

YuShan Soccer 2D Simulation Team Description Paper for RoboCup 2013

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Abstract: The paper describes new methods and technologies used in YuShan2013 Soccer 2D Simulation Team. Last year, YuShan2012 had gained great achievements with applying the technology of data mining to the team development, and this year, YuShan2013 makes this application to deeper level with using it to analysis and design offensive moving strategy. What's more, we design a new action chain system to improve the Through Pass tactics in YuShan2013, which eventually has great improvement in technology level compared with YuShan2012.

Keywords: Action Chain, Active Strategy, Data Mining,

1 Introduction

YuShan Soccer 2D Simulation Team was established in 2009, affiliated with Anhui University of Technology of China. YuShan has been continuously for research and study since established. It has participated in the RoboCup China Open and Robot Anhui province open. In the past few years, we had gotten the 6th and 4th in RoboCup China Open 2011 and 2012, 2th and 1th in Robot Anhui province open 2011 and 2012 .In addition; we took part in RoboCup2012 in Mexico City, and got the 7th in the end.

YuShan has its own technical characteristics. Under the guidance of the idea of data mining, we develop the team through analyzing log files, exploring implicit interesting modes, and using the modes to guide the team's strategy design. We had successfully applied the method above to the players passing strategy and increased the success rate of the team's pass in the last year ^[1]. This year, we do further research with using frequent pattern analysis method to plan the player's active movement strategy. In a word, the YuShan2013 has more obvious technical characteristics and stronger power.

2 Overall introduction of YuShan2013

YuShan2012 has found many problems in the process of the communication with domestic and international teams. Based on those problems, we do targeted research and design to develop YuShan2013. YuShan2013 inherits useful technical characteristics in YuShan2012 and seriously studies the modes of Through Pass and action chain Compared with YuShan2012, YuShan2013 has the following characteristics:

1, Offense Strategy

- a) YuShan2013 optimizes the bottom action chain system of Agent2D-3.1.0, firstly, we set action choose layer to do classification processing on action types inside the action chain system, and secondly, YuShan adds reasoning module of Pass and Dribble to the action

- choose layer, with which player can do action choice in the form of reasoning.
- b) We design new Through Pass tactics, making it from a single action to multi-players coordination tactics combining passer pass strategy, passer movement coordination strategy and receiver interception strategy.
 - c) The technology of data mining is made further application in YuShan2013. We analyze the player's offensive moving data, study the player's active moving strategy, and design the player's movement and Through Pass movement coordination strategy.
- 2, Defense Strategy
- a) According to the problems appeared in the switch of no play on mode and play on mode, we introduce the state switch buffer period, which adjusts the switch to ensure the effect under no play on mode.
 - b) Defensive player can adopt different defensive strategy to deal with each offensive strategy in YuShan2013. For example, our defensive player can choose BlockPass strategy or BlockDribble strategy by judging that the execution is Pass action or Dribble action. The following will highlight several core models used in YuShan2013.

3 The new Action Chain system

Action chain system is the Basic decision system of the Agent2D-3.10 Base^{[2][3]}. Player's with ball strategies, such as dribble and passes, are centralized simulated and evaluated by the unified evaluation function, from which we choose the action with highest score for implementation. Bottom action chain system can well unify player action decision, but a variety of players' action without separation are concentrated together except outside shooting action, which makes the optimal action judge can only be done by ball position after action executed. This method not only ignores the difference between the player actions, but also makes the execution of the action in action chain uncontrollably. For example, sometimes, pass to the back side is a good way to reorganize offensive, but in the evaluate function, the point in front is better than the point in back side, so player will not pass back. Change the function could make things better, but because the function is for all actions, once the function is changed, all actions will be affected.

