Annual Report 2019

Contents

1 Introduction 1

2 Executive Summary and Highlights for the Reporting Period 1

2.1 Research Output 4

3 Current Members 4

4 A first look at 2020 5

5 Summary and Self-Evaluation 6

1 Introduction

The Icelandic Centre of Excellence in Theoretical Computer Science (ICETCS) has been active since its establishment on 29 April 2005. This fourteenth annual report is meant to give the (Theoretical) Computer Science community in Iceland and elsewhere, our sponsors and funding agencies, and our scientific advisory board an overview of the activities of the centre in 2019. It will also present some of the activities in 2020 that are planned at the time of writing.

This annual report will briefly report on the main highlights of yet another active year for ICE-TCS. We refer our readers to the data collected at the centre's web page at

http://www.icetcs.ru.is

for full details. In particular, the news archive for the reporting year is at

http://www.icetcs.ru.is/news-2019.html

2 Executive Summary and Highlights for the Reporting Period

Once again, the calendar year 2019 has been an active one for ICE-TCS, both nationally and internationally. The quality and impact of the research carried out by the members of the centre in 2019 is witnessed by the following main achievements.

- Magnus M. Halldorsson and his co-workers published two papers at PODC 2019, the premier event on principles of distributed computing. Magnus M. Halldorsson also delivered a keynote address, entitled "How well do we know the physical model?", at DCOSS 2019.
- The Tilescope algorithm, developed by the combinatorics group at ICE-TCS, has led to fully automated proofs of known theorems in enumerative combinatorics, including some that have just recently been published in the literature. The increasing impact of this work on its research community is witnessed, for instance, by an invited three-lecture mini-course delivered by ICE-TCS postdoctoral researcher Christian Bean at the Permutation Patterns 2019, Pre-Conference Workshop on Computational Mathematics. Moreover, Henning Úlfarsson gave a colloquium talk entitled “Combinatorial Exploration: guided by humans, proven by computer” at Brown University, USA.
- Tarmo Uustalu and his co-workers published papers at CONCUR 2019 and FSCD 2019, which are the prime conference on concurrency theory and a top-class one covering all aspects of formal structures in computation and automatehttps://sites.google.com/view/permutation-patterns-2019/pre-conference-workshop?authuser=0d deduction, respectively.
- The concurrency group within ICE-TCS published papers on characterizing the monitorable specifications in a variety of settings at POPL 2019, the premier conference on principles of programming languages, and at SEFM 2019, a good quality conference in software engineering. Moreover, Luca Aceto delivered an invited talk on those topics at the Colloquium Jacques Morgenstern, INRIA Sophia Antipolis.
- ICE-TCS researchers received the only project grants awarded in computer science by the Icelandic Research Fund for 2019. The grants, which are for the period 2019-2021, are:
    - “Open problems in the Equational Logic of Processes” (Luca Aceto, PI; Anna Ingolfsdottir, Bas Luttik and Alexandra Silva co-proposers; 54,525 K ISK, roughly 395,962 EUR) and
    - “Quantified computational effects and interaction” (Tarmo Uustalu PI, Shin-ya Katsumata (NII) and Maciej Piróg (Wrocław U.) co-proposers; 48,900 K ISK, roughly 355,011 EUR).
- The three-year project “IT MATTERS: Methods and Tools for Trustworthy Smart Systems” was selected for funding by the Italian Ministry for University and Research under the grant programme PRIN. The project sees the involvement of Luca Aceto, who leads the team from the Gran Sasso Science Institute. The funding for Luca Aceto's team is of 128,000 EUR.
- Duncan Paul Attard and Henning Úlfarsson received Ph.D. Student Grants from the RU Research Fund for a period of one year for the research projects “Ensuring Correctness in Distributed Systems” and “Combinatorial Exploration with Applications to Permutation Patterns and Other Structures”, respectively. Each grant amounts to 5,340,000 ISK (roughly, 39,349 EUR).

As in previous years, ICE-TCS researchers organized high-quality scientific events at Reykjavik University and elsewhere, increasing the international visibility of the centre and of Reykjavik University as a whole. To wit, we mention the following events.

