

Communications in Computer and Information Science

830

Commenced Publication in 2007

Founding and Former Series Editors:

Alfredo Cuzzocrea, Xiaoyong Du, Orhun Kara, Ting Liu, Dominik Ślęzak,
and Xiaokang Yang

Editorial Board

Simone Diniz Junqueira Barbosa

*Pontifical Catholic University of Rio de Janeiro (PUC-Rio),
Rio de Janeiro, Brazil*

Phoebe Chen

La Trobe University, Melbourne, Australia

Joaquim Filipe

Polytechnic Institute of Setúbal, Setúbal, Portugal

Igor Kotenko

*St. Petersburg Institute for Informatics and Automation of the Russian
Academy of Sciences, St. Petersburg, Russia*

Krishna M. Sivalingam

Indian Institute of Technology Madras, Chennai, India

Takashi Washio

Osaka University, Osaka, Japan

Junsong Yuan

Nanyang Technological University, Singapore, Singapore

Lizhu Zhou

Tsinghua University, Beijing, China

More information about this series at <http://www.springer.com/series/7899>

Marcello Pelillo · Irene Poli
Andrea Roli · Roberto Serra
Debora Slanzi · Marco Villani (Eds.)


Artificial Life and Evolutionary Computation


12th Italian Workshop, WIVACE 2017
Venice, Italy, September 19–21, 2017
Revised Selected Papers

Editors


Marcello Pelillo 
Ca' Foscari University of Venice
Venice
Italy

Irene Poli 
Ca' Foscari University of Venice
Venice
Italy

Andrea Roli 
University of Bologna
Cesena
Italy

Roberto Serra 
University of Modena and Reggio Emilia
Modena
Italy

Debora Slanzi 
Ca' Foscari University of Venice
Venice
Italy

Marco Villani 
University of Modena and Reggio Emilia
Modena
Italy

ISSN 1865-0929 ISSN 1865-0937 (electronic)
Communications in Computer and Information Science
ISBN 978-3-319-78657-5 ISBN 978-3-319-78658-2 (eBook)
<https://doi.org/10.1007/978-3-319-78658-2>

Library of Congress Control Number: 2018937357

© Springer International Publishing AG, part of Springer Nature 2018

This work is subject to copyright. All rights are reserved by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed.

The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

The publisher, the authors and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, express or implied, with respect to the material contained herein or for any errors or omissions that may have been made. The publisher remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Printed on acid-free paper

This Springer imprint is published by the registered company Springer International Publishing AG part of Springer Nature
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

Preface

The Wivace conference series has been showing a vitality that is quite surprising, as it is not supported by any formal society or association. Instead, it is the scientific community that gathers at Wivace that continues to make it so lively. At each conference there is an informal meeting, where the organizer of the following Wivace is chosen. This method provides a continuous testing of the value of the conference for the participants, and it also explains why the flavors of various editions may differ, depending in part on the main scientific orientation of the organizers. In 2017 the burden of the organization was mostly on mathematical modelers, computer scientists, and statisticians, while in the two previous editions it had been on biologists and chemists. However, the interest of the two communities for the other's work is always high, and no "parallel sessions" are run.

The dual soul of Wivace is indeed rooted in its history, since it was born out of the coalescence of two independent initiatives. Two workshops on Artificial Life were held in 2003 in Cosenza and in 2005 in Rome, and a workshop on Evolutionary Computation took place in Milan in 2005 (as a part of the Conference of the Italian Association for Artificial Intelligence). The organizers of the two initiatives decided to co-locate their 2006 editions in Siena, sharing a day (the last day of one conference coincided with the first day of the other). It became clear that there was a strong mutual interest between the two scientific communities, so it was decided that the two initiatives had to merge – and the beautiful acronym Wivace was born!¹

The first true Wivace took place in Samperi (Sicily) in 2007, followed by the 2008 edition in Venice. This was the first time that some invited speakers and some participants came from abroad, and the conference proceedings were published in English by an international publisher. Wivace 2009 took place in Naples, and in that case the local organizer decided to work with an Italian publisher, and to accept papers in Italian. This prompted some reflections about what Wivace had to be, and it was eventually decided that its international features had to be preserved and improved. Therefore, since the edition that took place in Parma in 2012, there have always been international proceedings and international well-known invited speakers.

A possibly incomplete list of non-Italian invited speakers include Stuart Kauffman, Norman Packard, Christian Mueller-Schloer, Wim Hordijk, Yaroslav Sergeyev, Ricard Solé, Kepa Ruiz Mirazo, Olli Yli-Harja, Gabor Vattay, Steen Rasmussen, Ruedi Fuechsli, and Erik Schultes. Moreover, several Italian researchers working abroad have also been invited to Wivace.

