

# Brain-Mind Workshop

## Final Program

December 19 - 20, 2011

East Guanghua Tower  
Fudan University

220 Handan Road, Shanghai, China

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

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### Monday Dec. 19, 2011

RM 1501, East Guanghua Tower

9:00 - 9:10 **Welcome (Chairs)**

9:10 – 11:30 Monday Morning Session. Chair: Juyang Weng

9:10 - 9:50 **Keynote 1: Yanchao Bi**

Professor, National Key Laboratory of Cognitive Neuroscience and Learning, Beijing Normal University, Beijing, P. R. China

**Title:** Tools, animals, and other objects – neural correlates of human conceptual system

**ABSTRACT:** Semantic memory (conceptual system) is a system for the storage, retention, and recall of general conceptual knowledge about objects, people, facts, and beliefs that are unrelated to specific experiences (Tulving, 1972). This system serves as a foundation for various cognitive processes including language, object recognition and use, reasoning, and problem solving. How are object concepts represented in the brain? I will present a series of studies in my lab that explored this issue from multiple angles, including single case and group studies with patients with brain damage, resting-state and task-based brain imaging experiments with healthy and blind individuals. The results suggest a multi-dimension system in which object domains and modalities may both contribute.

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

10:10 - 10:50 **Keynote 2: Tiande Shou**

Professor, School of Life Sciences, Fudan University, Shanghai, P. R. China

**Title:** Neural basis of psychological “oblique effect”

**Abstract:** The oblique effect is a psychological or behavioral phenomenon that visual ability is better in horizontal and vertical contours than oblique in humans and animals. For half a decade many studies have studied and confirmed the oblique effect using visual evoked potentials, single cell recording and optical imaging techniques. The most popular explanation for oblique effect is that more cortical cells in the primary visual cortex (area 17) prefer to respond to horizontal and vertical meridians than oblique. However, optical image and physiological studies show that only about 5-7% more cells respond preferentially to horizontal and vertical meridians than those to oblique. It is questionable why such a weak difference in the primary cortex can cause a significant psychological or behavioral oblique effect. Using optical imaging based on intrinsic signals combined with local drug injection, we studied the orientation maps of cortical area 21a (corresponding to monkey’s V4) and area 17 evoked by visual grating stimuli of various orientations in the cat. The results show that 1) in area 21a about 25% more cells than those in area 17 preferred to horizontal and vertical meridians, compared with the oblique; 2) the response strength is stronger for horizontal and vertical meridians than oblique; 3) the neural oblique effect of area 17 is significantly enhanced or decreased by feedback signals from activated or inactivated area 21a. These studies suggest a neural basis of oblique effect that neurons in area 21a (or monkey V4) which have a significantly higher neural oblique effect may co-activate area 17 neurons to commonly contribute to the psychological or behavioral oblique effect.

10:50 - 11:30 **Oral Presentation Briefing 1, 5 minute 1 slide each**

Chair: Wenqiang Zhang

Session 1				
	Co-authors	Title	Email	Affiliation
1	Yuekai wang, Xiaofeng Wu, Juyang Weng	Skull-Closed Autonomous Development	10210720110@fudan.edu.cn	EE & CS, Fudan University
2	Zhouye Ding, Qi Zhang Xuanjing Huang	Learning to Extract Coherent Key Phrases from Online News	xjhuang@fudan.edu.cn	CS, Fudan University
3	Hao Ye, Xuanjing Huang Juyang Weng	Developmental Agents for Digital Games	yehao21cn@gmail.com	CS, Fudan University
4	Xipeng Qiu, Xuanjing Huang	Hierarchical Text Classification with Latent Concepts	xjhuang@fudan.edu.cn	CS, Fudan University
5	Gaosheng Chen, Ran Liu	Integrated Circuit and System technologies for BMI	rliu@fudan.edu.cn	EE, Fudan University

