

YINGCHU SUN

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EDUCATION

Ph.D. in Electrical and Computer Engineering, Rice University 08/2023 – Expected 09/2026
M.S. in Electrical and Computer Engineering, Rice University 09/2020 – 08/2023
M.S. Dissertation: Multimodal longitudinal imaging to monitor neurovascular responses
Coursework: Computer Vision, Machine Learning, Imaging Optics, Neural Signal Processing GPA: 3.78/4.00
B.S. in Optoelectronic Information Science and Engineering, Zhejiang University, China 09/2016 – 06/2020
Minor: Advanced Class of Engineering Education, Chu Kochen Honors College (CKC)
B.S. Dissertation: PET Image Reconstruction based on Deep Learning Methods
Coursework: Digital Audio and Video Processing, Artificial Intelligence, Advanced Data Structure and Algorithm Analysis, Physical Optics, Optoelectronics, Applied Optics, Python, C, Mathematical Modeling GPA: 3.91/4.00

PUBLICATIONS

- [1] Sun, Y.*, Yin, R.*, Zolotavin, P., ... & Luan, L. (2025). Stable Neural Dynamics Tracking in Freely Moving Mice During Motor Skill Learning via Ultra-flexible, High-density Electrodes. (in preparation)
[2] Yin, R., Rathore, H., Sun, Y., ... & Luan, L. (2025). Challenging Functional Remapping: Tracking Neural Activity Reveals Selective Potentiation in Stroke-Induced Neural Plasticity. Cell reports (in review)
[3] Jin, Y., He, F., Rathore, H., Sun, Y., ... & Luan, L. (2025). Longitudinal, Multimodal Tracking Reveals Lasting Neurovascular Impact of Individual Microinfarcts. Advanced Science, 2417003.
[4] Lycke, R., Kim, R., Zolotavin, P., Sun, Y., ... & Luan, L. (2023). Low-threshold, high-resolution, chronically stable intracortical microstimulation by ultraflexible electrodes. Cell reports, 42(6).
[5] He, F.*, Sun, Y.*, Jin, Y., Yin, R., Zhu, H., ... & Luan, L. (2022). Longitudinal neural and vascular recovery following ultraflexible neural electrode implantation in aged mice. Biomaterials, 291, 121905.

RESEARCH EXPERIENCE

Research Assistant || Rice University, Lab of Dr. Lan Luan

Bio-Inspired Visual Encoding and Perceptual Modeling from LGN Neural Dynamics 10/2024 – Current

- Recorded large-scale neural activity in lateral geniculate nucleus (LGN) using 128-channel ultraflexible probes during visual and electrical stimulation to characterize spatiotemporal receptive fields, frequency tuning and gain control.
- Developed **Python** program to remove the stimulation artifact and extract single unit activities by using template clusters.
- Built computational encoding models in **Python** (DoG-based filters and dynamic LN frameworks) to decode visual patterns and reconstruct perceived luminance and spatial contrast from population neural activity.

Neural Ensemble Dynamics During Reach Learning in the Cortex of Freely Moving Mice 02/2023 – 11/2024

- Built a custom automatic motor skill training apparatus using **SolidWorks** and 3D printer and programmed the control circuit (C) for the camera and Intan, achieving 0.01 ms accuracy of temporal alignment between different signals.
- Trained a **Resnet** model in **Deeplabcut** to robustly track the mouse paw trajectories, achieving MAE likelihood is over 0.99 across two months in six mice and dividing successful and failed reaches into two clusters.
- Programmed **GPFA** in **MATLAB** to conduct the dimension reduction and analyze the evolution of neural ensemble dynamics and representational geometry, showing increased scaling transformation in the latent space during learning, while the overall topology stays stable.
- Trained **linear Regression/ LSTM** to decode the mouse paw trajectories, showing that part of reliable neurons can achieve similar decoding accuracy as all neurons across months.

High-speed Biophysical and Biochemical Monitoring to Discover Early Markers of Unconventional Brain Injury

05/2022 – 04/2023

- Implemented multimodal **in vivo imaging platform** by combining two-photon imaging (2P), laser speckle contrast imaging and intrinsic imaging, achieving a 20ms temporal resolution and 1 μ m spatial resolution of the measurement for cerebral blood flow, neurotransmitter, and astrocyte responses before, during, and after microwave stimulation.
- Developed **Python** script to compute the dF/F of the fluorescence signal and rCBF of the blood flow, showing a significant statistical difference ($P < 0.05$ for dF/F, $P < 0.001$ for rCBF) between baseline and stimulation.
- Programmed **MATLAB** code to identify the response of **single neuron activities** and **LFP** to the microwave stimulation, showing a significant statistically increase after the microwave stimulation

Longitudinal neural and vascular recovery following neural electrode implantation

09/2021 -09/2022

- Preprocessed 2P vasculature images in **MATLAB** to improve SNR (144% surface layer, 45% deep layer) across 3D stacks by conducting background subtraction, normalizing z-slices, and correcting xy-plane illumination.
- Developed a “local contrast” code in **MATLAB** to convert the pre-processed image into binary stack and then used ImageJ to extract the skeleton and diameter map, achieving reliable quantification of the vascular morphology over two months, showing the vascular remodeling was most pronounced in the first two weeks.
- Programmed **MATLAB** code to quantify the **LFP** changes across time, showing a sharp increase in LFP at relatively low vascularization.

