Xuming Ran

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Research Experiences

AI for Science Mar, 2022 –Present
Shanghai AI Laboratory Shanghai, China
Research Engineer (Full Time)

- AI for Visual Neuroscience
- Multi-Mask Auto-encoder for Structural Variants Detection

Department of Biomedical Engineering Jul, 2021 –Nov, 2021
Southern University of Science and Technology(SUSTech) Shenzhen, China
Research Assistant (Full Time)
Advisor: Quanying Liu, Professor of SUSTech & Huihui Zhou, PI of Pengcheng Lab

- Deep Auto-encoder with Neural Responses
- Detecting out-of-distribution via VAE with reliable uncertainty estimation

Neuroscience and Intelligent Media Institute (NIMI) Sep, 2019 –Jan, 2020
Communication University of China Beijing, China
Research Intern
Mentor: Lihong Cao, Professor of Communication University of China, Chief of NIMI

- Learning the foundations of computational neuroscience such as visual mechanisms, single neuron models (e.g.,Hodgkin-Huxley model, Leaky integrate-and-fire model, Integrate-and-fire model)
- Inspired by concept cells in the hippocampus for continuous learning and adversarial examples

Center for Brain Inspired Computing Research (CBICR) Jul, 2019 –Sep, 2019
Tsinghua University Beijing, China
Research Intern
Mentor: Luping Shi, Professor of Tsinghua University & Chief of CBICR

- Training spiking neural networks(SNNs) by spike-timing-dependent plasticity and spatio-temporal backpropagation
- Data visualization by t-SNE, PCA, and Auto-encoder(AE)

Education

Department of Mathematics Sep, 2017 –Jul, 2019 & Sep, 2020 –Jul, 2021
Chongqing Jiaotong University Chongqing, China
Bachelor of Science GPA: 3.06/5.00

Cold Spring Harbor Asia Aug, 2021 –Sep, 2021
Cold Spring Harbor Laboratory Suzhou, China
AI and Brain Computation Summer School

Department of Biomedical Engineering Jan, 2020 –Jul, 2021
Southern University of Science and Technology(SUSTech) Shenzhen, China
As a visiting student at Neural Computing & Control Lab
Advisor: Quanying Liu, Professor of SUSTech & Huihui Zhou, Professor of Pengcheng Lab

- Mapping V4 to Artificial Neurons via Autoencoder allows Decoding Visual Information
- Deep Generative Model for Out-of-distribution Detection

Tsinghua Laboratory of Brain and Intelligence Aug, 2019 –Sep, 2019
Tsinghua University Beijing, China
CNeuro: Computational and Theoretical Neuroscience Summer School

