

CENTRE FOR DISCRETE MATHEMATICS AND THEORETICAL COMPUTER SCIENCE

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

Annual Report 2010

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 Gill Dobie (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,
- Turku Centre for Computer Science (TUCCS),
- Valparaiso Institute of Complex Systems,
- Research Reports at Martin-Luther-Universitat Halle-Wittenberg, Germany.

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 Algorithms and Optimization
- Computability and Complexity
- Unconventional Computation
- The Runge-Kutta Club
- Programming Contests

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,

Participating Members

The Centre includes the following faculty members:

Douglas S. Bridges (Mathematics, University of Canterbury),
John C. Butcher (Mathematics),
Cristian S. Calude (Computer Science),
Marston D. E. Conder (Mathematics),
Michael J. Dinneen (Computer Science),
Steven Galbraith (Mathematics),
Fred Kroon (Philosophy),
Bakh Khoussainov (Computer Science),
Radu Nicolescu (Computer Science)
Andre Nies (Computer Science),
Eamonn O'Brien (Mathematics),
Alexander Raichev (Computer Science),
Jeremy Seligman (Philosophy),
Ulrich Speidel (Computer Science),
Clark Thomborson (Computer Science),
Mark C. Wilson (Computer Science),
Xinfeng Ye (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-Universitat Halle-Wittenberg, Germany), K. Svozil (Technische Universitat, 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. Mike Stay. Higher Category Theory of Computation and some Relationships with Physics [PhD]
3. Hector Zenil. Experimental AIT [PhD]
4. Yun-Bum Kim, Membrane Computing [PhD]
5. A. Gandhi. Applications of Automatic Structures to databases [PhD]
6. T. Roblot. Finite-State Complexity and Randomness [MSc]
7. A. Abbott. Quantum Randomness [MSc]
8. A. Fenton. Meta-heuristics for FTL-pickup and delivery problem [MSc]
9. F.-T. Liou. Algorithms on Phlyogenies via Bayesian Inference [MSc]
10. Z. Huo. Real Time Entropy Estimation with Parallel Computing [MSc]
11. J. Xie. Towards real-time dynamic programming stereo matching [MSc]
12. I. Amith. Test sets and bounded treewidth automata [MSc]
13. Y. Sun. Data Classifications Using Entropy Estimations - CTW andT-entropy [MSc]
14. N. Datt. Membrane Computing [MSc]
15. G. Reihana. Arithmetic Progression Graphs [Hon]
16. A. Melnikov. Automatic Structures & Computability Theory [PhD]
17. J. Wu. Bayesian Inference of Microsatellite Models [Hon]
18. J. Heled. Modelling the Interface between Population Genetics and Phylogenetics [PhD]
19. S. Li. Comprative Genomic Approach to Detecting Selection in Genome non-coding Regions [PhD]
20. D. Kuhnert. Geo-epidemic Models of Evolving Virus Populations [PhD]
21. R. Reyhani. Social choice [PhD]
22. N. Ke. State Complexity of Determinization and Complementation for Automata [MSc]
23. M. Khosravani. Spanning Caterpillar Tree Algorithms [PhD]
24. R. Versteegen. Graph Minors and Obstructions [Hon]
25. J. Lai. Automatic Structures [PhD]
26. I. Khaliq. Games Played on Finite Graphs [PhD]

Visitors

The Centre hosted the following visitors:

- Prof. L. Staiger, Martin Luther Universitat Halle-Wittenberg, Germany
- Prof. K. Svozil, Tecnical University Vienna, Austria
- Prof. J. Case, University of Delaware, USA
- Dr. T. Forster, Cambridge University, UK
- Prof. F. Stephan, National University of Singapore, Singapore

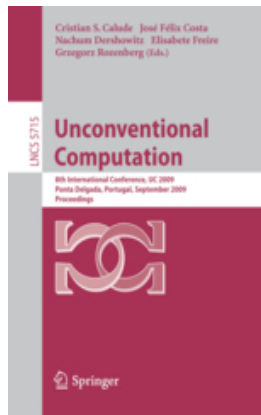
Major Activities

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 major activity of the Centre in 2010 has been the organization, in cooperation with the University of Tokyo, of the [9th International Conference Unconventional Computing UC10](#). The conference was held in Tokyo June 21-25, 2010. The volume including the proceedings of UC10 (which includes the CDMTCS logo on the cover page) has appeared as



[Calude, C.S.; Hagiya, M.; Morita, K.; Rozenberg, G.; Timmis, J. \(Eds.\)](#)
[Unconventional Computation. 9th International Conference, UC 2010, Tokyo, Japan, June 21-25, 2010, Proceedings, Lecture Notes in Computer Science, Vol. 6079.](#)

The [3rd International Workshop on Physics and Computation 2010](#) was held in Egypt from August 30 to September 6, 2010. Three special issues including a selection of the papers presented at the Workshop will be published by the journals Applied Mathematics and Computation (Elsevier), Natural Computing (Springer) and International Journal of Unconventional Computing (Old City Publ.)

