

## Editor-in-Chief

*Kai Rannenberg, Goethe University Frankfurt, Germany*

## Editorial Board

TC 1 – Foundations of Computer Science

*Jacques Sakarovitch, Télécom ParisTech, France*

TC 2 – Software: Theory and Practice

*Michael Goedicke, University of Duisburg-Essen, Germany*

TC 3 – Education

*Arthur Tatnall, Victoria University, Melbourne, Australia*

TC 5 – Information Technology Applications

*Erich J. Neuhold, University of Vienna, Austria*

TC 6 – Communication Systems

*Aiko Pras, University of Twente, Enschede, The Netherlands*

TC 7 – System Modeling and Optimization

*Fredi Tröltzsch, TU Berlin, Germany*

TC 8 – Information Systems

*Jan Pries-Heje, Roskilde University, Denmark*

TC 9 – ICT and Society

*Diane Whitehouse, The Castlegate Consultancy, Malton, UK*

TC 10 – Computer Systems Technology

*Ricardo Reis, Federal University of Rio Grande do Sul, Porto Alegre, Brazil*

TC 11 – Security and Privacy Protection in Information Processing Systems

*Steven Furnell, Plymouth University, UK*

TC 12 – Artificial Intelligence

*Ulrich Furbach, University of Koblenz-Landau, Germany*

TC 13 – Human-Computer Interaction

*Marco Winckler, University Paul Sabatier, Toulouse, France*

TC 14 – Entertainment Computing

*Matthias Rauterberg, Eindhoven University of Technology, The Netherlands*

## **IFIP – The International Federation for Information Processing**

IFIP was founded in 1960 under the auspices of UNESCO, following the first World Computer Congress held in Paris the previous year. A federation for societies working in information processing, IFIP's aim is two-fold: to support information processing in the countries of its members and to encourage technology transfer to developing nations. As its mission statement clearly states:

*IFIP is the global non-profit federation of societies of ICT professionals that aims at achieving a worldwide professional and socially responsible development and application of information and communication technologies.*

IFIP is a non-profit-making organization, run almost solely by 2500 volunteers. It operates through a number of technical committees and working groups, which organize events and publications. IFIP's events range from large international open conferences to working conferences and local seminars.

The flagship event is the IFIP World Computer Congress, at which both invited and contributed papers are presented. Contributed papers are rigorously refereed and the rejection rate is high.

As with the Congress, participation in the open conferences is open to all and papers may be invited or submitted. Again, submitted papers are stringently refereed.

The working conferences are structured differently. They are usually run by a working group and attendance is generally smaller and occasionally by invitation only. Their purpose is to create an atmosphere conducive to innovation and development. Refereeing is also rigorous and papers are subjected to extensive group discussion.

Publications arising from IFIP events vary. The papers presented at the IFIP World Computer Congress and at open conferences are published as conference proceedings, while the results of the working conferences are often published as collections of selected and edited papers.

IFIP distinguishes three types of institutional membership: Country Representative Members, Members at Large, and Associate Members. The type of organization that can apply for membership is a wide variety and includes national or international societies of individual computer scientists/ICT professionals, associations or federations of such societies, government institutions/government related organizations, national or international research institutes or consortia, universities, academies of sciences, companies, national or international associations or federations of companies.

More information about this series at <http://www.springer.com/series/6102>

Zhongzhi Shi · Ben Goertzel  
Jiali Feng (Eds.)

# Intelligence Science I

Second IFIP TC 12 International Conference, ICIS 2017  
Shanghai, China, October 25–28, 2017  
Proceedings

*Editors*

Zhongzhi Shi  
Chinese Academy of Sciences  
Beijing  
China

Jiali Feng  
Shanghai Maritime University  
Shanghai  
China

Ben Goertzel  
Machine Intelligence Research Institute  
Rockville, MD  
USA

ISSN 1868-4238                      ISSN 1868-422X (electronic)  
IFIP Advances in Information and Communication Technology  
ISBN 978-3-319-68120-7              ISBN 978-3-319-68121-4 (eBook)  
DOI 10.1007/978-3-319-68121-4

Library of Congress Control Number: 2017954896

© IFIP International Federation for Information Processing 2017

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 Springer Nature  
The registered company is Springer International Publishing AG  
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

## Preface

This volume comprises the proceedings of the Second International Conference on Intelligence Science (ICIS). Artificial intelligence research has made substantial progress in special areas. However, deeper understanding of the essence of intelligence is far from sufficient and, therefore, many state-of-the-art intelligent systems are still not able to compete with human intelligence. To advance research in artificial intelligence, it is necessary to investigate intelligence, both artificial and natural, in an interdisciplinary context. The objective of this conference is to bring together researchers from brain science, cognitive science, and artificial intelligence to explore the essence of intelligence and related technologies. The conference provides a platform for the discussion of key issues related to intelligence science.

