LARC 2010 Competition – Mixed Reality League S&TRN

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Abstract. In this paper, S&TRN RoboCup team for Latin American Robotic Competition (LARC) for Mixed Reality league is introduced, which contains information such as S&TRN team, Physical Visualization (PV) soccer league simulation server and our agent architecture.

1. Introduction

S&TRN team has been started since RoboCup 2009 in Graz-Austria in 3D soccer simulation league with the name of KNTU3D and also KNTU-ARMY in RoboCup 2010 Singapore. We are working in Intelligent Systems Laboratory (ISLAB). Our main research fields in ISLAB are intelligent control and robotics. Two bachelor student and one master student consists our team. In next section mixed reality including league and simulation server is introduced in brief. Finally our agent architecture and algorithms are elaborated.

2. Mixed Reality

2.1. Overview

The Eco-Be!-activities, started by a co-operation between Osaka University and Citizen Corporation [1], resulted in a considerably new sub-league of the RoboCup Soccer simulation. The Physical Visualization (PV) Soccer league, now renamed as Mixed-Reality Competition, is a new RoboCup league that started in RoboCup 2007. In this competition small, real, robots called Eco-Bes, play soccer on top of a virtual field with a virtual ball, thus using the concept of augmented reality [2]. The Mixed-Reality approach combines physical and virtual aspects and thus relies on simulation if multiple components as one of the main operational principles [3][4]. Simulation controls the virtual objects and robots, whilst the real robots are controlled by software agents. Simulation is also used for software development and self learning approaches, e.g. reinforcement learning, which rely on a high number of learning cycles.

2.2. The RoboCup Mixed Reality System

The basic hardware setup of the RoboCup MR system consists of a horizontally mounted display and a set of micro-robots. The left part of figure 1 depicted the hardware setup. One or more computers control the virtual environment, displayed on the screen, and the micro-robots. A camera that is mounted above the screen captures the scenery with all virtual and real objects. Image processing allows determining the position and orientation of the robots and other real objects on the screen.

The size of the robots is approximately 2.5 centimeters in all three dimensions. The robots can move freely on the screen. They are driven by two independently controllable wheels, according to the differential drive paradigm. We developed a new controller based on Central Pattern Generators (CPG) network to control the wheels that is explained in the next section. Robots are controlled by individual software agents. For identification, each robot is equipped with an individual marker. An IrDa link is used for wireless data exchange. Other wireless data link have been used previously and RF modules have been proposed for future systems.

