Research Proposal of Fantasia

Guangbin Cui, Pu Li, Liang Gao and Jinghui Jia

Institute of University Students' Innovation, Dalian University of Technology, China
{guangbincui, brton.rei, glee0413, jiajster}@gmail.com

Abstract. This paper simply describes the research proposal of the Fantasia team participating in RoboCup 3D Soccer Simulation League. Our main research focus lies on the cooperation of the multiagent system. Currently, our robot just could walk forward by experiential parameters. To improve this, we intend to use ZMP as estimate criteria for stability of the robot walking. Besides, other low level skills such as kicking, standing up should also be developed. After the development of the low level skills, we will begin to concentrate offence planning, defense planning and the conflict coordination.

1 Introduction

A multiagent system (MAS) [1, 2] is a distributed environment that consists of a number of agents, which interact with one another. An agent within the MAS is an autonomous entity that can receive information from the environment, and perform certain actions effecting the environment. In multiagent systems, the most complex and common type of environment is unobservable, uncertain, dynamic and continuous. A case in point is the open environment of the RoboCup Soccer Simulation domain, which has been widely used as a test bed for the studying of theories and technologies of multiagent systems and the collaboration behavior within groups of agents.

Fantasia as a research project that focuses on intelligent and autonomous agent and multiagent system problems was established in 2005. And the team has been devoted to the research and development of intelligent algorithms and mathematic models that deal with realistic issues [3]. Fantaisa2006 includes an approximate dynamics model, a BDI logic based 4-layer agent architecture, coordination mechanism and real-time contract net based offense planning [4]. We will develop new low level skills, and research on the high level skills based Fantasia2006.

The paper is organized as follows: The next section gives an overview of the development of individual soccer skills for the new simulator. The subsequent section presents cooperative multiagent planning, including offence planning, defense planning and the conflict coordination. Then the paper ends with a summary.

2 Individual Soccer Skills

As this year's competition will feature a new simulator and also a humanoid simulation, the development of the new low level skills is the principal task. The base of researching on low level skills is to study the gait continuity and stability of the robot, which needs knowledge of dynamics and bionics. Some scientists and researchers have found zero moment point (ZMP) [5~7] is an important criterion for stability of the biped locomotion, so we can use ZMP on this new simulator.

Since the new simulator is more perfect than reality, it is possible to try some methods to make the robot run, turn over, kick ball, catch ball and so on. There are large numbers of motions which robot can act, because control of joints is used in the new server. It would be effective to build a motion library, which contains a sequence of key frames of a motion. Nonlinear interpolation can be used to produce each frame between the key frames, in order to smooth the motion.

When a robot use a low level skill, the inputs of robot control system is the initial state and target state of the robot. The system creates serial motions, which can be found in the motion library. To make robot’s action steady, PID controller should be used in operating the active joints, and also driven joints.

3 Cooperative Multiagent Planning

In RoboCup Soccer Simulation, both sides have a number of players. It is difficult to win the game with only one agent, especially when their low level skills are close. All players of the same team have one global goal that is to win the game. Agent needs to collaborate to reach a joint dominant strategy to accomplish a common goal. The observation information is restrained, delayed and not accuracy, so it is difficult to design an algorithm to achieve a strategy balance among all players.

Players share the global goal of winning. Depending on the judgment of the situation, we can carry out two tasks to reach the global goal: one is scoring corresponding to joint offense planning. And the other one is stop scoring corresponding to joint defense planning. At the beginning of implementing the plan of offense and defense, all agents should make the same judgment of the situation which is the key issue. In the match, it is serious that cognitive differences lead to inconsistent consequences. For example, in defense, an agent mistakes defensive state for offensive state by visual errors, and takes some uncoordinated acts at a certain cycle, which is easily taken advantages of by opponents. So there is a need to establish a mechanism to coordinate the conflict among members. The routine which reduces the cognitive difference by group behavior, is based upon common knowledge among agents. The common knowledge, including some agents know other agents what act to take in some situation, could be implemented by the rule library. In the case of an agent transpire that the act taken by another is not the same dominant strategy, he could conclude that maybe there is difference judgment about the current situation between him and the other. But it is not concluded that whose act is wrong for the vision noise.

Generally, in the process of assigning task we should avoid conflict. For example, the conflict can be avoided by formation and role in the positioning task, and by broadcasting message in the process of interception. However, not every conflict can be avoided. Special conflict resolution mechanism should be imported; otherwise it is impossible to achieve a balance. Fantasia2006 includes a mechanism for discovering and reconciling conflictions. This method is a transformation from Harold Kuhn's Hungarian Method [8, 9] and probabilities of intensions matrix. And we will try to use this in the new simulator.

The judgment of offense state is based upon the team of the player who can first intercept the ball. In numbers of literatures, the planning of offense starts from getting the ball possession, which ignores distributing other players' tasks in the following step [10]. It is because that the situation of the game is always changing, in which is hard to make a decision during the ball interception, such as whether dribble or pass, and the target of them. So commonly, other robots are assigned to run formations of the team or some positions of the given model. In offense planning, there are two major tasks to resolve. One is analysis of the task, and the other task is issuance of the subproblem [4]. Task decomposition should use the interception time as soon as possible and consider the future task at the same time, namely consider subsequent task and sequent task. Passing is the most important action in the procedure of offense cooperation. If the passing target player and his approximate position could be known by the interception player, and other players are running for his passing at the same time, a task chain, from our each offence to shooting in front of the opponent’s goal, could be constructed.

The aim of defense is to prevent opponents gaining score and to disturb the opponent’s offense as much as possible. The general defense strategy contains zone defense, role defense and marking defense. We mainly use marking defense. There are two steps in the procedure of marking defense: distribution of task and the man-to-man marking defense [4]. Moreover, the most important problems in the marking defense are distributing task felicitously and opponent modeling.

4 Summary

In this paper, we have introduced our research proposal and the near future work. Because of the new simulator, we must develop new low level skills such as walking, kicking and getting up. Then we will focus on the high level skills such as conflict coordination, offense planning and defense planning. This method which is a transformation from Harold Kuhn's Hungarian Method and probabilities of intensions matrix, will be used to mediate conflictions. A collaboration method for passing has been stated for offense planning. Distributing task and opponent modeling is the most important problems in the making defense.

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