

CENTRE FOR DISCRETE MATHEMATICS AND THEORETICAL COMPUTER SCIENCE

<http://www.cs.auckland.ac.nz/CDMTCS>

Annual Report 2009

The Centre for Discrete Mathematics and Theoretical Computer Science was founded in 1995 in order to a) support basic research on the interface between mathematics and computing, b) increase local knowledge in these areas, and c) broaden research skills in New Zealand. The Centre is supported financially by the Department of Computer Science.

Director

Professor C.S. Calude

Deputy Director

Dr. Michael J. Dinneen

Management Committee

The activities of the Centre are overseen by a Management Committee consisting of

- Professor Douglas Bridges (External Researchers Representative, Canterbury University),
- Professor Cristian Calude (Director),
- Dr. Michael J. Dinneen (Deputy Director),
- Professor Robert Amor (HOD, Computer Science).

Research Reports Coordinator

Dr. Michael J. Dinneen

Seminar Coordinator

Dr. Alexander Raichev

International Advisory Board

The Centre has a International Advisory Board consisting of the following members:

M.A. Arslanov (Kazan State University, Russia), R.C. Backhouse (Eindhoven University of Technology, Netherlands), J. Butcher (University of Auckland), J. Casti (TU Vienna, Austria), G.J. Chaitin (IBM, New York, US), C.J. Colbourn (University of Vermont, US), E.W. Dijkstra (1995–2002), J.H. Dinitz (University of Vermont, US), J.A. Goguen (1941-2006), E. Goles (Adolfo Ibanez University, Chile), R.L. Graham (University of California at San Diego, US), J. Hartmanis (Cornell University, US), H. Jurgensen (University of Western Ontario, Canada and Potsdam University, Germany), C.C. Lindner (Auburn University, Alabama, US), R. Mathon (University of Toronto, Canada), B.D. Mackay (Australian National University, Australia), A. Nerode (Cornell University, US), I. Prigogine (1995–2003), G. Rozenberg (Leiden University, Netherlands), A. Salomaa (University of Turku, Finland), J. Seberry (University of Wollongong, Australia), D. van Dalen (University of Utrecht, Netherlands).

International Affiliations

- Logic Group at JAIST,
- Mindship International,
- Turku Centre for Computer Science (TUCS),
- Valparaiso Institute of Complex Systems.

Departments of Participating Members

Computer Science, Mathematics, Philosophy.

Introduction

The aim of the Management Committee to build one of the world's best centres for research in Discrete Mathematics and Theoretical Computer Science is coming true. The Centre has become a major force in fostering research and development in those areas within the South Pacific Region and creating productive links between that region's researchers and their counterparts in the rest of the world.

Plans, Objectives, Areas

Although the Centre encourages and supports a wide range of research activity, its primary research foci are the following:

- Combinatorial Optimisation
- Computability and Complexity
- Bioinformatics
- Unconventional Computation

The main objectives of the CDMTCS are:

- to stimulate and encourage the interest of undergraduate students in theoretical computer science and discrete mathematics (including ACM and regional programming contests),
- to foster research, development and cooperation in theoretical computer science and discrete mathematics (participating members, graduate students),
- to fund short and long term visitors, post-doctoral researchers, and doctoral students,
- to organize conferences, summer schools, workshops and seminars,
- to publish, in co-operation with Graz University of Technology and Turku University, the Journal of Universal Computer Science.

Participating Members

The Centre includes the following faculty members:

D. S. Bridges (Mathematics, Canterbury), C. Calude (Computer Science), M. D. E. Conder (Mathematics), M. J. Dinneen (Computer Science), R. W. Doran (Computer Science), A. Drummond (Computer Science), P. R. Hafner (Mathematics), F. Kroon (Philosophy), B. Khoussainov (Computer Science), R. Nicolescu (Computer Science, Tamaki), A. Nies (Computer Science), E. O'Brien (Mathematics), B. Pavlov (Mathematics), A. Raichev (Computer Science), J. Seligman (Philosophy), U. Speidel (Computer Science, Tamaki), M. Titchener (Bioengineering), C. Thomborson (Computer Science), M. C. Wilson (Computer Science).

