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MATHEMATICAL SOFTWARE

Proceedings of the First International Congress of Mathematical Software

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PREFACE

This proceedings consists of invited papers and contributed papers presented at the First International Congress of Mathematical Software (ICMS 2002) held at Beijing, China. The program of this conference can be found at <http://www.mathsoftware.org>.

Mathematics has a wide variety of branches. Despite this, we in the first International Congress of Mathematical Software believe that mathematics is fundamentally just one thing. Algebra, geometry and analysis are examples of separate specialities within mathematics, and of course we consider each of them valuable and hence study them. But we take the view that any branch of mathematics can borrow freely from these specialities. It is often worth while delving into them for ideas that might lead to fundamental new discoveries. The same can be said of mathematical software systems: the study of mathematical software is a coherent whole.

We believe that the appearance of mathematical software is one of the most important events in mathematics. Mathematical software systems are used to construct examples, to prove theorems, and to find new mathematical phenomena. Conversely, mathematical research often motivates developments of new algorithms and new systems. Beyond mathematics, mathematical software systems are becoming indispensable tools in many branches of science and technology.

The development of mathematical software systems relies on the cooperation of mathematicians, algorithm designers, programmers, and the feedback from users. The main audiences of this conference are mathematical software developers and programming mathematicians, but we also intend to provide an opportunity to discuss these topics with mathematicians and users from application areas. Topics for the conference include but are not limited to:

1. Software engineering problems for mathematical software
2. Mathematics and media (including user interfaces)
3. Mathematics related to mathematical software (experiments, algorithms)
4. High performance computing
5. Applications of mathematical software
6. Presentation of mathematical software

At ICM 1998 in Berlin, there was a mathematical software session. We have evolved it into a satellite conference of ICM 2002, and this is the first

International Congress of Mathematical Software. Many people have contributed to the organization of ICMS 2002. The idea of this conference came from an e-mail chat between Nobuki Takayama and Bernd Sturmfels. Kazuhiro Yokoyama mentioned this idea to Dongming Wang at Paris, and Dongming Wang introduced Nobuki Takayama to people at MMRC, Academy of Mathematical and System Sciences whose dedicated work has made the conference a great success. The efforts of the program committee members and external referees are essential to ensure the quality of the conference. We thank all of them for their great contribution, help, and cooperation. Especially, many many thanks go to our host MMRC and the people there.

We hope that ICMS 2002 will be a landmark conference in the development of mathematical software systems.

Arjeh M. Cohen, Xiao-Shan Gao, Nobuki Takayama
ICMS 2002, Program Committee Co-chairs

Invited Speakers

Plenary speakers

Henk Barendregt	University of Nijmegen
Jonathan Borwein	Simon Fraser University
John Cannon	University of Sydney
Henri Cohen	University of Bordeaux
Gert-Martin Greuel	University of Kaiserslautern
Michael Joswig	Technische Universität Berlin

Invited speakers in organized sessions

Manual Bronstein	INRIA
Andreas Enge	Ecole polytechnique
Hans-Christian Hege	ZIB
Ulrich Kortenkamp	Freie Universität Berlin
Masakazu Kojima	Tokyo Institute of Technology
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Preface

This volume contains the outstanding collection of invited papers and refereed papers selected for the Second International Congress on Mathematical Software, ICMS 2006, held in Castro Urdiales, Spain, September 1-3, 2006. We cordially invite you to visit the ICMS 2006 website <http://www.icms2006.unican.es> where you can find all relevant information about this interesting event.

ICMS 2006 was the second edition of this congress, which follows up the successful ICMS 2002 held in Beijing, China. Since its inception, this congress has been a satellite event of the International Congress of Mathematicians - ICM, the world's largest conference on mathematics, celebrated every four years since the edition of 1900 in Paris, where David Hilbert presented his 23 famous problems. For the first time, this 2006 edition of ICM is held in Spain (see: <http://www.icm2006.org> for details), and so is ICMS 2006.

This congress was devoted to all aspects of mathematical software, whose appearance is — in our opinion — one of the most important events in mathematics. Mathematical software systems are used to construct examples, to prove theorems, and to find new mathematical phenomena. Conversely, mathematical research often motivates developments of new algorithms and new systems. Beyond mathematics, mathematical software systems are becoming indispensable tools in many branches of science and technology.

The development of mathematical software systems relies on the cooperation of mathematicians, algorithm designers, programmers, and the feedback from users. The main audiences of this conference are mathematical software developers and programming mathematicians, but we also intend to provide an opportunity to discuss these topics with mathematicians and users from applied areas. The congress focused on the following major themes:

1. Software engineering problems for mathematical software
2. Mathematics and media (including user interfaces and integration of documents and software systems)
3. Mathematics related to mathematical software (experiments, algorithms) as well as scientific computing
4. High-performance computing
5. Applications of mathematical software.

ICMS 2006 comprised ten sessions — devoted to different mathematical software issues — some plenary talks and a general track. We would like to thank all session organizers for their diligent work, which further enhanced the congress standing and to all reviewers for their expertise and generous effort which led to a very high-quality event with excellent papers and presentations. We specially recognize the contribution of the Program Committee and Advisory Program Committee members for their tremendous support and for making this congress a very successful event.

To keep all congress activities within the planned three days we scheduled three parallel sessions, with the remarkable exception of the plenary talks. We are thankful

to the plenary and invited speakers for their kind acceptance to attend to this congress and deliver a talk.

