Lecture Notes in Computer Science

Commenced Publication in 1973 Founding and Former Series Editors: Gerhard Goos, Juris Hartmanis, and Jan van Leeuwen

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Computer Algebra and Geometric Algebra with Applications

6th International Workshop, IWMM 2004 Shanghai, China, May 19-21, 2004 and International Workshop, GIAE 2004 Xian, China, May 24-28, 2004 Revised Selected Papers



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Library of Congress Control Number: 2005927771

CR Subject Classification (1998): F.2.1-2, G.1, I.3.5, I.4, I.2, I.1

ISSN	0302-9743
ISBN-10	3-540-26296-2 Springer Berlin Heidelberg New York
ISBN-13	978-3-540-26296-1 Springer Berlin Heidelberg New York

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Typesetting: Camera-ready by author, data conversion by Scientific Publishing Services, Chennai, India Printed on acid-free paper SPIN: 11499251 06/3142 5 4 3 2 1 0

Preface

Mathematics Mechanization consists of theory, software and application of computerized mathematical activities such as computing, reasoning and discovering. Its unique feature can be succinctly described as AAA (Algebraization, Algorithmization, Application). The name "*Mathematics Mechanization*" has its origin in the work of Hao Wang (1960s), one of the pioneers in using computers to do research in mathematics, particularly in automated theorem proving. Since the 1970s, this research direction has been actively pursued and extensively developed by Prof. Wen-tsun Wu and his followers. It differs from the closely related disciplines like Computer Mathematics, Symbolic Computation and Automated Reasoning in that its goal is to make algorithmic studies and applications of mathematics the major trend of mathematics development in the information age.

The International Workshop on Mathematics Mechanization (IWMM) was initiated by Prof. Wu in 1992, and has ever since been held by the Key Laboratory of Mathematics Mechanization (KLMM) of the Chinese Academy of Sciences. There have been seven workshops of the series up to now. At each workshop, several experts are invited to deliver plenary lectures on cutting-edge methods and algorithms of the selected theme. The workshop is also a forum for people working on related subjects to meet, collaborate and exchange ideas.

There were two major themes for the IWMM workshop in 2004. The first was "Constructive and Invariant Methods in Algebraic and Differential Equations," or, in short, "Computer Algebra with Applications." The second was "Geometric Invariance and Applications in Engineering" (GIAE), or, in short, "Geometric Algebra with Applications." The two themes are closely related to each other. On the one hand, essentially due to the efforts of D. Hestenes and his followers, recent years have witnessed a dramatic resurgence of the venerable subject Geometric Algebra (which dates back to the 1870s), with dramatic new content and applications, ranging from mathematics and physics, to geometric reasoning, neural networks, robotics, computer vision and graphics. On the other hand, the rise of computer algebra systems and algorithms has brought previously infeasible computations, in particular those in geometric algebra and geometric invariance, within our grasp. As a result, the two intertwined subjects hold a particular fascination, not only for students and practitioners, but also for mathematicians, physicists and computer scientists working on effective geometric computing.

Since it is very difficult to put the two major themes into a single conference without parallel sessions, the organizers decided to split this year's *IWMM* workshop into two conferences, one for each theme. The first workshop was held in a beautiful quiet riverside town near Shanghai, called ZhuJiaJiao, from May 19 to 21. The second workshop was held in a glorious conference hall of the Xi'an

Hotel, Xi'an, from May 24 to 28. Altogether 169 scholars from China, USA, UK, Germany, Italy, Japan, Spain, Canada, Mexico and Singapore were attracted to the conferences and presented 65 talks. The following invited speakers presented the plenary talks:

Wen-tsun Wu (China)	Gerald Sommer (Germany)
Peter J. Olver (USA)	Alyn Rockwood (USA)
Anthony Lasenby (UK)	Joan Lasenby (UK)
Quan Long (Hong Kong, China)	Jingzhong Zhang (China)
Neil White (USA)	Timothy Havel (USA)
Jose Cano (Spain)	Greg Reid (Canada)
Andrea Brini (Italy)	Dongming Wang (China & France)
Xiaoshan Gao (China)	William Chen (China)
Hongging Zhang (China)	Ke Wu (China)

The two conferences were very successful, and the participants agreed on the desirability of publication of the postproceedings by a prestigious international publishing house, these proceedings to include the selected papers of original and unpublished content. This is the background to the current volume.

Each paper included in the volume was strictly refereed. The authors and editors thank all the anonymous referees for their hard work. The copyediting of the electronic manuscript was done by Ms. Ronghua Xu of KLMM. The editors express their sincere appreciation for her dedication.

It should be emphasized that this is the first volume to feature the combination and interaction of the two closely related themes of Computer Algebra and Geometric Algebra. It is the belief of the editors that the volume will prove to be valuable for those interested in understanding the state of the art and for further combining and developing these two powerful tools in geometric computing and mathematics mechanization.

Beijing, Minneapolis, Kiel March 2005 Hongbo Li Peter J. Olver Gerald Sommer

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