YuShan2013 added a new action selection module in the basis of original action chain system. In this module, we do action reasoning according to the state on the ball field, and then choose the best action type of this state, according to the preset tactical information, and finally use this type of evaluation function to select the optimal action of candidate actions for implementation. This design method can be convenient to realize the team tactics deployment and players' action control in action chain. The new action chain system schematic diagram is shown in figure 1:

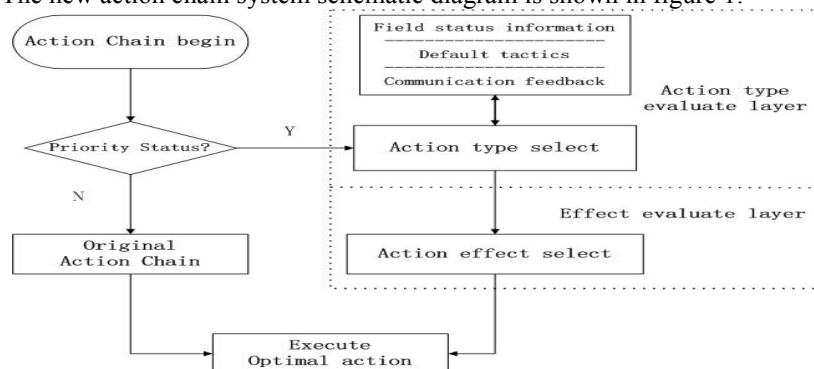


Figure 1 new action chain system schematic diagram

In the Action Chain of YuShan2013, evaluation of movement can be divided into two layers, action assessment layer and effect evaluation layer. Action assessment layer assesses the optimal

action type according to the current situation, and effect evaluation layer choose the best candidate action according to the forecast scene.

The detailed implementation steps of action chain in YuShan2013 are as follows:

Step1, Generating all the candidate actions, according to the preset tactical information to do action type segmentation.

Step2, According to the current situation of state, if according with tactical deployment of the priority action conditions, such as meet priority Through Pass tactical conditions, then executing Step3, or executing Step4.

Step3, Based on the current course information, doing action assessment layer assess according to the current tactics deployed. Besides, doing action effect evaluation layer assess with its own evaluation function, selecting the optimum action in this kind of action, and then implementing Step5.

Step4, Using unified evaluation function to do effect evaluation on all the candidate movements, and selecting an optimal action, and then implementing Step5.

Step5, Implementing the optimal action evaluated in Step3 or Step4.

Besides, because of the offensive strategy counted by different evaluation function has a bigger difference. A evaluate function can't always keep good effect while applied to teams with different characteristics, and so, YuShan2013 design a set of different characteristics, including the evaluation function focused on the passing of the flanks evaluation function and the middle of the offensive evaluation function. In the game, according to the stadium situation, players can flexibly switch between multiple sets of evaluation functions .For example, because of the other side team paying attention to defense, we continue to thousands of cycle but fail to break through the defense, And then, in the follow-up game, player switching focus on the middle attack action chain evaluation function to do the offensive in the middle.

The new action chain system in YuShan2013 enhances the action control in the chain of player movement, makes the players' attack strategy more agile, and has better adaptability according to different characteristics of the defense team.

4 The Through Pass of YuShan2013

Through pass could start a rapid attack, break through opponent's defensive line quickly and has a high scoring success rate. In through pass, kicker create the intention of through pass and give the receiver a long-distance, fast pass which will through the defender's defense line. Focuses on the pass action and the receiver's movement, YuShan make an in-depth study of through pass.

In Agent2D-Base, through pass is a basic pass action in action chain. Through pass is created, evaluated and executed by The Action Chain System with other actions. In YuShan2013 the priority level of through pass is increased. YuShan redesign a new Classification through Pass model, integrate Through Pass action and players receive and move strategy.

In YuShan2013, Through Pass is divided into two parts, one is the passer's strategy and another is the receiver's strategy.

4.1 Passer's strategy

The passer's strategy include two steps, step1 passing stage and step 2 passer's coordinate moving stage. In the passing stage, the Through Pass action is divided into five types, LTM (LeftToMiddle) RTM (RightToMiddle) MTL(MiddleToLeft) MTR(MiddleToRight) and LTP(Lead TP) . Each type is classified according to its passing position, for example the LTM stands for one Through Pass which the kicker is in the left side and the receiver is in the middle of the pitch. When passer passes the ball to receiver, he will record the Through Pass type and set the Through Pass flag, and then execute step2.

In step 2, player checks the Through Pass flag and type, and do coordinate moving according to the Through Pass type. Different types have different moving strategy. Step 2 will continue until player finish the moving target or the ball is intercept by opponents. The main purpose of step 2 is to make through pass as the first step of the offensive, by this kind of coordinate moving, players could put together to participate in the attack. The different kinds of moving trend are learning from Soccer 2D log files, which will give a detailed introduction in chapter 5.

