

Lecture Notes in Artificial Intelligence 4120

Edited by J. G. Carbonell and J. Siekmann

Subseries of Lecture Notes in Computer Science

Jacques Calmet Tetsuo Ida
Dongming Wang (Eds.)

Artificial Intelligence and Symbolic Computation

8th International Conference, AISC 2006
Beijing, China, September 20-22, 2006
Proceedings

Series Editors

Jaime G. Carbonell, Carnegie Mellon University, Pittsburgh, PA, USA
Jörg Siekmann, University of Saarland, Saarbrücken, Germany

Volume Editors

Jacques Calmet
University of Karlsruhe, IAKS
Am Fasanengarten 5, D-76131 Karlsruhe, Germany
E-mail: calmet@ira.uka.de

Tetsuo Ida
University of Tsukuba
Department of Computer Science
Tennoudai 1-1-1, Tsukuba 305-8573, Japan
E-mail: ida@cs.tsukuba.ac.jp

Dongming Wang
Beihang University
School of Science
37 Xueyuan Road, Beijing 100083, China
and Université Pierre et Marie Curie, Paris, France
E-mail: Dongming.Wang@lip6.fr

Library of Congress Control Number: 2006932044

CR Subject Classification (1998): I.2.1-4, I.1, G.1-2, F.4.1

LNCS Sublibrary: SL 7 – Artificial Intelligence

ISSN 0302-9743
ISBN-10 3-540-39728-0 Springer Berlin Heidelberg New York
ISBN-13 978-3-540-39728-1 Springer Berlin Heidelberg New York

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.

Springer is a part of Springer Science+Business Media

springer.com

© Springer-Verlag Berlin Heidelberg 2006
Printed in Germany

Typesetting: Camera-ready by author, data conversion by Scientific Publishing Services, Chennai, India
Printed on acid-free paper SPIN: 11856290 06/3142 5 4 3 2 1 0

Foreword

AISC 2006, the 8th International Conference on Artificial Intelligence and Symbolic Computation, was held on the campus of Beihang University, China, in the golden autumn of 2006. On behalf of the Organizing Committee and Beihang University, I had the pleasure to welcome the participants of this conference. The AISC series of specialized biennial conferences was founded in 1992 by Jacques Calmet and John Campbell with initial title “Artificial Intelligence and Symbolic Mathematical Computing” (AISMIC) and the previous seven conferences in this series were held in Karlsruhe (AISMIC-1, 1992), Cambridge (AISMIC-2, 1994), Steyr (AISMIC-3, 1996), Plattsburgh, NY (AISC 1998), Madrid (AISC 2000), Marseille (AISC 2002), and Hagenberg, Austria (AISC 2004).

Artificial intelligence and symbolic computation are two views and approaches for automating (mathematical) problem solving. They are based on heuristics and mathematical algorithmics, respectively, and each of them can be applied to the other. The AISC series of conferences has not only provided a lively forum for researchers to exchange ideas and views and to present work and new findings, but has also stimulated the development of theoretical insights and results, practical methods and algorithms, and advanced tools of software technology and system design in the interaction of the two fields and research communities, meanwhile leading to a broad spectrum of applications by the combined problem solving power of the two fields.

The success of the AISC series has benefited from the contributions of many people over the last decade. For AISC 2006, the Program Committee and, in particular, its Chair Tetsuo Ida deserve special credits: it is their expertise and tireless effort that made an excellent scientific program. I am most grateful to the four distinguished invited speakers, Arjeh M. Cohen, Heisuke Hironaka, William McCune, and Wen-tsün Wu, whose participation and speeches definitely helped make AISC 2006 a unique and high-level scientific event. The AISC 2006 General Chair, Dongming Wang, and Local Arrangements Chair, Shilong Ma, together with their organization team made considerable effort on many aspects to ensure the conference was successful. I would like to thank all the above-mentioned individuals, other Organizing Committee Members, referees, authors, participants, our staff members and students, and all those who have contributed to the organization and success of AISC 2006.

