

Zeng99 in RoboCup-99

Zeng99

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Abstract. *This paper discusses the design of the team Zeng99. The goal of robocup soccer simulation team Zeng99 is to show a performance of Hierarchical Fuzzy Intelligent Control system in the field of multi agent problems.*

1 Introduction

The goal of robocup simulation team Zeng99 is to show a performance of Hierarchical Fuzzy Intelligent Control system (HiFIC) in the field of multi agent problems, such as soccer simulation. The HiFIC is a scheme of controller for ill-defined/described objects. These days, there are many studies on intelligent control systems to perform high level control such as human operators do. Human knowledge based controller model is an approach to realize an intelligent control system. In this paper, HiFIC is adopted to intelligent control of soccer agent behavior planning and cooperative control. The HiFIC controller is a derivative of three layered control model by Jens Rasmussen. HiFIC also consist of three levels: lower layer to regulate primitive reaction control, middle layer to perform skill level behavior and highest layer to make decision on strategic and tactical playing plan. A main ability of this system is easy construction of hybrid controller which combines feedback loop regulator facility and feed-forward control facility. A lower module does reference tracking control with feedback loop, higher layer keeps good response with feed-forward control based on human beings knowledge. Realizing the HiFIC system, there is an information transfer problem between different layers, which have different information on different abstraction level each other. Fuzzy expression and fuzzy logic could handle those information transfer. Especially, middle layer makes macroscopic commands which couldn't be reduced directly into soccer server level commands. Soccer agents kinetic has non-holonomic restrictions, thus even simple behavior should be described in several server commands which are pre-planned. Hierarchical structure and fuzzy logic have to solve these inter-layer conflicts. This paper shows a way to construct HiFIC for a soccer agent. In sec. an

outline of HiFIC system is shown. Section explains middle and lower layer configuration those are main part of HiFIC system.

2 Hierarchical Fuzzy Intelligent Control System

¹[Fig.1]

shows a configuration of the system. That system is designed for unstable and/or nonlinear systems. Soccer agents have non-holonomic restriction. Thus the control needs complicated sequence of (**turn**) and (**dash**) command. In another hand, human beings could control such an ill-system and could learn how to control it. HiFIC is based on this type of human beings' control strategy, those main point is a macroscopic recognition. Every part of layer accept same sensory inputs. It reconstructs them on demand of decision making. Each layer accepts a macroscopic tactical commands from upper layer. An input from upper layer is in a form of macro command, and that can't be executed immediately at layer receiveing it. That macro command has some fuzziness of that meanings, consequently interpretation process is needed to execute it. These interpretation chain among layers are remarkable characteristics. To realize a cooperative behavior within the highest layer, three technical problem should be there; macroscopic recognition of game situation, simulation based prediction of game and decision making in fuzziness. Middle layer and lower layer, which are a main part of control, is explained in detail at next subsection

3 Middle layer and lower layer

Middle and lower layer makes sure primary movements. Lower controller interprets a behavior commands into executable command sequence.

βMiddle layer : behavior control Middle layer controls a behavior of tactical moves by means of fuzzy logic rules. Tactical moves consist of a server command sequence . This sequence is a tactical behavior (²[Fig.2]). This knowledge as tactical rules $R^{CURL}(sj)$ configured from three kind of arts. $R_i^{sj} : \mathbf{if} \mathbf{CONDITION} \mathbf{is} \mathbf{C}_i \mathbf{thendo} \mathbf{M}_i$, $i = 1..n$ where CONDITION is a vector of control and game situation at that time. Current index of the rule used at that time is included in the situation CONDITION vector, therefore they could apply rules sequentially according to the rule indexes. ³[Fig.2] shows the state transition through rules. M_i is a movement command which could be interpreted and executed at lower layer.

4 Lower layer : primitive command execution

The lower layer controller makes plan of server command sequence to execute macro command given from middle layer. It treats non-holonomic

¹Ref: <http://./figs/fig1.html>

²Ref: <http://./figs/fig2.html>

³Ref: <http://./figs/fig2.html>

properties of player agents in soccer server. If there were no errors in sensory inputs and server command results, any middle level command could be transformed into just one turn and one dash. However, errors exist in sensor and command execution. Error occurs after command execution. To avoid that error, the system needs feedback loop. A middle layer macro command "go to point X" should be realized as a feedback algorithm. **"Go To Point X"** 1. Turn to heading for the point (turn\$ a*t) 2. *Dashtocomeclosedestination(dash\$ p(d))* 3. until getting destination X, go to 1. and repeat. Function p(d) calculates power to go through d distance. "a" in the turn command is a feedback ratio. The lib-scient embedded Tcl/Tk shell, we call it *sc_wish, is forming prototypes with GUI facility. The sc_wish is a nameport-num"sc_s end"(servercommand)"setmsg[receive_message]sc_connectwithservernameandport*

5 Summary

Hierarchical Fuzzy Intelligent Control system is adopted to soccer agents. Zeng99 team becomes a test bench for developing how to design cooperative behavior on the HiFIC system. It enables us to make control rules from human knowledge since it accepts linguistic macroscopic command notation. The *sc_wish that embeds lib-scient library makes it easy to construct pr*

6 Bibliography

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