

Commenced Publication in 1973

Founding and Former Series Editors:

Gerhard Goos, Juris Hartmanis, and Jan van Leeuwen

Editorial Board

David Hutchison

Lancaster University, UK

Takeo Kanade

Carnegie Mellon University, Pittsburgh, PA, USA

Josef Kittler

University of Surrey, Guildford, UK

Jon M. Kleinberg

Cornell University, Ithaca, NY, USA

Alfred Kobsa

University of California, Irvine, CA, USA

Friedemann Mattern

ETH Zurich, Switzerland

John C. Mitchell

Stanford University, CA, USA

Moni Naor

Weizmann Institute of Science, Rehovot, Israel

Oscar Nierstrasz

University of Bern, Switzerland

C. Pandu Rangan

Indian Institute of Technology, Madras, India

Bernhard Steffen

TU Dortmund University, Germany

Madhu Sudan

Microsoft Research, Cambridge, MA, USA

Demetri Terzopoulos

University of California, Los Angeles, CA, USA

Doug Tygar

University of California, Berkeley, CA, USA

Gerhard Weikum

Max Planck Institute for Informatics, Saarbruecken, Germany

Roberto Bruni Juergen Dingel (Eds.)

Formal Techniques for Distributed Systems

Joint 13th IFIP WG 6.1 International Conference, FMOODS 2011
and 30th IFIP WG 6.1 International Conference, FORTE 2011
Reykjavik, Iceland, June 6-9, 2011
Proceedings



Springer

Volume Editors

Roberto Bruni
Università di Pisa
Dipartimento di Informatica
Largo Bruno Pontecorvo 3, 56127 Pisa, Italy
E-mail: bruni@di.unipi.it

Juergen Dingel
Queen's University
School of Computing
723 Goodwin Hall, Kingston, ON, K7L 3N6, Canada
E-mail: dingel@cs.queensu.ca

ISSN 0302-9743
ISBN 978-3-642-21460-8
DOI 10.1007/978-3-642-21461-5
Springer Heidelberg Dordrecht London New York

e-ISSN 1611-3349
e-ISBN 978-3-642-21461-5

Library of Congress Control Number: 2011928308

CR Subject Classification (1998): D.2, D.2.4, I.2.2, D.3, F.3, F.4, I.2.3

LNCS Sublibrary: SL 2 – Programming and Software Engineering

© IFIP International Federation for Information Processing 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)

Foreword

In 2011 the 6th International Federated Conferences on Distributed Computing Techniques (DisCoTec) took place in Reykjavik, Iceland, during June 6-9. It was hosted and organized by Reykjavik University. The DisCoTec series of federated conferences, one of the major events sponsored by the International Federation for Information processing (IFIP), included three conferences: Coordination, DAIS, and FMOODS/FORTE.

DisCoTec conferences jointly cover the complete spectrum of distributed computing subjects ranging from theoretical foundations to formal specification techniques to practical considerations. The 13th International Conference on Coordination Models and Languages (Coordination) focused on the design and implementation of models that allow compositional construction of large-scale concurrent and distributed systems, including both practical and foundational models, run-time systems, and related verification and analysis techniques. The 11th IFIP International Conference on Distributed Applications and Interoperable Systems (DAIS) elicited contributions on architectures, models, technologies and platforms for large-scale and complex distributed applications and services that are related to the latest trends in bridging the physical/virtual worlds based on flexible and versatile service architectures and platforms. The 13th Formal Methods for Open Object-Based Distributed Systems and 31st Formal Techniques for Networked and Distributed Systems (FMOODS/FORTE) together emphasized distributed computing models and formal specification, testing and verification methods.

Each of the three days of the federated event began with a plenary speaker nominated by one of the conferences. On the first day, Giuseppe Castagna (CNRS, Paris 7 University, France) gave a keynote titled “On Global Types and Multi-Party Sessions.” On the second day, Paulo Verissimo (University of Lisbon FCUL, Portugal) gave a keynote talk on “Resisting Intrusions Means More than Byzantine Fault Tolerance.” On the final and third day, Pascal Costanza (ExaScience Lab, Intel, Belgium) presented a talk that discussed “Extreme Coordination—Challenges and Opportunities from Exascale Computing.”

In addition, there was a poster session, and a session of invited talks from representatives of Icelandic industries including Ossur, CCP Games, Marorka, and GreenQloud.

