

# Lecture Notes in Artificial Intelligence 6334

Edited by R. Goebel, J. Siekmann, and W. Wahlster

Subseries of Lecture Notes in Computer Science

Yiyu Yao Ron Sun Tomaso Poggio  
Jiming Liu Ning Zhong Jimmy Huang (Eds.)

# Brain Informatics

International Conference, BI 2010  
Toronto, ON, Canada, August 28-30, 2010  
Proceedings

## Series Editors

Randy Goebel, University of Alberta, Edmonton, Canada

Jörg Siekmann, University of Saarland, Saarbrücken, Germany

Wolfgang Wahlster, DFKI and University of Saarland, Saarbrücken, Germany

## Volume Editors

Yiyu Yao

University of Regina, Regina, SK, Canada

E-mail: yyao@cs.uregina.ca

Ron Sun

Rensselaer Polytechnic Institute, Troy, NY, USA

E-mail: rsun@rpi.edu

Tomaso Poggio

Massachusetts Institute of Technology, Cambridge, MA, USA

E-mail: tp@ai.mit.edu

Jiming Liu

Hong Kong Baptist University, Kowloon Tong, Hong Kong

E-mail: jiming@comp.hkbu.edu.hk

Ning Zhong

Maebashi Institute of Technology, Maebashi-City, Japan

E-mail: zhong@maebashi-it.ac.jp

Jimmy Huang

York University, Toronto, ON, Canada

E-mail: jhuang@yorku.ca

Library of Congress Control Number: 2010932525

CR Subject Classification (1998): I.2, I.4, I.5, H.3, H.5, H.4

LNCS Sublibrary: SL 7 – Artificial Intelligence

ISSN 0302-9743

ISBN-10 3-642-15313-5 Springer Berlin Heidelberg New York

ISBN-13 978-3-642-15313-6 Springer Berlin Heidelberg New York

This work is subject to copyright. All rights are reserved, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, re-use of illustrations, recitation, broadcasting, reproduction on microfilms or in any other way, and storage in data banks. Duplication of this publication or parts thereof is permitted only under the provisions of the German Copyright Law of September 9, 1965, in its current version, and permission for use must always be obtained from Springer. Violations are liable to prosecution under the German Copyright Law.

springer.com

© Springer-Verlag Berlin Heidelberg 2010

Printed in Germany

Typesetting: Camera-ready by author, data conversion by Scientific Publishing Services, Chennai, India

Printed on acid-free paper 06/3180

# Preface

This volume contains the papers selected for presentation at *The 2010 International Conference on Brain Informatics* (BI 2010) held at York University, Toronto, Canada, during August 28–30, 2010. It was organized by the Web Intelligence Consortium (WIC), the IEEE Computational Intelligence Society Task Force on Brain Informatics (IEEE-CIS TF-BI), and York University. The conference was held jointly with the 2010 International Conference on Active Media Technology (AMT 2010).

*Brain informatics* (BI) has emerged as an interdisciplinary research field that focuses on studying the mechanisms underlying the human information processing system (HIPS). It investigates the essential functions of the brain, ranging from perception to thinking, and encompassing such areas as multi-perception, attention, memory, language, computation, heuristic search, reasoning, planning, decision-making, problem-solving, learning, discovery, and creativity. The goal of BI is to develop and demonstrate a systematic approach to achieving an integrated understanding of both macroscopic and microscopic-level working principles of the brain, by means of experimental, computational, and cognitive neuroscience studies, as well as utilizing advanced Web intelligence (WI)-centric information technologies. BI represents a potentially revolutionary shift in the way that research is undertaken. It attempts to capture new forms of collaborative and interdisciplinary work. In this vision, new kinds of BI methods and global research communities will emerge, through infrastructure on the wisdom Web and knowledge grids that enable high-speed and distributed, large-scale analysis and computations, and radically new ways of sharing data/knowledge.