11:30 - 13:30 **Lunch Break**

13:30 – 16:30 Monday Afternoon Session. Chair: Jianfeng Feng

13:30 - 14:10 **Keynote 3: Wei Hui**

**Professor, School of Computer Science, Fudan University, Shanghai, P. R. China**

**Title:** A computational neural model of orientation detection based on multiple guesses

**Abstract:** The implementation of Hubel and Wiesel's hypothesis that the orientation selection of a simple cell (SC) is based on the ordered arrangement of receptive fields (RFs) of ganglion cells (GCs) and lateral geniculate nucleus (LGN) cells involves some difficulty. It requires that the RFs of GCs and LGN cells be very similar in size and sub-structure, and arranged in perfect order. It also requires an adequate number of SCs regularly distributed to match ubiquitous edges. However, existing anatomical and electrophysiological evidence is not strong enough to support this geometric-arrangement-based model. In addition, these strict regularities make the model uneconomical both in evolutionary terms and in neural computation. Deviating from the classical model, we propose a new, algebraic neural model to estimate orientation, which synthesizes multiple guesses made by GCs and LGN cells and calculates local orientation information subject to groups of constraints. This algebraic model is not subject to the constraints of Hubel and Wiesel's hypothesis, and it can be easily implemented via neural network. By employing idea of the satisfiability problem of constraint, we also prove that both the precision and efficiency of this model are practicable in mathematics.

14:10 - 14:50 **Keynote 4: Keith Kendrick**

**Professor, Social Cognition and Affective Neuroscience Laboratory, School of Life Sciences and Technology, University of Electronic Science and Technology of China**

**Title:** Role of the amygdala in social cognition, normative behavior and empathy

**Abstract:** The brain amygdala is a major focus of interest in terms of its involvement in processing social and emotional cues. Through its links with the frontal cortex, hippocampus, striatum and brainstem it can influence a wide range of behavioral and physiological functions and it is also thought to be involved in a number of psychiatric disorders. Much of what we have learned about amygdala function in the human brain has come from the study of patients with damage to this region and in this talk I will discuss a series of behavioral and brain imaging experiments investigating the effects of bilateral amygdala lesions in patients with Urbach-Weithe syndrome on a range of social, cognitive and emotional behaviors, including socially facilitated learning, emotional empathy, fear-recognition and normative behavior.

14:50 - 15:30 **Keynoter 5: Baoliang LU**

**Professor, Department of Computer Science and Engineering, Shanghai Jiaotong University, P.**

**R.China**

**Title:** Towards to Robust Monitoring of Driver Fatigue by Using Electrooculogram (EOG)

**Abstract:** In this talk, we introduce a method for monitoring driver fatigue by using electrooculogram (EOG). Clinical researches usually take electroencephalogram (EEG) as the gold standard due to its high accuracy. In spite of this, it is still difficult to bring EEG based method to practical driving situation mainly because of its extremely low signal to noise rate (SNR). EOG signal is generated from the potential difference of retina and cornea. It reflects eye movements like the blinks and saccades. Normally two pairs of electrodes are used for EOG recording. The vertical EOG is recorded from two electrodes above and below one of eyes, and the horizontal EOG from two electrodes at the outer of each eye. From the vertical and horizontal EOGs, it is possible to recognize and identify the eyelid and eyeball movements for vigilance estimation. Although EOG may not reflect the vigilance so directly as EEG does, it benefits from high SNR and easy recording. Comparing with the video based methods, they utilize similar eye movement features but by EOG it is more likely to achieve high time resolution, high recognition rate, multiple feature quantities, and low equipment cost. We have proposed a method using EOG features, mainly slow eye movements (SEMs), to estimate human alertness. Since EOG signals are much more intense than EEG signals, a method based on EOG is robust and easy applied. In addition, recording EOG signals requires only a few electrodes on the face, which means lower requirements for the signal gathering. The performance evaluation of such method by the correlation coefficients between the estimated alertness level and the local error rates of the subjects shows that the correlation can achieve 0.79 by using EOG features off-line. To overcome the limitations of traditional electrode placement in practical applications, we have proposed a novel electrode placement for EOG recording. We rearrange the position of electrodes and gather them all on the forehead. With this arrangement, the electrodes will not impact the sight of the users, which makes the whole device more wearable and users more comfortable.

