

A Navigation System for Robot Soccer

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Abstract

This paper describes the navigation system used for the UQ RoboRoos robot soccer team, runner up in the 1998 world RoboCup championships. The navigation system has been developed to cope with the dynamic environment of robot soccer. Two interacting levels of the system called the schema and cognitive levels respectively, have been used to solve two orthogonal problems in spatial navigation: long-term planning and short-term motion control. A mechanism to compensate for the effects of sensor latency has been developed, overcoming the significant delay inherent in vision processing. This paper shows the performance of the system through the competition results, and the results of simulation.

1 Introduction

This paper presents the navigation and low-level control systems used by the UQ RoboRoos, a team of soccer playing robots. The architecture is capable of controlling the robots robustly in a dynamic environment with minimal computational power. Furthermore, the architecture actively compensates for sensor data that is old and out of date. The latter is a necessary requirement as the primary sensor for the robots, vision, introduces significant latency between events and their actual use in navigation.

The RoboRoos navigation system has been divided into two distinct components. A planning system, based on a coarse-grained occupancy grid [McKerrow, 1991], takes care of long-term planning problems, such as determining a path to the other side of the field without hitting any obstacles. Short-term planning problems, such as moment to moment control of individual wheel velocities, are handled by reactive control systems called *schemas* [Wyeth & Browning, 1998].

1.1 Robot Soccer

RoboCup games are the robot version of indoor soccer. The small-size league field consists of a table-tennis table, surrounded by white walls 10cm high. A middle-size league also exists where robots play on a field three times the size in every linear dimension. For the small-size league a standard orange golf ball is used in place of a soccer ball. The objective of the game is to score by

hitting the ball into the opposition goal. In the small sized league, teams are allowed to use an overhead camera for recognising and tracking the robots and the ball thus simplifying the problem of determining where the robots are.

RoboCup competitions have been held since 1997. The aim of the competition is to provide a motivating force for research into intelligent robotics by providing a competitive but friendly environment with a challenging problem. [Kitano *et al.*, 1997] describes the major robot soccer intelligence issues as multi-agent cooperation, navigation in a dynamic environment, strategy learning, and skill in both movement and control of the ball. It is hoped that in the years to come the successes of RoboCup will spin-off contributions to the wider robotics community.

The RoboRoos robot soccer team consists of four homogeneous field robots and one specialised goalkeeper, all custom built to play soccer in the small-size league of RoboCup competitions. Figure 1 shows a picture of the team on a competition field.

