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Debasis Giri · Ram N. Mohapatra
Heinrich Begehr · Mohammad S. Obaidat (Eds.)

Mathematics and Computing

Third International Conference, ICMC 2017
Haldia, India, January 17–21, 2017
Proceedings

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Message from the General Chairs

As we all are aware, Mathematics has always been a discipline of interest not only to theoreticians but also to all practitioners irrespective of their specific profession. Be it science, technology, economics, commerce or even sociology, new Mathematical principles and models have been emerging and helping in new research and in drawing inferences from practical data as well as through logic. The past few decades have seen an enormous growth in the applications of mathematics in different areas that are multidisciplinary in nature. Cryptography, security, and signal processing are such areas that are being focused on recently due to the need of securing communication while connecting with others. With emerging computing facilities and speeds, a phenomenal growth has occurred in problem solving area. Earlier, some observations were made and conjectures were drawn which remained conjectures until somebody either could prove it theoretically or find counter examples. Today, however, we can write algorithms and use computers for long calculations, verifications, or generation of huge amount of data. With available computing capabilities, we can find factors of very large integers in the size of hundreds of digits; we can find inverses of very large matrices and solve a large set of linear equations etc. Thus Mathematics and computation have become more integrated areas of research today and it was decided to organize an event where researchers can share ideas and deliberate on new challenging problems.

Apart from many other interdisciplinary areas of research, cryptography and security have emerged as one of the most important areas of research with discrete mathematics as a base. Several research groups are actively pursuing research on different aspects of cryptology not only in terms of new crypto-primitives and algorithms but also numerous concepts related to authentication, integrity and security proofs/protocols are being developed, often with open and competitive evaluation mechanisms to evolve standards.

As conferences, seminars, and workshops are the platforms for sharing knowledge and new research results giving us a chance to get new innovative ideas for future needs as the threats and computational capabilities of adversaries are ever increasing, it was thought appropriate to organize a conference focused on Mathematics and computations covering theoretical as well as practical aspects of research, with cryptography and security being one of these.

Eminent personalities working in Mathematical and computer science and related areas were invited to deliver invited talks and tutorials. The talks covered a wide spectrum, namely, number theoretic concepts, cryptography, algebraic concepts such as quasi groups and applications etc. The conference was spread over five days (January 17–21, 2017) with the first two days dedicated to tutorials. The main conference was planned with special talks by experts and paper presentations in each session.

I hope that the conference met the aspirations of the participants and its objective of sharing ideas and current research and identifying new targets/problems. We are confident that the young researchers and students found new directions to pursue in their future research.

We express our heartfelt thanks to the National Board for Higher Mathematics (NBHM), the Indian Space Research Organisation (ISRO), the Science and Engineering Research Board (Department of Science and Technology), the Council of Scientific and Industrial Research (CSIR), Defense Research and Development Organization (DRDO), the International Society for Analysis, Its Applications and Computation (ISAAC), the Indian National Science Academy (INSA), Haldia Institute of Technology (Haldia, India), and the University of Central Florida (USA).

We are also very much thankful to our fellow organizing chair, Prof. Debasis Giri, who is the founder of the International Conference on Mathematics and Computing (ICMC), for his effort to make the event a grand success. We extend our sincere thanks to all speakers, participants, referees, and organizers for their support.

March 2017

P.K. Saxena
P.D. Srivastava

Message from the Program Chairs

It was a great pleasure for us to organize the third International Conference on Mathematics and Computing held during January 17–21, 2017, at the Haldia Institute of Technology, Purba Medinipur, West Bengal, India. Our main goal was to provide an opportunity to the participants to learn about contemporary research in cryptography, security, mathematics, and computing and exchange ideas among themselves and with experts present in the conference as tutorial presenters and the plenary as well as invited speakers. With this aim in mind we carefully selected the invited speakers and the speakers for the tutorials. It is our sincere hope that the conference helped the participants in their research and training by opening new avenues for those who are either starting their research or are looking to extend their area of research to a different field in cryptography, security, mathematics, and computing.

During January 17–18, 2017, there were five tutorial talks by Prof. Dipanwita Roy Chowdhury (IIT, Kharagpur), Prof. Abhijit Das (IIT, Kharagpur), Dr. Avishek Adhikari (Calcutta University), Dr. Manish Kumar (Birla Institute of Technology and Science, Pilani), and Sweta Mishra (Indian Institute of Technology, Delhi).

The conference began after a formal opening ceremony on January 19. The program offered one 75-minute keynote talk by Prof. Mohammed S. Obaidat (Fordham University, USA) and 11 invited one-hour talks by Prof. Sudip Misra (IIT Kharagpur, India), Prof. Subhamoy Maitra (Indian Statistical Institute, Kolkata, India), Prof. Heinrich Begehr (Free University of Berlin, Germany), Prof. Ram N. Mohapatra (University of Central Florida, USA), Prof. S. Ponnusamy (Indian Statistical Institute, Chennai Centre, India), Prof. Maria A. Navascues (Universidad de Zaragoza, Spain), Prof. Margareta Heilmann (University of Wuppertal, Germany), Prof. Rifat Colak (Firat University, Turkey), Prof. Elena Berdysheva (Justus-Liebig-Universität, Giessen, Germany), Prof. W.M. Shah (Institute for Research in Mathematical Sciences, Srinagar, Kashmir, India), and Dr. Manish Kumar (Birla Institute of Technology & Science, Pilani, India). Our speakers/contributors were from Germany, Spain, Turkey, Bangladesh, India, Russia, and USA.