For the Second International Conference on Intelligence Science (ICIS 2017), we received more than 82 papers, of which 39 papers are included in this program as regular papers and nine as short papers. We are grateful for the dedicated work of both the authors and the referees, and we hope these proceedings will continue to bear fruit over the years to come. All papers submitted were reviewed by three referees.

A conference such as this cannot succeed without help from many individuals who contribute their valuable time and expertise. We want to express our sincere gratitude to the Program Committee members and referees, who invested many hours for reviews and deliberations. They provided detailed and constructive review reports that significantly improved the papers included in the program.

We are very grateful for the sponsorship of the following organizations: Chinese Association for Artificial Intelligence (CAAI), IFIP TC12, China Chapter of International Society for Information Studies, Shanghai Maritime University, Shanghai Society for Noetic Science. The event was co-sponsored by the Shanghai Association for Science and Technology (SAST), Shanghai Association for Artificial Intelligence (SAAI), Shanghai Logic Association (SLA), IEEE Shanghai Chapter, and Institute of Computing Technology, Chinese Academy of Sciences. Thanks to Professor Xiaofeng Wang for his role as chair of the Organizing Committee.

Finally, we hope you find this volume inspiring and informative.

August 2017

Zhongzhi Shi  
Ben Goertzel  
Jiali Feng

# Organization

## Sponsors

Chinese Association for Artificial Intelligence (CAAI)  
China Chapter under International Society for Information Studies

## Co-sponsors

IFIP Technical Committee 12  
Shanghai Association for Science and Technology (SAST)  
Shanghai Association for Artificial Intelligence (SAAI)  
Shanghai Logic Association (SLA)  
IEEE Shanghai Section Joint Chapter  
Science and Technology on Information Systems Engineering Laboratory,  
National University of Defense Technology

## Organizers

Shanghai Maritime University  
Shanghai Association for Noetic Science

## Supporters

Shanghai Municipal Commission of Economy and Informatization  
Shanghai Association for Science and Technology (SAST)

## Steering Committee

Muming Poo	Chinese Academy of Sciences, China
Xiongli Yang	Fudan University, China
Changjun Jiang	Donghua University, China
Aoying Zhou	East China Normal University, China
Guangjian Zhang	Chinese Association for Noetic Science, China

## General Chairs

Yixin Zhong	Beijing University of Posts and Telecommunications, China
Youfang Huang	Shanghai Maritime University, China
Karlheinz Meier	Heidelberg University, Germany

## Program Chairs

Zhongzhi Shi	Institute of Computing Technology, Chinese Academy of Sciences, China
Ben Goertzel	Machine Intelligence Research Institute, USA
Jiali Feng	Shanghai Maritime University, China

## Program Committee

Agnar Aamodt, Norway	Qingyong Li, China
Ansguar Bernardi, Germany	Wu Li, China
Jean-Yves Beziau, Brazil	Xiaoli Li, Singapore
Guoqiang. Bi, China	Yu Li, France
Joseph E. Brenner, Switzerland	Jiye. Liang, China
Jiang Cai, China	Chenglin Liu, China
Wen Cai, China	Derong Liu, China
Jinde Cao, China	Zengliang Liu, China
Mihir Kr. Chakraborty, India	Jiansu Luo, China
Dongsheng Chen, China	Ping Luo, China
Huanhuan Chen, China	Xudong Luo, China
Weineng Chen, China	Shaoping Ma, China
Zhicheng Chen, China	Pedro C. Marijuán, Spain
Zhihua Cui, China	Shimin Meng, China
Shifei. Ding, China	Zuqiang Meng, China
Gordana Dodig-Crnkovic, Sweden	Eunika Mercier-Laurent, France
Elias Ehlers, South Africa	Duoqian Miao, China
Jiali Feng, China	Miec Owoc, Poland
Xiaolan Fu, China	He Ouyang, China
Urich Furbach, Germany	Gang. Pan, China
Junbao Gao, China	Yan Peng, China
Xiaozhi Gao, China	Xi Peng, China
Ping Guo, China	Germano Resconi, Italy
Xiaokun Guo, China	Fuji Ren, Japan
Huacan He, China	Paul S. Rosenbloom, USA
Tzung-Pei Hong, Taiwan	Qiangjin Shao, China
Jincai Huang, China	Yinghuan Shi, China
Zhisheng Huang, The Netherlands	Yuhui Shi, China
Changjun Jiang, China	Zhongzhi Shi, China
Xiaoqian Jiang, USA	Katsunori Shimohara, Japan
Shengming Jiang, China	Bailu. Si, China
Licheng Jiao, China	Andreej Skowron, Poland
Yaochu Jin, UK	Fuchun Sun, China
Glgun Kayakutlu, Turkey	Chaoli Sun, China
Dehua Li, China	Huajin Tang, China
Gang Li, Australia	Lorna Uden, UK
Jiuyong Li, Australia	S. Vadera, UK

