

Lecture Notes in Artificial Intelligence 6856

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

Roderich Groß Lyuba Alboul
Chris Melhuish Mark Witkowski
Tony J. Prescott Jacques Penders (Eds.)

Towards Autonomous Robotic Systems

12th Annual Conference, TAROS 2011
Sheffield, UK, August 31 – September 2, 2011
Proceedings

Series Editors

Randy Goebel, University of Alberta, Edmonton, Canada
Jörg Siekmann, University of Saarland, Saarbrücken, Germany
Wolfgang Wahlster, DFKI and University of Saarland, Saarbrücken, Germany

Volume Editors

Roderich Groß
The University of Sheffield, Sheffield, UK, E-mail: r.gross@sheffield.ac.uk

Lyuba Alboul
Sheffield Hallam University, Sheffield, UK, E-mail: l.alboul@shu.ac.uk

Chris Melhuish
University of Bristol and University of the West of England, Bristol, UK
E-mail: chris.melhuish@brl.ac.uk

Mark Witkowski
Imperial College London, London, UK, E-mail: m.witkowski@imperial.ac.uk

Tony J. Prescott
The University of Sheffield, Sheffield, UK, E-mail: t.j.prescott@sheffield.ac.uk

Jacques Penders
Sheffield Hallam University, Sheffield, UK, E-mail: j.penders@shu.ac.uk

ISSN 0302-9743 e-ISSN 1611-3349
ISBN 978-3-642-23231-2 e-ISBN 978-3-642-23232-9
DOI 10.1007/978-3-642-23232-9
Springer Heidelberg Dordrecht London New York

Library of Congress Control Number: 2011934359

CR Subject Classification (1998): I.2.9, I.2, I.4, H.5

LNCS Sublibrary: SL 7 – Artificial Intelligence

© Springer-Verlag Berlin Heidelberg 2011

This work is subject to copyright. All rights are reserved, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, re-use of illustrations, recitation, broadcasting, reproduction on microfilms or in any other way, and storage in data banks. Duplication of this publication or parts thereof is permitted only under the provisions of the German Copyright Law of September 9, 1965, in its current version, and permission for use must always be obtained from Springer. Violations are liable to prosecution under the German Copyright Law.

The use of general descriptive names, registered names, trademarks, 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.

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

These proceedings contain the papers presented at TAROS 2011, the 12th edition of the conference Towards Autonomous Robotic Systems, held in Sheffield, UK, from August 31 to September 2, 2011.

The TAROS series was initiated by Ulrich Nehmzow in 1997 in Manchester, when the conference was known as “Towards Intelligent Mobile Robots” (TIMR). In 1999, Chris Melhuish joined Ulrich to form a conference Steering Committee, which was also joined by Mark Witkowski in 2003; at that time the name of the conference was also changed to “Towards Autonomous Robotic Systems” to better reflect the full breadth of UK research activities in robotics. The Steering Committee has provided continuity of vision as the conference has evolved to become the UK’s premier annual conference on autonomous robots, whilst also achieving an increasingly international attendance. Sadly, Ulrich Nehmzow died in 2010 after a long period of illness—a very great loss to UK robotics. To honor Ulrich’s contributions throughout the years, the TAROS best paper award has therefore been named the “Ulrich Nehmzow Best Paper Award.”

For the 2011 edition, TAROS received 94 paper submissions. We offered two submission categories—full-length papers, of which 74 submissions were received, and extended abstracts, of which we received 20 submissions. Most papers were reviewed by three members of our International Programme Committee. Of the full-length paper submissions, 32 were accepted as full-length papers, corresponding to an acceptance rate of 43%. Also included in this volume are 30 extended abstracts which were selected from the remaining 62 submissions. Of the full-length papers, 20 of the most highly ranked were selected for oral presentation at the conference. All other contributions, including extended abstracts, were presented in poster format. The publication of the collected papers from TAROS 2011 by Springer, in the *Lecture Notes in Artificial Intelligence* (LNAI) series, testifies to the high standard of the research efforts reported here. Following the conference, the journal *Robotics and Autonomous Systems* will publish extended and revised versions of some of the best papers presented at the meeting. This theme issue will also be dedicated to the memory of Ulrich Nehmzow.

