Brain-Mind Workshop 2013

2013 年脑心智研讨会

Saturday Dec. 21 - Sunday Dec. 22, 2013
Room 2201, East Guanghua Tower

Fudan University
220 Handan Road

Shanghai, China

Co-sponsored and co-organized by
Fudan University
Institute of Automation, Chinese Academy of Sciences
Xi'an Jiaotong University

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

Messages from the Chairs

The Brain-Mind Workshop has entered its third year. We are glad to see that U.S. and the European Union have announced their brain projects. Chinese research communities and government branches have been discussing Chinese own brain projects. It appears that the human race has entered a new era where it treats the brain not only as an organ but also serious wants to understand how it works. Although it is still controversial whether humans can successfully understand the working principles of the arguably most complex object (brain) facing the human race, the future of this endeavor seems to be bright!

As we all agree, brain-mind research is a cross-disciplinary subject. It requires the synergy and penetration of multiple disciplines, including biology, neuroscience, psychology, computer science, electrical engineering, mathematics, and other disciplines. This Workshop was created for this purpose.

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) 2013 is held based on the success of BMI 2011 and BMI 2012. We are glad the three institutes co-sponsor and co-organize BMI 2013: Fudan University, the Institute of Automation of the Chinese Academy of Sciences, and Xi'an Jiaotong University.

Although this subject is challenging, we encourage professors, researchers, and graduate students to come to this communication platform and communicate with one another. We believe that this subject will fundamentally change many disciplines, including, but not limited to, biology, neuroscience, psychology, computer science, electrical engineering, mathematics, philosophy, and all disciplines of social sciences.

The participations are by invitation only, but all are welcome to contact us if he is interested. Welcome to Fudan University!

Juyang Weng, General Chair, Fudan University and Michigan State University
Jianfeng Feng, General Co-Chair, Fudan University and Warwick University
Yihong Gong, Professor, Xi'an Jiaotong University
Tianzi Jiang, Program Co-Chair, Institute of Automation. Chinese Academy of Sciences
Xiangyang Xue, Program Co-Chair, Fudan University
Hongbo Yu, Program Co-Chair, Fudan University

December 18, 2013

Final Programs

Saturday Dec. 21, 2013

9:00 - 9:10 Welcome and introduction. Jianfeng Feng, Tianzi Jiang, Juyang Weng, Xiangyang Xue, Hongbo Yu.

AM Session
Chair: Jianfeng Feng
9:10 - 9:55 **Feedback of the Amygdala Globally Modulates Visual Response of Primary Visual Cortex in the Cat**
Hongbo Yu
Vision Research Laboratory, Center for Brain Science Research and School of Life Sciences, Fudan University
9:55 - 10:05 Questions and Discussion

10:05 - 10:20 **Coffee Break**

10:20 - 10:45 **The Brain-Inspired DN Model toward General-Purpose Developmental Vision: Computer Simulations**
Xiaofeng Wu, Yuekai Wang, Wenqiang Zhang, Qian Guo, and Juyang Weng, Fudan University
10:45 -10:50 Questions and Discussion

10:50 - 11:15 **Oxytocin Mediates Early Experience-dependent Crossmodal Plasticity in the Sensory Cortices**
Jing-Jing Zheng, Shu-Jing Li, Xiao-Di Zhang, Wan-Ying Miao, and Xiang Yu
Institute of Neuroscience, Chinese Academy of Sciences
11:15 - 11:20 Questions and Discussion

11:20 - 11:45 **Dopaminergic Gating of Visuomotor Transformation via Inhibitory Interneurons**
Yuan-yuan Yao, Xiaoquan Li and Jiu-lin Du
Institute of Neuroscience, Chinese Academy of Sciences
11:45 - 11:50 **Questions and Discussion**

11:55 - 13:20 **Lunch, Danyuan Dining Hall (旦苑餐厅), all participants are invited**

PM Session
Chair: Tianzi Jiang
13:30 - 14:15 **Anatomical and Functional Specialization of the Human Cerebral Hemispheres**
Qing Cai

The Institute of Cognitive Neurocience, East China Normal University
14:15 - 14:25 Questions and Discussion

