Lecture Notes in Artificial Intelligence 10989

Subseries of Lecture Notes in Computer Science

More information about this series at http://www.springer.com/series/1244

Jinchang Ren · Amir Hussain
Jiangbin Zheng · Cheng-Lin Liu
Bin Luo · Huimin Zhao
Xinbo Zhao (Eds.)

Advances in Brain Inspired Cognitive Systems

9th International Conference, BICS 2018
Xi'an, China, July 7–8, 2018
Proceedings

Springer

Editors
Jinchang Ren
University of Strathclyde
Glasgow
UK

Amir Hussain
Edinburgh Napier University
Edinburgh
UK

Jiangbin Zheng
Northwestern Polytechnical University
Xi'an
China

Cheng-Lin Liu
Chinese Academy of Sciences
Beijing
China

Bin Luo
Anhui University
Hefei
China

Huimin Zhao
Guangdong Polytechnic Normal University
Guangzhou
China

Xinbo Zhao
Northwestern Polytechnical University
Xi'an
China

ISSN 0302-9743 ISSN 1611-3349 (electronic)
Lecture Notes in Artificial Intelligence
ISBN 978-3-030-00562-7 ISBN 978-3-030-00563-4 (eBook)
https://doi.org/10.1007/978-3-030-00563-4

Library of Congress Control Number: 2018954488

LNCS Sublibrary: SL7 – Artificial Intelligence

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

Preface

Welcome to the proceedings of BICS 2018 – the 9th International Conference on Brain-Inspired Cognitive Systems. BICS has now become a well-established conference series on brain-inspired cognitive systems around the world, with growing popularity and increasing quality. BICS 2018 followed on from BICS 2004 (Stirling, Scotland, UK), BICS 2006 (Lesvos, Greece), BICS 2008 (Sao Luis, Brazil), BICS 2010 (Madrid, Spain), BICS 2012 (Shenyang, China), BICS 2013 (Beijing, China), BICS 2015 (Hefei, China), and BICS 2016 (Beijing, China).

Geographically located at the heart of China, Xi'an is the largest city of Shaanxi Province. It once served as the capital city of ancient China for 13 dynasties spanning over 1,000 years, with a history of 5,000 years. Xi'an witnessed the most glorious history of China, and now ranks as one of the top ten tourist destinations in China with a distinctive culture. Xi'an is the starting point of the Silk Road and home to the Terracotta Army of Emperor Qin Shi Huang, the first Emperor in Chinese history.

This volume of *Lecture Notes in Artificial Intelligence* constitutes the proceedings of BICS 2018. In this context, BICS 2018 aimed to provide a high-level international forum for scientists, engineers, and educators to present the state of the art in brain-inspired cognitive systems research and applications in diverse fields. The conference featured plenary lectures given by world-renowned scholars, regular sessions with broad coverage, and some special sessions and workshops focusing on popular and timely topics.

The conference received nearly 150 submissions from more than 270 authors in over ten countries and regions across four continents. Based on a rigorous review process carried out by the Program Committee members and reviewers, 84 high-quality papers were selected for publication in the conference proceedings. These papers cover many topics of brain-inspired cognitive systems – related research including biologically inspired systems, cognitive neuroscience, models of consciousness, and neural computation.

Many organizations and volunteers made great contributions toward the success of this event. We are grateful for the great support from the School of Software and Microelectronics, Northwestern Polytechnical University and School of Computer Sciences, Guangdong Polytechnic Normal University (also Guangzhou Key Laboratory of Digital Content Processing and Security Technologies). We also thank the University of Strathclyde and the University of Stirling as well as the IEEE Brain Initiatives for co-organizing the Brain Data Bank Competition with BICS. We would also like to sincerely thank all the committee members for their great effort and time in organizing the event. Special thanks go to the Program Committee members and reviewers, whose insightful reviews and timely feedback ensured the high quality of the accepted papers and the smooth flow of the conference. We would also like to thank the publisher, Springer, for their cooperation in publishing the proceedings in the

prestigious series of *Lecture Notes in Artificial Intelligence*. Finally, we would like to thank all the speakers, authors, and participants for their support.

July 2018

Jinchang Ren
Amir Hussain
Jiangbin Zheng
Cheng-Lin Liu
Bin Luo
Huimin Zhao
Xinbo Zhao

Organization

General Chairs

Yanning Zhang	Northwestern Polytechnical University, China
Jiangbin Zheng	Northwestern Polytechnical University, China
Amir Hussain	Edinburgh Napier University, UK
Jinchang Ren	University of Strathclyde, UK
Narisa Nan Chu	IEEE Brain Initiatives, USA
Huimin Zhao	Guangdong Polytechnic Normal University, China

Honorary Co-chairs

Derong Liu	University of Illinois, USA
Igor Aleksander	Imperial College London, UK
Tariq Durrani	University of Strathclyde, UK
Tieniu Tan	Chinese Academy of Sciences, China

Program Chairs

Xiaoya Fan	Northwestern Polytechnical University, China
Cheng-Lin Liu	Chinese Academy of Sciences, China
Bin Luo	Anhui University, China

Workshop Chairs

Meijun Sun	Tianjin University, China
Erfu Yang	University of Strathclyde, UK
Zheng Wang	Tianjin University, China

