Brain-Mind Workshop 2012

2012 年脑心智研讨会

Saturday Dec. 15 - Sunday Dec. 16, 2012
No. 1 Meeting Room, Yifu Science and Technology Building
Fudan University
220 Handan Road   Shanghai, China

Co-sponsored and co-organized by
Fudan University
Institute of Computing Technology, Chinese Academy of Sciences
Beijing University

http://www.brain-mind-workshop.org/

Messages from the Chairs

Brain-mind research is undergoing cross-disciplinary interactions. It requires the synergy and penetration of multiple disciplines, including biology, neuroscience, psychology, computer science, electrical engineering, mathematics, and other disciplines.

In order to exchange latest progress in leading research on this broad subject and to provide a platform for scientific education and discussion, the Brain-Mind Workshop (BMW) 2012 is held based on the success of Brain-Mind Workshop 2011.

We welcome professors, researchers, and graduate students who are interested in all related subjects to participate in this workshop.

All subjects that are related to brain or mind are welcome, especially those that have a potential to lead to synergies across different disciplines. They include, but are not limited to:

1. Biological principles of biochemistry, genetics, cells. The structure and regulation of genes, the structure and synthesis of proteins, how molecules are integrated into cells, how these cells are integrated into multicellular systems and organisms.
2. Principles underlying the structure and function of the nervous system. Development of the nervous system and its connections, sensory systems, motor systems, motivational systems, higher cortical functions. Pain, stress, depression, ADD/ADHD, and addiction.
3. The behavioral and neural bases of perception, language, emotion, learning, memory, cognition, cognitive architecture, reasoning, decision-making, and cognitive development, personality, psychopathology, and social interaction.
4. Biologically inspired artificial intelligence. Automata related to brain-mind. Pattern recognition principles. Symbolic and emergent representations. Machine learning and developmental learning.
5. Biologically inspired signal processing and controller techniques. Digital and analog circuits. Very-large-scale integrated circuits. Neural network computers and architectures.
6. Vectors and vector space. Linear space and nonlinear space. Functional analysis. Probability, density, distribution. Multivariate distribution. Entropy and mutual information. Statistical estimators and optimal estimation.

The participations are by invitation only. Welcome to Fudan University!

Juyang Weng, General Chair, Fudan University and Michigan State University
Jianfeng Feng, General Co-Chair, Fudan University and Warwick University
Zhongzhi Shi, Program Co-Chair, Institute of Computing Technology, Chinese Academy of Sciences
Xiangyang Xue, Program Co-Chair, Fudan University
Cong Yu, Program Co-Chair, Beijing University
Hongbo Yu, Program Co-Chair, Fudan University

Final Programs

Saturday Dec. 15, 2012

9:00 - 9:10 Welcome and introduction. J. Weng, J. Feng, Z. Shi, X. Xue, C. Yu, and H. Yu.

AM Session
Chair: Jianfeng Feng
9:10 - 9:50 **Keynote 1: Molecular Mechanism Underlying Intrinsic and Activity-Dependent Dendrite Development and Neural Circuit Formation**
Xiang Yu, Institute of Neuroscience, Chinese Academy of Sciences

9:50 - 10:10 **Coffee Break**

10:10 - 10:50 **Keynote 2: Experience-Dependent and Brain State-Dependent Processing in the Visual Cortex**
Haishan Yao, Institute of Neuroscience, Chinese Academy of Sciences

10:50 - 11:40 **Panel A: Molecular and cellular mechanisms of visual circuits**
Coordinator: Tiande Shou
Panelists: Tiande Shou, Xiaohong Xu, Haishan Yao, Hongbo Yu, and Xiang Yu.

11:40 - 13:30 **Lunch, Danyuan Dining Hall (旦苑餐厅), all participants are invited**

PM Session
Chair: Juyang Weng
13:30 - 14:10 **Keynote 3: Olfactory Processing in Drosophila Attenal Lobes**
Zuoren Wang, Institute of Neuroscience, Chinese Academy of Sciences

14:10 - 14:50 **Keynote 4: Mind Computation**
Zhongzhi Shi, Institute of Computing Technology, Chinese Academy of Sciences

14:50 - 15:10 **Coffee Break**

15:10 - 15:50 **Keynote 5: Endothermia Facilitates Evolution of Large Brains**
Yuguo Yu, Center for Computational Systems Biology, Fudan University

15:50 - 16:30 **Keynoter 6**: **Can Natural Intelligence and Artificial Intelligence Be Unified?**
Juyang Weng, Fudan University, China and Michigan State University, USA

