Communications
in Computer and Information Science

Editorial Board

Simone Diniz Junqueira Barbosa
  Pontifical Catholic University of Rio de Janeiro (PUC-Rio),
  Rio de Janeiro, Brazil

Phoebe Chen
  La Trobe University, Melbourne, Australia

Alfredo Cuzzocrea
  ICAR-CNR and University of Calabria, Italy

Xiaoyong Du
  Renmin University of China, Beijing, China

Joaquim Filipe
  Polytechnic Institute of Setúbal, Portugal

Orhun Kara
  TÜBİTAK BİLGEM and Middle East Technical University, Turkey

Tai-hoon Kim
  Konkuk University, Chung-ju, Chungbuk, Korea

Igor Kotenko
  St. Petersburg Institute for Informatics and Automation
  of the Russian Academy of Sciences, Russia

Dominik Ślężak
  University of Warsaw and Infobright, Poland

Xiaokang Yang
  Shanghai Jiao Tong University, China
Preface

This issue contains a selection of revised papers that were presented at the Software Aspects of Robotic Systems (SARS 2011) Workshop and the Machine Learning for System Construction (MLSC 2011) Workshop held during October 17–18 in Vienna, Austria, under the auspices of the International Symposium Series on Leveraging Applications of Formal Methods, Verification, and Validation (ISoLA).

Both workshops are in line with the general mission statement of the ISoLA Symposium series. That is to provide a forum for developers, users, and researchers for discussing issues related to the adoption and the use of rigorous tools for specification, analysis, verification, certification, construction, test, and maintenance of systems from their domain-specific point of view. Thereby, the ISoLA symposia contribute to bridging the gap between designers and developers of (formal methods based) rigorous tools, and users in engineering and in other disciplines.

The SARS workshop and the MLSC workshop pursue this mission within the domains of software aspects of robotic systems and machine learning for system construction.

The timeliness of the SARS workshop stems from the fact that development of autonomous robotic systems experienced a remarkable boost within the last few years. Away from stationary manufacturing units, current robots have grown up into autonomous, mobile systems that not only interact with real-world environments, but also fulfill mission critical tasks in collaboration with human individuals on a reliable basis. Typical fields of application are unmanned vehicles for exploration but also for transportation, reconnaissance and search-and-rescue in hazardous environments, and ambient-assisted living for elderly or disabled people.

Hence, algorithms in cognition, computer vision, and locomotion have become hot-spots of research and development. In addition, modern concepts like evolutionary and bio-inspired design have entered the stage to tackle open issues in robotics and to cope with domain-specific properties such as inherent indeterminism.

The back-side of this boost is an even larger increase in complexity of modern robotic systems. Numerous actuators and sensors have to be controlled simultaneously. Complex actions have to be performed via timed parallel execution of multiple instruction streams on distinct electronic control units. Autonomy, especially long-term autonomy as required by deep-sea or space exploration missions, necessitates features of fault-tolerance, error recovery, or at least well-defined fallbacks. Owing to the physical interaction of robots with the real world, safety violations are extremely harmful, in the worst case they might lead to severe damage and even to casualties.
The timeliness of the MLCS workshop follows from the fact that even state-of-the-art systems often lack adequate specifications or make use of un/under-specified components. In fact, the popular component-based software design paradigm naturally leads to under-specified systems, as most libraries only provide very partial specifications of their components. Moreover, revisions and last-minute changes typically hardly enter the system specification.

As observable in many practical contexts, revision cycles are often extremely short, making the maintenance of specifications unrealistic, and at the same time necessitating extensive testing effort. More generally, the lack of documentation is sadly perceived in many places, among which quality control is one of the most prominent.

Machine learning has been proposed to overcome this situation by automatically “mining” and then updating the required information. Promising results have been obtained here using active automata-learning technology, and there seems to be a high potential to also exploit other machine-learning techniques.

Both the SARS workshop and the MLSC workshop attracted researchers and practitioners from academia and industry and provided a lively forum for them to present and discuss their most recent research results in the respective fields of the two workshops.