Lei Wang, China	Dezhong Yao, China
Guoying. Wang, China	Yiyu Yao, Canada
Jianyong Wang, China	Kun Yue, China
Lei Wang, China	Dajun Zeng, China
Li Wang, China	Weiming Zeng, China
Pei Wang, USA	Yi Zeng, China
Peizhuang Wang, China	Guangjian Zhang, China
Shuang Wang, China	Jun Zhang, China
Wansen Wang, China	Junping Zhang, China
Xiaofeng Wang, China	Liqing. Zhang, China
Xiaojie Wang, China	Xiaohong Zhang, China
Guolin Wu, China	Yi Zhang, China
Kun Wu, China	Yinsheng Zhang, China
Yi Wu, China	Chuan Zhao, China
Xiangqian Wu, China	Keqin Zhao, China
Xiaolan Xie, China	Yixin Zhong, China
Hui Xiong, USA	Jinglun Zhou, China
Guibao Xu, China	Rigui Zhou, China
Guilin Xu, China	Zhihua Zhou, China
Xinzheng Xu, China	Yueting Zhuang, China
Yubin Yang, China	Jun. Zhu, China
Zhen Yang, China	Xiaohui Zou, China

## **Organizing Committee**

### **Chairs**

Xiaofeng Wang	Shanghai Maritime University and Shanghai Association for Noetic Science, China
Rigui Zhou	Shanghai Maritime University, China

### **Secretary General**

Jin Liu	Shanghai Maritime University, China
---------	-------------------------------------

### **Local Arrangements Chair**

Miao Song	Shanghai Maritime University, China
-----------	-------------------------------------

### **Finance Chair**

Han Zhang	Shanghai Maritime University, China Email: hanzhang@shmtu.edu.cn
-----------	---

### **Publication Chair**

Junbo Gao	Shanghai Maritime University, China
-----------	-------------------------------------

**Publicity Chair**

Min Liu

Shanghai Maritime University, China

**International Liaison**

Hong Zhu

Shanghai Maritime University, China  
Email: hongzhu@shmtu.edu.cn

**Keynote and  
Invited Presentations**

# Pattern Recognition by the Brain: Neural Circuit Mechanisms

Mu-ming Poo

Institute of Neuroscience, Chinese Academy of Sciences,  
and CAS Center for Excellence in Brain Science and Intelligence Technology

**Abstract.** The brain acquires the ability of pattern recognition through learning. Understanding neural circuit mechanisms underlying learning and memory is thus essential for understanding how the brain recognizes patterns. Much progress has been made in this area of neuroscience during the past decades. In this lecture, I will summarize three distinct features of neural circuits that provide the basis of learning and memory of neural information, and pattern recognition. First, the architecture of the neural circuits is continuously modified by experience. This process of experience-induced sculpting (pruning) of connections is most prominent early in development and decreases gradually to a much more limited extent in the adult brain. Second, the efficacy of synaptic transmission could be modified by neural activities associated with experience, in a manner that depends on the pattern (frequency and timing) of spikes in the pre- and postsynaptic neurons. This activity-induced circuit alteration in the form of long-term potentiation (LTP) and long-term depression (LTD) of existing synaptic connections is the predominant mechanism underlying learning and memory of the adult brain. Third, learning and memory of information containing multiple modalities, e.g., visual, auditory, and tactile signals, involves processing of each type of signals by different circuits for different modalities, as well as binding of processed multimodal signals through mechanisms that remain to be elucidated. Two potential mechanisms for binding of multimodal signals will be discussed: binding of signals through converging connections to circuits specialized for integration of multimodal signals, and binding of signals through correlated firing of neuronal assemblies that are established in circuits for processing signals of different modalities. Incorporation of these features into artificial neural networks may help to achieve more efficient pattern recognition, especially for recognition of time-varying multimodal signals.

