

RoboCup-99 Simulation League: Team KU-Sakura2

Harukazu Igarashi, Shougo Kosue, Takashi Sakurai
Kinki University, Higashi-Hiroshima, Hiroshima, 739-2116, Japan

Abstract. In this paper we describe our team, KU-Sakura2, which is to participate in the simulation league of RoboCup-99 Stockholm. KU-Sakura2 is characterized by soccer agents that make tactical plays and passes using communication between players.

1 Introduction

Robot soccer is one of the relevant candidates for the standard challenging problems in Artificial Intelligence. Our two teams, Team Miya and Team Niken, participated to the simulation league of RoboCup97 Nagoya (Japan, August 1997) [1]. Moreover, we sent Team Miya2 to the simulation league of RoboCup98 Paris (France, July 1998) [2]. Team KU-Sakura2 is an improved version of Miya[3] and Miya2[4]. In this short paper, we give a brief technical description of our Team KU-Sakura2.

Team Miya was characterized by individual tactical play[3]. Individual tactical play do not require communication between players, so the speed of passing was rapidly increased in RoboCup 97 games, and the team sometimes behaved as if it had been taught some tactical play. Team Miya proceeded to the quarterfinal match and was one of the best eight teams in the simulator league.

In Team Miya2, a kind of communication between players is realized by using a "say" command so that a passer can make a pass to a receiver without looking around for receivers[4]. Consequently, Team Miya2 was one of the best sixteen teams in RoboCup98.

However, more tactical play is required for the following two reasons. First, top teams of RoboCup98 showed very high-level skill in individual play. For examples, we observed a speedy dribble keeping the ball near the player's body and a safety pass without being intercepted by the opponent players. Second, the offside rule was introduced at RoboCup98. Thus forward players have to check whether they are in an offside position or not at all times. Some tactics is necessary to avoid the opponent's offside trap and succeed an offside trap against the opponent team. We use communication between players for realizing the tactics in Team KU-Sakura2.

2 Hierarchy of Actions

In Team KU-Sakura2, there is a hierarchy of actions. Actions are generally classified into four levels: strategy, tactics, individual play and basic commands(Table 1). A higher-level action includes more players and requires information in a wider range of time and space than a lower-level action. Coradeschi et al.[5] and Tambe[6] expressed the relationship between actions as a decision tree. We call such a decision tree an *action tree*. A soccer agent selects an action from the action tree at each action cycle

by analyzing visual and auditory information and by considering the agent's current state. The action is then *compiled* into a series of basic commands: kick, turn, dash, catch and say.

As shown in Table1, "individual tactical play" is introduced to reduce the delay time between decisions and actions. The *individual tactical play* is defined as an action that an individual plays in a specific local situation without communication from a teammate. However, an agent expects some cooperation from a teammate in individual tactical play. For Team KU-Sakura2, we implemented three actions as individual tactical play: the safety pass, the centering pass and the post play. These three plays speed up the tactical actions of the safety pass between two players, the centering pass from a wing player, and the post play of a forward player.

Table 1. Hierarchy of actions

	Action	Definition	Examples
Level 4	Strategy	Cooperative team action	Rapid attack, Zone defense
Level 3	Tactics	Cooperative action by a few players for a specific local situation	Pass with communication
Level 2	Individual tactical play	Action of an individual player for a specific local situation without communication, but expecting cooperation from a teammate	Safety pass, Post play, Centering pass
	Individual play	Individual player skill	Pass, Shoot, Dribble, Clear
Level 1	Basic command	Basic commands directly controlling soccer agents	Kick, Turn, Dash, Catch, Say

3 Action Tree

According to the role given to the agent, each agent has its own action tree based on the hierarchy shown in Table 1. An agent's next action is specified by prioritized rules organized into its own action tree. An example of an action tree, which is used in Miya2, is shown in Fig. 1. Here, if the node offense is selected, the firing conditions of action nodes at levels 2 and 3 are checked. The knowledge of selecting actions at levels 2 and 3 are expressed as if-then rules in a C program. Examples of the firing conditions include whether there are opponent players nearby, whether the player can kick the ball, whether the ball is moving, whether the player can estimate his position correctly, and whether the player can see the ball. In addition to the if-then rules, some actions at levels 2 and 3 are prioritized.

