Springer Proceedings in Advanced Robotics 15

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Jadran Lenarčič · Bruno Siciliano
Editors

Advances in Robot Kinematics 2020

Springer

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Foreword

At the dawn of the century's third decade, robotics is reaching an elevated level of maturity and continues to benefit from the advances and innovations in its enabling technologies. These all are contributing to an unprecedented effort to bringing robots to human environment in hospitals and homes, factories and schools; in the field for robots fighting fires, making goods and products, picking fruits and watering the farmland, saving time and lives. Robots today hold the promise for making a considerable impact in a wide range of real-world applications from industrial manufacturing to health care, transportation, and exploration of the deep space and sea. Tomorrow, robots will become pervasive and touch upon many aspects of modern life.

The *Springer Tracts in Advanced Robotics (STAR)* was launched in 2002 with the goal of bringing to the research community the latest advances in the robotics field based on their significance and quality. During the latest fifteen years, the STAR series has featured publication of both monographs and edited collections. Among the latter, the proceedings of thematic symposia devoted to excellence in robotics research, such as ISRR, ISER, FSR, and WAFR, has been regularly included in STAR.

The expansion of our field as well as the emergence of new research areas has motivated us to enlarge the pool of proceedings in the STAR series in the past few years. This has ultimately led to launching a sister series in parallel to STAR. The *Springer Proceedings in Advanced Robotics (SPAR)* is dedicated to the timely dissemination of the latest research results presented in selected symposia and workshops.

This volume of the SPAR series is dedicated to the proceedings of a special edition of ARK on Advances in Robot Kinematics. Returning to Ljubljana, Slovenia, where it was first founded in September 1988, ARK marks this year an important milestone in reaching its seventeenth gathering, establishing itself as a major anchor of research advances in robot kinematics serving the global robotics community.

The volume edited by Jadran Lenarčič and Bruno Siciliano contains 43 scientific contributions. This collection spans a wide range of research developments in robot mechanisms, kinematics, analysis, design, planning, and control.

Rich by topics and authoritative contributors, ARK brings this unique reference on the current developments and new directions in the field of kinematics. A fine addition to the SPAR series and a genuine tribute to ARK contributors, organizers, and founder!

May 2020

Bruno Siciliano
Oussama Khatib
SPAR Editors

Preface

The series of international symposia Advances in Robot Kinematics (ARK) was organized for the first time in Ljubljana in 1988. Since then, they were organized every two years, in Slovenia, Austria, Italy, France, and Spain, under the patronage of the International Federation for the Promotion of Machine Sciences (IFToMM). The first edited book was published by Springer in 1991, one year after the conference in Linz. Since 1994, a new volume has been published every two years. Each edited book is linked to a corresponding symposium, in which the participants exchange their results and opinions in a meeting that brings together the best researchers and scientists in the field of robot kinematics. The current book is the 15th, and the last three were included in the SPAR series. The book contains 43 contributions and a large team of reviewers contributed their critical and insightful recommendations to the authors.

In the 1980s, when we began organizing these symposia and publishing the books, we did not expect robot kinematics to remain at the forefront of robotics for so many years. However, in the current turbulent times of artificial intelligence, the analytical and in-depth work of kinematicians is even more important than it used to be. Kinematics remains an immense domain of topics that need to be explored if we are to continue the development of complex robot mechanisms. Industrial robots, and especially humanoid robots, open up many scientific intrigues that have not yet been answered. As an example, let us just mention that current humanoid robots are incapable of shrugging their shoulders. A movement that seems humanly childish is crucial for the reachability of the human arm, avoiding obstacles and, last but not least, for communications between people. High-performance computing and even artificial intelligence are undoubtedly tools that will help kinematicians solve the extremely difficult mathematical problems they have to deal with on a daily basis. The future of kinematics seems increasingly fascinating and unpredictable.

After 32 years, ARK is now back to where it all started. This edition is not held in the traditional June dates of the symposium because of the pandemic. As we write this preface, we still hope to be able to safely gather in Ljubljana later this year. We are grateful to the contributors of this volume for their work and enthusiasm. Some have been submitting their contributions for many years, and it is

because of them that the conference maintains its high quality. Special thanks go to Tadej Petrič, Conference Publishing Chair, who provided excellent technical support, and Aleš Ude, Conference Organizing Committee Chair. We are also grateful to the Springer staff who have supported our work throughout these years.

We hope that this new ARK book will again attract scholars and researchers specializing in robot kinematics and will outline the research guidelines for many years to come.

May 2020

Jadran Lenarčič
Bruno Siciliano

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