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# RoboCup 2021: Robot World Cup XXIV

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Cover Photo: - Author: Kevin Daun, Technical University of Darmstadt - Rights: The author confirms that he provides the right to use the illustration without restriction. Copyright remark(s): Kevin Daun, Technical University of Darmstadt - A brief description of the photo: The rescue robot “DRZ Telemax” by Team Hector Darmstadt - DRZ performs the shoring task

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# Preface

RoboCup 2021 was held under unprecedented circumstances – the COVID-19 pandemic resulted in the cancellation of RoboCup 2020, and precipitated the decision to move RoboCup 2021 to an online event. Despite the many challenges, the RoboCup community came together to create an online event to great success – leagues adopted creative solutions to hold competitions in extensive simulation environments, remote hardware challenges took place via video-conferencing, and through it all succeeded in bringing together the community for a week of competitions, discussions, and presentations.

As a challenging multidisciplinary endeavor, RoboCup has the opportunity to highlight advances in robotics research that translate to better, faster, safer, more capable robots - and competition wins. This book presents the science behind the advances in robotics, including the key innovations that led the winning teams to their success, and the outcomes of research inspired by challenges across the different leagues at RoboCup.

The RoboCup 2021 symposium received a total of 42 regular research paper submissions. The submissions were reviewed by the Program Committee of 51 members, producing three reviews per paper. The committee carefully weighed the merits and limitations of each paper, and accepted 19 papers for inclusion in the symposium, for an overall acceptance rate of 45%. Each accepted paper was accompanied by a virtual poster presentation and a pre-recorded talk. In addition to the regular research papers, the symposium proceedings includes 10 invited champions papers from the winners of the RoboCup 2021 competitions. The champions papers were reviewed by at least two members of the Trustees or Executive Members of the RoboCup Federation.

Among the 19 accepted regular research papers, five papers were nominated as best paper award finalists. The awards committee evaluated the finalists based on the paper as well as their associated posters and presentations, and selected one best paper: Emanuele Antonioni, Vincenzo Suriani, Filippo Solimando, Domenico Daniele Bloisi, and Daniele Nardi — “Learning from the Crowd: Improving the Decision Making Process in Robot Soccer using the Audience Noise”. The best paper award finalists included:

- Philip Reichenberg and Thomas Röfer — “Step Adjustment for a Robust Humanoid Walk”
- Moritz Zappel, Simon Bultmann, and Sven Behnke — “6D Object Pose Estimation using Keypoints and Part Affinity Fields”
- Arash Amini, Hafez Farazi, and Sven Behnke — “Real-time Pose Estimation for Multi-Humanoid Robots”
- Jan Blumenkamp, Andreas Baude, and Tim Laue — “Closing the Reality Gap with Unsupervised Sim-to-Real Image Translation”

The RoboCup 2021 symposium was delighted to host three keynote speakers:

- Dieter Fox (Nvidia Research and University of Washington): “Toward Robust Manipulation in Complex Environments”

- Jean-Paul Laumond (Centre national de la recherche scientifique, CNRS): “Robotics: The Science of Motion”
- Stefanie Tellex (Brown University): “Towards Complex Language in Partially Observed Environments”

We were saddened by the news of Jean-Paul Laumond’s death in December 2021, a big loss for the robotics community. He was a pioneer in humanoid robotics and motion planning, and approached robotics from a variety of disciplines including graph theory, algorithmic geometry, control theory, and neuroscience.

We thank the members of the Program Committee and the additional reviewers for their time and expertise to help uphold the high standards of the symposium technical program, as well as the members of the awards committee for their work in selecting the best paper award. This event would not have been possible without the tireless efforts of the Organizing Committee, including the team from Underline for providing the online platform for the event. We thank the enthusiastic support and participation of RoboCuppers across the world, and the technical and organizing committees of every league. Finally, we thank Peter Stone, the RoboCup 2021 General Chair, and the Co-chairs, Luca Iocchi, Flavio Tonidandel, and Changjiu Zhou. The symposium organizers greatly enjoyed working together to help make the event a success.

February 2022

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