

# SEU-RedSun 2010 Soccer Simulation Team Description

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**Abstract.** The purpose of SEU-RedSun is to develop a re-usable agent which can behave in a human-like way. This paper describes the main features of SEU-RedSun soccer 3D simulation team. SEU-RedSun improves itself to adapt the changes in RoboCup2010. This year our most work is making the location information more accurate, optimizing the basic skills such as walking and kicking, strengthen the cooperation between agents. At last, it describes the future work we will do.

## 1 Introduction

To get the ultimate goal of the RoboCup project, the RoboCup competition improved itself in different fields from the simulation platform to competition rules. And the influence of competition is increasing which is good for the research of robot.

As simspark is becoming more stable and real, it is easier for us to experiment on methods and algorithms for humanoid soccer behaviors. To close the reality, restricted vision preceptor is installed on NAO. On the other hand, to make developing more convenient, Accelerometer sensor which gives the information of linear acceleration was added, and sync mode was added.

There are two rules of the competition changed. One is that both length and width of playground expand to 1.5 size of original. The other is each team could send 6 agents instead of 3 agents. This means that the focus of the competition will turn to the aspect of strategy and cooperation from base skills. And this asks us to improve the autonomy and interactive of the agents. With the stability platform and base skills, the research of artificial intelligence will become the focus in the 3d simulation league.

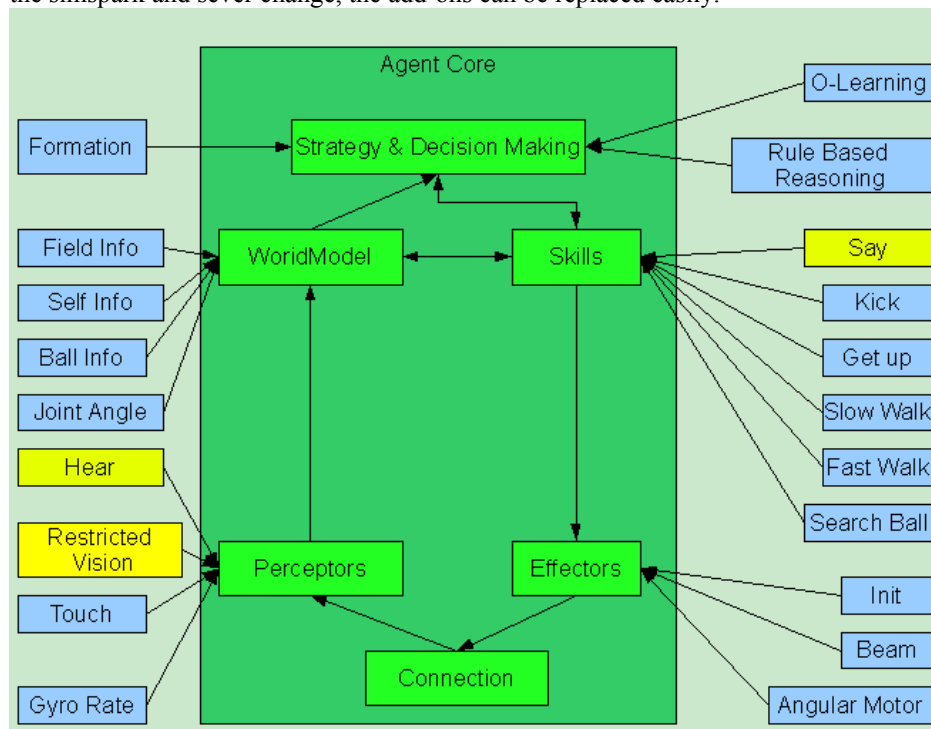
SEU-RedSun has been established in 2005, and successfully attended several competitions. After changing into the humanoid simulation, most of the team's work has been spent on developing a powerful and developmental base code, primary skills, development tool and adapt strategy[1]. Our team got the champion in both RoboCup Iran Open 2009 and RoboCup 2009 Graz.

This paper describes the main features and implementation of SEU-RedSun. Section 2 describes our agent architecture. Section 3 discusses the humanoid behavior generation in dynamic and adversarial environment. Section 4 shows our future work.