After an initial call for papers, 129 papers were submitted for presentation at the conference. All submitted papers were sent to external reviewers and after refereeing, 35 papers were recommended for publication in the conference proceedings published by Springer in their *Communications in Computer and Information Science* (CCIS) series.

We are grateful to the speakers, participants, reviewers, organizers, sponsors, and funding agencies for their support and help, without which it would have been impossible to organize the conference, the workshops, and the tutorials. We owe our gratitude to the volunteers who worked behind the scenes tirelessly taking care of the details to make this conference a success.

March 2017

Debasis Giri
Ram N. Mohapatra
Heinrich Begehr
Mohammad S. Obaidat

Preface

The Third International Conference on Mathematics and Computing (ICMC 2017) was held at the Haldia Institute of Technology, Haldia, during January 17–21, 2017. Haldia is a city and a municipality in Purba Medinipur in the Indian state of West Bengal, and Haldia Institute of Technology is a premier institution training engineers and computer scientists for the past several years. It has gained its reputation through its institutional dedication to teaching and research.

In response to the call for papers for ICMC 2017, 129 papers were submitted for presentation and inclusion in the proceedings of the conference. The papers were evaluated and ranked on the basis of their significance, novelty, and technical quality by at least two reviewers per paper. After a careful blind refereeing process, 35 papers were selected for inclusion in the conference proceedings. The papers cover current research in cryptography, security, abstract algebra, functional analysis, fluid dynamics, fuzzy modeling and optimization etc. ICMC 2017 had eminent personalities both from India and abroad (USA, Germany, Spain, China, and Turkey), who delivered invited addresses and tutorial talks. The speakers from India are recognized leaders in government, industry, and academic institutions such as the Indian Statistical Institute Kolkata, Indian Statistical Institute Chennai, IIT Kharagpur, Jammu and Kashmir Institute of Mathematical Sciences, Srinagar, Kashmir, Calcutta University, Birla Institute of Technology and Science, Pilani, and Indian Institute of Technology Delhi, etc. All of them are involved in research dealing with the current issues of interest related to the theme of the conference. The conference offered five tutorial talks by Prof. Dipanwita Roy Chowdhury (IIT, Kharagpur), Prof. Abhijit Das (IIT, Kharagpur), Dr. Avishek Adhikari (Calcutta University), Dr. Manish Kumar (Birla Institute of Technology and Science, Pilani), and Sweta Mishra (Indian Institute of Technology, Delhi). In addition to these the program included one keynote talk by Prof. Mohammed S. Obaidat (Fordham University, USA) and 11 invited talks by Prof. Sudip Misra (IIT Kharagpur, India), Prof. Subhamoy Maitra (Indian Statistical Institute, Kolkata, India), Prof. Heinrich Begehr (Free University of Berlin, Germany), Prof. Ram N. Mohapatra (University of Central Florida, USA), Prof. S. Ponnusamy (Indian Statistical Institute, Chennai Centre, India), Prof. Maria A. Navascues (Universidad de Zaragoza, Spain), Prof. Margareta Heilmann (University of Wuppertal, Germany), Prof. Rifat Colak (Firat University, Turkey), Prof. Elena Berdysheva (Justus-Liebig-Universität, Giessen, German), Prof. W.M. Shah (Institute for Research in Mathematical Sciences, Srinagar, Kashmir, India), and Dr. Manish Kumar (Birla Institute of Technology and Science, Pilani, India).

A conference of this kind would not be possible to organize without the full support from different people across different committees. All logistics and general organizational aspects were looked after by the Organizing Committee members, who spent their time and energy in making the conference a reality. We also thank all the Technical Program Committee members and external reviewers for thoroughly

reviewing the papers submitted for the conference and sending their constructive suggestions within the deadlines. Our hearty thanks to Springer for agreeing to publish the proceedings in its *Communications in Computer and Information Science* (CCIS) series.

We are indebted to the National Board for Higher Mathematics (NBHM), the Indian Space Research Organisation (ISRO), the Science and Engineering Research Board (Department of Science and Technology), the Council of Scientific and Industrial Research (CSIR), the Defense Research and Development Organization (DRDO), the International Society for Analysis, Its Applications and Computation (ISAAC), the Indian National Science Academy (INSA), Haldia Institute of Technology (Haldia, India), and the University of Central Florida (USA) for sponsoring the event. Their support has significantly helped raise the profile of the conference.

Last but not the least, our sincere thanks go to all authors who submitted papers to ICMC 2017 and to all speakers and participants. We sincerely hope that the readers will find the proceedings stimulating and inspiring.

March 2017

Debasis Giri
Ram N. Mohapatra
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