14:25 - 15:10 **The Cortical Loci and Integration from Local Cues to Global Representations**
Wei Wang
Institute of Neuroscience Chinese Academy of Sciences
15:10 - 15:20 Questions and Discussion

15:20 - 15:35 **Coffee Break**

15:35 - 16:20 **A Neural Circuitry View for Autism Spectrum Disorders**
Zilong Qiu
Institute of Neuroscience Chinese Academy of Sciences
16:20 - 16:30 Questions and Discussion

16:30 - 17:15 **How Brain-Mind Works with Vision but Beyond: Introduction to a Whole-Brain Theory**
Juyang Weng, Fudan University, China and Michigan State University, USA
17:15 - 17:25 Questions and Discussion

17:45 - 20:30 **Welcome Dinner, Danyuan Dining Hall, all participants are invited**

Sunday Dec. 22, 2013

AM Session
Chair: Juyang Weng
9:00 - 9:45 **Mind-Brain Association Studies with Mesoscale Connectomics: Methodology, Reproducibility and Challenges**
Xi-Nian Zuo
Institute of Psychology, Chinese Academy of Sciences
9:45 - 9:55 Questions and Discussion

9:55 - 10:40 **Prefrontal Cortex and Schizophrenia**
Yuan-Ye Ma
Kunming Institute of Zoology, Chinese Academy of Sciences
10:40 - 10:50 Questions and Discussion

10:50 - 11:05 **Coffee Break**

11:05 - 11:50 **Brain Networks: Pivotal Intermediate Phenotypes Connecting Genome and Psychiatric Disorders**
Bing Liu

Brainnetome Center, Institute of Automation, the Chinese Academy of Sciences
11:50 - 12:00 Questions and Discussion

12:05 - 13:20 **Lunch, Danyuan Dining Hall, all participants are invited**

PM Session
Chair: Xiangyang Xue
13:30 - 14:15 **A Retina-Inspired Neurocomputing Circuit for Image Representation**
Hui Wei
School of Computer Science, Fudan University
14:15 - 14:25 Questions and Discussion

14:25 - 15:10 **Lateral Inhibition Revisited and its Inspiration to Extreme Learning Machines, Deep Learning and Developmental Networks**
Jun Miao
Institute of Computing Technology, Chinese Academy of Sciences
15:10 - 15:20 Questions and Discussion

15:20 - 15:35 **Coffee Break**

15:35 - 16:20 **Feature Selection and Low-Rank Recovery Using Sparse and Schatten Norms**
Chris H. Q. Ding
Anhui University, Hefei, China, and University of Texas at Arlington, Arlinton, Texas USA
16:20 - 16:30 Questions and Discussion

16:30 - 16:55 Research on Image Semantic Segmentation
Wei Zhang
School of Computer Science, Fudan University
16:55 - 17:00 Questions and Discussion

17:00 **End of Workshop**

Detailed Programs

Saturday Dec. 21, 2013

9:00 - 9:10 Welcome and introduction. Jianfeng Feng, Tianzi Jiang, Juyang Weng, Xiangyang Xue, Hongbo Yu.

AM Session
Chair: Jianfeng Feng
9:10 - 9:55 **Feedback of the Amygdala Globally Modulates Visual Response of Primary Visual Cortex in the Cat**
Hongbo Yu
Vision Research Laboratory, Center for Brain Science Research and School of Life Sciences, Fudan University

Abstract

The amygdala is an important center for emotional behavior, and it influences other cortical regions. Long feedback projections from the amygdala to the primary visual cortex were recently reported in the cat and monkey, two animal models for vision research. However, the detailed functional roles of these extensive projections still remain largely unknown. In this study, intrinsic signal optical imaging was used to investigate the visually driven responses of the primary visual cortex of cats as focal drugs were injected into the basal nucleus of the amygdala. Both the visually evoked global signals and differential signals in the functional maps of primary visual cortex were enhanced or reduced by glutamate-induced activation or GABA-induced deactivation of neurons in the amygdala, respectively. This modulation was found to be non-selective, consistent with the gain control mechanism—both the preferred orientation and its mapped orientation tuning width remained unchanged. The single unit recordings showed similar results supporting the above observations. These results suggest that the distal feedback signals of the amygdala enhance the primary sensory information processing in a non-selective, gain-control fashion. This provides direct neurophysiological evidence and insight for previous studies on emotional-cue related psychological studies.