## 2 Agent Architecture

Considering of that the simspark is still under development, and many new features will be added in the future, we try to make our team enough flexible to adapt new changes. So we use the plug-in architecture based on on-strict layered agent architecture with singleton modules [2]. With plug-in architecture, we could just change some modules to adapt the changing of sever (Fig. 1).

The modules in the green box are core modules, which are implemented as singleton. The blue and yellow modules around the green box are add-ons. The yellow ones will be described in this paper. The core modules are relatively stable. If the simspark and sever change, the add-ons can be replaced easily.



**Fig. 1.** Plug-in architecture

## 3 Humanoid Behavior Generation

Humanoid behavior generation is a key problem in humanoid robot research. A competitive team needs both personal ability and teamwork. An Agent's Personal ability mainly refers to robust basic skills including biped walking, running, kicking, getting-up, etc. The teamwork needs good cooperative strategy and communication. And the basic skills which we want to design are that agent should behave in a human-like way and that it could transplant to real robot easily.

Agent makes decision base on its WorldModel. So the agent must get accurate information about the playground, the ball, itself and teammates. As the restrict vision, we use Noise Filtration and Zoning to make localization work.

At strategy part, we use Rational Passing Decision based on Region (RPDR ) method which was used by our 3D sphere agent simulation. And we improve the communication model to support the strategy.

### **3.1 Localization with Restricted Vision**

#### **3.1.1 Noise Filtration**

For the expanding of playground, the noise's influence increases. We use Kalman filter to solve this problem.

The Kalman filter is an efficient recursive filter that estimates the internal state of a linear dynamic system from a series of noisy measurements. [3]This means that only the estimated state from the previous time step and the current measurement are needed to compute the estimate for the current state. [3]

We impalement the Kalman filter to filter out the noise of the ball information, but it is impossible to figure out an accurate motion model of agent. Unlike the simulation of spherical agent, the driving force acted on agent is not controllable. Thus, Kalman filter is not useful for filtering the noise in self-localization, not to mention the noise in other agent's position.

#### **3.1.2 Localization**

According to our team's locating algorithm, vision perception of three flags is required for self-localization. Theoretically, only flags are enough, but agent needs to solve a quadratic equation in twelve unknowns [4]. As vision restrict, agent may not see enough flags to locate. They need to rotate their head to find enough flags. But rotating head costs much time. Therefore, we divide the playground in different regions. And in different region, the agent turns its head to right or left direction. So it can search the flags and the ball more quickly and do other motions smoothly.

#### **3.1.3 Keeping Object in View**

When a tank is running fast on a bumpy ground, Fire Control System can keep it aiming at target. A similar controller is implemented to keep some object in view when robot is moving, such as football and goal.

#### **3.1.4 Accelerometer**

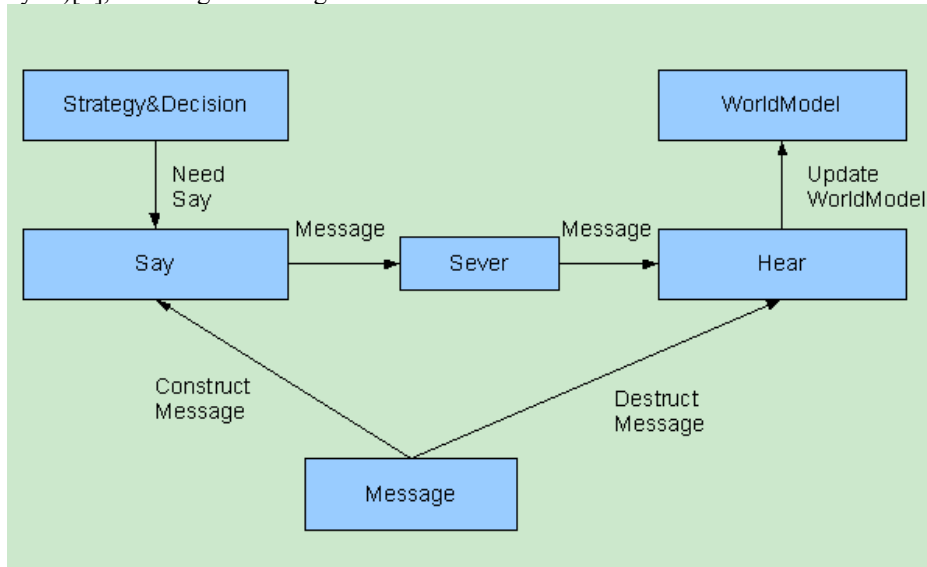
When an agent is standing on the ground or walking stably, we'll get relatively steady data from the accelerometer. If the accelerometer shows a strange value compared to the expected value which represents standing or walking, it's reasonable for us to believe that this agent is not in balanced state.

