# Lecture Notes in Computer Science

7349

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

Antonio Vallecillo Juha-Pekka Tolvanen Ekkart Kindler Harald Störrle Dimitris Kolovos (Eds.)

# Modelling Foundations and Applications

8th European Conference, ECMFA 2012 Kgs. Lyngby, Denmark, July 2-5, 2012 Proceedings



#### Volume Editors

Antonio Vallecillo

Universidad de Málaga, ETSI Informática

Campus de Teatinos, Bulevar Louis Pasteur 35, 29071 Málaga, Spain

E-mail: av@lcc.uma.es

Juha-Pekka Tolvanen

MetaCase

Ylistönmäentie 31, 40500 Jyväskylä, Finland

E-mail: jpt@metacase.com

Ekkart Kindler

Harald Störrle

Technical University of Denmark

Department of Informatics and Mathematical Modelling

Richard Petersens Plads, 2800 Kgs. Lyngby, Denmark

E-mail: {eki, hsto}@imm.dtu.dk

Dimitris Kolovos

University of York, Department of Computer Science

Deramore Lane, York, YO10 5GH, United Kingdom

E-mail: d.kolovos@cs.york.ac.uk

ISSN 0302-9743 ISBN 978-3-642-31490-2 e-ISSN 1611-3349 e-ISBN 978-3-642-31491-9

DOI 10.1007/978-3-642-31491-9

Springer Heidelberg Dordrecht London New York

Library of Congress Control Number: 2012940653

CR Subject Classification (1998): D.2.1-2, D.2.4-5, D.2.7, D.2.11, D.2, D.3, F.3, K.6

LNCS Sublibrary: SL 2 – Programming and Software Engineering

© Springer-Verlag Berlin Heidelberg 2012

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

The 2012 European Conference on Modelling Foundations and Applications (ECMFA 2012) was held at the Technical University of Denmark (DTU), Kgs. Lyngby, Denmark, during July 2–5, 2012.

ECMFA is the key European conference aiming at advancing the techniques and furthering the underlying knowledge related to model-driven engineering. Model-driven engineering (MDE) is a software development approach based on the use of models for the specification, design, analysis, synthesis, deployment, testing and maintenance of complex software systems, aiming to produce high-quality systems at lower costs. In the past seven years, ECMFA has provided an ideal venue for interaction among researchers interested in MDE both from academia and industry. The eighth edition of the conference covered major advances in foundational research and industrial applications of MDE.

In 2012, the Program Committee received 106 abstracts, which finally materialized into 81 full paper submissions. From these, 20 Foundations track papers and 10 Applications track papers were accepted for presentation at the conference and publication in these proceedings. This indicates the level of competition that occurred during the selection process. The submission and the reviewing processes were administered by EasyChair, which greatly facilitated these tasks. Papers on all aspects of MDE were received, including topics such as architectural modeling and product lines, code generation, domain-specific modeling, metamodeling, model analysis and verification, model management, model transformation and simulation. The breadth of topics and the high quality of the results presented in these accepted papers demonstrate the maturity and vibrancy of the field.

The ECMFA 2012 keynote speakers were Henrik Lönn, from VOLVO Technology in Sweden, and Ed Seidewitz, from Model Driven Solutions in the USA. Abstracts of their talks are included in these proceedings. We thank them very much for accepting our invitation and for their enlightening talks.

We are grateful to our Program Committee members for providing their expertise and quality and timely reviews. Their helpful and constructive feedback to all authors is most appreciated. We thank the ECMFA Conference Steering Committee for their advice and help. We also thank our sponsors, both keynote speakers and all authors who submitted papers to ECMFA 2012. Alfred Hofmann and the Springer team were really helpful with the publication of this volume.

July 2012

Antonio Vallecillo Juha-Pekka Tolvanen Ekkart Kindler Harald Störrle Dimitris Kolovos

# Organization

# **Program Committee**

Jan Øyvind Aagedal Norse Solutions

Vasco Amaral FCT, Universidade Nova de Lisboa, Portugal

Terry Bailey Vicinay Cadenas, S.A.