The present issue of Communications in Computer and Information Science contains the revised versions of selected papers that were presented at the workshops. These papers have undergone a second round of reviewing, and reflect the suggestions of the reviewers as well as feedback from the presentation and discussion of the papers at the workshops.

The topics covered by the papers of the SARS and the MLSC workshop demonstrate the breadth and the richness of the respective fields of the two workshops stretching from robot programming to languages and compilation techniques, to real-time and fault tolerance, to dependability, software architectures, computer vision, cognitive robotics, multi-robot coordination, and simulation to bio-inspired algorithms, and from machine learning for anomaly detection, to model construction in software product lines to classification of Web service interfaces.

In addition, the SARS workshop hosted a special session on the recently launched KOROS project on collaborating robot systems that is borne by a consortium of researchers of the faculties of architecture and planning, computer science, electrical engineering and information technology, and mechanical and industrial engineering at the Vienna University of Technology. The four papers devoted to this session highlighted important research directions pursued in this interdisciplinary research project.

Finally, we would like to thank the many individuals who contributed to making the ISoLA 2011 workshops a success. First of all, we thank the members of the SARS and MLSC Program Committees for their dedicated and diligent work of selecting the papers for presentation at the two workshops. We also thank the authors who submitted a paper to one of the workshops. Our special thanks go to the invited keynote speakers at the SARS workshop, Davide Brugali
(Università degli Studi di Bergamo), Rick Middleton (National University of Ireland Maynooth), Daniele Nardi (Sapienza Università di Roma), and Trevor Taylor (Microsoft, Redmond). Last but not least, we thank Alfred Hofmann, Anna Kramer, and Leonie Kunz at Springer for publishing these proceedings in the CCIS series and for the smooth co-operation.

August 2012

Reiner Hähnle
Jens Knoop
Tiziana Margaria
Dietmar Schreiner
Bernhard Steffen
ISoLA 2011 Workshop Organization

General Chair
Tiziana Margaria University of Potsdam, Germany

SARS 2011 Workshop Chairs
Jens Knoop TU Vienna, Austria
Dietmar Schreiner TU Vienna, Austria

Program Committee
José María Cañas Plaza Universidad Rey Juan Carlos, Fuenlabrada, Spain
Markus Bader TU Vienna, Austria
Karl M. Göschka TU Vienna, Austria
Vincent Hugel Université de Versailles, France
Jens Knoop, Co-chair TU Vienna, Austria
Gerald Steinbauer TU Graz, Austria
Dietmar Schreiner, Co-chair TU Vienna, Austria
Stefan Tasse TU Dortmund, Germany
Markus Vincze TU Vienna, Austria
Arnoud Visser Universiteit van Amsterdam, The Netherlands
Franz Wotawa TU Graz, Austria

MLCS 2011 Workshop Chairs
Reiner Hähnle TU Darmstadt, Germany
Bernhard Steffen TU Dortmund, Germany

Program Committee
Michael Felderer Universität Innsbruck, Austria
Falk Howar TU Dortmund, Germany
Reiner Hähnle, Co-chair TU Darmstadt, Germany
Valérie Issarny INRIA, Paris-Rocquencourt, France
Richard Johansson University of Gothenburg, Sweden
Fabio Massaci  
Università di Trento, Italy

Alessandro Moschitti  
Università di Trento, Italy

Tomas Piatrik  
Queen Mary University of London, UK

Riccardo Scandariato  
KU Leuven, Belgium

Ina Schäfer  
TU Braunschweig, Germany

Bernhard Steffen, Co-chair  
TU Dortmund, Germany
# Table of Contents

Software Aspects of Robotic Systems (SARS 2011)

