20th International Conference on Types for Proofs and Programs

TYPES'14, May 12–15, 2014, Paris, France

Edited by
Hugo Herbelin
Pierre Letouzey
Matthieu Sozeau

Editors

Hugo Herbelin
πr^2 team, P.P.S. laboratory
INRIA & Université Paris Diderot
France
hugo.herbelin@inria.fr

Pierre Letouzey
πr^2 team, P.P.S. laboratory
INRIA & Université Paris Diderot
France
pierre.letouzey@inria.fr

Matthieu Sozeau
πr^2 team, P.P.S. laboratory
INRIA & Université Paris Diderot
France
matthieu.sozeau@inria.fr

ACM Classification 1998
D.1.1 Applicative (Functional) Programming, D.2.4 Software/Program Verification, F.3.1 Specifying and Verifying and Reasoning about Programs, F.4.1 Mathematical Logic

ISBN 978-3-939897-88-0

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/978-3-939897-88-0.

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.TYPES.2014.i

ISBN 978-3-939897-88-0 **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
Hugo Herbelin, Pierre Letouzey, and Matthieu Sozeau vii

Terminal Semantics for Codata Types in Intensional Martin-Löf Type Theory
Benedikt Ahrens and Régis Spadotti 1

A Calculus of Constructions with Explicit Subtyping
Ali Assaf 27

Objects and Subtyping in the $\lambda\Pi$-Calculus Modulo
Raphaël Cauderlier and Catherine Dubois 47

Typeful Normalization by Evaluation
Olivier Danvy, Chantal Keller, and Matthias Puech 72

Dialectica Categories and Games with Bidding
Jules Hedges 89

The General Universal Property of the Propositional Truncation
Nicolai Kraus 111

On the Structure of Classical Realizability Models of ZF
Jean-Louis Krivine 146

An Extensional Kleene Realizability Semantics for the Minimalist Foundation
Maria Emilia Maietti and Samuele Maschio 162

Investigating Streamless Sets
Erik Parmann 187

Nominal Presentation of Cubical Sets Models of Type Theory
Andrew M. Pitts 202

On Extensionality of $\lambda*$
Andrew Polonsky 221

Restricted Positive Quantification Is Not Elementary
Aleksy Schubert, Paweł Urzyczyn, and Daria Walukiewicz-Chrząszcz 251

On Isomorphism of Dependent Products in a Typed Logical Framework
Sergei Soloviev 274

An Intuitionistic Analysis of Size-change Termination
Silvia Steila 288

20th International Conference on Types for Proofs and Programs (TYPES 2014).
Editors: Hugo Herbelin, Pierre Letouzey, and Matthieu Sozeau

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

Preface

The 20th International Conference on Types for Proofs and Programs (TYPES'14) was held in Paris, France from May 12 to May 16, 2014, consisting of the main conference and one satellite event[1].

The conference was attended by about a hundred scientists. The responsible persons for local organisation were Hugo Herbelin, Pierre Letouzey and Matthieu Sozeau, and the program committee for the selection of the conference presentations consisted of:

- Andreas Abel, Chalmers University of Technology and Gothenburg University, Sweden
- Andrej Bauer, Fakulteta za matematiko in fiziko, Ljubljana, Slovenia
- Małgorzata Biernacka, University of Wroclaw, Poland
- Lars Birkedal, Aarhus University, Denmark
- Paul Blain Levy, University of Birmingham, UK
- Herman Geuvers, Radboud University and Eindhoven University of Technology, Netherlands
- Hugo Herbelin, INRIA Paris-Rocquencourt, France (co-chair)
- Pierre Letouzey, University Paris-Diderot, France (co-chair)
- Ralph Matthes, IRIT, CNRS and University of Toulouse, France
- Conor McBride, University of Strathclyde, UK
- Luís Pinto, University of Minho, Braga, Portugal
- Claudio Sacerdoti, University of Bologna, Italy
- Aleksy Schubert, University of Warsaw, Poland
- Matthieu Sozeau, INRIA Paris-Rocquencourt, France (co-chair)
- Thomas Streicher, TU Darmstadt, Germany

The TYPES meetings were first organised in the late 1980's and were supported by a series of EU programmes from 1989 to 2008. Previous meetings were held in Antibes (1990), Edinburgh (1991), Båstad (1992), Nijmegen (1993), Båstad (1994), Turin (1995), Aussois (1996), Kloster Irsee (1998), Lökeberg (1999), Durham (2000), Berg en Dal (2002), Turin (2003), Jouy-en-Josas (2004), Nottingham (2006), Cividale del Friuli (2007), Turin (2008), Aussois (2009), Warsaw (2010), Bergen (2011) and Toulouse (2013).

Three invited talks and 39 contributed talks were given at the meeting, and we got 17 submissions to these open post-proceedings, out of which 14 papers were accepted. All papers obtained at least two reviews, and up to six reviews, counting a second round of review.

As editors of this post-proceedings volume, we would like to thank the authors of the paper submissions, whether accepted or not. And we gratefully acknowledge all 31 anonymous external referees for their valuable work. The overall very high quality of the resulting papers is in part due to their careful reading and commenting on the obtained material.

The TYPES'14 conference received financial and/or logistic support from the Institut Henri Poincaré (IHP), INRIA Paris-Rocquencourt, and Université Paris Diderot. The EasyChair platform was used for reviewing and it was a very agreeable experience as editors of these post-proceedings to work with Marc Herbstritt and Schloss Dagstuhl.

Hugo Herbelin, Pierre Letouzey and Matthieu Sozeau
July 2015

[1] PCC: Proof, Computation, Complexity.

20th International Conference on Types for Proofs and Programs (TYPES 2014).
Editors: Hugo Herbelin, Pierre Letouzey, and Matthieu Sozeau
Leibniz International Proceedings in Informatics
LIPICS Schloss Dagstuhl – Leibniz-Zentrum für Informatik, Dagstuhl Publishing, Germany

Authors Index

Ahrens, Benedikt, 1

Assaf, Ali, 26

Cauderlier, Raphaël, 47

Danvy, Olivier, 72

Dubois, Catherine, 47

Hedges, Jules, 89

Keller, Chantal, 72

Kraus, Nicolai, 111

Krivine, Jean-Louis, 146

Maietti, Maria Emilia, 162

Maschio, Samuele, 162

Parmann, Erik, 187

Pitts, Andrew, 202

Polonsky, Andrew, 221

Puech, Matthias, 72

Schubert, Aleksy, 251

Soloviev, Sergei, 274

Spadotti, Régis, 1

Steila, Silvia, 288

Urzyczyn, Paweł, 251

Walukiewicz-Chrząszcz, Daria, 251

20th International Conference on Types for Proofs and Programs (TYPES 2014).
Editors: Hugo Herbelin, Pierre Letouzey, and Matthieu Sozeau
Leibniz International Proceedings in Informatics
LIPICS Schloss Dagstuhl – Leibniz-Zentrum für Informatik, Dagstuhl Publishing, Germany