The Brain Informatics Conferences started with the First WICI International Workshop on Web Intelligence meets Brain Informatics (WImBI 2006), held at Beijing, China, December 15–16, 2006. The second conference, Brain Informatics 2009, was held again in Beijing, China, October 22–24, 2009. This series is the first conference specifically dedicated to interdisciplinary research in BI and provides an international forum to bring together researchers and practitioners from diverse fields, such as computer science, information technology, artificial intelligence, Web intelligence, cognitive science, neuroscience, medical science, life science, economics, data mining, data science and knowledge science, intelligent agent technology, human–computer interaction, complex systems, and systems science, to present the state of the art in the development of BI, and to explore the main research problems in BI that lie in the interplay between the studies of the human brain and the research of informatics. All the papers submitted to BI 2010 were rigorously reviewed by three committee members and external reviewers. The selected papers offered new insights into the research challenges and development of BI.

There are bidirectional mutual support tracks of BI research. In one direction, one models and characterizes the functions of the human brain based on the notions of information processing systems. WI-centric information technologies are applied to support brain science studies. For instance, the wisdom Web, knowledge grids, and cloud computing enable high-speed, large-scale analysis, simulation, and computation as well as new ways of sharing research data and scientific discoveries. In another direction, informatics-enabled brain studies, e.g., based on fMRI, EEG, and MEG, significantly broaden the spectrum of theories and models of brain sciences and offer new insights into the development of human-level intelligence toward brain-inspired wisdom Web computing.

BI 2010 had a very exciting program with many features, ranging from keynote talks, regular technical sessions, WIC featured sessions and social programs. All of these would not have been possible without the great support of the authors in submitting and presenting their best and latest research results, the distinguished contributions of keynote speakers, Vinod Goel (York University, Canada), Jianhua Ma (Hosei University, Japan), Ben Shneiderman (University of Maryland, USA) and Yingxu Wang (University of Calgary, Canada), in preparing and delivering their very stimulating talks, and the generous dedication of the Program Committee members and the external reviewers in reviewing the submitted papers. We wish to express our gratitude to all authors, the keynote speakers, and the members of the Conference Committees for their instrumental and unfailing support.

BI 2010 could not have taken place without the great team effort of the Local Organizing Committee, the support of the International WIC Institute, Beijing University of Technology, China and York University, Canada. Our special thanks go to Aijun An, Juzhen Dong, Jian Yang, and Daniel Tao for organizing and promoting BI 2010 and coordinating with AMT 2010. We are grateful to the Springer *Lecture Notes in Computer Science* (LNCS/LNAI) team for their generous support. We thank Alfred Hofmann and Anna Kramer of Springer for their help in coordinating the publication of this special volume in an emerging and interdisciplinary research field.

August 2010

Yiyu Yao  
 Ron Sun  
 Tomaso Poggio  
 Jiming Liu  
 Ning Zhong  
 Jimmy Huang

# Conference Organization

## Conference General Chairs

Tomaso Poggio	Massachusetts Institute of Technology, USA
Jiming Liu	International WIC Institute, Beijing University of Technology, China Hong Kong Baptist University, Hong Kong

## Program Chairs

Yiyu Yao	International WIC Institute, Beijing University of Technology, China University of Regina, Canada
Ron Sun	Rensselaer Polytechnic Institute, USA

## Organizing Chair

Jimmy Huang	York University, Toronto, Canada
-------------	----------------------------------

## Publicity Chairs

Jian Yang	International WIC Institute, Beijing University of Technology, China
Daniel Tao	Queensland University of Technology, Australia

## IEEE-CIS TF-BI Chair

Ning Zhong	Maebashi Institute of Technology, Japan International WIC Institute, Beijing University of Technology, China
------------	--

## WIC Co-chairs/Directors

Ning Zhong	Maebashi Institute of Technology, Japan
Jiming Liu	Hong Kong Baptist University, Hong Kong

