Lecture Notes in Artificial Intelligence 8810

Subseries of Lecture Notes in Computer Science

LNAI Series Editors

Randy Goebel
University of Alberta, Edmonton, Canada
Yuzuru Tanaka
Hokkaido University, Sapporo, Japan
Wolfgang Wahlster
DFKI and Saarland University, Saarbrücken, Germany

LNAI Founding Series Editor

Joerg Siekmann
DFKI and Saarland University, Saarbrücken, Germany

Davide Brugali Jan F. Broenink
Torsten Kroeger Bruce A. MacDonald (Eds.)

Simulation, Modeling, and Programming for Autonomous Robots

4th International Conference, SIMPAR 2014
Bergamo, Italy, October 20-23, 2014
Proceedings

Springer

Volume Editors

Davide Brugali
Università degli Studi di Bergamo, Department of Engineering
Viale Marconi 5, 24044 Dalmine, Italy
E-mail: brugali@unibg.it

Jan F. Broenink
University of Twente, Faculty EE-Math-CS
CTIT Institute, Robotics and Mechatronics Group
P.O. Box 217, 7500 AE Enschede, The Netherlands
E-mail: j.f.broenink@utwente.nl

Torsten Kroeger
Stanford University, Artificial Intelligence Laboratory
Stanford, CA 94305-9010, USA
E-mail: t@kroe.org

Bruce A. MacDonald
University of Auckland, Faculty of Engineering
Electrical and Computer Engineering, Science Centre - Mathphysic
38 Princess Street, Auckland 1010, New Zealand
E-mail: b.macdonald@auckland.ac.nz

ISSN 0302-9743 e-ISSN 1611-3349
ISBN 978-3-319-11899-4 e-ISBN 978-3-319-11900-7
DOI 10.1007/978-3-319-11900-7
Springer Cham Heidelberg New York Dordrecht London

Library of Congress Control Number: 2014950057

LNCS Sublibrary: SL 7 – Artificial Intelligence

© Springer International Publishing Switzerland 2014
This work is subject to copyright. All rights are reserved by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed. Exempted from this legal reservation are brief excerpts in connection with reviews or scholarly analysis or material supplied specifically for the purpose of being entered and executed on a computer system, for exclusive use by the purchaser of the work. Duplication of this publication or parts thereof is permitted only under the provisions of the Copyright Law of the Publisher's location, in ist current version, and permission for use must always be obtained from Springer. Permissions for use may be obtained through RightsLink at the Copyright Clearance Center. Violations are liable to prosecution under the respective Copyright Law.
The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.
While the advice and information in this book are believed to be true and accurate at the date of publication, neither the authors nor the editors nor the publisher can accept any legal responsibility for any errors or omissions that may be made. The publisher makes no warranty, express or implied, with respect to the material contained herein.

Typesetting: Camera-ready by author, data conversion by Scientific Publishing Services, Chennai, India

Printed on acid-free paper

Springer is part of Springer Science+Business Media (www.springer.com)

Preface

Robots are versatile machines that are increasingly being used not only to perform dirty, dangerous, and dull tasks in manufacturing industries, but also to achieve societal objectives, such as enhancing safety in transportation, reducing the use of pesticide in agriculture, helping people with health conditions, providing companionship, and improving efficacy in the fight against crime and civilian protection.

Compared to the manufacturing workcell, a public road, a cornfield, a hospital, a home, or a crime scene are open-ended environments, which require autonomous robots to be equipped with advanced cognitive capabilities, such as perception, planning, monitoring, coordination, and control in order to cope with unexpected situations reliably and safely.

In this scenario, the cost of creating new robotics products is significantly related to the complexity of developing software control systems that are robust, dependable, and whose correct behavior can be certified. This complexity can be managed by exploiting system engineering methodologies and tools that build on the power of software models and domain-specific programming languages to analyze, design, simulate, implement, test, and deploy complex robotic control systems.