16:30 - 17:20 **Panel B： What Is Evolved, Innate, and Experience Dependant?**
Coordinator: Juyang Weng
Panelists: Jianfeng Feng, Zhongzhi Shi, Zuoren Wang and Juyang Weng

17:20 - 20:30 **Welcome Dinner, Danyuan Dining Hall, all participants are invited**

Sunday, Dec. 16, 2012

AM Session
Chair: Hongbo Yu
9:00 - 9:40 **Keynote 7: Visual Perceptual Learning and Its Specificity and Transfer: A New Perspective**
Cong Yu, Department of Psychology and Peking-Tsinghua Center for Life Sciences, Peking University

9:40 - 10:20 **Keynote 8: The Gating Role of the Intermediate Level Visual Mechanisms in Object and Space Perception**
Zijiang J. He, University of Louisville, USA and East China Normal University, China

10:20 - 10:40 **Coffee Break**

10:40 - 11:20 **Keynote 9: Task-Dependent Effects of Perceptual Decision and Learning**
Sheng Li, Department of Psychology, Peking University

11:20 - 12:00 **Panel C： How Can We Reconcile the Behavior Data and Computational Models?**
Coordinator: Cong Yu
Panelists: Zijiang J. He, Sheng Li, Cong Yu and Juyang Weng

12:00 - 13:30 **Lunch, Danyuan Dining Hall (旦苑餐厅), all participants are invited**

PM Session
Chair: Yu Cong
13:30 - 14:10 **Keynote 10: Brainnetome: A New Avenue to Understand the Brain Disorders**

Tianzi Jiang, LIAMA Center for Computational Medicine, National Laboratory of Pattern Recognition,
Institute of Automation, Chinese Academy of Sciences

14:10 - 14:25 Analysis and Circuit Modeling for Multi-Electrode Matrix Data
Hui Wei, Fudan University

14:25 - 14:40 Visualizing an Emotional Valence Map in the Limbic Forebrain by TAI-FISH
Jianbo Xiu, Tao Zhou, Qi Zhang, Tingting Zhou, and Hailan Hu, Institute of Neuroscience, Chinese Academy of Sciences

14:40 - 14:55 Brain-Inspired Where-What Visual Network 7: Deal with Object Scales
Yukai Wang, Xiaofeng Wu, and Juyang Weng, Fudan University

14:55 - 15:10 How Does a Brain-Inspired Developmental Network Deal with Inconsistent Training?
Hao Ye, Xuanjing Huang, and Juyang Weng, Fudan University

15:10 - 15:30 **Coffee Break**

15:30 - 16:10 **Keynote 11: Brain Computer Interfaces and Neurofeedback for Motor Functional Rehabilitation**
Liqing Zhang, MOE-MSRA Joint Lab for Intelligent Computing and Intelligent Systems
Department of Computer Science and Engineering, Shanghai Jiao Tong University

16:10 - 17:00 **Panel D: Brain, Technology, and Applications**
Coordinator: Tianzi Jiang
Panelists: Tianzi Jiang, Hui Wei, Juyang Weng, Hongbo Yu, and Liqing Zhang

17:00 **End of Workshop**

Detailed Programs

Saturday Dec. 15, 2012

9:00 - 9:10 Welcome and introduction. J. Weng, J. Feng, Z. Shi, X. Xue, C. Yu, and H. Yu.

AM Session
Chair: Jianfeng Feng
9:10 - 9:50 **Keynote 1: Molecular Mechanism Underlying Intrinsic and Activity-Dependent Dendrite Development and Neural Circuit Formation**
Xiang Yu, Institute of Neuroscience, Chinese Academy of Sciences

Abstract

Over a century ago, the Spanish neuroscientist Ramon y Cajal illustrated the beauty, complexity and diversity of neuronal dendritic morphology through his elegant and meticulous drawings. In recent years, a combination of molecular, genetic, pharmacological and imaging approaches has significantly advanced our understanding of the molecular mechanisms underlying dendrite morphogenesis. Yet, many questions remain unanswered. For example, what factors determine the morphology of a pyramidal neuron and differentiate it from a Purkinje cell or a granule cell? To what extent do genetic (intrinsic) and extracellular (extrinsic, activity-dependent) factors contribute to regulation of dendritic morphogenesis? How does the refinement of dendritic structures contribute to neuronal function? In previous work, we identified the cadherin/catenin cell adhesion complex as an important mediator of activity-dependent dendrite development. We further showed that N-cadherin, through its extracellular interaction, is specifically required for the maintenance of newly formed dendritic arbors. In ongoing work, we are studying the in vivo role of cell adhesion molecules in regulating dendritic morphology, as well as their effect on neural circuit formation. We are also interested in the mechanism underlying intrinsic determination of dendrite morphology, and the patterning of different neuronal types with distinct dendrite morphologies.

