

Preface

Unconventional computing is a science in flux. What is unconventional today will be conventional tomorrow. Designs being standard in the past are seen now as a novelty. Unconventional computing is a niche for interdisciplinary science, cross-bred of computer science, physics, mathematics, chemistry, electronic engineering, biology, material science and nanotechnology. The aims were to uncover and exploit principles and mechanisms of information processing in and functional properties of physical, chemical and living systems to develop efficient algorithms, design optimal architectures and manufacture working prototypes of future and emergent computing devices.

I invited world's leading scientists and academicians to describe their vision of unconventional computing and to highlight most promising directions of future research in the field. Their response was overwhelmingly enthusiastic: over fifty chapters were submitted spanning almost all fields of natural and engineering sciences. Unable to fit over one and half thousands pages into one volume, I grouped the chapters as "theoretical" and "practical". By "theoretical", I mean constructs and algorithms which have no immediate application domain and do not solve any concrete problems, yet they make a solid mathematical or philosophical foundation to unconventional computing. "Practical" includes experimental laboratory implementations and algorithms solving actual problems. Such a division is biased by my personal vision of the field and should not be taken as an absolute truth.

The first volume brings us mind-bending revelations from gurus in computing and mathematics. The topics covered are computability, (non-)universality and complexity of computation; physics of computation, analogue and quantum computing; reversible and asynchronous devices; cellular automata and other mathematical machines; P-systems and cellular computing; infinity and spatial computation; and chemical and reservoir computing. As a dessert, we have two vibrant memoirs by founding fathers of the field.

The second volume is a tasty blend of experimental laboratory results, modelling and applied computing. Emergent molecular computing is presented by enzymatic logical gates and circuits, and DNA nanodevices. Reaction-diffusion chemical

computing is exemplified by logical circuits in Belousov–Zhabotinsky medium and geometrical computation in precipitating chemical reactions. Logical circuits realised with solitons and impulses in polymer chains show advances in collision-based computing. Photochemical and memristive devices give us a glimpse into hot topics of novel hardware. Practical computing is represented by algorithms of collective and immune-computing and nature-inspired optimisation. Living computing devices are implemented in real and simulated cells, regenerating organisms, plant roots and slime mould. Musical biocomputing and living architectures make the ending of our unconventional journey non-standard.

The chapters are self-contained. No background knowledge is required to enjoy the book. Each chapter is a treatise of marvellous ideas. Open the book at a random page and start reading. Abandon all stereotypes, conventions and rules. Enter the stream of unusual. Even a dead fish can go with the flow. You can too.

Bristol, UK
March 2016

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Advances in Unconventional Computing

Volume 2: Prototypes, Models and Algorithms

Adamatzky, A. (Ed.)

2017, IX, 812 p. 428 illus., 234 illus. in color., Hardcover

ISBN: 978-3-319-33920-7