Short Bio

B. A. degree in Biology in 1995 from University of Science and Technology of China (USTC); Ph. D. in Biophysics from USTC in 2000, in a joint program of USTC and Fudan University from 1997 to 2000. Post-doctoral fellow at Picower Institute of Learning and Memory and Department of Brain and

Cognitive Sciences in MIT from 2000 to 2009; Professor in the School of Life Sciences, Fudan University, since 2009. His main research interests: Combining two photon laser imaging, intrinsic signal optical imaging and traditional electrophysiological recording, we enable online evaluation of a broad range of brain function and its dynamic micro-structures in vivo (from functional columns to single synapse), and investigate the information process in the visual pathway, and new roles of glia cells (which is greater in number than neurons, and is thought to be "silent" cells in brain), to unravel the interaction mechanisms of neurons and glia cells in network computation.

9:55 - 10:05 Questions and Discussion

10:05 - 10:20 **Coffee Break**

10:20 - 10:45 **The Brain-Inspired DN Model toward General-Purpose Developmental Vision: Computer Simulations**

Xiaofeng Wu, Yuekai Wang, Wenqiang Zhang, Qian Guo, and Juyang Weng, Fudan University

Abstract

As one application in vision of the general-purpose brain-inspired neural network, Developmental Network (DN), Where-What-Networks (WWNs) model the dorsal and ventral two-way streams in the brain that converge to, and also receive information from, specific motor areas in the frontal cortex. In other words, the visuomotor "brain" is a bridge that bi-directionally link two islands, the retina island and the motor island that includes a number of concepts subislands: location, type, and scale. Through autonomous development, both visual detection and visual recognition have been achieved concurrently in such a single, highly integrated network. By "autonomous development", we mean that not only that the internal structure (inside the "skull") is self-organized autonomously so that different "brain" areas emergent autonomously, but the developmental program that regulates the growth and adaptation of the network is also task non-specific. In this talk, we will focus on "skull-closed" WWN-7 which deals with object location, type and scale simultaneously. By "skull-closed", we mean that, except the sensory ends and motor ends, the "brain" inside the skull is off limit throughout development to its teachers in the external physical world. The concurrent presence of multiple learned concepts from many object patches is an interesting issue in dealing with objects in cluttered visual backgrounds. The motor areas initiated expectations through top-down connections as temporal context assist the perception in a real continuously-changing world, with which the network interacts. The inputs to the network are drawn from continuous video taken in natural environment where, in general, everything is moving while the network is autonomously learning.

10:45 -10:50 Questions and Discussion

10:50 - 11:15 **Oxytocin Mediates Early Experience-dependent Crossmodal Plasticity in the Sensory Cortices**

Jing-Jing Zheng, Shu-Jing Li, Xiao-Di Zhang, Wan-Ying Miao, and Xiang Yu
Institute of Neuroscience, Chinese Academy of Sciences

Abstract

During the early postnatal period, neural activity, both in the form of spontaneous electrical activity and natural sensory stimulation, is critical to the formation of functional neural circuits. In addition to inducing changes within the target sensory cortex, sensory experience can also crossmodally affect other brain regions. Here, we report a novel form of plasticity in neonatal mice, where early sensory experience crossmodally regulates development of all sensory cortices via oxytocin signaling. Unimodal sensory deprivation from birth through whisker-deprivation or dark-rearing reduced excitatory synaptic transmission both in the correspondent sensory cortex, and crossmodally in other sensory cortices. Sensory expression regulated synthesis and secretion of the neuropeptide oxytocin, as well as its cortical level. Importantly, both *in vivo* oxytocin injection and increased sensory experience elevated excitatory synaptic transmission in multiple sensory cortices, and significantly rescued the effects of sensory deprivation. Together, these results identify a novel function for oxytocin in promoting crossmodal, experience-dependent cortical development. This link between sensory experience and oxytocin is particularly relevant to autism, where hyper- or hyposensitivity to sensory inputs is prevalent and oxytocin is a hotly debated potential therapy.