Short Bio

Dr. Xiang Yu graduated from Trinity College at the University of Cambridge in 1995 and completed her Ph.D in Drosophila embryonic development at the MRC Laboratory of Molecular Biology in Cambridge in 1999. As a post-doctoral fellow at Stanford University she identified the cadherin/catenin complex as a critical mediator of dendritic morphogenesis and showed that Wnt/β-catenin signaling is likely to be important during activity-dependent dendritic development. In 2005, she joined ION as Principle Investigator and head of the "Laboratory of Dendrite Development and Neural Circuit Formation". Her laboratory is interested in understanding the molecular mechanism underlying intrinsic and extrinsic dendritic development, as well as the morphological trace underlying activity-dependent neural circuit formation. She is recipient of the Wellcome Trust Internatioal Fellowship (1999), the Grass Fellowship at the Marine Biological Laboratory (2005), the Hundred Talent Program of the Chinese Academy of Science (2005), the Shanghai Pujiang Program (2006) and the Talented Young Investigator Award of the National Science Foundation of China (2011). She published papers as corresponding authors in journals including Nature Neuroscience, Neuron, P.N.A.S and the Journal of Neuroscience and serves as an editorial board member of Neuropharmacology.

9:50 - 10:10 **Coffee Break**

10:10 - 10:50 **Keynote 2: Experience-Dependent and Brain State-Dependent Processing in the Visual Cortex**

Haishan Yao, Institute of Neuroscience, Chinese Academy of Sciences

Abstract

Sensory processing is influenced by both the experience and the brain state of the animal. We use in vivo whole-cell recordings and extracellular recordings in primary visual cortex (V1) to examine how receptive field (RF) property is dynamically modified by external visual stimulation and internal brain state. We found that repetitive stimulation of natural movies could increase the similarity between cortical RF structure and the subset of movie images that depolarized the cell. This effect depended on the spatiotemporal correlation of the conditioning movie and required the activation of NMDA receptors. Such dynamic RF modification may play an important role in dynamic coding of natural scenes. To study how brain state influences visual processing, we examined the response latency of V1 neurons in both awake and anesthetized rats. We found that V1 neurons exhibited shorter response latency in the desynchronized state than in the synchronized state. In vivo whole-cell recording showed that both the resting and the evoked conductances were higher in the desynchronized state. We further showed that the latency advance in V1 could be accounted for by a cascade mechanism, which incorporates the latency advance in LGN and an increasing latency advance across successive V1 layers caused by the conductance increase.

Short Bio

Dr. Haishan Yao graduated from Wuhan University in 1994 and received her Ph.D. from the Shanghai Institute of Physiology, Chinese Academy of Sciences in 1999. She did her postdoctoral research at the University of California, Berkeley during 2000-2005. She joined the Institute of Neuroscience, Chinese Academy of Sciences as an Investigator and Head of the Laboratory of Visual Neurophysiology in November 2005. Her major research interest is the neural mechanism of visual processing and the plasticity of the visual system. The lab studies how the early visual system processes information in complex visual scenes, how the visual circuits adapt to different patterns of visual stimulation, and how brain state or behavioral state influences visual processing.

10:50 - 11:40 **Panel A: Molecular and cellular mechanisms of visual circuits**
Coordinator: Tiande Shou
Panelists: Tiande Shou, Xiaohong Xu, Haishan Yao, Hongbo Yu, and Xiang Yu.

Panel questions:

- **A1**: How are the dendritic and axonal growths guided?
- **A2**: How do neuronal activities affect the dendritic and axonal growth, targeting, and branching?
- **A3**: What molecular factors are likely involved in the maintenance of synapses (e.g., spine and conductance) and how they work?
- **A4**: How do presynaptic and post-synaptic activities affect the conductance (weight) of a synapse?
- **A5**: What is known about how the plasticity of a neuron is affected by the cellular age counted from the neurogenesis?

