Expert introduction

Tianzi Jiang
Institute of Automation,
Chinese Academy of Sciences

Michael A. Nitsche
The Leibniz Research Centre for Working Environment and Human Factors

Kewei Chen
Banner Alzheimer's Institute

Baoliang Lu
Shanghai Jiao Tong University

Hongen Liao
Tsinghua University

Hui Zhang
Shanxi Medical University

Qi Yang
Capital Medical University

Peng Xu
University of Electronic Science and Technology

Tianyi Yan
Beijing Institute of Technology

Badong Chen
Xi'an Jiaotong University

Zhiguo Zhang
Shenzhen University

Xun Chen
University of Science and Technology of China

Yong Xu
First Hospital of Shanxi Medical University

Dongrui Wu
Huazhong University of Science and Technology

Banghua Yang
Shanghai University

Lei Du
Northwestern Polytechnical University

Yuhui Du
Shanxi University

Bin Wang
Taiyuan University of Technology

Junhai Xu
Tianjin University

Hao Guo
Taiyuan University of Technology

Brain science and brain imaging analysis

Time: 2021.8.7 8:30-12:10 **Host: Tianyi Yan**

Report guest : Tianzi Jiang

Report title : The Human Brainnetome Atlas and its applications in Cognitive Science and Brain Diseases

Guest profile : He is director of the Research Center of Brain Network Group, Institute of Self-Chemistry, Chinese Academy of Sciences, and director of Beijing Key Laboratory of Brain Network Group. He is foreign Academician of the European Academy of Sciences (MAE), IEEE Fellow, IAPR Fellow, AIMBE Fellow, winner of the National Outstanding Youth Fund, Changjiang Scholar Distinguished Professor, Chief Scientist of the 973 Project. His main areas of expertise include multi-modal cross-scale brain network atlas research, brain-computer fusion based on brain network atlas.

Report abstract : The Human Brainnetome atlas is constructed with brain connectivity profiles obtained using multimodal magnetic resonance imaging. It is in vivo, with fine-grained brain subregions, and with anatomical and functional connection profiles. In this lecture, we will summarize the advance of the human brainnetome atlas, its biological basis and practical applications in neuroscience and brain diseases. We first present the basic ideas of the human brainnetome atlas and the procedure to construct this atlas. Then some parcellation results of the human brain areas with different types of cytoarchitectures will be provided. After that, we will present the biological basis of the brainnetome atlas from aspects of genetics, evolution, and relationships between structure and functions of the brain. Next, we will show how to use the human brainnetome atlas in practice to address issues in cognitive neuroscience and clinical research. Finally, we will give a brief perspective on multiscale brainnetome atlas and the related neurotechniqes.

Report guest : Kewei Chen

Report title : The use of neuroimaging techniques and artificial intelligence in the study of AD and AD prevention

Guest profile : Kewei Chen, Ph.D. is a Senior Scientist. He is the founding director of the Computational Image Analysis Program at Banner Alzheimer's Institute. His current H-index is 92 according to Google scholar. And his partial publications can be found in ResearchGate, Google Scholar, and NIH sponsored my bibliography.

Report abstract : The presentation consists of two parts. The first part is on the use of neuroimaging techniques to define AD relevant biomarkers related to beta-amyloid, tau-protein, and the generic risks for generic neurodegeneration disease including Alzheimer's disease (AD). We will highlight the use of neuroimaging techniques we developed in recent clinical trials and in researches, our investigation of various techniques to imbed these relevant biomarkers for trials and the efficacy evaluations of interventions. For the second part of the talk, we will the use of AI in the study of AD together with neuroimaging techniques.

Report guest : Badong Chen

Report title : Brain visual cognitive decoding based on fMRI

Guest profile : Professor, School of Artificial Intelligence, Faculty of Telecommunications, Xi'an Jiaotong University. In 2008, he graduated from Tsinghua University with a Ph.D. degree in computer science, and did post-doctoral research in the Department of Electrical and Computer Engineering at the University of Florida. He has published more than 200 academic papers in internationally renowned journals and conferences (including more than 80 IEEE serial journal papers). The papers have been cited more than 7,000 in Google Scholar, and 15 papers have been selected as "ESI Highly Cited Papers".