- Luca Aceto and Anna Ingolfsdottir organized a public talk by Kim G. Larsen (Aalborg University, Denmark) entitled “Synthesis, Verification and Optimization for Cyber-Physical Systems”.
- Luca Aceto co-organized Nominal Techniques, 3rd School on Foundations of Programming and Software Systems, Warsaw, Poland. (The other organizers were Bartek Klin, Andrew Pitts and Joanna Ochremiak.) The school was supported by the EATCS, ETAPS, ACM SIGLOG and ACM SIGPLAN.
- Magnús M. Halldórsson co-organized a public talk by Muriel Médard (MIT) entitled “Guessing Random Additive Noise Decoding (GRAND)” at Reykjavik University.
- Magnús M. Halldórsson was local organizing chair for the 2019 IEEE Communication Theory Workshop (IEEE CTW 2019), Selfoss, Iceland.
- The 15th annual ICE-TCS Theory Day was held at Reykjavik University and featured invited talks by Ravi Boppana (Department of Mathematics, MIT) and Exequiel Rivas (INRIA Sophia Antipolis, France). Further details on this event are available here.
- Tarmo Uustalu organized the 24th Estonian Winter School in Computer Science in Palmse, Estonia.

The centre also maintained a vibrant guest programme and hosted 23 foreign researchers in 2019 for stays ranging from a few days to about five months. (The typical length of a research visit was roughly a working week.) Most of the guests delivered a seminar in the ICE-TCS seminar series, which consisted of 22 seminars in the reporting period. At the time of writing the ICE-TCS seminar series has hosted 346 talks since the establishment of the centre.

ICE-TCS researchers have also continued to serve the community in a variety of leading roles. By way of example, we limit ourselves to mentioning that

- Tarmo Uustalu is the publicity chair and member of the Executive Board of ETAPS; he is also vice-chair of the EU COST action EUTYPES running in the period 2016-2020;
- Magnús Halldórsson was a member of the Council of the EATCS, chairs the steering committees of SIROCCO and SWAT, and is a member of the steering committee of ALGOSENSORS;
- Antonis Achilleos is a member of the Executive Committee of the Scandinavian Logic Society, and is DisCoTec 2020 workshop co-chair;
- Luca Aceto is the chair of the editorial board of LIPIcs (Leibniz International Proceedings in Informatics) and will chair the jury for the first CONCUR Test-of-Time-Award. Since 1

March 2019, he also acts as head of the Department of Computer Science at Reykjavik University (sometimes abbreviated to CS@RU in what follows).

2.1 Research Output in 2019

During the reporting period, ICE-TCS researchers published 2 books or edited volumes (out of 3 for CS@RU as a whole), 6 book chapters (out of 10 for CS@RU as a whole), 18 journal papers (out of 25 for CS@RU as a whole), 15 conference/workshop papers (out of 43 for CS@RU as a whole), and 6 other refereed publications (out of 8 for CS@RU as a whole). Based on the above-mentioned data, it seems fair to say that ICE-TCS continues to contribute a good share of the research output from CS@RU and the vast majority of journal publications. More importantly, most of the research output of the centre is published in high-quality venues.

The full list of accepted and published papers authored by members of the centre in 2019 is in the appendix at the end of this report.

3 Current Members

At the time of writing, ICE-TCS has nine permanent members (seven at Reykjavik University and one at deCODE Genetics and at the University of Iceland), namely Luca Aceto, Eyjólfur Ingi Ásgeirsson (Department of Engineering at Reykjavik University; Scientific Co-director), Yngvi Björnsson (mostly with CADIA), Bjarni V. Halldórsson (deCODE Genetics), Magnús M. Halldórsson (Scientific Director), Anna Ingólfsdóttir (Scientific Co-director), Páll Melsted (University of Iceland), Henning Úlfarsson and Tarmo Uustalu. Until September 2019, Luca Aceto held a position as Professor of Computer Science at the Gran Sasso Science Institute in L'Aquila, where he was the director of the PhD programme in computer science and the scientific director of the computer science group. However, he kept a part-time position at Reykjavik University and actively contributed to the activities of ICE-TCS.

