Austrian-Kangaroos 2011
Team Description Paper (TDP)

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Abstract. The Austrian-Kangaroos are a joint team of Vienna University of Technology and University of Applied Sciences Technikum Vienna. After successful participation in the years 2009 and 2010 we are attending again in RoboCup 2011 within the Standard Platform League. Our team is a joint effort of researchers, lecturers and students of the University of Applied Sciences Technikum Vienna (UASTW)¹, and of the Vienna University of Technology (VUT)² with two directly involved institutes: The Automation and Control Institute (ACIN)³, and the Institute of Computer Languages (Compilers and Languages Group) (COMPLANG)⁴.

1 Introduction

RoboCup, especially humanoid robotic soccer, provides an excellent platform for research on a wide field of topics. Consequently, the research groups of all institutions participating in the Austrian-Kangaroos are applying their specific research questions to the league’s standardized platform. In the following sections we provide a brief overview of ongoing research conducted by the involved working groups.

1.1 Concurrent and Embedded Real-Time Systems

One of the emphases of the Compilers and Languages Group (COMPLANG) is that of robust embedded systems. Within this context research is conducted for analyses and certification of dependable software, as much as for the development of new programming methodologies and languages that simplify the development of mission-critical embedded system applications.

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We especially focus on static analyses at source code level, in particular aiming at the calculation of code properties like worst-case execution times (WCET) [1, 2], heap structure, or stack usage. Research targeting at software architectures covers the design and synthesis of middleware for distributed real-time embedded systems, as much as model driven development methodologies [3–5], and programming languages for reactive and concurrent systems.

1.2 Vision for Robotics

The working group Vision for Robotics (V4R)\(^5\) utilizes the Austrian-Kangaroos as a test bed for their research towards robots that see and interact with the real world. Research in object detection, localization, grasping and their affordances are crucial parts in this group [6, 7]. Work done in these fields is reflected in the techniques used within the teams’ software.

1.3 Nonlinear Controls

Knowledge on nonlinear control systems is gathered by the Complex Dynamical Systems Group (CDS)\(^6\) [8–11] involving bipedal walking algorithms. Ongoing research of the CDS group aims at combining traditional control systems with classical learning algorithms.

1.4 Robotics in Education

The UASTW has been in RoboCup since 2003, Padua/Italy [12], with successes in the Small Size League, and since 2009 in the Standard Platform league and the Rescue Virtual Robot League. In addition the UASTW is highly involved in the Austrian RoboCupJunior community [13] on a grounding level by hosting events like the Austrian-RoboCupJunior competition. One goal of the involved institute’s work group is to teach students in a motivating environment. This is achieved by participating at RoboCup, which is a challenging environment in a committed community.

2 Research and Development

2.1 Past Achievements

The Austrian-Kangaroos successfully participated in the RoboCup WC 2009 in Graz [14] for the first time and reached the quarter-finals. After our first year we redesigned our software framework reflecting the team’s experiences from the 2009 season. In 2010 we reached the 3rd place at the German Open and at the Mediterranean Open. At this time we were already using our new framework as announced in the last year’s TQD [15], Section 2.1. At the WorldCup in

\(^5\) V4R http://v4r.acin.tuwien.ac.at
\(^6\) CDS http://cds.acin.tuwien.ac.at
Singapore our system was finally capable of detecting faulty system states and misbehaving software components, and hence was able to set counter measures at a coarse grained level [16]. These achievements enabled us to score the best time on the technical dribbling challenge in Singapore.

**Software Architecture:** The team’s current software architecture, as depicted in Fig. 1, consists of several loosely coupled components, each residing in its own address space:

- The **Communication** component is responsible for all network communication including sharing of each robot’s world model with teammates, and receiving referee commands.
- The **Vision** component extracts information about recognizable objects (e.g. ball, goal posts) in the environment from the camera image.
- The **World Model** component combines the locally extracted world objects with the other robots’ world models into a belief about the world’s current state.
- The **Control** component is responsible for role selection based on the belief calculated by the word model component. It also sends commands to execute planned actions to the motion component.
- The **Motion** component is responsible for executing motions. It relies on the Aldebaran ALMotion NaoQI module to control the Nao’s joints and the Aldebaran walking engine.
- The **Monitor** is responsible for detecting faulty or misbehaving components. Based on a simple rule set, it is able to set counter measures to different kinds of faults.