There were five satellite events:

1. The 4th DisCoTec workshop on Context-Aware Adaptation Mechanisms for Pervasive and Ubiquitous Services (CAMPUS)
2. The Second International Workshop on Interactions Between Computer Science and Biology (CS2BIO) with keynote lectures by Jasmin Fisher (Microsoft Research - Cambridge, UK) and Gordon Plotkin (Laboratory for Foundations of Computer Science - University of Edinburgh, UK)

3. The 4th Workshop on Interaction and Concurrency Experience (ICE) with keynote lectures by Prakash Panangaden (McGill University, Canada), Rocco de Nicola (University of Florence, Italy), and Simon Gay (University of Glasgow, UK)
4. The First Workshop on Process Algebra and Coordination (PACO) with keynote lectures by Jos Baeten (Eindhoven University of Technology, The Netherlands), Dave Clarke (Katholieke Universiteit Leuven, Belgium), Rocco De Nicola (University of Florence, Italy), and Gianluigi Zavattaro (University of Bologna, Italy)
5. The 7th International Workshop on Automated Specification and Verification of Web Systems (WWV) with a keynote lecture by Elie Najm (Telecom Paris, France)

I believe that this rich program offered each participant an interesting and stimulating event. I would like to thank the Program Committee Chairs of each conference and workshop for their effort. Moreover, organizing DisCoTec 2011 was only possible thanks to the dedicated work of the Publicity Chair Gwen Salaun (Grenoble INP - INRIA, France), the Workshop Chairs Marcello Bonsangue (University of Leiden, The Netherlands) and Immo Grabe (CWI, The Netherlands), the Poster Chair Martin Steffen (University of Oslo, Norway), the Industry Track Chairs Björn Jónsson (Reykjavik University, Iceland), and Oddur Kjartansson (Reykjavik University, Iceland), and the members of the Organizing Committee from Reykjavik University: Árni Hermann Reynisson, Steinar Hugi Sigurðarson, Georgiana Caltai Goriac, Eugen-Ioan Goriac and Ute Schiffel. To conclude I want to thank the International Federation for Information Processing (IFIP), Reykjavik University, and CCP Games Iceland for their sponsorship.

June 2011

Marjan Sirjani

Preface

This volume contains the proceedings of the FMOODS/FORTE 2011 conference, a joint conference combining the 13th IFIP International Conference on Formal Methods for Open Object-Based Distributed Systems (FMOODS) and the 31st IFIP International Conference on Formal Techniques for Networked and Distributed Systems (FORTE).

FMOODS/FORTE was hosted together with the 13th International Conference on Coordination Models and Languages (COORDINATION) and the 11th IFIP International Conference on Distributed Applications and Interoperable Systems (DAIS) by the federated conference event DisCoTec 2011, devoted to distributed computing techniques and sponsored by the International Federation for Information Processing (IFIP).

FMOODS/FORTE provides a forum for fundamental research on the theory and applications of distributed systems. Of particular interest are techniques and tools that advance the state of the art in the development of concurrent and distributed systems and that are drawn from a wide variety of areas including model-based design, component and object technology, type systems, formal specification and verification and formal approaches to testing. The conference encourages contributions that combine theory and practice in application areas of telecommunication services, Internet, embedded and real-time systems, networking and communication security and reliability, sensor networks, service-oriented architecture, and Web services.

The keynote speaker of FMOODS/FORTE 2011 was Giuseppe Castagna of CNRS, University Paris Diderot, who is known for his foundational work on semantic subtyping, contracts for Web services, and efficient and effective languages for the processing of XML documents. Castagna contributed a paper on global types for multi-party sessions to these proceedings.

The FMOODS/FORTE 2011 program consisted of the above invited paper and 21 regular papers which were selected by the Program Committee (PC) out of 65 submissions received from 29 different countries. Each submitted paper was evaluated on the basis of at least three detailed reviews from 28 PC members and 76 external reviewers. Additional expert reviews were solicited if the reviews of a paper had diversified or controversial assessments or if the reviewers indicated low confidence. The final decision of acceptance was preceded by a 9-day online discussion of the PC members. The selected papers constituted a strong program of stimulating, timely, and diverse research. Papers presented techniques from formal verification (using model checking, theorem proving, and rewriting), formal modeling and specification (using process algebras and calculi, type systems, and refinement), run-time monitoring, and testing to address challenges in many different application areas including dynamic and ad hoc networks, mobile

and adaptive computation, reactive and timed systems, business processes, and distributed and concurrent systems and algorithms.