11:40 - 13:30 **Lunch, Danyuan Dining Hall (旦苑餐厅), all participants are invited**

PM Session
Chair: Juyang Weng
13:30 - 14:10 **Keynote 3: Olfactory Processing in Drosophila Attenal Lobes**
Zuoren Wang, Institute of Neuroscience, Chinese Academy of Sciences

Abstract

The Drosophila olfactory system is a useful model for studying the circuitry mechanisms of sensory information processing. Similar to the mammalian mitral/tufted cells in olfactory bulbs, Drosophila PN dendrites are both pre- and post-synaptic in ALs, with homotypic PNs making cholinergic and electrical synapses among themselves, as well as with processes of excitatory local interneurons (LNs) in the same glomerulus. How PN connections within

ALs contribute to olfactory signal processing remains to be fully understood. Here we show that inter-glomeruli crosstalk mediated by PNs exists in ALs and directly modulates olfactory processing. Using dual whole-cell recording and high-resolution optogenetic manipulation, we found that activation of individual PNs resulted in depolarization of PNs of different glomeruli and LNs in ALs were simultaneously excited. Furthermore, upon odorant reception in vivo, activity of individual PNs was strongly modulated by coincident activities of heterotypic PNs, indicating active role of PN-mediated inter-glomerular crosstalk in physiological olfactory processing. Thus, PNs not only relay information from ALs to higher brain regions, but also actively contribute to signal processing in ALs. This PN-mediated inter-glomerular crosstalk may represent a major mechanism for sharpening the olfactory response in specific glomeruli and for gain control in ALs.

Short Bio

Dr. Zuoren Wang did his undergraduate study at East China University of Science and Technology, and received his master degree from Shanghai Institute of Biochemistry in the Chinese Academy of Sciences. He pursued his Ph.D. degree at Rutgers University-New Brunswick in New Jersey from September 1997 to April 2002. Then, he conducted his post-doctoral research in the Department of Molecular and Cell Biology at University of California-Berkeley. He joined the faculty of ION in 2005 as Principal Investigator and Head of the "Laboratory of Neural Circuits and Animal Behavior".The research in his lab is aimed at mechanistically understanding the modulation of animal behavior by chemosensory inputs at the level of the neural circuitry.

14:10 - 14:50 **Keynote 4: Mind Computation**
Zhongzhi Shi, Institute of Computing Technology, Chinese Academy of Sciences

Abstract

Intelligence Science is an interdisciplinary subject that dedicates to joint research on basic theory and technology of intelligence by brain science, cognitive science, artificial intelligence and others. Brain-like intelligent machine is a potential way to reach the human-level artificial intelligence. This talk will focus on the progress of mind computation research in the intelligence science laboratory.

One of main tasks in Intelligence Science is mind modeling which tries to model the human mental activity, such as perception, learning, memory, thinking, consciousness. From the artificial intelligence perspective, the mind modeling is to construct computational artifacts which combine many cognitive abilities in one integrated system and make the artifacts have the same intellectual capacity as humans. A new mind model named CAM (Consciousness And Memory model) , which is proposed by the Intelligence Science Laboratory, will be discussed. Updated results, including cognitive cycle and motivation theory will be covered in the presentation.

Short Bio

Zhongzhi Shi is a professor at the Institute of Computing Technology, Chinese Academy of Sciences, leading the Intelligence Science Laboratory. His research interests include intelligence science, machine learning, multi-agent systems, image processing and semantic Web. Professor Shi has published 14 monographs, 15 books and more than 450 research papers in journals and conferences. He has won a 2nd-Grade National Award at Science and Technology Progress of China in 2002, two 2nd-Grade Awards at Science and Technology Progress of the Chinese Academy of Sciences in 1998 and 2001, respectively. He is a fellow of CCF and CAAI, senior member of IEEE, member of AAAI and ACM, Chair for the WG 12.2 of IFIP. He serves as Chief Editor of Series on Intelligence Science. He has served as Vice President for Chinese Association of Artificial Intelligence and General Secretary of China Computer Federation.

14:50 - 15:10 **Coffee Break**

15:10 - 15:50 **Keynote 5: Endothermia Facilitates Evolution of Large Brains**

Yuguo Yu, Center for Computational Systems Biology, Fudan University

Abstract

Mammals and birds have much larger brains than do other vertebrates. They are also different in having warm and constant body temperatures. Is this a coincidence, or is there some formal or necessary link between the two facts? Here I derive a general model, based on principles of temperature-dependent biochemical kinetics and allometry, that characterizes the effect of temperature and body size on body metabolism and brain size. The model fits well with the scaling relationship of brain-body mass for both cold-blood animals and warm-blood animals, thus provides a possible explanation for the reason that endothermic animals contain brains 10-20 times heavier than ectothermic animals, and human brains 5 times heavier than mammalian animals. This model also predicts that ectothermic animals living under warmer conditions should have a larger size brain than those under colder conditions. Analysis of data from fish collected from different environmental temperature conditions well supports this prediction.

