

Tsam Kiu (Ewina) Pun

Ph.D. in Biomedical Engineering

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Education

- 2018–2024 **Ph.D. in Biomedical Engineering**, *Brown University*, Providence, RI.
Advisor: Prof. Leigh Hochberg
Topic: Towards Stable & Reliable Intracortical Brain-Computer Interfaces for Long-term Independent Use.
Cumulative GPA: 4.00
- 2022–2024 **M.S. in Computer Science (AI/ML track)**, *Brown University*, Providence, RI.
Advisor: Prof. Stephen Bach
Topic: Effective Long-term Neural Decoding with Meta-Learning.
Cumulative GPA: 4.00
- 2017–2018 **M.S. in Biomedical Engineering**, *University of Southern California*, Los Angeles, CA.
Advisor: Prof. Maryam Shanechi
Thesis: Adaptive Subspace Identification Algorithm for Dynamic Tracking.
Graduation GPA: 3.81 – *Magna Cum Laude*
- 2014–2018 **B.S. in Electrical Engineering**, *University of Southern California*, Los Angeles, CA.
Advisor: Prof. Ellis Meng
Graduation GPA: 3.78 – *Magna Cum Laude*

Technical Skills

- Programming Python, MATLAB, PyTorch, Tensorflow, scikit-learn, Redis, Pandas, Git, wandb, neptune, Simulink, C++, Adobe Illustrator.
- Analytic Skills Machine learning, deep learning, meta-learning, continual learning, statistical inference, system identification, control design, time-series data analysis, signal processing, behavioral experimental design, data collection, data curation, data visualization, computer vision, MLOps.
- Neurotech Utah microelectrode array, multi-unit spiking activity and non-spiking feature extraction, single-unit spike sorting, neural signal processing, functional ultrasound imaging.

Industry Experience

- Summer 2024 **Forest Neurotech**, *ML Software Engineer Intern*, Palo Alto, CA.
Supervisors: Dr. Charles Guan, Dr. Will Biederman
- Designed a motion filtering and correction algorithm using computer vision toolkit to stabilize functional ultrasound imaging, which improved the precision and reliability by more than 60%.
 - Accelerated data analysis time from days to less than 5 minutes by automating the image preprocessing pipeline, and migrated team onto a MLOps platform to enable real-time visualization during recording sessions.
 - Revamped the data infrastructure using the BIDS standard format, which simplified the process of data sharing with external stakeholders.
- Summer 2016 **Abbott Vascular**, *Engineering Intern*, Temecula, CA.
Supervisors: Kevin Zhang and Sal Mendez
- Supported quality control of finished goods (Absorb GT1™ bioresorbable vascular scaffolds and catheter tubes).
 - Proposed a \$20,000+ cost savings project and streamlined equipment testing and replacement across European and American sites.

Research Experience

2018 – 2024 **BrainGate Consortium**, *Research Fellow*, Providence, RI.

Advisor: Prof. Leigh Hochberg

- Designed the next-gen intracortical brain-computer interfaces to restore communication and mobility for people with paraplegia with a multi-disciplinary team of 50+ across 4 clinical sites.
- Developed, deployed and tested a real-time monitoring algorithm of distribution shifts in *in vivo* neuro-physiological signals from clinical trial participants during sessions.
- Extended cursor control stability with an LSTM from daily recalibration to 3-month continuous use without any recalibration, enabling independent use of iBCI for clinical trial participants.
- Studied neural representation of daily activities from a 24h continuous neural recording.
- Decoded gestures for action commands used during personal use of a desktop computer.
- Analyzed and curated years worth of clinical neural and behavioral health data.
- Mentored undergrads; built and launched a new internal website to facilitate knowledge transfer.
- Migrated team to use GitHub for better code management and version control.

2023 – 2024 **BATS machine learning research group**, *Graduate Researcher*, Providence, RI.

Advisor: Prof. Steve Bach

- Developed a novel meta-learning decoding approach that enables rapid learning of new tasks within a day, significantly reducing the need of recalibration and minimizing adaptation time from 5 mins to 20 seconds (presented at Society for Neuroscience in *Chicago, IL*).

2017 – 2018 **USC Shanechi Lab**, *Undergraduate Researcher*, Los Angeles, CA.

Advisor: Prof. Maryam Shanechi

- Implemented an adaptive subspace identification algorithm to enable online tracking and predicting neural dynamics for closed-loop BCI control.

