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Mathematical Software – ICMS 2010

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Preface

The ICMS Developer's Meeting is an international congress for which the main theme is mathematical software. The 2010 meeting was the third of a series of meetings of similar theme, the first being held in Beijing, China in 2002, and the second in Castro-Urdiales, Spain in 2006.

The field of mathematics has numerous branches, and in each branch we find that algorithms, and also implementations and applications of software systems, are studied. Researchers who endeavor to make such studies also have international meetings within their specific branches of mathematics, and these meetings have made significant contributions to the fields in which they lie. The ICMS (International Congresses on Mathematical Software), on the other hand, is a general (not branch specific) meeting on mathematical software, which is held every four years, and is a rare opportunity for developers of mathematical software from different branches of mathematics, as well as mathematicians who are interested in mathematical software, to gather together.

Since the first meeting in Beijing, eight years have passed, and this is now a good occasion for us to ask this important question, and we beg the readers' indulgence for its bluntness: is this kind of general meeting useful? In order to have a productive meeting, the participants should have a base of common interests and knowledge. Do we have such common interests and knowledge? To help us consider this question, let us note the following points:

(1) We are interested in mathematics and want to explore the world of mathematics, regardless of whether we have the aid of a computer. The discovery or proof of a new mathematical fact is an exciting application of mathematical software. Certainly all of us would agree with this claim.

(2) Which objects in mathematics are computable, and which are not? To what degree can we be efficient in computation? Can we implement algorithms efficiently? All participants and authors of these proceedings will surely agree that these are fundamental questions, and will have a strong interest in answering them.

(3) All participants and authors know at least one programming language. For instance, most people will understand the programming language C and/or its derivatives. All participants are interested in using software environments to study mathematics.

(4) We understand that technology transfers from mathematics to industry and other fields are done primarily via software systems. We should be able to explain how our favorite algorithms are used in industrial applications.

We have listed above four points of common knowledge and interests, and certainly there are more. It is through points like these that we can exchange a wide variety of ideas and knowledge with each other, resulting in the advance-

ment of mathematical software. On the basis of points like these, we can give a resounding "yes" to the first blunt question above.

We believe that mathematics itself is a coherent whole, and there are copious examples of how the interplay between seemingly disparate branches of mathematics yields new results. In mathematical software, let us note some such examples that have come to fruition in the last eight years: software systems in tropical geometry have been produced using computer algebra and polyhedral geometry software as a base; applications of computer algebra have created a new area of research called "algebraic statistics." There are many other cases as well, and a network of researchers from different disciplines has been an important foundation for this, leading to a wealth of interdisciplinary research.

The articles in these proceedings were written by speakers at the ICMS 2010 and reviewed by the Program Committee members and some external referees. No doubt the authors wish that not only their peers, but also researchers in other branches of mathematics, will become interested in their results and will apply their outcomes to those other branches. The authors also surely hope that mathematicians, scientists and engineers will read articles in this volume, and will then have a deeper understanding of what is going on at present in the study of mathematical software, and will in turn suggest new applications of mathematical software and also give new proposals for developing mathematical software.

The activities of the last two conferences are archived in proceedings, in software and document DVD's, and in video format. This material can be accessed through *http://www.mathsoftware.org*. ICMS 2010 will also be archived in this way.

We hope that these proceedings will contribute to the advancement of a wide array of research directions, led by many researchers with varied backgrounds.

September 2010

Nobuki Takayama
Komei Fukuda
Joris van der Hoeven
Michael Joswig

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ICMS 2010 was organized by the Department of Mathematics Kobe University, Rokko, Kobe, Japan.

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Software for Optimization and Polyhedral Computation
Achill Schuermann (Delft University of Technology, The Netherlands)
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