

6th Conference on Algebra and Coalgebra in Computer Science

CALCO'15, June 24–26, 2015, Nijmegen, Netherlands

Edited by

**Lawrence S. Moss
Paweł Sobociński**



Editors

Lawrence S. Moss Department of Mathematics Indiana University Bloomington, IN 47405 USA lsm@cs.indiana.edu	Paweł Sobociński Department of Electronics and Computer Science University of Southampton Southampton, United Kingdom SO17 1BJ ps@ecs.soton.ac.uk
--	---

ACM Classification 1998

F. Theory of Computation, F.3 Logics and Meanings of Programs, F.3.2 Semantics of Programming Languages

ISBN 978-3-939897-84-2

Published online and open access by

Schloss Dagstuhl – Leibniz-Zentrum für Informatik GmbH, Dagstuhl Publishing, Saarbrücken/Wadern, Germany. Online available at <http://www.dagstuhl.de/dagpub/978-3-939897-84-2>.

Publication date

October, 2015

Bibliographic information published by the Deutsche Nationalbibliothek

The Deutsche Nationalbibliothek lists this publication in the Deutsche Nationalbibliografie; detailed bibliographic data are available in the Internet at <http://dnb.d-nb.de>.

License

This work is licensed under a Creative Commons Attribution 3.0 Unported license (CC-BY 3.0): <http://creativecommons.org/licenses/by/3.0/legalcode>.



In brief, this license authorizes each and everybody to share (to copy, distribute and transmit) the work under the following conditions, without impairing or restricting the authors' moral rights:

- Attribution: The work must be attributed to its authors.

The copyright is retained by the corresponding authors.

Digital Object Identifier: 10.4230/LIPIcs.CALCO.2015.i

ISBN 978-3-939897-84-2

ISSN 1868-8969

<http://www.dagstuhl.de/lipics>

LIPICS – Leibniz International Proceedings in Informatics

LIPICS is a series of high-quality conference proceedings across all fields in informatics. LIPICS volumes are published according to the principle of Open Access, i.e., they are available online and free of charge.

Editorial Board

- Susanne Albers (TU München)
- Chris Hankin (Imperial College London)
- Deepak Kapur (University of New Mexico)
- Michael Mitzenmacher (Harvard University)
- Madhavan Mukund (Chennai Mathematical Institute)
- Catuscia Palamidessi (INRIA)
- Wolfgang Thomas (*Chair*, RWTH Aachen)
- Pascal Weil (CNRS and University Bordeaux)
- Reinhard Wilhelm (Saarland University)

ISSN 1868-8969

<http://www.dagstuhl.de/lipics>

Contents

Preface <i>Lawrence S. Moss and Paweł Sobociński</i>	vii
---	-----

Regular Papers

Syntactic Monoids in a Category <i>Jiří Adámek, Stefan Milius, and Henning Urbat</i>	1
Extensions of Functors From Set to \mathcal{V} -cat <i>Adriana Balan, Alexander Kurz, and Jiří Velebil</i>	17
Towards Trace Metrics via Functor Lifting <i>Paolo Baldan, Filippo Bonchi, Henning Kerstan, and Barbara König</i>	35
A Fibration Approach to Automata Theory <i>Liang-Ting Chen and Henning Urbat</i>	50
Canonical Coalgebraic Linear Time Logics <i>Corina Cîrstea</i>	66
An Intensionally Fully-abstract Sheaf Model for π <i>Clovis Eberhart, Tom Hirschowitz, and Thomas Seiller</i>	86
Partial Higher-dimensional Automata <i>Uli Fahrenberg and Axel Legay</i>	101
A Recipe for State-and-Effect Triangles <i>Bart Jacobs</i>	116
Towards Concept Analysis in Categories: Limit Inferior as Algebra, Limit Superior as Coalgebra <i>Toshiki Kataoka and Dusko Pavlovic</i>	130
Codensity Liftings of Monads <i>Shin-ya Katsumata and Tetsuya Sato</i>	156
A First-order Logic for String Diagrams <i>Aleks Kissinger and David Quick</i>	171
Presenting Morphisms of Distributive Laws <i>Bartek Klin and Beata Nachyla</i>	190
Approximation of Nested Fixpoints – A Coalgebraic View of Parametric Datatypes <i>Alexander Kurz, Alberto Pardo, Daniela Petrişan, Paula Severi, and Fer-Jan de Vries</i>	205
Final Coalgebras from Corecursive Algebras <i>Paul Blain Levy</i>	221
Uniform Interpolation for Coalgebraic Fixpoint Logic <i>Johannes Marti, Fatemeh Seifan, and Yde Venema</i>	238

