

*Commenced Publication in 1973*

Founding and Former Series Editors:

Gerhard Goos, Juris Hartmanis, and Jan van Leeuwen

## Editorial Board

David Hutchison

*Lancaster University, Lancaster, 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, Zurich, Switzerland*

John C. Mitchell

*Stanford University, Stanford, CA, USA*

Moni Naor

*Weizmann Institute of Science, Rehovot, Israel*

C. Pandu Rangan

*Indian Institute of Technology Madras, Chennai, India*

Bernhard Steffen

*TU Dortmund University, Dortmund, Germany*

Demetri Terzopoulos

*University of California, Los Angeles, CA, USA*

Doug Tygar

*University of California, Berkeley, CA, USA*

Gerhard Weikum

*Max Planck Institute for Informatics, Saarbrücken, Germany*

More information about this series at <http://www.springer.com/series/7408>

Frank de Boer · Marcello Bonsangue  
Jan Rutten (Eds.)

# It's All About Coordination

Essays to Celebrate the Lifelong Scientific  
Achievements of Farhad Arbab

*Editors*

Frank de Boer  
Centre for Mathematics  
and Computer Science  
Amsterdam  
The Netherlands

Marcello Bonsangue  
Leiden University  
Leiden  
The Netherlands

Jan Rutten  
Centre for Mathematics  
and Computer Science  
Amsterdam  
The Netherlands

ISSN 0302-9743                      ISSN 1611-3349 (electronic)  
Lecture Notes in Computer Science  
ISBN 978-3-319-90088-9              ISBN 978-3-319-90089-6 (eBook)  
<https://doi.org/10.1007/978-3-319-90089-6>

Library of Congress Control Number: 2018939624

LNCS Sublibrary: SL2 – Programming and Software Engineering

© Springer International Publishing AG, part of Springer Nature 2018

This work is subject to copyright. All rights are reserved by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed.

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

The publisher, the authors and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, express or implied, with respect to the material contained herein or for any errors or omissions that may have been made. The publisher remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Cover illustration: The cover illustration was created by the editors. Used with permission.

Printed on acid-free paper

This Springer imprint is published by the registered company Springer International Publishing AG  
part of Springer Nature  
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland



Farhad Arbab

## Preface

Having Iranian, American, and Dutch nationality, Farhad Arbab is a citizen of the world, a fact that is reflected not only by his personality and views of life, but also by his scientific career.

Farhad was born in Iran and got his bachelor's degree in chemical engineering at Sharif University in Tehran, in July 1976. One year later, he obtained his master's degree in computer science, again at Sharif, in August 1977. Before and during his university studies, Farhad found the time for various other activities. He worked as a computer systems analyst and as a system engineer at various companies in Tehran, including IBM, and married Hamideh Afsarmanesh, in March 1977.

Newly wed and freshly graduated, Farhad moved to the United States, in the Fall of the same year, to start his PhD studies at the University of California, Los Angeles (UCLA). He obtained his PhD degree in 1982, by defending a thesis with the somewhat mysterious (at least, to some of us) title "Requirements and Architecture of a CAM-Oriented CAD System for Design and Manufacture of Mechanical Parts." In the period 1980–1989, i.e., both during and after his PhD studies, Farhad held various positions at UCLA, and at the University of Southern California (USC). And again, life was more than only science: Hamideh and Farhad became the proud parents of two beautiful daughters, Taraneh in 1985 and Mandana in 1987.

On his way to a third nationality, then, Farhad moved to Amsterdam, in January 1990, to start the Dutch branch of his career at CWI, a position he combined later, in 2014, with an appointment as professor at the University of Leiden.

All in all, Farhad worked in different countries, in various fields, on many diverse subjects, a border-crossing experience which led to scientific explorations in various directions.

In the United States, Farhad worked in the fields of computer graphics, solid modeling, and computer-aided design and manufacturing of mechanical parts. At CWI, in the 1990s, Farhad worked on the design, implementation, and applications of *Manifold*: a coordination language for managing the interactions among cooperating autonomous concurrent processes in heterogeneous distributed computing environments. Over the years, the scope of Farhad's research at CWI became wider still, including software composition, service-oriented computing, component-based software, concurrency theory, coordination models and languages, parallel and distributed computing, visual programming environments, constraints, logic and object-oriented programming.