In 2019, the centre hosted the postdoctoral researchers Antonis Achilleos (logic in computer science, runtime verification)[1], Christian Bean (combinatorics, until November 2019), Valentina Castiglioni (concurrency theory, from May 2019), Dylan McDermott (semantics of programming languages, from November 2019), Mathias Ruggaard Pedersen (concurrency theory and logic in computer science, from May 2019), Murilo Santos de Lima (design and analysis of algorithms, until October 2019) and Tigran Tonoyan (design and analysis of algorithms, until July 2019), and two PhD students, namely Elli Anastasiadi (supervised by Luca Aceto and Anna Ingólfsdóttir) and Emile Nadeau (supervised by Henning Ulfarsson). Tarmo Uustalu supervises Hendrik Maarand, a doctoral student at Tallinn University of Technology. In addition, Luca Aceto and Anna Ingólfsdóttir co-supervise Duncan Paul Attard and Ian Cassar, two PhD students from

[1] Antonis Achilleos has also been a part-time assistant professor since July 2019.

the University of Malta who are enrolled in a joint Reykjavik University/University of Malta doctorate and whose main supervisor is Adrian Francalanza.
To our mind, ICE-TCS has been blessed with a good number of high-quality postdoctoral researchers. However, we still find it difficult to attract PhD students, even though two new doctoral students started within the reporting period. We hope to be in a position to offer some PhD scholarships in 2020, making use of any funding we might be able to obtain from the Icelandic Research Fund, the Reykjavik University Research Fund or the Department of Computer Science at Reykjavik University.

4 A first look at 2020

The calendar year 2020 will, once again, be rich of scientific events involving the members of ICE-TCS. To wit, the centre's calendar already lists the following activities:

- 29 June-3 July 2020: Henning Úlfarsson will deliver an invited talk at Permutation Patterns 2020, Valparaiso University, USA.
- Wednesday, 29 April 2020: The ICE-TCS Theory Day for 2020 will be held on this day.
- 20-24 April 2020: Tarmo Uustalu will be the main external lecturer at the 2020 edition of the Midlands Graduate School in the Foundations of Computing Science, which will be held in Sheffield, UK.
- 25-27 March 2020: Paola Inverardi (former rector of the University of L'Aquila, Italy) will visit ICE-TCS to provide her advice to the centre and to the Department of Computer Science at Reykjavik University as a whole. During her stay, Paola will also deliver a talk entitled "Ethics and Privacy in Autonomous Systems". The hosts for her visit will be Luca Aceto and Anna Ingolfsdottir.
- 1-6 March 2020: Tarmo Uustalu will co-organize the 25th Estonian Winter School in Computer Science, EWSCS '20.
- 16-21 February 2020: Niccolò Veltri (Department of Software Science, Tallinn University of Technology) will visit ICE-TCS. The host for his stay is Tarmo Uustalu.
- 26 January-6 February 2020: Shin-ya Katsumata (National Institute for Informatics, Japan) will visit ICE-TCS. The host for his stay is Tarmo Uustalu.

In the period January-March 2020, Luca Aceto will chair the jury for the first CONCUR Test-of-Time Award and Antonis Achilleos will be DisCoTec 2020 workshop co-chair.

In the latter half of October 2020, ICE-TCS will host the 32nd Nordic Workshop on Programming Theory at Reykjavik University. Moreover, we are in the process of submitting a bid for hosting the Logic Colloquium 2021 at Reykjavik University in June 2021.

In February 2020, Alexandre Nolin will join ICE-TCS as a postdoctoral researcher to work with Magnus M. Halldorsson, but Mathias Ruggaard Pedersen will leave the centre to return to Denmark. In the period February-May 2020, Tarmo Uustalu will host Ülo Reimaa (University of Tartu, Estonia) as a postdoc.

In keeping with our track record in previous years, we look forward to hosting a number of guests at ICE-TCS in 2020 and have issued invitations to some high-profile computer scientists.

Unfortunately, the news for 2020 from the Icelandic Research Fund isn't good for Computer Science. Once again, ICE-TCS submitted the only funded application in Computer Science, which was awarded to Christian Bean's postdoctoral grant application (amount: 9,775K ISK, which is roughly 71,500 EUR). Despite this sub-optimal level of funding for 2020, and even though predicting the future is difficult, we trust that 2020 will be another successful year for ICE-TCS and its members.