The meeting in Milan in 2013 was followed by Wivace 2014 in Vietri sul Mare, co-located with that year's edition of Wirm, a series of workshops on neural networks dating back to 1986. In 2015 the meeting took place in Bari and in 2016 in Salerno. And in 2017 we were back in Venice, for the ninth conference under the name of Wivace.

¹ In Italian, "vivace" means "lively."

However, since (as detailed above) three “parent” Wiva workshops had taken place earlier, this can be regarded as the 12th edition of the series.

Wivace is not a big conference, the number of participants typically ranging around 50. During the conference, presentations are discussed in depth, without, however, indulging in uselessly aggressive polemics. The combination of scientific rigor with a relaxed atmosphere, and with the openness to novel suggestions and hypotheses, also facilitates informal discussions and exchange of ideas.

We have been lucky to host some invited speakers who combined their outstanding scientific merits with the capability to effectively communicate their thoughts, and thus we are deeply indebted to Stuart Kauffman, Steen Rasmussen, Ruedi Fuechslin, Erik Schultes, and Roberto Taramelli for their contributions.

The review process was quite long, involving two phases. The call for papers left the choice of presenting an extended abstract or a full paper to the contributors, and the acceptance of the presentation to the conference was based on this document. Two reviewers were involved for each submission, and comments and suggestions were sent to the authors. After the conference, all the authors of accepted contributions were asked to send a full paper, which was scrutinized by three reviewers who also sent their evaluations and suggestions for improvements. The 23 papers in this volume are the outcome of this selection procedure. We thank all the contributors and all the participants for their role in making Wivace 2017 a successful event. And special thanks are due to the members of the Program Committee and the reviewers for their precious work.

This year’s organization profited from the strong and highly qualified support of the European Centre for Living Technology (ECLT), an international research center run by the Università Cà Foscari, which is associated with several universities and research institutions in Europe and the USA. We wish to thank in particular Agnese Boscarol and Roberta D’Argenio, who managed the complicated organizational and financial aspects of the conference, and Marco Fiorucci, who took care of the website. We also thank the student Feliks Hibraji for his help.

Thanks are also due to the host institutions of the organizers, namely, the Università Ca’ Foscari di Venezia, the Università di Modena e Reggio Emilia, and the Università di Bologna.

Let us finally acknowledge the precious advice of the staff at Springer, who provided their professional support through all the phases that led to this volume.

February 2018

Marcello Pelillo
Irene Poli
Roberto Serra
Andrea Roli
Debora Slanzi
Marco Villani

Organization

General Chairs

Marcello Pelillo	Ca'Foscari University of Venice, Italy
Irene Poli	Ca'Foscari University of Venice, Italy
Andrea Roli	University of Bologna, Italy
Roberto Serra	University of Modena and Reggio Emilia, Italy
Debora Slanzi	Ca'Foscari University of Venice, Italy
Marco Villani	University of Modena and Reggio Emilia, Italy

Program Committee

Michele Amoretti	University of Parma, Italy
Leonardo Bich	Universidad de Chile, Chile
Matteo Borrotti	CNR-IMATI, Italy
Michele Braccini	University of Bologna, Italy
Marcello Antonio Budroni	University of Sassari, Italy
Stefano Cagnoni	University of Parma, Italy
Angelo Cangelosi	University of Plymouth, UK
Timoteo Carletti	University of Namur, Belgium
Antonio Chella	University of Palermo, Italy
Simona Concilio	University of Salerno, Italy
Chiara Damiani	University of Milan Bicocca, Italy
Luca Di Gaspero	University of Udine, Italy
Alessandro Filisetti	Explora Biotech Srl, Italy
Francesco Fontanella	University of Cassino and Southern Lazio, Italy
Massimo Franceschet	University of Udine, Italy
Mario Giacobini	University of Turin, Italy
Alex Graudenzi	University of Milano-Bicocca, Italy
Roberto Marangoni	University of Pisa, Italy
Giancarlo Mauri	University of Milano-Bicocca, Italy
Sara Montagna	University of Bologna, Italy
Stefano Piotto	University of Salerno, Italy
Clara Pizzuti	CNR-ICAR, Italy
Riccardo Righi	European Commission, Joint research Center, Spain
Simone Righi	University College London, UK
Federico Rossi	University of Salerno, Italy
Hiroki Sayama	Binghamton University, SUNY, USA
Giandomenico Spezzano	CNR-ICAR and University of Calabria, Italy
Pasquale Stano	University of Salento, Italy
Thomas Stuetzle	Université Libre de Bruxelles, Belgium
Pietro Terna	University of Turin, Italy

Marco Tomassini	University of Lausanne, Switzerland
Vito Trianni	ISTC-CNR, Italy
Olli Yli-Harja	Tampere University of Technology, Finland