The series of the International Conference on Simulation, Modeling, and Programming for Autonomous Robots (SIMPAR) is organized to foster research in the above topics. Gathering the most recent works in this field enhances the reusability of software for robotics and pushes research forward swiftly.

The 2014 event of SIMPAR was held at the "Giovanni XXIII" Conference Center in Bergamo, Italy during October 20–23. It followed the previous works of the first SIMPAR 2008 in Venice, Italy, the second SIMPAR 2010 in Darmstadt, Germany, and the third SIMPAR 2012 in Tsukuba, Japan and provided a forum for concentrated discussions on the topics of interest.

The number of submitted papers has increased steadily up to 62 for the SIMPAR 2014 event. Also the paper quality has increased significantly, which is demonstrated by the 49 contributed papers collected in this book. 41 papers were presented during regular sessions, while the remaining eight papers were presented as posters. Each submitted paper received at least two reviews by the members of a carefully selected international Program Committee.

We also had two impressive plenary talks presented by Raffaello D'Andrea (ETH Zurich, Swizerland) and Nate Koenig (Open Source Robotics Foundation, USA). A third plenary talk was planned to be given by Mike Stilman (Georgia Tech, USA), who passed away following an apparent accident in Atlanta on May 6th 2014, leaving all robotics community bereft of an emerging leader in humanoid robotics research.

We want to gratefully thank all Program Committee members and all other reviewers, supporters, organizers, and volunteers who contributed to this year's event of SIMPAR. Without their efforts, it would not be possible to hold this important conference.

October 2014

Davide Brugali
Jan Broenink
Torsten Kroeger
Bruce MacDonald

Organization

Program Committee

Martin Adams	Universidad de Chile, Chile
Hoseok Ahn	University of Auckland, New Zealand
Rachid Alami	LAAS, France
Monica Anderson	University of Alabama, USA
Noriaki Ando	AIST, Japan
Marcelo Ang	National University of Singapore, Singapore
Soumela Atmatzidou	Aristotle University of Thessaloniki, Greece
Ravi Balasubramanian	Oregon State University, USA
Kostas Bekris	Rutgers University, USA
Spring Berman	Arizona State University, USA
Geoffrey Biggs	AIST, Japan
Stan Birchfield	Clemson University, USA
Jan Broenink	University of Twente, The Netherlands
Davide Brugali	Università degli Studi di Bergamo, Italy
Zack Butler	Rochester Institute of Technology, USA
Mario Campos	Universidade Federal de Minas Gerais, Brazil
Stefano Carpin	University of California at Merced, USA
Filippo Cavallo	Scuola Superiore Sant'Anna, Italy
Heping Chen	Texas State University, USA
Ian Chen	Open Source Robotics Foundation, USA
Toby Collett	Auckland, New Zealand
Nikolaus Correll	University of Colorado at Boulder, USA
Anthony Cowley	University of Pennsylvania, USA
Mehmet Dogar	Massachusetts Institute of Technology, USA
Evan Drumwright	George Washington University, USA
Lars-Peter Ellekilde	University of Southern Denmark, Denmark
Vlad Estivill-Castro	Griffith University, Australia
Alessandro Farinelli	Verona University, Italy
David Feil-Seifer	University of Southern California, USA
Nicholas Gans	University of Texas at Dallas, USA
Luiz M. Garcia Gonçalves	Univ. Federal do Rio Grande do Norte, Brazil
Giuseppina Gini	Politecnico di Milano, Italy
Antoni Grau	Technical University of Catalonia, Spain
Takayuki Kanda	ATR, Japan
Hyun Kim	ETRI, South Korea
Jaehong Kim	ETRI, South Korea
Tomasz Kornuta	Warsaw University of Technology, Poland