5 Summary and Self-Evaluation

Overall, ICE-TCS has maintained a high level of activity during the reporting period. We feel that we can be proud of what the centre has achieved since its establishment in 2005 and of its visibility within the international TCS community, which is also witnessed by the high quality of applications from TCS researchers for academic positions at the Department of Computer Science and the wide interest in postdoctoral vacancies at ICE-TCS. Of course, we are always looking at ways in which we can improve our activities and scientific impact, and welcome suggestions on this point from our advisory board and other readers of this report.

For the time being, we will keep exploiting all available means to maximize our impact and research collaborations, as we have done since April 2005.

Acknowledgements We are grateful to the CS@RU School Office for its continuous support of ICE-TCS activities.

Appendix: List of ICE-TCS Publications in 2019

Books and Edited Volumes

1. Luca Aceto, Arnaud Carayol and Anna Ingólfsdóttir, guest eds. Logical Methods in Computer Science, special issue in memory of Zoltán Ésik, preface +10 articles, 2019. https://lmcs.episciences.org/volume/view/id/272
2. Tarmo Uustalu, Jüri Vain, eds. 31st Nordic Workshop on Programming Theory, NWPT 2019: Tallinn, Estonia, 13-15 November 2019, Abstracts, vii+88 pp. Tallinn University of Technology, 2019. https://doi.org/10.23658/taltech.nwpt/2019

Book Chapters

1. L. Aceto, A. Achilleos, A. Francalanza, A. Ingólfsdóttir and K. Lehtinen. Testing Equivalence vs. Runtime Monitoring. In: Boreale M., Corradini F., Loreti M., Pugliese R.

(eds) Models, Languages, and Tools for Concurrent and Distributed Programming. Lecture Notes in Computer Science, v. 11665. Springer, 2019.
2. L. Aceto, A. Achilleos, A. Francalanza, A. Ingólfsdóttir, K. Lehtinen. The cost of monitoring alone. In Ezio Bartocci, Rance Cleaveland, Radu Grosu and Oleg Sokolsky, eds., From Reactive Systems to Cyber-Physical Systems, Lecture Notes in Computer Science, v. 11500, pp. 259-275, Springer, 2019.
3. L. Aceto, G. D'Angelo, M. Flammini, O. Inverso, L. Iovino, C. Trubiani. Building International Doctoral Schools in Computer Science in Italy, De Nicola's Way. In: Boreale M., Corradini F., Loreti M., Pugliese R., eds., Models, Languages, and Tools for Concurrent and Distributed Programming. Lecture Notes in Computer Science, v. 11665. Springer, 2019.
4. V. Castiglioni, R. Lanotte, S. Tini. Fully Syntactic Uniform Continuity Formats for Bisimulation Metrics. In M. Alvim, K. Chatzikokolakis, C. Olarte and F. Valencia, eds., The Art of Modelling Computational Systems: A Journey from Logic and Concurrency to Security and Privacy: Essays Dedicated to Catuscia Palamidessi on the Occasion of Her 60th Birthday, pp. 293-312. Springer, 2019.
5. Magnús M. Halldórsson, Roger Wattenhofer: Wireless Network Algorithmics. In Bernhard Steffen, Gerhard J. Woeginger, eds., Computing and Software Science: State of the Art and Perspectives, Lecture Notes in Computer Science, v. 10000, pp. 141-160, Springer 2019
6. Tarmo Uustalu, Niccolò Veltri and Noam Zeilberger. The sequent calculus of skew monoidal categories. In Claudia Casadio, Philip J. Scott, eds., Joachim Lambek memorial volume, Outstanding Contributions to Logic Series, Springer, to appear.

Journal Papers

1. L. Aceto, A. Achilleos, A. Francalanza, A. Ingólfsdóttir and S.Ö. Kjartansson. Determinizing monitors for HML with recursion. Journal of Logical and Algebraic Methods in Programming, to appear.
2. L. Aceto, A. Achilleos, A. Francalanza, A. Ingólfsdóttir and K. Lehtinen. Adventures in Monitorability --- From Branching to Linear Time and Back Again. Proceedings of the ACM on Programming Languages (PACMPL), 3(POPL):52:1-52:29 (2019)
3. L. Aceto, D. Della Monica, I. Fabregas and A. Ingólfsdóttir. When are prime formulae characteristic? Theoretical Computer Science 777:3-31 (2019) https://doi.org/10.1016/j.tcs.2018.12.004
4. L. Aceto, I. Fabregas, A. Garcia-Perez, A. Ingólfsdóttir and Y. Ortega-Mallen. *Rule Formats for Nominal Process Calculi*. Logical Methods in Computer Science, 15(4): 2:1-2:46 (2019)
5. L. Aceto, I. Fabregas, C. Gregorio-Rodriguez and A. Ingólfsdóttir. Logical characterisations, rule formats and compositionality for input-output conformance simulation. Journal of Logical and Algebraic Methods in Programming 106:78-106, Elsevier, August 2019. https://doi.org/10.1016/j.jlamp.2019.04.005