Stephen Barrett Concordia University, Canada

Mariano Belaunde Orange R&D

Reda Bendraou INRIA Bretagne Atlantique Rennes, France

Jorn Bettin SoftMetaWare

Xavier Blanc Bordeaux 1 University, France Behzad Bordbar University of Birmingham, UK Marco Brambilla Politecnico di Milano, Italy

Jordi Cabot INRIA-École des Mines de Nantes, France

Tony Clark Middlesex University, UK

Benoit Combemale IRIT CNRS
Diarmuid Corcoran Ericsson AB

Zhen Ru Dai University of Applied Science Hamburg,

Germany

Juan Antonio De La Puente Universidad Politécnica de Madrid, Spain

Zinovy Diskin University of Waterloo, Canada Gregor Engels University of Paderborn, Germany Anne Etien University of Lille and INRIA Lille

Nord-Europe, France

Stephan Flake Orga Systems GmbH, Germany Robert France Colorado State University, USA Mathias Fritzsche SAP Research CEC Belfast, UK Jesus Garcia-Molina Universidad de Murcia, Spain

Sebastien Gerard CEA, LIST

Marie-Pierre Gervais LIP6 and Université de Paris 10 Nanterre,

France

Martin Gogolla University of Bremen, Germany Jeff Gray University of Alabama, USA

Esther Guerra Universidad Autónoma de Madrid, Spain Michael R. Hansen Technical University of Denmark, Denmark

Reiko Heckel University of Leicester, UK

Markus Heller SAP Research Karlsruhe, SAP AG, Germany

Andreas Hoffmann Fraunhofer, Germany

Teemu Kanstrén VTT

Gabor Karsai Vanderbilt University, USA

#### VIII Organization

Thomas Kuehne Victoria University of Wellington, New Zealand

Jochen Kuester IBM Research

Tata Research Development and Design Centre, Vinay Kulkarni

India

Ivan Kurtev

University of Twente, The Netherlands Roberto Erik Lopez-Herrejon Institute for Systems Engineering and

Automation, Johannes Kepler University,

Austria

Dragan Milicev

Parastoo Mohagheghi

Birger Møller-Pedersen

Tor Neple

Alfonso Pierantonio

Ivan Porres

Olli-Pekka Puolitaival

Arend Rensink

Laurent Rioux

Tom Ritter Louis Rose Julia Rubin

Bernhard Rumpe

Andrey Sadovykh

Houari Sahraoui Bernhard Schaetz

Douglas Schmidt Andy Schürr Bran Selic

Renuka Sindhgatta

John Slaby

Jim Steel Alin Stefanescu

Gabriele Taentzer

Francois Terrier Juha-Pekka Tolvanen

Salvador Trujillo

Andreas Ulrich

Antonio Vallecillo

Ragnhild Van Der Straeten

Pieter Van Gorp

Marten J. Van Sinderen

Hans Vangheluwe

Daniel Varro

Cristina Vicente-Chicote

University of Belgrade, Serbia

SINTEF, Norway

University of Oslo, Norway

Norse Solutions AS

University of L'Aquila, Italy

Åbo Akademi University, Finland

F-Secure Corporation

University of Twente, The Netherlands

THALES R&T

Fraunhofer FOKUS, Germany The University of York, UK IBM Research at Haifa, Israel

RWTH Aachen University, Germany

Softeam

DIRO, Université de Montréal, Canada

TU München, Germany Vanderbilt University TU Darmstadt, Germany Malina Software Corp. IBM Research - India

Raytheon Company The University of Queensland, Australia

University of Pitesti, Romania

Philipps-Universität Marburg, Germany

CEA, LIST Metacase

IKERLAN Research Centre

Siemens AG

University of Malaga, Spain

Vrije Universiteit Brussel, Belgium Eindhoven University of Technology,

The Netherlands

University of Twente, The Netherlands

McGill University

Budapest University of Technology and

Economics, Hungary

Technical University of Cartagena, Spain

Markus Voelter Independent Michael Von Der Beeck BMW Group

Edward Willink Eclipse Modeling Project

Manuel Wimmer Business Informatics Group, Vienna University

of Technology, Austria

Tao Yue Carleton University and Simula Research

Laboratory

Gefei Zhang arvato systems

Olaf Zimmermann IBM Research GmbH Steffen Zschaler King's College London, UK

### Additional Reviewers

Abbors, Fredrik Al-Lail, Mustafa Ali, Shaukat Almeida, Marcos Anjorin, Anthony Aranega, Vincent Bajwa, Imran Bapodra, Mayur Barat, Souvik Barroca, Bruno Baudry, Benoit Blouin, Arnaud Brucker, Achim D. Brunelière, Hugo Burgueño, Loli Büttner, Fabian Cadavid, Juan Cichos, Harald Criado, Javier Cuccuru, Arnaud Dang, Duc-Hanh De Lara, Juan