Here we would like to highlight the foundational contributions of Farhad to the field of coordination models and languages. His insight that it is all about exogenous coordination gave rise to the IWIM (idealized workers and idealized managers) model for coordination of concurrent activities, which emphasized the basic separation of concerns between computation and coordination. This line of research culminated in the striking elegance and beauty of *Reo*: an exogenous coordination model whose formal semantics is based on a calculus of channel composition. This powerful

declarative model of coordination offers a visual glue-code language for the construction of coordinating connectors in distributed, mobile, and dynamically reconfigurable component-based systems. Reo has been extremely successful and is having a great impact in many of the areas mentioned here, as is illustrated by the high number of citations of Farhad's scientific publications.

We believe that it took someone as talented as Farhad, capable of crossing boundaries, to be able to observe and distill the essence of interaction, communication, and coordination, and to come up with the definition of Reo.

On the occasion of Farhad's retirement, the present volume collects a number of papers by several of Farhad's close collaborators over the years. On behalf of all your friends in science, we wish you all the best, Farhad!

March 2018

Frank de Boer  
Marcello Bonsangue  
Jan Rutten

# Organization

This festschrift was organized by Farhad's colleagues and friends Frank de Boer, Marcello Bonsangue, and Jan Rutten. We are grateful to Susanne van Dam for her help. We acknowledge the Centrum Wiskunde en Informatica (CWI) for the support in the organization of the associated workshop.

## Reviewers

Wil van der Aalst  
Krzysztof Apt  
Christel Baier  
Luís S. Barbosa  
Kees Bloom  
Kasper Dokter  
Fabio Gaducci  
Jean-Marie Jacquet  
Ali Jafari  
Einar Broch Johnsen  
Sung-Shik Jongmans

Ehsan Khamespanah  
Tobias Kappé  
Matteo Sammartino  
Francesco Santini  
Alexandra Silva  
Marjan Sirjani  
Meng Sun  
Carolyn Talcott  
Leendert van der Torre  
Erik de Vink



# Contents

Discovering the “Glue” Connecting Activities: Exploiting Monotonicity to Learn Places Faster . . . . .	1
<i>Wil M. P. van der Aalst</i>	
Self-stabilization Through the Lens of Game Theory . . . . .	21
<i>Krzysztof R. Apt and Ehsan Shoja</i>	
Energy-Utility Analysis of Probabilistic Systems with Exogenous Coordination . . . . .	38
<i>Christel Baier, Philipp Chrszon, Clemens Dubsclaff, Joachim Klein, and Sascha Klüppelholz</i>	
A Note on Reactive Transitions and Reo Connectors . . . . .	57
<i>Daniel Figueiredo, Manuel A. Martins, and Luís S. Barbosa</i>	
Personal Note: Working with Farhad Arbab 1990–2005 . . . . .	68
<i>Kees Blom</i>	
Soft Constraint Automata with Memory . . . . .	70
<i>Kasper Dokter, Fabio Gadducci, and Francesco Santini</i>	
On the Relation Between Control-Based and Data-Based Coordination Languages. . . . .	86
<i>Jean-Marie Jacquet, Isabelle Linden, and Denis Darquennes</i>	
Release the Beasts: When Formal Methods Meet Real World Data . . . . .	107
<i>Rudolf Schlatte, Einar Broch Johnsen, Jacopo Mauro, S. Lizeth Tapia Tarifa, and Ingrid Chieh Yu</i>	
Formalizing Propagation of Priorities in Reo, Using Eight Colors . . . . .	122
<i>Sung-Shik Jongmans</i>	
Learning to Coordinate . . . . .	139
<i>Gerco van Heerdt, Bart Jacobs, Tobias Kappé, and Alexandra Silva</i>	
Reo Connectors and Components as Tagged Signal Models . . . . .	160
<i>Marjan Sirjani, Fatemeh Ghassemi, and Bahman Pourvatan</i>	
Generating Arduino C Codes from <i>Mediator</i> . . . . .	174
<i>Yi Li and Meng Sun</i>	
From Soft Agents to Soft Component Automata and Back . . . . .	189
<i>Carolyn Talcott</i>	

Argumentation as Exogenous Coordination . . . . . 208  
    *Leendert van der Torre, Tjitze Rienstra, and Dov Gabbay*

Extending Paradigm with Data . . . . . 224  
    *Luuk P. J. Groenewegen, Jan H. S. Verschuren, and Erik P. de Vink*

**Author Index** . . . . . 245