2015 – 2017 **USC BioMEMS Meng Lab**, *Undergraduate Researcher*, Los Angeles, CA.

Advisor: Prof. Ellis Meng

- Designed brain-implantable sensors with lithography microfabrication, rapid prototyping and real-time experiment control.
- Received Interdisciplinary award at the Undergraduate Symposium, titled *A Biocompatible Impedance-based Microbubble Pressure Transducer to Treat Hydrocephalus Patients* (one awardee across all life science departments at USC)

Summer 2015 **USC Norris Cancer Research Center**, *Undergraduate Researcher*, Los Angeles, CA.

Advisor: Prof. Amy Lee

- Constructed mutated form of Substrate Binding Domain of GRP78 to investigate its mobility to go up to the cell surface. Research published in PNAS.

Teaching Experience

Summer 2021 **Neuromatch Academy**, *Teaching Assistant*, Virtual.

Supervisor: Prof. Megan Peters

2019 **Brown University**, *Teaching Assistant*, Providence, RI.

Lecturer: Prof. Wilson Truccolo - Statistical Neuroscience (NEUR2110)

Honors and Awards

2021 – 2023 T32 training program supported by NIH NIMH (T32-MH115895) for Interactionist Cognitive Neuroscience (2 years; full-ride: **\$194,500**)

2019 – 2021 Croucher Foundation scholarship for HK doctoral students (2 years; full-ride: **\$199,000**)

2017 USC Undergraduate Symposium for Scholarly and Creative Work - Interdisciplinary award (one awardee in all life sciences: **\$1,000**)

2015 – 2017 USC Provost's Undergraduate Research Fellowship: **\$1,000/semester**

2016 USC Academic Achievement Awards: **\$5,000/semester**

2014 – 2018 USC Presidential Scholarship and Hong Kong Schools Alumni Federation Scholarship Foundation (4-year; full-ride: **\$241,100**)

Publications

Journal

- 2024 **T. K. Pun**, T. Hosman, M. Khoshnevis, G. H. Wilson, A. Kapitonava, F. Kamdar, J. M. Henderson, J. D. Simeral, C. E. Vargas-Irwin, M. T. Harrison, L. R. Hochberg. Measuring instability in multi-day human intracortical neural recordings towards stable, long-term brain-computer interfaces. *Nature Communication Biology*. 7, Article no. 1363.
- 2024 C. E. Vargas-Irwin, T. Hosman, J. T. Gusman, **T. K. Pun**, J. D. Simeral, A. Kapitonava, C. Nicolas, N. P. Shah, D. Avansino, F. Kamdar, J. M. Henderson, L. R. Hochberg. Gesture Encoding in human motor cortical single unit ensembles. (Prepare for submission.)
- 2023 G. H. Wilson, E. A. Stein, F. Kamdar, D. T. Avansino, **T. K. Pun**, R. Gross, T. Hosman, T. Singer-Clark, A. Kapitonava, L. R. Hochberg, J. D. Simeral, K. V. Shenoy, S. Druckmann, J. M. Henderson, F. R. Willett. Long-term unsupervised recalibration of cursor BCIs (Under review.)
- 2018 Y. L. Tsai, D. P. Ha, H. Zhao, A. J. Carlos, S. Wei, **T. K. Pun**, K. Wu, E. Zandi, K. Kelly, and A. S. Lee. Endoplasmic reticulum stress activates SRC relocating chaperones to the cell surface where GRP78/CD109 blocks TGF- β signaling. *PNAS*. 115(18):E4245-E4254.

Proceedings

- 2023 **T. K. Pun***, T. Hosman*, A. Kapitonava, J. D. Simeral, L. R. Hochberg. Months-long high-performance fixed LSTM decoder for cursor control in human intracortical brain-computer interfaces. *IEEE/EMBS Conference on Neural Engineering (NER)*. *Baltimore, MD*. pp. 1-5. *equal contributions.
- 2016 L. Yu, **T. K. Pun**, E. Meng. A Contactless Electrochemical Impedance Measurement Method. *A Solid State Sensors, Actuators and Microsystems Workshop*. p. 121. *Hilton Head Island, SC*