6. Antonis Achilleos. Modal Logics with Hard Diamond-free Fragments. Journal of Logic and Computation, March 2020 (special issue on Logical Foundations of Computer Science, to appear)
7. Christian Bean, Bjarki Gudmundsson, Henning Úlfarsson. Automatic discovery of structural rules of permutation classes. Math. Comput., 88(318):1967-1990 (2019) https://doi.org/10.1090/mcom/3386
8. C. Bean, M. Tannock and H. Ulfarsson. Pattern avoiding permutations and independent sets in graphs. Journal of Combinatorics, to appear. http://arxiv.org/abs/1512.08155
9. Valentina Castiglioni, Konstantinos Chatzikokolakis and Catuscia Palamidessi. Logical Characterization of Differential Privacy. Sci. Comput. Program, to appear..
10. Valentina Castiglioni, Michele Loreti, Simone Tini. The Metric Linear Time - Branching Time Spectrum on Nondeterministic Probabilistic Processes. Theor. Comput. Sci., to appear. https://doi.org/10.1016/j.tcs.2019.09.019
11. Valentina Castiglioni, Simone Tini. Probabilistic Divide & Congruence: Branching Bisimilarity. Theor. Comput. Sci., 802:147-196 (2020) https://doi.org/10.1016/j.tcs.2019.09.037
12. James Chapman, Tarmo Uustalu, Niccolò Veltri. Quotienting the delay monad by weak bisimilarity. Math. Struct. Comput. Sci. 29(1): 67-92 (2019) https://doi.org/10.1017/s0960129517000184
13. Magnús M. Halldórsson, Sven Köhler, Dror Rawitz: Distributed approximation of k-service assignment. Distributed Computing 32(1): 27-40 (2019)
14. Magnús M. Halldórsson, Yuexuan Wang, Dongxiao Yu: Leveraging multiple channels in ad hoc networks. Distributed Computing 32(2): 159-172 (2019)
15. B. Kristinsson and H. Ulfarsson. Occurrence graphs of patterns in permutations. Involve 12(6) 901-918 (2019) https://arxiv.org/abs/1607.03018
16. Murilo Santos de Lima, Mário César San Felice, Orlando Lee. Group parking permit problems. Discrete Applied Mathematics, to appear. https://doi.org/10.1016/j.dam.2019.05.013
17. Hendrik Maarand, Tarmo Uustalu. Certified normalization of generalized traces. Innov. Syst. Softw. Eng. 15(3-4): 253-265 (2019) https://doi.org/10.1007/s11334-019-00347-1
18. J. Smith, and H. Ulfarsson. The poset of mesh patterns. Discrete Mathematics, to appear. https://arxiv.org/abs/1802.08672

Conference and Workshop Papers

1. Luca Aceto, Antonis Achilleos, Adrian Francalanza, Anna Ingólfsdóttir and Karoliina Lehtinen. An Operational Guide to Monitorability. In Proceedings of the 17th International Conference on Software Engineering and Formal Methods (SEFM 2019),