11:15 - 11:20 Questions and Discussion

11:20 - 11:45 **Dopaminergic Gating of Visuomotor Transformation via Inhibitory Interneurons**

Yuan-yuan Yao, Xiaoquan Li and Jiu-lin Du
Institute of Neuroscience, Chinese Academy of Sciences

Abstract

To adapt to varying environment, animals need to generate different behaviors in response to sensory cues with distinct ecological meanings. Accumulating evidence shows that early sensory areas can differentially process sensory inputs. However, it remains largely unknown how the transformation from sensory inputs into motor outputs is controlled at late stages of sensorimotor pathways. Here, using the visual

escape circuit of zebrafish as a model system, we find that a functional module constituted by dopaminergic neurons in the hypothalamus and glycinergic interneurons in the hindbrain gates the visuomotor transformation in a visual stimulus-dependent manner. The dopaminergic neurons are visually responsive and positively regulate the activity of the interneurons. Through the interneurons, the dopaminergic neurons can regulate visual signal transfer from the visual center to the command-like neuron of escape behaviors. In respond to the attention-evoking stimulus flash, both the two types of neurons are activated, leading to shut down visuomotor transformation. Instead, the predator-simulating stimulus looming suppresses the activity of these neurons, thus permitting visual signal to reach the command-like neuron and initiate escape behaviors. Our study illustrates a stimulus-discriminative gating mechanism of visuomotor transformation.

11:45 - 11:50 **Questions and Discussion**

11:55 - 13:20 **Lunch, Danyuan Dining Hall (旦苑餐厅), all participants are invited**

PM Session
Chair: Tianzi Jiang
13:30 - 14:15 **Anatomical and Functional Specialization of the Human Cerebral Hemispheres**
Qing Cai
The Institute of Cognitive Neurocience, East China Normal University

Abstract

Hemispheric specialization is a common finding in the human being. Cognitive functions like language preferentially activate the left hemisphere (LH). Right hemisphere (RH) speech dominance is rare but can be found with some effort in non-clinical populations, especially in left-handers. We compared neural correlates of different cognitive functions in typical LH and atypical RH language dominant subjects, and found that (1) The complementary specialization for language production and visuo-spatial attention is not just a statistical phenomenon (i.e. different functions lateralize independently) but has a causal origin (i.e. the lateralization of one function causes the opposite lateralization of the other, or both are driven by a third function), which probably derives from a longstanding evolutionary origin (Cai et al., 2013); (2) There is a co-lateralized and common functional network underlying language production and praxis, which shed light on the close relationship between language and tool-using (Vingerhoets et al., 2013); (3) Intriguingly, the morphometric results showed that functional language lateralization is only subtly linked to gross anatomical asymmetry (Greve et al., 2013).

Short Bio

Qing Cai received her bachelor in Biotechnology from Shanghai Jiaotong University, and Ph.D in Cognitive Sciences from Lyon University, France. Dr. Qing Cai worked in L2C2 (Laboratory of language, brian and cognition), CNRS during her Ph.D., and then in Ghent University, Belgium and in INSERM Cognitive Neuroimaging Unit, France as post-doc fellow. Her main research interests include but are not limited to: (1) the relationship between cerebral lateralization of cognitive functions and anatomical asymmetry; (2) Functional brain networks in resting state and in task-dependent settings, (3) the relationship between language tasks and non-language tasks including visuo-spatial attention, spatial frequency information processing, cognitive control, etc., and (4) the development of language and numerical abilities in children.

14:15 - 14:25 Questions and Discussion

14:25 - 15:10 **The Cortical Loci and Integration from Local Cues to Global Representations**