Short Bio

Yuguo Yu is with the Center for Computational Systems Biology of Fudan University. He received B.Sc and the M.S. in Physics from Lanzhou University in 1995 and 1998, and Ph.D. in Physics from Nanjing University. He was trained in Computational/Behavior Neuroscience at Carnegie Mellon University as a Postdoctoral Fellow from 2001 to 2004; and then served as a Postdoc Associate and Associate Research Scientist at the Department of Neurobiology, Yale University from 2005-2011. Since 2011, he joins CCSB at Fudan University as a Principal Investigator (PI) faculty. His research interests include nonlinear dynamics, systems identification, cellular mechanisms of cortical spiking dynamics and information transmission, neural encoding and decoding, large scale of cortical network modeling, and neuroinformatics.

15:50 - 16:30 **Keynoter 6**: **Can Natural Intelligence and Artificial Intelligence Be Unified?**
Juyang Weng, Fudan University, China and Michigan State University, USA

Abstract

It has been well recognized that a von-neumann computer and a brain compute very differently. Furthermore, they have very different capabilities. In this talk, I will discuss that "general-purpose" for a computer is very different from that for a brain. However, a digital computer seems to be capable of simulating a biological brain not only in the ways individual neurons compute, but also in terms of how brain capabilities arise from experience, such as perception, cognition, reasoning, motivation, and motor skills. Recently, I have published an admittedly controversial book titled "Natural and Artificial Intelligence: Introduction to Computational Brain-Mind." The two words "brain" and "mind" are hyphenated because the work intends to map a brain-inspired developmental model to brain's external behaviors widely studied in psychology and simulated by artificial intelligence techniques. In particular, (1) some experimental evidences that human brains exhibited, such as the evidence of transfer in perceptual learning demonstrated by Prof. Cong Yu and coworkers and the "global first" principle in visual recognition and visual motion advocated by Prof. Lin Chen, have been computationally explained and simulated by a new kind of model called Developmental Network (DN), (2) abstraction and some rich rule-like operations that traditional neural networks models have been problematic in learning have been theoretically proven and experimentally preliminarily shown to have been overcome by the DN. This DN model hopefully is useful for psychologists and neuroscientists in their future experimental studies.

Short Bio

Juyang (John) Weng is a professor at the Department of Computer Science and Engineering, the Cognitive Science Program, and the Neuroscience Program, Michigan State University, East Lansing, Michigan, USA, and a visiting professor at the Computer Science School of the Fudan University, Shanghai, China. He received his BS degree from Fudan University in 1982, his MS and PhD degrees from University of Illinois at Urbana-Champaign, 1985 and 1989, respectively, all in Computer Science. From August 2006 to May 2007, he was also a visiting professor at the Department of Brain and Cognitive Science of MIT. His research interests include computational biology, computational neuroscience, computational developmental psychology, biologically inspired systems, computer vision, audition, touch, behaviors, and intelligent robots. He is the author or coauthor of over two hundred fifty research articles. He was an associate editor of IEEE Trans. on Pattern Recognition and Machine Intelligence and an associate editor of IEEE Trans. on Image Processing. He is an editor-in-chief of International Journal of Humanoid Robotics, the editor-in-chief of the Brain-Mind Magazine, an associate editor of IEEE Transactions on Autonomous Mental Development, and a Fellow of IEEE.

16:30 - 17:20 **Panel B： What Is Evolved, Innate, and Experience Dependant?**
Coordinator: Juyang Weng
Panelists: Jianfeng Feng**,** Zhongzhi Shi, Zuoren Wang and Juyang Weng

Panel questions:

B1: How are multisensory information integrated in the Drosophila (fruitfly) brain?
B2: Is there a master feature map (Re: Anne Treisman and David Van Essen) that normalizes positions and scales of an object?
B3: What roles does the top-down projections from the primary motor area (or actions) play in object representation?
B4: What roles does neuromodulation play in object perception, representation, motivation, and behavior generation?
B5: Without a central controller, how does a brain perform consistent visual detection, attention, recognition, and action generation?

