

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

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

University of Dortmund, Germany

Madhu Sudan

Massachusetts Institute of Technology, MA, USA

Demetri Terzopoulos

New York University, NY, USA

Doug Tygar

University of California, Berkeley, CA, USA

Moshe Y. Vardi

Rice University, Houston, TX, USA

Gerhard Weikum

Max-Planck Institute of Computer Science, Saarbruecken, Germany

Frank S. de Boer Marcello M. Bonsangue
Susanne Graf Willem-Paul de Roever (Eds.)

Formal Methods for Components and Objects

Second International Symposium, FMCO 2003
Leiden, The Netherlands, November 4-7, 2003
Revised Lectures

Volume Editors

Frank S. de Boer
Centre for Mathematics and Computer Science, CWI
Kruislaan 413, 1098 SJ Amsterdam, The Netherlands
E-mail: F.S.de.Boer@cwi.nl

Marcello M. Bonsangue
Leiden University, Leiden Institute of Advanced Computer Science
P.O. Box 9512, 2300 RA Leiden, The Netherlands
E-mail: marcello@liacs.nl

Susanne Graf
VERIMAG
2 Avenue de Vignate, Centre Equitation, 38610 Grenoble-Gières, France
E-mail: Susanne.Graf@imag.fr

Willem-Paul de Roever
Christian-Albrechts-University of Kiel
Institute of Computer Science and Applied Mathematics
Hermann-Rodewald-Straße 3, 24118 Kiel, Germany
E-mail: wpr@informatik.uni-kiel.de

Library of Congress Control Number: 2004112623

CR Subject Classification (1998): D.2, D.3, F.3, F.4

ISSN 0302-9743
ISBN 3-540-22942-6 Springer Berlin Heidelberg New York

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.

Springer is a part of Springer Science+Business Media
springeronline.com

© Springer-Verlag Berlin Heidelberg 2004
Printed in Germany

Typesetting: Camera-ready by author, data conversion by Scientific Publishing Services, Chennai, India
Printed on acid-free paper SPIN: 11315810 06/3142 5 4 3 2 1 0

Preface

Large and complex software systems provide the necessary infrastructure in all industries today. In order to construct such large systems in a systematic manner, the focus in the development methodologies has switched in the last two decades from functional issues to structural issues: both data and functions are encapsulated into software units that are integrated into large systems by means of various techniques supporting reusability and modifiability. This encapsulation principle is essential to both the object-oriented and the more recent component-based software engineering paradigms.

Formal methods have been applied successfully to the verification of medium-sized programs in protocol and hardware design. However, their application to large systems requires a further development of specification and verification techniques supporting the concepts of reusability and modifiability.

In order to bring together researchers and practitioners in the areas of software engineering and formal methods, we organized the 2nd International Symposium on Formal Methods for Components and Objects (FMCO) in Leiden, The Netherlands, from November 4 to 7, 2003. The program consisted of invited tutorials and technical presentations given by leading experts in the fields of theoretical computer science and software engineering. The symposium was attended by more than 80 people from all over the world.

This volume contains the contributions of the invited speakers to FMCO 2003. We believe that the presented material provides a unique combination of ideas on software engineering and formal methods which we hope will form an inspiration for those aiming at further bridging the gap between the theory and practice of software engineering.

The very idea to organize FMCO arose out of the NWO/DFG bilateral project Mobi-J. In particular we acknowledge the financial support of the NWO funding of Mobi-J. Additional financial support was provided by the Lorentz Center, the IST project Omega (2001-33522), the Dutch Institute for Programming Research and Algorithmics (IPA), the Royal Netherlands Academy of Arts and Sciences (KNAW), the Centrum voor Wiskunde en Informatica (CWI), and the Leiden Institute of Advanced Computer Science (LIACS).

July 2004

F.S. de Boer
M.M. Bonsangue
S. Graf
W.-P. de Roever

The Mobi-J Project

Mobi-J is a project funded by a bilateral research program of the Dutch Organization for Scientific Research (NWO) and the Central Public Funding Organization for Academic Research in Germany (DFG).