Lect. Notes Comput. Sci., v. 11724, pp. 433-453. Springer, 2019. https://doi.org/10.1007/978-3-030-30446-1_23
2. Luca Aceto, Elli Anastasiadi, Valentina Castiglioni, Anna Ingólfsdóttir and Mathias Ruggaard Pedersen. On the axiomatizability of priority III: The return of sequential composition. In Proceedings of ICTCS 2019, the 20th Italian Conference on Theoretical Computer Science, CEUR Workshop Proceedings, v. 2504. RWTH Aachen, 2019.
3. Luca Aceto, Ian Cassar, Adrian Francalanza and Anna Ingólfsdóttir. Comparing Controlled System Synthesis and Suppression Enforcement. In Proceedings of RV 2019, 19th International Conference on Runtime Verification (B. Finkbeiner and L. Mariani Eds.), Lecture Notes in Computer Science, v. 11757, pp. 148-164, Springer, 2019. https://doi.org/10.1007/978-3-030-32079-9_9
4. Danel Ahman and Tarmo Uustalu. Decomposing comonad morphisms. In M. Roggenbach, A. Sokolova, eds., Proc. of 8th Conf. on Algebra and Coalgebra in Computer Science, CALCO 2019, v. 139 of Leibniz Int. Proc. in Inf., article 14. Dagstuhl Publishing, 2019. https://doi.org/10.4230/lipics.calco.2019.14
5. Michael Dinitz, Magnús M. Halldórsson, Taisuke Izumi, Calvin Newport: Distributed Minimum Degree Spanning Trees. PODC 2019: 511-520
6. Michael Dinitz, Magnús M. Halldórsson, Calvin Newport, Alex Weaver. The Capacity of Smartphone Peer-To-Peer Networks. In Proc. DISC, Budapest, October 2019.
11. José Espírito Santo, Luís Pinto, Tarmo Uustalu. Modal embeddings and calling paradigms. In H. Geuvers, ed., Proc. of 4th Int. Conf. on Formal Structures for Computation and Deduction, FSCD 2019 (Dortmund, June 2019), v. 131 of Leibniz Int. Proc. in Inf., article 18. Dagstuhl Publishing, 2019. https://doi.org/10.4230/lipics.fscd.2019.18
12. Magnús M. Halldórsson, Murilo Santos de Lima: Query-Competitive Sorting with Uncertainty. MFCS 2019: 7:1-7:15
13. Magnús M. Halldórsson, Tigran Tonoyan. Link Scheduling under Correlated Shadowing. In Proc. WiOpt, Avignon, June 2019.
14. Magnús M. Halldórsson, Tigran Tonoyan: Plain SINR is Enough! PODC 2019: 127-136
15. Hendrik Maarand, Tarmo Uustalu. Reordering derivatives of trace closures of regular languages. In W. Fokkink, R. van Glabbeek, eds., Proc. of 30th Int. Conf. on Concurrency Theory, CONCUR 2019 (Amsterdam, Aug. 2019), v. 140 of Leibniz. Int. Proc. in Inf., article 40. Dagstuhl Publishing, 2019. https://doi.org/10.4230/lipics.concur.2019.40

Other Refereed Publications

1. L. Aceto, A. Achilleos, E. Anastasiadi, A. Ingólfsdóttir. Axiomatizing equivalences over regular monitors. In T. Uustalu, J. Vain, eds. 31st Nordic Workshop on Programming Theory, NWPT 2019: Tallinn, Estonia, 13-15 November 2019, Abstracts, pp. 4-7. Tallinn University of Technology, 2019. https://doi.org/10.23658/taltech.nwpt/2019

2. L. Aceto, A. Achilleos, A. Francalanza, A. Ingólfsdóttir. The Complexity of Recursion in Modal Logic: First Steps. Proceedings of the 12th Panhellenic Logic Symposium, June 2019.
3. L. Aceto, E. Anastasiadi, A. Ingólfsdóttir. An Axiomatization of Verdict Equivalence over Regular Monitors. Proceedings of the 12th Panhellenic Logic Symposium, June 2019.
4. Antonis Achilleos, Mathias Ruggaard Pedersen. Axiomatising Weighted Monadic Second-Order Logic on Finite Words. In T. Uustalu, J. Vain, eds. 31st Nordic Workshop on Programming Theory, NWPT 2019: Tallinn, Estonia, 13-15 November 2019, Abstracts, pp. 8-11. Tallinn University of Technology, 2019. https://doi.org/10.23658/taltech.nwpt/2019
5. Magnús M. Halldórsson, Tigran Tonoyan. Plain SINR is Enough! In HALG, June 2019. (Poster)
6. Murilo Santos de Lima. Graph theory exercises (translation). Paulo Feofiloff (author), 2019 - https://www.ime.usp.br/~pf/graph-exercises/index.html