September 2006

Wei Li
Honorary Chair
AISC 2006
President of Beihang University

Preface

This volume contains invited presentations and contributed papers accepted for AISC 2006, the 8th International Conference on Artificial Intelligence and Symbolic Computation held during September 20–22, 2006 in Beijing, China. The conference took place on the campus of Beihang University and was organized by the School of Science and the School of Computer Science and Engineering, Beihang University.

In the AISC 2006 call for papers, original research contributions in the fields of artificial intelligence (AI) and symbolic computation (SC), and in particular in the fields where AI and SC interact were solicited. In response to the call, 39 papers were submitted. This volume contains 18 contributed papers, selected by the Program Committee on the basis of their relevance to the themes of AISC and the quality of the research expounded in the papers. The program of the conference featured 5 invited talks, out of which 4 presentations are included in the proceedings.

The papers in this volume cover a broad spectrum of AI and SC. The papers may be characterized by key words such as theorem proving, constraint solving/satisfaction, term rewriting, deductive system, operator calculus, quantifier elimination, triangular set, and mathematical knowledge management. Despite the breadth of the papers, we can observe their mathematical aspect in common.

For 15 years since the conception of AISMC (AI and Symbolic Mathematical Computing), changed to AISC in 1998, the mathematical aspect has remained as the common profile of the conferences. We see challenges as the problems that we face become more complex with the rapid development of computer technologies and the transformation of our society to an *e*-society. Such problems are tackled by using mathematical tools and concepts, which become highly sophisticated. The interaction of AI and SC bound by mathematics will become more relevant in problem solving. We hope that this unique feature of the conference will remain and gather momentum for further expansion of AISC.

We would like to express our thanks to the Program Committee members and external reviewers for their efforts in realizing this high-quality conference. Our thanks are also due to Wei Li, President of Beihang University, and the Local Arrangements Committee chaired by Shilong Ma for making the conference such a success.

We acknowledge the support of EasyChair for administering paper submissions, paper reviews and the production of the proceedings. With its support, the whole preparation process for the AISC 2006 program and proceedings was streamlined.

September 2006

Jacques Calmet
Tetsuo Ida
Dongming Wang

Organization

AISC 2006, the 8th International Conference on Artificial Intelligence and Symbolic Computation, was held at Beihang University, Beijing, September 20–22, 2006. The School of Science and the School of Computer Science and Engineering, Beihang University were responsible for the organization and local arrangements of the conference. AISC 2006 was also sponsored by the State Key Laboratory of Software Development Environment and the Key Laboratory of Mathematics, Informatics and Behavioral Semantics of the Ministry of Education of China.

Conference Direction

Honorary Chair	Wei Li (Beihang University, China)
General Chair	Dongming Wang (Beihang University, China and UPMC–CNRS, France)
Program Chair	Tetsuo Ida (University of Tsukuba, Japan)
Local Chair	Shilong Ma (Beihang University, China)

Program Committee

Luigia Carlucci Aiello	(Università di Roma “La Sapienza,” Italy)
Michael Beeson	(San Jose State University, USA)
Bruno Buchberger	(RISC-Linz, Austria)
Jacques Calmet	(University of Karlsruhe, Germany)
John Campbell	(University College London, UK)
William M. Farmer	(McMaster University, Canada)
Martin Charles Golumbic	(University of Haifa, Israel)
Thérèse Hardin	(Université Pierre et Marie Curie – LIP6, France)
Hoon Hong	(North Carolina State University, USA)
Joxan Jaffar	(National University of Singapore, Singapore)
Deepak Kapur	(University of New Mexico, USA)
Michael Kohlhase	(International University Bremen, Germany)
Steve Linton	(University of St Andrews, UK)
Salvador Lucas	(Technical University of Valencia, Spain)
Aart Middeldorp	(University of Innsbruck, Austria)
Eric Monfroy	(UTFSM, Chile and LINA, France)
Jochen Pfalzgraf	(University of Salzburg, Austria)
Zbigniew W. Ras	(University of North Carolina, Charlotte, USA)
Eugenio Roanes-Lozano	(Universidad Complutense de Madrid, Spain)
Masahiko Sato	(Kyoto University, Japan)

