

PNU_S3D – Team Description

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Abstract : This paper describes the main ideas and strategies of pnu_s3d team . In this page we explain : our team formation , agent Localization methods , reinforcement learning of team strategies , and the base layers of our team .

1. Introduction

The Robocup Simulation League 3D Soccer Competition has been held for the first Time in Robocup2004 . which is an important milestone on the path to the ultimate goal of the Robocup .The Server of Soccer3D (rcssserver3d) is a Multi-Agent simulations system for Physical agent in three dimensional environment and resembles to the real world much better than 2D.This Server is based on SPADES(system for parallel Agent Discrete Event Simulation) which is a middleware system and has unique properties; it is an event-based system that can be distributed among several machines . Rcssserver3D consider real physical rules like friction and gravity.So calculation of some facts like prediction of position and velocity of ball and agent or interception are much more complex .[5]

Simulated environments are a commonly used method for researching artificial intelligence Methods in physical multi-agent system.Simulations are especially useful for two different Types of problems : (1) to experiment with different sensors,actuators or morphologies of Agents and (2) to study team behavior with a set of given agents. Additionally the connection Between both types of problems is an interesting research problem[1].

According to our experience in developing a team of intelligent agents , we have come to A customized methodology and approach to construct an extensible , reusable and robust Framework.

2. Localization

The localization of agents is based only on the vision perception about the flags that agents receives from the server in each cycle . The flags are not moving so the server noise is very Little for them and they are the best guidance for Localization . The agent has 360 degree view of the field and no direction,so location can be computed Using relative position of only one flag.However, because the agent percepts each falgs with Different amount of noise in

each cycle(server generates noise for each flag independently)We used all 8 flages informa tion to minimize the noise of localization . Using this method ,The method, the average error decreased to 2cm in x-axis and 3 cm in y-axis.

We implementing Particle filtering, one of the most improved methods on localization to decrease the amount of the localization error. It considers both current vision percept of agent and its previous states and actions. The method needs the worldmodel to predict the effect of actions.

3.PNU_S3D Agent Architecture

Our team architecture consist of communication layer, decision layer and then skill layer That is shown in the figure 1. we are going to explain the roles of our components in pnu Agent in the following paragraphs briefly.

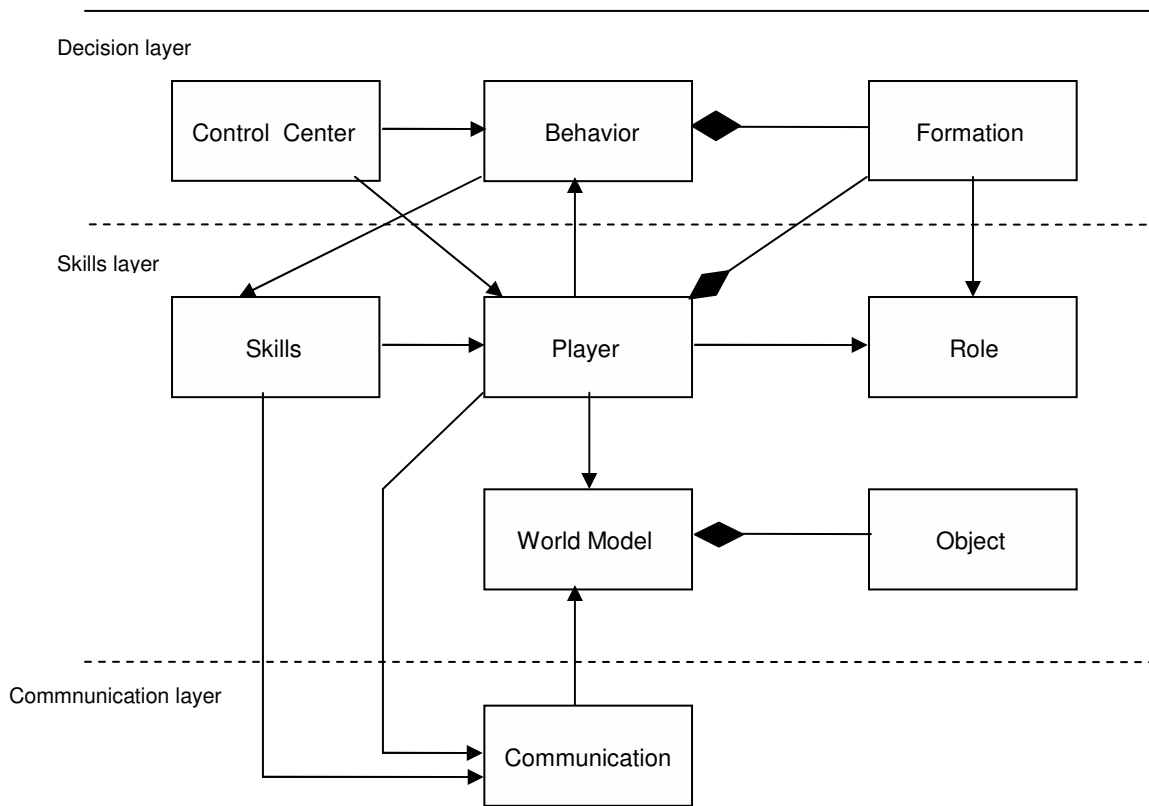


Figure 1:PNU Agent Architecture

Communication : The communication component is responsible for communicating with the 3d soccer server, i.e. Receiving message from the server (agent state, vision information about soccer field, football and other information send by server) and sending command to the server (init, beam, drive, kick and so on).

Object : In this class we have some information about all objects that produce and engaged in our system. these object are two kinds : dynamic and static. the static object includes information about static and fixed objects in the system such as flags, lines and goals. The dynamic objects contains some information about moving objects such as player and ball.

