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Progress in VLSI Design and Test

16th International Symposium, VDAT 2012
Shibpur, India, July 1-4, 2012
Proceedings

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ISSN 0302-9743	e-ISSN 1611-3349
ISBN 978-3-642-31493-3	e-ISBN 978-3-642-31494-0
DOI 10.1007/978-3-642-31494-0	
Springer Heidelberg Dordrecht London New York	

Library of Congress Control Number: 2012940576

CR Subject Classification (1998): B.7-8, C.0, C.2.1, C.2-4, F.3, D.2.4

LNCS Sublibrary: SL 1 – Theoretical Computer Science and General Issues

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Typesetting: Camera-ready by author, data conversion by Scientific Publishing Services, Chennai, India

Printed on acid-free paper

Springer is part of Springer Science+Business Media (www.springer.com)

Message from the Steering Committee Chair, VLSI Design Conference

It is a pleasure to welcome you to the proceedings of the 16th International Symposium on VLSI Design and Test (VDAT) held in Shibpur, India. From a modest beginning in January 1998 at Chennai, this meeting has become a recognized forum for technical exchange in India.

Let me begin by expressing thanks to the entire VDAT Organizing Committee, headed by Indranil Sengupta and Biplab Sikdar, for their tireless effort in putting the symposium together. Beside the technical papers and tutorials, this year we had a PhD forum that invited doctoral students to present their research. This was sponsored by the VLSI Society of India (VSI) and the Women in Engineering (WiE) group of the IEEE Kolkata Section. Expansion of education in India still has a long way to go and the PhD effort in engineering is just starting. This forum is a step in the right direction and we hope that other conferences will follow the lead.

The Program Chairs, Hafizur Rahaman and Sanatan Chattopadhyay, and their Program Committee selected the papers that appear in this book. Their peer reviewing process accepted less than 30% of the submitted papers. The topics are indicative of the wide variety of research in India and abroad. Some of the unconventional or emerging topics are quantum logic, reversible circuits, 3D stacked integrated circuits, carbon nanotube devices, finFETs, quantum dot cellular automata, and Vedic arithmetic. You are least likely to see the last item anywhere else.

Continuing the VDAT tradition, we had tutorials, an education day and invited talks. I am pleased that VDAT is publishing the papers in Springer's *Lecture Notes in Computer Science* (LNCS) Series, so that they get the world-wide attention they deserve.

The *VDAT Symposium Series* <http://vlsi-india.org/> is sponsored by the VLSI Society of India <http://vlsi-india.org/vsi/>. A ten-member VLSI Design Conference Steering Committee looks after the continuity of this symposium and the International Conference on VLSI Design, presently scheduled for January 5–10, 2013, in Pune, India <http://vlsidesignconference.org/>.

July 2012

Vishwani D. Agrawal

Message from Advisory Committee Patron

I am extremely happy that Bengal Engineering and Science University, Shibpur, in collaboration with IIT Khragpur, IIM Calcutta, ISI Calcutta, Calcutta University and Jadavpur University, India, organized the 16th International Symposium on VLSI Design and Test (VDAT 2012) during July 1–4th, 2012, with the objective of strengthening VLSI education and research in India.

To mark this important event, eminent keynote speakers and authors of research papers from industry, research institutions, and universities presented their work. I am sure that these presentations have inspired the creative minds of young researchers to take up advanced innovative research in diverse areas of VLSI technology.

The role of VLSI technology in shaping our lives can never be over emphasized. From computing to healthcare, energy, the environment, transportation, natural resource harnessing or industrial product development, mankind finds VLSI technology in all aspects of everyday life.

I would like to thank the officials of the VLSI Society of India for consenting to host this symposium at our university. I would also like to express my thanks to the keynote speakers and the tutorial speakers for kindly agreeing to deliver their lectures. We would like to thank the authors of all the papers for submitting their quality research work. Finally, on behalf of the Organizing Committee of VDAT 2012, I heartily welcome all the delegates, presenters and speakers for helping to make this event a grand success.

Let all our efforts in education and research be directed toward the welfare of mankind.

Ajoy K. Ray

Message from the Technical Program Chairs

It is great pleasure to welcome you to the proceedings of the 16th International Symposium on VLSI Design and Test (VDAT 2012) held at Bengal Engineering and Science University, Shibpur (Kolkata), India. VDAT 2012, sponsored by the VLSI Society of India (VSI), was organized by the Bengal Engineering and Science University, Shibpur, in collaboration with IIT Kharagpur, IIM Calcutta, ISI Calcutta, Calcutta University, and Jadavpur University. This annual event was initiated 16 years ago in 1997 by the VSI and has gradually matured into one of the topmost international VLSI conferences.