### **3.2 Communication**

As the competition change to 6V6, the communication between agents becomes more

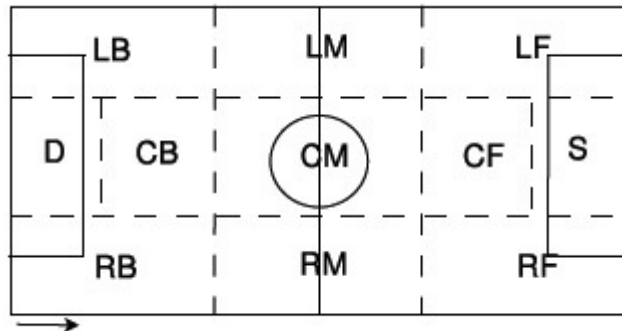
important.

Say and Hear model were used send and receive message. Fig.2 shows our communication model. As messages are restricted to a maximal length (currently 20 bytes)[5], we design a message class to deal different sentence.



**Fig.2.** Communication Model

### 3.3 Rational Passing Decision based on Region



**Fig.3** Tactical Region of football field[4]

According paper [4], we divide playground as 11 region(Fig. 3). Three edges are left(L),center(C),right(R). Three rows are front(F),middle(M),back(B);and special region:Shoot(S) and Dangerous(D).

The calculate process as follow:

(1)calculate different kinds of region;

- (2) calculate the intersection of the regions
- (3) select the target region.

Passing ball to a region instead of a point could decrease the calculation and increase the success.

### **3.4 World Model(WM) of Agent**

Vision information obtained is polar coordinates. WM analyzes vision information and calculates something to create a Cartesian coordinate system which is static to the court. WM describe information about agents and their environment in this global coordinate system, such as agent's position and goal's position. In strategy level, it's so easy to make decision depend on global coordinates provided by WM. Because global coordinate is complete information for thinking (sometimes global coordinates need to be transformed into local coordinates).

In the past, vision information sent by server is maximized, that means agent could see all things in the environment. So, it's easy to create a global coordinate system and data in this coordinate system is relatively accurate in WM.

Currently, vision sense is restricted by server and larger court leads to bigger error in vision information. Agent cannot see both the ball and the flags simultaneously for most of the time. If he sees only a ball, he would not able to create the global coordinate system. Else if he sees only flags, there would be no information of the ball.

The old method is not suitable for current server environment. Vision information is originally local coordinates, what is simply needed in some action. Transform data from local and transform back not only waste time, but also carry error in calculation. So, in our future code, WM will include two parts. One is global while the other is local. Then the strategy level and action level will be able to take data whatever they want. The program will be more efficient and more accurate.

## **4 Future Work**

The results achieved by SEU-RedSun team are very hopeful. But there is much work to do in the future. Both basic skills and decision making will be the primary work of SEU-RedSun. On the one hand we should improve the stability of walking, decrease the time of adapting kicking, on the other hand, we should design a good formation and strategy.

As the line information sensor will be added, we will try to use the line information to make our localization better.

If the occlusion in the vision perceptor is implemented, we will do something to predict the positions of the ball and players.

Considering that the agent often fall after shooting, we should improve the accurate of vision and optimize the kicking.

As the number of teammates increased, we will adapt the position of agents and use the communication between agents to keep the balance of offensive and defensive.

At the same time, we are keeping on developing the development tool and improving the server in the future.

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