FU-Fighters Small Size 2004

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1 Introduction

Our F180 team, the FU-Fighters, takes part for the sixth time in the RoboCup competition. This year, we have improved our omnidirectional robots in the following ways: we added a fourth wheel and a modified shooting device with a new magnet coil, we added Plug & Play components to the vision system, we use new color markers, Bluetooth communication modules, an improved microcontroller board, and a new behavior framework.

Our team won third place in the small size league competition in 2003 (1). We won second place in 1999, 2000, and 2002.

2 Team Development

Team Leader:
Alexander Gloye (scientific staff): organisation, behavior contol
Team Members:
Achim Liers (scientific staff): electronics
Marian Luft (laboratory assistant): electronics
Anna Egorova (student): vision, behavior control
Cüneyt Göktekin (student): simulation
Mark Simon (student): vision
Oliver Tenchio (student): mechanics
Fabian Wiesel (student): microcontroller software
Raul Rojas (academic supervisor).

3 Mechanical and Electrical Design

For RoboCup 2004 we improved our omnidirectional robots, which we used in RoboCup 2003 in Padova, Italy [6, 5]. The robots are equipped with four DC-motors with an integrated 14:1 gear and an impulse generator with 16 ticks per revolution. Further, the robots use a linear kicking device and a dribbling device with a rotating horizontal bar, as used by many other teams in the F180 league.

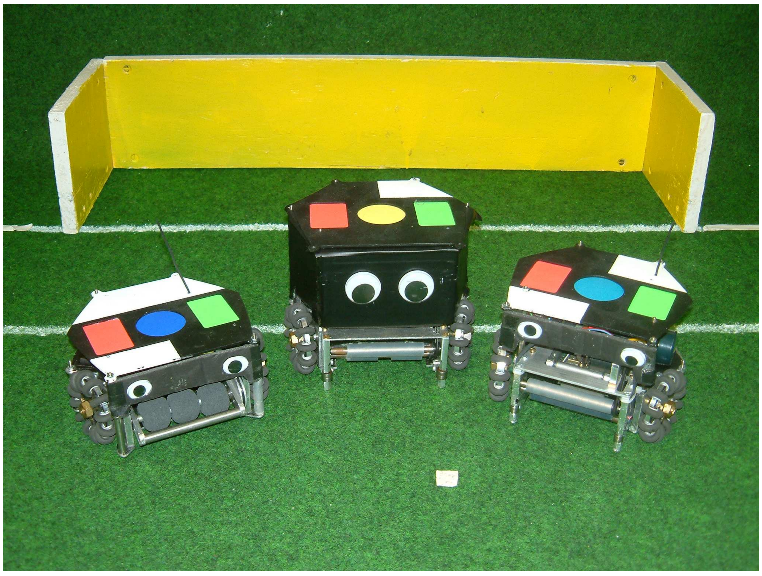

Fig. 1. Our Omnidirectional robots 2003.

For local control we use an improved microcontroller board as in [7], with modular and more powerful motor drivers. We have included now Bluetooth modules for a bidirectional communication link. We can use these electronic boards both for our mid-size and small-size robots without modifications.

4 Computer Vision

The only physical sensors for our behavior control software are two progressive scan cameras with a frame rate of up to 60 Hz and a FireWire interface. Two video streams in raw format — without compression and without interpolating the Bayer filter color information — are captured by a PC. The computer vision system running on the PC finds and tracks the ball and the robots. We use an improved version of the system described in [9]. We have improved the setup time by implementing Plug & Play components for semi automatic color calibration and automatic camera distortion. The camera distortion is eliminated by the vision system by fitting a model of the field to the image, using gradient descent. The color calibration is achieved by constructing a color map of the green field and using this information to adjust the maps for other colors. These techniques are described in [3].

5 Prediction

Unfortunately, the information about the position of the robots is extracted with a delay caused by communication, mechanical constraints, and the computer vision system. The feedback (the result) of an action decision is perceived typically between 100ms and 150ms after the decision has been made. We compensate this by predicting the positions and orientations of the robots for the next few frames [1, 2]. The predicted positions and orientations are used for behavior control.

6 Simulation

To develop new behaviors, especially high-level behaviors, it is favorably to have a good simulator to test them without having to use the real robots. In contrast to other teams, with an explicit physical model of their robots, we adapted our prediction system to provide an implicit model of physical robots. In our simulator, the delay predictor controls the robots. Adjustments of the predicted data is only necessary to detect and handle collisions between objects. This approach reduces the development cycle time for the simulator and reduces the adaptation time of the system to new robots with modified physical behaviors. It is also easy to simulate other robot models, for example robots of other teams, by observing them play. We use a modified version of our prediction system to reach this goal [4].

7 Vision Client

One goal in the small-size league community is to provide a common vision system for new teams or for teams who have other main research areas. We have extend our vision system to propagate the positions and orientations of the robots on the field over the network with UDP/IP. To allow other teams to easily use these information we have implemented a vision client prototype which receives and presents these information on a virtual playground.

8 Hierarchical Reactive Behavior and Learning

We use a hierarchy of reactive behaviors to control the robots. A detailed description of our control architecture is given in [8, 10]. This year, we implemented a new behavior framework for better prototyping and a faster and easier development phase for new behaviors.

We have implemented a learning algorithm for automatically adjusting the parameters of a PID controller. The new controller lets the robots drive smoothly. New hardware can be learnt in a few minutes.

We also use learning algorithms to enhance some critical and difficult behaviors, for example dribbling the ball without an active dribbling device.

9 Additional Information

Additional information, technical reports, images, and videos can be found at our web site www.fu-fighters.de.

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