Wei Wang
Institute of Neuroscience Chinese Academy of Sciences

Abstract

A central question in the visual processing of form and motion is how the cortex integrates local visual cues to form global representations. We investigated the cortical representation of second-order contours defined by contrast modulation, phase reversal, and motion in macaque V1 and V2. We found that the iso-orientation domains elicited by contours defined by contrast modulation or phase reversal were in precise register with those activated by luminance-defined contours. However, iso-orientation domains activated by motion-defined contours were closely correlated with the motion axes of their local-noise inducers rather than the oriented motion contours. A simple spatio-temporal energy model reproduced all our experimental results in V1 and V2. Thus, our simulation and experimental results revealed that population responses to second-order contours in macaque V1 and V2 were driven through the linear processing of local luminance or motion cues within these classical second-order contour stimuli. The central issue addressed here is concerning the cortical loci and integration from local cues into global representations across different hierarchically organized processing stages in primate ventral visual pathway. The population responses recorded in macaque V1 and V2 reflect actually the local luminance or motion cues (physically present) and not the illusory and second-order contours they define (but we see perceptually). Furthermore, our results suggest that the

global contours could be accomplished in high-tier visual areas such as in V4 via pooling inputs from multiple V1 and V2 neurons with small spatio-temporal receptive fields that are spatially aligned in precise retinotopic coordinates.

Short Bio

Dr. Wei Wang is a Principal Investigator and Head of the Laboratory of Visual Perceptual Mechanisms. He graduated and received his Ph.D. from University of Science & Technology of China in 1998. He was working as a research fellow and senior research fellow at University College London (UCL), University of Manchester Institute of Science & Technology (UMIST) and University of Manchester (UM) respectively from 1998 to 2006. Dr. Wang was awarded the prestige Wellcome Trust Career Development Research Fellowship at the Faculty of Life Sciences, University of Manchester on 1st June 2006. His major research interests lie in the cortical neural mechanisms of visual perceptual phenomena.

15:10 - 15:20 Questions and Discussion

15:20 - 15:35 **Coffee Break**

15:35 - 16:20 **A Neural Circuitry View for Autism Spectrum Disorders**

Zilong Qiu
Institute of Neuroscience Chinese Academy of Sciences

Abstract

Objective: Autism spectrum disorders are a group of neuropsychiatric disorders featuring abnormal social communication and repetitive behaviors. We would like to address whether there are any abnormality in neural circuitry level in mouse model for ASD. Methods: We used pseudo-rabies virus mediated transsynaptic tracing and in vivo spine imaging on one of ASD mouse model, MeCP2 overexpression mice. Results: We found that the neural connections to DG region of hippocampus are significantly altered in MeCP2 overexpression mice, comparing to wild type mice. The development-associated spine elimination is surprisingly increased in MeCP2 overexpression, comparing to wild type mice. Conclusion: We identified critical defects on neural circuit and synapse level in an ASD mouse model.

Short Bio

Zilong Qiu was born in Beijing and grew up in Anhui, China. From 1994-1998, he attended Shanghai Jiao Tong University and graduated with a BS in Biological Sciences. He was a graduate student with Dr. Kan Liao from 1998-2003 at the Shanghai Institute of Biochemistry and Cell Biology, Chinese Academy of Sciences. In his Ph.D. thesis, he focused on the molecular mechanism of adipocyte differentiation. With this molecular biology and cell signalling background, he became eager to explore the field of molecular neuroscience during the last several years as a graduate student and came to Dr. Anirvan Ghosh's Lab at University of California, San Diego to pursue this dream. His postdoctoral project focuses on activity dependent transcriptional regulation of genes in the rodent cerebral cortex. He joined ION faculty as Principle Investigator from July, 2009. His lab now is focusing on the molecular mechanisms of autism spectrum disorders. A wide range of cutting edge technology, including genetic mouse, rat, non-human primates models, in vivo imaging, and neural circuitry tracing tools were applied to address the defects in neural circuitry of autism spectrum disorder animal models.

16:20 - 16:30 Questions and Discussion

16:30 - 17:15 **How Brain-Mind Works with Vision but Beyond: Introduction to a Whole-Brain Theory**