The technical program included (a) four keynote talks and a banquet talk from eminent people in the field of VLSI, (b) four invited talks from well-known researchers in their respective areas of expertise, (c) 54 peer-reviewed papers and (d) six half-day tutorials on some of the hottest topics in VLSI, (e) Half Day Education Day, and (f) Half Day PhD Forum.

This year we received 135 papers from all over the world. After a rigorous review process, the Program Committee (PC) selected 30 regular papers, 10 short papers and 13 poster papers. In all, 146 expert reviewers were involved in rating the papers and each paper received at least three independent reviews made by the 64 PC members and also by additional external experts. The papers along with the reviews were scrutinized by the PC members during final selection phase. We would like to thank the authors of all the papers for submitting their quality research work. Special thanks go to the PC members and the external reviewers who gave their precious time in reviewing and selecting the best set of papers.

We would like to thank Vishwani D. Agrawal, V. Ramgopal Rao, Krishnendu Chakrabarty, M. Balakrishnan, and Rolf Drechsler for readily accepting our invitation to deliver keynote and invited talks at the symposium. The main conference program was preceded by a day of tutorial presentations. We would also like to thank the tutorial speakers for kindly agreeing to deliver their lectures. We would like to express our thanks to the Keynote Chairs, Prasun Ghosal and S. Ramesh, and the Tutorial Chair, Partha Sarathi Dasgupta and Partha Bhattacharyya, for their active initiation and enthusiasm to make the sessions a success.

This year we introduced a new half-day session of a PhD forum hosted by the VSI and Women in Engineering (WiE) Affinity Group of the IEEE Kolkata Section. The efforts made by Susmita Sur-Kolay and B.B. Bhattacharyya in this regard deserve special mention. We would like to express our thanks to the staff of EasyChair for providing assistance with the online submission. We must thank

the staff of Springer for agreeing to publish the proceedings of VDAT 2012 as part of Springer's *Lecture Notes in Computer Science Series*. Our Publication Chair, Santanu Chattopadhyay, did a great job of composing the technical contents of the proceedings in the LNCS format.

We hope that you will find the VDAT 2012 proceedings technically rewarding.

July 2012

Hafizur Rahaman
Sanatan Chattopadhyay

Message from the General Chairs

The International Symposium on VLSI Design and Test (VDAT), which was first held in 1998 as a small workshop in Chennai, has been successfully organized every year in different parts of the country. The 16th symposium in this series, VDAT 2012, was held during July 1–4, 2012, at the Bengal Engineering and Science University (BESU), Shibpur, West Bengal. Over the last one and a half decades, the symposium has left its mark in the field of VLSI design and test.

This year, VDAT attracted a large number of submissions (135) from India and abroad. With painstaking effort, the Program Committee selected 30 regular papers, 10 short papers, and 13 poster presentations. Also, this is the first time the proceedings of the symposium are published as a Springer LNCS volume.

The program of the symposium spanned over four days and included, in addition to a high-quality technical program during the last two days, six half-day tutorials on the first day delivered by eminent researchers and practitioners in the field, giving young researchers and students an excellent opportunity to learn about the latest trends in VLSI design and test.

In addition, an Education Day and a PhD Forum were organized during the second day to encourage the budding researchers and academicians in this field.

The Program Chairs, Hafizur Rahaman and Sanatan Chattopadhyaya, along with the PC members did an excellent job in completing a rigorous review process. We take this opportunity to record our appreciation to the Program Committee members. We would also like to thank V. Ramgopal Rao, Krishnendu Chakrabarty, M. Balakrishnan, Rolf Drechsler, and Vishwani D. Agrawal for readily accepting our invitation to deliver keynote and invited talks at the symposium.

We would also like to thank the Tutorial Speakers for kindly agreeing to deliver their lectures. The efforts made by the Keynote Chairs, Prasun Ghosal and S. Ramesh, and the Tutorial Chair, Partha Sarathi Dasgupta and Partha Bhattacharyya, in this regard deserve special mention.

The Organizing Committee, headed by Arindam Biswas and Chandan Kumar Sarkar, should be commended for taking the necessary steps to ensure that the symposium could be successfully conducted at BESU. We are indebted to the sponsors of the event who contributed significantly even in a period of financial crunch. We would also like to thank Sumit Goswami and Mrinal Das, Industry Liason Chairs, for their active initiatives in getting sponsorship.

Our Publication Chair, Santanu Chattopadhyay, did a great job of composing the technical contents of the proceedings in the LNCS format. Finally, we would like to thank Alope Maity and Chandan Giri, the Finance Chairs, for doing all the hard work in the background, thereby making the event a grand success.

July 2012

Indranil Sengupta
Biplab Kumar Sikdar

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