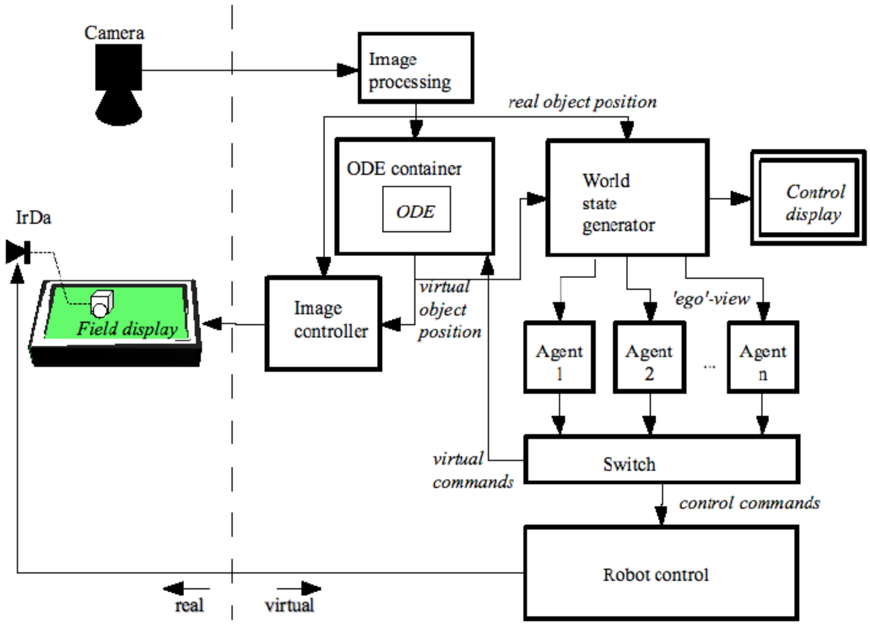

Figure 1. RoboCup Mixed Reality System

The right part of figure 1, marked ‘virtual ‘, shows the structure of the software. There is an overall framework with a number of modules for in-and output, simulation and control. The image processing module captures the camera output and provides information on positions and poses of the robots and possibly other real objects to the other software modules. The world State generator generates an individual view for every single robot in the system. A control display can be attached for debugging and development purposes. The individual views are then communicated to the agents that control the robots. There is one individual agent module for every robot. The switch module separates the commands issued by the agents into commands that affect virtual objects, like kicking a virtual ball and control of real robots.

The robot control module takes care of interfacing and communicating with the robots. The ODE container wraps the Open Dynamic Engine [5] physics engine and takes care of simulation of the virtual objects. It processes data of real objects, like position and space occupied, and commands that affect virtual objects. It outputs information on new poses and position of the virtual objects. The image controller displays all virtual objects on the screen.

3. S&TRN Team

In this section our Goalie strategy and moving controller of the robots are introduced.

3.1. Goalie Strategy

The Goalie was chosen to have straightforward behavior as the goal was relatively narrow. This choice implied that the goalie had a fixed strategy, it would position itself on a half-circle centered in our own goal center, and move radially as the ball approached and changed its position with respect to the goal (Figure 2).

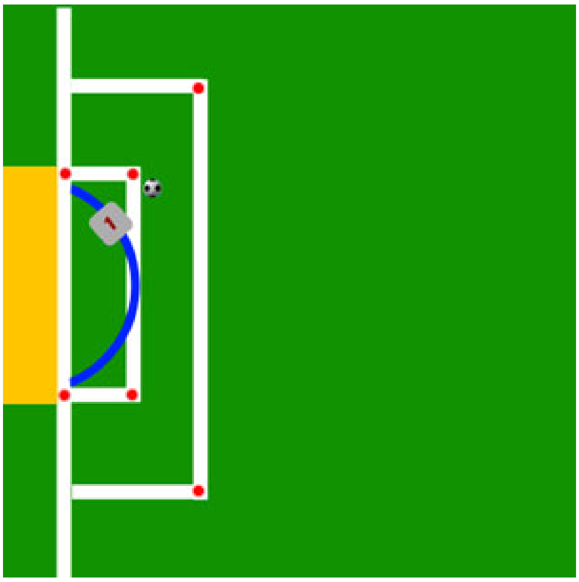

Figure 2. Goalie Behavior

3.2. Moving Controller

Central Pattern Generators (CPG) is used to control wheels for making movement behavior. Central pattern generators (CPGs) can be defined as neural networks that can endogenously (i.e., without rhythmic sensory or central input) produce rhythmic patterned outputs or as neural circuits that generate periodic motor commands for rhythmic movements such as locomotion [6]. CPGs have been shown to produce rhythmic outputs resembling normal rhythmic motor pattern production even in isolation from motor and sensory feedback from limbs and other muscle targets. To be classified as a rhythmic generator, a CPG requires: 1. two or more processes that interact such that each process sequentially increases and decreases, and 2. that, as a result of this interaction, the system repeatedly returns to its starting condition.

CPGs consist of neural oscillators and each neural oscillator could control one degree of freedom, motor or wheel. Each neural oscillator consists of two neurons. Oneuron plays extensor role and other one flexor.

According above we have two neural oscillators for controlling two wheels of the robot for moving. Due to its simplicity and effectiveness, the Matsuoka oscillator is widely used in much research on robotics and CPGs.

References

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