Low-threshold, high-resolution, chronically stable intracortical microstimulation

10/2020 – 09/2021

- Programmed **MATLAB** code to quantify 2P calcium imaging dataset, measuring stimulation-induced neural activation.
- Conducted Kruskal-Wallis test and identified significant differences between multiple stimulation parameters.

Research Assistant || Zhejiang University, Lab of Dr. Huafeng Liu

PET Image Reconstruction based on Deep Learning Methods

09/2019-06/2020

- Programmed **ISTA-net** model in **Python** to reconstruct the PET image, improving 83.7% of the PSNR compared to the maximum likelihood expectation maximization (MLEM) method.

Research Intern || Boston University, Computational Imaging System Laboratory, Dr. Lei Tian

Miniscope Pupil Engineering using Binary Diffractive Optics

07/2019-09/2019

- Designed a **MATLAB** program to do 3D particle simulation in a 4F system with out-of-focus input and evaluated the SNR and point ratio (PR) in the formed image.
- Optimized the phase mask by GA method, achieving 4~6× times extension for the depth-of-focus in the miniscope system and SNR remained over 15 across the depth.

Student Researcher || Zhejiang University, Visual Assistive Technology Laboratory Lab, Dr. Kaiwei Wang

3D Model Reconstruction based on Multi-angle Pictures

09/2018-06/2019

- Designed and assembled a 3D scanner in **SolidWorks** to capture multi-angle stereoscopic images.
- Trained a monodepth network in **Python** to estimate the depth and reconstructed a 3D point cloud model.

PROJECT EXPERIENCE

Robotic Arm Control Through BCI | Neural Signal Processing, Rice University

09/2022-01/2023

- Programmed online single neuron detection in **MATLAB** for the M2 cortex of the mouse.
- Utilized single neuron activities to control the movement of a robotic arm and, thus, change the 2D positions of the food awards, showing a dramatic increase in the success rate (from 30%, chance level, to 80%) in three days among 5 mice.

Real Time Body Posture Detection | Computer Vision, Rice University

01/2022-05/2022

- Trained **YOLO-v5** in **OpenCV** to do the real time tracking of the mouse skeleton, achieving the average error smaller than 0.2 and the accuracy is over 95%.

Video Editing Detection | Digital Audio and Video Processing, Zhejiang University

02/2019-07/2019

- Designed a **MATLAB** algorithm to frame-split, compress, apply 2D-FFT transformation, extract **perceptual hash features** and access similarity through bit error rates from video, successfully segmenting a three-minute video containing 87 instances of various special effects.

Image classification and Image style transfer | Artificial Intelligence, Zhejiang University

09/2019-01/2020

- Trained a **VGG** network in **Caffe** and evaluated it on ImageNet, achieving 88.0% accuracy across 1000 classes.
- Trained this model on Van Gogh image collection and achieved style transfer to other images.

Fixed-focus Digital Camera Lens Design | Applied Optics, Zhejiang University

07/2018 -09/2018

- Designed a 15.0mm focal length, five-lens system using **Zemax**, achieving on-axis MTF of 0.71 and off-axis (0.707 field) MTF of 0.51 at Nyquist frequency for 1.2m imaging, with a maximum distortion less than 0.5%.
- Developed a C program for ray tracing and aberration evaluation of the designed lens system, achieving 0.08% error compared to Zemax.

Wheeled Collection Robot Design | The 13th Zhongkong Cup Robotics Competition (Top 20%) , ZJU

09/2017-05/2018

- Assembled the customized Robot using **SolidWorks** and 3D printer, implementing functions including 180-degree ultrasonic ranging, infrared line tracking, target collection, etc.
- Designed an Arduino program to implement path planning, motor control, and strategy switching for the robot.

TEACHING & MENTORSHIP EXPERIENCE

Research Mentor|| Louis Chen, Master in Bioengineering, Rice University

09/2024-current

- Guided the method of mouse paw trajectories extraction and neural population dynamics analysis.
- Coached the simulation of the visual stimuli in human LGN (**Python**) through high density ultraflexible neural probes.

Research Mentor|| Kelvin Phung, Undergraduate in Computer Science, Rice University

04/2023-09/2023

- Trained him about the procedures of conducting ephys recording and sorting the data into single neurons activities in the motor cortex of the freely moving mice.
- Developed the program to track over 400 neurons in 6 mice across two months together.

Research Mentor|| Alex Sadamune, Ph.D. in Bioengineering, Rice University

09/2022-11/2022

- Guided the assembly of the ultraflexible neural probes and the behavioral experiments.

Teaching Assistant || Imaging Optics, Rice University

01/2023-05/2023;01/2024 - 05/2024

- Held weekly office hours for helping students understand class material and address issues for assignments and took major responsibility for going through concepts that were taught during class sessions.

Volunteer Teacher || Weishan No.1 Middle School, Yunnan, China

06/2017-08/2017

- Organized and led a 20-member volunteer teacher team, planning educational and extracurricular activities, communicating with foundation partners and supporting student learning and mentorship.

HONORS & AWARDS

Distinguished graduates, Zhejiang University (magna cum laude)

2020

Distinguished College Student Award of Zhejiang Province (2/110), China

2018

Outstanding undergraduate student prize (Top 8%), Zhejiang University

2017

SKILLS

Programming: MATLAB, C, Python, OpenCV, Caffe, PyTorch

Software: Zemax, SolidWorks/AutoCAD, ImageJ, IMARIS, Arduino