

YuShan Team Description Paper for RoboCup2019

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1 Introduction

YuShan Soccer 2D Simulation Team was established in 2009, affiliated with AnHui University of Technology in China. Having participated in RoboCup five times since 2012, YuShan team ranked 6th in the RoboCup2018 in Montreal, Canada and won three consecutive championships in RoboCup China Open Tournaments from 2016 to 2018. The development of YuShan2019 is based on the reconstruction project of Agent2D-Base in version 3.1.0[1]. The server version is 15.3.0.

2 Team's Overall Framework and Action Chain Optimization

The overall framework of YuShan2019 follows its excellent fine tradition, namely, DoKick or DoMove strategy is largely taken into consideration, which is determined by the holding-ball states of players. Given the comparison in both cases, the DoKick strategy optimizes the action chain model while the DoMove strategy advantages the players' movement model. YuShan2018 utilizes the inference and execution model of action chain in Agent2D while YuShan2019 further subdivides the Dribble action so that it initially realizes the optimization of multi-layer action chain and the chain's evaluation function.

The action chain model adopted by YuShan2018 contains two layers. The first layer is the pass or dribble action, and the second layer is the shoot action. YuShan2019 attempts and manages to implement a more stable multi-layer action chain based on the relevant principles in TDP of HELIOS2012, and to optimize the state-space search by means of the addition of direct pass, short dribble and other actions between the two layers[2]. At the same time, YuShan2019 optimizes the

evaluation function to strengthen the ball-control ability of forward strikers and midfielders. Fast advancement of Pass action contrasts with its poorest ability, and stability of Dribble action with its slowness. Therefore, the optimization of the evaluation system and integration of various situations on the field conducted by YuShan2019 finally contribute to reasonable preference for either action.

3 The Digital Twin Model and its Application

YuShan team has been implementing secondary development and optimization based on the underlying open source. However, the underlying state space of Agent2D is extremely large. Obviously, it is difficult to optimize and develop. YuShan makes use of data mining to find some interesting and valuable models to guide the team's research and development.

With the rise and development of big data, Digital Twin and other technologies, YuShan2019 sums up the related work in recent years and proposes to build a portrait of the player for the simulated 2D team with the Digital Twin model framework, therefore, the Digital Twin model is established to guide the team's research and development by feeding back differences between portraits. The model is divided into three layers: physical layer, information layer and Digital Twin layer, as shown in Fig.1.

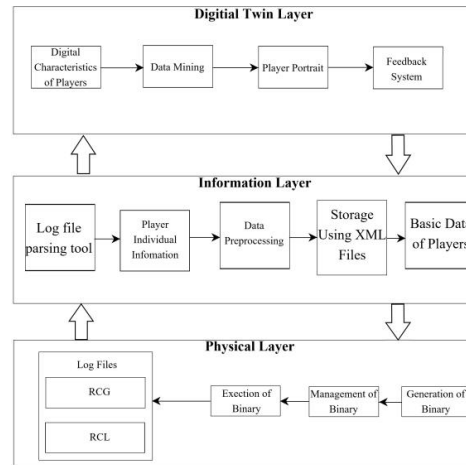


Fig.1.Three-layer architecture of the team's Digital Twin model

It can be seen from the figure that the physical layer is used to manage Binary

generation and optimization, which generates game logs such as RCG and RCL by executing Binary. And the log information in the log file RCG is shown in Fig.2. In the RCL, the player's kick, tackle and other command information are recorded. The physical layer not only receives feedback information from the Digital Twin layer, but guides Binary optimization.

The information layer is used to manage the data parsing, classification and storage of log files. After data cleaning, data integration, data transformation, data specification and data discretization, the data are stored in XML format and visualized for output.

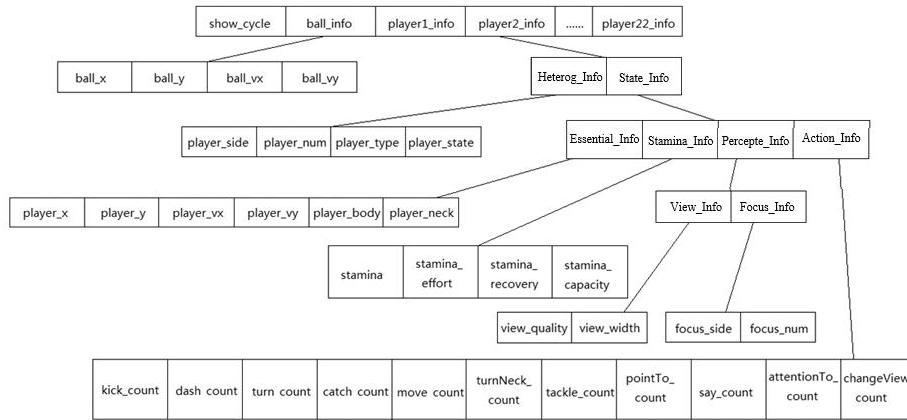


Fig.2.Information contained in the RCG file

In information layer, the basic information of players' behaviors such as passing, dribbling, tackling and holding the ball can be obtained by synthesizing on the relevant information in the RCG and RCL file.

The Digital Twin layer receives the information from the information layer and exploits the data mining algorithm to create the player portrait, there by discovering differences among player portraits and feeding back to the physical layer.

