THE UNIVERSITY OF AUCKLAND
NEW ZEALAND

RESEARCH UNITS, CENTRES AND INSTITUTES

Annual Report 2012

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)	*[signature]*
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 Robert Amor (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

1. Douglas S. Bridges (Mathematics, University of Canterbury)
2. John C. Butcher (Mathematics)
3. Cristian S. Calude (Computer Science)
4. Marston D. E. Conder (Mathematics)
5. Michael J. Dinneen (Computer Science)
6. Steven Galbraith (Mathematics)
7. Fred Kroon (Philosophy)
8. Bakh Khoussainov (Computer Science)
9. Sebastian Link (Computer Science)
10. Radu Nicolescu (Computer Science)
11. Andre Nies (Computer Science)
12. Eamonn O'Brien (Mathematics)
13. Alexander Raichev (Computer Science)
14. Jeremy Seligman (Philosophy)
15. Ulrich Speidel (Computer Science)
16. Jing Sun (Computer Science)
17. Clark Thomborson (Computer Science)
18. David Welch (Computer Science)
19. Mark C. Wilson (Computer Science)
20. 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

Known CS: M. Stay, Y-B. Kim, A. Gandhi, T. Roblat, A. Abbot, Kui Wei, A. Melnikov, R. Reyhani, R. Versteegen, A. Probert, N. Amarasinghe, D. Bertinshaw, E. Cocker, M. Memari, H. Wu, M. Kohko, G. Haokun, Y. Chen, R. Wang

International students in residence

M. S. Queen (Darthmouth College, USA).

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:

1. Increase the activity of CDMTCS staff and their students in giving seminars and adding high quality research reports.

2. Encourage interdisciplinary research within the CDMTCS.
3. Reclaim UOA position as top NZ programming and problem solver in the regional programming contests.
4. Increase the number of the number of international post-graduate students in residence at the CDMTCS.

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 11th International Conference on Unconventional Computation (UCNC 2012) was held at the University of Orléans (France), 3–7 September 2012. It was organized by the LIFO laboratory University of Orléans and the CDMTCS, under the auspices of EATCS and Academia Europaea. The proceedings was published as:

Durand-Lose, Jerome; Jonoska, Natasa (Eds.). *Proc. 11th International Conference Unconventional Computation and Natural Computation*, Lecture Notes Comput. Sci. 7445, Springer, Heidelberg, 2012, Springer Link.

CDMTCS member Marston Conder has been appointed Distinguished Professor in 2012.

The CDMTCS has started in 2008 the series of workshops on Physics and Computation. The 5th Workshop on Physics and Computation was organised at Swansea University, UK, 29-31 August 2012.

The **Workshop on Theoretical Computer Science** dedicated to C. S. Calude's 60th birthday was held in December 12-13 . The volume Dinneen, Michael J.; Khoussainov, Bakhadyr; Nies, P. Andre (Eds.). *Computation, Physics and Beyond*, Lecture Notes Comput. Sci. 7160, Springer, Heidelberg, 2012, XIII, 427 p. 64 illus., Springer Link, was published in the prestigious LNCS Festschrifts Series of Springer.

Gibbons Memorial Lecture Series 2012 have been organised in cooperation with CDMTCS.

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

International Programming Contest

CDMTSC members have been involved in the organisation of several programming contests. The ANZAC league of six rounds was offered during the first part of the year. Dr. Michael Dinneen prepared the problem set for the 3nd round and had several regular competing teams throughout. Our top five UA teams were (Scott Goodhew, Boshen Chen, Khan Ho), (Ronald Chan, Hengjie Wang, Bryan Chen), (Timothy Resnick, Daniel Resnick, Miranda Emery), (Nick Stones-Havas, Mary Gao, Kris Pritchard), and (Mark Tooley, Ho Yeung Chin, Vong Vithyea Srey)
In addition to coaching, Dr. Michael Dinneen also organised an Auckland Site for the New Zealand Programming Contest and was the Auckland regional head judge for the ACM South-Pacific Regional

Contest, Sept 15. He also participated in the Regional ACM-South Pacific Directors Meeting, Brisbane Australia, Dec 7-8.

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).

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). **In 2012 new course COMPSci 301 (Philosophy of Computation) taught by CDMTCS staff was introduced.**
- 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.
- **Lee Penkman** is recipient of the **J. C. Butcher Award in Theoretical Computer Science** for 2012.

International Activities

The members of the CDMTCS have been actively involved in more than 35 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-2012 (Brussels).

Section 7 – Reviews
    a. **Date of last review:**
    b. **Review Recommendations:**

No review in 2012.

Section 8 – RESEARCH OUTPUTS

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 2012:

417	R. Nicolescu and H. Wu	New Solutions for Disjoint Paths in P Systems	03/2012
418	J. Hertel	Inductive Complexity of Goodstein's Theorem	04/2012
419	L. Staiger	A Correspondence Principle for Exact Constructive Dimension	04/2012
420	M. McKubre-Jordens and R. Sainudiin (eds.)	Construmath South 2012	04/2012
421	A. Raichev	Leinartas's Partial Fraction Decomposition	06/2012
422	A.A. Abbott, C.S. Calude, J. Conder and K. Svozil	Kochen-Specker Theorem Revisited and Strong Incomputability of Quantum Randomness	07/2012
423	M.J. Dinneen and Y.-B. Kim	A New Universality Result on P Systems	07/2012
424	M.J. Dinneen and K. Wei	On the Analysis of a (1+1) Self-Adjusting Memetic Algorithm	08/2012
425	S. Hartmann and S. Link	The Implication Problem of Data Dependencies over SQL Table Definitions: Axiomatic, Algorithmic and Logical Characterizations	10/2012
426	M. Kirchberg, S. Hartmann and S. Link	Design by Example for SQL Table Definitions with Functional Dependencies	10/2012
427	F. Ferrarotti, S. Hartmann and S. Link	Efficiency Frontiers of XML Cardinality Constraints	10/2012
428	S. Link	Sound Approximate Reasoning about Saturated Conditional Probabilistic Independence under Controlled Uncertainty	10/2012
429	C.S. Calude, E. Calude and M.S. Queen	Inductive Complexity of the P Versus NP Problem	10/2012
430	M.J. Dinneen and R. Versteegen	Obstructions for the Graphs of Vertex Cover Seven	12/2012
4	H. ElGindy, R.	Fast Distributed DFS Solutions for Edge-disjoint Paths	03/2

3 1	Nicolescu and H. Wu	in Digraphs	012