Report abstract : With the development of cognitive psychology and cognitive neuroscience, especially the brain imaging technologies such as EEG, MEG and fMRI, the interpretation of brain mind by scientific means has become a research hotspot in the cross field of neuroscience and artificial intelligence. This report introduces the related concepts and research status of brain visual cognitive decoding based on fMRI, discusses the main decoding methods, such as Voxel-Wised Model and Multi Voxel Pattern Analysis, and introduces the new models and methods proposed by the reporter's research team.

Report guest : Baoliang Lu

Report title : Emotion Recognition from EEG and Eye Movement Signals with Deep Learning

Guest profile : Shanghai Jiao Tong University Computer Science and Engineering Department Dean-appointed professor, doctoral supervisor, IEEE Fellow. He is currently the director of the Research Center for Brain-like Computing and Machine Intelligence in the Department of Computer Science and Engineering, Shanghai Jiaotong University. He won the 2018 IEEE Transactions on Autonomous Mental Development Best Paper Award and the 2020 First Prize of Wenjun Wu Artificial Intelligence Natural Science, and was selected as the "Highly Cited Scholar in China" by Ixel 2020.

Report abstract : Emotion recognition plays an important role in affective Brain Computer Interface. Many modalities have been adopted to recognize human emotions, including facial expression, skin conductance response, eye movement, and electroencephalograph. However, the performance of those individual modality turn out to be at an inadequate low level that cannot be generalized since emotions are complex psycho-physiological processes associated with both internal and external activities. The combination of EEG signals, reflecting internal physiological responses, and eye movements, has been proven to be a promising approach that would achieve better performance than single modality. In this talk, I would like to introduce our recent work on emotion recognition from EEG and eye movement signals by using deep learning. The second one is a generative adversarial networks-based framework, in which a single modality of eye movements is used as input and it is capable of mapping the information onto multimodal features.

Report guest : Peng Xu

Report title : Research on brain network construction method and its application based on EEG

Guest profile : Professor of the School of Life Science and Technology, University of Electronic Science and Technology of China, winner of the National Outstanding Youth Fund, and New Century Outstanding Talents of the Ministry of Education. He published more than 100 SCI papers, applied for approval of 5 national invention patents, received 6 software copyrights, and won the first prize of natural science of the Ministry of Education (ranked 4). In 2012, he was selected as the New Century Excellent Talents Program of the Ministry of Education.

Report abstract : The brain usually processes the information in the cognitive process in the form of network. Brain network analysis can effectively measure the functional relationship between brain regions. Because of its high time resolution, EEG based network analysis can effectively describe the dynamic information processing network mechanism of the brain. However, EEG network analysis is largely affected by the inherent of EEG, such as low spatial resolution, low signal-to-noise ratio and volume effect, which leads to the popularization and application of EEG network analysis. This report will introduce how to develop corresponding EEG network analysis methods from the new mathematical space and the new signal space to deal with the inherent defects of the above EEG signals, and how to mine the brain network information in combination with EEG network analysis, so as to realize the understanding of the information processing mechanism of relevant cognitive processes and the auxiliary diagnosis and evaluation of diseases

Brain computer interface

Time: 2021.8.7 14:00-17:30 **Host: Zhiguo Zhang**

Report guest : Zhiguo Zhang

Report title : Individualized accurate evaluation of pain based on brain image

Guest profile : Professor, Doctoral Supervisor, Assistant Dean, and National Talent Program candidate of the School of Biomedical Engineering, School of Medicine, Shenzhen University. He has published more than 90 SCI papers (published journals including IEEE Transactions, Journal of Neuroscience, NeuroImage, Human Brain Mapping, etc.), co-authored two EEG processing books. His work on non-invasive neural interfaces won the first prize of the Natural Science Award of the Ministry of Education in 2021 (ranked 4th).

Report abstract : Accurate pain assessment is the key premise of clinical pain diagnosis and treatment. Pain measurement mainly depends on patients' subjective score, and its reliability and feasibility are very limited. Decoding pain intensity from EEG and brain images is a potential technique for objectively measuring pain, but the huge individual differences in pain and its related neural activities significantly reduce the accuracy and applicability of this technique. This report will introduce how to clarify the neural mechanism of individual differences in pain through in-depth analysis of brain images, and further introduce the machine learning model that can effectively overcome individual differences in pain.