# Interactive Granular Computing: Toward Computing Model for Turing Test

Andrzej Skowron

University of Warsaw and Systems Research Institute PAS  
skowron@mimuw.edu.pl

*The Turing test, as originally conceived, focused on language and reasoning; problems of perception and action were conspicuously absent.*

— *Ch. L. Ortiz Jr. Why we need a physically embodied Turing test and what it might look like, AI Magazine 37(1) 55–62 (2016).*

**Abstract.** We extended Granular Computing (GrC) to Interactive Granular Computing (IGrC) by introducing complex granules (c-granules or granules, for short). They are grounded in the physical reality and are responsible for generation of the information systems (data tables) through interactions with the physical objects. These information systems are next aggregated as a part of networks of information systems (decision systems) in the search of relevant computational building blocks (patterns or classifiers) for initiating actions or plans or understanding behavioral patterns of swarms of c-granules (in particular, agents) satisfying the user's needs to a satisfactory degree. Agents performing computations based on interaction with the physical environment learn rules of behavior, representing knowledge not known a priori by agents. Numerous tasks of agents may be classified as control tasks performed by agents aiming at achieving the high quality computational trajectories relative to the considered quality measures over the trajectories. Here, e.g., new challenges are related to developing strategies for predicting and controlling the behavior of agents. We propose to investigate these challenges using the IGrC framework. The reasoning used for controlling of computations is based on adaptive judgment. The adaptive judgment is more than a mixture of reasoning based on deduction, induction and abduction. IGrC is based on perception of situations in the physical world with the use of experience. Hence, the theory of judgment has a place not only in logic but also in psychology and phenomenology. This reasoning deals with c-granules and computations over them. Due to the uncertainty the agents generally cannot predict exactly the results of actions (or plans). Moreover, the approximations of the complex vague concepts, e.g., initiating actions (or plans) are drifting with time. Hence, adaptive strategies for evolving approximations of concepts are needed. In particular, the adaptive judgment is very much needed in the efficiency management of granular computations, carried out by agents, for risk assessment, risk treatment, and cost/benefit analysis.

**Keywords:** (Interactive) Granular computing • Complex granule • Adaptive judgment • Interaction rule • Rough sets, Adaptive approximation of complex vague concepts and games • Risk management

# Optimal Mass Transportation Theory Applied for Machine Learning

David Xianfeng Gu

Computer Science Department, State University of New York at Stony Brook,  
USA

gu@cs.stonybrook.edu

**Abstract.** Optimal mass transportation (OMT) theory bridges geometry and probability, it offers a powerful tool for modeling probability distributions and measuring the distance between distributions. Recently, the concepts and method of optimal mass transportation theory have been adapted into the field of Machine Learning. It interprets the principle of machine learning from different perspective and points out new direction for improving machine learning algorithms.

This work introduces the fundamental concepts and principles of optimal mass transportation, explains how to use OMT framework to represent probability distributions, measure the distance among the distributions, reduce dimensions, approximate the distributions. In general, the machine learning principles and characteristics are explained from the point of view of OMT.

# Quantifying Your Brain and Identifying Brain Disease Roots

Jianfeng Feng<sup>1,2</sup>

<sup>1</sup> Warwick University, UK

<sup>2</sup> Fudan University, China

**Abstract.** With the available data of huge samples for the whole spectrum of scales both for healthy controls and patients including depression, autism and schizophrenia etc, we are in the position to quantify human brain activities such as creativity, happiness, IQ and EQ etc and search the roots of various mental disorders. With novel machine learning approaches, we first introduced functional entropy and entropy rate of resting state to characterize the dynamic behaviour of our brain. It is further found that the functional entropy is an increasing function of age, but a decreasing function of creativity and IQ. Its biological mechanisms are explored. With the brain wide associate study approach, for the first time in the literature we are able to identify the roots of a few mental disorders. For example, for depression, we found that the most altered regions are located in the lateral and medial orbitofrontal cortex for punishment and reward. Follow up rTMS at the lateral orbitofrontal cortex demonstrated the significant outcomes of the treatments.