The player portrait is the core of the Digital Twin layer. The internal digital features which includes shooting feature, kick action feature, dribble action feature, tackle feature, shouting feature, attacking line feature, moving feature, tackle action feature and passing feature of players reflect the player's real information.

YuShan2019 combines the characteristics of the portrait to focus on the player's shoot behavior and the team's offensive or defensive judgment. The practical results show that the coding efficiency can be improved, and the winning rate of the top 8

teams of RoboCup2018 is improved. That indicates the validity of the Digital Twin model.

4 Shooting Strategy Analysis and Optimization by Shoot Data

Shooting strategy is one of the key techniques[3]. YuShan extracted there lated shoot data from the log files, mainly including the information of the shooting point coordinates, the shooting speed, the shooting process period, the shooting angle, the shooting error and the goal y-axis coordinate. Based on this, the exploratory analysis is carried out. YuShan2019 builds a portrait of the player and analyzes the player portrait in the Digital Twin framework. Including the following:

This point is the intrinsic connection of various factors of the shoot data. The data of the team's Binary goals in recent years are selected for analysis, as shown in Table 1. As can be seen from the Table 1, the shooting distance is the primary factor.

Table 1.Analysis of the connection factors of different factors in different teams' shooting. These teams include Cyrus[4], Cyrus2018[5], Gliders2016[6], Helios2017[7], Helios2018[8], MT2018[9] and HfutEngine2017[10].

	Cyrus	Cyrus2018	Gliders2016	Helios2017	Helios2018	MT2018	HfutEngine2017
Dist	<u>0.988</u>	<u>0.965</u>	<u>0.952</u>	<u>0.943</u>	<u>0.952</u>	<u>0.868</u>	<u>0.951</u>
Cycle	<u>0.986</u>	<u>0.956</u>	<u>0.946</u>	<u>0.888</u>	<u>0.824</u>	<u>0.916</u>	<u>0.864</u>
Point	0.491	0.745	0.829	0.337	0.541	0.515	0.673
InitialVel	0.622	0.829	0.802	0.693	0.648	0.643	0.547
Angle	0.004	0.175	0.865	0.817	0.600	0.446	0.800

YuShan2019 continues to analyze the distribution of the shooting distance of each team according to the region. YuShan2019 uses it as the guiding direction for the optimization of the moving model of the front line players. It shows that the effect is remarkable. According to the cluster center point and frequency, the portrait of the player's forward movement is established, which clearly represents the penetration point of the opposite attack and the loophole of our defense. Furthermore, it is the feedback that acts on the physical layer and directs the underlying Binary optimization.

5 The Determination of Offensive and Defensive State

The formation strategy is one of the important research directions. The Agent2D-base however judges the offensive or defensive state only from the interception cycle[11]. The tremendous differentiation between an offensive formation and a defensive one, also among players' standard points frustrates DoMove efficiency, which thus significantly pushes one to accurately judge the offensive and defensive states of a team. In terms of YuShan2019, first of all, portraits of players' offensive and defensive states are drawn[12]. Secondly, some characteristics of the information concerning the interception cycle, ball, offensive and defensive line position, players of both teams in a certain area are selected. Thirdly, relevant data are extracted from the game log files and labeled before pre-processing by discretization. Finally, the discrete Naive Bayes classifier is implemented by Python for predictive analysis. The experimental results take accuracy rate as the evaluation standard, and three groups of experiments have been conducted, whose results are shown in Fig.3.

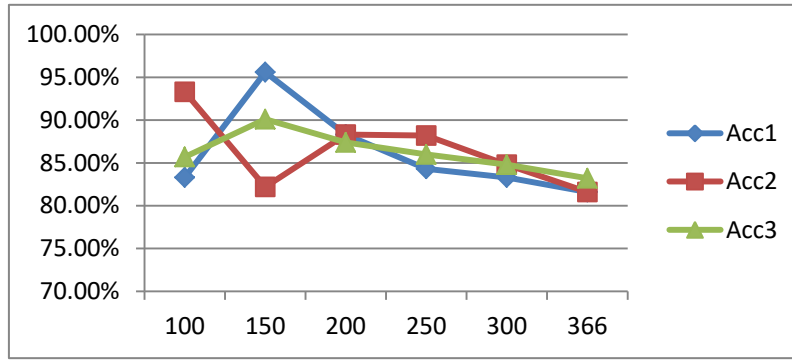


Fig.3.Line graph of each data test results

As seen from Fig.3, the predictive accuracy is about 85%. The actual experimental results reflect that after YuShan2019 optimizes the judgment of offensive and defensive states, the winning percentage has increased slightly.

6 Conclusion and Prospect

YuShan2019 proposes the digital twin module, and draws different portraits of different players, by which the underlying Binary's optimization is guided and enhanced. This paper analyzes and evaluates the portraits of players such as shooting formations in detail. YuShan will further introduce Big Data analysis technology to enrich the player portraits. Finally, we would like to thank especially Hidehisa

Akiyama and Oliver Obst for their selfless dedication to the 2D Alliance over the years. Particularly, we are grateful to Gliders Mikhail Prokopenko who supporting the open source that further promote the development of the RoboCup2D Simulation.

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