17:20 - 20:30 **Welcome Dinner, Danyuan Dining Hall, all participants are invited**

Sunday, Dec. 16, 2012

AM Session
Chair: Hongbo Yu
9:00 - 9:40 **Keynote 7: Visual Perceptual Learning and Its**

Specificity and Transfer: A New Perspective

Cong Yu, Department of Psychology and Peking-Tsinghua Center for Life Sciences, Peking University

Abstract

Visual perceptual learning is known to be location and orientation specific, and is thus assumed to reflect the neuronal plasticity in the early visual cortex. However, in recent studies we created "Double training" and "TPE" procedures to demonstrate that these "fundamental" specificities can be decoupled from perceptual learning and that learning can completely transfer to a new location or orientation. We proposed a rule-based learning theory to reinterpret perceptual learning and its specificity and transfer: A high-level decision unit learns the rules of performing a visual task through training. However, the learned rules cannot be applied to a new location or orientation automatically because the decision unit cannot functionally connect to new visual inputs with sufficient strength because these inputs are likely suppressed by multi-session training and focused spatial/feature attention on trained location and orientation. It is double training and TPE training that reactivate these new inputs, so that the functional connections can be strengthened to enable rule application and learning transfer. I will report new experimental evidence that will provide further insights into the mechanisms underlying perceptual learning and its specificity and transfer.

Short Bio

1985 年华东师范大学心理系本科毕业，1995 年获 University of Louisville 实验心理学博士学位，1995 年至 2003 年分别在 University of Houston 和 University of California, Berkeley 做博士后研究，2003 年任中国科学院神经科学研究所研究员（百人计划），2006 年任北京师范大学认知神经科学与学习国家重点实验室研究员，2008 年任教育部长江学者特聘教授并获国家杰出青年基金，2012 年起任北京大学心理系教授暨北京大学-清华大学联合生命科学中心高级研究员。目前研究受国家自然科学基金重点项目和北京大学-清华大学联合生命科学中心支持。

9:40 - 10:20 **Keynote 8: The Gating Role of the Intermediate Level Visual Mechanisms in Object and Space Perception**

Zijiang J. He, University of Louisville, USA and East China Normal University, China

Abstract

Visual signals carried by the early visual levels are inherently fragmentary and ambiguous. This is largely due to the retinal images being two-dimensional and the early cortical neurons being limited to coding local orientation edges (features), resulting in a lack of image coherence. The role of parsing these visual signals into coherent, global surface representations belongs to the intermediate level visual mechanisms. In this capacity, the intermediate level visual mechanisms essentially play a gating role in that their outputs, surface representations, serve as building blocks for object recognition and space perception. Not fully understood is how the intermediate level visual mechanisms synthesize the locally represented early feature signals into surface representations. I will describe a series of psychophysical investigations from my laboratory focused on resolving this issue. We tested human observers on perceptual tasks of binocular rivalry, motion, visual search, texture spreading-in, surface completion and depth judgments. Generally, our studies reveal that the intermediate level visual mechanisms construct surface representations using a collection of "perceptual rules" based on real world ecological and 3-D geometric constraints. In addition, top-down attention and implicit memory also influence the integration of the spatially separated fragments into global surface representations.

Short Bio

Zijiang J. He, Ph.D. is a University Scholar and Professor at the Department of Psychological and Brain Sciences, University of Louisville, USA. He also holds a Chang-jiang visiting scholar position at the East China Normal University. Dr. He's research focuses on human mid-level vision, perceptual learning, space perception and action. Dr. He received his B.S. in Biophysics (1983) from the University of Science and Technology, China. From 1983 to 1986 he studied Neurobiology at the Shanghai Institute of Physiology, Academia Sinica and obtained an M.S. degree. He subsequently pursued his Ph.D. degree in Physiological Optics & Neuroscience (1990) at the University of Alabama at Birmingham, U.S.A. Dr. He conducted his post-doctoral research on human visual perception and cognition at Harvard University until 1994, when he joined the faculty of the University of Louisville. Dr. He has received several honors and awards including the Sloan Research Fellow, University Scholar at the University of Louisville, Chang-jiang Scholar (Ministry of Education of China), and Distinguished College/University Scientist for 2009 award (Kentucky Academy of Science).