TAROS was originally intended as a forum enabling PhD students to have their first conference experience. Whilst the conference has become larger and now attracts a wide range of papers, from both senior and junior scientists, the ethos of providing an event that encourages new researchers has been retained. TAROS 2011 was therefore a single-track event with many of the platform talks presented by postgraduates—for some their first public talk. The conference also featured three distinguished plenary presentations: “Approaches to Autonomous

Behavior with Simple Neural Networks” by Joseph Ayers, “Robot Navigating, Mapping and Understanding with Laser and Vision” by Paul Newman, and “Bioinspired Assistive Robotics for Children and Adults with Special Needs” by Yiannis Demiris.

Worldwide robotics is evolving quickly, and whilst the UK has a strong research community in robotics (evidenced, for instance, by our leading contribution to the EU Challenge 2 programme for robotics and cognitive systems), it is essential that this community becomes better organized and more effective in recognizing and exploiting commercial opportunities. In recent years the aims of TAROS have therefore expanded to include the goal of forging links with UK companies and commercial organizations that build or use robots. To encourage these interactions, TAROS 2011 hosted an Industry-Academia day, featuring a plenary talk from Simon Blackmore on agricultural robots, a platform discussion with representatives from UK and European funding organizations, and a public exhibition with live demonstrations of robotic systems. The Industry-Academia day also included the launch of a new forum for UK robotics researchers which was established with the support of the British Automation and Robot Association (BARA) and will be known as the BARA Academic Forum (BARA-AFR). The forum will provide a direct link between robotics researchers and the UK robotics industry facilitating technology transfer and improving the focus of robotics research toward commercial and industrial needs.

Finally, TAROS 2011 provided the opportunity for the local hosts—Sheffield Hallam University and the University of Sheffield—to launch their new city-wide initiative for robotics research. The Sheffield Centre for Robotics (SCentRo) will bring together five existing research groups across the two universities with the aim of enhancing inter-disciplinary research and raising the profile of robotics research in Sheffield.

We take this opportunity to thank the many people that were involved in making TAROS 2011 possible. On the organizational side this included Amir Naghsh, Alan Holloway, Georgios Chliveros, Charles Fox, Tony Dodd, Kevin Gurney, Gillian Hill, Jane Wright and Gill Ryder. We would also like to thank the authors who contributed their work, and the members of the International Programme Committee, and the additional referees, for their detailed and considered reviews. We are grateful to the four keynote speakers who shared with us their vision of the future.

Finally, we wish to thank the sponsors of TAROS 2011: Sheffield Hallam University, The University of Sheffield, The British Automation and Robot Association, The Institution of Engineering and Technology (sponsor of a public talk), Springer (Ulrich Nehmzow Best Paper Award), and the IEEE Robotics and Automation Society UKRI Chapter (co-sponsor).

We hope the reader will find this volume useful both as a reference to current research in autonomous robotic systems and as a starting point for their own future work. If you are inspired by this research we would encourage you to submit to future editions of TAROS!

June 2011

The TAROS 2011 Programme Committee

Jacques Penders

Tony Prescott

Roderich Groß

Lyuba Alboul

The TAROS Steering Committee

Chris Melhuish

Mark Witkowski

Organization

TAROS 2011 was organized jointly by Sheffield Hallam University and the University of Sheffield.

Conference Chairs

Jacques Penders	Sheffield Hallam University, UK
Tony Prescott	The University of Sheffield, UK

Organizing Committee

Roderich Groß (Technical Programme)	The University of Sheffield, UK
Lyuba Alboul (Technical Programme)	Sheffield Hallam University, UK
Alan Holloway (Industry-Academia Workshop and Exhibition)	Sheffield Hallam University, UK
Georgios Chliveros (Industry-Academia Workshop and Exhibition)	Sheffield Hallam University, UK
Charles Fox (Industry-Academia Workshop and Exhibition)	The University of Sheffield, UK
Amir Naghsh (Publication Chair)	Sheffield Hallam University, UK
Tony Dodd	The University of Sheffield, UK
Kevin Gurney	The University of Sheffield, UK

General Enquiries

Gillian Hill	Sheffield Hallam University, UK
Gill Ryder	University of Sheffield, UK

TAROS Steering Committee

Chris Melhuish	University of the West of England, UK
Mark Witkowski	Imperial College London, UK