Jana Kosecka	George Mason University, USA
Tetsuo Kotoku	AIST, Japan
Gerhard Kraetzschmar	Bonn-Rhein-Sieg University of Applied Sciences, Germany
Torsten Kroeger	Stanford University, USA
Daniel Kubus	TU Braunschweig, Germany
Dana Kulić	University of Waterloo, Canada
Konrad Kułakowski	AGH University of Science and Technology, Poland
Jyh-Ming Lien	George Mason University, USA
Dikai Liu	University of Technology Sydney, Australia
Bruce MacDonald	University of Auckland, New Zealand
Iraklis Markelis	Aristotle University of Thessaloniki, Greece
Emanuele Menegatti	University of Padua, Italy
Michael Milford	Queensland University of Technology, Australia
Issa Nesnas	Jet Propulsion Laboratory, USA
Itsuki Noda	AIST, Japan
Cyril Novales	Université d'Orléans, France
Jason O'Kane	University of South Carolina, USA
Sangrok Oh	KIST, South Korea
Hong Seong Park	Kangwon National University, South Korea
Bruno Patin	Dassault Aviation, France
Raquel E. Patiño Escarcina	Universidad Católica San Pablo, Peru
Alba Pérez Gracia	Idaho State University, USA
Anna Helena Reali Costa	Universidade de São Paulo, Brazil
Christian Schlegel	Ulm University of Applied Sciences, Germany
Ulrik Page Schultz	University of Southern Denmark, Denmark
Dezhen Song	Texas A&M University, USA
Domenico G. Sorrenti	Universita' degli Studi di Milano, Italy
Gerald Steinbauer	Graz University of Technology, Austria
Serge Stinckwich	Institute de Recherche pour le Développement, France
David Stirling	University of Wollongong, Australia
Lydia Tapia	University of New Mexico, USA
Flavio Tonidandel	Centro Universitario da FEI, Brazil
Jeff Trinkle	Rensselaer Polytechnic Institute, USA
Piotr Trojanek	Warsaw University of Technology, Poland
Pieter Van Zutven	Eindhoven University of Technology, The Netherlands
Cristina Vicente-Chicote	Universidad de Extremadura, Spain
Oskar von Stryk	Technische Universität Darmstadt, Germany
Marsette Vona	Northeastern University, USA
Ralf Waspe	RWTH Aachen, Germany
Uchechukwu Wejinya	Michigan State University, USA
Burkhard Wuensche	The University of Auckland, New Zealand
Wonpil Yu	ETRI, South Korea

Massimiliano Zecca	Loughborough University, UK
Hong Zhang	University of Alberta, Canada
Cezary Zielinski	Warsaw University of Technology, Poland
Uwe Zimmerman	KUKA Laboratories, Germany

Additional Reviewers

Baumann, Oliver
Hochgeschwender, Nico
Kim, Doik
Kluth, Jan-Henrik
Lu, Yan
Mobilio, Marco
Muxfeldt, Arne
Raibulet, Claudia
Roop, Partha
Taylor, James
Was, Jaroslaw

Table of Contents

Simulation

Making Time Make Sense in Robotic Simulation 1
James R. Taylor, Evan M. Drumwright, and Gabriel Parmer

Simulation and HRI Recent Perspectives with the MORSE Simulator . . . 13
Séverin Lemaignan, Marc Hanheide, Michael Karg, Harmish Khambhaita, Lars Kunze, Florian Lier, Ingo Lütkebohle, and Grégoire Milliez

A Dynamic Simulator for Underwater Vehicle-Manipulators 25
Olivier Kermorgant

Extending Open Dynamics Engine for the DARPA Virtual Robotics Challenge 37
John M. Hsu and Steven C. Peters

Control and Scheduling Co-design for a Simulated Quadcopter Robot: A Model-Driven Approach 49
Matteo Morelli and Marco Di Natale

Simulating Human-Robot Interactions for Dialogue Strategy Learning 62
Grégoire Milliez, Emmanuel Ferreira, Michelangelo Fiore, Rachid Alami, and Fabrice Lefèvre

A Simulation Based Architecture for the Development of an Autonomous All Terrain Vehicle 74
Gianluca Bardaro, Davide Antonio Cucci, Luca Bascetta, and Matteo Matteucci