Juyang Weng, Fudan University, China and Michigan State University, USA

Abstract

Neuroscience has made impressive advances, but there is a lack of a computational whole-brain theory. I would like to present a simplified computational theory in an intuitive language about how the brain wires itself as a multi-interchange *bridge* that bi-directionally connects many *islands* where each island is a *sensor* or *effector*. The wiring process of the brain is highly self-supervised while the baby manipulates an object, e.g., sucking a milk bottle. My theory explains that the way a human brain works with vision and visual behaviors is similar to its ways to work with other sensory modalities, other sensory-modality-dependent behaviors, and integrative capabilities such as languages, emotion, and consciousness. I explain how the self-wired basic circuits that use glutamate and GABA become motivated through four additional neural transmitters beyond glutamate and GABA --- serotonin, dopamine, acetylcholine, and norepinephrine. A layman or a researcher in another discipline can get a gist of this theory by attending this short introductory talk. However, to be fully convinced and to effectively use the theory, he must attend some brain-integrated courses in biology, neuroscience, cognitive science, computer science, electrical engineering, and mathematics. I argue that only the Brain-Mind Institute (BMI) currently offer such a series of brain-integrated courses because the material of each BMI

course is guided by the whole-brain theory, through the course instructors and course discussions.

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. 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 a Fellow of IEEE, an editor-in-chief of International Journal of Humanoid Robotics and an associate editor of the new IEEE Transactions on Autonomous Mental Development. He has chaired and co-chaired some conferences, including the NSF/DARPA funded Workshop on Development and Learning 2000 (1st ICDL), 2nd , 7th, and 8th ICDL. He was the Chairman of the Governing Board of the International Conferences on Development and Learning (ICDLs) (2005-2007), http://cogsci.ucsd.edu/~triesch/icdl/), chairman of the Autonomous Mental Development Technical Committee of the IEEE Computational Intelligence Society (2004-2005), an associate editor of IEEE Trans. on Pattern Recognition and Machine Intelligence, and IEEE Trans. on Image Processing.

17:15 - 17:25 Questions and Discussion

17:45 - 20:30 **Welcome Dinner, Danyuan Dining Hall, all participants are invited**

Sunday Dec. 22, 2013

AM Session
Chair: Juyang Weng
9:00 - 9:45 **Mind-Brain Association Studies with Mesoscale Connectomics: Methodology, Reproducibility and Challenges**
Xi-Nian Zuo
Institute of Psychology, Chinese Academy of Sciences

Abstract

Human connectomics has become a central focus in efforts to map complex brain-behavior/mind relationships and identify clinical biomarkers. Because of the desire to characterize inter-individual variation in the connectome, there is a critical need to establish reliability and reproducibility for functional and structural imaging methodologies, as well as identify factors that can impact them. Test-retest reliability and reproducibility are crucial for creating reliable quantitative imaging measures, as various sources of noise are invariably included in all measurements. Previous studies have demonstrated that many 'noisy variables' such as machine noise, scanner type, body heat, cardiac and respiration artifacts, head motion, experimental instructions, data pre-/post-processing strategies, and data standardization can impact the reliability and reproducibility of various connectome metrics. To achieve highly reliable and reproducible brain connectomics, researchers across multiple disciplines are required to interactively develop a public, high quality, large sample of test-retest reliability and reproducibility datasets. This talk will survey prior methodology efforts and challenges to establish reliability and reproducibility and introduce a large-scale aggregate multimodal neuroimaging dataset that will be openly shared in 2014.

Short Bio

Xi-Nian Zuo, Ph.D., Full Research Professorship, PI of Laboratory for Functional Connectome and Development, deputy director of Magnetic Resonance Imaging Research Center, Institute of Psychology, Chinese Academy of Sciences. Dr. Zuo has made substantial contributions to establishing the reliability of resting state fMRI and proving its utility for applications. He is currently leading an 1000 Functional Connectomes Project (FCP)-based consortium to assemble and release a multisite test-retest dataset that will include resting state fMRI and structural MRI for over 1000 individuals, as well as, diffusion and arterial spin labeling MRI data, when available. He published more than 50 scientific papers. The full list of publications can be found at http://lfcd.psych.ac.cn/publications.html.

9:45 - 9:55 Questions and Discussion

9:55 - 10:40 **Prefrontal Cortex and Schizophrenia**

Yuan-Ye Ma
Kunming Institute of Zoology, Chinese Academy of Sciences

Abstract

Prefrontal dysfunction and schizophrenia have a close relationship, however, for the specific mechanisms we still do not know. In the study of the PCP-induced schizophrenia-like behavior in monkeys, we found that the

effects of PCP on the orbital cortex are longer than that on the dorso-lateral prefrontal area. We also found that the PCP led to the prefrontal myelination accelerated in juvenile macaque.