We are deeply indebted to the PC members and external reviewers for their hard and conscientious work in preparing 198 reviews. We thank Marjan Sirjani, the DisCoTec General Chair, for his support, and the FMOODS/FORTE Steering Committee for their guidance. Our gratitude goes to the authors for their support of the conference by submitting their high-quality research works. We thank the providers of the EasyChair conference tool that was a great help in organizing the submission and reviewing process.

April 2011

Roberto Bruni
Juergen Dingel

Organization

Program Committee

Saddek Bensalem	VERIMAG, France
Dirk Beyer	University of Passau, Germany
Gregor Bochmann	University of Ottawa, Canada
Roberto Bruni	Università di Pisa, Italy
Nancy Day	David R. Cheriton School of Computer Science, University of Waterloo, Canada
John Derrick	University of Sheffield, UK
Juergen Dingel	Queen's University, Kingston, Canada
Khaled El-Fakih	American University of Sharjah, UAE
Holger Giese	Hasso Plattner Institute, Germany
John Hatcliff	Kansas State University, USA
Valerie Issarny	INRIA, France
Claude Jard	ENS Cachan Bretagne, France
Einar Broch Johnsen	University of Oslo, Norway
Ferhat Khendek	Concordia University, Canada
Jay Ligatti	University of South Florida, USA
Luigi Logrippo	Université du Québec en Outaouais, Canada
Niels Lohmann	Universität Rostock, Germany
Fabio Massacci	University of Trento, Italy
Uwe Nestmann	Technische Universität Berlin, Germany
Peter Olveczky	University of Oslo, Norway
Alexandre Petrenko	CRIM, Canada
Frank Piessens	K.U. Leuven, Belgium
Andre Platzer	Carnegie Mellon University, USA
António Ravara	Universidade Nova de Lisboa, Portugal
Kenneth Turner	University of Stirling, UK
Keiichi Yasumoto	Nara Institute of Science and Technology, Japan
Nobuko Yoshida	Imperial College London, UK
Elena Zucca	DISI - University of Genoa, Italy

Steering Committee

Gilles Barthe	IMDEA Software, Spain
Gregor Bochmann	University of Ottawa, Canada
Frank S. de Boer	Centrum voor Wiskunde en Informatica, The Netherlands
John Derrick	University of Sheffield, UK
Khaled El-Fakih	American University of Sharjah, UAE

Roberto Gorrieri	University of Bologna, Italy
John Hatcliff	Kansas State University, USA
David Lee	The Ohio State University, USA
Antonia Lopes	University of Lisbon, Portugal
Elie Najm	Telecom ParisTech, France
Arnd Poetzsch-Heffter	University of Kaiserslautern, Germany
Antonio Ravara	Technical University of Lisbon, Portugal
Carolyn Talcott	SRI International, USA
Ken Turner	University of Stirling, UK
Keiichi Yasumoto	Nara Institute of Science and Technology, Japan
Elena Zucca	University of Genoa, Italy

Additional Reviewers

Abraham, Erika	Kazemeyni, Fatemeh
Amtoft, Torben	Keremoglu, Erkan
Bae, Kyungmin	Kolberg, Mario
Becker, Basil	Krause, Christian
Ben Hafaiedh, Khaled	Krichen, Moez
Bentea, Lucian	Lagorio, Giovanni
Borgström, Johannes	Legay, Axel
Bouchy, Florent	Lehmann, Andreas
Carbone, Marco	Loos, Sarah
Chatzikokolakis, Konstantinos	Magill, Evan
Costa Seco, João	Martins, Francisco
Delzanno, Giorgio	Merro, Massimo
Denilou, Pierre-Malo	Mousavi, Mohammadreza
Desmet, Lieven	Mühlberg, Jan Tobias
Devriese, Dominique	Nakata, Akio
Dury, Arnaud	Neumann, Stefan
Fahrenberg, Uli	Nikiforakis, Nick
Fararooy, Ashgan	Okano, Kozo
Fokkink, Wan	Peters, Kirstin
Gabrysiak, Gregor	Philippou, Anna
Gamboni, Maxime	Phillips, Andrew
Gori, Roberta	Pous, Damien
Haller, Philipp	Quo, Larry
Hildebrandt, Stephan	Reggio, Gianna
Hüttel, Hans	Ricca, Filippo
Israr, Toqeer	Rosenthal, Malte
Jaghoori, Mohammad Mahdi	Santos, Tiago
Jean, Quilboeuf	Sasse, Ralf
Jones, Simon	Schaefer, Andreas
Kaschner, Kathrin	Schlatte, Rudolf