4.2 Receiver's strategy

YuShan2013 add a new say key words "L", use it to stand for through pass. The receiver's strategy is begin at the time hear the "L" pass message.

YuShan2013 design two different types of receive model for through pass.

One is On_line_receive, receiver will first go to an intercept base point, which is a point between pass begin point and pass target point. In the point, receiver will have more accurate information about the ball. And the time receivers go to the point is smaller than the ball move to the point. Receiver goes to the base point, and do intercept action to get the ball.

Figure 2 show the way to get intercept base point.

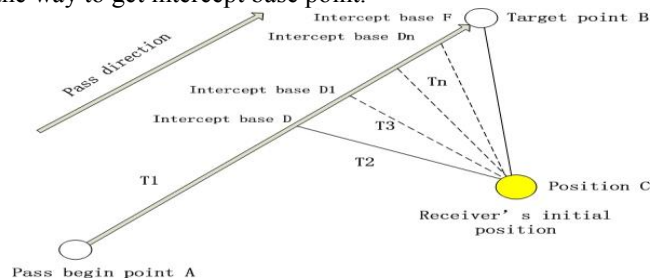


Figure 2 the way to get intercept base point.

Here we set: passing begin from position A, pass target point for position B, receiver for position C. Figure 2 shows the pass path line AB. to intercepting player in the pass path needs catching the ball in path AB. When the ball player in position C hears "L" message, he prefers to the halfway point of the D in line AB. We calculate the ball running distance AD's time T1, as well as receiver position from C to D's time T2. If $T2 < T1 - 2$ (deducting two turn cycle), we explain position D can be used as a reference to intercept, and then intercepting player moves to D and updates the ball information and intercepting table information, preparing to intercept. If $T2 > T1 - 2$, use the segment DB as the new pass route to find a new D_n , until find point D_n , in D_n the $T_n < T1 - 2$. If could not find D_n , player will not get the ball on the pass route.

Another is the Out_line_receive, receiver will run with the ball, the actually intercept point always over the pass target point. Because Through Pass is a special pass, sometimes receiver do not need to get the ball in the pass route. Receiver could run with the ball, approach the ball gradually. Although, this kind of receive may spend more cycles, but, in some kind of status, it will bring a good offensive effect. The Out_line_receive as Figure 3 shows:

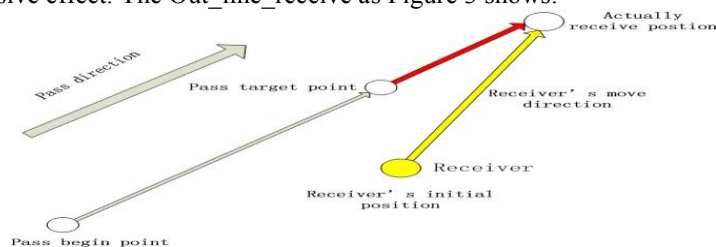


Figure 3 the Out_line_receive model

By combine through pass and players moving and receive strategy, through pass is no more a simple action, but a basic offensive tactics of YuShan2013.

5 Data Mining using in YuShan2013

Using the method of data mining as the guide of our development is the technical features of YuShan. YuShan collects log files of the Soccer 2D games and use data mining method to analysis these files. In this way, we found some implied useful modes; finally, we use these modes to develop YuShan Soccer 2D team.

In YuShan2012, we analyzed the pass date from log files, which improved the success rate of pass. This year, we mainly use data mining method to analysis the moving tread of our players.

Generally, the moving strategy is designed by human experience; developers devise the formation or moving tread of players, watch the games, find the problem of moving strategy, and correct it. The design is lack of reference, has much more randomness. There are lots of moving information of players were recorded in the log files. The log files recorded the position of all players of every cycle, the position is a discretization point on the pitch, but with the game cycles, we could found the moving tread of every player in the game. The moving data of players could be seen as the position sequence, methods of frequent sequential pattern mining could be use to analysis the moving data.

we develop a data analysis tools – LogAnaysis last year, in the base of LogAnaysis, we add the moving data analysis function, the interface of moving data analysis as Figure 4 follows:

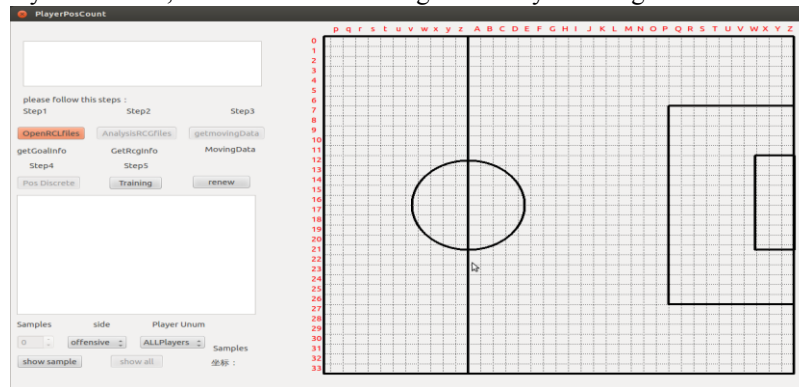


Figure 4 the interface of moving data analysis in LogAnaysis

The process of moving strategy data mining as follow:

- Determine offensive moving data samples. Get 100 cycles before each goal from rcl files, and collect all offensive players' position of each cycle from rcg files. We collected 323 goals from some log files and get all moving data of each goal.
- Establish the projection relationship between log file data and player's action. Use the moving data stand for player's moving tread, eliminate unreasonable data and duplicate data, get offensive moving data set.
- Discrete player's position, player's position are merged into a unit area of $2*2$, each area has its own name. Player's moving thread becomes a sequence of areas.
- Set the minimum support threshold $min_sub = 0.6$, use AprioriAll^[6] algorithm to do Sequential pattern mining, could get the frequent pattern of each player's. These frequent pattern stands for the player's best moving thread in offensive situation. The frequent patterns of offensive moving as list1 shows:

Table 1 frequent patterns of offensive moving

Player type	frequent patterns
Left	{B2 C2 D2 E2 F3} {T12 U13 V14 W15} {Q10 R11 S12}
Forward	{ P8 Q10 P9 } { V13 V14 W14 W15 }
Right	{D31 E31 F31 G30 G29} {R22 S21 T20 U19 V20} { Q23
Forward	P24 }
Center	{ A16 B16 } { G16 G17} { U19 U20 U21 V20} { U14 V13
Forward	V12 V11}

As table1 shows, the patterns {B2 C2 D2 E2 F3} means that in a success offensive , the left forward player most likely move as the trend B2->C2->D2->E2->F3. With these patterns, we could set our moving rules. We also get the most frequently area as the key area, our player's moving strategy use the key area as the center. In order to be more intuitive expression, we draw each pattern in the pitch, like the Figure 5 shows:

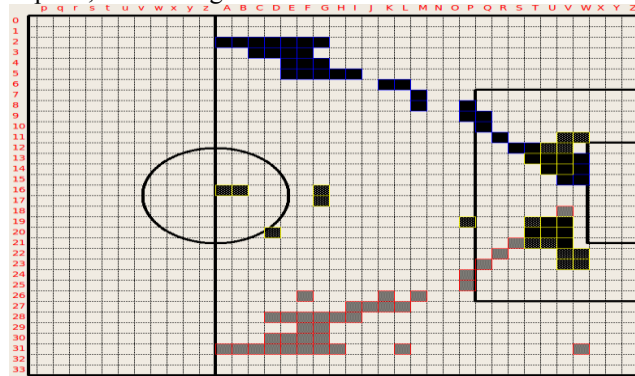


Figure 5 the offensive moving frequent patterns of forwards

e) According to the offensive moving frequent patterns, a new offensive moving strategy and the coordinate moves after Through Pass tactics were devised. To test the effect of these strategies, use the improved team to play 15 games with the original team, as a comparison, another 15 games were between original itself. The result of test games as table2 shows:

Table 2 the result of test games between improved team and original team

	original team VS original team	improved team VS original team
win	8	11
lose	6	3
draw	1	1
Field goals	2.1	4.0
Win%	53%	73%

6 Future works

We continue the technical characteristics of YuShan2013, made an in-depth study of data mining techniques use in RoboCup Simulation 2D, YuShan2013 use a new Action Chain system, which make the action is easier to be controlled. In the future, YuShan will make a deep study of the action model in Action Chain, make our team more powerful. At the same time, YuShan research the online-coach, with which, YuShan will be more flexible.

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