All presentations were given at the congress venue, La Residencia, a recently rebuilt palace intended to become the new "Centro Internacional de Encuentros Matemáticos - CIEM" (International Center for Mathematical Meetings), an ambitious initiative of the Spanish mathematical community oriented towards the creation of an international center for mathematics in Spain. La Residencia offers advanced audio-visual equipment for conferences and presentations as well as a unique indoors-outdoors environment for both fruitful discussions and relaxing enjoyment. In addition, it is placed in Castro Urdiales, one of the most beautiful places of the north coast of Spain. Castro Urdiales — in the region of Cantabria — is an old fishermen's town with magnificent buildings, beautiful promenades, a very rich history and a lovely combination between the antique and the modern. We thank the Director of CIEM, Laureano González-Vega, for his support before and during the congress, and the Castro Urdiales Town Council for the facilities to organize the congress in this beautiful place.

ICMS 2006 was jointly organized by the Department of Mathematics, Statistics and Computation and the Department of Applied Mathematics and Computational Sciences of the University of Cantabria, Spain. We thank both departments for their encouraging support to this congress from the very beginning. We would like to express our gratitude to the Local Organizing Committee — and especially to the local Organizing Chair, Jaime Gutierrez — for their persistent and enthusiastic work towards the success of ICMS 2006. The smoothness of the organization was ensured by the cooperation of the Ph.D. students Alvar Ibeas and Akemi Gálvez, who took care of a number of tasks, including the congress website and the posters.

We owe special thanks to our sponsors: AddLink Software Científico, the University of Cantabria, the International Congress of Mathematicians, the Spanish Ministry of Education and Science, the Fundación Leonardo Torrès Quevedo and the Centro Internacional de Encuentros Matemáticos, for their continuous support without which this congress would not be possible. We also thank our publisher, Springer — and especially LNCS editor Alfred Hofmann and his team — for their acceptance to publish the proceedings and for their kind assistance and cooperation during the editing process.

Finally, we thank all authors for their submissions and all congress attendants for making ICMS 2006 truly an excellent forum on mathematical software, facilitating exchange of ideas, fostering new collaborations and shaping the future of mathematical software. Last, but certainly not least, we wish to thank our readers for their interest in this volume. We really hope you find in these pages interesting material and fruitful ideas for your future work.

September 2006

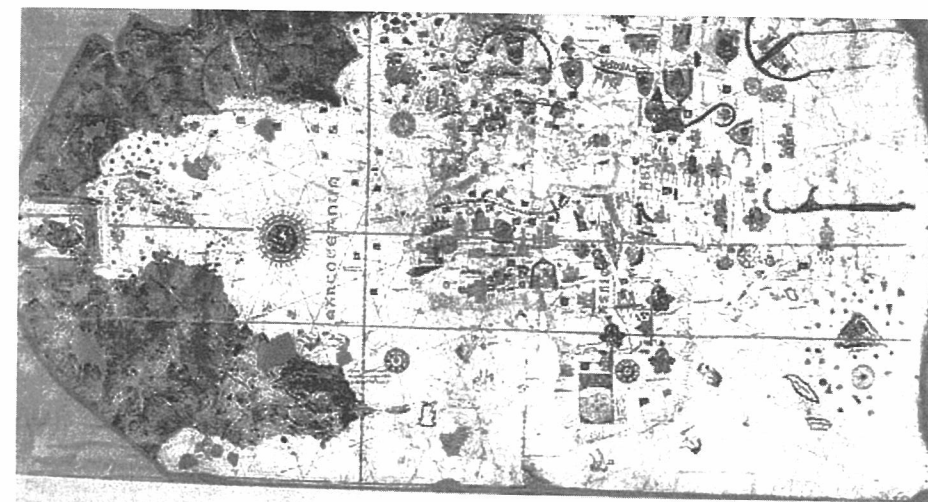
Nobuki Takayama
Andrés Iglesias

Note

The picture below shows the famous "Mappa Mundi" the world's oldest representation of the New World, dating back to 1500 AD. It was made by Juan de La Cosa, a Spanish sea captain who sailed with Columbus to the new world on his first three voyages. Juan de la Cosa was born in Santoña — a small town on the north coast of Spain — near Castro Urdiales (ICMS 2006 congress venue). After several trips to the coast of Africa, he became a proficient navigator and map maker and when Christopher Columbus was planning his 1492 first voyage to the "New World," he joined the expedition with his own vessel: Santa Maria.

Of special interest in this map is the outline of Cuba, which Christopher Columbus never believed to be an island. In fact, on Columbus's third trip, Juan de la Cosa traveled alongside Columbus on the "La Niña" ship and a difference of opinion arose concerning the lands newly discovered. Juan de la Cosa was one of the signers to the Perez-Luna agreement, which stated that Cuba was a continent. He signed this under the orders of Columbus, although he was sure that the island now known as Cuba was *not* forming part of the continent. Amazingly, Columbus remarked: "Juan de la Cosa thinks he knows more than I do in the art of navigating".

The map is currently in the Naval Museum of Madrid (ICM 2006 congress venue) and it is a good example of the application of mathematical techniques to cartography.



(Carta de Juan de la Cosa. Año de 1500)

Organization

ICMS 2006 was organized by the Department of Mathematics, Statistics and Computation and the Department of Applied Mathematics and Computational Sciences of the University of Cantabria, Spain.

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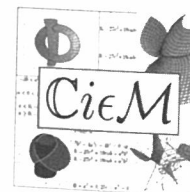


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