15:30 - 15:50 **Coffee Break**

15:50 - 16:30 **Keynoter 6: : Jianfeng Feng**

**Professor, Centre for Scientific Computing and Computer Science, University of Warwick, Coventry,**

**UK**

**Title:** Charting Mental Disorder Brain Circuits

**Abstract:** In the talk, we will introduce and summarize some of our recent endeavours to deal with various types of data related to fMRI, with the aim to improve our understanding of various brain function (disorders). From a multi-million ARDI project, we successfully performed whole genome-wide and whole brain-wide association studies, different from the single voxel-wise and single-locus approach. From depression data, we introduced a holistic approach to identify 'hate

circuit' as the top candidates of all altered functional circuits. Further results on other brain disorders such as Schizophrenia, ADHD, drug addiction, Parkinson's disease are covered.

16:30 - 17:30 **Oral Presentation Briefing 2, 5 minute 1 slide each**

Chair: Xiaofeng Wu

Session 2				
	name	Title	Email	Affiliation
1	Jie Zhang	Pattern Classification of Large-scale Functional Brain Networks: Identification of Informative Neurobiological Markers for Epilepsy	jzhang080@gmail.com	Math, Fudan U.
2	Bing Xu	Neural Modeling of Epilepsy	xub@fudan.edu.cn	Math, Fudan U.
3	Wenbo Sheng	Extended Granger Causality Based on AR Models with Nonlinear Signal-Dependent Noise	wbsheng@fudan.edu.cn	Math, Fudan U.
4	Chenyang Tao	Electrophysiological Signal Analysis	11210700135@fudan.edu.cn	Math, Fudan U.
5	Ye Yao	Diffusion approach of DTI	yyao@fudan.edu.cn	Math, Fudan U.
6	Xiangnan He	Synchronization Propagation in neuronal networks	seanhe2007@gmail.com	Math, Fudan U.

17:30 - 20:30 **Welcome Dinner. All participants are invited.**

## Tuesday Dec. 20, 2011

9:10 – 11:30 Tuesday Morning Session. Chair: Hongbo Yu

**RM 1501, East Guanghua Tower**

9:00 - 9:40 **Keynote 7: Zhongzhi Shi**

**Professor, Key Lab of Intelligent Information Processing, Institute of Computing Technology,**

**Chinese Academy of Sciences, Beijing, P. R.China**

**Title:** Brain-like Intelligent Machines

**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 introduce the progress of three kinds of projects in the world, that is, the brain MoNETA of novel machine, IBM brain computer, common artificial intelligent framework LIDA. 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.

9:40 - 10:20 **Keynote 8:Rubin Wang**

**Professor, Institute for Cognitive Neurodynamics, East China University of Science and Technology, Shanghai, P. R. China**

**Title:** Computation of neural energy based on information coding

**Abstract:** This talk addresses the computation of neural energy during the activities of neurons. We found that the widely published literature about the energy consumed during neuronal activities is not complete. Our computation shows that a neuron first absorbs energy and then consumes energy during firing of action potential. This result is new in the past models about neuronal model and biological neural network. According to this important discovery, we can explain why during the excitation of a neuron in the brain considerably increases the volume of blood flow but the consumption of oxygen only increases slightly. This phenomenon has not been explained clearly till now. This discovery also explains why during the presentation external stimuli there is a synchronization with the perception. This phenomenon has not been well explained in the neuroscience community.

