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Algorithmic Foundations of Robotics XI

Selected Contributions of the Eleventh International Workshop on the Algorithmic Foundations of Robotics

Springer
Foreword

Robotics is undergoing a major transformation in scope and dimension. From a largely dominant industrial focus, robotics is rapidly expanding into human environments and is vigorously engaged in its new challenges. Interacting with, assisting, serving, and exploring with humans, the emerging robots will increasingly touch people and their lives.

Beyond its impact on physical robots, the body of knowledge robotics has produced is revealing a much wider range of applications reaching across diverse research areas and scientific disciplines, such as: biomechanics, haptics, neurosciences, virtual simulation, animation, surgery, and sensor networks among others. In return, the challenges of the new emerging areas are proving an abundant source of stimulation and insights into the field of robotics. It is indeed at the intersection of disciplines that the most striking advances happen.

The *Springer Tracts in Advanced Robotics* (STAR) is devoted to bringing to the research community the latest advances in the robotics field on the basis of their significance and quality. Through a wide and timely dissemination of critical research developments in robotics, our objective with this series is to promote more exchanges and collaborations among the researchers in the community and contribute to further advancements in this rapidly growing field.

Since its inception in 1994, the biennial *Workshop Algorithmic Foundations of Robotics* (WAFR) has established some of the field’s most fundamental and lasting contributions. The launching of STAR, WAFR, and several other thematic symposia in robotics found an important platform for closer links and extended reach within the robotics community.

This volume is the outcome of the WAFR eleventh edition hosted by Boğaziçi University and is edited by Levent Akin, Nancy Amato, Volkan Isler, and Frank van der Stappen. The book offers a valuable collection highlighting the cutting-edge research in classical robotics problems (e.g., manipulation, motion, path, multi-robot, and kinodynamic planning), geometric and topological computation in robotics as well as novel applications such as informative path planning, active sensing, and surgical planning.
The contents of the 42 contributions represent a cross-section of the current state of research from one particular aspect: algorithms, and how they are inspired by classical disciplines, such as control theory, computational geometry and topology, geometrical and physical modeling, reasoning under uncertainty, probabilistic algorithms, game theory, and theoretical computer science. Validation of algorithms, design concepts, or techniques is the common thread running through this focused collection.

Rich in topics and authoritative contributors, WAFR culminates with this unique reference on the current developments and new directions in the field of algorithmic foundations. A very fine addition to the series!

Naples, Italy
January 2015

Bruno Siciliano
STAR Editor
This is an exciting time for robotics. Governments across the world have recently announced major robotics programs such as the National Robotics Initiative, the DARPA Robotics Challenge in the U.S., and the European Commission’s euRobotics initiative. The demand for industrial automation is more than ever. Companies like Google and Amazon have made significant robotics investments. There is considerable start-up activity around robotics. New, more capable platforms ranging from legged robots to aerial vehicles are being developed at a rapid pace. In this environment, developing algorithms for robots (and automation systems in general) so that they can operate in complex and unstructured environments has become crucial. These algorithms have applications beyond physical robotic and sensing systems as they are used for scientific inquiry in other disciplines such as biology and neurosciences.

The Workshop on Algorithmic Foundations of Robotics (WAFR) is the premier venue which showcases cutting-edge research in algorithmic robotics. The eleventh WAFR, which was held at Boğaziçi University in Istanbul, Turkey continued this tradition. We received 83 very strong submissions. Each submission was assigned to three members of the Program Committee (PC) which was composed of the leading researchers in the field. Each PC member provided a review. After a discussion phase open to the entire PC, and the collection of additional reviews as needed, 42 papers were selected for presentation at the workshop. WAFR took place during August 3–5, 2014.

This volume of Springer Tracts in Advanced Robotics contains extended versions of these papers. These contributions highlight the cutting-edge research in classical robotics problems (e.g., manipulation, motion, path, multi-robot, and kinodynamic planning), geometric and topological computation in robotics as well as novel applications such as informative path planning, active sensing, and surgical planning. About half of the accepted papers have been forwarded for further review for dedicated special issues of the International Journal of Robotics Research and IEEE Transactions on Automation Science and Engineering.

In addition to paper presentations, WAFR 2014 featured three invited speakers: Vijay Kumar gave a seminar on “Aerial Robot Swarms.” Çağatay Başdoğan’s topic
was “Haptic Role Exchange and Negotiations for Human Robot Interaction.” Oussama Khatib focused on “Working with the New Robots.”

We owe many thanks to all the authors for submitting such high quality work, all the PC members and auxiliary reviewers for all of their hard work, and all WAFR participants for making WAFR 2014 a success. We would like to express our gratitude to Boğaziçi University’s Faculty of Engineering for the venue with breathtaking views, and University of Minnesota’s Department of Computer Science and Engineering for their support. Finally, we gratefully acknowledge travel support by the United States National Science Foundation for student participants.

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