Applying Simulation and a Domain-Specific Language for an Adaptive Action Library 86
Jacob Pørksen Buch, Johan Sund Laursen, Lars Carøe Sørensen, Lars-Peter Ellekilde, Dirk Kraft, Ulrik Pagh Schultz, and Henrik Gordon Petersen

Simulation Environment for Multi-robot Cooperative 3D Target Perception 98
André Dias, Jose Almeida, Nuno Dias, Pedro Lima, and Eduardo Silva

Combining Complex Simulations with Realistic Virtual Testing Environments – The eRobotics-Approach for Semantics-Based Multi-domain VR Simulation Systems 110
Nico Hempe, Ralf Waspe, and Juergen Rossmann

Modeling

Analysis of Knee-Ankle Orthosis Modelling: An Inverse Dynamics Approach Using Adaptive Coupled Oscillator 122
Michael Oluwatosin Ajayi, Karim Djouani, and Yskandar Hamam

Optimizing Robotic Team Performance with Probabilistic Model Checking 134
Sagar Chaki, Joseph Giampapa, David Kyle, and John Lehoczky

Modelling and Analysis of a Redundant Mobile Robot Architecture Using AADL 146
Geoffrey Biggs, Kiyoshi Fujiwara, and Keiju Anada

Fault Avoidance in Development of Robot Motion-Control Software by Modeling the Computation 158
Yury Brodskiy, Robert Wilterdink, Stefano Stramigioli, and Jan Broenink

Robotic Engineer's Specifications for a Well-Fitted Model-Driven Control Architecture for Robots 170
Éric Moliné, Nicolas Morette, Cyril Novales, and Pierre Vieyres

Programming

High Performance Relaying of `C++11` Objects across Processes and Logic-Labeled Finite-State Machines 182
Vlad Estivill-Castro, René Hexel, and Carl Lusty

A Survey on Domain-Specific Languages in Robotics 195
Arne Nordmann, Nico Hochgeschwender, and Sebastian Wrede

Towards Rule-Based Dynamic Safety Monitoring for Mobile Robots 207
Sorin Adam, Morten Larsen, Kjeld Jensen, and Ulrik Pagh Schultz

A Proposed Software Framework Aimed at Energy-Efficient Autonomous Driving of Electric Vehicles 219
José-Luis Torres Moreno, José-Luis Blanco Claraco, Mauro Bellone, Francisco Rodrìguez, Antonio Gimènez, and Giulio Reina

Structured Design and Development of Domain-Specific Languages in Robotics 231
Sven Schneider, Nico Hochgeschwender, and Gerhard K. Kraetzschmar

ROS-I Interface for COMAU Robots 243
Stefano Michieletto, Elisa Tosello, Fabrizio Romanelli, Valentina Ferrara, and Emanuele Menegatti

Robot Unit Testing 255
Andreas Bihlmaier and Heinz Wörn

IMI2S: A Lightweight Framework for Distributed Computing 267
Salvatore M. Anzalone, Marie Avril, Hanan Salam, and Mohamed Chetouani

Are Middlewares Ready for Multi-robots Systems? 279
Stefan-Gabriel Chitic, Julien Ponge, and Olivier Simonin

Architectures

Declarative Specification of Robot Perception Architectures 291
Nico Hochgeschwender, Sven Schneider, Holger Voos, and Gerhard K. Kraetzschmar

A Modeling Framework for Software Architecture Specification and Validation 303
Nicolas Gobillot, Charles Lesire, and David Doose

Reverse Engineering of Middleware for Verification of Robot Control Architectures 315
Ali Khalili, Lorenzo Natale, and Armando Tacchella

An Extensible Software Architecture for Composing Motion and Task Planners 327
Zakary Littlefield, Athanasios Krontiris, Andrew Kimmel, Andrew Dobson, Rahul Shome, and Kostas E. Bekris

