Preface

The topic of this special issue on *Physics and Computation* is the presentation of some aspects of the varied and extensive – and to some researchers even mind boggling – connections between the disciplines of physics and computer science. Whereas the former one is rooted in empirical evidence, the latter subject depends on some suitable physical substrate but transcends any concrete realization by reducing and "purifying" the act of computation to its formal aspects.

In comparing the concepts of both domains and interpreting any physical performance as computation, and any computation as a physical process, new aspects, insights and stimuli can be obtained for both fields.

Physics and Computation 2010, which has been a continuation of previous conferences, took place on the River Nile, on a boat that brought its participants from ancient Thebes (today's Luxor) to Aswan and allowed them to fly on even further to Abu Simbel. Thus the event took place in three worlds: under the aegis of Ramses II, in overpopulated contemporary Egypt on the edge of social turmoil that lead to a period of political instability, and in the scientific realm; all in parallel.

It is not easy to render the resulting amalgam of experiences enjoyed by the participants. The lectures were staged in the central saloon of the cruise boat, which was almost entirely darkened and cooled down to freezing frenzy. If one stepped outside of this lecture theatre one could see through bullet eye windows the legs of idle participants as they were swimming or rather stirring in the tiny greenish pool that was hanging from the top ceiling and filling the upper part of the space formed by the central staircase. The pool served also as a great communication mediator. I still remembers a vivid discussion we had on physical quantum random number generators while we were slowly paddling along the pool's circumference.

Anecdotes aside, as the boat silently tucked away there were interesting ideas floating over the river Nile, some of which are communicated in the following articles.

Proving that a dynamical system is chaotic is a central problem in chaos theory. In *Fermat's last theorem and chaoticity* by Elena Calude the author applies a specific computational method to evaluate the algorithmic complexity of the Fermat's last theorem and proves that the theorem is in the lowest complexity class associated with that measure. Using this result a two dimensional Hamiltonian system is conceived for which the proof that the system has a Smale horseshoe has a very low complexity.

In *the physical Church thesis as an explanation of the Galileo thesis* Gilles Dowek discussed Galileio's assumption that the (book of the) Universe "is written in the language of mathematics" and its specification in terms of a physical Church thesis very pointedly stating that the Universe computes.

Membrane system models for super-Turing paradigms by Marian Gheorghe and Mike Stannet continues 2004 paper of Cristian Calude and Gheorghe Paun on using biologically inspired models of computation for building accelerated

membrane systems able to simulate super-Turing machines. In this paper multiple accelerated membrane systems are built in order to solve multiple inputs in parallel and in finite time. The resulting systems have hyperarithmetical computational power.

The paper *how much contextuality* discusses certain quantitative bounds on the (non)classical behavior of quantized systems. Stated differently, it attempts to answer the question: "how many violations (if any) of the classical logical operations and truth assignments are necessary in order to obtain certain expectations, or frequencies, or (in a certain counterfactual, nonsimultaneous sense) operational expressions occurring in quantum theory?"

The contributors gratefully acknowledge support and contributions of Alexandria University in Egypt, of the Centre for Discrete Mathematics and Theoretical Computer Science of the University of Auckland in New Zealand, of the Centre for Applied Mathematics and Information Technologies of the University of Azores in Portugal, as well as of the Centro de Matemàtica e Aplicações Fundamentais of the University of Lisbon in Portugal.

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