Programme Committee

Francesco Amigoni	Politecnico di Milano, Italy
Christos Ampatzis	Research Executive Agency, Belgium
Iain Anderson	The University of Auckland, New Zealand
Brenna Argall	EPFL, Switzerland
Ronald C. Arkin	Georgia Institute of Technology, GA, USA
Lijin Aryananda	Universität Zürich, Switzerland
Joseph Ayers	Northeastern University, MA, USA
Tony Belpaeme	University of Plymouth, UK
Luc Berthouze	University of Sussex, UK
Simon Blackmore	Unibots Ltd., UK
Martin Brown	The University of Manchester, UK
Joanna Bryson	University of Bath, UK
Guido Bugmann	University of Plymouth, UK
Lola Canamero	University of Hertfordshire, UK
Andrea Carbone	Université Pierre et Marie Curie, France
Gregory Chirikjian	Johns Hopkins University, MD, USA
Anders Lyhne Christensen	Instituto de Telecomunicações & Instituto Universitário de Lisboa, Portugal
David Johan Christensen	Technical University of Denmark, Denmark
Mark Cutkosky	Stanford University, CA, USA
Torbjørn Semb Dahl	University of Wales, UK
Kerstin Dautenhahn	University of Hertfordshire, UK
Geert De Cubber	Royal Military Academy, Belgium
Yiannis Demiris	Imperial College London, UK
Peter Dominey	CNRS and INSERM U846, France
Stéphane Doncieux	Université Pierre et Marie Curie, France
Marco Dorigo	Université Libre de Bruxelles, Belgium
Toshio Fukuda	Nagoya University, Japan
Simon Garnier	Princeton University, NJ, USA
Antonios Gasteratos	Democritus University of Thrace, Greece
Dongbing Gu	University of Essex, UK
Verena Hafner	Humboldt-Universität zu Berlin, Germany
Heiko Hamann	Karl-Franzens-Universität Graz, Austria
William Harwin	University of Reading, UK
Ani Hsieh	Drexel University, PA, USA
Huosheng Hu	University of Essex, UK
Phil Husbands	University of Sussex, UK
Roberto Iglesias Rodríguez	Universidade de Santiago de Compostela, Spain
Yaochu Jin	University of Surrey, UK
Serge Kernbach	Universität Stuttgart, Germany
Annemarie Kokosy	ISEN, France
Maarja Kruusmaa	Tallinn University of Technology, Estonia
Haruhisa Kurokawa	AIST, Japan

Theocharis Kyriacou	Keele University, UK
Fred Labrosse	Aberystwyth University, UK
Stanislao Lauria	Brunel University, UK
Mark Lee	Aberystwyth University, UK
Nathan Lepora	The University of Sheffield, UK
Hod Lipson	Cornell University, NY, USA
Stéphane Magnenat	ETH Zurich, Switzerland
Raul Marin	Universitat Jaume I, Spain
Chris Melhuish	University of the West of England, UK
Giorgio Metta	Università degli Studi di Genova, Italy
Ben Mitchinson	The University of Sheffield, UK
Francesco Mondada	EPFL, Switzerland
Lazaros Nalpantidis	Democritus University of Thrace, Greece
Samia Nefti-Meziani	University of Salford, UK
Paul Newman	University of Oxford, UK
Cagdas D. Onal	MIT, MA, USA
Martin Pearson	University of the West of England, UK
Tony Pipe	University of the West of England, UK
Marcos Rodrigues	Sheffield Hallam University, UK
Ferdinando Rodriguez y Baena	Imperial College, UK
Erol Şahin	Middle East Technical University, Turkey
Thomas Schmickl	Karl-Franzens-Universität Graz, Austria
Kasper Støy	University of Southern Denmark, Denmark
Mototaka Suzuki	Columbia University, NY, USA
Jon Timmis	The University of York, UK
M. Osman Tokhi	The University of Sheffield, UK
Vito Trianni	Université Libre de Bruxelles, Belgium
Elio Tuci	Aberystwyth University, UK
Bram Vanderborght	Vrije Universiteit Brussel, Belgium
Richard T. Vaughan	Simon Fraser University, Canada
Hugo Vieira Neto	Universidade Tecnológica Federal do Paraná, Brazil
Gurvinder Virk	Massey University, New Zealand
Marsette Vona	Northeastern University, MA, USA
Barbara Webb	The University of Edinburgh, UK
Myra Wilson	University of Wales, UK
Alan Winfield	University of the West of England, UK
Mark Witkowski	Imperial College London, UK
Ulf Witkowski	South Westphalia University of Applied Sciences, Germany
Hartmut Witte	Technische Universität Ilmenau, Germany
Jeremy Wyatt	University of Birmingham, UK
Masaki Yamakita	Tokyo Institute of Technology, Japan
Klaus-Peter Zauner	University of Southampton, UK
Jianwei Zhang	Universität Hamburg, Germany