Worldmodel : One of the most important parts of our base is its world. It is designed so that each agent will be able to access precise information about all objects in the simulation, reliably and simply. In fact, the worldmodel provides the agent with all of information that it wants to need. The position of all players, ball and their velocities and accelerations are one of the most important information that saved in the world model.

Skill : The behavior of an agent depends on the individual skills this agent can perform. A skill can be regarded as the ability to execute a certain action. In general, these skills can be divided into simple skills that correspond to basic actions and more advanced skills that use the simple skills as parts of more complex behavior. The execution of each skill depends on the current state of the world model which is represented by the agent world model.

Formation : This component consists some information about our team formation method for determining a strategic position. For example this class includes an algorithm for automata changing the formation of the team in the different situations.

4. Reinforcement Learning of team Strategies

Some decisions are very complex and difficult and hard to program by hand. For example stop to the position to perform the goalshot, dribbling, passing and etc.

Machine Learning provides algorithms that find good solutions to these problems.

The idea behind our approach is to find a value function $M(s,a)$ that describes how desirable a pair of situation and action is. M is a mapping from a state s and an action a to a value in $[0,1]$.

A value close 1 indicates success, a value close to 0 failure.

The value function is estimated using $Q(Lambda)$ algorithm [1. chapter 7] with λ close to 1. The state s consists of the position of the agent, the ball and the opponents. The action a consists of five different relative positions, the decision whether to kick or not and the kick force.

As we restrict the value of Q to the range $[0,1]$, we can reinterpret it as the probability of success and use logistic regression [2] as function approximator. This is mathematically equivalent to a neural net without hidden layers.

5. Formation

For making a collaborative play, we find out some ways, and one of them is using some different formations, in which we had assigned different roles to each player and it would change in different situations. We have located four players as defenders and three as forwards and three middle players which will join whether defenders or forwards in different game situations. In addition to these players we have introduced a developed goalie which can change its position depending on the relative position of ball and opponent attackers.

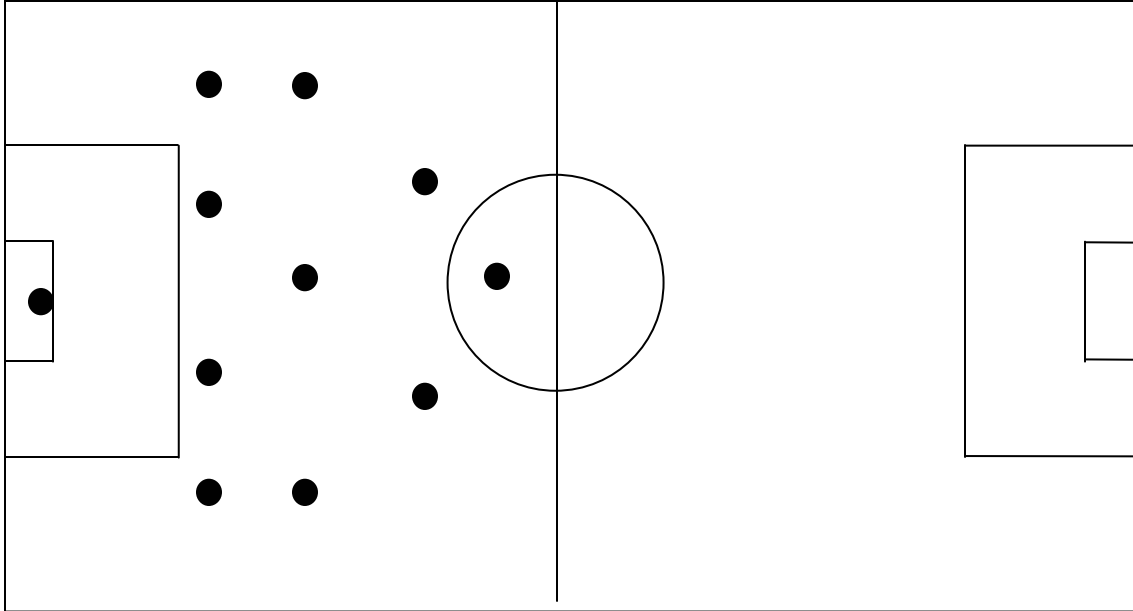


Figure2 : PNU Formation

6. High Level Skills

Pass : Straight passes between the agents, forces the receiving agent to turn around the ball for correct alignment. Since aligning takes considerable amount of time, we prefer lead passes Between the agents where the receiving agent can easily collide with the ball. Air Kicks are preferred when the selected teammate to pass is at a longer distance relative to the active agent.

Dribbling : When there is no teammate available to receive the ball, we use this skill to maintain ball possession. We use a 2-phase algorithm for finding the optimal dribble direction. In the first phase, we consider all the opponents within a certain area and enumerate all the possible directions in which our agent can dribble. In the second phase, we select the best direction by considering our teammates within a limited region. Dribble length is based on the two nearest opponents in the dribble direction.

Predicating : Some prediction methods like FastGoToBall, NearestToBall, NearestToOpponent, GetNrCycleToPoint, GetNrPlayersInRegion, PredictStateAfterCommand, LineOfBall. For predicate the line of ball, when the ball is moving, we draw an imaginative line along the line of ball moving. Then with ball's velocity and acceleration, the position of start and line formulations in the mathematics we predicate the position of ball destination. So drive the nearest agent to the position.[6]

Clear Ball : Align position skill takes considerable time to kick the ball in the desired direction. So, in our defense zone, we use air-kick in the direction of the widest angle between the opponents to move the ball away from our goal post.

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