Report guest : Michael A. Nitsche

Report title : News about modulation of neuroplasticity, and oscillations in the human brain via transcranial electric stimulation (tES)

Guest profile : Director of the Dept. Psychology and Neurosciences at the Leibniz Research Centre for Working Environment and Human Factors in Dortmund, and holds a position as scientific staff member at the Dept. He received the Alois Kornmüller and the GESET Award by the German Society of Electrostimulation and Electrotherapy for his work on non-invasive brain stimulation in humans.

Report abstract : Transcranial electric stimulation (tES) is a non-invasive brain stimulation tool to induce alterations of cortical excitability, neuroplasticity, and oscillations in the human brain. It main variants are transcranial direct current, and alternating current stimulation (tDCS, tACS). It is increasingly used in basic studies, and for clinical applications in recent years. In this talk, an overview will be given about new tDCS and tACS protocol developments, including dose-enhancement, and repetition of stimulation, transferability of results from the motor to the prefrontal cortex, and a new stimulation protocol which allows to induce and stabilize oscillatory brain activity. Furthermore, the specific impact of individual factors, such as age and chronotype, on stimulation effects will be discussed.

Report guest : Dongrui Wu

Report title : Machine Learning in Brain-Computer Interfaces

Guest profile : Bachelor of Automatic Control from University of Science and Technology of China, Master of Electronic Engineering from National University of Singapore, Ph.D. of Electronic Engineering from University of Southern California. Professor and PhD supervisor of the School of Artificial Intelligence and Automation, Huazhong University of Science and Technology, deputy director of the Key Laboratory of Image Information Processing and Intelligent Control of the Ministry of Education, and a national overseas high-level talent (youth).

Report abstract : A brain-computer interface (BCI) enables a user to communicate with a computer directly using brain signals. Electroencephalograms (EEGs) used in BCIs are weak, easily contaminated by interference and noise, non-stationary for the same subject, and varying across different subjects and sessions. Thus, sophisticated machine learning approaches are needed for accurate and reliable EEG-based BCIs. This talk will introduce the basic concepts of BCIs, review the latest progress, and describe several newly proposed machine learning approaches for BCIs.

Report guest : Tianyi Yan

Report title : Biofeedback regulation technology and Application

Guest profile : Associate Dean of the School of Life Sciences, Beijing Institute of Technology, head of the Department of Biomedical Engineering, professor, and doctoral supervisor. Presided over more than 10 national key research and development programs, key projects of the National Natural Science Foundation of China, major science and technology projects in Beijing. He served as the editorial board member of 4 SCI journals. He published more than 80 academic papers, including hot papers and 1 highly cited paper , cover paper 2.

Report abstract : Neuropsychiatric diseases are major social problems, which have brought a heavy burden to the aging society and are the primary cause of disability. Due to the complex etiology and great individual differences, it brings great difficulty to the rehabilitation technology. Noninvasive neural rehabilitation technology brings hope to the treatment of neuropsychiatric diseases. This report will introduce the software and hardware development of biofeedback and neural regulation technology, the application of artificial intelligence algorithm and clinical application research progress.

Report guest : Banghua Yang

Report title : Application of motor imagery BCI in intelligent diagnosis and rehabilitation

Guest profile : Shanghai University School of Mechanical and Electrical Engineering and Automation, School of Medicine, double-appointed professor, doctoral supervisor, director of the Brain-Computer Engineering Research Center. Shanghai Pujiang Talents, Shanghai May 1st Labor Medal Winner, Shanghai March 8th Red Banner Bearer. She has published more than 110 academic papers and has been invited to give more than 40 conference reports. Reported by CCTV-9 and CCTV-1 in 2020.

