Chang Liu

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EDUCATIONS

Boston University Expected May 2025
Ph.D. in Computational Imaging, Advised by Prof. Lei Tian

Carnegie Mellon University May 2020
M.S. in Biomedical Engineering, Advised by Prof. Bin He
Relevant Coursework: Machine Learning, Introduction to Deep Learning, Computer Vision

Tsinghua University July 2018
B.S. in Biomedical Engineering, Advised by Prof. Bo Hong

TECHNICAL SKILLS

Programming: Python (PyTorch, TensorFlow, scikit-learn, pandas), MATLAB, C++, Qt, Linux, Bash, Git, AWS, Docker, SQL

Deep Learning: Denoising, Self-supervised Learning, Unsupervised Learning, Contrastive Learning, Autoregressive Models, Diffusion Models, Generative Models, Uncertainty Quantification, Transformer, LLM, Foundation Models, Neural Fields

Science and Engineering: Computational Imaging, Computer Vision, Machine Learning, Statistics, Image Processing, Signal Processing, Optimization, Inverse Problems, Time-series Analysis, Brain Computer Interface (BCI), Neuromodulation

RESEARCH EXPERIENCES

Doctoral Research Fellow June 2021 – Present
Boston University, Computational Imaging Systems Lab Boston, MA

- Developed and deployed DeepVID, a **self-supervised video denoising** framework for low-photon shot-noise limited data in **PyTorch**, without need of ground-truth high signal-to-noise ratio (SNR) measurements. (GitHub)
- Designed an **autoregressive deep-learning model** based on temporal and spatial statistics, enabling high-speed inference for 1000 Hz fluorescence signals, and large field-of-view spikes detection from 150+ regions of interests.
- Improved spatial resolution by 34% while preserving fast dynamics by detecting 50% more spiking events compared with raw data, and overcome tradeoff between spatial and temporal performance with **spatial prior integration** designs.
- Assessed **generalizability** and **robustness** of denoising models in different imaging conditions, including simulation of noisy videos in extreme low-photon conditions and time-series measurements with various SNR.
- Proposed **uncertainty quantification** for denoising by **generative diffusion models** and conformal quantile regression.
- Collaborated with a multidisciplinary team including optical engineers, neuroscientists and biologists to integrate framework into existing imaging systems, enhancing experiment and data analysis efficiency.

Graduate Research Fellow January 2019 – August 2020
Carnegie Mellon University Pittsburgh, PA

- Designed frequency discrimination tasks under tactile vibration stimuli; investigated simultaneous behavior and brain responses at both EEG sensor and source domain by **time-series analysis** in **Python** and **MATLAB**.
- Revealed that transcranial focused ultrasound stimulation (tFUS) improves sensory discrimination capability with 30% higher accuracy through excitatory neuromodulation at targeted sensory cortical areas.

Research Assistant February 2018 – December 2018
Tsinghua University Beijing, China

- Built multi-process platform for EEG-based wireless **brain-computer interface (BCI)** visual speller; programmed **user interfaces**, biomedical **signal processing**, and **SVM-based decoding** algorithms by **Python** and **Qt**.
- Implemented non-flashing real-time typing with wireless BCI system for 10 subjects, achieved information transfer rate (ITR) up to 124.8 bits/min and median gain of 202% on ITR over conventional speller.

TEACHING EXPERIENCES

Teaching Assistant Fall 2021 & Spring 2023
Boston University, Signals and Controls (ENG BE 403)

PROJECTS

Computer Vision for 3D Perception
Carnegie Mellon University, Computer Vision (16-720) September 2019 – December 2019

- Implemented **multiple-view geometry** and **3D reconstruction** by **SfM** (Structure from Motion); **panorama** by **homography** and **RANSAC**; image alignment and tracking by **SLAM** (Simultaneous Localization and Mapping).

Attention-based End-to-End Speech-to-Text Deep Neural Network
Carnegie Mellon University, Introduction to Deep Learning (11-785) January 2019 – May 2019

- Designed a speech-to-text **natural language processing (NLP)** system by **attention-based** neural networks.
- Enabled transcribing speech utterance to its corresponding transcript; achieved top 10% in the Kaggle competition.