## WIC Advisory Board

Edward A. Feigenbaum	Stanford University, USA
Setsuo Ohsuga	University of Tokyo, Japan

Benjamin Wah	University of Illinois, Urbana-Champaign, USA
Philip Yu	University of Illinois, Chicago, USA
L.A. Zadeh	University of California, Berkeley, USA

## WIC Technical Committee

Jeffrey Bradshaw	UWF/Institute for Human and Machine Cognition, USA
Nick Cercone	York University, Canada
Dieter Fensel	University of Innsbruck, Austria
Georg Gottlob	Oxford University, UK
Lakhmi Jain	University of South Australia, Australia
Jianchang Mao	Yahoo! Inc., USA
Pierre Morizet-Mahoudeaux	Compiègne University of Technology, France
Hiroshi Motoda	Osaka University, Japan
Toyoaki Nishida	Kyoto University, Japan
Andrzej Skowron	Warsaw University, Poland
Jinglong Wu	Okayama University, Japan
Xindong Wu	University of Vermont, USA
Yiyu Yao	University of Regina, Canada

## Program Committee

John R. Anderson	Carnegie Mellon University, USA
Chang Cai	National Rehabilitation Center for Persons with Disabilities, Japan
Xiaocong Fan	The Pennsylvania State University, USA
Mohand-Said Hacid	Universite Claude Bernard Lyon 1, France
D. Frank Hsu	Fordham University, USA
Kazuyuki Imamura	Maebashi Institute of Technology, Japan
Kuncheng Li	Xuanwu Hospital, China
Peipeng Liang	Beijing University of Technology, China
Pawan Lingras	Saint Mary's University, Canada
Duoqian Miao	Tongji University, China
Mariofanna Milanova	University of Arkansas at Little Rock, USA
Sankar Kumar Pal	Indian Statistical Institute, India
Frank Ritter	Penn State University, USA
Hideyuki Sawada	Kagawa University, Japan
Lael Schooler	Max Planck Institute for Human Development, Germany
Tomoaki Shirao	Gunma University Graduate School of Medicine, Japan
Andrzej Skowron	Warsaw University, Poland
Dominik Slezak	University of Warsaw and Infobright Inc., Poland

Diego Sona	Fondazione Bruno Kessler, Italy
Piotr S. Szczepaniak	Technical University of Lodz, Poland
Shusaku Tsumoto	Shimane University, Japan
Frank van der Velde	Leiden University, The Netherlands
Guoyin Wang	Chongqing University of Posts and Telecommunications, China
Jinglong Wu	Okayama University, Japan
Jian Yang	International WIC Institute, Beijing University of Technology, China
Fabio Massimo Zanzotto	University of Rome “Tor Vergata”, Italy
Bo Zhang	Tsinghua University, China
Yanqing Zhang	Georgia State University, USA
Ning Zhong	Maebashi Institute of Technology, Japan
Haiyan Zhou	International WIC Institute, Beijing University of Technology, China
Yangyong Zhu	Fudan University, China

## Additional Reviewers

Paolo Avesani	Yang Mei	Andrea Mognon
Emanuele Olivetti	Linchang Qin	Shujuan Zhang



# Table of Contents

## Keynote Talks

Fractionating the Rational Brain.....	1
<i>Vinod Goel</i>	
Cognitive Informatics and Denotational Mathematical Means for Brain Informatics.....	2
<i>Yingxu Wang</i>	