Report abstract : Brain-computer interface (BCI) is an important aspect of brain science research which is an international frontier field. It is a human-computer interaction mode developed in recent years. Through this technology, people can directly express or manipulate other devices by the brain without the need for the language or body movement. BCI technology can be used as a new mode for active recovery of the brain disease, by decoding the brain signals and combining the closed-loop feedbacks such as VR through vision, touch or hearing. It can make patients repeat training on specific brain regions. Based on brain plasticity, this brain training can stimulate the reconstruction of the damaged neural function. This report will introduce the basic principle of BCI, the core artificial intelligence decoding method, the specific application of BCI combined with VR on the typical medical and industrial fields such as rehabilitation of stroke patients, rehabilitation of drug addiction diagnosis, and diagnosis of mental depression patients.

Disease diagnosis and treatment

Time: 2021.8.8 8:30-12:00 **Host: Haifang Li**

Report guest : Hongen Liao

Report title : Intelligent Diagnostic and Therapeutic Techniques for Precision Medicine

Guest profile : He received his Ph.D. degrees in biomedical precision engineering from the University of Tokyo, Japan in 2003. He is the author and co-author of more than 290 peer-reviewed articles and proceedings papers, as well as over 50 patents, 300 abstracts and numerous invited lectures.

Report abstract : Intelligent and precise minimally invasive diagnosis and treatment has become one of the main trends of clinical medical development. Development of novel diagnostic and treatment techniques will be helpful for integrating minimally invasive treatment into an intelligent medical system. In the field of intra-operative imaging and processing, integrated diagnosis and therapeutic systems, which combines preoperative and intraoperative images have been established for precision tissue identification, tumor resection during surgery. We have investigated novel image processing and multimodality image fusion methods in the field of quantitative and automatic analysis of lesions and anatomic structures to guide accurate diagnosis, efficient implant determination and radiation-free intraoperative navigation. The intelligent medical image analysis techniques have been carried out to guide precision treatment in different medical applications such as cardiovascular, orthopedics, and neurosurgery. Our goals expect break through the traditional concept of minimally invasive robotics surgery, open up a new field of minimally invasive diagnosis and treatment for precision medicine.

Report guest : Hui Zhang

Report title : Research progress of intelligent imaging of brain tumors

Guest profile : Second level Professor, doctoral supervisor, postdoctoral instructor. Former vice president of Shanxi Medical University, now president of medical imaging School of Shanxi Medical University, expert enjoying special allowance of the State Council, national outstanding scientific and technological worker, standing member of Radiology branch of Chinese Medical Association, standing member of Radiology branch of Chinese Medical Association.

Report abstract : Brain tumors are one of the diseases that pose a great threat to human health, with high morbidity, high mortality, wide pathology (complexity, more tissue origin), and complex imaging features (spatial and temporal heterogeneity within the tumor). Tumors are highly heterogeneous, and it is difficult to accurately assess the malignant progress and survival prognosis in an early stage. Therefore, accurate preoperative diagnosis of brain tumors and postoperative prognostic evaluation are very important, and have always been the focus of clinical imaging and scientific research workers. This lecture mainly focuses on the intelligent imaging research of brain tumors, from the differential diagnosis, graded diagnosis, molecular classification, and prognosis of brain tumors. Tell, and finally realize the early and accurate diagnosis and treatment of brain tumors through intelligent imaging methods.

Report guest : Qi Yang

Report title : Construction of auxiliary clinical diagnosis and treatment system for acute cerebrovascular diseases based on artificial intelligence and clinical transformation application

Guest profile : Deputy dean of beijing institute of critical brain diseases, executive deputy director of the cardiovascular disease medical engineering laboratory of the ministry of education, deputy director of the advanced center for big data precision medicine. Published more than 110 SCI papers in JACC, Stroke, Advanced Science, Annals of Surgery and other magazines, obtained 6 national invention patents.

Report abstract : The eStroke national thrombolytic imaging platform was led by professor qi yang of capital medical university, and was jointly established with neusoft Intelligent medical research institute and shenyang neusoft nedical system. The platform combines deep learning technology with traditional perfusion image analysis methods to provide quantitative analysis including the ischemic penumbra and core infarct area, intelligent image analysis services such as micro-hemorrhage detection and quantification, Realize efficient and accurate evaluation of multimodal imaging of thrombolysis and thrombectomy, rapid identification of salvable tissues through images, development of remote and mobile first aid for stroke, intelligent early warning and intervention for high-risk groups, combined stroke treatment, virtual surgery and other technologies and engineering. At the technical level, The platform mainly calculates and outputs CBF, CBV, MTT, TTP, Tmax and other perfusion parameter maps for CT whole brain perfusion images and MR whole brain perfusion images.