# Multi-objective Ensemble Learning and Its Applications

XinYao

Department of Computer Science and Engineering,  
Southern University of Science and Technology, Shenzhen, 518055, China  
xiny@sustc.edu.cn

**Abstract.** Multi-objective learning might be a strange concept as some people thought that the only objective in learning would be to maximise the generalisation ability of a learner. What else do you need, one might ask. It turns out that there are different perspectives and aspects to learning. First, machine learning is almost always formulated as an optimisation problem by defining a cost function, an energy function, an error function, or whatever-it-is-called function. Once this function is defined, the rest is the development (or the direct application) of an optimisation algorithm. Interestingly, most of such functions have more than one term. For example, it is not uncommon for such a function to include a loss term and a regularisation term, which then have to be balanced by a parameter (hyper-parameter). Much research work in the literature has been devoted to the setting and tuning of such a hyper-parameter. However, loss and regularisation are clearly two conflicting objectives from the perspective of multi-objective optimisation. Why not treat these two objectives separately so that we do not have to tune the hyper-parameter? The first part of this talk explains how this is done [1, 2] and what the potential advantages and disadvantages are. Second, measuring the error of a machine learner is not always as straightforward as one might think. Different people may use different metrics. It is not always clear how different metrics relate to each other and whether a learner performs well under one metric would look very poor according to a different metric. The second part of this talk gives an example in software effort estimation, where a more robust learner is trained using multi-objective learning, which performs well under different metrics [3]. The third and last part of this talk is devoted to two important areas in machine learning, i.e., online learning with concept drift [4] and class imbalance learning [5, 6]. Multi-objective learning in these two areas will be introduced.

## References

1. Chandra, A., Yao, X.: Ensemble learning using multi-objective evolutionary algorithms. *J. Math. Model. Algorithms* **5**(4), 417–445 (2006)
2. Chen, H., Yao, X.: Multiobjective neural network ensembles based on regularized negative correlation learning. *IEEE Trans. Knowl. Data Eng.* **22**(12), 1738–1751 (2010)
3. Minku, L.L., Yao, X.: Software effort estimation as a multi-objective learning problem. *ACM Trans. Softw. Eng. Methodol.* **22**(4), 32 (2013). Article No. 35

4. Wang, S., Minku, L., Yao, X.: A multi-objective ensemble method for online class imbalance learning. In: Proceedings of the 2014 International Joint Conference on Neural Networks, IJCNN 2014, pp. 3311–3318. IEEE Press, July 2014
5. Wang, P., Emmerich, M., Li, R., Tang, K., Baeck, T., Yao, X.: Convex hull-based multi-objective genetic programming for maximizing receiver operating characteristic performance. *IEEE Trans. Evol. Comput.* **19**(2), 188–200 (2015)
6. Bhowan, U., Johnston, M., Zhang, M., Yao, X.: Reusing genetic programming for ensemble selection in classification of unbalanced data. *IEEE Trans. Evol. Comput.* **18**(6), 893–908 (2014)

# On Intelligence: Symbiotic, Holonic, and Immunological Agents

Elizabeth Marie Ehlers

Academy of Computer Science and Software Engineering,  
University of Johannesburg, South Africa  
emehlers@uj.ac.za

**Abstract.** Currently, Artificial Intelligence has become a focal point of interest in the development of new and innovative applications in modern technology. The presentation will discuss and compare symbiotic, holonic, and immunological agents. Immunological agency will be considered in the context of biologically inspired Artificial Intelligence techniques as it is based on the advantageous adaptive properties of the vertebrate immune system. Furthermore, the discussion will explore how these types of agent can contribute to realizing intelligence in applications such as mentioned above.

# **Extreme Learning Machines (ELM) – Filling the Gap between Machine Learning and Biological Learning**

Guang-Bin Huang

School of Electrical and Electronic Engineering,  
Nanyang Technological University, Singapore

**Abstract.** One of the most curious in the world is how brains produce intelligence. Brains have been considered one of the most complicated things in the universe. Machine learning and biological learning are often considered separate topics in the years. The objectives of this talk are three-folds: (1) It will analyse the differences and relationships between artificial intelligence and machine learning, and advocates that artificial intelligence and machine learning tend to become different, they have different focus and techniques; (2) There exists some convergence between machine learning and biological learning; (3) Although there exist many different types of techniques for machine learning and also many different types of learning mechanism in brains, Extreme Learning Machines (ELM) as a common learning mechanism may fill the gap between machine learning and biological learning, in fact, ELM theories have been validated by more and more direct biological evidences recently. ELM theories actually show that brains may be globally ordered but may be locally random. ELM theories further prove that such a learning system happens to have regression, classification, sparse coding, clustering, compression and feature learning capabilities, which are fundamental to cognition and reasoning. This talk also shows how ELM unifies SVM, PCA, NMF and a few other learning algorithms which indeed provide suboptimal solutions compared to ELM.

