Strive3D Team Description 2008

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Abstract: This paper simply describes the history, background and its solutions of achieved and implemented in RoboCup 3D Soccer Simulation League. Beginning with the introduction of the Strive3D team, the paper firstly describes its history and background. Secondly, it briefly introduces its main technical features including agent architecture and basic individual skills. Conclusion and vision are illustrated in the 3rd part.

I. Brief Introduction of The Team

The RoboCup soccer simulation 3D league has taken a big step forward to the RoboCup's ultimate long-term goal Since the 2007. The simspark with humanoid robots was used in RoboCup-2007. The simspark is an experimentally platform for researchers of humanoid robots behavior. Comparing with real humanoid robots, humanoid simulation environment has advantage in costs and convenience, so we can experiment on methods and algorithms for humanoid soccer behaviors in order to optimize them and apply results in real humanoid robots finally.

Founded in 2005, Strive3D team started to explore in the frontier of 3D simulation with the ultimate aim to apply its solution to real humanoid robots. After the reorganization of Strive3D team in 2006, it participated in the 1st RoboCup China Open and did not get great achievement in 3D Simulation League. In order to catch up the change from Sphere Agent Model to Humanoid Agent Model happened in 2007, the focus of the team immediately shifted to the research on biped humanoid

agent locomotion. Grasping a rough command of controlling the humanoid agent, it attended Iran Open 2007 in which biped humanoid agents premiered in the RoboCup competition. In Latin America Open 2007, it got the 3rd places.

II. Technological Features

1. Agent Architecture

More modules have been added The Strive3D's agent architecture. It makes the agent architecture more flexible. *Basic_skill* layer is necessary for the humanoid agent. For flexible group the action, *middle_disposal* layer is added between the *Basic_skill* layer and the *Strategy* layer. When more agents cooperate in the match, *Strategy* layer will deal with the relationship between them. Here is the simple map of Strive team's architecture.

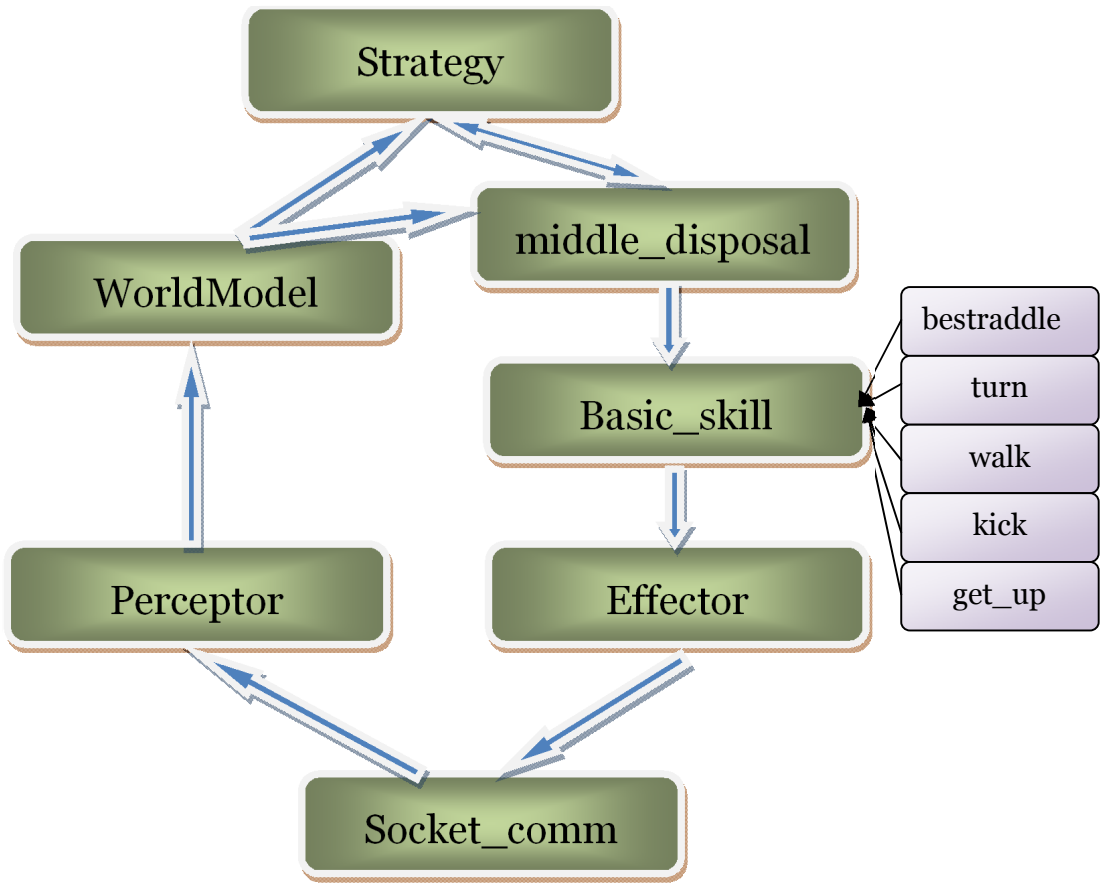

Fig. 1. Strive3D agent architecture

2. Basic Individual Skills

The humanoid model is used in 3D simulation. It was derived from the Fujitsu HOAP-2 robot model[1] So, the basic individual skills will be essential to the further development of the 3D simulation. For instance, biped locomotion is considered to be a very complex task, as it implies controlling a very large number of *degrees of freedom* (DOFs), the non-linear dynamics of the humanoid body and a wide range of interactions with the environment (gravity, force, collision, perturbations, etc.). The main difficulty is to achieve dynamical stability, and particularly resistance to unexpected perturbations.

