



Centre for Discrete Mathematics and Theoretical Computer Science
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CDMTCS: 1998 ANNUAL REPORT

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 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.

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

- Artificial Intelligence
- Combinatorial Optimisation
- Computability and Complexity
- Constructive Algorithmics
- Quantum and Molecular Computation

The Centre is supported financially by the Departments of Computer Science and Mathematics and sponsored by *Pukekohe Travel*.

The major activity of the Centre in 1998 was the organisation of its third international conference, a joint conference, *DMTCS'99* and *CATS'99*, part of the Australasian Computer Science Week (ACSW'99); the conference was held in Auckland on 18-21 January 1999. The conference was a remarkable success, with speakers from Europe, Asia, the USA, Canada, and Australasia. The volume containing invited papers and regular contributions has appeared as: C. S. Calude, M. Dinneen (eds.). *Combinatorics, Computation, Logic, Proceedings of DMTCS'99-CATS'99*, Springer-Verlag, Singapore, 1999, 368 pp.

Director

Professor C.S. Calude (Auckland)

Deputy Director

Dr. Bakhadyr Khoussainov

Research Reports Coordinator

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, Waikato University)
- Professor Cristian Calude
- Professor Ian Collins (Auckland University Research Committee Representative)
- A/Professor Peter Gibbons, HOD, Computer Science,
- Dr. Bakhadyr Khoussainov
- Professor Ivan Reilly (Director, SMIS, University of Auckland)

Participating Members

The Centre includes the following faculty members:

P. Bonnington (Mathematics, Tamaki), D. S. Bridges (Mathematics, Waikato), C. Calude (Computer Science, Auckland), M. D. E. Conder (Mathematics, Auckland), M. J. Dinneen (Computer Science, Auckland), R. W. Doran (Computer Science, Auckland), J. Gibbons (Computer Science, Auckland), P. Gibbons (Computer Science, Auckland), H. Guesgen (Computer Science, Auckland), P. R. Hafner (Mathematics, Auckland), F. Kroon (Philosophy, Auckland) B. Khoussainov (Computer Science, Auckland), M. Lennon (Computer Science, Tamaki), M. Morton (Mathematics, Auckland), R. Nicolescu (Computer Science, Tamaki), E. O'Brien (Mathematics, Auckland), B. Pavlov (Mathematics, Auckland), I. Reilly (Mathematics, Auckland), M. Titchener (Computer Science, Tamaki), C. Thomborson (Computer Science, Auckland).

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. Casti (Santa Fé Institute, New Mexico, US, and Technische Universität, Vienna, Austria), G.J. Chaitin (IBM, New York, US), C.J. Colbourn (University of Vermont, US), E.W. Dijkstra (University of Texas, Austin, US), J.H. Dinitz (University of Vermont, US), J.A. Goguen (University of California at San Diego, US), R.L. Graham (University of California at San Diego, US), J. Hartmanis (Cornell University, US), H. Jürgensen (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 (Solvay Institute, Belgium), G. Rozenberg (Leiden University, Netherlands), A. Salomaa (University of Turku, Finland), J. Seberry (University of Wollongong, Australia), D van Dalen (University of Utrecht, Netherlands).

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. Păun (Institute of Mathematics, Romanian Academy, Romania), C.E. Praeger (University of Western Australia), K. Svozil (Technische Universität, Vienna), D. Ştefănescu (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. G. Alford (Masters student, "DNA Computation: From Turing Machines to H Systems"). [Completed in 1998].
2. A. Arslanov (PhD student, "Theoretical Computer Science"). [Completed in 1998].
3. E. Calude (PhD student, "Theoretical Aspects of Artificial Intelligence"). [Completed in 1998].
4. R. Curtis (Masters student, "Finitely-presented Groups"). [Completed in 1998].
5. L. Dediu (PhD student, "Recursive Methods in Algebra").
6. P. Dobcsanyi (PhD student, "Applications & Adaptations of the Low Index Subgroups Process").
7. C. Grozea (PhD student, "Non-Binary Codings").
8. U. Guenther (PhD student, "Robust Source Coding with Generalised T-Codes"). [Completed in 1998].
9. R. Havea (PhD student, "Constructive Operator Theory on Hilbert Space").
10. U. Loerch (PhD student, "Artificial Intelligence").
11. J. Pearson (PhD student, "Computational aspects of topological graph theory"), [completed 1998].
12. S. Todorovic-Vasiljevic (PhD student, "Bounds on the number of symmetries of a non-orientable surface of given genus").
13. J. Sneddon (PhD student).
14. C. Shu (PhD student, "Special Problems in Algorithmic Information Theory").
15. Cameron Walker (PhD student, "Vertex-transitive graphs with large vertex-stabiliser"). [completed 1998].