Short Bio

YuanYe Ma is a professor and director of Laboratory of Primate Cognitive Neuroscience, Kunming Institute of Zoology, Chinese Academy of Sciences and also a professor in State Key Laboratory of Brain and Cognitive Science in Institute of Biophysics, Chinese Academy of Science, He focuses on the cognitive function of the prefrontal cortex and the prefrontal mechanisms of some related mental disorders, such as schizophrenia , depression and autism.

10:40 - 10:50 Questions and Discussion

10:50 - 11:05 **Coffee Break**

11:05 - 11:50 **Brain Networks: Pivotal Intermediate Phenotypes Connecting Genome and Psychiatric Disorders**

Bing Liu
Brainnetome Center, Institute of Automation, the Chinese Academy of Sciences

Abstract

The disruptions of brain networks measured by multimodal imaging techniques have been widely reported in psychiatric disorders. Recent twin and pedigree studies supported that the specific brain networks are under genetic control. From an imaging genetics perspective, abnormalities of brain connectivity and brain networks may be regarded as plausible neural intermediate phenotypes. They are helpful in understanding the genetic mechanisms of cognitive function or the risk for psychiatric disorders and are attracting more and more attention in recent imaging genetic studies. We have investigated the connections between schizophrenia risk genetic variants (MIR137, DISC1 and COMT) and brain networks from ROI-based analyses, specific subnetwork analyses and whole brain network analyses. In this talk, we will present whether and how specific brain networks (especially focus on default mode network and thalamic-prefrontal networks, which are vital imaging biomarkers of psychiatric disorders) are modulated by risk genes of psychiatric disorders. Integrating different scale data sets will provide the possibility of understanding the mechanisms of psychiatric disorders.

Short Bio

Dr. Bing Liu is an associate professor in Brainnetome Center, Institute of Automation, the Chinese Academy of Sciences. She obtained a Ph.D. in the Institute of Automation in 2007. Since June 2007, she has worked as an assistant/associate professor in the institute. She is a member of Youth Innovation Promotion Association of CAS (2011) ans received the Award of Beijing Nova Program (2010). Her research interests mainly focus on imaging genetics, systems biology and brain networks in psychiatric disorders. By combining imaging and genetic techniques, her recent studies reported the connections between the genetic variations and the specific brain connectivity and brain networks.

11:50 - 12:00 Questions and Discussion

12:05 - 13:20 **Lunch, Danyuan Dining Hall, all participants are invited**

PM Session
Chair: Xiangyang Xue
13:30 - 14:15 **A Retina-Inspired Neurocomputing Circuit for Image Representation**
Hui Wei
School of Computer Science, Fudan University

Abstract

Biological vision systems have become highly optimized over millions of years of evolution, developing complex neural structures to represent and process stimuli. Moreover, biological systems of vision are typically far more efficient than current human-made machine vision systems. The present report describes a non-task-dependent image representation schema that simulates the early phase of a biological neural vision mechanism. We designed a neural model involving multiple types of computational units to simulate ganglion cells and their non-classical receptive fields, local feedback control circuits and receptive field dynamic self-adjustment mechanisms in the retina. We found that, beyond the pixel level, our model was able to represent images self-adaptively and rapidly. In addition, the improved representation was found to substantially facilitate contour detection. We propose that this improvement arose because ganglion cells can resize their receptive fields, enabling multi-scale analysis functionality, a neighborhood referring function and a localized synthesis function. The ganglion cell layer is the starting point of subsequent diverse visual processing. The universality of this cell type and its functional mechanisms suggests that it will be useful for designing image processing algorithms in future.

Short Bio

Hui Wei received the Ph.D. degree at the Department of ComputerSscience at Beijing University of Aeronautics and Astronautics in 1998. From 1998 to 2000, he was a postdoctoral fellow at the Department of Computer Science and the Institute of Artificial Intelligence at Zhejiang University. Since November 2000, he has joined the Department of Computer Science and Engineering at Fudan University. His research interests include artificial intelligence and cognitive science.