Publication Chairs

Genyun Sun	China University of Petroleum, China
Xinbo Zhao	Northwestern Polytechnical University, China
Jamie Zabalza	University of Strathclyde, UK

Publicity Chairs

Haibo He	University of Rhode Island, USA
Newton Howard	Massachusetts Institute of Technology, USA
El-Sayed El-Alfy	King Fahd University of Petroleum and Minerals, Saudi Arabia
Mohamed Chetouani	Pierre and Marie Curie University, France

Anna Esposito	Second University of Naples, Italy
Giacomo Indiveri	University of Zurich and ETH Zurich, Switzerland
Stefan Wermter	University of Hamburg, Germany
Erik Cambria	Nanyang Technological University, Singapore
Jonathon Wu	University of Windsor, Canada
Genyun Sun	China University of Petroleum, China

Finance Chairs

Sophia Zhao	University of Strathclyde, UK
Qianru Wei	Northwestern Polytechnical University, China

Registrations and Local Arrangements Chairs

Yuying Wang	Northwestern Polytechnical University, China
Chunxia Xiao	Northwestern Polytechnical University, China
Mingchen Feng	University of Strathclyde, UK
Qiaoyuan Liu	University of Strathclyde, UK

Program Committee

Andrew Abel	Stirling University, UK
Peter Andras	Keele University, UK
Xiang Bai	Huazhong University of Science and Technology, China
Vladimir Bajic	KAUST, Thuwal, Saudi Arabia
Yanchao Bi	Beijing Normal University, China
Erik Cambria	Nanyang Technological University, Singapore
Lihong Cao	Communication University of China, China
Chun-I Philip Chen	California State University, USA
Mingming Cheng	Nankai University, China
Dazheng Feng	Xidian University, China
David Yushan Fong	CITS Group, USA
Marcos Faundez	Zanuy Tecnocampus, Barcelona, Spain
Fei Gao	Beihang University, China
Alexander Gelbukh	CIC IPN, Mexico
Hugo Gravato	Marques ETH Zurich, Switzerland
Claudius Gros Goethe	University of Frankfurt, Germany
Junwei Han	Northwestern Polytechnical University, China
Xiangjian He	University of Technology Sydney, Australia
Bingliang Hu	Xi'an Institute of Optics and Precision Mechanics, Chinese Academy of Sciences, China
Xiaolin Hu	Tsinghua University, China
Kaizhu Huang	Xi'an Jiaotong Liverpool University, China
Tiejun Huang	Peking University, China
Amir Hussain	Edinburgh Napier University, UK
Rongrong Ji	Xiamen University, China

Yi Jiang	Institute of Psychology, Chinese Academy of Sciences, China
Jingpeng Li	Stirling University, UK
Yongjie Li	University of Electronic Science and Technology of China, China
Cheng-Lin Liu	Institute of Automation, Chinese Academy of Sciences, China
Huaping Liu	Tsinghua University, China
Weifeng Liu	China University of Petroleum, China
Iman Yi Liao	University of Nottingham Malaysia Campus, Malaysia
Xiaoqiang Lu	Xi'an Institute of Optics and Precision Mechanics, Chinese Academy of Sciences, China
Bin Luo	Anhui University, China
Mufti Mahmud	University of Padova, Italy
Zeeshan Malik	Stirling University, UK
Deyu Meng	Xi'an Jiaotong University, China
Tomas Henrique Maul	University of Nottingham Malaysia Campus, Malaysia
Junaid Qadir National	University of Sciences and Technology, Pakistan
Jinchang Ren	University of Strathclyde, UK
Simone Scardapane	University of Rome, Italy
Bailu Si	Shenyang Institute of Automation, Chinese Academy of Sciences, China
Mingli Song	Zhejiang University, China
Genyun Sun	China University of Petroleum (East China), China
Meijun Sun	Tianjin University, China
Walid Taha	Halmstad University, Sweden
Dacheng Tao	University of Technology Sydney, Australia
Yonghong Tian	Peking University, China
Isabel Trancoso	INESC-ID, Portugal
Stefano Vassanelli	University of Padua, Italy
Liang Wang	Institute of Psychology, Chinese Academy of Sciences, China
Zheng Wang	Tianjin University, China
Zhijiang Wang	Institute of Mental Health, Peking University, China
Qi Wang	Northwestern Polytechnical University, China
Hui Wei	Fudan University, China
Jonathan Wu	University of Windsor, Canada
Qiang Wu	University of Technology Sydney, Australia
Min Xu	University of Technology Sydney, Australia
Erfu Yang	University of Strathclyde, UK
Tianming Yang	Institute of Neuroscience, China
Zhijing Yang	Guangdong University of Technology, China
Jin Zhan	Guangdong Polytechnic Normal University, China
Daoqiang Zhang	Nanjing University of Aeronautics and Astronautics, China
Li Zhang	University of Birmingham, UK
Yanning Zhang	Northwestern Polytechnical University, China

Yifeng Zhang	Institute of Neuroscience, China
Huimin Zhao	Guangdong Polytechnic Normal University, China
Xinbo Zhao	Northwestern Polytechnical University, China
Jiangbin Zheng	Northwestern Polytechnical University, China
Bing Zhou	Sam Houston State University, USA
Jun Zhu	Tsinghua University, China

Contents

Neural Computation

Biologically Inspired Systems

Image Recognition: Detection, Tracking and Classification

Applications