

*Commenced Publication in 1973*

Founding and Former Series Editors:

Gerhard Goos, Juris Hartmanis, and Jan van Leeuwen

## Editorial Board

David Hutchison, UK

Josef Kittler, UK

Alfred Kobsa, USA

John C. Mitchell, USA

Oscar Nierstrasz, Switzerland

Bernhard Steffen, Germany

Demetri Terzopoulos, USA

Gerhard Weikum, Germany

Takeo Kanade, USA

Jon M. Kleinberg, USA

Friedemann Mattern, Switzerland

Moni Naor, Israel

C. Pandu Rangan, India

Madhu Sudan, USA

Doug Tygar, USA

## Advanced Research in Computing and Software Science

Subline of Lectures Notes in Computer Science

## Subline Series Editors

Giorgio Ausiello, *University of Rome 'La Sapienza', Italy*

Vladimiro Sassone, *University of Southampton, UK*

## Subline Advisory Board

Susanne Albers, *University of Freiburg, Germany*

Benjamin C. Pierce, *University of Pennsylvania, USA*

Bernhard Steffen, *University of Dortmund, Germany*

Madhu Sudan, *Microsoft Research, Cambridge, MA, USA*

Deng Xiaotie, *City University of Hong Kong*

Jeannette M. Wing, *Carnegie Mellon University, Pittsburgh, PA, USA*

Antoine Miné David Schmidt (Eds.)

# Static Analysis

19th International Symposium, SAS 2012  
Deauville, France, September 11-13, 2012  
Proceedings



Springer

## Volume Editors

Antoine Miné  
École Normale Supérieure  
Département d'Informatique  
45, rue d'Ulm  
75005 Paris, France  
E-mail: mine@di.ens.fr

David Schmidt  
Kansas State University  
Department of Computing and Information Sciences  
234 Nichols Hall  
Manhattan, KS 66506, USA  
E-mail: das@ksu.edu

ISSN 0302-9743 e-ISSN 1611-3349  
ISBN 978-3-642-33124-4 e-ISBN 978-3-642-33125-1  
DOI 10.1007/978-3-642-33125-1  
Springer Heidelberg Dordrecht London New York

Library of Congress Control Number: 2012945543

CR Subject Classification (1998): D.2.4-5, D.2.7, D.3.1-2, D.3.4, F.3.1-3, F.4.1

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

Static analysis is increasingly recognized as a fundamental tool for program verification, bug detection, compiler optimization, program understanding, and software maintenance. The series of Static Analysis Symposia has served as the primary venue for presentation of theoretical, practical, and application advances in the area.

This volume contains the proceedings of the 19th International Static Analysis Symposium, SAS 2012, which was held during September 11–13 in Deauville, France. Previous symposia were held in Venice, Perpignan, Los Angeles, Valencia, Kongens Lyngby, Seoul, London, Verona, San Diego, Madrid, Paris, Santa Barbara, Pisa, Aachen, Glasgow, and Namur.

As in the last two years, the 19th International Static Analysis Symposium was held together with three workshops. The 4th Workshop on Numerical and Symbolic Abstract Domains (NSAD 2012) and the Third Workshop on Static Analysis and Systems Biology (SASB 2012) were held in parallel on September 10. The Third Workshop on Tools for Automatic Program Analysis (TAPAS 2012) was held on September 14.

The program of the 19th International Static Analysis Symposium consisted in the presentation of 25 articles selected among 62 submissions from 23 countries. The contributions were selected by the Program Committee based on scientific quality, originality, and relevance to SAS, after a rigorous reviewing process involving at least three Program Committee members and external reviewers. In addition to the contributed papers, the program of the symposium featured four invited presentations by Gilles Barthe (IMDEA Software Institute, Spain), Dino Distefano (Queen Mary University of London and Monoidics, UK), Shriram Krishnamurthi (Brown University, USA), and Jens Palsberg (University of California, Los Angeles, USA). This volume includes an invited article by Jens Palsberg et al.