Additional Referees

Alberto Albiol	Micha Hersch	Basilio Noris
Verónica Esther	Geoffrey Hollinger	Jose Nunez-Varela
Arriola Ríos	Kaijen Hsiao	Dmitry Oleynikov
Alper Bozkurt	Karl Iagnemma	Amit Kumar Pandey
Ladislau Bölöni	Hannes Kaufmann	Pei-Luen Patrick Rau
Joost Broekens	Jean-François Lalonde	James Roberts
Lucian Busoni	Friedrich Lange	Raphael Rouveure
Sotirios Chatzis	Antonio Leite	Selma Šabanović
Liang Ding	Mohamed Marzouqi	Felix Stephan Schill
Nadia Garcia-Hernandez	Matteo Matteucci	Jeffrey Too Chuan Tan
Jim Gilbert	Annalisa Milella	Rich Walker
Fernando Gómez Bravo	Michael Milford	Wenwei Yu
Dan Grollman	Luis Yoichi Morales Saiki	Claudio Zito
Lars Hammarstrand	Jozsef Nemeth	
Just Herder	Juan Nieto	

Sponsoring Institutions

Sheffield Hallam University, Sheffield, UK
<http://www.shu.ac.uk>

The University of Sheffield, Sheffield, UK
<http://www.shef.ac.uk>

The British Automation and Robot Association (BARA), UK
<http://www.bara.org.uk>

The Institution of Engineering and Technology (IET), UK
<http://www.theiet.org>

Springer, London, UK (as a sponsor of the Ulrich Nehmzow Best Paper Award)
<http://www.springer.com>

IEEE Robotics and Automation Society UKRI Chapter
(as a technical co-sponsor)
<http://ieee-ukri.org>

Table of Contents

A Cricket-Controlled Robot Orienting towards a Sound Source.....	1
<i>Jan Wessnitzer, Alexandros Asthenidis, Georgios Petrou, and Barbara Webb</i>	
A General Classifier of Whisker Data Using Stationary Naive Bayes: Application to BIOTACT Robots	13
<i>Nathan F. Lepora, Charles W. Fox, Mat Evans, Ben Mitchinson, Asma Motiwala, J. Charlie Sullivan, Martin J. Pearson, Jason Welsby, Tony Pipe, Kevin Gurney, and Tony J. Prescott</i>	
A Navigation System for a High-Speed Professional Cleaning Robot	24
<i>Gorka Azkune, Mikel Astiz, Urko Esnaola, Unai Antero, Jose Vicente Sogorb, and Antonio Alonso</i>	
A Recursive Least Squares Solution for Recovering Robust Planar Homographies	36
<i>Saad Ali Imran and Nabil Aouf</i>	
Airborne Ultrasonic Position and Velocity Measurement Using Two Cycles of Linear-Period-Modulated Signal	46
<i>Shinya Saito, Minoru Kuribayashi Kurosawa, Yuichiro Orino, and Shinnosuke Hirata</i>	
An Eye Detection and Localization System for Natural Human and Robot Interaction without Face Detection	54
<i>Xinguo Yu, Weicheng Han, Liyuan Li, Ji Yu Shi, and Gang Wang</i>	
An Implementation of a Biologically Inspired Model of Head Direction Cells on a Robot	66
<i>Theocharis Kyriacou</i>	
Contextual Recognition of Robot Emotions	78
<i>Jiaming Zhang and Amanda J.C. Sharkey</i>	
Costs and Benefits of Behavioral Specialization	90
<i>Arne Brutschy, Nam-Luc Tran, Nadir Baiboun, Marco Frison, Giovanni Pini, Andrea Roli, Marco Dorigo, and Mauro Birattari</i>	
CrunchBot: A Mobile Whiskered Robot Platform	102
<i>Charles W. Fox, Mathew H. Evans, Nathan F. Lepora, Martin Pearson, Andy Ham, and Tony J. Prescott</i>	