# How Can We Effectively Analyze Big Data in Terabytes or Even Petabytes?

Joshua Zhexue Huang

National Engineering Laboratory for Big Data System Computing Technology,  
Shenzhen University, Shenzhen, China  
zx.huang@szu.edu.cn

**Abstract.** The big values in big data can only be dug out through deep analysis of data. In the era of big data, datasets with hundreds of millions objects and thousands of features become a phenomenon rather than an exceptional case. The internet and telecom companies in China have over hundred million customers. Such datasets are often in the size of terabytes and can easily exceed the size of the memory of the cluster system. Current big data analysis technologies are not scalable to such data sets because of the memory limitation. How can we effectively analyze such big data? In this talk, I will present a *statistical-aware strategy* to divide big data into data blocks which are distributed among the nodes of the cluster or even in different data centers. I will propose a *random sample partition data model* to represent a big data set as a set of distributed random sample data blocks. Each random sample data block is a random sample of the big data so it can be used to estimate the statistics of the big data and build a classification or prediction model for the big data. I will also introduce an *asymptotic ensemble learning framework* that stepwise builds ensemble models from selected random sample data blocks to model the big data. Using this set of new technologies, we will be able to analyze big data effectively without the memory limit. With this new architecture for big data, we are able to separate data analysis engines from data centers and make the data centers more accessible to big data analysis.

# Cyborg Intelligent Systems

Gang Pan

Department of Computer Science, Zhejiang University, Hangzhou, China  
gpan@zju.edu.cn

**Abstract.** Advances in multidisciplinary fields such as brain-machine interfaces, artificial intelligence, and computational neuroscience, signal a growing convergence between machines and biological beings. Especially, brain-machine interfaces enable a direct communication pathway between the brain and machines. It promotes the brain-in-loop computational paradigm. A biological-machine intelligent system consisting of both organic and computing components is emerging, which we called *cyborg intelligent systems*. This talk will introduce the concept, architectures, and applications of cyborg intelligent systems. It will also discuss issues and challenges.

# Learning and Memory in Mind Model CAM

Zhongzhi Shi

Key Laboratory of Intelligent Information Processing, Institute of Computing  
Technology, Chinese Academy of Sciences, Beijing, 100190, China  
shizz@ics.ict.ac.cn

**Abstract.** Intelligent science is the contemporary forefront interdisciplinary subject of brain science, cognitive science, artificial intelligence and other disciplines, which studies intelligence theory and technology. The one of its core issues is to build the mind model. Mind is the human spirit of all activities, is a series of cognitive abilities, which enable individuals to have consciousness, sense the outside world, think, make judgment, and remember things. Mind model CAM (Consciousness And Memory) is mainly composed of five parts, namely, memory, consciousness, high-level cognitive functions, perception input, behavior response. CAM is general intelligent system architecture. This lecture will mainly introduce the learning and memory mechanism of the mind model CAM, focusing on the physiological basis of memory, complementary learning system, learning and memory evolution and other issues. Human brain learning and memory is a comprehensive product of two complementary learning systems. One is the brain neocortex learning system, through the experience, slowly learning about knowledge and skills. The other is the hippocampus learning system, which memorizes specific experiences and allows these experiences to be replayed and thus effectively integrated with the new cortical learning system. Explore the complementary learning and memory of short - term memory and long - term memory in CAM. The essence of learning and memory evolution is through learning, not only to increase knowledge, but also to change the structure of memory.

**Acknowledgements.** This work is supported by the National Program on Key Basic Research Project (973) (No. 2013CB329502).

# Factor Space and Artificial Intelligence

Peizhuang Wang

College of Intelligence Engineering and Math,  
Technical University of Liaoning, China  
peizhuangw@126.com

**Abstract.** Different from human intelligence, the subject of AI is not brain, but machine. How do machine emulate intelligence of brain? Is it possible to construct a brain-like machine? No matter how advanced science becomes, it is not possible to make a machine as a clone of brain. It is mystery that the insuperable barrier does not take away all belief from AI researchers. Even though the ebb of fifth generation computer in 1990s hints that computer must emulate from the structure of human brain, people still have confidence on AI facing the difficulty of structure-emulation. Indeed, we would cognize that brain is the cognition's subject, but not the very cognition. Is there a cognition theory keeping a little independence from brain? It concerns with the relationship between cognition information and ontological information. Even though brain has influence to ontology information, ontology information is independent from the subject of cognition essentially, and there exists inner cognition theory to guide artificial intelligence. There were theories arising in artificial intelligences, unfortunately, they are not deep and united but shallow and split. There have been no deep and united artificial intelligence theory yet. No a strong theory, no substantial practice! Therefore, we are going to build a strong theory of artificial intelligence. Factor space aims to build a mathematical theory of AI. Factor is a generalization of gene since gene was called Mendelian factor. Gene is the root of a bunch of bio-attributes, factor is the root of a bunch of attributes for anything. Factor space is the generalization of Cartesian coordinate space with axes named by factors. Factor space provides united platform to do concept generation and implication, which is the mathematics of cognition. Which provides united theory for artificial intelligence, especially, for special information processing faced big data.

