Lecture Notes in Computer Science 2958

Edited by G. Goos, J. Hartmanis, and J. van Leeuwen

Springer
Berlin
Heidelberg
New York
Hong Kong
London
Milan
Paris

Lawrence Rauchwerger (Ed.)

Languages and Compilers for Parallel Computing

16th International Workshop, LCPC 2003
College Station, TX, USA, October 2-4, 2003
Revised Papers

Springer

Series Editors

Gerhard Goos, Karlsruhe University, Germany
Juris Hartmanis, Cornell University, N! , USA
Jan van Leeuwen, Utrecht University, The Netherlands

Volume Editor

Lawrence Rauchwerger
Texas A&M University
Department of Computer Science
3112 TAMU, College Station, TX 77843-3112, USA
E-mail: rwerger@cs.tamu.edu

Cataloging-in-Publication Data applied for

A catalog record for this book is available from the Library of Congress.

Bibliographic information published by Die Deutsche Bibliothek
Die Deutsche Bibliothek lists this publication in the Deutsche Nationalbibliografie; detailed bibliographic data is available in the Internet at <http://dnb.ddb.de>.

CR Subject Classification (1998): D.3, D.1.3, F.1.2, B.2.1, C.2.4, C.2, E.1

ISSN 0302-9743
ISBN 978-3-540-21199-0 ISBN 978-3-540-24644-2 (eBook)
DOI 10.1007/978-3-540-24644-2

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-Verlag. Violations are liable for prosecution under the German Copyright Law.

Springer-Verlag is a part of Springer Science+Business Media

springeronline.com

© Springer-Verlag Berlin Heidelberg 2004

Typesetting: Camera-ready by author, data conversion by DA-TeX Gerd Blumenstein
Printed on acid-free paper SPIN: 10987957 06/3142 5 4 3 2 1 0

Preface

The 16th Workshop on Languages and Compilers for Parallel Computing was held in October 2003 at Texas A&M University in College Station, Texas. It was organized by the Parasol Lab and the Department of Computer Science at Texas A&M and brought together almost 100 researchers from academia and from corporate and government research institutions spanning three continents.

The program of 35 papers was selected from 48 submissions. Each paper was reviewed by at least two program committee members and, in many cases, by additional reviewers. Prior to the workshop, revised versions of accepted papers were informally published on the workshop's Web site and on a CD that was distributed at the meeting. This year, the workshop was organized into sessions of papers on related topics, and each session consisted of an initial segment of 20-minute presentations followed by an informal 20-minute panel and discussion between the attendees and all the session's presenters. This new format both generated many interesting and lively discussions and reduced the overall time needed per paper. Based on feedback from the workshop, the papers were revised and submitted for inclusion in the formal proceedings published in this volume. The informal proceedings and presentations will remain available at the workshop Web site: `parasol.tamu.edu/lcpc03`

This year's experience was enhanced by the pleasant environment offered by the Texas A&M campus. Different venues were selected for each day and meals were served at various campus locales, ranging from a fajitas lunch in the Kyle Field Press Box, to a Texas barbeque dinner on the alumni center lawn. The banquet was held at Messina Hof, a local winery, and was preceded by a widely attended tour and wine tasting session.

The success of LCPC 2003 was due to many people. We would like to thank the Program Committee members for their timely and thorough reviews and the LCPC Steering Committee (especially David Padua) for providing invaluable advice and continuity for LCPC. The Parasol staff (especially Kay Jones) did an outstanding job with the local arrangements and workshop registration and the Parasol students (especially Silvius Rus, Tim Smith, and Nathan Thomas) provided excellent technical services (wireless internet, presentation support, electronic submission, Web site, proceedings) and local transportation, and just generally made everyone feel at home.

Last, but certainly not least, we are happy to thank Microsoft Research and Steve Waters from Microsoft University Relations for sponsoring the banquet and Dr. Frederica Darema's program at the National Science Foundation for providing a substantial travel grant for LCPC attendees.

December 2003 Lawrence Rauchwerger

Organization

The 16th Workshop on Languages and Compilers for Parallel Computing was hosted by the Parasol Laboratory and the Department of Computer Science at Texas A&M University in October 2003 and was sponsored by the National Science Foundation and Microsoft Research.

Steering Committee

Utpal Banerjee	Intel Corporation
David Gelernter	Yale University
Alex Nicolau	University of California at Irvine
David Padua	University of Illinois at Urbana-Champaign

General and Program Chair

Lawrence Rauchwerger	Texas A&M University

Local Arrangements Chair

Nancy Amato	Texas A&M University

Program Committee

Nancy Amato	Texas A&M University
Hank Dietz	University of Kentucky
Rudolf Eigenmann	Purdue University
Zhiyuan Li	Purdue University
Sam Midkiff	Purdue University
Bill Pugh	University of Maryland
Lawrence Rauchwerger	Texas A&M University
Bjarne Stroustrup	Texas A&M University
Chau-Wen Tseng	University of Maryland

Table of Contents

Search Space Properties for Mapping Coarse-Grain Pipelined FPGA Applications
Heidi Ziegler, Mary Hall, and Byoungro So 1

Adapting Convergent Scheduling Using Machine-Learning
Diego Puppin, Mark Stephenson, Saman Amarasinghe, Martin Martin, and Una-May O'Reilly 17