Blood Pressure Prediction from Single-channel Photoplethysmography (PPG) with Deep Learning
University of California, San Diego July 2017 – October 2017

- Designed a **convolution-recurrent neural network** model to predict blood pressure from single-channel PPG which significantly outperformed benchmark methods with up to 15% improvement on mean absolute error.

JOURNAL PUBLICATIONS

Liu, C., Lu, J., Wu, Y., Ye, X., Ahrens, A. M., Platisa, J., … & Tian, L. (2024). DeepVID v2: self-supervised denoising with decoupled spatiotemporal enhancement for low-photon voltage imaging. *Neurophotonics, 11*(4), 045007.
Platisa, J., Ye, X., Ahrens, A. M., **Liu, C.**, Chen, I. A., Davison, I. G., … & Chen, J. L. (2023). High-speed low-light in vivo two-photon voltage imaging of large neuronal populations. *Nature methods, 20*(7), 1095-1103.
Ding, G., **Liu, C.**, Yin, J., Teng, X., Tan, Y., He, H., … & Cheng, J. X. (2024). Self-Supervised Elimination of Non-Independent Noise in Hyperspectral Imaging. *arXiv preprint arXiv:2409.09910*.
Kosnoff, J., Yu, K., **Liu, C.**, & He, B. (2024). Transcranial focused ultrasound to V5 enhances human visual motion brain-computer interface by modulating feature-based attention. *Nature Communications, 15*(1), 4382.
Liu, C.*, Yu, K.*, Niu, X., & He, B. (2021). Transcranial Focused Ultrasound Enhances Sensory Discrimination Capability through Somatosensory Cortical Excitation. *Ultrasound in Medicine & Biology*, *47*(5), 1356-1366.
Yu, K., **Liu, C.**, Niu, X., & He, B. (2020). Transcranial focused ultrasound neuromodulation of voluntary movement-related cortical activity in humans. *IEEE Transactions on Biomedical Engineering, 68*(6), 1923-1931.
Liu, D., **Liu, C.**, Chen, J., Zhang, D., & Hong, B. (2020). Doubling the Speed of N200 Speller via Dual-Directional Motion Encoding. *IEEE Transactions on Biomedical Engineering*, *68*(1), 204-213.

CONFERENCE PROCEEDINGS

Liu, C., Platisa, J., Ye, X., Ahrens, A. M., Chen, I. A., Davison, I. G., ... & Tian, L. (2024, March). Resolution-improved self-supervised two-photon voltage imaging denoising. In *Neural Imaging and Sensing 2024* (p. PC1282807). SPIE.
Liu, C., Platisa, J., Ye, X., Ahrens, A. M., Chen, I. A., Davison, I. G., ... & Tian, L. (2023, March). Two-photon voltage imaging denoising by self-supervised learning. In *Neural Imaging and Sensing 2023* (Vol. 12365, pp. 13-14). SPIE.
Liu, C., Platisa, J., Ye, X., Ahrens, A. M., Chen, I. A., Davison, I. G., ... & Tian, L. (2022, April). DeepVID: A Self-supervised Deep Learning Framework for Two-photon Voltage Imaging Denoising. In *Optics and the Brain* (pp. BTu4C-4). Optica.
Liu, D., **Liu, C.**, & Hong, B. (2019, March). Bi-directional visual motion based BCI speller. In *2019 9th International IEEE/EMBS Conference on Neural Engineering (NER)* (pp. 589-592). IEEE.

AWARDS

Boston University Distinguished Biomedical Engineering Fellowship 2020

SERVICES

Reviewer 2022 – Present

- Scientific Reports, Neurophotonics, Biomedical Optical Express, Optical Letters, Frontiers in Neuroscience

ACTIVITIES

Photographer 2015 – 2018
Tsinghua University, Student Art Troupe

- Professional **landscape** and **astro** photographer in Photography Team (5% admission rate)