Deformation-Based Tactile Feedback Using a Biologically-Inspired Sensor and a Modified Display	114
<i>Calum Roke, Chris Melhuish, Tony Pipe, David Drury, and Craig Chorley</i>	
Design and Control of an Upper Limb Exoskeleton Robot RehabRoby	125
<i>Fatih Ozkul and Duygun Erol Barkana</i>	
Distributed Motion Planning for Ground Objects Using a Network of Robotic Ceiling Cameras	137
<i>Andreagiovanni Reina, Gianni A. Di Caro, Frederick Ducatelle, and Luca M. Gambardella</i>	
Evaluating the Effect of Robot Group Size on Relative Localisation Precision	149
<i>Frank E. Schneider and Dennis Wildermuth</i>	
Instance-Based Reinforcement Learning Technique with a Meta-learning Mechanism for Robust Multi-Robot Systems	161
<i>Toshiyuki Yasuda, Motohiro Wada, and Kazuhiro Ohkura</i>	
Locomotion Selection and Mechanical Design for a Mobile Intra-abdominal Adhesion-Reliant Robot for Minimally Invasive Surgery	173
<i>Alfonso Montellano López, Mojtaba Khazravi, Robert Richardson, Abbas Dehghani, Rupesh Roshan, Tomasz Liskiewicz, Ardian Morina, David G. Jayne, and Anne Neville</i>	
Mapping with Sparse Local Sensors and Strong Hierarchical Priors	183
<i>Charles W. Fox and Tony J. Prescott</i>	
Multi-rate Visual Servoing Based on Dual-Rate High Order Holds	195
<i>J. Ernesto Solanes, Josep Tornero, Leopoldo Armesto, and Vicent Girbés</i>	
Optimal Path Planning for Nonholonomic Robotic Systems via Parametric Optimisation	207
<i>James Biggs</i>	
Probabilistic Logic Reasoning about Traffic Scenes	219
<i>Carlos R.C. Souza and Paulo E. Santos</i>	
Real-World Reinforcement Learning for Autonomous Humanoid Robot Charging in a Home Environment	231
<i>Nicolás Navarro, Cornelius Weber, and Stefan Wermter</i>	

Robot Routing Approaches for Convoy Merging Maneuvers	241
<i>Fernando Valdes, Roberto Iglesias, Felipe Espinosa, Miguel A. Rodríguez, Pablo Quintia, and Carlos Santos</i>	
Sensing with Artificial Tactile Sensors: An Investigation of Spatio-temporal Inference	253
<i>Asma Motiwala, Charles W. Fox, Nathan F. Lepora, and Tony J. Prescott</i>	
Short-Range Radar Perception in Outdoor Environments	265
<i>Giulio Reina, James Underwood, and Graham Brooker</i>	
Smooth Kinematic Controller vs. Pure-Pursuit for Non-holonomic Vehicles	277
<i>Vicent Gurbés, Leopoldo Armesto, Josep Tornero, and J. Ernesto Solanes</i>	
Supervised Traversability Learning for Robot Navigation	289
<i>Ioannis Kostavelis, Lazaros Nalpantidis, and Antonios Gasteratos</i>	
Task Space Integral Sliding Mode Controller Implementation for 4DOF of a Humanoid BERT II Arm with Posture Control	299
<i>Said Ghani Khan, Jamaludin Jalani, Guido Herrmann, Tony Pipe, and Chris Melhuish</i>	
Towards Autonomous Energy-Wise ROBJECTS	311
<i>Florian Vaussard, Michael Bonani, Philippe Rétornaz, Alcherio Martinoli, and Francesco Mondada</i>	
Towards Safe Human-Robot Interaction	323
<i>Elena Corina Grigore, Kerstin Eder, Alexander Lenz, Sergey Skachek, Anthony G. Pipe, and Chris Melhuish</i>	
Towards Temporal Verification of Emergent Behaviours in Swarm Robotic Systems	336
<i>Clare Dixon, Alan Winfield, and Michael Fisher</i>	
Walking Rover Trafficability - Presenting a Comprehensive Analysis and Prediction Tool	348
<i>Brian Yeomans and Chakravathini M. SaaJ</i>	
What Can a Personal Robot Do for You?	360
<i>Guido Bugmann and Simon N. Copleston</i>	

Extended Abstracts

A Systems Integration Approach to Creating Embodied Biomimetic Models of Active Vision	372
<i>Alex Cope, Jon Chambers, and Kevin Gurney</i>	

