponents to avoid them to get close and for determining way of performing actions we have defined The Game Situation Score (GSS) which is calculated by S of each cycle , score each opponents by the position they have in the field and their distance to strategic points, And by GSS we separate the highest scored opponent player that must be blocked or marked , In fact, the most important component of reinforcement learning algorithms in defense decision making is a method for Sufficiently rating the opponents.

We are yet to improve our defensive skills the way that while we are playing change the values of the states in which we got them during the game , So we can attempt to make them more accurate estimates .

## 9 Future :

In the future , we will try to make it possible for kickable player to make the best decision in each cycle by using decision tree based on future , decreasing the process time by using artificial intelligence and football strategies , dividing the process in the cycles in which the ball is arriving the player and also using algorithms with variable process time so that as the decision tree nodes go forward, we have lower process time .

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