Post-doctoral Fellows

- R. Coles (Computer Science, Auckland)
- P. Hertling (Computer Science, Auckland)
- P. McKenna (Mathematics, Auckland)
- M. Lipponen (Computer Science, Auckland)

Visitors

The Centre hosted the following visitors in 1998:

- M. Amos, University of Liverpool, UK,
- I. Antoniou, Solvay Institute, Belgium,
- A. Camina, University of East Anglia, UK,
- B. Chor, Technion, Israel,
- R. Downey, Victoria University in Wellington, NZ,
- A. Ekert, Oxford University, UK,
- D. Flannery, University College Galway (Ireland),
- A. Gibbons, University of Liverpool, UK,
- C. Heng Li, University of Western Australia,
- H. Ishihara, JAIST, Japan,
- H. J. Kimble, Caltech, US,
- R. Liebler, University of Colorado US,
- S. Lloyd, MIT, US,
- C. Moore, Santa Fe Institute, US,
- A. Nies, University of Chicago, US,
- Gh. Păun, Institute of Mathematics, Romanian Academy,
- J. Reif, Duke University, US,
- A. Salomaa, Turku University, Finland,
- K. Svozil, Technische Universität, Vienna.

Graduate Students Sponsored by the Centre

- G. Alford
- S. Rubin

Post-Doctoral Fellows Sponsored by the Centre

- P. Hertling
- M. Lipponen

Research Grants

1. P. Bonnington and M. Morton: *Infinite Planar Graphs*, Marsden Fund, NZ\$43,200.
2. P. Bonnington: *High-performance computing in the mathematical sciences*, AURC Infrastructure Grant, NZ\$30,000.
3. C. Calude: *Physical versus computational complementarity*, AURC Grant, A18/XXXXX/62090/F3414082, NZ\$4,500.
4. C. Calude, C. Collberg, M. Dinneen, P. Fenwick, P. Gibbons, H. Guesgen, J. Hamer, J. Hosking, B. Khoussaionov, J. Lennon, R. Murgridge, P. Riddle, C. Thmborson, X. Ye: AURC Infrastructure Grant, A18/XXXXX/9343/3391207, NZ\$75,000.
5. M. Conder: *Combinatorial methods in mathematics and applications*, Marsden Fund, NZ\$315,00.
6. M. Conder, J. An, E. O'Brien: *Effective computation approaches to questions in group theory and applications*, Marsden Fund, NZ\$80,000.
7. M. Conder: *Computation approaches to questions in group theory and applications*, AURC Grant, NZ\$4,000.
8. M. Conder, S. Todorovic-Vasiljevic: *Bounds on the number of symmetries of a non-orientable surface of given genus*, Auckland University Research Committee, NZ\$1,800.
9. H. Guesgen: AURC Grant, A18/XXXXX/62090/F3414082, NZ\$6,500.
10. B. Khoussaionov: NSF Division of International Programs grant for cooperative research between USA and New Zealand, INT-9602579, 1997-2000, US\$ 30,000, for the project *Computability, Logic and Complexity*,
11. B. Khoussaionov: *Mathematics Department Grant for Visiting Scholars*, University of Wisconsin (Madison), US.
12. B. Khoussaionov: *Travel Grant of the Center for Foundations of Intellegent Systems*, Cornell University, US.

Financial Statement

Pukekohe Travel's contribution for 1998 (\$ 5,000) has been transferred to us.

A financial statement is attached.

Workshops/Conferences Organised by the Centre

- The Second Japan-New Zealand Workshop "Logic in Computer Science" (Auckland, October, 1998); abstracts of talks have appeared as special research report of the CDMTCS.
- The International Conference "DMTCS'99-CATS'99" (Auckland, January, 1999); the volume of proceedings has appeared in the DMTCS Series of Springer Verlag.

Affiliations

- Logic Group at JAIST,
- Mindship International,
- Turku Centre for Computer Science (TUCS).

Publications and Technical Reports

The CDMTCS is editing Springer-Verlag Books Series *Discrete Mathematics and Theoretical Computer Science* and cooperates with Graz University of Technology and Turku University in editing Springer-Verlag *Journal of Universal Computer Science*.