A special session [Computability of the Physical](#) of CiE2010 organised by C. Calude and S. B. Cooper featured as invited speakers Seth Lloyd (MIT), Yuri Manin (Max-Planck Inst. Bonn/Northwestern), Cris Moore (Santa Fe) and David Wolpert (Intelligent Systems Div., Ames Research Centre, NASA). A special issue based on this session will be published by the journal Mathematical Structures in Computer Science in 2011.

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, International Journal of Unconventional Computing.

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 Mathematics 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 210 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 reports were published in 2010:

375	M.J. Dinneen, Y.-B. Kim and R. Nicolescu	<i>P Systems and the Byzantine Agreement</i>	01/20 10
376	M. Andreev, I. Razenshteyn and A. Shen	<i>Not Every Domain of a Plain Decompressor Contains the Domain of a Prefix-Free One</i>	02/20 10
377	Y.I. Manin	<i>Renormalization and Computation II: Time Cut-Off and the Halting Problem</i>	02/20 10
378	M.J. Dinneen, Y.-B. Kim and R. Nicolescu	<i>Synchronization in P Modules</i>	02/20 10
379	V. Putz and K. Svozil	<i>Can a Computer be “pushed” to Perform Faster-Than-Light?</i>	03/20 10
380	K. Tadaki	<i>A New Representation of Chaitin Omega Number Based on Compressible Strings</i>	04/20 10
381	A.A. Abbott and C.S. Calude	<i>Understanding the Quantum Computational Speed-up via De-quantisation</i>	04/20 10
382	C.S. Calude, M. Cavaliere and R. Mardare	<i>An Observer-Based De-Quantisation of Deutsch's Algorithm</i>	05/20 10
383	E. Calude	<i>Fermat's Last Theorem and Chaoticity</i>	06/20 10
384	C.S. Calude, E. Calude and K. Svozil	<i>The Complexity of Proving Chaoticity and the Church-Turing Thesis</i>	06/20 10
385	S. Schwarz and L. Staiger	<i>Topologies refining the CANTOR topology on X^Ω</i>	06/20 10
386	R. Polley and L. Staiger	<i>The Maximal Subword Complexity of Quasiperiodic</i>	06/20

		<i>Infinite Words</i>	10
387	A.A. Abbott	<i>De-quantisation of the Quantum Fourier Transform</i>	06/20 10
388	M.J. Dinneen, Y.-B. Kim and R. Nicolescu	<i>A Faster P Solution for the Byzantine Agreement Problem</i>	07/20 10
389	K. Tadaki	<i>Properties of Optimal Prefix-Free Machines as Instantaneous Codes</i>	07/20 10
390	B. Whitworth	<i>The Light of Existence</i>	08/20 10
391	G. Chaitin	<i>To a Mathematical Theory of Evolution and Biological Creativity</i>	09/20 10
392	A.A. Abbott and C.S. Calude	<i>Von Neumann Normalisation of a Quantum Random Number Generator</i>	10/20 10
393	C.S. Calude, M.J. Dinneen and A.M. Gardner	<i>Opening the Book of Randomness (Extended Version)</i>	10/20 10
394	M.J. Dinneen and M. Khosravani	<i>Hardness of Approximation and Integer Programming Frameworks for Searching for Caterpillar Trees</i>	11/20 10
395	M.J. Dinneen, Y.-B. Kim and R. Nicolescu	<i>Faster Synchronization in P Systems</i>	11/20 10
396	A.A. Abbott, C.S. Calude and K. Svozil	<i>A Quantum Random Number Generator Certified by Value Indefiniteness</i>	12/20 10

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 ANZAC, NZ and ACM programming contests.
- Michael Dinneen coached the 2nd place New Zealand team at the ACM South-Pacific Programming Contest 2010 .
- Anna Wu is the recipient of the [J.C. Butcher Award in Theoretical Computer Science](#) for 2010.
- University of Auckland Team ranked 2nd in international [IEEEExtreme 3.0 Programming Contest](#) for the two years in a row (2009 out of 700 teams and 2010 out of 970 teams).

International Recognition

Prof. John Butcher was elected as a [SIAM 2010 Fellow](#).

C. Calude

Professor Cristian S. Calude