# Contents

## Theory of Intelligence Science

Ecological Methodology and Mechanism Approach: New Perspective to Intelligence Science . . . . .	3
<i>Yixin Zhong</i>	
Collaborative Model in Brain-Computer Integration . . . . .	10
<i>Zhongzhi Shi, Gang Ma, and Jianqing Li</i>	
Entanglement of Inner Product, Topos Induced by Opposition and Transformation of Contradiction, and Tensor Flow . . . . .	22
<i>Jiali Feng</i>	
Go Mapping Theory and Factor Space Theory Part I: An Outline . . . . .	37
<i>He Ouyang</i>	

## Cognitive Computing

A Case-Based Approach for Modelling the Risk of Driver Fatigue . . . . .	45
<i>Qiaoting Zhong and Guangnan Zhang</i>	
Gazes Induce Similar Sequential Effects as Arrows in a Target Discrimination Task . . . . .	57
<i>Qian Qian, Xiaoting Wang, Miao Song, and Feng Wang</i>	
Discrete Cuckoo Search with Local Search for Max-cut Problem . . . . .	66
<i>Yingying Xu, Zhihua Cui, and Lifang Wang</i>	
A New Cuckoo Search . . . . .	75
<i>Zhigang Lian, Lihua Lu, and Yangquan Chen</i>	
Resting State fMRI Data Classification Method Based on K-means Algorithm Optimized by Rough Set . . . . .	84
<i>Xianzhe Li, Weiming Zeng, Yuhu Shi, and Shaojun Huang</i>	
The Research of Attribute Granular Computing Model in Cognitive and Decision-Making . . . . .	93
<i>Ruqi Zhou and Yuepeng Zhou</i>	
Power Control in D2D Network Based on Game Theory . . . . .	104
<i>Kai Zhang and Xuan Geng</i>	

HCI Based on Gesture Recognition in an Augmented Reality System for Diagnosis Planning and Training . . . . . 113  
*Qiming Li, Chen Huang, Zeyu Li, Yimin Chen, and Lizhuang Ma*

The Effect of Expression Geometry and Facial Identity on the Expression Aftereffect . . . . . 124  
*Miao Song, Qian Qian, and Shinomori Keizo*

**Big Data Analysis and Machine Learning**

A Dynamic Mining Algorithm for Multi-granularity User’s Learning Preference Based on Ant Colony Optimization . . . . . 133  
*Shengjun Liu, Shengbing Chen, and Hu Meng*

Driver Fatigue Detection Using Multitask Cascaded Convolutional Networks. . . . . 143  
*Xiaoshuang Liu, Zhijun Fang, Xiang Liu, Xiangxiang Zhang, Jianrong Gu, and Qi Xu*

A Fast Granular Method for Classifying Incomplete Inconsistent Data . . . . . 153  
*Zuqiang Meng and Hongli Li*

Sentiment Analysis of Movie Reviews Based on CNN-BLSTM . . . . . 164  
*Qianzi Shen, Zijian Wang, and Yaoru Sun*

Playlist Recommendation Based on Reinforcement Learning . . . . . 172  
*Binbin Hu, Chuan Shi, and Jian Liu*

Transfer Learning for Music Genre Classification . . . . . 183  
*Guangxiao Song, Zhijie Wang, Fang Han, and Shenyi Ding*

A Functional Model of AIS Data Fusion . . . . . 191  
*Yongming Wang and Lin Wu*

Entropy-Based Support Matrix Machine. . . . . 200  
*Changming Zhu*

Using Convolutional Neural Network with Asymmetrical Kernels to Predict Speed of Elevated Highway . . . . . 212  
*Di Zang, Jiawei Ling, Jiujun Cheng, Keshuang Tang, and Xin Li*

Enlightening the Relationship Between Distribution and Regression Fitting . . . . . 222  
*Hang Yu, Qian Yin, and Ping Guo*