14:15 - 14:25 Questions and Discussion

14:25 - 15:10 **Lateral Inhibition Revisited and its Inspiration to Extreme Learning Machines, Deep Learning and Developmental Networks**

Jun Miao
Institute of Computing Technology, Chinese Academy of Sciences

Abstract

Lateral inhibition (LI) is a classical biological mechanism found in neural systems. In a lot of literature of learning and computing models, LI is referenced as the roles of saliency or edge detection, Winner-Take-All (WTA) or Population-Take-All (PTA). From the point of view of interconnection of neurons, LI is a neuronal structure of Local-Excitation and Global-Inhibition (LEGI). As the central part of LI, Local-Excitation is related to Self Organization Map (SOM) or clustering. As the surrounding part of LI, Global-Inhibition is related to discriminative analysis or classification. In this talk, I will discuss some inspirations form LI to the current frontier topics, such as Extreme Learning Machines (ELM), Deep Learning (DL) and Developmental Networks (DN) and some recent results will be reported.

Short Bio

Jun Miao received the Ph.D. degree in computer science from the Institute of Computing Technology, Chinese Academy of Sciences, in 2005. He is currently an Associated Professor at the Institute of Computing Technology, Chinese Academy of Sciences, Beijing. His research interests include artificial intelligence, neural networks and biologically inspired computer vision. He has published more than 40 research articles in refereed journals and proceedings on object detection, vision neural networks, visual neural information coding, visual perception and cognition. His two main contributions are the technique of Human Face Gravity-Center Template for

face detection and the model of Vision Neural Networks for visual search, respectively.

15:10 - 15:20 Questions and Discussion

15:20 - 15:35 **Coffee Break**

15:35 - 16:20 **Feature Selection and Low-Rank Recovery Using Sparse and Schatten Norms**

Chris H. Q. Ding
Anhui University, Hefei, China, and University of Texas at Arlington, Arlinton, Texas USA

Abstract

Low-dimensional representation (LDR) of high-dimensional objects such as images can significantly improve their clustering performance. In this work, we show that the widely used LDR methods such as principal component analysis (PCA), Laplacian Embedding, and tensor decomposition are in fact mathematically equivalent to k-means clustering and graph spectral clustering that minimize cross-cutting edges. This provides a theoretical understanding of why these LDR techniques work well in practice. It also provides a solid foundation to build more complicated models to tackle more complex problems. On cognitive point of view, does human brain process high-dimensional images as low-dimensional objects?

Short Bio

Chris Hong-Qiang Ding obtained Ph.D. from Columbia University, did research at California Institute of Technology, Jet Propulsion Laboratory, and Lawrence Berkeley National Laboratory. He joined University of Texas at Arlington as a professor in 2007. His research areas are data mining, bioinformatics, high performance computing, focusing on matrix/ tensor approaches. He served on several top data mining conference committees, and reviewed research grants for National Science Foundations of USA, Israel, Ireland, and Hong Kong. He gave invited seminars at UC Berkeley, Stanford, Carnegie Mellon, University of Waterloo, University of Alberta, Google Research, IBM Research, Microsoft Research. He published 200 research papers with 12000 citations.

16:20 - 16:30 Questions and Discussion

16:30 - 16:55 Research on Image Semantic Segmentation

Wei Zhang
School of Computer Science, Fudan University

Abstract

Semantic segmentation is an interesting and challenging problem in computer vision, which aims to assign each superpixel in an image to one of pre-defined semantic categories. The key problem of semantic segmentation is to learn superpixel classifiers which identify semantic label for each superpixel in images. In traditional fully supervised methods, various machine learning techniques are used to train classifiers on labeled superpixels; however, in many practical applications, it is not easy to obtain enough labeled superpixels to learn satisfying classifiers for semantic segmentation. On the contrary, only image-level labels are necessary in weakly supervised semantic segmentation. We perform semantic segmentation in weak supervision by two approaches: I) We try to estimate the superpixel labels in the training set based on image-level labels such that superpixel classifiers can be trained. II) Alternatively, we select optimal classifier by parameters evaluation instead of training. More specifically, we firstly sample the classifier parameters at random and then evaluate the superpixel classifiers by measuring the reconstruction errors among the ground-truth negative samples and the predicted positive samples.

16:55 - 17:00 Questions and Discussion

17:00 **End of Workshop**


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