THE UNIVERSITY OF AUCKLAND
NEW ZEALAND

RESEARCH UNITS, CENTRES AND INSTITUTES

Annual Report 2011

Section 1a - IDENTIFICATION INFORMATION:

Title of Unit, Centre or Institute	Centre for Discrete Mathematics and Theoretical Computer Science
Name of Director	Prof. CS Calude
Name of Deputy Director	Dr. MJ Dinneen

Section 1b – ENDORSEMENT OF REPORT:

Signatures:	*Please sign in appropriate space below*
Director (Required for all Units/Centres/Institutes)	C. Calude
Head of Department (Required only for Department Units/Centres)	G. C Dobbie
Dean (Required for Faculty/University Centres/Institutes)	

Section 2 – ADVISORY BOARDS AND MEETING DATES:

Management Committee

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

International Advisory Board

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).

Section 3 – PARTICIPATING MEMBERS AND EMPLOYEES /STUDENTS:

Participating departments

Computer Science, Mathematics, Philosophy

Staff

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

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 (FernUniversitat 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

Nicholas J. Hay, Mike Stay, Hector Zenil, Yun-Bum Kim, A. Gandhi, T. Roblot, A. Abbott, A. Fenton, F.-T. Liou, Z. Huo, Xie, Kui Wei, Y. Sun, N. Datt, G. Reihana, A. Melnikov., J. Wu. J. Heled,, S. Li, D. Kuhnert, R. Reyhani, N. Ke, M. Khosravani, R. Versteegen, J. Lai, I. Khaliq, Andrew Probert, Ralph Versteegen, Jesse Kershaw.

International Affiliations

- Logic Group at JAIST,
- Turku Centre for Computer Science (TUCS),
- Valparaiso Institute of Complex Systems,
- Research Reports at Martin-Luther-Universitat Halle-Wittenberg, Germany.

Section 4 – 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.

Section 5 – AIMS, GOALS AND FUTURE PLANS:

a. General Aims:

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

b. Goals for Reporting Year:

- 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 international conferences, workshops and seminars.

c. Plans for Upcoming Year:

To continue the achievement of the goals for the reporting year.

Section 6 – MAJOR ACHIEVEMENTS AND OTHER NOTABLE 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 10th International Conference on Unconventional Computation (UC 2011) took place in Turku, Finland, on June 6-10, 2011. It was organized by the FUNDIM laboratory of the Mathematics Department, University of Turku and the CDMTCS, under the auspices of EATCS and Academia Europaea. The proceedings was published as:

C. S. Calude, J. Kari, I. Petre, G. Rozenberg (eds.). Proc. 10th International Conference Unconventional Computation, Lecture Notes Comput. Sci. 6714, Springer, Heidelberg, 2011, 247 pp, SpringerLink.

The **4th Workshop on Physics and Computation** and the **4th Workshop on Hypercomputation** were held in Turku, Finland June 6-10, 2011 in conjunction with UC'11.

The **Workshop Analysis and Randomness in Auckland** was held in December 12-13.

The Centre runs "J. C. Butcher Numerical Analysis" Workshop.

International Programming Contest

CDMTSC staff helped organize serveral programming contests. The ANZAC league of six rounds was offered during the first part of the year. Michael Dinneen prepared the problem set for the 2nd round and had about 5 regular competing teams throughout.

Radu Nicolescu organized an Auckland Site for the New Zealand Programming Contest. We had a few strong teams with the Intermediate category winners (University of Auckland team Rexes : **Felix Fei Mann, Roy Lin** and **Kwun Hung Cheung**). Unfortunately the University of Canterbury took the Junior and Tertiary Open categories.

For the main ACM South-Pacific Regional Contest we again took the Auckland Site with repeat winners for the Auckland Site (7th in region)--- **Ronald Chan, Tapio Saarinen** and **Ralph Versteegen.** Michael Dinneen acted as coach and site judge (and assisted in the problem set preparation). The regional representatives to the ACM Finals will be by teams from the University of New South Wales and University of Canterbury.

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 Com¬puter 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).

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 actively participate in organizing, judging ANZAC, NZ and ACM programming contests.
- **Miranda Jane Emery** is recipient of the **J.C. Butcher Award in Theoretical Computer Science** for 2011.

International Activities

The members of the CDMTCS have been actively involved in more than 30 Program Committees for international conferences and workshops, in the activity of the Informatics Section of the Academia Europaea and in the ICT, Call : FP7-ICT-2011-8 (Brussels).

Section 7 – Reviews

a. Date of last review:
b. Review Recommendations:

No review in 2011.

Section 8 – FINANCIAL REPORT

See attached.

Section 9 – RESEARCH OUTPUTS

More than 180 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 2011:

397	G.J. Chaitin	A Mathematical Theory of Evolution and Biological Creativity	01/2011
398	Y. Bugeaud	Continued Fractions of Transcendental Numbers	02/2011
399	R. Nicolescu and H. Wu	BFS Solution for Disjoint Paths in P Systems	03/2011
400	A. Akhtarzada, C. S. Calude and J. Hosking	A Multi-Criteria Metric Algorithm for Recommender Systems	04/2011

401	G. Gimel'farb, R. Nicolescu and S. Ragavan	P Systems in Stereo Matching (extended version)	04/2011
402	L. Staiger	Constructive Dimension and Hausdorff Dimension: The Case of Exact Dimension	04/2011
403	U. Speidel	A Forward-Parsing Randomness Test Based on the Expected Codeword Length of T-codes	05/2011
404	M.J. Dinneen, Y.-B. Kim and R. Nicolescu	An Adaptive Algorithm for P System Synchronization	05/2011
405	A.A. Abbott, M. Bechmann, C.S. Calude, and A. Sebald	A Nuclear Magnetic Resonance Implementation of a Classical Deutsch-Jozsa Algorithm	05/2011
406	K. Tadaki	A Computational Complexity-Theoretic Elaboration of Weak Truth-Table Reducibility	07/2011
407	K. Svozil	Neutrino Dispersion Relation Changes Due to Radiative Corrections as the Origin of Faster-than-Light-in-Vacuum Propagation in a Medium	09/2011
408	A.A. Abbott, C.S. Calude and K. Svozil	On Demons and Oracles	11/2011
409	C.S. Calude and E. Calude	The Complexity of Euler's Integer Partition Theorem	11/2011
410	C.S. Calude and E. Calude	The Complexity of Mathematical Problems: An Overview of Results and Open Problems	11/2011
411	L. Staiger	On Oscillation-free Chaitin h-random Sequences	11/2011
412	L. Staiger	Asymptotic Subword Complexity	11/2011
413	D.H. Bailey, J.M. Borwein, C.S. Calude, M.J. Dinneen, M. Dumitrescu and A. Yee	An Empirical Approach to the Normality of π	11/2011
414	S. Datt and M.J. Dinneen	Towards Practical P Systems: Discovery Algorithms	12/2011
415	R. Nicolescu	Parallel and Distributed Algorithms in P Systems	12/2011
416	M. Burgin, C.S. Calude and E. Calude	Inductive Complexity Measures for Mathematical Problems	12/2011