
**HANDBOOK OF NATURE-INSPIRED
AND INNOVATIVE COMPUTING**
*Integrating Classical Models with
Emerging Technologies*

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Edited by

Albert Y. Zomaya
The University of Sydney, Australia

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*To my family for their help,
support, and patience.
Albert Zomaya*

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CONTRIBUTORS

Editor in Chief

Albert Y. Zomaya
Advanced Networks Research Group
School of Information Technology
The University of Sydney
NSW 2006, Australia

Advisory Board

David Bader
University of New Mexico
Albuquerque, NM 87131, USA

Richard Brent
Oxford University
Oxford OX1 3QD, UK

Jack Dongarra
University of Tennessee
Knoxville, TN 37996
and
Oak Ridge National Laboratory
Oak Ridge, TN 37831, USA

Mary Eshaghian-Wilner
Dept of Electrical Engineering
University of California, Los Angeles
Los Angeles, CA 90095, USA

Gerard Milburn
University of Queensland
St Lucia, QLD 4072, Australia

Franciszek Seredynski
Institute of Computer Science
Polish Academy of Sciences
Ordona 21, 01-237 Warsaw, Poland

Authors/Co-authors of Chapters

Matthew Allen
Computer Science Dept
University of California, Santa
Barbara
Santa Barbara, CA 93106, USA

Srinivas Aluru
Iowa State University
Ames, IA 50011, USA

Boualem Benatallah
School of Computer Science
and Engineering
The University of New South
Wales
Sydney, NSW 2052, Australia

Peter J. Bentley
University College London
London WC1E 6BT, UK

John Brevik
Computer Science Dept
University of California, Santa
Barbara
Santa Barbara, CA 93106, USA

Rajkumar Buyya
Grid Computing and Distributed
Systems Laboratory and NICTA
Victoria Laboratory
Dept of Computer Science and
Software Engineering
The University of Melbourne
Victoria 3010, Australia

Sajal K. Das
Center for Research in Wireless
Mobility and Networking
(CReWMaN)
The University of Texas, Arlington
Arlington, TX 76019, USA

Jack Dongarra
University of Tennessee
Knoxville, TN 37996
and Oak Ridge National Laboratory
Oak Ridge, TN 37831, USA

Peter Eades
National ICT Australia
Australian Technology Park
Eveleigh NSW, Australia

Jens Eisert
Universität Potsdam
Am Neuen Palais 10
14469 Potsdam, Germany
and
Imperial College London
Prince Consort Road
SW7 2BW London, UK

Mary M. Eshaghian-Wilner
Dept of Electrical Engineering
University of California, Los Angeles
Los Angeles, CA 90095, USA

Rasit Eskicioglu
Parallel and Distributed Systems
Laboratory
Dept of Computer Sciences
The University of Manitoba
Winnipeg, MB R3T 2N2, Canada

Amar H. Flood
Dept of Chemistry
University of California, Los Angeles
Los Angeles, CA 90095, USA

Claude Godart
INRIA-LORIA
F-54506 Vandœuvre-lès-Nancy
Cedex, France

Timothy G. W. Gordon
University College London
London WC1E 6BT, UK

Peter Graham
Parallel and Distributed Systems
Laboratory
Dept of Computer Sciences
The University of Manitoba
Winnipeg, MB R3T 2N2, Canada

Lili Hai
State University of New York
College at Old Westbury
Old Westbury, NY 11568-0210, USA

Reiner Hartenstein
TU Kaiserslautern
Kaiserslautern, Germany

Seokhee Hong
National ICT Australia
Australian Technology Park
Eveleigh NSW, Australia

Jim Kennedy
Bureau of Labor Statistics
Washington, DC 20212, USA

Alex Khitun
Dept of Electrical Engineering
University of California,
Los Angeles
Los Angeles, CA 90095, USA

E. V. Krishnamurthy
Computer Sciences Laboratory
Australian National University,
Canberra
ACT 0200, Australia

Vikram Krishnamurthy
Dept of Electrical and Computer
Engineering
University of British Columbia
Vancouver, V6T 1Z4, Canada

Mohan Kumar
Center for Research in Wireless
Mobility and Networking
(CReWMaN)
The University of Texas,
Arlington
Arlington, TX 76019, USA

David J. Lilja
Dept of Electrical and Computer
Engineering
University of Minnesota
200 Union Street SE
Minneapolis, MN 55455, USA

Keith Nesbitt
Charles Sturt University
School of Information Technology
Panorama Ave
Bathurst 2795, Australia

Daniel Nurmi
Computer Science Dept
University of California, Santa
Barbara
Santa Barbara, CA 93106, USA

Graziano Obertelli
Computer Science Dept
University of California, Santa
Barbara
Santa Barbara, CA 93106, USA

Olivier Perrin
INRIA-LORIA
F-54506 Vandœuvre-lès-Nancy
Cedex, France

Hossein Pourreza
Parallel and Distributed Systems
Laboratory
Dept of Computer Sciences
The University of Manitoba
Winnipeg, MB R3T 2N2, Canada

Fethi A. Rabhi
School of Information Systems,
Technology and Management
The University of New South Wales
Sydney, NSW 2052, Australia

