Research Proposal
TsinghuAeolus3D Team 2007

Qin Xiao, Xide Lin, Rujia Liu, and Zengqi Sun

Department of Computer Science and Technology
Tsinghua University, Beijing 10084, China
ginx.thu@gmail.com

Abstract. This paper descripes the research work of TsinghuAeolus3D team in 2007. We first introduce the new humanoid simulation enviroment in 3D League and present our main research goal, then the key tasks and related methods are discussed, which are our major interests this year.

1 Introduction

The TsinghuAeolus3D team has been participating in RoboCup 3D Simulation League since 2004. In 2007, 3D simulation competition will feature a new simulator and also humanoid players instead of old sphere ones. So that, 3D Simulation League and Humanoid League will have some cross research area now.

The main research goal of TsinghuaAeolus3D team this year is to develop an efficient and effective soccer team in humanoid simulation and to participate in the Technical Challenges and 5-vs-5 Soccer Matches. To achieve this goal, we will employ different methods to solve different problems, including fundamental work, low-level skills and high-level strategies.

Since it's the first year that humanoid players are introduced into 3D simulation competition, we will focus on those specific problems related to humanoid soccer behaviors. Besides, we will introduce some known methods and algorithms achieved by teams in Humanoid League into our work and have them optimized for humanoid simulation environment. At the same time, comparing with real humanoid robots, humanoid simulation environment has advantage in costs and conveniency, so that we will also experiment on methods and algorithms for humanoid soccer behaviors in orde to optimize them and apply results in real humanoid robots.

The rest of the paper is organized as follow: section 2 is an introduction to some key tasks we are currently concentrating on: pose recognition and humanoid soccer behavior. They are two of our major research interests now and their solutions will definitely push us towards our main research goal. Section 3 is gives a summary of our current research and a brief discussion about future work.

2 Key Tasks in Humanoid Simulation

World model and individual skills are most important parts of the fundamental work in a soccer team's development, and are also most difficult two. Because of the magnificent changes in simulation system, these two parts are not as same as those in previous 3D simulation competitions. So that, we considerate these two parts as the key tasks in our research and are highly interested in how to solve all related problems.

2.1 Pose Recognition

We build and maintain world model of the game in order to provide a highly dependable simulation of the real soccer world, serving as the foundation layer for any higher skill or strategy layers. Agents use information of world model to evaluate the situation and make appropriate decisions. In traditional simulation games, most useful parts are ball's and agents' positions and velocities.

Humanoid agents are no longer same-looking spheres: at different time, different humanoid agents have different pose information, including each joint's angel and angular velocity, centroid position, contact surface with ground, face direction and so on, some of which are even more valuable than position or velocity. In real soccer environment, one's pose often indicates what he is doing or is going to do, while human can read poses easily. However, it is hard for program to understand and evaluate them. So that, we want an accurate and robust pose recognition system established during our researching on building and maintaining world model.

Different methods, esspecially those are effecient in pattern recognition and classification will be employed when building the pose recognition system in humanoid simulation, including machine learning, neuron network and so on[1]. At last we will select the best-performing one integrated in the world model module to serve other higher level modules such as the decision maker module.

2.2 Implementation of Agents' Soccer Behavior

In previous 3D simulation competitions, sphere agents can finish complex soccer behavior by only two basic effector: drive and kick, based on a complicated system implements agents' individual skills. Now, with humanoid agents, the design of this system becomes an extremely difficult task. Without these basic or advanced soccer behaviors being implemented, humanoid players will actually do nothing, even when they are able to evaluate situation and make decision correctly.

Single Behaviors: Walking, Jumping, Getting Up and So on. These basic behaviors are only done by one humanoid agent alone, composite of a group of serial movements of almost all joints among agent's body. To some extent, they are easiest soccer behaviors of a humanoid agent. Although previous individual

skill can help little when implement new behaviors of humanoid agents, luckily we can obtain a great quantity of material and experience from other leagues or even other domains related to humanoid robots. For example, bipedal walking is a well-researched topic in every domain related to humanoid robots(e.g see in [2] and [3]). There are already many optimized models and algorithms for it, especially in Humanoid League, in which real humanoid robots compete in soccer games. We will use them as reference, as well as optimize them in 3D humanoid simulation environment. Details omitted here.

With Ball Behaviors: Kicking, Dribbling, Catching(Goalkeeper) and So on. These more complicated behaviors are done by one humanoid agent and a ball, including some basic behaviors like kicking, and some combinational behaviors like dribbling(walking/running and kicking). Comparing to single behaviors, these behaviors are more complex and require more information about the soccer simulation environment. Development of with-ball behaviors will be base on the development of single behaviors.

Collaborative and Adversarial Behaviors. These advanced soccer behaviors are much more complicated behaviors involving two or more humanoid agents belonging to same or different teams. It requires sufficient information about the soccer simulation world even including pose recognition mentioned above. [4] is a good starting point, [5] and [6] are also good references. As we concerned, some of these collaborative and adversarial behaviors are no longer fundamental skill but associated with the high-level decision maker system, while we still have to focus on humanoid features when developing them.

3 Summary

Since the humanoid simulation server was released in February, TsinghuAeolus3D team has been studying and researching on it for some weeks. We have finished some low-level modules such as communication, information parsing, and a simple world model including localization. We are also familiar with the specific "soccerbot" humanoid agent, and designed some basic soccer behavior for it. As mentioned above, pose recognition and implementation of basic and advanced soccer behavior will be our main tasks during the research, because they are the major differences between old 3D simulation and humanoid simulation.

At the same time, since 3D Simulation League and Humanoid League have more and more common elements in research area, we are also promoting cooperation with teams in Humanoid League. This kind of cooperation will definitely benefits all teams in both leagues and also the future of RoboCup.

References

1. S M Weiss, I Kapouleas.: An empirical comparison of pattern recognition, neural nets, and machine learning classification methods. Morgan Kaufmann:Detroit (1989) 781–787.
2. Pratt J, Pratt G.: Intuitive control of a planar bipedal walking robot. Robotics and Automation, (1998).
3. Pratt J, Dilworth P, Prat G, Michalek R, Tarantello G.: Virtual model control of a bipedal walking robot. Robotics and Automation, (1997).
4. Peter Stone, Manuela Velosso.: Towards collaborative and adversarial learning: a case study in robotic soccer. Int. J. Human-Computer Studies, 48, (1998), 83-104.
5. Barry Brian Werger.: Cooperation without deliberation: A minimal behavior-based approach to multi-robot teams. Artificial Intelligence, 110, (1999), 293-320.
6. Milind Tambe, Jafar Adibi, Yaser Al-Onaizan, Ali Erdem, Gal A.Kaminka, Stacy C.Marsella, Ion Muslea. Building agent teams using an explicit teamwork model and learning. Artificial Intelligence, 110, (1999), 215-239.