Report guest : Yong Xu

Report title : Digital and Computational Psychiatry for Intelligent Diagnosis and Therapy

Guest profile : Professor, and Dean of the Department of Mental Hygiene, Shanxi Medical University. New Century Outstanding Talents of the Ministry of Education, Head of the Leading Clinical Specialty of 136 Xing Medical Project in Shanxi Province.

Report abstract : Nowadays, there is widely acknowledged that current psychiatric diagnostic and treatment lack a robust biological foundation. There are many forms we have explored including virtual reality, recognition of emotion, natural language processing. We created the AVATAR digital robot by integrated mixed reality(MR) and artificial intelligence(AI) technology and drafted relevant AVATAR therapy to treat auditory verbal hallucination(AVHs) and depressive disorder. Meanwhile, we develop the procedures of emotional escort robots for autism spectrum disorder and this procedures include emotional image and voice information assisted robots to make diagnose more accurate and Applied Behavior Analysis(ABA) computerized to insist rehabilitation of child more effective. We expect that digital and computational psychiatry can get beyond the conventional model of psychiatry and bring new hope to patients suffered from mental disorders.

Report guest : Xun Chen

Report title : Neurophysiological Signal Processing and Analysis: Multiset and Multimodal Methods

Guest profile : Xun Chen received the B.Sc. and the Ph.D. degrees. He has been a research scientist in the Department of Electrical and Computer Engineering at UBC. He has published over 100 scientific articles in prestigious IEEE/Elsevier journals and conferences, including 2020 IEEE TIM Andy Chi Best Paper Award, 1 Feature Article in IEEE SPM, 5 ESI Highly Cited Papers and 1 “Top 5 Highly Cited Articles” in Elsevier-BSPC.

Report abstract : Neurophysiological signals contain rich human health information, and their processing and analysis play an important role in the whole process of health care such as active prevention, intelligent diagnosis, precision treatment, and scientific rehabilitation. However, neurophysiological signals have the characteristics of weak magnitude, strong randomness, and diverse modalities, leading to serious aliasing, poor repeatability, and multiple sources of heterogeneity. The talk will introduce neurophysiological signal denoising, signal association and signal fusion methods as well as their related applications based on joint blind source separation and deep feature representation from the multiset and multimodal perspective. The talk will discuss how to effectively isolate complex interference information, extract potential common information, mine heterogeneous complementary information, to achieve the goal of overcoming interference, seeking common ground while reserving difference.

Youth Forum

Time: 2021.8.8 14:00-17:30 **Host: Qi Li**

Report guest : Yuhui Du

Report title : Using brain imaging to explore the brain and brain diseases

Guest profile : Yuhui Du has published more than 60 academic papers, with a citation rate of more than 2,245 times and an H factor of 26. Yuhui Du is a reviewer of more than 40 international journals and conference papers, presided over and participated in a number of national natural science funds.

Report abstract : Brain imaging is a powerful tool for exploring mental illness and understanding the brain. Mining objective imaging indicators of brain mutation based on brain magnetic resonance imaging, extracting sparse and effective features from multi-modal high-dimensional image data to improve the classification performance of different mental diseases.

(1) Steady-state and dynamic brain function network analysis methods. It focuses on sharing how to maintain the comparability of brain function networks of different subjects while optimizing individual characteristics to obtain accurate brain function networks, and how to conduct brain function network analysis of large sample data from multiple sites.

(2) Exploring image signs of mental illness based on multimodal brain images.

(3) Use machine learning and deep learning to assist in the diagnosis of mental illness and understanding of the brain. Focus on sharing how to dig out effective features from high-dimensional brain image data.

