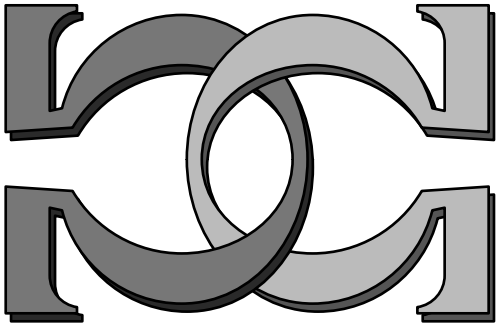

Centre for Discrete Mathematics and Theoretical Computer Science
Computer Science Department, The University of Auckland
Private Bag 92019, Auckland, New Zealand
Phone: +64-9-373-7599, Fax: +64-9-373-7453
http://www.cs.auckland.ac.nz/CDMTCS/

CDMTCS: 2002 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 2002 was the organisation of the Third International Conference on "Unconventional Models of Computation (UMC'02)" at Kobe, Japan from October 15 to October 19, 2002. It was organized jointly by the CDMTCS and the Kansai Advanced Research Center of the Communications Research Laboratory. The volume containing invited papers and regular contributions has appeared as C.S. Calude, M. J. Dinneen, F. Peper (eds.). *Unconventional Models of Computation (UMC'02)*, Lecture Notes Comput. Sci. 2509, Springer Verlag, Heidelberg, 2002, 338 pp. Other contributions to UMC'02 have been published in C.S. Calude, M.J. Dinneen and F. Peper (eds.). Supplemental Papers for the 3nd Unconventional Models of Computation Conference, *CDMTCS Research Report* 195, 2002, 5 pp. The web-site of the Conference is `http://www.cs.auckland.ac.nz/CDMTCS/conferences/umc02/`.

Director

Professor C.S. Calude (Auckland)

Deputy Director

Dr. Michael J. Dinneen

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, Canterbury University),
- Professor Cristian Calude (Director),
- Dr. Michael J. Dinneen (Deputy Director),
- Professor David Gauld (HOD Mathematics Department),
- Professor John Hosking (HOD, Computer Science).

Participating Members

The Centre includes the following faculty members:

> C. P. Bonnington (Mathematics, Auckland), D. S. Bridges (Mathematics, Canterbury), C. Calude (Computer Science, Auckland), M. D. E. Conder (Mathematics, Auckland), M. J. Dinneen (Computer Science, Auckland), R. W. Doran (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), R. Nicolescu (Computer Science, Tamaki), A. Nies (Computer Science, Auckland), E. O'Brien (Mathematics, Auckland), B. Pavlov (Mathematics, Auckland), I. Reilly (Mathematics, Auckland), U. Speidel (Computer Science, Tamaki), M. Titchener (Computer Science, Tamaki), C. Thomborson (Computer Science, Auckland), M.C. Wilson (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), 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 (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), L. Staiger (Martin-Luther-Universität Halle-Wittenberg, Germany), 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. Joshua Arulanandham, Natural Algorithms [PhD]
2. Gary Cleveland, Multi-Agent Systems [Phd]
3. Myra Cohen, A combinatorial Design Platform for Automating Software Test Coverage, [PhD]
4. S. Dragomir, A User Friendly Version of An Interpreter for Register Machine Programs, [Masters]
5. Li Fajie, Computer Search for Queens Domination Numbers on the Torus [Graduate Project]
6. Matthew Goode, Computational Aspects of Phylogenetics, [PhD]
7. Cristian Grozea, Non-Binary Codings [Phd]
8. Jeong Seon Koo, A Decision Support System for Air Pollution Health Risk Analysis [PhD]
9. Byung-Doo Lee, A Heuristic Life-and-Death Problem Solver for the Game of Go [Phd]
10. Yang Jia, Similarity Measures [PhD]
11. Ute Loerch, Intelligent Question Answering in an Internet-Based Remote Learning Environment [Phd]
12. Andrew Luxton, Cognitive Maps for Exploration [PhD]
13. Sikimeti Mau, Directed Graph Embeddings [Masters]
14. Paul Reedy, DNA Computation: Gene Networks and DNA Computers [Masters]
15. Sasha Rubin, Finite Automata and Algebraic Structures [Phd]
16. Chi-Kou Shu, Computing Exact Approximations of a Chaitin Omega Number [Phd]
17. Jamie Sneddon, Structural Graph Theory [PhD]
18. Luminiţa Viţă, Recursive-Theoretical Methods in Algebra [PhD, completed 2002]
19. Anna Torstensson, Maximal Symmetry Groups of Hyperbolic 3-manifolds [PhD]
20. Alfred (Nian) Zhu, Directed Broadcast Networks [Masters]
21. Ming Li, Distributed Graph Algorithm Platform [Masters]