In order to make the components work together, we provide two communication facilities:

- **Shared memory** is used to propagate information to all relevant components. Our shared memory provides a full-fledged publisher-subscriber infrastructure. Hence, it triggers signals in all connected components, if a subscribed memory location is altered.
- **RPC calls** allow point-to-point communication between two components.

**Team play:** As a last years newcomer we mainly focused our work on the stabilization of our software framework for the WC 2010; the Kangaroos’ team play capabilities have not been a main concern. Nevertheless, a role based goal driven behaviour engine was implemented and was sufficient for a 3 vs. 3 soccer match. The roles a robot could be assigned to are (i) goalkeeper, (ii) defender, and (iii) attacker. Role assignment is dynamic (except the goal keeper), and worked for the 2010 set-up. In addition we successfully adopted the robots’ sonar sensors to avoid pushing penalties. However, with increasing number of field players we expect more complex team action to become a key to success.

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7 Nao SDK: [http://www.aldebran.com](http://www.aldebran.com)
**Robotics in Education:** The Austrian-Kangaroo team is a learning environment for students that intrinsically motivates [17]. The rotation lifecycle [18] that was developed for UASTW’s SSL team Vienna Cubes has been implemented for the Austrian-Kangaroos as well and enforces the keep of knowledge and increases the sustainability of the team. In the EU-project Centrobot a platform for exchange of learning material with robots was developed [19] to share digital content for teachers in robotic classes.

### 2.2 Planned Improvements

The exchange of software components and messages between teams and other robot-hardware is one goal in this season’s work plan. To do so we are planning to release our shared memory based framework as ROS [20] package. In addition, we plan to improve our team behaviour by introducing more shared knowledge between the players.

**Software Architecture** We are currently in the process of implementing a message passing facility for point-to-point communication between components, replacing the remote procedure calls. This will make our API more consistent with ROS and allow for an easy integration with other ROS components, once the Nao platform is fully supported\(^8\).

\(^8\) ROS for the Nao: [http://www.ros.org/wiki/nao](http://www.ros.org/wiki/nao)
Robust Robotic System Software  To increase the robot’s software robustness we are currently working on more sophisticated real-time monitoring capabilities. Our research is targeted towards automatic deployment of software sensors and derivation of counter measures from dependency trees and error models.

Team Coordination  We expect team play and coordination to become a vital point in the next years’ RoboCup seasons. For a team play with 4 vs. 4, self-localization, object sensing and dynamic role assignment have to go hand in hand. Therefore, our next year’s vision system will propagate beliefs from the low level sensing up to shared knowledge between robots. This will enable us to enhance the current used localization method and the dynamic assigned team leader to select a strategy for game play. A ROS debugging interface is on schedule, to monitor and interact with players online, in order to quickly find parameters and solve problems.

Robotics in Education  Within the next year a UASTW research group (Section 1.4) tries to present robots to children from kindergarten. In 10 sessions students and research members present different robot models and the children use a BeeBot for their first robot programming experiences. Because of the importance of documentation of scientific work the children use cameras to take pictures of the robots, print the pictures and place them into their personal lab book. Furthermore, first experiences in elementary schools are planned. After this, the activities in Robotics in Education will reach from Kindergarten to University level. Currently some research at the UASTW are working on a new learning model for robots that will focus more on the motivation of children learning with robots.

3 Conclusion

In this document we presented the Austrian-Kangaroo SPL team. To this end we briefly described the research groups that jointly form the Austrian-Kangaroos team and stated our research interest within RoboCup, both by referring to past achievements and to planned future work. In particular, we outlined our expectation that team coordination will be a vital key to success in upcoming seasons. Based on that we discussed our plans to improve our current framework by adding features to make it more robust by adding know-how from all participating research groups. Finally, we outlined our plans to increase the usability of our work for the community by publishing ROS packages, which demonstrates our active work as member of the RoboCup community.
4 Demonstration Video

A demonstration video of our current working system can be found on YouTube http://www.youtube.com/watch?v=_TezX0YRSwI. It shows a friendly match against the team Robo Eireann.

References


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9 Robo Eireann: http://www.eeng.nuim.ie/robocup/