Fig. 2. humanoid agent

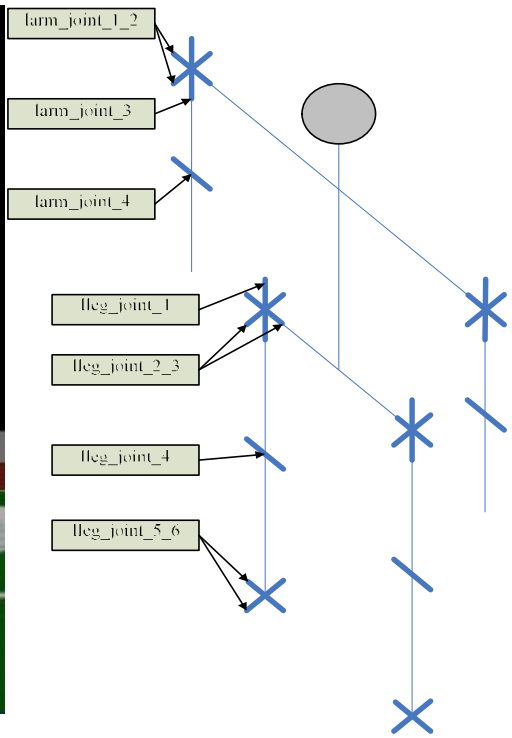

Fig. 3. humanoid agent's joints

In Stive3D agent, several kinds of actions have been created such as walking, rotating, bestraddling, countermarch or the action consisting of any two of them. In the actions, a simple balancing movement is necessary, which will periodically transfer the center of mass (COM) from one side to the other, without lifting the leg. This models the inverted pendulum dynamics of the robot's body in the frontal plane. Then the complete stepping movement will be implemented. The robot has to push the floor with its stance leg, while bending the swing leg. This will allow the further forward movement without the feet rubbing the ground. To obtain this, harmonious controlling the hip, knee and ankle joints in the sagittal plane is the best choice.

The trajectory of the leg's joints is periodic, when agent is walking, turning, etc.

It is similar to sinusoid, bases on the balance posture. For achieving the comportable parameter, we calculate the ZMP[2][3] based on the information from the *force preceptor*. Depending on the ZMP, we can judge agent whether it will tumble.

From the *force preceptor,* we can get the force and coordinate:

$$\begin{cases} F_L = [f_{Lx}, f_{Ly}, f_{Lz}]^T \\ F_R = [f_{Rx}, f_{Ry}, f_{Rz}]^T \\ P_L = [p_{Lx}, p_{Ly}, p_{Lz}]^T \\ P_R = [p_{Rx}, p_{Ry}, p_{Rz}]^T \end{cases}$$

Then, the coordinate of ZMP can be calculated:

$$p_x = \frac{p_{Rx} f_{Rz} + p_{Lx} f_{Lz}}{f_{Rz} + f_{Lz}}$$

$$p_y = \frac{p_{Ry} f_{Rz} + p_{Ly} f_{Lz}}{f_{Rz} + f_{Lz}}$$

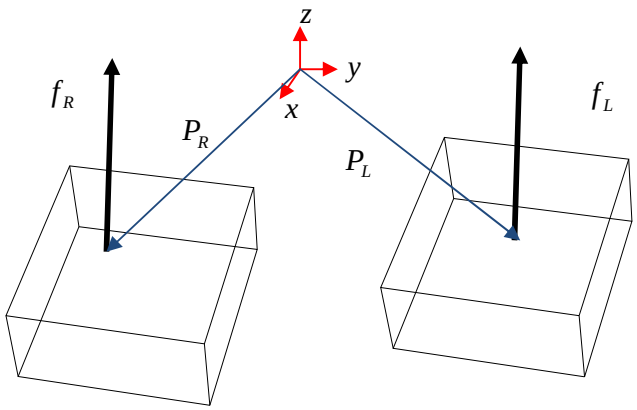

Fig. 4. Calculate the ZMP on biped

In Strive3D agent, all joints has its own coordinate, the respect to two coordinates also is described in the code. Then the kinematics and dynamics about the agent can be analyzed. Depending on these, we can complete the actions further.

III. Conclusion and Vision

With the development and enhancement of the 3D Simulation worldwide, it will strive for making a great forward to more sophisticated i ndividual skills and strategy. For instance, the research on faster and steady walk, smooth transition between actions, etc. Meanwhile, a development tool will be anther focus of its planning.

References

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