

February 7, 2007

Report on the Research Sabbatical Leave July–December 2006

My sabbatical goals were a) to visit various colleagues to continue our joint research or to initiate new co-operations in algorithmic information theory and quantum computing, b) to attend a couple of international conferences (where I presented invited lectures), c) to support the major CDMTCS international conference *Unconventional Computing* (held in York, UK, in 2006), and d) to promote our PhD programme and to recruit good PhD candidates.

Main Activities

0. 25 May - 5 June 2006: Switzerland and Turkey

- Incompleteness, Uncertainty and Complexity, *Turing's Day 2006*, Istanbul Bilgi University, Turkey, May 2006 (invited)
- Condensed graduate course: *Algorithmic Information Theory: A Personal Perspective*, Istanbul Bilgi University, Turkey
- Algorithmic Information Theory, *Workshop on Information Theories*, Münchenwiler, Switzerland, May 2006 (invited)

1. 1 July 15 August: Auckland

- Work with Greg Chaitin (IBM New York) in Auckland on the physical nature of mathematics
- Work with Michael Dinneen on computing the values of the halting probability of a compact universal prefix-free machine
- Finished the joint paper (with Mike Stay) “Natural halting probabili-

ties, partial randomness, and Zeta functions”, accepted by *Information and Computation*

- Work with Mike Stay (UC Riverside) on the de-quantisation of the halting problem
- Work on de-quantisation of the quantum algorithm for Deutsch’s problem
- Started the project of the book “Complexity & Randomness, from Leibniz to Chaitin” contracted to be published in 2007 by World Scientific (Singapore). The book includes contributions by more than 30 researchers around the world, including M. Davis (Courant Institute), A. Salomaa (Turku), G. Rozenberg (Leiden), S. Marcus (Romanian Academy), T. Slaman (Berkeley), P. Davies (Macquarie), S. Wolfram (Wolfram), etc.

2. 15 - 19 August: Hong Kong

On my way to Europe I had a brief stop at Hong Kong University of Science and Technology to talk to Prof. Cunsheng Ding problems of complexity and security. PR activities to promote our department for PhD recruitment

3. 20-29 August: Bucharest

- Work with Acad. S. Marcus on the physical nature of mathematics
- PR activities to promote our department for PhD recruitment

4. 1 - 12 September: UK

- Attended the conference *Unconventional Computing*, York
- UC’06 Invited Tutorial: *Computing with Randomness*
- Attended the Steering Committee for UC meeting
- Work on preparing UC’07 to be held at Queens University, Canada
- Finalised Research Grant Proposal (joint work with two teams from the Universities of Essex and Birmingham) submitted to EPSRC (UK)

5. 13 - 17 September: Paris

- Invited talk at ‘Le Séminaire Complexité’ (organised by Hervé Zwirn) at IHPST (Sorbonne, Paris): *Natural Complexity, Partial Randomness and Zeta Functions*
- Discussions Prof. Jean-Paul Delahaye on Deutsch’s algorithm.
- Work with Prof. Serge Grigorieff, University Paris 7 on randomness and zeta functions

6. 18 - 20 September: Spain

Work with Dr. G. Păun on the special issue of the journal *Natural Computing*

dedicated to a selection of papers presented at the conference *Unconventional Computing*, York, 2006

7. 21 September - 3 October: Slovakia and Czech Republic

- Visited the Quantum Laboratory, Slovak Academy of Science, Bratislava, lead by Prof. V. Bužek. Possible future co-operation
- Talk: *An Exercise in De-Quantisation*, Slovak Academy of Science, Bratislava
- Work with Prof. J. Gruska, Masaryk University, Brno.
- Pilgrimage to Gödel's house in Brno
- Colloquium talk, Masaryk University, Brno, Czech Republik: *What Is the Halting Problem?*

8. 3 - 15 October: Vienna

- Co-operation with Prof. John Casti on a project to be submitted to AgrResearch (Hamilton)
- Visited the Institute for Theoretical Physics, Technical University of Vienna. Work with Prof. K. Svozil on quantum randomness
- Inaugural lecture "Algorithmic Randomness and Quantum Randomness" to the stage-3 course *Statistical Mechanics II*

