10th International Workshop on Worst-Case Execution Time Analysis

WCET 2010, July 6, 2010, Brussels, Belgium

Edited by

Björn Lisper



Editor

Björn Lisper School of Innovation, Design, and Engineering Mälardalen University Västerås, Sweden bjorn.lisper@mdh.se

ACM Classification 1998

C.4 Performance of Systems, D.2.4 Software/Program Verification, J.7 Computers in Other Systems

ISBN 978-3-939897-21-7

Published online and open access by

Schloss Dagstuhl – Leibniz-Center for Informatics GmbH, Dagstuhl Publishing, Saarbrücken/Wadern, Germany.

Publication date

December, 2010.

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-Noncommercial-No Derivative Works license: http://creativecommons.org/licenses/by-nc-nd/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 author's moral rights:

- Attribution: The work must be attributed to its authors.
- Noncommercial: The work may not be used for commercial purposes.
- No derivation: It is not allowed to alter or transform this work.

The copyright is retained by the corresponding authors.

Digital Object Identifier: 10.4230/OASIcs.WCET.2010.i

ISBN 978-3-939897-21-7

ISSN 2190-6807

http://www.dagstuhl.de/oasics

OASIcs - OpenAccess Series in Informatics

OASIcs aims at a suitable publication venue to publish peer-reviewed collections of papers emerging from a scientific event. OASIcs volumes are published according to the principle of Open Access, i.e., they are available online and free of charge.

Editorial Board

Dorothea Wagner (Karlsruhe Institute of Technology)

ISSN 2190-6807

www.dagstuhl.de/oasics

Contents

Session 1: Cache and low-level analysis

Timing Anomalies Reloaded Gernot Gebhard	1
Bounding the Effects of Resource Access Protocols on Cache Behavior Enrico Mezzetti, Marco Panunzio, and Tullio Vardanega	11
Toward Precise PLRU Cache Analysis Daniel Grund and Jan Reineke	23
Integrating Abstract Caches with Symbolic Pipeline Analysis Stephan Wilhelm and Christoph Cullmann	36
Session 2: Measurement-based methods and flow analysis	
Realism in Statistical Analysis of Worst Case Execution Times David Griffin and Alan Burns	44
Hybrid measurement-based WCET analysis at the source level using object-level traces	
Adam Betts, Nicholas Merriam, and Guillem Bernat	54
On the Use of Context Information for Precise Measurement-Based Execution Time Estimation	
Stefan Stattelmann and Florian Martin	64
A Code Policy Guaranteeing Fully Automated Path Analysis Benedikt Huber and Peter Puschner	77
Invited talk	
WCET Computation of Safety-Critical Avionics Programs: Challenges, Achievements and Perspectives	
Jean Souyris	89
Session 3: Parallel systems, model checking	
WCET Analysis of a Parallel 3D Multigrid Solver Executed on the MERASA Multi-Core	
Christine Rochange, Armelle Bonenfant, Pascal Sainrat, Mike Gerdes, Julian Wolf, Theo Ungerer, Zlatko Petrov, and František Mikulu	90
Towards WCET Analysis of Multicore Architectures Using UPPAAL Andreas Gustavsson, Andreas Ermedahl, Björn Lisper, and Paul Pettersson	101
METAMOC: Modular Execution Time Analysis using Model Checking Andreas E. Dalsgaard, Mads Chr. Olesen, Martin Toft, René R. Hansen, and Kim G. Larsen	113
10 th International Workshop on Worst-Case Execution Time Analysis (WCET 2010). Editor: Björn Lisper OpenAccess Series in Informatics OASICS Schloss Dagstuhl – Leibniz-Zentrum für Informatik, Dagstuhl Publishing, Germany	

vi Contents

Session 4: Benchmarks, memory allocation						
Precomputing Memory Locations for Parametric Allocations						
Jörg Herter and Sebastian Altmeyer	124					

Preface

On July 6, 2010, the 10^{th} International Workshop on Worst-Case Execution Time Analysis (WCET 2010) was held in Brussels, Belgium. The workshop was organised as a satellite event of the $22^{\rm nd}$ Euromicro Conference on Real-Time Systems (ECRTS'10). The goal of this annual workshop is to bring together people from academia, tool vendors, and tool users in industry who are interested in all aspects of timing analysis for real-time systems. The workshop features a highly interactive format with ample time for in-depth discussions. Topics of interest include:

- different approaches to WCET computation,
- flow analysis for WCET, loop bounds, feasible paths,
- low-level timing analysis, modeling and analysis of processor features,
- strategies to reduce the complexity of WCET analysis,
- integration of WCET and schedulability analysis,
- evaluation, case studies, benchmarks,
- measurement-based WCET analysis,
- tools for WCET analysis,
- program and processor design for timing predictability,
- integration of WCET analysis in development processes,
- compiler optimizations for worst-case paths, and
- WCET analysis for multi-threaded and multi-core systems.

The papers were presented at the workshop were selected based on peer reviews by program committee members and external reviewers. 13 submissions out of 23 were finally selected for presentation. These proceedings contain the presented papers, and the abstract of the invited talk by Dr. Jean Souyris. For the first time a printed version of the final proceedings was printed in advance, and distributed at the workshop, rather than being edited as post-proceedings after the workshop. This version of the proceedings was printed and published by OCG (ISBN 978-3-85403-268-7). The current online version of the proceedings is a re-publication of the printed version.

I am happy to thank the authors, the Program Committee including the external reviewers, the WCET Workshop Steering Committe, and the ECRTS'10 organizers for assembling the components of a very stimulating workshop. The workshop organizers are also deeply grateful to the ArtistDesign Network of Excellence for financial support.

November 2010 Björn Lisper

Organization

WCET 2010 Steering Committee

Guillem Bernat, Rapita Systems Ltd., UK Jan Gustafsson, Mälardalen University, Sweden Peter Puschner, Vienna University of Technology, Austria

WCET 2010 Program Committee

Antoine Colin, Rapita Systems Ltd., UK Amine Marref, Mälardalen University, Sweden Christine Rochange, IRIT, University of Toulouse, France Isabelle Puaut, IRISA Rennes, France Niklas Holsti, Tidorum Ltd., Finland Stefan Petters, Polytechnic Institute of Porto, Portugal Heiko Falk, Technische Universität Dortmund, Germany Chris Healy, Furman University, USA Raimund Kirner, University of Hertfordshire, UK Daniel Grund, Saarland University, Germany Abhik Roychoudhury, National University of Singapore, Singapore

WCET 2010 External Reviewers

Daniel Kästner, AbsInt GmbH, Germany

Sven Bünte

Benjamin Lesage

Michael Zolda

Jose Marinho

Lei Ju

Stephan Wilhelm

Christoph Cullmann

Sudipta Chattopadhyay

Hugues Cassé

Gernot Gebhard

Paul Emberson

Marc Schlickling