4 Safety Pass and Safety Kick

The actions of level 2 are not unrelated to one another. The actions, shoot, centering pass, post play, dribble and clear, consist of two basic skills[4]: the safety pass and the safety kick. The *safety pass* is a skillful pass to a receiver so that it is not easily

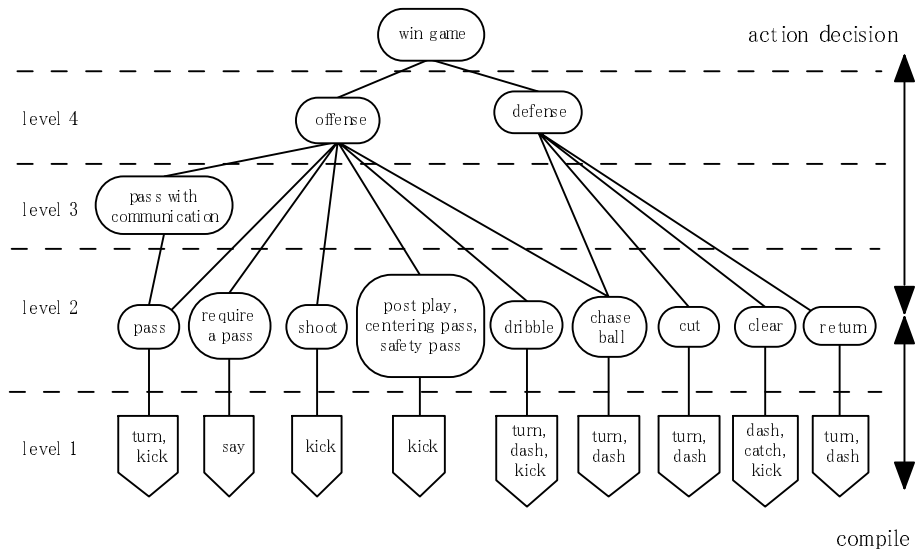


Fig. 1. Action tree used in Team Miya2

intercepted by the opponents. The *safety kick* is a skillful kick, which eludes interception by the opponents, in the direction of the objective. We call these two kinds of play *individual tactical play*.

5 Team Play Using Communication between Players

5.1 Team play in defence

The goalkeeper is a commander who orders defence players to go forward or backward. In Fig.2, the goal keeper is denoted by G and defence players are denoted by D. The optimal position of the defence line is determined by the goalkeeper taking

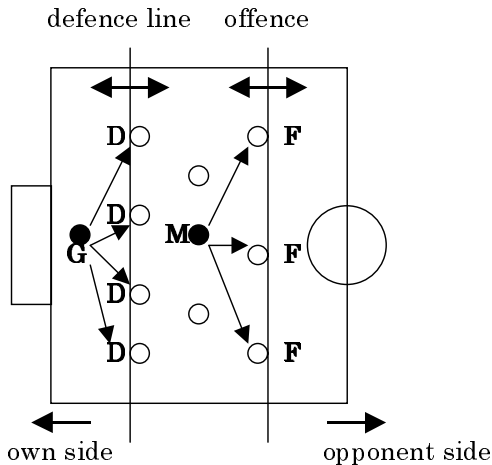


Fig.2. Movement of the defence line and the offence line.

positions of the opponent forward players into account.

5.2 Team play in offence

A midfielder in the center of a team, denoted by M in Fig.2, is a commander who orders forward players to go forward or backward. The optimal position of the offence line is determined by the midfield player taking positions of the opponent defence players into account.

5.3 Experiment

We ran 30 simulation games between Team KU-Sakura2 and Team Miya2. No team play mentioned in 5.1 or 5.2 is implemented on Miya2. The time length of each game is 3000 simulation-cycle steps. The results of the games are shown in Table 2.

In Table 2, one finds that the frequency of offside in Miya2, 6.77 per game, was reduced to 1.43 in KU-Sakura2. Moreover, this reduction of offside contributed to increase of scoring from 0.40 to 0.67 per game, and winning from 5 to 10 wins. The results prove that our team play is effective in actual simulation games.

Table 2. Experimental results of 30 games between KU-Sakura2 and Miya2

	Offside		Score		Win	Loss	Draw
	total	avr.	total	avr.			
KU-Sakura2	43	1.43	20	0.67	10	5	15
Miya2	203	6.77	12	0.40	5	10	15

6 Summary

Team KU-Sakura2 has a hierarchy of actions. According to the role given to the agent, each agent has its own action tree based on the hierarchy. KU-Sakura2 is characterized by individual tactical plays at level 2 and tactical plays using communication between players at level 3 of the hierarchy of actions.

References

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