9. 15 - 30 October: Halle and Potsdam

- Work with Prof. L. Staiger on universal c.e. prefix codes
- Colloquium talk, Martin-Luther-Universität Halle-Wittenberg, Germany: *What Is the Halting Problem?*
- Work with Prof. H. Jürgensen on a special issue of the journal *Fundamenta Informaticae* dedicated to algorithmic complexity (to appear in 2008)
- Work with Prof. H. Jürgensen and Prof. L. Staiger on topologies on finite and infinite sequences
- Talk at the Institut für Informatik, Universität Potsdam: *Natural Complexity, Partial Randomness and Zeta Functions*

10. 30 October - 4 November: Italy

- Talk at University of Bologna: *Computation, Randomness and Beyond*

11. 4 - 15 November: Heidelberg

- Talk at Heidelberg University: *A New Probabilistic Approach to the Halting Problem*
- Work with Prof. K. Ambos-Spies and Dr. Wolfgang Merkle on univer-

sal c.e. prefix codes (continuation of the work done in Halle)

12 17 November - 17 December: Auckland

- Writing parts of the joint papers started in Germany
- Finishing the special issue of NACO for UC'06

Conferences

1. *Turing's Day 2006*, Istanbul Bilgi University, Turkey.
2. *Workshop on Information Theories*, Münchenwiler, Switzerland.
3. *Unconventional Computation 2006*, York, UK.

Publications

I. Papers in Refereed Journals

1. C. S. Calude, M. A. Stay. Most programs stop quickly or never halt, *Adv. Appl. Math.*, accepted.
2. C. S. Calude, M. J. Dinneen. Exact approximations of omega numbers, *Int. Journal of Bifurcation & Chaos*, 17, 6 (2007), in press.
3. C. S. Calude, G. J. Chaitin. A dialogue on mathematics & physics, *The Rutherford Journal: The New Zealand Journal for the History and Philosophy of Science and Technology* 2, 2006–2007, <http://www.rutherfordjournal.org>.
4. C. S. Calude, M. A. Stay. Natural halting probabilities, partial randomness, and Zeta functions, *Information and Computation*, 204 (2006), 1718–1739.
5. C. S. Calude, Elena Calude, M. J. Dinneen. A new measure of the difficulty of problems, *Journal for Multiple-Valued Logic and Soft Computing* 12 (2006), 285–307.
6. C. S. Calude, C. Câmpeanu, Monica Dumitrescu. Automata recognizing no words: A statistical approach, *Fundamenta Informaticae* 72 (2006), 1–18.
7. C. S. Calude, L. Staiger, S. A. Terwijn. On partial randomness, *Annals of Applied and Pure Logic*, 138 (2006), 20–30.

II. Papers in Refereed Proceedings or Collections

1. C. Calude. Information: the algorithmic paradigm, in J. Kohlas, G. Sommaruga (eds.) *Theories of Information*, Lecture Notes Comput. Sci., to appear in 2007.

III. Book Editor

1. C. S. Calude, M. J. Dinneen, G. Păun, G. Rozenberg, S. Stepney (eds.). *Proc. 5th International Conference Unconventional Computation*, Lecture Notes Comput. Sci. 4135, Springer, Heidelberg, 2006, 270 pp.

IV. Special Issue Editor

1. M. Burgin, C. S. Calude (eds.). Special issue: “Complexity of Computation and Algorithms”, *Theoret. Comput. Sci.*, 2007, to appear.
2. C. S. Calude, R. Lupachchini, G. Sandri (eds.). Special issue: “Natural Processes and Models of Computation”, *Natural Computing*, 2006, to appear.
3. C. S. Calude, G. Păun (eds.). Special issue: “Selected papers from the 5th International Conference Unconventional Computation”, *Natural Computing*, 2007, to appear.
4. C. Calude, H. Maurer, A. Salomaa, K. Tochtermann (eds.). *J. UCS: the Journal of Universal Computer Science*, Vol. 11–2005, Springer-Verlag, Berlin, 2006, 2191 pp.

