# Chang Liu

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## EDUCATION

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|---|---|---|
| Expected May 2025 | **Ph.D. in Biomedical Engineering**<br>Department of Biomedical Engineering<br>Boston University, Boston, MA<br>Advisor: Prof. Lei Tian | **GPA: 3.80/4.00** |
| May 2020 | **M.S. in Biomedical Engineering**<br>Department of Biomedical Engineering<br>Carnegie Mellon University, Pittsburgh, PA<br>Advisor: Prof. Bin He | **GPA: 3.85/4.00** |
| July 2018 | **B.S. in Biomedical Engineering**<br>Department of Biomedical Engineering<br>Tsinghua University, Beijing, China<br>Advisor: Prof. Bo Hong | **GPA: 85/100** |

## JOURNAL PUBLICATIONS AND PREPRINTS

5] 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.

4] Kosnoff, J., Yu, K., **Liu, C.**, & He, B. (2023). Transcranial Focused Ultrasound to V5 Enhances Human Visual Motion Brain-Computer Interface by Modulating Feature-Based Attention. *bioRxiv*, 2023-09.

3] **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.

2] 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.

1] 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

4] **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.

3] **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.

2] **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 Publishing Group.

1] 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.

## AWARD & HONORS

Boston University Distinguished Biomedical Engineering Fellowship 2020

## RESEARCH EXPERIENCE

**Self-supervised Deep Learning Framework for Two-photon Voltage Imaging Denoising**
Advisor: Prof. Lei Tian Boston University June 2021 – Present

- Developed self-supervised denoising framework for low-photon shot-noise limited voltage imaging data based on independent temporal and spatial statistics, without need of ground-truth high signal-to-noise ratio (SNR) measurements.
- Enabled inferencing kilohertz fluorescence signals in single frames and identifying potential spiking events for population-level neurons.
- Improved spatial resolution while preserving fast neuronal dynamics by incorporating edge information, and overcome tradeoff between spatial and temporal performance with advanced self-supervised deep learning framework designs.
- Assessed generalizability and robustness of denoising models by simulating noisy videos with degraded photon counts in various SNR.
- Achieved 15-fold improvement in SNR when comparing denoised and raw image data.

**Transcranial Focused Ultrasound Enhances Sensory Discrimination through Cortical Excitation**
Advisor: Prof. Bin He Carnegie Mellon University January 2019 – August 2020

- Designed frequency discrimination tasks under tactile vibration stimuli; programmed in Python.
- Performed tasks in sham and ultrasound conditions in which tFUS was directed onto somatosensory cortex.
- Investigated simultaneous brain responses at both EEG sensor and source domain by means of electrophysiological source imaging (ESI); compared both behavior data and EEG patterns between sham and ultrasound conditions.
- Revealed that tFUS stimulation is able to improve the sensory discrimination capability with higher percentage of response correct through excitatory neuromodulation at targeted sensory cortical areas.

**Doubling the Speed of N200 Speller via Dual-directional Visual Motion Encoding**
Advisor: Prof. Bo Hong Tsinghua University February 2018 – December 2018

- Built multi-process platform for EEG-based wireless motion-onset visual evoked potential (mVEP) BCI by Python.
- Discovered spatiotemporal asymmetry of mVEP responses elicited by visual motion stimuli in different directions.
- Designed novel dual-directional visual N200 speller which presented visual stimuli moving in two directions simultaneously; programmed interface and algorithm by Python.

- Implemented non-flashing online typing with wireless mVEP BCI system for ten subjects, achieved information transfer rate (ITR) up to 124.8 bits/min and median gain of 202% on ITR over conventional N200 speller.

**Blood Pressure Prediction with Single-channel PPG based on Deep Learning**
Advisor: Prof. Tzyy-Ping Jung University of California, San Diego July 2017 – October 2017

- Designed novel convolution-recurrent neural network model to predict blood pressure from single-channel PPG which significantly outperformed existing method with up to 15% improvement on mean absolute error.
- Compared predictions among CNN, RNN, CRNN networks in UCI Cuff-less Blood Pressure Estimation Data Set.
- Validated generalizability of models in MIMIC II Waveform Database Matched Subset, which contains records from over 150 subjects.

## TEACHING EXPERIENCE

**ENG BE 403 Biomedical Signals and Controls (undergraduate, 4 credits)** Spring 2023
Teaching Assistant, College of Engineering, Boston University

**ENG BE 403 Biomedical Signals and Controls (undergraduate, 4 credits)** Fall 2021
Teaching Assistant, College of Engineering, Boston University

## PRESENTATIONS

7] "Resolution-improved self-supervised two-photon voltage imaging denoising" (oral), Photonics West, San Francisco, CA, January 27, 2024.

6] "Resolution-improved self-supervised two-photon voltage imaging denoising" (poster), Neurophotonics Center's 7th Annual Symposium, Boston University, Boston, MA, January 17, 2024.

5] "Two-photon voltage imaging denoising by self-supervised learning" (oral), Photonics West, San Francisco, CA, January 30, 2023.

4] "DeepVID: A Self-supervised Deep Learning Framework for Two-photon Voltage Imaging Denoising" (poster), Sculpted Light in the Brain, Boston, MA, June 26, 2022.

3] "DeepVID: A Self-supervised Deep Learning Framework for Two-photon Voltage Imaging Denoising" (oral), Optica Biophotonics Congress: Biomedical Optics, Fort Lauderdale, FL, April 26, 2022.

2] "DeepVID: A Self-supervised Deep Learning Framework for Two-photon Voltage Imaging Denoising" (poster), Neurophotonics Center's 5th Annual Symposium, Boston University, Boston, MA, January 12, 2022.

1] "Bi-directional visual motion based BCI speller" (poster), 9th International IEEE/EMBS Conference on Neural Engineering (NER), San Francisco, CA, March 21-22, 2019.

## TECHNICAL SKILLS

**Programming:** Python, Matlab, C/C++, SQL

**Skills:** Deep Learning (proficient in Pytorch and Tensorflow), Computational Imaging, Computer Vision, Self-supervised Learning, Signal Processing, Denoising, Git, EEG Analysis, MRI Processing