DMTCS Book Series with Springer

1. C.S. Calude, J. Casti, M.J. Dinneen (eds.). *Unconventional Models of Computation*, Springer-Verlag, Singapore, 1998.
2. K. Svozil. *Quantum Logic*, Springer-Verlag, Singapore, 1998.
3. C. S. Calude (ed.). *People and Ideas in Theoretical Computer Science*, Springer-Verlag, Singapore, 1998.
4. J. Grundy, M. Schwenke, T. Vickers (ed.). *Proceedings of the International Refinement Workshop and Formal Methods Pacific'98*, Springer-Verlag, Singapore, 1998.
5. G. Păun (ed.). *Computing with Biomolecules. Theory and Experiments*, Springer-Verlag, Singapore, 1998.
6. C. S. Calude, M. Dinneen (eds.). *Combinatorics, Computation, Logic, Proceedings of DMTCS'99-CATS'99*, Springer-Verlag, Singapore, 1999, 368 pp.
7. M. Mignotte, D. Ștefănescu. *Polynomials. An Algorithmic Approach*, Springer-Verlag, Singapore, 1999.

Journal Special Issues

1. C. Calude, H. Maurer, A. Salomaa (eds.), *J.UCS—The Journal of Universal Computer Science*, Vol. 2–1996, Springer, Berlin, 1998, 860 pp.
2. C. Calude, H. Maurer, A. Salomaa (eds.), *J.UCS—The Journal of Universal Computer Science*, Vol. 3–1998, Springer, Berlin, 1998, 1417 pp.
3. C. S. Calude, J. L. Casti (eds.). *Unconventional Models of Computation, Complexity*, Vol. 4, 1, (1998), 13-42. (special issue)

Research Papers

More than 160 research papers have been published by faculty members, graduate students and post-doctoral fellows.

CDMTCS Research Reports

81. A. Arslanov. On Hypersimple Sets and Chaitin Complexity.
82. M.J. Dinneen. Group-Theoretic Methods for Designing Networks.
83. C.S. Calude, E. Calude and C. Stefanescu. Computational Complementarity for Mealy Automata.
84. C.S. Calude and M.J. Dinneen. Breaking the Turing Barrier.
85. P.C. Denny. Search and Enumeration Techniques for Incidence Structures.
86. C.S. Calude, W. Merkle and Y. Wang. A Note on Pseudorandom Generators.
87. H. Ishihara, B. Khossainov and A. Nerode. Computable Kripke Models and Intermediate Logics.
88. L. Staiger. The Hausdorff Measure of Regular Omega-Languages is Computable.
89. F.W. Meyerstein. Is Movement An Illusion? Zeno's Paradox From a Modern Viewpoint.
90. C.S. Calude, R. Coles, P.H. Hertling and B. Khossainov. Degree-Theoretic Aspects of Computably Enumerable Reals.
91. M.J. Dinneen (editor). Abstracts of the 2nd Japan - New Zealand Workshop on Logic in Computer Science.
92. C.S. Calude and E. Calude. Bisimulations and Behaviour of Nondeterministic Automata.

- 93. C.S. Calude. A Glimpse into Algorithmic Information Theory.
- 94. C.S. Calude and R. Coles. On a Theorem of Solovay.
- 95. C.S. Calude. A Characterization of C.E. Random Reals.

Honours

- 1. The CDMTCS was cited in the MORST Report *Mathematics in New Zealand: Past, Present and Future*, July 1998; see <http://www.mcs.vuw.ac.nz/edith/front.html>.
- 2. The CDMTCS is listed as a major research group by *The World Combinatorics Exchange*; see <http://www.combinatorics.org/People/index.html>.
- 3. C. S. Calude was elected Associate Member of the International Solvay Institutes, Brussels Free University, Brussels, Belgium.
- 4. C. S. Calude has been elected to Editorial Board of *Romanian Journal of Information Science and Technology*.
- 5. M. Conder has been elected to Fellowship of the *Royal Society of NZ*.

C. Calude

Professor Cristian S. Calude

Centre for Discrete Mathematics and Theoretical Computer Science

Financial Statement for 1998

Income	Carry on from 1997 Auckland, Computer Science Department Auckland Mathematics Department SMIS Grant Total income:	\$24,000 \$15,000 \$3,000 \$2,500 \$45,500
Expenditure	Communication Travel and accommodation visitors (in cluding UMC'99) Sundry expenses Total expenditure	\$895.73 \$ 15,307.5 \$6,029.55 \$22,438.61
Surplus		\$ 22,061.39