V. Research Reports

1. C. S. Calude, M. J. Dinneen. Exact Approximations of Omega Numbers, *CDMTCS Research Report 293*, 2006, 23 pp.
2. C. S. Calude. Information: The Algorithmic Paradigm, *CDMTCS Research Report 292*, 2006, 15 pp.
3. C. S. Calude, K. Svozil. Quantum Randomness and Value Indefiniteness, *CDMTCS Research Report 291*, 2006, 12 pp.
4. C. S. Calude. De-Quantising the Solution of Deutsch’s Problem, *CDMTCS Research Report 285*, 2006, 7 pp.
5. C. S. Calude, M. A. Stay. Most Programs Stop Quickly or Never Halt, *CDMTCS Research Report 284*, 2006, 17 pp.
6. C. S. Calude, G. J. Chaitin. A Dialogue on Mathematics & Physics, *CDMTCS Research Report 283*, 2006, 10 pp.
7. C.S. Calude, Elena Calude, M.J. Dinneen. A New Measure of the Difficulty of Problems, *CDMTCS Research Report 277*, 2006, 20 pp.

VI. Miscellanea Papers

1. C. Calude. Review essay on ‘Jan Kåhre. The Mathematical Theory of Information, Kluwer, Boston, 2002’, *The Mathematical Intelligencer*, (2007), to appear.
2. C. Calude. News from New Zealand – 40, *EATCS Bull.* (2006), 30–39.
3. C. Calude. News from NZ – 39, *EATCS Bull.* 89 (2006), 20.

Steering Committee

1. Co-chair, *International Conference Series “Unconventional Computation”*, <https://www.cs.auckland.ac.nz/CDMTCS/conferences/uc>.
2. Member, *Developments in Language Theory*, <http://www.cs.auckland.ac.nz/CDMTCS/conferences/dlt/DLTConfSeries.html>.

Programme Committee

1. *11th International Conference on Algebraic Methodology and Software Technology (AMAST'06)*, Kuressaare, Estonia, July 2006.
2. *11th International Conference on Implementation and Application of Automata (CIAA'06)*, Taipei, Taiwan, August 2006.
3. *Third International Colloquium on Theoretical Aspects of Computing (ICTAC06)*, Tunisia, November, 2006.
4. *Descriptive Complexity of Formal Systems (DCFS'06)*, Las Cruces, New Mexico, USA, June 2006.
5. *Tenth International Conference on Developments in Language Theory (DLT'06)*, Santa Barbara, USA, June 2006.

Expert

1. FP6 evaluator, European Commission - DG Research, Brussels, Belgium, 2006 on.
2. Expert evaluator, European Science Foundation, Strasbourg, France, 2006 on.

Interviews

1. Interviewed by the Radio Romania International (interviewer: Mihaela Dincă) in the series “Romanian Personalities”. Broadcast: 17 September 2006.

Highlight output

The paper (co-authored with my former MSc student Mike Stay), “Natural halting probabilities, partial randomness, and Zeta functions”, was published in arguably the best journal in my area, *Information and Computation*. I hope it will have a significant impact, mainly because it proposes a more general (and natural) framework for algorithmic information theory. Time will tell! Mike (Google, USA) is in the process of applying to do a PhD under my supervision (remotely from California).

Miscellanea

I was privileged to travel to Switzerland, Turkey, Hong Kong, Romania, UK,

France, Spain, Slovakia, Check Republic, Austria, Germany, Italy, and to meet/discuss/co-operate with very interesting people.

Acknowledgment

The *support* of the Research Committee of the University of Auckland, the Department of Computer Science and the Centre for Discrete Mathematics and Theoretical Computer Science, Istanbul Bilgi University, Hong Kong University of Science & Technology, University of York, Slovak Academy of Science, Masaryk University, Technical University of Vienna, Martin-Luther-Universität Halle-Wittenberg, Universität Potsdam is acknowledged with gratitude.

C. Calude

Cristian S. Calude