<table>
<thead>
<tr>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>A Role-Based Language for Collaborative Robot Applications</td>
<td>1</td>
</tr>
<tr>
<td>Sebastian Götz, Max Leuthäuser, Jan Reimann, Julia Schroeter,</td>
<td></td>
</tr>
<tr>
<td>Christian Wende, Claas Wilke, and Uwe Aßmann</td>
<td></td>
</tr>
<tr>
<td>Efficient Localization for Robot Soccer Using Pattern Matching</td>
<td>16</td>
</tr>
<tr>
<td>Thomas Whelan, Sonja Stüdli, John McDonald, and Richard H. Middleton</td>
<td></td>
</tr>
<tr>
<td>A NUPlatform for Software on Articulated Mobile Robots</td>
<td>31</td>
</tr>
<tr>
<td>Jason Kulk and James S. Welsh</td>
<td></td>
</tr>
<tr>
<td>Service Component Architectures in Robotics: The SCA-Orocos Integration</td>
<td>46</td>
</tr>
<tr>
<td>Davide Brugali, Luca Gherardi, Markus Klotzbücher, and Herman Bruynckx</td>
<td></td>
</tr>
<tr>
<td>Safe Autonomous Transport Vehicles in Heterogeneous Outdoor Environments</td>
<td>61</td>
</tr>
<tr>
<td>Tobe Toben, Sönke Eilers, Christian Kuka, Sören Schweigert, Hannes Winkelmann, and Stefan Ruehrup</td>
<td></td>
</tr>
<tr>
<td>Adaptive Autonomous Systems – From the System’s Architecture to Testing</td>
<td>76</td>
</tr>
<tr>
<td>Franz Wotawa</td>
<td></td>
</tr>
<tr>
<td>Representing Knowledge in Robotic Systems with KnowLang</td>
<td>91</td>
</tr>
<tr>
<td>Emil Vassev and Mike Hinchey</td>
<td></td>
</tr>
<tr>
<td>Object Detection and Classification for Domestic Robots</td>
<td>106</td>
</tr>
<tr>
<td>Markus Vincze, Walter Wohlkinger, Sven Olufs, Peter Einramhof,</td>
<td></td>
</tr>
<tr>
<td>Robert Schwarz, and Karthik Varadarajan</td>
<td></td>
</tr>
<tr>
<td>A Software Integration Framework for Cognitive Systems</td>
<td>121</td>
</tr>
<tr>
<td>Michael Zillich, Wolfgang Ponweiser, and Markus Vincze</td>
<td></td>
</tr>
</tbody>
</table>

**Special Session on KOROS**

<table>
<thead>
<tr>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>KOROS Initiative: Automatized Throwing and Catching for Material Transportation</td>
<td>136</td>
</tr>
<tr>
<td>Martin Pongratz, Klaus Polhammer, and Alexander Szep</td>
<td></td>
</tr>
</tbody>
</table>
Cognitive Decision Unit Applied to Autonomous Robots ................. 144
  Dietmar Bruckner and Friedrich Gelbard

Building iRIS: A Robotic Immune System .......................... 150
  Dietmar Schreiner

Towards Reorientation with a Humanoid Robot ...................... 156
  Dietmar Bruckner, Markus Vincze, and Isabella Hinterleitner

Machine Learning for System Construction
(MLSC 2011)

Monitoring Anomalies in IT-Landscapes Using Clustering Techniques
and Complex Event Processing ........................................ 162
  Matthias Gander, Michael Felderer, Basel Katt, and Ruth Breu

A Hierarchical Variability Model for Software Product Lines ........ 181
  Dilian Gurov, Bjarte M. Østvold, and Ina Schaefer

Learning-Based Software Testing: A Tutorial ...................... 200
  Karl Meinke, F. Niu, and M. Sindhu

Machine Learning for Automatic Classification of Web Service Interface
Descriptions .......................................................... 220
  Amel Bennaceur, Valérie Issarny, Richard Johansson,
  Alessandro Moschitti, Daniel Sykes, and Romina Spalazzese

The Teachers’ Crowd: The Impact of Distributed Oracles on Active
Automata Learning ................................................... 232
  Falk Howar, Oliver Bauer, Maik Merten, Bernhard Steffen, and
  Tiziana Margaria

Automata Learning with On-the-Fly Direct Hypothesis Construction ...
  Maik Merten, Falk Howar, Bernhard Steffen, and Tiziana Margaria

Author Index ...................................................... 261