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

10:40 - 11:20 **Keynote 9: Hailan Hu**

**Institute of Neuroscience, Chinese Academy of Sciences, Shanghai, P. R.China**

**Title:** Circuit mechanism of depression and social hierarchy

**Abstract:** My lab is interested in the synaptic and circuit mechanisms underlying emotional and social behaviors and psychiatric diseases. One of the directions is to identify the molecular mechanisms accounting for the altered neuroplasticity in depressed animal brain. Toward this goal, we have performed a high-throughput quantitative proteomic screen to look for protein changes in habenula, a brain region that responds to negative emotional stimulus and is hyperactive during depression. In a second line of research, we are investigating the neural circuit mechanism of social hierarchy, a most robust form of social behavior. We established that dominance ranking in group-housed mice is transitive, relatively stable, and highly correlated among multiple dominance measures. Using electrophysiology recording and viral-based gene manipulation, we found that social rank correlates with the synaptic strength in the medial prefrontal cortex (mPFC), and can be tweaked by molecular manipulations that alter the synaptic efficacy in mPFC.

11:20 - 12:00 **Oral Presentation Briefing 3, 5 minute 1 slide each**

Chair: Wenqiang Zhang

<b>Session 3</b>				
	<b>name</b>	<b>Title</b>	<b>Email</b>	<b>Affiliation</b>
<b>1</b>	Lei Tong	Feedback from Area 21a Influences Orientation but not Direction Selectivity	leitong@fudan.edu.cn	Life, Fudan U.
<b>2</b>	Dake Li	Functional Plasticity in Retina: An ERG Study in Dark Reared Rodent	lidake@163.com	Life, Fudan U.
<b>3</b>	Hongjian Li	Decoding the Population Responses of Neurons: Oblique Effect from the View of Physiology	07300700142@fudan.edu.cn	Life, Fudan U.
<b>4</b>	Zhong Li	Orientation Selectivity in Monkey V1: the Size of CO Patch Matters	0570024@fudan.edu.cn	Life, Fudan U.
<b>5</b>	Xiaoying Song	Where-What Network 5: Dealing with Scales for Objects in Complex Backgrounds	09210240073@fudan.edu.cn	CS, Fudan U.

12:00 - 13:30 **Lunch Break**

13:30 – 16:30 Tuesday Afternoon Session. Chair: Xiangyang Xue

**RM 102, East Guanghua Tower**

13:30 - 14:10 **Keynote 10: Xiangyang Xue**

**Professor, School of Computer Science, Fudan University, P. R. China**

**Title:** Image Tagging based on Content and Collaborative Filtering

**Abstract:** Increasing availability of large quantities of user generated images with labels has provided much more opportunities to develop automatic tools to tag images to facilitate image search and retrieval. We presented a novel hybrid probabilistic model (HPM) which integrates low-level image features and high-level user provided tags to automatically tag images. For images without any tags, HPM predicts new tags based solely on the low-level image features (i.e. content). For images with user provided tags, HPM jointly exploits both the image features and the tags in a unified probabilistic framework to recommend additional tags to label the images. The HPM framework makes use of the tag-image association matrix (TIAM). However, since the number of images is usually very large and user provided tags are diverse which means that TIAM is very sparse thus making it difficult to reliably estimate tag to tag co-occurrence probabilities. We developed a Collaborative Filtering method based on non-negative matrix factorization (NMF)

for tackling this data sparsity issue. The effectiveness of the proposed approach has been evaluated using three datasets.