6th International Conference on Algebra and Coalgebra in Computer Science (CALCO'15).
Editors: Lawrence S. Moss and Paweł Sobociński



Leibniz International Proceedings in Informatics
Schloss Dagstuhl – Leibniz-Zentrum für Informatik, Dagstuhl Publishing, Germany

Generic Trace Semantics and Graded Monads <i>Stefan Milius, Dirk Pattinson, and Lutz Schröder</i>	253
Open System Categorical Quantum Semantics in Natural Language Processing <i>Robin Piedeleu, Dimitri Kartsaklis, Bob Coecke, and Mehrnoosh Sadrzadeh</i>	270
Modules Over Monads and Their Algebras <i>Maciej Piróg, Nicolas Wu, and Jeremy Gibbons</i>	290
Revisiting the Institutional Approach to Herbrand's Theorem <i>Ionuț Tuțu and José Luiz Fiadeiro</i>	304
Coalgebraic Infinite Traces and Kleisli Simulations <i>Natsuki Urabe and Ichiro Hasuo</i>	320
Finitary Corecursion for the Infinitary Lambda Calculus <i>Stefan Milius and Thorsten Wißmann</i>	336

Preface

This volume contains the Proceedings of the 6th Conference on Algebra and Coalgebra in Computer Science, CALCO'15, held in Nijmegen, the Netherlands, 24–26 June 2015. Previous CALCO conferences have been held in Swansea (Wales, 2005), Bergen (Norway, 2007), Udine (Italy, 2009), Winchester (UK, 2011) and Warsaw (Poland, 2013). CALCO is a high-level, bi-annual conference formed by joining the forces and reputations of CMCS (the International Workshop on Coalgebraic Methods in Computer Science), and WADT (the Workshop on Algebraic Development Techniques). CALCO received 47 submissions. Of these, 21 papers were accepted.

The invited speakers at CALCO were Chris Heunen, Matteo Mio, Daniela Petrisan, and Andy Pitts. We thank them for their stimulating talks. In addition, CALCO has a tradition of Early Ideas talks, allowing presentation of work in progress and original research proposals. CALCO'15 had 11 Early Ideas talks.

We are grateful to the programme committee of CALCO for their hard work:

Andrej Bauer	Paul-André Melliés
Filippo Bonchi	Stefan Milus
Corina Cîrstea	Lawrence S. Moss (co-chair)
Andrea Corradini	Dusko Pavlovic
Ross Duncan	Daniela Petrisan
Martín Escardó	Damien Pous
Dan Ghica	John Power
Helle Hansen	Jan Rutten
Ichiro Hasuo	Lutz Schröder
Bart Jacobs	Monika Seisenberger
Bartek Klin	Alexandra Silva
Barbara König	Pawel Sobociński (co-chair)
Dexter Kozen	Ana Sokolova
Alexander Kurz	Andrzej Tarlecki

We also are pleased to thank the local organizers for their work in bringing such a wonderful conference to fruition: Alexandra Silva, Bart Jacobs, Nicole Messink, and Sam Staton.

