

REPORT ON UC 2009

The 8th International Conference on Unconventional Computation

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The 8th International Conference on Unconventional Computation (UC 2009) took place at the University of the Azores, 7–11 September 2009.

UC 2009 was organised by the University of the Azores and the Centre for Discrete Mathematics and Theoretical Computer Science of the University of Auckland, under the auspices of the European Association for Theoretical Computer Science (EATCS). The conference received support from the University of Azores, from Centro de Matemática e Aplicações Fundamentais (CMAF) of the University of Lisbon, from the Regional Government of the Azores, from FLAD—Associação para a Mobilidade Antero de Quental, from Fundação para a Ciência e a Tecnologia (FCT), and from the Banco Internacional do Funchal (BANIF).

The fully international list of participants includes 87 names, coming from all parts of the globe: Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Hungary, Israel, Italy, Japan, New Zealand, Poland, Portugal, Romania, Russia, South Korea, Spain, UK, and USA.

The invited plenary session speakers (in alphabetical order) and their talk titles were: Edwin Beggs (Swansea University): “Using Physical Experiments as Oracles”, Jarkko Kari (University of Turku): “Structure of Reversible Cellular Automata”, Carlos Lourenço (University of Lisbon): “Brain Dynamics Promotes Function”, Jonathan W. Mills (Indiana University): “Awakening the Analogue Computer: Rubel’s Extended Analog Computer Workshop”, James M. Nyce (Ball State University and Indiana School of Medicine): “Artifice, Interpretation and Nature: Key Categories in Radiology Work”, Przemyslaw Prusinkiewicz (University of Calgary): “Developmental Computing”, Lukáš Sekanina (Brno University of Technology): “Evolvable Hardware: From Successful Applications to Implications for the Theory of Computation”, Philip Welch (University of Bristol): “Relativistic Computers and Transfinite Computation” (Philip was unfortunately unable to deliver his talk).

There were three tutorials, by: Manuel Lameiras Campagnolo (Technical University of Lisbon): “Analogue Computation”, James Crutchfield (University of California at Davis): “Computational Mechanics: Natural Computation and Self-Organization”, Martin Davis (New York University and Berkeley): “Diophantine Equations”.

These, together with and the scientific programme of technical presentations of the published papers, comprised of three full days and two half days, which

included a poster session where the authors had the opportunity to make a short informal presentation of their work.

Proceedings of UC 2009 are published in the Springer series as LNCS volume 5715 (ISBN 978-3-642-03744-3). The volume contains abstracts and extended abstracts of the invited papers and tutorials, 18 refereed 14 page full papers, and 5 one page poster papers. Several authors have been invited to submit extended versions for a special issue of Springer's Natural Computing journal.

In addition to the main technical conference, there were three parallel associated workshops on related unconventional topics (thoughtfully scheduled so as not to coincide with main conference's invited speakers): Hypercomputation Workshop 2009, Novel Computing Substrates Workshop, Physics and Computation 2009.

Additionally, Stephan Wolfram gave a presentation on "Mining the Computational Universe", via videolink, arranged as part of the Physics and Computation workshop, but hosted as a plenary session in the main auditorium.

Topics in the main conference session ranged over many aspects of unconventional computation, including computing with real numbers and other mathematical constructs, quantum computing, optical computing, billiard ball computing, membrane computing, neurocomputing, and slime mold computing. The workshops focused on specialised themes, and included tutorials and refereed technical contributions.

Because of the parallel conference and workshop sessions, I attended only a selection of the presentations. Particular highlights for me include the following.

E. Beggs' plenary on physical oracles helped expose some of the practical difficulties of computing with real numbers. His group's research provides persuasive evidence to support the conjecture that each successive digit of precision takes exponentially more time to extract from the system. P. Prusinkiewicz's plenary looked at the topology of computation, and showed how this could illuminate certain classical algorithms: from the sieve of Eratosthenes to the rather more recent shunting algorithm of Dijkstra, and then calculating the convex hull of a Sierpinski fractal curve!

J. Crutchfield's tutorial on Computational Mechanics helped elucidate some of the properties of epsilon-machines and their use in complexity measurements. He had some exciting results about the relationship of these to "reverse epsilon machines" that retrodict the past from the future. S. Wolfram's videotalk left me wondering if I have been too dismissive of the message from *A New Kind Of Science*. It is not just cellular automata, but many diverse kinds of seemingly simple computational devices, that he is exhaustively mining, exposing interesting similarities and correspondences.

In the main conference, J. Jones, in his presentation "Approximating the Behaviours of Physarum polycephalum for the Construction and Minimisation of

Synthetic Transport Networks”, described an agent-based model of this singled celled creature that can be used to solve certain geometric problems. He presented a compelling link between the model’s behaviour (and hence possibly the biological behaviour) and classical graph hierarchy results.

C. Horsham spoke at the Hypercomputation workshop on “Hybrid hyper-computing: towards a unification of quantum and classical computation”. This approach includes a new graphical formalism for quantum circuits, and unifies quantum and non-unitary (measurement) operations in a way that helps expose the underlying structure and commonalities of these two paradigms.

V. Kendon spoke at the Novel Computing Substrates Workshop on “Analogue computation with microwaves”, a first step towards a novel analogue computational device. The long term goal is to progress the understanding of continuous quantum variable computation. In the same workshop K.-P. Zauner explored the interface between organic and inorganic components in a hybrid computer, and defined matter as animate “if it uses information processing to persist.”

Hopefully this brief survey gives some indication of the vast range of topics making up Unconventional Computation that were covered at this conference. I am sure there were also many other excellent talks in other parallel sessions; maybe I attended these in other parallel universes.

The social programme included a (slightly alarming) lecture on the active geology of the islands, by Dr. Gabriela Queiroz, Director of the Centre of Volcanology and Geological Risks Assessment at the University of Azores (accompanied by an illustrated article in the proceedings), and trips to a magnificent arboretum, active hot springs, past beautiful hedges of hydrangeas to stunning volcanic calderas, and the beach. The conference dinner fully embraced the local geology, by using geothermal energy to cook the food underground, which provided an intriguing sulphurous suggestion to the enjoyable evening. Delegates at the dinner were entertained by a troupe of traditional Azorean folkdancers, and some delegates were persuaded to join in one of the “easier” dances.

Many thanks for an excellent event go to the local organisers : José Félix Costa (Technical University of Lisbon, and Swansea University), and Elisabete Freire, Matthias Funk, Luís Mendes Gomes, and Hélia Guerra (University of Azores).

The next Unconventional Computation conference in the series will take place 21-25 June 2010, in Tokyo, Japan. See <http://arn.local.frs.riken.jp/UC10>.