31 International Symposium on Distributed Computing

DISC 2017, October 16–20, Vienna, Austria

Edited by

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ACM Classification 1998
C.2 Computer-Communication Networks, C.2.4 Distributed Systems, D.1.3 Concurrent Programming, E.1 Data Structures, F Theory of Computation, F.1.1 Models of Computation, F.1.2 Modes of Computation

ISBN 978-3-95977-053-8

Published online and open access by
Schloss Dagstuhl – Leibniz-Zentrum für Informatik GmbH, Dagstuhl Publishing, Saarbrücken/Wadern, Germany. Online available at http://www.dagstuhl.de/dagpub/978-3-95977-053-8.

Publication date
October, 2017

Bibliographic information published by the Deutsche Nationalbibliothek
The Deutsche Nationalbibliothek lists this publication in the Deutsche Nationalbibliografie; detailed bibliographic data are available in the Internet at http://dnb.d-nb.de.

Digital Object Identifier: 10.4230/LIPIcs.DISC.2017.0

LIPIcs – Leibniz International Proceedings in Informatics

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ISSN 1868-8969

http://www.dagstuhl.de/lipics

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Brief Announcements

Preface

DISC, the International Symposium on DIStributed Computing, is an international forum on the theory, design, analysis, implementation and application of distributed systems and networks. DISC is organized in cooperation with the European Association for Theoretical Computer Science (EATCS).

This volume contains the papers presented at DISC 2017, the 31st International Symposium on Distributed Computing, held on October 16–20, 2017 in Vienna, Austria. The volume includes the citation for the 2017 Edsger W. Dijkstra Prize in Distributed Computing, jointly sponsored by DISC and the ACM Symposium on Principles of Distributed Computing (PODC), that was presented at DISC 2017 to Elizabeth Borowsky and Eli Gafni for their work *Generalized FLP Impossibility Result for t-resilient Asynchronous Computations*. The volume also includes the citation for the 2017 Doctoral Dissertation Award, also jointly sponsored by DISC and PODC, that was presented at PODC 2017 in Washington, DC, USA to Mohsen Ghaffari for his PhD thesis titled *Improved Distributed Algorithms for Fundamental Graph Problems*, supervised by Nancy Lynch at the Massachusetts Institute of Technology.

DISC 2017 received a very high number of submissions — 160 regular paper and 11 brief announcement submissions — which were all peer reviewed. The quality of the submissions was also very high this year, posing a challenge to the Program Committee (PC). Every submission was read and evaluated by at least three members of the PC, with the assistance of 134 external reviewers. Following a 7-day discussion period, the PC held a virtual meeting on June 28–29, 2017, which was attended by all but a few of its members. The PC selected 39 contributions out of the 160 regular paper submissions, for 37 regular presentations at the symposium: Three of the papers had highly overlapping results and were therefore asked to combine their published and oral presentations (the combined paper appears as *Three Notes on Distributed Property Testing*).

For each regular presentation, the authors were invited to submit a paper of up to 15 pages for this volume (the final number of pages per paper may vary slightly due to the final typesetting of this volume); the only exception was the paper resulting from the 3-way merge, which was allowed a longer proceedings version. Nineteen brief announcements were accepted in total, for a short presentation accompanied by a 3-page publication in the proceedings each: Four of those were originally submitted as a brief announcements; the other 15 were regular submissions that were rejected, but generated substantial interest among the members of the PC and were invited to be published as brief announcements. Each brief announcement summarizes ongoing work or recent results, and it can be expected that these results will appear as full papers in later conferences or journals.

This was the first year that DISC had its proceedings published by LIPIcs (Leibniz International Proceedings in Informatics): Jukka Suomela, the DISC 2017 proceedings chair, embraced the challenge and successfully led the transition to LIPIcs. Revised and expanded versions of several selected proceedings papers will be considered for publication in a special issue of the journal Distributed Computing.

The Best Paper Award for DISC 2017 was presented to Mohsen Ghaffari, Juho Hirvonen, Fabian Kuhn, Yannic Maus, Jukka Suomela and Jara Uitto for their paper *Improved Distributed Degree Splitting and Edge Coloring*. The Best Student Paper Award for DISC 2017 was presented to Manuela Fischer for her solo-authored paper *Improved Deterministic Distributed Matching via Rounding*.