Carsten Schürmann	(Yale University, USA)
Jörg Siekmann	(Universität des Saarlandes, DFKI, Germany)
Carolyn Talcott	(SRI International, USA)
Dongming Wang	(Beihang University, China and UPMC–CNRS, France)
Stephen M. Watt	(University of Western Ontario, Canada)
Jian Zhang	(Chinese Academy of Sciences, China)

Local Arrangements

Xiaoyu Chen	(Beihang University, China)
Li Ma	(Beihang University, China)

External Reviewers

Enrique Alba	Tony Lambert
Jesús Almendros	Ziming Li
Jamie Andrews	Ana Marco
Philippe Aubry	Mircea Marin
Carlos Castro	Marc Moreno Maza
Arthur Chtcherba	Immanuel Normann
Abram Connelly	Vicki Powers
Robert M. Corless	Maria Cristina Riff
Marco Costanti	Renaud Rioboo
Andreas Dolzmann	Miguel A. Salido
Frederic Goualard	Frédéric Saubion
Martin Henz	Ashish Tiwari
Sandy Huerter	Sergey P. Tsarev
Stephan Kepser	Christian Vogt
Ilias Kotsireas	Min Wu
Temur Kutsia	Yuanlin Zhang

Table of Contents

Invited Presentations

Interactive Mathematical Documents	1
<i>Arjeh M. Cohen</i>	
Algebra and Geometry – Interaction Between “Equations” and “Shapes”	2
<i>Heisuke Hironaka</i>	
An Inductive Inference System and Its Rationality	3
<i>Wei Li</i>	
Semantic Guidance for Saturation Provers	18
<i>William McCune</i>	

Contributed Papers

Artificial Intelligence and Theorem Proving

Labeled @-Calculus: Formalism for Time-Concerned Human Factors	25
<i>Tetsuya Mizutani, Shigeru Igarashi, Yasuwo Ikeda, Masayuki Shio</i>	
Enhanced Theorem Reuse by Partial Theory Inclusions	40
<i>Immanuel Normann</i>	
Extension of First-Order Theories into Trees	53
<i>Khalil Djelloul, Dao Thi-Bich-Hanh</i>	
The Confluence Problem for Flat TRSs	68
<i>Ichiro Mitsuhashi, Michio Oyamaguch, Florent Jacquemard</i>	

Symbolic Computation

Some Properties of Triangular Sets and Improvement Upon Algorithm CharSer	82
<i>Yong-Bin Li</i>	
A New Definition for Passivity and Its Relation to Coherence	94
<i>Moritz Minzloff, Jacques Calmet</i>	

A Full System of Invariants for Third-Order Linear Partial Differential Operators	106
<i>Ekaterina Shemyakova</i>	
An Algorithm for Computing the Complete Root Classification of a Parametric Polynomial	116
<i>Songxin Liang, David J. Jeffrey</i>	
Quantifier Elimination for Quartics	131
<i>Lu Yang, Bican Xia</i>	
On the Mixed Cayley-Sylvester Resultant Matrix	146
<i>Weikun Sun, Hongbo Li</i>	
Implicitization of Rational Curves	160
<i>Yongli Sun, Jianping Yu</i>	
Operator Calculus Approach to Solving Analytic Systems	170
<i>Philip Feinsilver, René Schott</i>	
Constraint Satisfaction/Solving	
Solving Dynamic Geometric Constraints Involving Inequalities	181
<i>Hoon Hong, Liyun Li, Tielin Liang, Dongming Wang</i>	
Constraints for Continuous Reachability in the Verification of Hybrid Systems	196
<i>Stefan Ratschan, Zhikun She</i>	
Using Hajós’ Construction to Generate Hard Graph 3-Colorability Instances	211
<i>Sheng Liu, Jian Zhang</i>	
Finding Relations Among Linear Constraints	226
<i>Jun Yan, Jian Zhang, Zhongxing Xu</i>	
Mathematical Knowledge Management	
A Search Engine for Mathematical Formulae	241
<i>Michael Kohlhase, Ioan Sucan</i>	

Hierarchical Representations with Signatures for Large Expression
Management 254
*Wenqin Zhou, Jacques Carette, David J. Jeffrey,
Michael B. Monagan*

Author Index 269