Shankland, Carron
Simao, Adenilso
Smans, Jan
Stolz, Volker
Tapia Tarifa, Silvia Lizeth
Taylor, Ramsay
Tiezzi, Francesco
Tran, Thi Mai Thuong

Vanoverberghe, Dries
Vieira, Hugo Torres
Vogel, Thomas
Von Essen, Christian
Wendler, Philipp
Wimmel, Harro
Yamaguchi, Hirozumi
Zavattaro, Gianluigi

Table of Contents

On Global Types and Multi-party Sessions	1
<i>Giuseppe Castagna, Mariangiola Dezani-Ciancaglini, and Luca Padovani</i>	
Linear-Time and May-Testing in a Probabilistic Reactive Setting	29
<i>Lucia Acciai, Michele Boreale, and Rocco De Nicola</i>	
A Model-Checking Tool for Families of Services	44
<i>Patrizia Asirelli, Maurice H. ter Beek, Alessandro Fantechi, and Stefania Gnesi</i>	
Partial Order Methods for Statistical Model Checking and Simulation	59
<i>Jonathan Bogdoll, Luis María Ferrer Fioriti, Arnd Hartmanns, and Holger Hermanns</i>	
Counterexample Generation for Markov Chains Using SMT-Based Bounded Model Checking	75
<i>Bettina Bratling, Ralf Wimmer, Bernd Becker, Nils Jansen, and Erika Ábrahám</i>	
Adaptable Processes (Extended Abstract)	90
<i>Mario Bravetti, Cinzia Di Giusto, Jorge A. Pérez, and Gianluigi Zavattaro</i>	
A Framework for Verifying Data-Centric Protocols	106
<i>Yuxin Deng, Stéphane Grumbach, and Jean-François Monin</i>	
Relational Concurrent Refinement: Timed Refinement	121
<i>John Derrick and Eerke Boiten</i>	
Galois Connections for Flow Algebras	138
<i>Piotr Filipiuk, Michał Terepeta, Hanne Riis Nielson, and Flemming Nielson</i>	
An Accurate Type System for Information Flow in Presence of Arrays	153
<i>Séverine Fratani and Jean-Marc Talbot</i>	
Analysis of Deadlocks in Object Groups	168
<i>Elena Giachino and Cosimo Laneve</i>	

Monitoring Distributed Systems Using Knowledge	183
<i>Susanne Graf, Doron Peled, and Sophie Quinton</i>	
Global State Estimates for Distributed Systems	198
<i>Gabriel Kalyon, Tristan Le Gall, Hervé Marchand, and Thierry Massart</i>	
A Process Calculus for Dynamic Networks	213
<i>Dimitrios Kouzapas and Anna Philippou</i>	
On Asynchronous Session Semantics	228
<i>Dimitrios Kouzapas, Nobuko Yoshida, and Kohei Honda</i>	
Towards Verification of the Pastry Protocol Using TLA ⁺	244
<i>Tianxiang Lu, Stephan Merz, and Christoph Weidenbach</i>	
Dynamic Soundness in Resource-Constrained Workflow Nets	259
<i>María Martos-Salgado and Fernando Rosa-Velardo</i>	
SimGrid MC: Verification Support for a Multi-API Simulation Platform	274
<i>Stephan Merz, Martin Quinson, and Cristian Rosa</i>	
Ownership Types for the Join Calculus	289
<i>Marco Patrignani, Dave Clarke, and Davide Sangiorgi</i>	
Contracts for Multi-instance UML Activities	304
<i>Vidar Slåtten and Peter Herrmann</i>	
Annotation Inference for Separation Logic Based Verifiers	319
<i>Frédéric Vogels, Bart Jacobs, Frank Piessens, and Jan Smans</i>	
Analyzing BGP Instances in Maude	334
<i>Anduo Wang, Carolyn Talcott, Limin Jia, Boon Thau Loo, and Andre Scedrov</i>	
Author Index	349