We would like to thank the external reviewers for their participation in the reviewing process. We would also like to thank the Département d'informatique de l'École normale supérieure and the Délégation régionale du CNRS Paris B for their administrative support. We thank the EasyChair team for the use of their software. We are grateful to our sponsors: CNRS, École normale supérieure, and INRIA.

September 2012

Antoine Miné  
Dave Schmidt

# Organization

## Program Chairs

Antoine Miné  
David Schmidt

CNRS and École Normale Supérieure, France  
Kansas State University, USA

## Program Committee

Elvira Albert  
Patrick Cousot

Complutense University of Madrid, Spain  
École Normale Supérieure, France and  
New York University, USA

Pietro Ferrara  
Gilberto Filè  
Chris Hankin  
Suresh Jagannathan  
Matthieu Martel

ETH Zurich, Switzerland  
University of Padova, Italy  
Imperial College London, UK  
Purdue University, USA  
Université de Perpignan Via Domitia, France

Matthew Might  
Anders Møller  
David Monniaux  
Markus Müller-Olm  
Andreas Podelski  
G. Ramalingam  
Sriram Sankaranarayanan  
Francesca Scozzari  
Manu Sridharan  
Thomas Wies  
Eran Yahav  
Kwangkeun Yi

University of Utah, USA  
Aarhus University, Denmark  
CNRS, Verimag, France  
Universität Münster, Germany  
University of Freiburg, Germany  
Microsoft Research, India  
University of Colorado Boulder, USA  
Università di Chieti-Pescara, Italy  
IBM Research, USA  
New York University, USA  
Technion, Israel  
Seoul National University, Korea

## Steering Committee

Patrick Cousot

École Normale Supérieure, France and  
New York University, USA

Radhia Cousot  
Roberto Giacobazzi  
Gilberto Filè  
Manuel Hermenegildo  
David Schmidt

CNRS and École Normale Supérieure, France  
University of Verona, Italy  
University of Padova, Italy  
IMDEA Software Institute, Spain  
Kansas State University, USA

## Additional Reviewers

Diego Esteban Alonso-Blas

Gianluca Amato

Sylvie Boldo

Olivier Bouissou

Hugues Cassé

Pavol Černý

Alexandre Chapoutot

Sungkeun Cho

Livio Colussi

Mauro Conti

Jesús Correas Fernández

Antonio Flores-Montoya

Goran Frehse

Sumit Gulwani

Arie Gurfinkel

Miguel Gómez-Zamalloa

Julien Henry

Kihong Heo

Jochen Hoenicke

Arnault Ioualalen

François Irigoin

Deokhwan Kim

Andy King

Tim King

Soonho Kong

Michael Kuperstein

Vincent Laviro

Oukseh Lee

Wonchan Lee

Woosuk Lee

Shuying Liang

Mark Marron

Isabella Mastroeni

Laurent Mauborgne

Yuri Meshman

Andrzej Murawski

Benedikt Nordhoff

Aditya Nori

Hakjoo Oh

Nimrod Partush

Simon Perdrix

Gustavo Petri

Ruzica Piskac

Corneliu Popeea

Noam Rinetzk

Sukyoung Ryu

Oliver Rüthing

Yassamine Seladji

Mihaela Sighireanu

Axel Simon

Fausto Spoto

Tullio Vardanega

Alexander Wenner

Enea Zaffanella

Damiano Zanardini

## Sponsoring Institutions

École Normale Supérieure, CNRS, INRIA

# Table of Contents

## Invited Talks

Computer-Aided Cryptographic Proofs . . . . .	1
<i>Gilles Barthe, Benjamin Grégoire, and Santiago Zanella Béguelin</i>	
A Voyage to the Deep-Heap . . . . .	3
<i>Dino Distefano</i>	
Semantics and Analyses for JavaScript and the Web . . . . .	4
<i>Shriram Krishnamurthi</i>	
Efficient May Happen in Parallel Analysis for Async-Finish Parallelism . . . . .	5
<i>Jonathan K. Lee, Jens Palsberg, Rupak Majumdar, and Hong Hong</i>	