A Component-Based Meta-Model and Framework in the Model Driven Toolchain C-Forge 340
Francisco J. Ortiz, Diego Alonso, Francisca Rosique, Francisco Sánchez-Ledesma, and Juan A. Pastor

Methods and Tools

Merging Partially Consistent Maps 352
Taigo Maria Bonanni, Giorgio Grisetti, and Luca Iocchi

Lower Limb Stiffness Estimation during Running: The Effect of Using Kinematic Constraints in Muscle Force Optimization Algorithms 364
Roberto Bortoletto, Enrico Pagello, and Davide Piovesan

On the Benefits of Component-Defined Real-Time Visualization of Robotics Software 376
Max Reichardt, Gregor Zolynski, Michael Arndt, and Karsten Berns

A Primate-Inspired Autonomous Navigation Algorithm Using the Cognitive Mechanism of Mental Rotation 388
Michael J. Pettinati and Ronald C. Arkin

The Cognitive Interaction Toolkit – Improving Reproducibility of Robotic Systems Experiments 400
Florian Lier, Johannes Wienke, Arne Nordmann, Sven Wachsmuth, and Sebastian Wrede

Enhancing Humanoids' Walking Skills through Morphogenesis Evolution Method 412
Nicolas Jouandeau and Vincent Hugel

Stability Analysis of Densest Packing of Objects Using Partial Order Representation of Feasible Procedural Sequences 424
Hiromu Onda

Team Size Optimization for Multi-robot Exploration 438
Zhi Yan, Luc Fabresse, Jannik Laval, and Noury Bouraqadi

Automatic Evaluation of Task-Focused Parallel Jaw Gripper Design 450
Adam Wolniakowski, Konstantsin Miatliuk, Norbert Krüger, and Jimmy Alison Rytz

Automatic Verification of Autonomous Robot Missions 462
Matthew O'Brien, Ronald C. Arkin, Dagan Harrington, Damian Lyons, and Shu Jiang

Probabilistic 2D Acoustic Source Localization Using Direction of Arrivals in Robot Sensor Networks 474
Riccardo Levorato and Enrico Pagello

Control and Omni-directional Locomotion of a Crawling Quadruped 486
Douwe Dresscher, Michiel van der Coelen, Jan Broenink, and Stefano Stramigioli

Embodiment Sensing for Self-generated Zigzag Turning Algorithm Using Vision-Based Plume Diffusion 498
Jouh Yeong Chew, Takumi Yoshihara, and Daisuke Kurabayashi

Handling of Asynchronous Data Flow in Robot Perception Subsystems 509
Maciej Stefańczyk and Tomasz Kornuta

Systems and Applications

Design of a Healthcare Sensor Managing System for Vital Sign Measuring Devices 521
Min Ho Lee, Ho Seok Ahn, Kevin Wang, and Bruce A. MacDonald

Kinesthetic Teaching in Assembly Operations – A User Study 533
Arne Muxfeldt, Jan-Henrik Kluth, and Daniel Kubus

A Constraint Based Motion Optimization System for Quality Inspection Process Improvement 545
Nicolò Boscolo, Elisa Tosello, Stefano Tonello, Matteo Finotto, Roberto Bortoletto, and Emanuele Menegatti

Dealing with Conflicting Requirements in Robot System Engineering: A Laboratory-Based Course 554
Luca Gherardi, Davide Brugali, and Andrea Luzzana

Using Augmented Measurements to Improve the Convergence of ICP . . . 566
Jacopo Serafin and Giorgio Grisetti

Design of a Kiosk Type Healthcare Robot System for Older People in Private and Public Places 578
Ho Seok Ahn, I-Han Kuo, Chandan Datta, Rebecca Stafford, Ngaire Kerse, Kathy Peri, Elizabeth Broadbent, and Bruce A. MacDonald

Erratum

Automatic Evaluation of Task-Focused Parallel Jaw Gripper Design E1
Adam Wolniakowski, Konstantsin Miatliuk, Norbert Krüger, and Jimmy Alison Rytz

Author Index 591