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Guest Editorial: Robotics: Science and Systems 2018 (RSS 2018)

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This special edition of Autonomous Robots (AURO) features papers from the fourteenth Robotics: Science and Systems (RSS) conference. This conference, which brought together researchers for presentation and discussion of cutting-edge research in many areas of robotics, was hosted at Carnegie Music Hall next to Carnegie Mellon University in Pittsburgh, Pennsylvania, USA on June 26–30, 2018. The papers included in this special issue were selected from papers presented at RSS 2018 for their impact and significance to the field of robotics. This issue contains five papers on diverse topics spanning autonomous agricultural robots, human–machine interfaces for human–robot interaction, multi-agent navigation, motion synthesis of robotic manipulators, and route planning under motion constraints.

The first paper in this issue is "High Precision Control and Deep Learning-based Corn Stand Counting Algorithms for Agricultural Robot" by Zhongzhong Zhang, Erkan Kayacan, Ben Thompson, and Girish Chowdhary. This paper presents a 3D printed autonomous field robot for agriculture operations that uses a novel deep learning-based approach to automate the measurement of specific plant characteristics. Algorithms for object detection, visual tracking, estimation, navigation, and control are presented along with a detailed description of the TerraSentia robot developed for this purpose. Experimental results show high performance navigation and a vision system capable of performing labor-intensive agricultural survey operations without human intervention.

The next paper in this issue is "Plug-and-Play Supervisory Control Using Muscle and Brain Signals for Real-Time Gesture and Error Detection" by Joseph DelPreto, Andres F. Salazar-Gomez, Stephanie Gil, Ramin M. Hasani, Frank H. Guenther, and Daniela Rus. This paper introduces a novel approach to human–robot interaction using electromyography (EMG) and electroencephalography (EEG) biosignals. The technical approach classifies both hand gestures and brain signals to observe and correct robot mistakes when performing specific tasks. Experimental results involving target selection with a Baxter Research Robot with untrained human subjects are presented in this article.

The third paper in this special issue is "Planar Max Flow Maps and Determination of Lanes with Clearance" by Renato Farias and Marcelo Kallmann. This paper addresses the problem of route planning via continuous maximum flow in a two-dimensional environment with polygonal obstacles. The proposed approach, which leverages recent advances in GPU programming, optimizes lanes extracted from maximum flow maps to efficiently guide agents between source and sink locations. The paper also describes a variation of this method that additionally considers clearance between routes. Experimental results characterize the performance of path/lane length with respect to two baselines and show an increase in the number of agents able to navigate from source to sink in three different scenarios.

The fourth paper is "An Analysis of RelaxedIK: An Optimization-based Framework for Generating Accurate and Feasible Robot Arm Motions" by Daniel Rakita, Bilge Mutlu, and Michael Gleicher. This paper presents a real-time algorithm for synthesizing motions for controlling robot manipulators. This approach, called RelaxedIK, achieves pose boundary constraints while also avoiding joint-space discontinuities, kinematic singularities, and self-collisions through weighted-sum non-linear optimization. The article shows experimental results on seven simulated robot manipulators with between five and eight degrees of freedom that show fast solution times and no discontinuities, singularities, or self-collisions for a variety of inverse kinematics problems and compares the performance against three baselines. Additional experiments show the performance of RelaxedIK with different optimization solvers, gradient calculation methods, and objective functions.

The final paper in this special issue is "Optimal Solution of the Generalized Dubins Interval Problem" by Petr

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Váňa and Jan Faigl. This paper addresses the problem of finding the shortest path between two disk-shaped regions under departure and arrival heading constraints and curvature bounds. The approach, which transforms the problem into the One-Sided Generalized Dubins Interval Problem, is shown to find the optimal path between these boundary and motion constraints by identifying seven distinct maneuvers. The paper analyzes each of these maneuvers and finds analytical solutions for six of these seven types of motions and presents an optimization-based approach to solving the seventh. The paper also presents results in the context of the Dubins Touring Regions Problem, which searches for the shortest curvature-constrained path through a sequence of regions. The paper illustrates results for both the Generalized Dubins Internal Problem and the Dubins Touring Regions Problem in experimental results that analyze path length and solution times.

The editors would like to thank the reviewers for their efforts in reading the submissions and providing thoughtful comments that shaped the final versions of the papers included in this special issue. We would also like to thank Gaurav Sukhatme for the opportunity to put together this special issue on RSS 2018, Sarvagnan Subramanian for help in setting up and managing the online tools for submission, reviews, and edits, and Katherine Moretti for the final editing of the special issue. We believe that these five articles highlight exceptional work presented at RSS 2018 and hope that readers enjoy this special issue.