10:20 - 10:40 **Coffee Break**

10:40 - 11:20 **Keynote 9:** **Task-Dependent Effects of Perceptual Decision and Learning**

Sheng Li, Department of Psychology, Peking University

Abstract

We combined psychophysics and multi-modal brain imaging techniques, aiming to understand the spatiotemporal dynamics of perceptual decision and learning processes. We generated two types of perceptual decision tasks. That is, the task based on signal detection and the task based on criterion comparison. We trained separate groups of human subject on the two tasks and recorded simultaneous EEG-fMRI signals before and after the training. We found that the learning effects for the two tasks correspond to different cortical networks. Particularly, in the task based on signal detection, the learning effect is correlated with the neural activities at both the early stage perceptual processing. Therefore, the learning shapes feedforward interactions across brain areas. On the other hand, in the task based on criterion comparison, the learning effect is correlated only with the late stage activities, indicating that learning acts on a feedback-based circuit. We also varied the task uncertainty for both tasks. In the task based on signal detection, task difficulty modulates brain activities in higher visual cortex related to information accumulation. In the task based on criterion comparison, such modulation happens in frontal areas that are thought to be responsible for rule retrieval. Our findings demonstrate that the neural systems represent the task-related perceptual information with a flexible and adaptive strategy.

Short Bio

Sheng Li is a professor (tenure-track, Bairen Project) at the Department of Psychology, Peking University, China. He received his B.Eng degree from Beijing University of Posts and Telecommunications, China, in 1998 and D.Phil degree from the University of Sussex, UK, in 2006. From 2006 to 2009, he was a postdoctoral research fellow at the School of Psychology, University of Birmingham, UK. His research focused on three topics related to the human perception, decision, and learning: (1) the neural mechanisms of human categorical and perceptual learning, (2) the neural mechanism of human perceptual decision, and (3) the modulatory effects of reward signal on learning and memory. He combined psychophysics, multi-modal functional brain imaging (fMRI, EEG, and EEG- fMRI simultaneous recording), and computational modeling in his research. His research findings have been published at journals including Neuron, Journal of Neuroscience, Cerebral Cortex, European Journal of Neuroscience, and IEEE Transactions on Neural Networks.

11:20 - 12:00 **Panel C: How Can We Reconcile the Behavior Data and Computational Models?**
Coordinator: Cong Yu
Panelists: Zijiang J. He, Sheng Li, Cong Yu and Juyang Weng

Panel questions:

C1: What is perceptual learning in general?
C2: What is transfer in perceptual learning?
C3: What are intermediate representations?
C4: What is the role of task settings in perceptual decision?
C5: How general are the mechanisms underlying the known transfer properties in perceptual learning?

12:00 - 13:30 **Lunch, Danyuan Dining Hall (旦苑餐厅), all participants are invited**

PM Session
Chair: Yu Cong
13:30 - 14:10 **Keynote 10**: **Brainnetome: A New Avenue to Understand the Brain Disorders**

Tianzi Jiang, LIAMA Center for Computational Medicine, National Laboratory of Pattern Recognition,
Institute of Automation, Chinese Academy of Sciences

Abstract

Convergent evidence has shown that the psychiatric diseases are faulty brain networks. In order to understand the pathophysiological mechanism of psychiatric disorders, it is necessary to integrate the multi-level network features obtained with various functional and anatomical brain imaging technologies on different scales. On macroscale, such features can be obtained from networks based on illness special region of interest, networks related to specific cognitive function, and whole brain networks. We have proposed a new concept of "Brainnetome" to represent such integration framework. We define the essential components of Brainnetome as network topological structure (connectome), performance, dynamics, manifestation of functions and malfunctions of brain on different scales, genetic basis of brain networks, and simulating and modeling brain networks on supercomputing facilities. In fact, several projects have been launched in China to conduct studies of brainnetome for four different diseases with focal lesion (stoke and glioma) and diffusion lesions (schizophrenia and AD). The Brainnetome Consortium has been established (www.brainnetome.org). This lecture will cover the above aspects of Brainnetome. It envisions that Brainnetome will become an emerging co-frontier of brain imaging, information technology, neurology and

psychiatry. Some long-standing issues in neuropsychiatry may be solved by combining Brainnetome with genome.