External Researchers

The *External Researchers* had a great contribution to the Centre's activities by refereeing papers, assisting with conference and workshop organisation, and by other means. The current External Researchers are

I. Antoniou (Solvay Institute, Belgium), E. Calude (Massey University at Albany, New Zealand), R. Downey (Victoria University of Wellington, New Zealand), B. Everitt (University of Aberdeen, Scotland), R. Goldblatt (Victoria University of Wellington, New Zealand), P. Hertling (FernUniversität Hagen, Germany), D. Holton (University of Otago, New Zealand), K.W. Lih (Institute of Mathematics, Academia Sinica, Taiwan), C. Little (Massey University, New Zealand), M. Lipponen (Turku University, Finland), J. McKay (Concordia University, Canada), Gh. Paun (Institute of Mathematics, Romanian Academy, Romania), C.E. Praeger (University of Western Australia), L. Staiger (MartinLuther-Universität Halle-Wittenberg, Germany), K. Svozil (Technische Universität, Vienna), D. Stefanescu (Bucharest University, Romania), S. Yu (University of Western Ontario, Canada), I. Tomescu (Bucharest University, Ontario).

Graduate Students

The following graduate students are working in close connection with the research program of the Centre:

1. Nicholas J. Hay. Provability in Algorithmic Information Theory [PhD]
2. Jiamou Liu. Automatic Structures [PhD]
3. Mike Stay. Higher Category Theory of Computation and some Relationships with Physics [PhD]
4. Hector Zenil. Experimental AIT [PhD]
5. Yun-Bum Kim, Membrane Computing [PhD]
6. A. Gandhi. Applications of Automatic Structures to databases [PhD]
7. T. Roblot. De-quantization of Quantum Algorithms [Honours]
8. A. Abbott. Finite-state Complexity and Randomness [Honours]
9. L. Fearnley. Accelerated Turing Machines [Honours]
10. N. Kasto. Algorithmic Information Theory [PhD]
11. A. Fenton. Meta-heuristics for FTL-pickup and delivery problem [MSc]
12. F.-T. Liou. Algorithms on Phylogenies via Bayesian Inference [MSc]
13. Z. Huo. Real Time Entropy Estimation with Parallel Computing [MSc]
14. J. Xie. Towards real-time dynamic programming stereo matching [MSc]
15. I. Amith. Towards real-time dynamic programming stereo matching [MSc]
16. Y. Sun. Data Classifications Using Entropy Estimations - CTW and T-entropy [MSc]
17. N. Datt. Graph Containment Algorithm [Hon]
18. G. Reihana. Magic Graphs [Hon]
19. A. Melnikov. Automatic Structures & Computability Theory [PhD]
20. J. Wu. Bayesian Inference of Microsatellite Models [Hon]
21. J. Heled. Modelling the Interface between Population Genetics and Phylogenetics [PhD]
22. S. Li. Comparative Genomic Approach to Detecting Selection in Genome non-coding Regions [PhD]
23. D. Kuhnert. Geo-epidemic Models of Evolving Virus Populations [PhD]
24. R. Reyhani. Social choice [PhD]

Visitors

The Centre hosted the following visitors:

- Prof. L. Staiger, Martin Luther Universitat Halle-Wittenberg, Germany
- Prof. K. Svozil, Technical University Vienna, Austria
- Prof. M. Kolhase, Jacobs University, Germany
- C. Mueller, Jacobs University, Germany
- Prof. Kai Salomaa, Queen's University, Canada
- Oron Shagrir, Tel Aviv University, Israel
- A/Prof. G. Rosu, University of Illinois at Urbana-Champaign, USA
- N. Mueller, Jacobs University, Germany
- Prof. K. Tadakki, Chuo University, Tokyo, Japan
- A/Prof. I. Chitoran, Dartmouth University, USA
- Dr. J. P. Lewis, Massey University, Wellington
- A/Prof. D. Damian, Victoria University, Canada
- Dr. G. Barmpalias, Victoria University, Wellington

Major Activities

The major activity of the Centre in 2009 has been the organisation of the [Eight International Conference UC'09](#), held in [Ponta Delgada \(Azores\)](#), Portugal on 7-11 September 2009. The volume including the proceedings of UC'09 (which includes the CDMTCS logo on the cover page)



has appeared as

[Calude, C.S.; Costa, J.F.G.; Dershowitz, N.; Freire, E.; Rozenberg, G. \(Eds.\) 2009, XXI, 293 p., Softcover ISBN: 978-3-642-03744-3.](#)