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The program featured three keynote lectures, presented by Anne-Marie Kermarrec (INRIA, Rennes, France), Christian Cachin (IBM Research Zurich, Switzerland), and Dana Randall (Georgia Tech, USA). An abstract of each keynote lecture is included in the proceedings. The program also included a celebration for Yoram Moses' 60th birthday, organized by Nir Shavit, which included a set of invited talks by Shafi Goldwasser (MIT, USA), Joe Halpern (Cornell University, USA), Sergio Rajsbaum (UNAM, Mexico), Moshe Tenenholtz (Technion, Israel), and Moshe Vardi (Rice University, USA).

Six workshops were co-located with the DISC symposium this year. The following workshops were held on the day preceding the main conference (October 16): the *4th Workshop on Formal Reasoning in Distributed Algorithms (FRIDA)*, organized by Swen Jacobs, Igor Konnov, Stephan Merz, and Josef Widder; the *1st Workshop on Blockchain Technology and Theory*, organized by Emmanuelle Anceaume, Christian Cachin, Maurice Herlihy, and Maria Potop-Butucaru; and the *1st Workshop on the Theory and Practice of Concurrency*, organized by Dan Alistarh. The following workshops were held following the main conference on October 20: the *6th Workshop on Advances in Distributed Graph Algorithms (ADGA)*, chaired by Fabian Kuhn; the *2nd Workshop on Computing in Dynamic Networks (CoDyn)*, organized by Arnaud Casteigts and Swan Dubois; and the *1st Workshop on Hardware Design and Theory (HDT)*, chaired by Cristoph Lenzen.

We wish to thank the many contributors to DISC 2017: the authors of the submitted papers, the PC members and the reviewers, the three keynote speakers, the conference general chairs and local organizers Ulrich Schmid and Josef Widder, the publicity chair Dan Alistarh, the proceedings chair Jukka Suomela, the web chair Kyrill Winkler, all the workshop organizers led by the workshop chair Josef Widder, the DISC Steering Committee, under the guidance of Shlomi Dolev, and the sponsors for their generous support of DISC 2017.

October 2017

Andréa W. Richa,
DISC 2017 Program Chair

Symposium Organization

DISC, the International Symposium on Distributed Computing, is an annual forum for presentation of research on all aspects of distributed computing. It is organized in cooperation with the European Association for Theoretical Computer Science (EATCS). The symposium was established in 1985 as a biannual International Workshop on Distributed Algorithms on Graphs (WDAG). The scope was soon extended to cover all aspects of distributed algorithms and WDAG came to stand for International Workshop on Distributed AlGorithms, becoming an annual symposium in 1989. To reflect the expansion of its area of interest, the name was changed to DISC (International Symposium on DIStributed Computing) in 1998, opening the symposium to all aspects of distributed computing. The aim of DISC is to reflect the exciting and rapid developments in this field.

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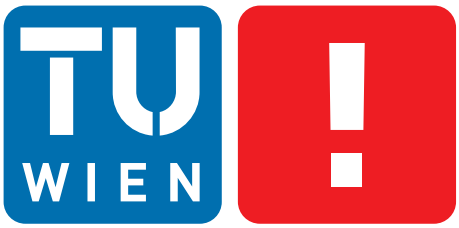

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Der Wissenschaftsfonds.

DISC 2017 acknowledges the use of the EasyChair system for handling submissions and managing the review process, and LIPIcs for producing and publishing the proceedings.

2017 Edsger W. Dijkstra Prize in Distributed Computing

The Edsger W. Dijkstra Prize in Distributed Computing was created to acknowledge outstanding papers on the principles of distributed computing whose significance and impact on the theory or practice of distributed computing have been evident for at least a decade. The Prize is sponsored jointly by the ACM Symposium on Principles of Distributed Computing (PODC) and the EATCS Symposium on Distributed Computing (DISC). This award is presented annually, with the presentation taking place alternately at PODC and DISC.

The 2017 Award Committee, composed of Alexander Schwarzmann (Chair), Marcos K. Aguilera, Alessandro Panconesi, Andrzej Pelc, Andréa W. Richa, and Roger Wattenhofer, has selected

Elizabeth Borowsky and Eli Gafni

to receive the 2017 Edsger W. Dijkstra Prize in Distributed Computing for the outstanding paper:

Elizabeth Borowsky, Eli Gafni:
Generalized FLP impossibility result for t-resilient asynchronous computations.
Proceedings of the 25th Annual ACM Symposium on Theory of Computing (STOC 1993), pages 91–100, 1993.

This is a fundamental paper in the original sense. It contains two breakthrough contributions. First, it lays a new concept of read-write simulations in the very foundation of distributed computing. Second, it introduces the *immediate-snapshot* model. For the first contribution, the paper argues that, even though distributed systems exhibit multiple seemingly incomparable instantiations, they operate on the same fundamental principles. By deriving these principles, we could obtain computability and complexity results concerning a given specific distributed system via simulations and reductions.

