ViperRoos 2001

Mark M. Chang and Gordon F. Wyeth

Department of Computer Science and Electrical Engineering,
University of Queensland, St Lucia, QLD 4072, Australia.
{chang, wyeth}@csee.uq.edu.au

Abstract. The ViperRoos are a team of three autonomous local vision robots that were developed to play robot soccer. The team participated for the second time at the RoboCup 2001. This paper describes the on-board intelligent and the simulator implemented to aid the team development. The paper concludes with future direction of the ViperRoos.

1 Introduction

The ViperRoos are a team of soccer playing robots entering the F180 league at RoboCup. Unlike most other F180 teams, the Viper robot relies on on-board vision, rather than an overhead camera, as its primary means of perceiving the world. Each Viper robot is completely autonomous, and this makes ViperRoos different from some other local vision teams that use off-board PCs to perform the necessary vision processing and team planning. Therefore, much of the ViperRoos development devotes to hardware design to achieve faster on-board vision processing and reliable communication.

Since the basic design of both the hardware and the software has already been published in [1]. This paper concentrates on the progress of the continuing development of the team. The next section describes the DP-MAPS, a planning system derived from the MAPS which has been successfully developed by RoboRoos[3]. The third section explains the SimViper simulator, with its purposes and advantages towards team development. Section 4 concludes the paper with some thoughts for future development.

2 Intelligence

The on-board intelligence of the ViperRoos has been improved from the previous system. The behavior-based reactive system has been modified to perform the low level navigation only. While the high-level decisions for the Viper robots are now generated by DP-MAPS (Distributed Perception/Processing Multi-Agent Planning System). The DP-MAPS is derived from the MAPS system used by RoboRoos[3]. On the RoboRoos, the MAPS received the world view generated by the vision system using the images captured by the overhead camera. The cooperative action for each team member is obtained by constructing potential field using predefined parameters. The MAPS system has been proven to be

A. Birk, S. Coradeschi, and S. Tadokoro (Eds.): RoboCup 2001, LNAI 2377, pp. 607–610, 2002.

effective at several RoboCup competitions, the system is described in detailed in [2]. Clearly, the RoboRoos system is capable of feeding the MAPS system a global world model, and this allows MAPS to generate suitable action for each robots from the perspective of the whole team. Since ViperRoos utilize local vision as its only perception, the information that can be extracted from the on-board camera is limited. For the ViperRoos to achieve effective team cooperation, the perceiving information from all robots must be shared in order for DP-MAPS to produce suitable actions for each team member to achieve the team goal. At the current stage, perception information is not shared among the team, however, this is an intermediate stage for the development of DP-MAPS.

The vision system on the Viper robots gives information of the objects seen by the camera in a local sense. These coordinates are then transformed into global positions using the on-board localization information. For the DP-MAPS system, these global positions are further converted into large grids. Depending on the processing bandwidth available and the accuracy required, the grid size can be adjusted. DP-MAPS functions as a very high level planning system for the robot, it outputs only several commands such as search, defend, kick, and kick-to. Each command is accompanied with grid position to indicate where the robot should carry out the action. The navigation system handles the lower level robot behavior, it modifies the received DP-MAPS commands to accommodate obstacles avoidance and collisions. In addition, the position information is re-calculated from the information provided by the proximity map, which is also generated by the vision system. Fig. 1 shows the software system of the Viper robot. The advantage of using DP-MAPS is that the robots can perform task cooperatively as long as their knowledge are shared. Ideally, the system will give similar performance as a global vision with accurate vision and reliable communication system.

3 Simulation

A kinematically accurate simulator for ViperRoos has been developed to ease the development phase. The SimViper software is implemented to simulate a soccer field which allows virtual Viper robots to play on it. Fig. 2 shows a typical 3 on 3 game with proximity map option turned on for debugging. The planning and the navigation codes on the robots can be taken from the robot and executed as a virtual robot without modification. Just like the real robot, the simulated robot requires vision input to see the world. SimViper generates a set of vision data according to the current state of the field, and this set of information is in the same format as the vision data produced by the real vision modules. The accuracy of the vision data can be altered to simulated the uncertainties that are usually presented in the real environment to some extent. This is a very useful feature, because it allows the developer to focus on the game strategy by running the robot with "perfect vision". For navigation, the simulator interacts with the virtual robot by interpreting the motor output and updating the robot position in the virtual field, the simulator also provides necessary encoder feedback.

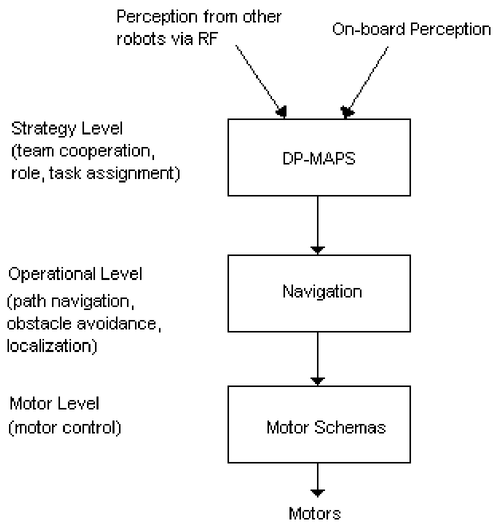

Fig. 1. The ViperRoos software system.

SimViper provides a GUI debugging environment for the ViperRoos. System parameters that are usually difficult to obtain can be observed easily. This is important for DP-MAPS, because the performance of DP-MAPS can only be observed while the game in progress. Therefore, SimViper is a convenient tool for calibrating the parameters for DP-MAPS with the option of diplaying potential field on the screen. The most important purpose of implementing SimViper is that the simulator reduces the time and effort that are usually associated with real robots, this includes programming the robots (because all codes reside on-board the robots), battery charging and time-consuming vision calibration. Although the system has to be tested on the real robots eventually to make final adjustments, we believe that the simulator is a convenient tool for the development of the ViperRoos.

4 Conclusions and Future Work

This paper has described the new on-board intelligence for the ViperRoos system and the SimViper simulator. The development on local vision teams in F180 league can depend largely on the hardware technology. There is considerable remaining work to develop the ViperRoos into a truly ccompetitiverobot soccer team. This work requires both the redesign of the system to incorporate the latest technology and the improvement on the on-board intelligence.

At the time of submitting this article, the final testing phase of the new vision module is being carried out. The new vision module consists of a new color

Fig. 2. SimViper - ViperRoos Simulator.

camera that provides additional features not found on our previous camera, this includes subsampling, interlaced and yuv output. In addition, the new vision processing board has the capability of performing image processing and DP-MAPS at 360MIPS. The increased processing power can be allocated to handle higher resolution images, faster frame rate or complex vision processing routines. Once the new vision module is completed, we wish to focus our development on issues such as inter-robot communication and special kicking and/or dribbling hardware.

References

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