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Robotics Research

The 19th International Symposium ISRR

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 in 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, and 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 the 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, have 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 brings the proceedings of the seventeen edition of the International Symposium of Robotics Research (ISRR). The event took place in Hanoi, Vietnam, from October 6 to 10, 2019. The volume edited by Tamim Asfour, Eiichi Yoshida, Jaeheung Park, Philippe Bidaud, Henrik Christensen, and Oussama Khatib is a collection of 60 articles addressing a broad range of topics in robotics ranging from design to control, from vision to learning, and from planning to integrated systems. The content of these contributions provides a wide coverage of the current state of robotics research: the advances and challenges in its

theoretical foundation and technology basis, and the developments in its traditional and new emerging areas of applications. The diversity, novelty, and span of the work unfolding in these areas reveal the field's increased pace of development and expanded scope.

From its beautiful venue to its excellent program, the seventeen edition of ISRR culminates with this important reference on the current developments and new directions in the field of robotics—a true tribute to its contributors and organizers!

January 2021

Bruno Siciliano
Oussama Khatib
SPAR Editors

Preface

This volume contains the papers that were presented at the 17th International Symposium of Robotics Research (ISRR). This biennial meeting is sponsored and organized by the International Foundation of Robotics Research (IFRR). The ISRR promotes the development and dissemination of groundbreaking research and technological innovation in robotics useful to society by providing a lively, intimate, forward-looking forum for discussion and debate about the current status and future trends of robotics with great emphasis on its potential role to benefit humankind.

This particular meeting took place in Hanoi during October 6–10, 2019. As one of the pioneering symposia in robotics, ISRR has established some of the most fundamental and lasting contributions in the field bringing together top experts in robotics from overall world since 1983. The ISRR 2019 program comprises a combination of distinguished talks, oral and interactive presentations as well as an attractive social program. Eighteen distinguished talks were given by leading roboticists presenting blue sky ideas and their views on the field including past experience, lessons learned, success and failure stories of robotics, views on the future, latest developments in robotics, and impact of robotics on society. In addition, the program includes 60 presentations, each presented in oral and interactive sessions, giving time for discussions between the participants. All presented papers were selected in a peer-review process of submitted papers in response to an open call for papers.

Scientific interaction is the keyword of ISRR, and the social program was designed to support the rich discussions among participants in the most suitable conditions, culminating in the collective trip to admire the beautiful Halong Bay on October 9 of this inspiring gathering. In addition, a workshop on robotics and AI was organized at the Hanoi University of Science & Technology (HUST) on October 10 with several talks given by ISSR2019 invited speakers, participation of HUST representative, and more than 300 students.

We are very grateful to all the contributing authors, distinguished speakers, the program committee, reviewers, sponsors as well as the organization supporting teams in Hanoi and Karlsruhe for their contributions and support to ISRR 2019.

Finally, the meeting would not have been possible without the support of the Sandra Tartarelli, Christine Grinewitsch, and Fabian Paus from KIT. We acknowledge and thank them all.

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