## Cognitive Computing

An Adaptive Model for Dynamics of Desiring and Feeling Based on Hebbian Learning.....	14
<i>Tibor Bosse, Mark Hoogendoorn, Zulfiqar A. Memon, Jan Treur, and Muhammad Umair</i>	
Modelling the Emergence of Group Decisions Based on Mirroring and Somatic Marking.....	29
<i>Mark Hoogendoorn, Jan Treur, C. Natalie van der Wal, and Arlette van Wissen</i>	
Rank-Score Characteristics (RSC) Function and Cognitive Diversity....	42
<i>D. Frank Hsu, Bruce S. Kristal, and Christina Schweikert</i>	
Cognitive Effort for Multi-agent Systems.....	55
<i>Luca Longo and Stephen Barrett</i>	
Behavioural Abstraction of Agent Models Addressing Mutual Interaction of Cognitive and Affective Processes.....	67
<i>Alexei Sharpanskykh and Jan Treur</i>	

## Data Brain and Analysis

The Effect of the Normalization Strategy on Voxel-Based Analysis of DTI Images: A Pattern Recognition Based Assessment.....	78
<i>Gloria Díaz, Gonzalo Pajares, Eduardo Romero, Juan Alvarez-Linera, Eva López, Juan Antonio Hernández-Tamames, and Norberto Malpica</i>	

Single Trial Classification of EEG and Peripheral Physiological Signals for Recognition of Emotions Induced by Music Videos .....	89
<i>Sander Koelstra, Ashkan Yazdani, Mohammad Soleymani, Christian Mühl, Jong-Seok Lee, Anton Nijholt, Thierry Pun, Touradj Ebrahimi, and Ioannis Patras</i>	
Brain Signal Recognition and Conversion towards Symbiosis with Ambulatory Humanoids .....	101
<i>Yasuo Matsuyama, Keita Noguchi, Takashi Hatakeyama, Nimiko Ochiai, and Tatsuro Hori</i>	
Feature Rating by Random Subspaces for Functional Brain Mapping ...	112
<i>Diego Sona and Paolo Avesani</i>	
Recurrence Plots for Identifying Memory Components in Single-Trial EEGs .....	124
<i>Nasibeh Talebi and Ali Motie Nasrabadi</i>	
Comparing EEG/ERP-Like and fMRI-Like Techniques for Reading Machine Thoughts .....	133
<i>Fabio Massimo Zanzotto and Danilo Croce</i>	
Improving Individual Identification in Security Check with an EEG Based Biometric Solution .....	145
<i>Qinglin Zhao, Hong Peng, Bin Hu, Quanying Liu, Li Liu, YanBing Qi, and Lanlan Li</i>	
<b>Neuronal Modeling and Brain Modeling</b>	
Segmentation of 3D Brain Structures Using the Bayesian Generalized Fast Marching Method .....	156
<i>Mohamed Baghdadi, Nacéra Benamrane, and Lakhdar Sais</i>	
Domain-Specific Modeling as a Pragmatic Approach to Neuronal Model Descriptions .....	168
<i>Ralf Ansorg and Lars Schwabe</i>	
Guessing What's on Your Mind: Using the N400 in Brain Computer Interfaces .....	180
<i>Marijn van Vliet, Christian Mühl, Boris Reuderink, and Mannes Poel</i>	
A Brain Data Integration Model Based on Multiple Ontology and Semantic Similarity .....	192
<i>Li Xue, Yun Xiong, and Yangyong Zhu</i>	

## Perception and Information Processing

How Does Repetition of Signals Increase Precision of Numerical Judgment? .....	200
<i>Eike B. Kroll, Jörg Rieger, and Bodo Vogt</i>	
Sparse Regression Models of Pain Perception .....	212
<i>Irina Rish, Guillermo A. Cecchi, Marwan N. Baliki, and A. Vania Apkarian</i>	
A Study of Mozart Effect on Arousal, Mood, and Attentional Blink ....	224
<i>Chen Xie, Lun Zhao, Duoqian Miao, Deng Wang, Zhihua Wei, and Hongyun Zhang</i>	

## Learning

Attentional Disengage from Test-Related Pictures in Test-Anxious Students: Evidence from Event-Related Potentials .....	232
<i>Rui Chen and Renlai Zhou</i>	
Concept Learning in Text Comprehension .....	240
<i>Manas Hardas and Javed Khan</i>	
A Qualitative Approach of Learning in Parkinson's Disease .....	252
<i>Delphine Penny-Leguy and Josiane Caron-Pargue</i>	

