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Preface

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About two decades ago, with the expansion of new experimental techniques in a variety of scientific areas like quantum mechanics, optical physics, molecular biology, bottom–up chemical self-assembly etc., it became clear that the notions of "information processing" and "computing" have meanings way beyond the realm of the field known as computer science. Scientists observed that one can use a variety of natural phenomena as computation, and computational devices can be designed that work on completely different physical principles than the electronics providing qualitative changes in the science of computing. Although advances in quantum computing and DNA-based computing may have received the most public attention in the past, nowadays, the notion of "unconventional computing" encapsulates many more unorthodox information processing approaches such as self-organization and self-assembly, optical computing, membrane computing, spatial computing, chaos and dynamical systems based computing; granular, fuzzy and rough computing; mechanical computing; cellular, evolutionary, neural, and amorphous computing; swarm intelligence; artificial immune systems; physics of computation; chemical computation; evolving hardware; developmental processes, bacterial communication, brain processes… Most of these unconventional approaches to computing are either exploiting the natural processes or are models that use our understanding of natural processes to perform computation, such that many of these ideas are slowly entering the mainstream of computer science.

The international conference on *Unconventional Computing and Natural Computing* (UCNC) is now an established venue where idiosyncratic ideas about computing are being presented, discussed and sometimes developed. The first venue of the UCNC series (till 2011, only UC) was Auckland, New Zealand in 1998. Subsequent sites of the conference were Brussels, Belgium in 2000, Kobe, Japan in 2002, Seville, Spain in 2005, York, UK in 2006, Kingston, Canada in 2007, Vienna, Austria in 2008, Ponta Delgada, Portugal in 2009, Tokyo, Japan in 2010 and Turku, Finland in 2011.

In 2012, UCNC was organized by the Laboratoire d'Informatique Fondamentale d'Orléans at the Université d'Orléans in France during September 3–7. As co-chairs of this edition, we would like to express our gratitude to the Université d'Orléans, the City of Orléans, the Conseil Général du Loiret, the Région Centre, INRIA, the CNRS and its GdR IM for their support.

This special issue of the *Journal of Natural Computing* contains five articles that are extensions of a selection of papers presented at UCNC 2012. The authors made significant modifications and expansions to provide journal articles. Each submission has gone through additional refereeing and revision process to meet and ensure that the standards of the journal have been met. In addition, we are pleased that the papers show the diversity of the topics that are usually covered by UCNC.

The issue starts with the invited review paper by Matthew Patitz on algorithmic tile self-assembly. His paper *An Introduction to Tile-Based Self-Assembly and a Survey of Recent Results* is an excellent reference paper for anybody interested in the field. It covers the basic theoretical models

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of abstract Tile Assembly Model (aTAM) as well as the more experimentally realistic kinetic Tile Assembly Model (kTAM). The paper surveys a series of results in those models and discusses a more recent 2-Handed Assembly Model (2HAM), which allows larger assembled structures to combine with each other in pairs (as opposed to the restriction of single-tile addition in the aTAM and kTAM). The paper ends with a wide array of recently developed models and approaches in the field.

The contribution by the group led by Marco Dorigo from Université Libre de Bruxelles is entitled *A Self-Adaptive Communication Strategy for Flocking in Stationary and Non-Stationary Environments*. This paper is in the area of robotics and swarm intelligence, and it reflects the extensive research of the group in this area. It describes a communication strategy for a controlled directional movement of a swarm of robots. The authors show how a small group of robots can lead a larger group in a given controlled environment.

Computing signal transmission by droplets, surrounded by lipid boundaries, in oil is investigated in the paper *Symbol Representations and Signal Dynamics in Evolving Droplet Computers* by Gerd Gruenert, Gabi Escuela, and Peter Dittrich. Since the environment allows droplets to interact among each other, the chemical compounds within droplets also interact in a manner similar to biological cell interactions. Through simulations, the authors show how in a two-dimensional environment of 10×10 droplets a variety of boolean functions can be represented.

The paper *Generating and Accepting P Systems with Minimal Left and Right Insertion and Deletion* authored by Rudolf Freund, Yurii Rogozhin and Sergey Verlan shows that insertion/deletions at the end of the string can be more powerful when used within the concept of membrane systems. As such operations are known to achieve universal computation when one allows insertions and deletions at the ends of the string of lengths at least two or three, these operations performed with a single symbol in the framework of membrane systems are computationally universal.

The last paper that we present in this issue is by Sama Goliaei and Mohammad-Hadi Foroughmand-Araabi entitles *On the Complexity of Nonuniform Wavelength-Based Machine*. The paper deals with optical computing performed by wavelength-based machine where one can consider as information the different wavelengths simultaneously present in each part of a light ray. The authors study the types of languages that can be generated by constant and polynomial size nonuniform wavelength machines.

We wish to thank all authors of the contributed papers. We are also very grateful to all reviewers who spent their valuable time reviewing and commenting on these papers. Without their constructive comments we would not have been able to put together such a satisfying and diverse group of papers. In addition, we wish to thank Grzegorz Rozenberg for his careful guidance in this process.