Local Organizing Committee

Agnese Boscarol	European Centre for Living Technology, Ca'Foscari University of Venice, Italy
Roberta d'Argenio	European Centre for Living Technology, Ca'Foscari University of Venice, Italy
Marco Fiorucci	European Centre for Living Technology, Ca'Foscari University of Venice, Italy
Feliks Hibraj	European Centre for Living Technology, Ca'Foscari University of Venice, Italy

Contents

Physical–Chemical Phenomena

Quantum Neural Networks Achieving Quantum Algorithms	3
<i>Delphine Nicolay and Timoteo Carletti</i>	
Signal Transduction and Communication Through Model Membranes in Networks of Coupled Chemical Oscillators	16
<i>Federico Rossi, Kristian Torbensen, Sandra Ristori, and Ali Abou-Hassan</i>	
Controlling Chemical Chaos in the Belousov-Zhabotinsky Oscillator	32
<i>Marcello A. Budroni, Mauro Rustici, Nadia Marchettini, and Federico Rossi</i>	
Fragment Based Molecular Dynamics for Drug Design	49
<i>Lucia Sessa, Luigi Di Biasi, Simona Concilio, and Stefano Piotto</i>	
Stochastic Numerical Models of Oscillatory Phenomena.	59
<i>Raffaele D’Ambrosio, Martina Moccaldi, Beatrice Paternoster, and Federico Rossi</i>	

Biological Systems

Understanding Embodied Cognition by Building Models of Minimal Life: Preparatory Steps and a Preliminary Autopoietic Framework	73
<i>Luisa Damiano and Pasquale Stano</i>	
Computing Hierarchical Transition Graphs of Asynchronous Genetic Regulatory Networks	88
<i>Marco Pedicini, Maria Concetta Palumbo, and Filippo Castiglione</i>	
The Impact of Self-loops in Random Boolean Network Dynamics: A Simulation Analysis	104
<i>Sara Montagna, Michele Braccini, and Andrea Roli</i>	
A Comparison Between Threshold Ergodic Sets and Stochastic Simulation of Boolean Networks for Modelling Cell Differentiation	116
<i>Michele Braccini, Andrea Roli, Marco Villani, and Roberto Serra</i>	
A Relevance Index Method to Infer Global Properties of Biological Networks	129
<i>Marco Villani, Laura Sani, Michele Amoretti, Emilio Vicari, Riccardo Pecori, Monica Mordonini, Stefano Cagnoni, and Roberto Serra</i>	

Dynamical Properties of a Gene-Protein Model.	142
<i>Davide Sapienza, Marco Villani, and Roberto Serra</i>	
Simulating Populations of Protocells with Uneven Division	153
<i>Martina Musa, Marco Villani, and Roberto Serra</i>	
An Integrated Model Quantitatively Describing Metabolism, Growth and Cell Cycle in Budding Yeast	165
<i>Pasquale Palumbo, Marco Vanoni, Federico Papa, Stefano Busti, Meike Wortel, Bas Teusink, and Lilia Alberghina</i>	
Estimating Effects of Extrinsic Noise on Model Genes and Circuits with Empirically Validated Kinetics.	181
<i>Samuel M. D. Oliveira, Mohamed N. M. Bahrudeen, Sofia Startceva, and Andre S. Ribeiro</i>	
Economy and Society	
Calibrating Dynamic Factor Models with Genetic Algorithms	197
<i>Fabio Della Marra</i>	
Functional Interactions in Complex Networks: A Three-Step Methodology for the Implementation of the Relevance Index (RI)	212
<i>Riccardo Righi and Sofia Samoili</i>	
Modeling Urbanization Perception: Emerging Topics on Hangzhou Future Sci-Tech City Development	229
<i>Debora Slanzi, Valentina Anzoise, and Irene Poli</i>	
Complexity	
Complexity Measures in Automatic Design of Robot Swarms: An Exploratory Study	243
<i>Andrea Roli, Antoine Ligot, and Mauro Birattari</i>	
Identification of “Die Hard” Nodes in Complex Networks: A Resilience Approach	257
<i>Angela Lombardi, Sabina Tangaro, Roberto Bellotti, Angelo Cardellicchio, and Cataldo Guaragnella</i>	
Optimization	
Automatic Algebraic Evolutionary Algorithms	271
<i>Marco Baiocchi, Alfredo Milani, and Valentino Santucci</i>	

Multi-objective Optimization in High-Dimensional Molecular Systems.	284
<i>Debora Slanzi, Valentina Mameli, Marina Khoroshiltseva, and Irene Poli</i>	
Multiple Network Motif Clustering with Genetic Algorithms	296
<i>Clara Pizzuti and Annalisa Socievole</i>	
Searching Relevant Variable Subsets in Complex Systems Using K-Means PSO	308
<i>Gianluigi Silvestri, Laura Sani, Michele Amoretti, Riccardo Pecori, Emilio Vicari, Monica Mordonini, and Stefano Cagnoni</i>	
Author Index	323