## Cognition-Inspired Applications

Modelling Caregiving Interactions during Stress .....	263
<i>Azizi Ab Aziz, Jan Treur, and C. Natalie van der Wal</i>	
Computational Modeling and Analysis of Therapeutical Interventions for Depression .....	274
<i>Fiemke Both, Mark Hoogendoorn, Michel C.A. Klein, and Jan Treur</i>	
A Time Series Based Method for Analyzing and Predicting Personalized Medical Data .....	288
<i>Qinwin Vivian Hu, Xiangji Jimmy Huang, William Melek, and C. Joseph Kurian</i>	
Language Analytics for Assessing Brain Health: Cognitive Impairment, Depression and Pre-symptomatic Alzheimer's Disease .....	299
<i>William L. Jarrold, Bart Peintner, Eric Yeh, Ruth Krasnow, Harold S. Javitz, and Gary E. Swan</i>	
The Effect of Sequence Complexity on the Construction of Protein-Protein Interaction Networks .....	308
<i>Mehdi Kargar and Aijun An</i>	

Data Fusion and Feature Selection for Alzheimer's Diagnosis . . . . .	320
<i>Blake Lemoine, Sara Rayburn, and Ryan Benton</i>	
A Cognitive Architecture Based on Neuroscience for the Control of Virtual 3D Human Creatures . . . . .	328
<i>Felipe Rodríguez, Francisco Galvan, Félix Ramos, Erick Castellanos, Gregorio García, and Pablo Covarrubias</i>	
Towards Inexpensive BCI Control for Wheelchair Navigation in the Enabled Environment – A Hardware Survey . . . . .	336
<i>Kenyon Stamps and Yskandar Hamam</i>	
Expression Recognition Methods Based on Feature Fusion . . . . .	346
<i>Chang Su, Jiefang Deng, Yong Yang, and Guoyin Wang</i>	
Investigation on Human Characteristics of Japanese Katakana Recognition by Active Touch . . . . .	357
<i>Suguru Yokotani, Jiajia Yang, and Jinglong Wu</i>	

## WICI Perspectives on Brain Informatics

Towards Systematic Human Brain Data Management Using a Data-Brain Based GLS-BI System . . . . .	365
<i>Jianhui Chen, Ning Zhong, and Runhe Huang</i>	
The Role of the Parahippocampal Cortex in Memory Encoding and Retrieval: An fMRI Study . . . . .	377
<i>Mi Li, Shengfu Lu, Jiaojiao Li, and Ning Zhong</i>	
Brain Activation and Deactivation in Human Inductive Reasoning: An fMRI Study . . . . .	387
<i>Peipeng Liang, Yang Mei, Xiuqin Jia, Yanhui Yang, Shengfu Lu, Ning Zhong, and Kuncheng Li</i>	
Clustering of fMRI Data Using Affinity Propagation . . . . .	399
<i>Dazhong Liu, Wanxuan Lu, and Ning Zhong</i>	
Interaction between Visual Attention and Goal Control for Speeding Up Human Heuristic Search . . . . .	407
<i>Rifeng Wang, Jie Xiang, and Ning Zhong</i>	
The Role of Posterior Parietal Cortex in Problem Representation . . . . .	417
<i>Jie Xiang, Yulin Qin, Junjie Chen, Haiyan Zhou, Kuncheng Li, and Ning Zhong</i>	
Basic Level Advantage and Its Switching during Information Retrieval: An fMRI Study . . . . .	427
<i>Haiyan Zhou, Jieyu Liu, Wei Jing, Yulin Qin, Shengfu Lu, Yiyu Yao, and Ning Zhong</i>	
<b>Author Index . . . . .</b>	<b>437</b>