Visitors

The Centre hosted the following visitors:

- Prof. G.J. Chaitin, IBM T.J. Watson Research Center, New York, USA
- Dr. V. Brattka, Open University, Hagen, Germany
- Prof. R. Downey , Victoria University of Wellington, NZ
- Prof. H. Maurer, Technical University of Graz, Austria
- Prof. J. Casti, Santa Fe Institute, USA
- Dr. L. Vâţă, Christchurch University, NZ
- Prof. C. Thomassen, Denmark Technical University, Denmark
- Prof. N. Hartsfield, Washington State University, USA
- Prof. J. Siran, Slovak Technical University, Slovakia
- Prof. N. Robertson, Ohio State University, USA
- Dr. J. Geelen, Waterloo University, Canada
- Prof. V. Uspensky, Moscow University, Russia
- Prof. Michel Chein, CNRS & University of Montpellier II Montpellier, France
- Assoc. Prof. Marie-laure Mugnier, CNRS & University of Montpellier II Montpellier, France
- Dr. Richard Dearden, NASA Ames Research Center Moffett Field, California, USA
- Prof. Michael Fellows, University of Newcastle, Australia
- Prof. Franz J. Brandenburg, Universitat Passau, Germany
- Prof. Charles Colbourn, Arizona State University, USA
- J. Walsh, Armstrong University, USA
- Jane He, Zhejang University City College, China

Research Grants

1. Paul Bonnington, M. Morton, Dr R. Aldred, Marsden Fund Grant continued,
2. C. S. Calude, H. Carmichael, B. Pavlov, The Vice-Chancellor's University Development Fund 23124
3. Marston Conder, Jianbei An & Eamonn O'Brien Marsden Fund Grant, continued.
4. Hans Guesgen, Mike Barley, Ute Loerch, Pat Riddle, Intelligent Agents for the Robocup Rescue Simulation Project, University of Auckland Research Committee
5. Bakh Koussainov, Marsden Fund Grant, continued. Japan Society for Promotion of Science and Humbolt Foundation fellowships.
6. Vaughan Jones, Marston Conder, Rod Downey, David Gauld, Gaven Martin, Marsden Fund Grant, continued.
7. M.C. Wilson, Automated Analysis of Multivariate Generating Functions, UoA New Staff Research Fund.

Workshops/Conferences Co-Organised by the Centre

- Third International Conference on "Unconventional Models of Computation (UMC'02)" at Kobe, Japan from October 15 to October 19, 2002.

Workshops/Conferences Organised by Members of the CDMTCS

- C. Calude has co-organized the section dedicated to applications to computer science of the *17th "Summer" Topology Conference*, Auckland University, 1-4 July, 2002.
- Hans Guesgen: co-chair of the *2002 AAAI Spring Symposium on Safe Learning Agents*, the Special Track on *Spatio-Temporal Reasoning at FLAIRS-02*, and *ECAI-02 and AAAI-02 Workshops on Spatial and Temporal Reasoning*.

Programme Committee

- Cristian Calude: *DLT'02*, Kyoto, Japan, *DCFS'02*, London, Ontario, Canada, *Quantum Computation and Learning*, Riga, Latvia, 2002.
- Marston Conder, *Discrete Groups and Surfaces*, Banach Center Conference on Conformal Geometry, 2003.
- Peter Gibbons: *COMBINATORICS 2003*
- Hans Guesgen: *AI-02, FLAIRS-02, IEA/AIE-02, PRICAI-02, AWCL-02*.

Conference Invited Talks

- C. Calude, "NZ Mathematical Colloquium" (Auckland, December 2002) (invited lecture).
- C. Calude, "Quantum Structures 2002", (Vienna, Austria, July 2002) (invited lecture).
- Marston Conder, "Symmetries of Graphs, Maps & Complexes, II", (Aveiro, Portugal, July 2002) (invited plenary lecture).
- Marston Conder, "AMS Summer Conference on Groups, Representations & Cohomology", (Sth Hadley (MA), USA, June 2002) (invited lecture).

Affiliations

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

Programming Contests

The centre's staff supports both the NZ and ACM local programming contests.

The University of Auckland (coach Michael Dinneen) team "Void" (Tom Leys, Tim Sutherland, Chris Wilson), who were the top New Zealand team at the ACM South-Pacific Contest (Sept 2002), will represent New Zealand in the World Finals in (March 2003). Several of our other teams did very well – see `http://www.sppcontest.org/`.

Radu Nicolescu is currently the head judge for the Australasian South-Pacific Region, while Michael Dinneen is in charge of the Judging Systems for the region.