TFP: Time-Sensitive, Flow-Specific Profiling at Runtime
Sagnik Nandy, Xiaofeng Gao, and Jeanne Ferrante 32

A Hierarchical Model of Reference Affinity
Yutao Zhong, Xipeng Shen, and Chen Ding 48

Cache Optimization for Coarse Grain Task Parallel Processing Using Inter-Array Padding
Kazuhisa Ishizaka, Motoki Obata, and Hironori Kasahara 64

Compiler-Assisted Cache Replacement: Problem Formulation and Performance Evaluation
Hongbo Yang, R. Govindarajan, Guang R. Gao, and Ziang Hu 77

Memory-Constrained Data Locality Optimization for Tensor Contractions
Alina Bibireata, Sandhya Krishnan, Gerald Baumgartner, Daniel Cociorva, Chi-Chung Lam, P. Sadayappan, J. Ramanujam, David E. Bernholdt, and Venkatesh Choppella 93

Compositional Development of Parallel Programs
Nasim Mahmood, Guosheng Deng, and James C. Browne 109

Supporting High-Level Abstractions through XML Technology
Xiaogang Li and Gagan Agrawal 127

Applications of HPJava
Bryan Carpenter, Geoffrey Fox, Han-Ku Lee, and Sang Boem Lim 147

Programming for Locality and Parallelism with Hierarchically Tiled Arrays
Gheorghe Almási, Luiz De Rose, Basilio B. Fraguela, José Moreira, and David Padua 162

Co-array Fortran Performance and Potential: An NPB Experimental Study
Cristian Coarfa, Yuri Dotsenko, Jason Eckhardt, and John Mellor-Crummey 177

Evaluating the Impact of Programming Language Features
on the Performance of Parallel Applications on Cluster Architectures
Konstantin Berlin, Jun Huan, Mary Jacob, Garima Kochhar, Jan Prins, Bill Pugh, P. Sadayappan, Jaime Spacco, and Chau-Wen Tseng 194

Putting Polyhedral Loop Transformations to Work
Cédric Bastoul, Albert Cohen, Sylvain Girbal, Saurabh Sharma, and Olivier Temam 209

Index-Association Based Dependence Analysis and its Application
in Automatic Parallelization
Yonghong Song and Xiangyun Kong 226

Improving the Performance of Morton Layout by Array Alignment
and Loop Unrolling (Reducing the Price of Naivety)
Jeyarajan Thiyagalingam, Olav Beckmann, and Paul H. J. Kelly 241

Spatial Views: Space-Aware Programming for Networks
of Embedded Systems
Yang Ni, Ulrich Kremer, and Liviu Iftode 258

Operation Reuse on Handheld Devices (Extended Abstract)
Yonghua Ding and Zhiyuan Li 273

Memory Redundancy Elimination
to Improve Application Energy Efficiency
Keith D. Cooper and Li Xu 288

Adaptive MPI
Chao Huang, Orion Lawlor, and L. V. Kalé 306

MPJava: High-Performance Message Passing in Java Using Java.nio
William Pugh and Jaime Spacco 323

Polynomial-Time Algorithms for Enforcing Sequential Consistency
in SPMD Programs with Arrays
Wei-Yu Chen, Arvind Krishnamurthy, and Katherine Yelick 340

C^3: A System for Automating Application-Level Checkpointing
of MPI Programs
Greg Bronevetsky, Daniel Marques, Keshav Pingali, and Paul Stodghill 357

The Power of Belady's Algorithm in Register Allocation
for Long Basic Blocks
Jia Guo, María Jesús Garzarán, and David Padua 374

Load Elimination in the Presence of Side Effects, Concurrency
and Precise Exceptions
Christoph von Praun, Florian Schneider, and Thomas R. Gross 390

To Inline or Not to Inline? Enhanced Inlining Decisions
Peng Zhao and José Nelson Amaral 405

A Preliminary Study on the Vectorization of Multimedia Applications for Multimedia Extensions
Gang Ren, Peng Wu, and David Padua 420

A Data Cache with Dynamic Mapping
Paolo D'Alberto, Alexandru Nicolau, and Alexander Veidenbaum 436

Compiler-Based Code Partitioning for Intelligent Embedded Disk Processing
Guilin Chen, Guangyu Chen, M. Kandemir, and A. Nadgir 451

Much Ado about Almost Nothing: Compilation for Nanocontrollers
Henry G. Dietz, Shashi D. Arcot, and Sujana Gorantla 466

Increasing the Accuracy of Shape and Safety Analysis of Pointer-Based Codes
Pedro C. Diniz 481

Slice-Hoisting for Array-Size Inference in MATLAB
Arun Chauhan and Ken Kennedy 495

Efficient Execution of Multi-query Data Analysis Batches Using Compiler Optimization Strategies
Henrique Andrade, Suresh Aryangat, Tahsin Kurc, Joel Saltz, and Alan Sussman 509

Semantic-Driven Parallelization of Loops Operating on User-Defined Containers
Dan Quinlan, Markus Schordan, Qing Yi, and Bronis R. de Supinski 524

Cetus – An Extensible Compiler Infrastructure for Source-to-Source Transformation
Sang-Ik Lee, Troy A. Johnson, and Rudolf Eigenmann 539

Author Index 555