Short Bio

Tianzi Jiang is Professor of Brain Imaging and Cognitive Disorders, Institute Automation, Chinese Academy of Sciences, and Professor of Queensland Brain Institute, University of Queensland. He received his Ph.D. degree from Zhejiang University in1994. After he graduated, he worked as a postdoctoral research fellow (1994-1996) and Associate Professor (1996-1999), and full professor (1999-present) at his current institution. During that time, he worked as a Vice-Chancellor's postdoctoral fellow at the University of New South Wales, a visiting scientist at Max Planck Institute for Human Cognitive and Brain Sciences, a research fellow at the Queen's University of Belfast, and a visiting professor at University of Houston. He is the Chinese Director of the Sino-French Laboratory in Computer Science, Automation and Applied Mathematics (LIAMA), one National Center for International Research, since 2006. His research interests include neuroimaging, Brainnetome, imaging genetics, and their clinical applications in brain disorders and development. He is the author or co-author of over 170 reviewed journal papers in these fields and the co-editor of six issues of the Lecture Notes in Computer Sciences. He is Associate Editor of IEEE Transactions on Medical Imaging, IEEE Transactions on Autonomous Mental Development, Neuroscience Bulletin and an Academic Editor of PLoS One.

14:10 - 14:25 Analysis and Circuit Modeling for Multi-Electrode Matrix Data
Hui Wei, Fudan University

14:25 - 14:40 Visualizing an Emotional Valence Map in the Limbic Forebrain by TAI-FISH
Jianbo Xiu, Tao Zhou, Qi Zhang, Tingting Zhou, and Hailan Hu, Institute of Neuroscience, Chinese Academy of Sciences

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Yukai Wang, Xiaofeng Wu, and Juyang Weng, Fudan University

14:55 - 15:10 How Does a Brain-Inspired Developmental Network Deal with Inconsistent Training?
Hao Ye, Xuanjing Huang, and Juyang Weng, Fudan University

15:10 - 15:30 **Coffee Break**

15:30 - 16:10 **Keynote 11: Brain Computer Interfaces and Neurofeedback for Motor Functional Rehabilitation**

Liqing Zhang, MOE-MSRA Joint Lab for Intelligent Computing and Intelligent Systems
Department of Computer Science and Engineering, Shanghai Jiao Tong University

Abstract

Brain-computer interfaces are emerging technology of establishing direct link between human intentions and devices, allowing people to communicate and control devices in their environment without using the peripheral neural system but instead through the use of signals from the brain. The talk introduces general framework of BCI platform developed in SJTU, including the electroneurophysiologic mechanism for BCI, communication protocols, cognitive task-related EEG feature analysis, pattern classification, and multi-neurofeedback for motor functional rehabilitation. In this framework, a new tensor decomposition method is developed for extracting features of online EEG data. We further introduce multi-neurofeedback training platform for motor functional rehabilitation. Large clinical rehabilitation experiments will be reported to confirm that the multi-neurofeedback paradigm is able to improve the rehabilitation performance of motor functions for stroke patients. Finally we will provide some new perspectives and applications of BCI technology.

Short Bio

Liqing Zhang received the Ph.D. degree from Zhongshan (SUN YAT-SEN) University, China, in 1988. He was promoted to full professor position in 1995 at South China University of Technology. He worked as a research scientist in RIKEN Brain Science Institute, Japan from 1997 to 2002. He is now a Professor with Department of Computer Science and Engineering, Shanghai Jiao Tong University. He is also a visiting scientist of RIKEN Brain Science Institute. His current research interests cover computational theory for cortical networks, brain–computer interface, perception and cognition computing model, statistical learning and inference. He has published more than 200 papers in international journals and conferences, including IEEE journals (IEEE PAMI, TNN, IEEE TSP, IEEE Computer, IEEE NSRE, IEEE ASLP) and top computer conferences (NIPS, CVPR, ACMMM, ECCV). He serves as the associate editor of “International Journal of Computational Intelligence and Neuroscience”, the director of the committee of Biocybernetics and Biomedical engineering, Chinese Automation Association; member of Chinese Neural Network Society, member of neuroinformatics and neuroengineering committee, Chinese Neuroscience Association.

16:10 - 17:00 **Panel D: Brain, Technology, and Applications**
Coordinator: Tianzi Jiang
Panelists: Tianzi Jiang, Hui Wei, Juyang Weng, Hongbo Yu, and Liqing Zhang

Panel questions:

D1: What are the roles of brain connections in assisting our understanding brain mechanisms?
D2: How do brain areas (e.g., Brodmann areas) arise from activities?
D3: What are the roles of the mid-brain, the hind brain, and the spinal cord?
D4: How does a brain integrate information in the forebrain, midbrain, hind brain, and spinal cord?
D5: What roles can government policy and applications (e.g., rehabilitation, disease treatment, and robotics) play in the future of brain-mind research, education, and technology transfer?

17:00 **End of Workshop**