PUBLICATIONS

- **Xuming Ran**, Mingkun Xu, Lingrui Mei, Qi Xu, and Quanying Liu. "Detecting out-of-distribution samples via variational auto-encoder with reliable uncertainty estimation." Neural Networks (2021).
- **Xuming Ran**, Mingkun Xu, Qi Xu, Huihui Zhou, and Quanying Liu. "Bigeminal Priors Variational auto-encoder." arXiv preprint arXiv:2010.01819 (2020).
- **Xuming Ran**, Jie Zhang, Ziyuan Ye, Haiyan Wu, Qi Xu, Huihui Zhou, and Quanying Liu. "A computational framework to unify representation similarity and function in biological and artificial neural networks."**Under Review** at: *IEEE Transactions on Pattern Analysis and Machine Intelligence, 2022.*
- **Xuming Ran**, et al, Self-supervised deep learning encodes multi-modalities features of genome sequence for detecting complex structural variants, **Submit to** at: *Nature Machine Intelligence*, 2023.
- Lingrui Mei, **Xuming Ran**, and Jin Hu. "Weakly Supervised Attention Inference Generative Adversarial Network for Text-to-Image." In 2019 IEEE Symposium Series on Computational Intelligence (SSCI), 2019.
- Jie Yuan, **Xuming Ran**, Keyin Liu, Chen Yao, Yi Yao, Haiyan Wu, and Quanying Liu. "Machine Learning Applications on Neuroimaging for Diagnosis and Prognosis of Epilepsy: A Review." Journal of neuroscience methods (2021).
- Li Ma, Renjun Shuai, **Xuming Ran**, Wenjia Liu, and Chao Ye. "Combining DC-GAN with ResNet for blood cell image classification." Medical biological engineering computing 58, no. 6 (2020): 1251-1264.
- Qi Xu, Jiangrong Shen, **Xuming Ran**, Huajin Tang, Gang Pan, and Jian K. Liu. "Robust transcoding sensory information with neural spikes." IEEE Transactions on Neural Networks and Learning Systems (2021).
- Hong Peng, Mingkun Xu Bo Wang, Zheyu Yang, **Xuming Ran**, Bo Li, Jiaohua Huo, Jing Pei, Yuanyuan Cui , Huafeng Xiao, Xin Lou, Cuiping Mao, Guangming Zhu, Liang zhang , Zheng You, Lin Ma, A New Virtual MR Contrast - enhancement Method based on Deep Learning: Faster, Safer, and Easier, **Under Review** at: *Nature Machine Intelligence*, 2022.
- Songming Zhang, Xiaofeng Chen, **Xuming Ran**, Zhongshan Li, Wenming Cao, Even decision tree needs causality,**Under Review** at: *IEEE Transactions on Neural Networks and Learning Systems, 2022.*
- Mengyu Yang, Ye Tian, Rui Su, **Xuming Ran**, Efficient Recognition for Long-untrimmed Videos with Multi-modalities,**Under Review** at: *ICCV, 2023.*
- Shan-Shan Li, Yu-Shi Jiang, Xue-Ling Luo, **Xuming Ran**, Yuqiang Li, Dong Wu, Cheng-Xue Pan, Peng-Ju Xia, Photocatalytic Vinyl Radical-Mediated Multicomponent 1,4-/1,8-carboimination Across Alkynes and Olefins/(Hetero)Arenes, **Under Review** at: *Nature Communication, 2023.*
- Chen Wei, Jiachen Zou, **Xuming Ran**, Dietmar Heinke, Quanying Liu, MISE: a computational model for simulating visual perception and cognitive decision-making via CLIP,**Under Review** at: *NeurIPS, 2023.*
- Qi Xu, Yuyuan Gao, Jiangrong Shen, Yaxin Li, **Xuming Ran**, Huajin Tang, Gang Pan, Enhancing Adaptive History Reserving by Spiking Convolutional Block Attention Module in Recurrent Neural Networks,**Under Review** at: *NeurIPS, 2023.*
- Qi Xu, Sibo Liu, **Xuming Ran**, Yaxin Li, Jiangrong Shen, Huajin Tang, Jian K. Liu, and Gang Pan, Robust Sensory Information Reconstruction and Classification with Augmented Spikes,**Under Review** at: *IEEE Transactions on Neural Networks and Learning Systems, 2023.*

Research Interests

- **AI & Neuroscience**: Visual cortex modeling, Neural encoding and decoding, Brain-inspired computing
- **AI & Statistics**: Deep generative model, Self-supervised learning, Image synthesis,Reference prior
- **AI & Genome**: Structural variants detection

Selected Projects and Competitions

2020 Guangdong Academic Forum Jul, 2020 –Aug, 2020

–Biomedical Engineering Brain Science Symposium Southern University of Science and Technology

- I propose a new framework taht utilizes an over-parameterized auto-encoder with V4 neural representation as inputs and the third convolutional layer (Conv3) of AlexNet as the latent code, and then feedforward to the following layers of AlexNet to decode the category of images seen by monkey. The results show that the decoding accuracy of the V4 neural population reached the same level as the categorization accuracy of AlexNet when the neuron number exceeded 200. Our method allows to reciprocally map of neurons between the biological and the artificial neural network.

– Awarded third prize of abstract and prize money ¥600 CNY

2018 International Collegiate Competition on Brain-inspired Computing Jul, 2018 –Oct, 2018
Tsinghua University

– Our team designed and implemented a high-dimensional cross-domain GAN, Weakly Supervised Attention Inference Generative Adversarial Network(WSAI-GAN), successfully visualized the human synesthesia phenomena, and achieved excellent results in some image cross- domain translation tasks.

– As the **only undergraduate** team to awarded third prize of final contest and prize ¥30,000 CNY

Professional Service

Conference Reviewing:MICCAI; IJCNN; IEEE WCCI; FUZZ-IEEE, IEEE-CEC; ICONIP
Journal Reviewing: Pattern Recognition, Pattern Recognition Letters, Heliyon