FU-Fighters 2002 (Middle Size)

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The RoboCup team of the Freie Universität Berlin has been a successful competitor in the Small Size league since 1999. In Seattle 2001, we won the Small Size Local Vision contest with a team of robots that featured an omnidirectional drive and an omnidirectional local vision system. For RoboCup 2002, we decided to port our design to the Middle Size league. This has the advantage that we can include the computational resources needed for real time image analysis on board the robots.

We constructed a flat robot base of low weight that contains three omnidirectional wheels. This base can move fast in any direction and turn at the same time. The three motors and a kicking device are controlled by a microcontroller board that also reads a ring of infrared proximity sensors. If the microcontroller detects obstacles it can prevent collisions. For higher level behavior control and computer vision, a sub-notebook PC is located on top of the base. Two infrared optical flow detectors sense the motion of the robot.

The main sensor for the robots is an omnidirectional camera that is mounted at the top. It has a Firewire interface and can provide images up to a resolution of 640×480 at a rate of 30fps in YUV color space. Image analysis works in two modes: localization and tracking. A global image analysis is used to initially estimate the parameters of a world model. Tracking updates the world model by inspecting only parts of the captured images to register the back-projected model. Such a tracking approach allows to interpret high resolution images at high frame rates without consuming much computing power.

We use a hierarchy of reactive behaviors to control the robots. Simple behaviors are arranged in layers that work on different time scales. Fast primitive behaviors like velocity control, taxis, and obstacle aviodance, are implemented in the lower layers. In the middle layers, skills like approaching the ball, dribbling, and kicking it towards a target, are controlled. More complex, but slower behaviors are produced by the higher layers of the system. They include path planning and team cooperation.

The robots communicate via a wireless local network with a central station located outside the field. Here, the local views are merged in a probabilistic framework to produce a global view. In addition to the global world model, the central station also runs the team level of behavior control. Here, the actions of the individual players are coordinated.

For the Middle Size RoboCup competition 2002 we have developed a team of fast and lightweight robots that are capable of controlled and coordinated play. By accelerating the game, we hope to advance the state of the league.