The partners of the Mobi-J projects are:

- Centrum voor Wiskunde en Informatica (F.S. de Boer)
- Leiden Institute of Advanced Computer Science (M.M. Bonsangue)
- Christian-Albrechts-Universität Kiel (W.-P. de Roever)

This project aims at the development of a programming environment which supports component-based design and verification of Java programs annotated with assertions. The overall approach is based on an extension of the Java language called Mobi-J with a notion of component which provides for the encapsulation of its internal processing of data and composition in a network by means of mobile asynchronous channels.

The activities of Mobi-J include the organization of international symposia funded by the NWO and Ph.D. research funded by the DFG. By means of regular meetings the partners discuss intensively Ph.D. research involving Mobi-J related topics. Mobi-J also maintains contacts with other German universities, including the universities of Oldenburg and Munich, and a close collaboration with the European IST project OMEGA.

The Omega Project

The overall aim of the European IST project Omega (2001-33522) is the definition of a development methodology in UML for embedded and real-time systems based on formal verification techniques. The approach is based on a formal semantics of a suitable subset of UML, adapted and extended where needed with a special emphasis on time-related aspects.

The Omega project involves the following partners: VERIMAG (France, Coordinator), Centrum voor Wiskunde en Informatica (The Netherlands), Christian-Albrechts-Universität (Germany), University of Nijmegen (The Netherlands), Weizmann Institute (Israel), OFFIS (Germany), EADS Launch Vehicles (France), France Telecom R&D (France), Israeli Aircraft Industries (Israel), and National Aerospace Laboratory (The Netherlands).

Table of Contents

| | |
|---|-----|
| Causality and Scheduling Constraints in Heterogeneous Reactive Systems Modeling <i>Albert Benveniste, Benoît Caillaud, Luca P. Carloni, Paul Caspi, Alberto L. Sangiovanni-Vincentelli</i> | 1 |
| Machine Function Based Control Code Algebras <i>Jan A. Bergstra</i> | 17 |
| Exploiting Abstraction for Specification Reuse. The Java/C# Case Study <i>Egon Börger, Robert F. Stärk</i> | 42 |
| On the Verification of Cooperating Traffic Agents <i>Werner Damm, Hardi Hungar, Ernst-Rüdiger Olderog</i> | 77 |
| How to Cook a Complete Hoare Logic for Your Pet OO Language <i>Frank S. de Boer, Cees Pierik</i> | 111 |
| Behavioural Specification for Hierarchical Object Composition <i>Răzvan Diaconescu</i> | 134 |
| Consistency Management Within Model-Based Object-Oriented Development of Components <i>Jochen M. Küster, Gregor Engels</i> | 157 |
| CommUnity on the Move: Architectures for Distribution and Mobility <i>José Luiz Fiadeiro, Antónia Lopes</i> | 177 |
| TulaFale: A Security Tool for Web Services <i>Karthikeyan Bhargavan, Cédric Fournet, Andrew D. Gordon, Riccardo Pucella</i> | 197 |
| A Checker for Modal Formulae for Processes with Data <i>Jan Friso Groote, Tim A.C. Willemse</i> | 223 |
| Semantic Essence of AsmL <i>Yuri Gurevich, Benjamin Rossman, Wolfram Schulte</i> | 240 |
| An MDA Approach to Tame Component Based Software Development <i>Jean-Marc Jézéquel, Olivier Defour, Noël Plouzeau</i> | 260 |
| An Application of Stream Calculus to Signal Flow Graphs <i>J.J.M.M. Rutten</i> | 276 |

Synchronous Closing and Flow Analysis for Model Checking Timed
Systems

Natalia Ioustinova, Natalia Sidorova, Martin Steffen 292

Priority Systems

Gregor Gössler, Joseph Sifakis 314

Preserving Properties Under Change

Heike Wehrheim 330

Tools for Generating and Analyzing Attack Graphs

Oleg Sheyner, Jeannette Wing 344

Author Index 373