A Validation of Localisation Accuracy Improvements by the Combined Use of GPS and GLONASS	374
<i>Dennis Wildermuth and Frank E. Schneider</i>	
Adaptive Particle Filter for Fault Detection and Isolation of Mobile Robots	376
<i>Michał Zając</i>	
An Approach to Improving Attitude Estimation Based on Low-Cost MEMS-IMU for Mobile Robot Navigation	378
<i>Lu Lou, Mark Neal, Frédéric Labrosse, and Juan Cao</i>	
Cooperative Multi-robot Box Pushing Inspired by Human Behaviour ...	380
<i>Jianing Chen and Roderich Groß</i>	
Cooperative Navigation and Integration of a Human into Multi-robot System	382
<i>Joan Saez-Pose, Amir M. Naghsh, and Leo Nomdedeu</i>	
Coordination in Multi-tiered Robotic Search	384
<i>Paul Ward and Stephen Cameron</i>	
Covert Robotics: Improving Covertness with Escapability and Non-Line-of-Sight Sensing	386
<i>Tom Moore, Richard Ratmanský, Bob Chevalier, David Sharp, Vincent Baker, and Brian Satterfield</i>	
Designing Electric Propulsion Systems for UAVs	388
<i>Mohamed Kara Mohamed, Sourav Patra, and Alexander Lanzon</i>	
Enhancing Self-similar Patterns by Asymmetric Artificial Potential Functions in Partially Connected Swarms	390
<i>Giuliano Punzo, Derek Bennet, and Malcolm Macdonald</i>	
Evolving Modularity in Robot Behaviour Using Gene Expression Programming	392
<i>Jonathan Mwaura and Ed Keedwell</i>	
Forming Nested 3D Structures Based on the Brazil Nut Effect	394
<i>Stephen Foster and Roderich Groß</i>	
Grasping of Deformable Objects Applied to Organic Produce	396
<i>Alon Ohev-Zion and Amir Shaprio</i>	
Learning to Grasp Information with Your Own Hands	398
<i>Dimitri Ognibene, Nicola Catenacci Volpi, and Giovanni Pezzulo</i>	

Long-Term Experiment Using an Adaptive Appearance-Based Map for Visual Navigation by Mobile Robots	400
<i>Feras Dayoub, Grzegorz Cielniak, and Tom Duckett</i>	
Occupancy Grid-Based SLAM Using a Mobile Robot with a Ring of Eight Sonar Transducers	402
<i>George Terzakis and Sanja Dogramadzi</i>	
On the Analysis of Parameter Convergence for Temporal Difference Learning of an Exemplar Balance Problem	404
<i>Martin Brown and Onder Tutsoy</i>	
Online Hazard Analysis for Autonomous Robots	406
<i>Roger Woodman, Alan F.T. Winfield, Chris Harper, and Mike Fraser</i>	
Results of the European Land Robot Trial and Their Usability for Benchmarking Outdoor Robot Systems	408
<i>Frank E. Schneider and Dennis Wildermuth</i>	
Solutions for a Variable Compliance Gripper Design	410
<i>Maria Elena Giannaccini, Sanja Dogramadzi, and Tony Pipe</i>	
Study of Routing Algorithms Considering Real Time Restrictions Using a Connectivity Function	412
<i>Magali Arellano-Vázquez, Héctor Benítez-Pérez, and Jorge L. Ortega-Arjona</i>	
Systematic Design of Flexible Magnetic Wall and Ceiling Climbing Robot for Cargo Screening	414
<i>Yuanming Zhang and Tony Dodd</i>	
Tactile Afferent Simulation from Pressure Arrays.....	416
<i>Rosana Matuk Herrera</i>	
The Interaction between Vortices and a Biomimetic Flexible Fin	418
<i>Jennifer Brown, Lily Chambers, Keri M. Collins, Otar Akanyeti, Francesco Visentin, Ryan Ladd, Paolo Fiorini, and William Megill</i>	
Toward an Ecological Approach to Interface Design for Teaching Robots	420
<i>Guillaume Doisy, Joachim Meyer, and Yael Edan</i>	
Towards Adaptive Robotic Green Plants	422
<i>Janine Stocker, Aline Veillat, Stéphane Magnenat, Francis Colas, and Roland Siegwart</i>	
Using Image Depth Information for Fast Face Detection	424
<i>Sasa Bodirosa</i>	

Using Sequences of Knots as a Random Search	426
<i>C.A. Pina-Garcia and Dongbing Gu</i>	
Vision-Based Segregation Behaviours in a Swarm of Autonomous Robots	428
<i>Michael J. Price and Roderich Groß</i>	
Visual-Inertial Motion Priors for Robust Monocular SLAM	430
<i>Usman Qayyum and Jonghyuk Kim</i>	
Author Index	433