Arnold L. Rosenberg
Dept of Computer Science
University of Massachusetts Amherst
Amherst, MA 01003, USA

Franciszek Seredynski
Institute of Computer Science
Polish Academy of Sciences
Ordona 21, 01-237 Warsaw, Poland

Leslie Smith
Dept of Computing Science and
Mathematics
University of Stirling
Stirling FK9 4LA, Scotland

Frank Sommers
Autospaces, LLC
895 S. Norton Avenue
Los Angeles, CA 90005, USA

J. Fraser Stoddart
Dept of Chemistry
University of California,
Los Angeles
Los Angeles, CA 90095, USA

George G. Szpiro
P.O.Box 6278, Jerusalem, Israel

Javid Taheri
Advanced Networks Research Group
School of Information Technology
The University of Sydney
NSW 2006, Australia

Masahiro Takatsuka
The University of Sydney
School of Information Technology
NSW 2006, Australia

Zahir Tari
Royal Melbourne Institute of
Technology
School of Computer Science
Melbourne, Victoria 3001, Australia

Kang Wang
Dept of Electrical Engineering
University of California, Los Angeles
Los Angeles, CA 90095, USA

M.M. Wolf
Max-Planck-Institut für Quantenoptik
Hans-Kopfermann-Str. 1
85748 Garching, Germany

Rich Wolski
Computer Science Dept
University of California, Santa
Barbara
Santa Barbara, CA 93106, USA

Chee Shin Yeo
Grid Computing and Distributed
Systems Laboratory and NICTA
Victoria Laboratory
Dept of Computer Science and
Software Engineering
The University of Melbourne
Victoria 3010, Australia

Joshua J. Yi
Freescale Semiconductor Inc,
7700 West Parmer Lane
Austin, TX 78729, USA

Albert Y. Zomaya
Advanced Networks Research
Group
School of Information Technology
The University of Sydney
NSW 2006, Australia

PREFACE

The proliferation of computing devices in every aspect of our lives increases the demand for better understanding of emerging computing paradigms. For the last fifty years most, if not all, computers in the world have been built based on the von Neumann model, which in turn was inspired by the theoretical model proposed by Alan Turing early in the twentieth century. A Turing machine is the most famous theoretical model of computation (A. Turing, On Computable Numbers, with an Application to the Entscheidungsproblem, *Proc. London Math. Soc.* (ser. 2), **42**, pp. 230–265, 1936. Corrections appeared in: *ibid.*, **43** (1937), pp. 544–546.) that can be used to study a wide range of algorithms.

The von Neumann model has been used to build computers with great success. It has also been extended to the development of the early supercomputers and we can also see its influence on the design of some of the high performance computers of today. However, the principles espoused by the von Neumann model are not adequate for solving many of the problems that have great theoretical and practical importance. In general, a von Neumann model is required to execute a precise algorithm that can manipulate accurate data. In many problems such conditions cannot be met. For example, in many cases accurate data are not available or a “fixed” or “static” algorithm cannot capture the complexity of the problem under study.

Therefore, *The Handbook of Nature-Inspired and Innovative Computing: Integrating Classical Models with Emerging Technologies* seeks to provide an opportunity for researchers to explore the new computational paradigms and their impact on computing in the new millennium. The handbook is quite timely since the field of computing as a whole is undergoing many changes. Vast literature exists today on such new paradigms and their implications for a wide range of applications -a number of studies have reported on the success of such techniques in solving difficult problems in all key areas of computing.

The book is intended to be a Virtual Get Together of several researchers that one could invite to attend a conference on ‘futurism’ dealing with the theme of Computing in the 21st Century. Of course, the list of topics that is explored here is by no means exhaustive but most of the conclusions provided can be extended to other research fields that are not covered here. There was a decision to limit the number of chapters while providing more pages for contributed authors to express their ideas, so that the handbook remains manageable within a single volume.

It is also hoped that the topics covered will get readers to think of the implications of such new ideas for developments in their own fields. Further, the enabling technologies and application areas are to be understood very broadly and include, but are not limited to, the areas included in the handbook.

The handbook endeavors to strike a balance between theoretical and practical coverage of a range of innovative computing paradigms and applications. The handbook is organized into three main sections: (I) Models, (II) Enabling Technologies and (III) Application Domains; and the titles of the different chapters are self-explanatory to what is covered. The handbook is intended to be a repository of paradigms, technologies, and applications that target the different facets of the process of computing.

The book brings together a combination of chapters that normally don't appear in the same space in the wide literature, such as bioinformatics, molecular computing, optics, quantum computing, and others. However, these new paradigms are changing the face of computing as we know it and they will be influencing and radically revolutionizing traditional computational paradigms. So, this volume catches the wave at the right time by allowing the contributors to explore with great freedom and elaborate on how their respective fields are contributing to re-shaping the field of computing.

The twenty-two chapters were carefully selected to provide a wide scope with minimal overlap between the chapters so as to reduce duplications. Each contributor was asked to cover review material as well as current developments. In addition, the choice of authors was made so as to select authors who are leaders in the respective disciplines.

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Albert Y. Zomaya