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RoboCup 2016: Robot World Cup XX

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Preface

RoboCup fosters robotics and AI research by setting formidable challenges, which bring researchers from around the world together through publicly appealing competitions and organized scientific meetings. RoboCup 2016 was held at Leipziger Messe, Germany, from June 30 to July 4. The competition inspired 31,500 visitors to watch 3,500 participants from 45 countries with over 1,200 robots compete in various disciplines. In the RoboCupJunior leagues the focus is on the technical education and development of middle and high school students through project-oriented robotic challenges. The research-oriented major leagues were held in the areas of: RoboCup Soccer, with eight leagues spanning simulated robots to full-size humanoid robots competing in soccer; RoboCup Rescue, with three leagues investigating how robots can support first-responders in emergency situations; RoboCup@Home, where the development of service robots in everyday environments is promoted; and RoboCup Industrial, with two leagues exploring future uses of robots in industrial applications.

Amazon Robotics held their annual Amazon Picking Challenge at RoboCup for the first time in 2016 co-located with RoboCup. The goal of the challenge is to strengthen ties between the industrial and academic robotic communities, and to promote shared and open solutions to unsolved problems in unstructured manipulation and automation. The contest focuses on vision, grasping, and motion planning to solve picking and stowing tasks, with prizes awarded based on how many items are successfully transferred in a fixed amount of time. In addition to the competitions, exhibitors from 60 companies displayed their latest results at the RoboCup venue.

This book highlights the approaches of champion teams from the competitions and documents the proceedings of the 20th annual RoboCup International Symposium that was held at the Leipzig Congress Center, adjacent to the competition venue, on July 4. Due to the complex research challenges set by the RoboCup initiative, the RoboCup International Symposium offers a unique perspective for exploring scientific and engineering principles underlying advanced robotic and AI systems. The highly experimental and interactive character of RoboCup, along with its unique opportunities to benchmark and validate research progress, provides a natural forum where novel ideas and promising technologies can be disseminated across a large and growing community.

For the RoboCup 2016 Symposium, a total of 63 submissions were received. The submissions were carefully reviewed by the 72 members of the international Program Committee who generously helped to read and evaluate each of the submissions. Each paper was scored and discussed by three reviewers. The committee ultimately decided to accept 34 regular papers and four papers for a special track on open source hard- and software for an overall acceptance rate of 60%. Among the accepted papers, 14 were selected for oral presentations and the remainder were presented as posters.

The RoboCup 2016 Symposium was fortunate to have three invited keynote speakers:

- Martin Riedmiller (Google DeepMind): “Intelligence Scores Goals: Machine Learning for Autonomous Robots”
- Davide Scaramuzza (University of Zurich): “Towards Agile Flight of Vision-Controlled Micro Flying Robots: From Active Perception to Event-Based Vision”
- Ruzena Bajcsy (University of California, Berkeley): “Framework for Individualized Dynamical Modeling of Human Motion”

Prof. Riedmiller described his group’s history at RoboCup and how it has inspired their current work on deep reinforcement learning. Prof. Scaramuzza showed how novel vision sensors and algorithms can be used to guide quadrotors to navigate quickly through unstructured environments. Prof. Bajcsy presented her group’s work on modeling human movement dynamics to better enable machine understanding for human–robot interfaces. Their three exciting presentations helped to attract over 600 participants to the symposium.

The Award Committee selected two best papers, printed first in the book:

- Best Paper Award for Scientific Contribution: Alexander Hagg, Frederik Hegger and Paul Gerhard Plöger, “On Recognizing Transparent Objects in Domestic Environments Using Fusion of Multiple Sensor Modalities”
- Best Paper Award for Engineering Contribution: Daniel Speck, Pablo Barros, Cornelius Weber and Stefan Wermter, “Ball Localization for Robocup Soccer Using Convolutional Neural Networks”

Additionally, three submissions were awarded HARTING Open Source Prizes for contributions that have made software and/or mechatronic design plans available to the general public on the basis of the open source principle. These papers are also featured in this book.

We want to first thank our program managers, Steve McGill and Marcell Missura, who were instrumental in overseeing the review process on EasyChair. We also want to thank the members of the Program Committee and our additional reviewers for their time and expertise to ensure the quality of the technical program, as well as the members of the Award Committee for their work during the symposium. Our thanks go to the Leipziger Messe team, who supported us in the preparation and running of the symposium, in particular Nora Furchner and Hanna Krajczyk. We also thank all the authors and participants for their contributions and enthusiasm. Finally, we are grateful to the general chair of RoboCup 2016, Gerhard Kraetzschmar, who dedicated his complete time and energy, and the members of the Organizing Committee who helped make RoboCup 2016 one of the best RoboCup events ever. As symposium co-chairs, we had the great pleasure of working together and seeing each other in Leipzig. We sincerely thank the entire RoboCup community for their support and friendship!

December 2016

Sven Behnke
Raymond Sheh
Sanem Sariel
Daniel D. Lee

Organization

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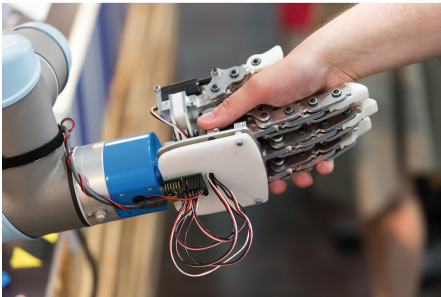
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RoboCup 2016 mascot



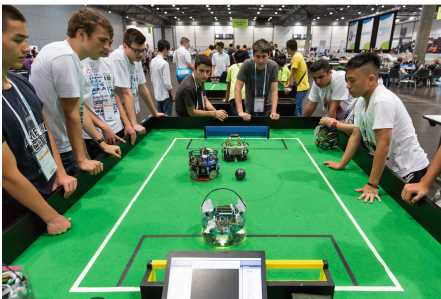
@Home League



Handshake



RoboCup Rescue



Junior Soccer



Amazon Picking Challenge



Middle Size League

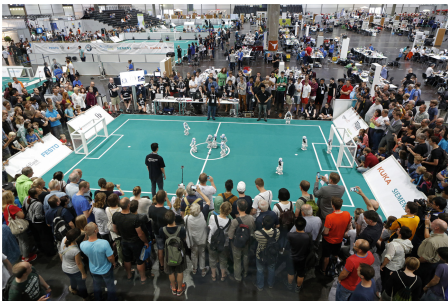


Junior OnStage

Fig. 1. Impressions from RoboCup 2016 (Image credit: Leipziger Messe).



@Home League



Standard Platform League



@Work League



Humanoid League



SmallSize League



Junior Rescue



Logistics League



Amazon Picking Challenge

Fig. 2. Impressions from RoboCup 2016 (Image credit: Leipziger Messe).



Standard Platform League



Board of Trustees



Social event party



Symposium lecture hall



Invited speaker: Martin Riedmiller



Invited speaker: Davide Scaramuzza



Invited speaker: Ruzena Bajcsy



Symposium poster session

Fig. 3. Impressions from RoboCup 2016 (Image credit: Leipziger Messe).

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