Starting with 2005, International Conference Unconventional Computation has become an annual event, organised by the following Steering Committee (see <https://www.cs.auckland.ac.nz/uc/>):

C. Calude, co-chair, Auckland, L.K. Grover, Murray Hill, NJ, USA, J. Kari, Turku, Finland, L. Kari, London, Ont., Canada, J. van Leeuwen, Utrecht, Holland, S. Lloyd, Cambridge, MA, USA, Gh. Paun, Seville, Spain, T. Toffoli, Boston, MA, USA, C. Torras, Barcelona, Spain, G. Rozenberg, Leiden, co-chair, Holland, A. Salomaa, Turku, Finland.

The [Second International Workshop on Physics and Computation 2009](#) will be held Ponta Delgada (Azores), Portugal on 7-11 September 2009. Two special issues including a selection of the papers presented at the Workshop have been published:

C. S. Calude, J. F. Costa (eds.). Special issue: Physics and Computation, Appl. Math. Comput., 215, 4 (2009), 122 pp.

C. S. Calude, J. F. Costa (eds.). Special issue: Physics and Computation, Natural Computing, 8, 3 (2009), Springer, 212 pp.

The Centre runs “J. C. Butcher Numerical Analysis” Workshop.

Editorial Work

Members of the CDMTCS in the editorial boards of the following international journals:

Journal of Universal Computer Science, N.Z. Journal of Mathematics, International Journal of Applied Intelligence, EATCS Bullentin, Math. Logic Quarterly, Pattern Analysis and Applications Journal, Australasian Journal of Combinatorics, Philosophia Mathematica, Journal of Computing and Information, Fundamenta Informaticae, Romanian Journal of Information Science and Technology, Natural Computing Journal, Contributions to Discrete Mathematics, Molecular Biology and Evolution, Bullentin of Suymbolic Logic, Annals of Pure and Applied Logic, Archive of Mathematical Logic, unoMolti. Modi della Filosofia, Revista de Filosofie Analitica, Journal of Advanced Mathematical Studies, The Open Software Engineering Journal, Theoretical Computer Science, International Journal of Nanotechnology and Molecular Computation, Mathematical Structures in Computer Science

Special Issues of the *Fundamenta Informaticae, International Journal of Foundations of Computer Science, International Journal on Applied Intelligence, Natural Computing, Journal of Universal Computer Science, Applied Mathematis Computation* are regularly been edited. Members of the Centre regularly edit conference proceedings published in LNCS and LNAI Series (Springer), IEEE Series, and EPTCS (Elsevier).

Research Papers

More than 170 research papers have been published by faculty members and graduate students.

CDMTCS Research Reports

The Series is very well cited; the reports are announced in the column “News from NZ” published three times a year in the [EATCS Bulletin](#). The following 31 reports were published in 2009:

344	C.S. Calude and J.P. Lewis	<i>Is there a Universal Image Generator</i>	01/2009
345	M. Schimpf and K. Svozil	<i>A Glance at Singlet States and Four-Partite Correlations</i>	02/2009
346	K. Svozil	<i>Some Observations Concerning the Plasticity of Nonlocal Quantum Correlations Exceeding Classical Expectations</i>	02/2009
347	M. Schaller and K. Svozil	<i>Scale-Invariant Cellular Automata and Recursive Petri Nets</i>	02/2009
348	K. Svozil	<i>Proposed Direct Test of Quantum Contextuality</i>	02/2009
349	K. Svozil	<i>Quantum Scholasticism: On Quantum Contexts, Counterfactuals, and the Absurdities of Quantum Omniscience</i>	02/2009
350	C.S. Calude and L. Staiger	<i>A Note on Accelerated Turing Machines</i>	02/2009
351	P.H. Potgieter and E.E. Rosinger	<i>Output Concepts for Accelerated Turing Machines</i>	02/2009
352	J.C. Baez and M. Stay	<i>Physics, Topology, Logic and Computation: A Rosetta Stone</i>	03/2009
353	K. Svozil	<i>Bertlmann's Chocolate Balls and Quantum Type Cryptography</i>	03/2009
354	C.S. Calude and C. Müller	<i>Formal Proof: Reconciling Correctness and Understanding</i>	03/2009
355	K. Tadaki	<i>Fixed Point Theorems on Partital Randomness</i>	03/2009
356	M.J. Dinneen, N.R. Ke and M. Khosravani	<i>Arithmetic Progression Graphs</i>	03/2009
357	R. Reyhani, G. Pritchard and M.C. Wilson	<i>New Measures of the Difficulty of Manipulation of Voting Rules</i>	03/2009
358	K. Tadaki	<i>A Statistical Mechanical Interpretation of Algorithmic Information Theory III: Composite Systems and Fixed Points</i>	04/2009
359	K. Tadaki	<i>Chaitin Omega Numbers and Halting Problems</i>	04/2009
360	K. Svozil	<i>On the Brightness of the Thomson Lamp. A Prolegomenon to Quantum Recursion Theory</i>	04/2009
361	K. Svozil	<i>The Diagonalization Method in Quantum Recursion Theory</i>	04/2009
362	K. Svozil	<i>Three Criteria for Quantum Random Number Generators Based on Beam Splitters</i>	04/2009
363	A. Nies	<i>Lowness for Computable and Partial Computable Randomness</i>	04/2009
364	K. Svozil	<i>Randomness in Physics: Five Questions, Some Answers</i>	05/2009
365	C.S. Calude, N.J. Hay and F. Stephan	<i>Representation of Left-Computable ϵ-Random Reals</i>	05/2009
366	J. Mielke and L. Staiger	<i>On Oscillation-free ϵ-random Sequences II</i>	07/2009
367	J. Hertel	<i>On the Difficulty of Golbach and Dyson Conjectures</i>	07/2009
368	C.S. Calude and E. Calude	<i>The Complexity of the Four Colour Theorem</i>	08/2009
369	C.S. Calude and E. Calude	<i>Evaluating the Complexity of Mathematical Problems. Part 2</i>	08/2009
370	E. Calude	<i>The Complexity of Goldbach's Conjecture and Riemann's Hypothesis</i>	08/2009
371	A.A. Abbott	<i>The Deutsch-Jozsa Problem: De-quantization and Entanglement</i>	08/2009
372	C.S. Calude, M.J. Dinneen, M. Dumitrescu and K. Svozil	<i>How Random Is Quantum Randomness? (Extended Version)</i>	12/2009
373	R. Nicolescu, M.J. Dinneen and Y.-B. Kim	<i>Structured Modelling with Hyperdag P Systems: Part B</i>	10/2009
374	C.S. Calude, K. Salomaa, and T.K. Roblot	<i>Finite-State Complexity and Randomness</i>	12/2009

Educational Activities

The CDMTCS supports the following activities:

- The group of courses “[Logic and computation](#)“ leading to BA, BSc, MA, MSc degrees organized in cooperation with the departments of computer science, mathematics, philosophy and linguistics.
- The CDMTCS is the major contributor to the undergraduate core courses CompSci 220 (Algorithms and Data Structures), CompSci 225 (Discrete Structures in Mathematics and Computer Science), CompSci 350 (Mathematical Foundations of Computer Science), CompSci 314 (Data Communications Fundamentals), CompSci 320 (Applied Algorithmics), CompSci 369 (Computational Science).
- Two theoretical graduate courses CompSci 720 (Advanced Design and Analysis of Algorithms), CompSci 750 (Computational Complexity) were taught by CDMTCS staff.
- CDMTCS members spend time organizing, judging NZ and ACM programming contests.
- Michael Dinneen coached the advancing NZ.
- Prabhjot Singh Jassal is the recipient of the "[J.C. Butcher Award in Theoretical Computer Science](#)" for 2009.
- University of Auckland Team ranked 2nd (out of 700) in [IEEEExtreme 3.0 Programming Contest](#).
- Ronald Chan was the winner of the international Dyalog APL contest 2009. ([archived announcements](#)).

C. Calude

Professor Cristian S. Calude
Centre for Discrete Mathematics and Theoretical Computer Science