De Mol, Maarten Di Ruscio, Davide Duddy, Keith El Kouhen, Amine Eramo, Romina Espinazo-Pagán, Javier Fatemi, Hassan Fazal-Bagaie, Masud Fritzsche, Mathias Gerth, Christian Haber, Arne Hamann, Lars Hesari, Shokoofeh Horst, Andreas Horváth, Ákos Ingles-Romero, Juan F. Iovino, Ludovico Izsó, Benedek Jalali, Arash Jnidi, Rim Khan, Tamim Kuhlmann, Mirco

Lauder, Marius Liu, Qichao Look, Markus Mallet, Frédéric Monperrus, Martin Novrit, Florian Pedro, Luís Planas, Elena Radermacher, Ansgar Rath. Istvan Rossini, Alessandro Saller, Karsten Sanchez, Oscar Soltenborn, Christian Strüber, Daniel Sun, Wuliang Truscan, Dragos Wouters, Laurent Wozniak, Ernest Ziane, Mikal

# **Table of Contents**

Executable UML: From Multi-domain to Multi-core	1
Models Meeting Automotive Design Challenges	2
A Commutative Model Composition Operator to Support Software Adaptation	4
Sébastien Mosser, Mireille Blay-Fornarino, and Laurence Duchien	
Comparative Study of Model-Based and Multi-Domain System Engineering Approaches for Industrial Settings	20
Strengthening SAT-Based Validation of UML/OCL Models by Representing Collections as Relations	32
Model Interchange Testing: A Process and a Case Study	49
An Internal Domain-Specific Language for Constructing OPC UA Queries and Event Filters	62
Combining UML Sequence and State Machine Diagrams for Data-Flow Based Integration Testing	74
Model Transformations for Migrating Legacy Models: An Industrial Case Study	90
Derived Features for EMF by Integrating Advanced Model Queries István Ráth, Ábel Hegedüs, and Dániel Varró	102
A Lightweight Approach for Managing XML Documents with MDE Languages	118

Support Non-functional Testing: Industrial Case Studies	133
Badger: A Regression Planner to Resolve Design Model Inconsistencies	146
Aspect-Oriented Modeling of Mutual Exclusion in UML State Machines	162
TexMo: A Multi-language Development Environment	178
On-the-Fly Emendation of Multi-level Models	194
Specifying Refinement Relations in Vertical Model Transformations $Jan\ Rieke\ and\ Oliver\ Sudmann$	210
Model-Based Automated and Guided Configuration of Embedded Software Systems	226
Lightweight String Reasoning for OCL	244
Domain-Specific Textual Meta-Modelling Languages for Model Driven Engineering	259
Metamodel Based Methodology for Dynamic Component Systems	275
Bidirectional Model Transformation with Precedence Triple Graph Grammars	287
A Timed Automata-Based Method to Analyze EAST-ADL Timing Constraint Specifications	303
Code Generation Nirvana	319
A Plug-in Based Approach for UML Model Simulation	328

Table of Contents	XIII
MADES: A Tool Chain for Automated Verification of UML Models of Embedded Systems	340
Time Properties Verification Framework for UML-MARTE Safety Critical Real-Time Systems	352
Unification of Compiled and Interpreter-Based Pattern Matching Techniques	368
OCL-Based Runtime Monitoring of Applications with Protocol State Machines	384
On Model Subtyping	400
BOB the Builder: A Fast and Friendly Model-to-PetriNet Transformer	416
Solving Acquisition Problems Using Model-Driven Engineering Frank R. Burton, Richard F. Paige, Louis M. Rose, Dimitrios S. Kolovos, Simon Poulding, and Simon Smith	428
Author Index	445