Larry Moss and Paweł Sobociński
October 2015

List of Authors

Jiří Adámek Institut für Theoretische Informatik Technische Universität Braunschweig Germany j.adamek@tu-bs.de	Jeremy Gibbons University of Oxford United Kingdom Jeremy.Gibbons@cs.ox.ac.uk
Adriana Balan University Politehnica of Bucharest Romania adriana.balan@mathem.pub.ro	Ichiro Hasuo Department of Computer Science University of Tokyo, Japan ichiro@is.s.u-tokyo.ac.jp
Paolo Baldan Dipartimento di Matematica Università di Padova Italy baldan@math.unipd.it	Tom Hirschowitz CNRS, Université Savoie Mont-Blanc France tom.hirschowitz@univ-savoie.fr
Filippo Bonchi CNRS, ENS Lyon, Université de Lyon France filippo.bonchi@ens-lyon.fr	Bart Jacobs ICIS, Radboud University Nijmegen Netherlands bart@cs.ru.nl
Liang-Ting Chen Institut für Theoretische Informatik Technische Universität Braunschweig Germany l.chen@iti.cs.tu-bs.de	Dimitri Kartsaklis Queen Mary University of London United Kingdom d.kartsaklis@qmul.ac.uk
Corina Cîrstea ECS, University of Southampton United Kingdom cc2@ecs.soton.ac.uk	Toshiki Kataoka University of Tokyo Japan toshikik@is.s.u-tokyo.ac.jp
Bob Coecke University of Oxford United Kingdom coecke@cs.ox.ac.uk	Shin-Ya Katsumata Kyoto University Japan sinya@kurims.kyoto-u.ac.jp
Clovis Eberhart Université Savoie Mont-Blanc France ceberhar@ens-cachan.fr	Henning Kerstan Universität Duisburg-Essen Germany henning.kerstan@uni-due.de
Uli Fahrenberg IRISA/INRIA, Rennes France ulrich.fahrenberg@irisa.fr France	Aleks Kissinger Oxford University United Kingdom aleks.kissinger@cs.ox.ac.uk
	Bartek Klin University of Warsaw Poland klin@mimuw.edu.pl

Authors

Barbara König
 Universität Duisburg-Essen, Germany
 barbara_koenig@uni-due.de

Alexander Kurz
 University of Leicester
 United Kingdom
 kurz@mcs.le.ac.uk

Axel Legay
 IRISA/INRIA, Rennes
 France
 Axel.Legay@inria.fr

Paul Blain Levy
 University of Birmingham
 United Kingdom
 p.b.levy@cs.bham.ac.uk

Stefan Milius
 FAU Erlangen
 Germany
 mail@stefan-milius.eu

Beata Nachyla
 Institute of Computer Science
 Polish Academy of Science
 Poland
 beatanachyla@gmail.com

Alberto Pardo
 Universidad de la República
 Uruguay
 pardo@fing.edu.uy

Dirk Pattinson
 Australian National University
 Australia
 dirk.pattinson@anu.edu.au

Dusko Pavlovic
 University of Hawaii
 United States of America
 dusko@hawaii.edu

Daniela Petrisan
 Radboud University
 Netherlands
 daniela.petrisan@gmail.com

Robin Piedeleu
 University of Oxford
 United Kingdom
 robin.piedeleu@cs.ox.ac.uk

Maciej Piróg
 University of Oxford
 United Kingdom
 maciej.adam.pirog@gmail.com

David Quick
 Oxford University
 United Kingdom
 david.quick@cs.ox.ac.uk

Mehrnoosh Sadrzadeh
 Queen Mary University of London
 United Kingdom
 mehrnoosh.sadrzadeh@qmul.ac.uk

Lutz Schröder
 Department of Computer Science
 FAU Erlangen-Nürnberg
 Germany
 lutz.schroeder@fau.de

Fatemeh Seifan
 ILLC, University of Amsterdam
 Netherlands
 fateme.sayfan@gmail.com

Thomas Seiller
 PPS, Université Paris VII
 France
 seiller@ihes.fr

Paula Severi
 University of Leicester
 United Kingdom
 ps330@leicester.ac.uk

İonuț Tuțu
 Royal Holloway University of London
 United Kingdom
 ittutu@gmail.com

Natsuki Urabe
 University of Tokyo
 Japan
 urabenatsuki@is.s.u-tokyo.ac.jp

Henning Urbat
 Institut für Theoretische Informatik
 Technische Universität Braunschweig
 Germany
 urbat@iti.cs.tu-bs.de

Jiří Velebil
Czech Technical University
Czech Republic
velebil@math.feld.cvut.cz

Fer-Jan de Vries
University of Leicester
United Kingdom
fdv1@mcs.le.ac.uk

Thorsten Wißmann
Universität Erlangen-Nürnberg
Germany
thorsten.wissmann@fau.de

Nicolas Wu
University of Bristol
United Kingdom
nicolas.wu@bristol.ac.uk