## Contributed Papers

Modular Static Analysis with Zonotopes . . . . .	24
<i>Eric Goubault, Sylvie Putot, and Franck Védrine</i>	
Polyhedral Analysis Using Parametric Objectives . . . . .	41
<i>Jacob M. Howe and Andy King</i>	
Inference of Polynomial Invariants for Imperative Programs: A Farewell to Gröbner Bases . . . . .	58
<i>David Cachera, Thomas Jensen, Arnaud Jobin, and Florent Kirchner</i>	
A New Abstract Domain for the Representation of Mathematically Equivalent Expressions . . . . .	75
<i>Arnault Ioualalen and Matthieu Martel</i>	
An Abstract Domain to Infer Types over Zones in Spreadsheets . . . . .	94
<i>Tie Cheng and Xavier Rival</i>	
Bilateral Algorithms for Symbolic Abstraction . . . . .	111
<i>Aditya Thakur, Matt Elder, and Thomas Reps</i>	
Making Abstract Interpretation Incomplete: Modeling the Potency of Obfuscation . . . . .	129
<i>Roberto Giacobazzi and Isabella Mastroeni</i>	
Invariant Generation for Parametrized Systems Using Self-reflection . . . .	146
<i>Alejandro Sanchez, Sriram Sankaranarayanan, César Sánchez, and Bor-Yuh Evan Chang</i>	

Automatic Fence Insertion in Integer Programs via Predicate Abstraction .....	164
<i>Parosh Aziz Abdulla, Mohamed Faouzi Atig, Yu-Fang Chen, Carl Leonardsson, and Ahmed Rezzine</i>	
Control Flow Analysis for the Join Calculus .....	181
<i>Peter Calvert and Alan Mycroft</i>	
When the Decreasing Sequence Fails .....	198
<i>Nicolas Halbwachs and Julien Henry</i>	
Loop Leaping with Closures .....	214
<i>Sebastian Biallas, Jörg Brauer, Andy King, and Stefan Kowalewski</i>	
Path-Sensitive Backward Slicing .....	231
<i>Joxan Jaffar, Vijayaraghavan Murali, Jorge A. Navas, and Andrew E. Santosa</i>	
Symbolic Learning of Component Interfaces .....	248
<i>Dimitra Giannakopoulou, Zvonimir Rakamarić, and Vishwanath Raman</i>	
Liveness-Based Pointer Analysis .....	265
<i>Uday P. Khedker, Alan Mycroft, and Prashant Singh Rawat</i>	
Succinct Representations for Abstract Interpretation: Combined Analysis Algorithms and Experimental Evaluation .....	283
<i>Julien Henry, David Monniaux, and Matthieu Moy</i>	
Craig Interpretation .....	300
<i>Aws Albarghouthi, Arie Gurfinkel, and Marsha Chechik</i>	
Satisfiability Solvers Are Static Analysers .....	317
<i>Vijay D'Silva, Leopold Haller, and Daniel Kroening</i>	
A Generalization of Stålmarch's Method .....	334
<i>Aditya Thakur and Thomas Reps</i>	
A Structural Soundness Proof for Shivers's Escape Technique: A Case for Galois Connections .....	352
<i>Jan Midtgaard, Michael D. Adams, and Matthew Might</i>	
Modular Heap Analysis for Higher-Order Programs .....	370
<i>Ravichandhran Madhavan, G. Ramalingam, and Kapil Vaswani</i>	
Binary Reachability Analysis of Higher Order Functional Programs ....	388
<i>Ruslán Ledesma-Garza and Andrey Rybalchenko</i>	



On the Limits of the Classical Approach to Cost Analysis . . . . .	405
<i>Diego Esteban Alonso-Blas and Samir Genaim</i>	
Termination Proofs for Linear Simple Loops . . . . .	422
<i>Hong Yi Chen, Shaked Flur, and Supratik Mukhopadhyay</i>	
Finding Non-terminating Executions in Distributed Asynchronous Programs . . . . .	439
<i>Michael Emmi and Akash Lal</i>	
<b>Author Index . . . . .</b>	<b>457</b>