The paper illustrates this approach by proposing an ingenious simulation tool, now commonly referred to as the *BG Simulation*. The tool allows a system of $k+1$ processes to consistently *simulate* algorithms designed for any *k-resilient* system. The BG Simulation proved to be instrumental in establishing impossibility results and building reductions between them. In particular, this paper uses the BG Simulation to derive the fundamental impossibility of k-resilient k-set consensus from the impossibility of *wait-free* set consensus.

The second key contribution, the immediate-snapshot model, leads to a simple and elegant combinatorial characterization of the set of runs of a protocol. This characterization then leads to the impossibility of wait-free set consensus through a simple application of Sperner's Lemma.

These two points—the use of a simpler model of computation to establish the wait-free set-consensus impossibility and the use of simulation to derive the generalized k-resilient impossibility from the wait-free one—distinguishes this paper from two concurrent papers appeared at STOC 1993, by Herlihy and Shavit and by Saks and Zaharoglou, journal versions of which were later awarded the prestigious Gödel prize.

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Since 1993, both contributions of this paper were widely adopted by the distributed-computing community. The illuminating BG Simulation technique gave rise to a broad spectrum of results in various contexts: from adversarial shared-memory computing to mobile Byzantine robots. The BG simulation and abstractions around it establish now the very basis of the state-of-the-art research field of distributed computability theory. The (iterated) immediate-snapshot model is widely adopted nowadays in combinatorial representations of distributed computations. As was correctly conjectured by the authors in a concurrent paper, the *protocol complex* of this model is precisely captured by the *standard chromatic subdivision*, enabling straightforward reasoning about the model's computability. The two contributions also help us in *teaching* the foundations of resilience: it is much easier to deal with the wait-free model, and deduce computability of other models via simulation.

In summary, this paper turned out to be crucial for our understanding of fault-tolerant distributed computing. It proposed a powerful reduction technique, the BG simulation, it introduced the immediate-snapshot model, and it established the fundamental impossibility of k-resilient k-set consensus.

Yehuda Afek, Tel Aviv University, Israel
Rachid Guerraoui, EPFL, Switzerland
Taisuke Izumi, Nagoya Institute of Technology, Japan
Petr Kuznetsov, Télécom ParisTech, France

2017 Principles of Distributed Computing Doctoral Dissertation Award

The winner of the 2017 Principles of Distributed Computing Doctoral Dissertation Award is Dr. **Mohsen Ghaffari**, for his dissertation **Improved Distributed Algorithms for Fundamental Graph Problems**, written under the supervision of Prof. Nancy Lynch at the Massachusetts Institute of Technology.

Ghaffari's thesis represents an extraordinary study of network algorithms which is, at the same time, both deep and extensive. Many of the results included in this thesis (5, to be precise) have already been awarded "Best Student Paper" award or "Best Paper" award (and sometimes both) in top-notch conferences. The number of publications produced by Ghaffari while working on his thesis is also staggering (over 35 papers!): the thesis covers only a small part of his work. Most important, Ghaffari made a very significant contribution to the Theory of Network Algorithms, particularly to randomized network algorithms.

Specifically, the thesis contains three parts. In the first part, a new randomized algorithm for the Maximal Independent Set (MIS) problem is developed. The algorithm is simple and local in a strong sense: the termination time of a node depends only the coin-tosses within distance 2. This algorithm improves on all previous results and thus leads to improved time complexity in the many applications that use MIS as a building block. In the second part, Ghaffari presents results concerning vertex- and edge-connectivity in graphs, with applications to different problems such as Connected Dominated Set and Minimum Spanning Tree computation. And in the last part of the thesis, following classical packet routing results, scheduling multiple network tasks concurrently is considered. It is shown that in fact, there may be an unavoidable logarithmic gap between the case of packet routing and general tasks, but on the positive side, we never need to pay more than a single logarithmic factor (beyond the "congestion+dilation" lower bound) to schedule multiple tasks.

The award. The award is sponsored jointly by the ACM Symposium on Principles of Distributed Computing (PODC) and the EATCS Symposium on Distributed Computing (DISC). This award is presented annually, with the presentation taking place alternately at PODC and DISC. The 2017 award will be presented at PODC 2017, to be held in Washington DC, USA.

The 2017 Principles of Distributed Computing Doctoral Dissertation Award Committee:

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