Application and Implementation of Batch File Transfer in Redis Storage . . . . . 228  
*Hu Meng, Yongsheng Pan, and Lang Sun*

The Optimization Algorithm of Circle Stock Problem with Standard Usage Leftover . . . . .	234
<i>Chen Yan, Qiqi Xie, Qiulin Chen, Li Zhang, Yaodong Cui, and Zuqiang Meng</i>	
Weighting Features Before Applying Machine Learning Methods to Pulsar Search . . . . .	241
<i>Dayang Wang, Qian Yin, and Hongfeng Wang</i>	
<b>Machine Perception</b>	
Patch Image Based LSMR Method for Moving Point Target Detection . . . . .	251
<i>Weina Zhou, Xinwei Lin, Zhijing Xu, and Xiangyang Xue</i>	
An Improved Image Transformation Network for Neural Style Transfer. . . . .	260
<i>Hong-Xu Qiu and Xiao-Xia Huang</i>	
An Improved Algorithm for Redundant Readers Elimination in Dense RFID Networks . . . . .	268
<i>Xin Zhang and Zhiying Yang</i>	
A Coding Efficiency Improvement Algorithm for Future Video Coding. . . . .	279
<i>Xiantao Jiang, Xiaofeng Wang, Yadong Yang, Tian Song, Wen Shi, and Takafumi Katayama</i>	
A Two-Step Pedestrian Detection Algorithm Based on RGB-D Data . . . . .	288
<i>Qiming Li, Liqing Hu, Yaping Gao, Yimin Chen, and Lizhuang Ma</i>	
Inferring and Analysis Drivers Violation Behavior Through Trajectory . . . . .	295
<i>Zouqing Cai, Wei Pei, Yongying Zhu, Mingyu Lu, and Lei Wu</i>	
Improved CNN Based on Super-Pixel Segmentation . . . . .	305
<i>Yadong Yang and Xiaofeng Wang</i>	
Speaker Verification Channel Compensation Based on DAE-RBM-PLDA . . .	311
<i>Shuangyan Shan and Zhijing Xu</i>	
<b>Intelligent Information Processing</b>	
Channels' Matching Algorithm for Mixture Models. . . . .	321
<i>Chenguang Lu</i>	
Understanding: How to Resolve Ambiguity . . . . .	333
<i>Shunpeng Zou and Xiaohui Zou</i>	
Exploration on Causal Law of Understanding and Fusion Linking of Natural Language . . . . .	344
<i>Peihong Huang</i>	

Depression Tendency Recognition Model Based on College Student’s  
 Microblog Text. . . . . 351  
*Jie Qiu and Junbo Gao*

**Intelligent Applications**

Traffic Parameters Prediction Using a Three-Channel Convolutional  
 Neural Network . . . . . 363  
*Di Zang, Dehai Wang, Jiujun Cheng, Keshuang Tang, and Xin Li*

Research of the Evaluation Index System of Green Port Based on Analysis  
 Approach of Attribute Coordinate . . . . . 372  
*Xueyan Duan, Xiaolin Xu, and Jiali Feng*

Two Stages Empty Containers Repositioning of Asia-Europe Shipping  
 Routes Under Revenue Maximization . . . . . 379  
*Hengzhen Zhang, Lihua Lu, and Xiaofeng Wang*

Speed Optimization of UAV Vehicle Tracking Algorithm . . . . . 390  
*Yanming Xu, Wei Pei, Yongying Zhu, Mingyu Lu, and Lei Wu*

Application of Ant Colony Optimization in Cloud Computing  
 Load Balancing. . . . . 400  
*Zheng-tao Wu*

Beam Bridge Health Monitoring Algorithm Based on Gray  
 Correlation Analysis . . . . . 409  
*Jianguo Huang, Lang Sun, and Hu Meng*

Designing an Optimal Water Quality Monitoring Network . . . . . 417  
*Xiaohui Zhu, Yong Yue, Yixin Zhang, Prudence W.H. Wong,  
 and Jianhong Tan*

Ship Identification Based on Ship Blade Noise . . . . . 426  
*Haitao Qi and Zhijing Xu*

A Composite Weight Based Access Network Selection Algorithm  
 in Marine Internet. . . . . 435  
*Liang Zhou and Shengming Jiang*

Online Shopping Recommendation with Bayesian Probabilistic  
 Matrix Factorization . . . . . 445  
*Jinming Wu, Zhong Liu, Guangquan Cheng, Qi Wang,  
 and Jincai Huang*

**Author Index** . . . . . 453