**14:10 - 14:50    Keynote 11: Konstantinos Efstathiou**

**Researcher, Department of Mathematics, University of Groningen, Netherlands**

**Title:** Applications of dynamical systems in biology and synchronization

**Abstract:** The concept of synchronization plays a very important role in biology. I will present two systems that exhibit synchronization. The first such system is a network of pulse coupled oscillators with delay. Such networks are used for modeling, for example, the activity in biological neuron networks or the synchronization processes in networks of interacting agents. Because of the non-zero delay the state space of such systems is infinite dimensional. We study the existence of unstable attractors, i.e., of saddle periodic orbits whose stable set has non-empty interior. We prove that for any number of oscillators  $n \geq 3$  there is an open parameter region in which the system has unstable attractors. Moreover, in the case of  $n=4$  oscillators we show that there exist unstable attractors with heteroclinic cycles between them. The second such system is a model for circadian rhythms. We study how a single pacemaker cell synchronizes to an external periodic signal. This signal includes the effect of the external environment (light-dark cycle) but also the effect of the rest of the pacemaker cells. It turns out that such a system can be described by a family of circle maps. We discuss the properties of this family (emphasizing resonances and Arnold's tongues) and their biological significance.

**14:50 - 15:10    Coffee Break**

**15:10 - 15:50    Keynote 12: Hongbo Yu**

**Professor, School of Life Sciences, Fudan University, Shanghai, P. R. China**

**Title:** Self Organization in Visual Cortex: from Model to Experiment

**Abstract:** Self organization (elastic) model has been widely applied in neuroscience. We adopted this model to investigate the formation of multiple feature maps in primary visual cortex, and examined it in real animal experiment. We found that multiple feature maps were not necessarily perpendicular to each other (as traditional hypercolumn model suggested), and they avoided each other at the level of fast changing area. By using intrinsic optical imaging and two-photon imaging techniques, we demonstrated that the experimental data matched very well with the model. We further examined the dynamic plasticity of self organization model, by using the monocular deprivation protocol, and proved not only the existence of critical period, but also a noncompetitive shift of ocular dominance, which is consistent with our *in vivo* chronic functional and dendritic spine imaging. Taken together, the self-organization model and experiment data are well matched, and the combination of computation and experiment can strengthen each other for further fundamental research.



15:50 - 16:30 **Keynote 13: Juyang Weng**

**Professor, Department of Computer Science and Engineering, Michigan State University, USA**

**Title:** Understanding the (5+1)-Chunk Brain-Mind Model Requires 6-Discipline Knowledge

**Abstract:** Over 20 years of our research has led to a brain-mind network model at the (5+1)-chunk scale. The 5 conceptual chunks are development, architecture, area, space, and time. The development addresses not only what the brain is now but also how the mind emerges. The architecture explains how the brain self-organizes overall. The area corresponds to the basic building unit of the brain in dealing with features, memory and learning. The space clarifies how the brain deals with spatial information. The time explains how the brain copes with temporal information. These are the 5 most basic chunks of a brain-mind, from a simple fruit fly to a human. The additional chunk is called modulation, which sits on top of the basic 5 chunks, dealing with motivation, novelty and uncertainty. In this talk, we will give an overview of this (5+1)-chunk model. However, true understanding of this model requires knowledge in at least 6 disciplines --- biology, neuroscience, psychology, computer science, electrical engineering, and mathematics. In other words, not only must such an overarching model be supported by rich evidence from the six disciplines, understanding of such a model also requires 6-disciplinary knowledge. This overarching model seems to provide a great opportunity of many new and important research topics to anyone who works in one of the 6 disciplines. The Brain-Mind Institute in US scheduled to start from summer 2012 at MSU provides an infrastructure for anyone who is interested in taking up this great opportunity.

16:30 - 17:30 **Panel: The Era of Brain-Mind**

**Chair: Juyang Weng**

**Panel members:**

**Xiaoman Chen: Future of functional analysis**

**Jianfeng Feng: Mental disorders**

**Lin Wei: Mathematical Modeling and Complexity**

**Zhongzhi Shi: Brain-like intelligent machines**

**Juyang Weng: Computational brain models**

**Xiangyang Xue: Computer vision challenges**

**Hongbo Yu: Cortical circuits**

**Ran Liu: VLSI for brain-scale computing**

17:30 **End of Workshop**