Conferences

- 2024 **T. K. Pun**, J. Jude, S. Allcroft, A. Kapitonava, L. R. Hochberg. S. Bach. Stable Long-Term Neural Decoding with Minimum Adaptation *Society for Neuroscience*. *Chicago, IL*.
- 2023 J. Jude, **T. K. Pun**, T. Hosman, C. Nicolas, A. Kapitonava, J. N. Kelemen, L. R. Hochberg, D. Rubin. Spatiotemporal transformers accommodate future neural nonstationarities for iBCIs with minimal training data through contrastive learning. *Society for Neuroscience*. *Washington, D.C.*
- 2022 **T. K. Pun**, T. Hosman, A. Kapitonava, C. E. Vargas-Irwin, J.D. Simeral, M. T. Harrison, L. R. Hochberg. Tracking nonstationarity In multi-day intracortical neural recordings during iBCI cursor control by a person with tetraplegia. *Society for Neuroscience*. *San Diego, CA*.
- 2022 **T. K. Pun**, T. Hosman, A. Kapitonava, C. E. Vargas-Irwin, J.D. Simeral, M. T. Harrison, L. R. Hochberg. Tracking nonstationarity In multi-day intracortical neural recordings during iBCI use by a person with tetraplegia. *AREADNE*. *Santorini, Greece*.
- 2021 **T. K. Pun**, M. Khoshnevis, M. Harrison, L. R. Hochberg. Statistical measures of nonstationarity in simulated neural data during BCI 2D control. *Society for Neuroscience*. *Virtual*.
- 2019 **T. K. Pun**, A. Catoya, C. E. Vargas-Irwin, S. S. Cash, J. D. Simeral, L. R. Hochberg. Identifying changes in volitional state and BCI task engagement based on the intrinsic structure of neural ensemble activity patterns in motor cortex of people with tetraplegia. *Society for Neuroscience*. *Chicago, IL*.
- 2017 S. M. R. Arnold, **T. K. Pun**, T. J. Denisart, F. J. Valero-Cuevas. Shapechanger: Environments for Transfer Learning. *SoCal Robotics Symposium*. *Los Angeles, CA*.

Mentorship

- 2021–2022 **Jacqueline Jia, B.S. in Neuroscience.**
Project title: Characterizing long-term instability in single-unit neural activity.
Current position: Software engineer at Rula.
- 2020–2021 **Connor Johnson, B.S. in Computational Biology.**
Senior thesis title: Stabilizing brain-computer interfaces using ADAN architecture.
Current position: Computational Biologist at Getz Lab (Broad's institute).
- Summer 2019 **Tiancheng (Tony) Wang, B.S. in Computer Science-Applied Mathematics.**
Project title: Distinguishing neural activity during BCI task with different end effectors.
Current position: Software Engineer at Roblox.

Community Services

- 2022-present **Brown Neurotech Journal Club**, *Founder and organizer*, Providence, RI.
- 2022-2023 **BrainPost**, *occasional writer*, remote.
- 2021-2023 **Brown Biomedical Engineering and Biotechnology Graduate Advisory Board**, *Program Cohesion Committee*, Providence, RI.

Invited Talks

- 2024 Women in Data Science guest speaker: *Turning Thought into Action: Restoring Communication and Mobility with Brain-Computer Interfaces for People with Paralysis.*
- 2023 Hang Lung Mathematics Awards Ceremony guest speaker: *Bridging Neuroscience and Engineering with Mathematics.*
- 2023 Croucher Foundation Research Symposium guest speaker: *Restoring mobility and communication for people with paralysis with brain-computer interfaces.*
- 2022 Hang Lung Mathematics Awards Research Club: *Equip Yourself for a Future in Science and Research.*
- 2021 Brown Robotics Group Seminar: *The Next-Generation BrainGate Intracortical Brain-Computer Interface System.*
- 2020 Veteran Affairs Center for Neurorestoration and Neurotechnology Virtual Seminar: *Identifying changes in volitional state of people with tetraplegia with intracortical brain computer interfaces.*

Professional Societies

- 2023-present IEEE
- 2019-present Society for Neuroscience
- 2017-present Member of Tau Beta Pi (Engineering Honors Society)

Language

- English Native
- Chinese Native (Mandarin, Cantonese)
- French Elementary

Interest

- Competitive ballroom dancing (Silver)
- Artisan chocolate making (level 1 certified by the International Institute of Chocolate and Cacao Tasting)
- Badminton, skiing