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*. Members of the CDMTCS are members of the editorial boards of the following journals: *N.Z. Journal of Mathematics, International Journal of Applied Intelligence, Pattern Analysis and Applications Journal, Australasian Journal of Combinatorics, Philosophia Mathematica, Analele Universităţii Bucureşti, Matematică-Informatică, Journal of Computing and Information, Grammars, Fundamenta Informaticae, Romanian Journal of Information Science and Technology*. Special Issues of the *International Journal on Applied Intelligence, Journal of Universal Computer Science* have been edited.

DMTCS Book Series with Springer

1. J. Kohlas. *Information Algebras: Generic Structures for Inference*, Springer-Verlag, London, 2003.

Research Papers

More than 164 research papers have been published by faculty members and graduate students.

CDMTCS Research Reports

171. J.J. Arulanandham, C.S. Calude and M.J. Dinneen. Bead–Sort: A Natural Sorting Algorithm. 01/2002

172. H. Ishihara, B. Khoussainov and S. Rubin. On Isomorphism Invariants of Some Automatic Structures. 01/2002

173. R.G. Downey. Some Computability-Theoretical Aspects of Reals and Randomness. 01/2002

174. B. Khoussainov. Games Played on Finite Graphs and Temporal Logic. 01/2002

175. L. Staiger. How Large is the Set of Disjunctive Sequences? 01/2002

176. S.S. Goncharov and B. Khoussainov. On Complexity of Computable $\aleph_1$–Categorical Models. 01/2002

177. I. Tomescu. On the Number of Occurrences of All Short Factors in Almost All Words. 02/2002

178. H. Ishihara and B. Khoussainov. Complexity of Some Infinite Games Played on Finite Graphs. 02/2002

179. K. Svozil. Logical Equivalence Between Generalized Urn Models and Finite Automata. 02/2002

180. C.S. Calude, E. Calude and S. Marcus. Passages of Proof. 02/2002

181. B. Khoussainov and T. Kowalski. Computable Isomorphism of Boolean Algebras with Operators. 03/2002

182. G.J. Chaitin. Meta-Mathematics and the Foundations of Mathematics. 05/2002

183. K. Svozil. What Could be More Practical than a Good Interpretation? 05/2002

184. K. Svozil. N-ary Quantum Information Defined by State Partitions. 05/2002

185. B. Khoussainov and S. Rubin . Some Thoughts on Automatic Structures. 05/2002

186. J.J. Arulanandham. Implementing Bead–Sort with P-systems. 05/2002

187. V. Becher and G.J. Chaitin. Another Example of Higher Order Randomness. 05/2002

188. G.J. Chaitin. Paradoxes of Randomness. 05/2002

189. B. Khoussainov. Finite State Strategies in One Player McNaughton Games. 05/2002

190. S.S. Goncharov and B. Khoussainov. Complexity of Computable Models. 05/2002

191. L. Staiger and H. Yamasaki. A Simple Example of an ω-language Topologically Ine- quivalent to a Regular One. 07/2002

192. L. Staiger. The Entropy of Lukasiewicz Languages. 08/2002

193. N. Zhou. The Broadcasting Problem For Bounded-Degree Directed Networks. 09/2002

194. M. Ohya and I.V. Volovich. A New Quantum Algorithm for NP-complete Problems, 09/2002

195. C.S. Calude, M.J. Dinneen and F. Peper (editors). Supplemental Papers for the 3nd Unconventional Models of Computation Conference, 10/2002

196. L. Staiger. Weighted Finite Automata and Metrics in Cantor Space, 10/2002

197. C.S. Calude, S. Marcus and L. Staiger. A Topological Characterization of Random Sequences, 10/2002

198. V.A. Adamyan, C.S. Calude and B.S. Pavlov. A Quantum Scattering Approach to Undecidable Problems: Preliminary Version, 10/2002

199. J.J. Arulanandham, C.S. Calude and M.J. Dinneen. Solving SAT with Bilateral Computing, 12/2002

200. G. Kapoulas. Infinitesimals Via the Cofinite Filter, 12/2002

201. A. Nies. Lowness Properties of Reals and Randomness, 12/2002

202. A. Nies. Reals which Compute Little, 12/2002

203. J. Yang and U. Guenther. An Improved T–Decomposition Algorithm, 12/2002

204. U. Guenther. An Entropy Measure for Finite Strings based on the Shannon Entropy of a Code Set, 12/2002

205. J. Walsh and M.J. Dinneen. Checking for Substructures in Graphs of Bounded Pathwidth and Treewidth, 12/2002

Honours

1. B. Khoussainov has been awarded the NZMS Research Award for 2002.

Professor Cristian S. Calude