Report guest : Lei Du

Report title : Image-Genome Association Analysis

Guest profile : Associate professor and doctoral supervisor of Northwestern Polytechnical University School of Automation. He has been engaged in brain imaging genomics and machine learning algorithm research for a long time, and applied the algorithm to brain disease research. Currently as the first author, he has published more than 30 academic papers in important international journals and international conferences, including Medical Image Analysis, IEEE TMI, Bioinformatics, ISMB, IPMI, MICCAI, BIBM, etc., and won the BIBM 2018 Best Paper Award.

Report abstract : Brain imaging genomics combines imaging and genomics, and uses brain imaging as the internal phenotype to study the regulatory mechanism of genetic variation on the brain. Brain imaging genomics combines imaging and genomics, and uses brain imaging as the internal phenotype to study the regulatory mechanism of genetic variation on the brain, so as to clarify the brain structure, function, and neural mechanisms and internal genetic mechanisms of brain diseases. Brain imaging genomics integrates genes, brain imaging, and other omics data for systems biology research, establishing a multi-level research bridge from micro to macro.Existing imaging genomics analysis methods are difficult to integrate rich brain imaging data and protein and other multi-omics data. At the same time, discover imaging markers, protein markers, and risk genes related to brain diseases can achieve precise diagnosis and intervention of brain diseases assisted by computing technology

Report guest : Bin Wang

Report title : Research on brain lateralization based on brain network

Guest profile : Professor, doctoral supervisor; member of the International Computer Association, member of the Chinese Computer Society, young member of the Medical Imaging Engineering and Technology Branch of the Chinese Society of Biomedical Engineering, member of the Society of Compound Medical Engineering; reviewers of journals such as Neuroscience Letters and Brain Imaging and Behavior. In recent years, 45 scientific research papers have been published.

Report abstract : The human brain exhibits a typical hemispheric functional separation pattern. The lateralized tissue structure of the brain is a combination of genetics and environment, which affects people's feelings, cognition, emotions and behaviors extensively. Lateralization studies our understanding and pathological problems. We use multi-modal imaging technology to build a hemispherical network of the brain, From the connection model and network topology, study the organization principle of the hemispheric network and the abnormal pattern of brain diseases, and it is found that the degree of lateralization of the hemispheric network is affected by gender, mood, etc. In AD, schizophrenia, mania, and ADHD show different degrees and patterns of lateralization and disappearance.

Report guest : Junhai Xu

Report title : Research on brain information decoding based on Fmri

Guest profile : Ph.D. and master's supervisor, Associate Professor of Tianjin University's Department of Intelligence and Computing, Tianjin Key Laboratory of Cognitive Computing and Application, Visiting Scholar of University of Southern California, Standing Committee Member of Shandong Neuroscience Society Artificial Intelligence and Brain-like Research Branch, CCF YOCSEF Tianjin Members. Presided over the National Natural Science Foundation of China, National Key Research and Development Program sub-projects.

Report abstract : The continuous development of fMRI technology makes it possible to interpret cerebral cortex signals. Studying the information decoding model of the human brain can deepen our understanding of the information processing mechanism of the human brain. This report will introduce the current development of human brain information decoding technology and its application in diseases and task states in combination with the research of the team in the decoding model, and make a certain prospect is made for the future of decoding technology.

Report guest : Hao Guo

Report title : Research progress of hypernetworks based on hypergraphs: theory and applications

Guest profile : Professor, supervisor of master's students, director of the Department of Artificial Intelligence, School of Information and Computer Science, Taiyuan University of Technology, senior member of the Chinese Computer Society, member of the International Computer Society, director of the Shanxi Association of Experts and Scholars, a communication review expert of the Degree Center of the Ministry of Education, a letter commentary from the National Natural Science Foundation of China expert.

Report abstract : According to the development of network science, hypernets as a new method that can be used to describe complex systems and complexity problems, have gradually attracted the attention of experts in the field, and has been widely solved practical problems. Successful application of the technology, it can flexibly model complex group interaction relationships in real-world systems, and provide general and most unconstrained high-level interaction descriptions, thereby avoiding simple networks that describe binary simple descriptions of real-world systems. This report starts from the development process of the hypernetwork, and introduces the basic concepts, basic characteristics, modeling methods and other theoretical analysis frameworks of the hypernetwork, introduce the research progress of hypergraph theory and the latest developments in the application of hypergraph theory to the learning method of hypergraph representation based on neural network.