Hao-Lun Hsu

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Education

Duke University — *Durham, NC, USA*
Ph.D. in Computer Science — *starting from 08/2022*
- Research on Deep Reinforcement Learning and Robotics
- NSF Traineeship: Advancement of Surgical Technologies (TAST)

Georgia Institute of Technology (GaTech) — *Atlanta, GA, USA*
M.S. in Biomedical Engineering — *08/2019 - 05/2021*
- Diversity Ambassador, Georgia Tech Student Diversity Program, 2020

National Taiwan University (NTU) — *Taipei, Taiwan*
B.S. in Mechanical Engineering — *09/2014 - 06/2018*

Technical Skills

Programming: Python, MATLAB, C++, C#, VBA
OS: Linux (Ubuntu), Microsoft Windows
ML: Tensorflow,PyTorch, Keras, Scikit-learn, PyTorch Lightning
Simulation Env: OpenAI Gym, Mujoco

Selected Publications

Conference Publications

[C3] P Sarikhani, **HL Hsu**, and B Mahmoudi*, "Automated Tuning of Closed-loop Neuromodulation Control Systems using Bayesian Optimization", 2022 44rd Annual International Conference of the IEEE Engineering in Medicine & Biology Society (EMBC)

[C2] **HL Hsu**, Q Huang, and S Ha*, "Improving Safety in Deep Reinforcement Learning using Unsupervised Action Planning", *IEEE International Conference on Robotics and Automation (ICRA)*, 2022

[C1] JH Chen, **HL Hsu**, WH Yang, YC Chen, and HM Hsiao*, "New Spherical Stent Concept for Occlusion", *Annual Scientific Meeting of Taiwanese Society of Biomechanics*, 2017

Workshop Papers

[W2] P Sarikhani, **HL Hsu**, JK Kim, S Kinzer, E Mascarenhas, H Esmaeilzadeh, and B Mahmoudi*, "Neuroweaver: Towards a Platform for Designing Translatable Intelligent Closed-loop Neuromodulation Systems", *NeurIPS Research2Clinics Workshop 2021*

[W1] **HL Hsu**, Q Huang, and S Ha*, "Safe Exploration for Reinforcement Learning Using Unsupervised Action Planning", *RSS 2021 Workshop on Integrating Planning and Learning*, 2021

Abstract

[A3] P Sarikhani, **HL Hsu**, M Zeydabadinezhad, Y Yao, M Kothare, and B Mahmoudi*, "Sparc: Adaptive Closed-loop Control of Vagal Nerve Stimulation for Regulating Cardiovascular Function Using Deep Reinforcement Learning: A Computational Study", *Neuroscience 2021, 50th Annual Meeting*

[A2] P Sarikhani, **HL Hsu**, O Kara, JK Kim, H Esmaeilzadeh, and B Mahmoudi*, "Neuroweaver: A Platform for Designing Intelligent Closed-loop Neuromodulation Systems", *4th International Brain Stimulation Conference*

[A1] **HL Hsu**, "Functional Connectivity Correlates to Individual Difference in Human Brains during Working Memory Task and Resting State", *IEEE EMBS North American Virtual International Student Conference*, 2021

Research Experience

Reinforcement Learning and Optimal Closed-loop Neuromodulation — *Atlanta, GA, USA*
Advisor: Prof. Babak Mahmoudi (Neuroinformatics & Intelligent System Lab, Emory) — *01/2021 – Present*
- Use Bayesian Optimization automated tuning PI controllers for closed-loop neuromodulation **[C2]**
- Suppress pathologically synchronous neurons for Parkinson's via RL approaches evaluating with sample efficiency **[W2, A3]**
- Regulate cardiovascular system via selective vagal nerve stimulation with set-point control based RL algorithms **[A4]**

Safety Reinforcement Learning *Atlanta, GA, USA*
Advisor: Prof. Sehoon Ha (Computer Animation & Robotics Lab, GaTech) *01/2020 - 09/2021*
- Integrated on-policy reinforcement learning (RL) agent with unsupervised action planning for safe exploration **[C1, W1]**
- Deployed Augmented Random Search for training the power grid policy to adapt to less controllable renewables
- Sim-to-sim transfer for different power load with dynamic randomization

Medical Device Research & Development *Taipei, Taiwan*
Advisor: Prof. Hao-Ming Hsiao (Advanced Medical Device Laboratory, NTU) *09/2015 – 09/2018*
- Designed a double spherical stent to reduce the blood flow volume by 44% for cerebral aneurysm treatment **[A1]**
- Invented a novel dural defect occluder to prevent bacterial meningitis and cerebrospinal fluid rhinorrhea after Expanded Endonasal Approach

Talks and Presentations
- Georgia Tech Robotics Research Showcase: "Improving Safety in Deep Reinforcement Learning using Unsupervised Action Planning", 03/2022
- Invited talk at Artificial Intelligence Medicine (AIM) Organization weekly webinar: "Applications of Reinforcement Learning in healthcare and power grid control", 03/2021
- Invited talk at Prof. Constantine Dovrolis's research group: "Functional Connectivity Correlates to Individual Difference in Human Brains during Working Memory Task and Resting State", 02/2021

Teaching Experience
Georgia Institute of Technology *(Instructor: Prof. Constantine Dovrolis)* *Atlanta, GA, USA*
Graduate Teaching assistant of CS 7280 Network Science *01/2021 – 12/2021*
- Hold office hours for ~130 graduate students to answer questions related to lectures, quizzes, and assignments
- Develop and grade quizzes and assignments for three semesters

National Taiwan University *Taipei, Taiwan*
Teaching assistant of Clinical Application of Medical Electronic Device *09/2017 - 01/2018*
- Led several team projects to develop concrete prototypes to demonstrate the feasibility of solving unmet clinical need

National Taiwan University *Taipei, Taiwan*
Teaching Assistant of Clinical Observation & Demands Exploration *07/2017 - 08/2017*
- Led several team projects to cooperate with clinicians and to solve clinical problems
- Prepared course materials and invited lecture speakers

Work Experience
Curai Health *Palo Alto, CA (Remote)*
Machine Learning Research Intern *from 05/2022*
Mentors: Dr. Anitha Kannan and Dr. Ilya Valmianski
- Building a Reinforcement Learning model for text response from patients to make diagnoses automatically via chatbots

Reazon Holdings, inc. *Tokyo, Japan (Remote)*
Machine Learning Research Intern
Mentors: MD. Shubham Gupta and Dr. Daijro Mori *10/2021 – 12/2021*
- Build ShuffleNet and GhostNet for gaze estimation and eye moving tracking on mobile devices improving upon published accuracy
- Adapt a Capsule Network to gaze estimation problem including eyes, face, and gray frame models and incorporated reconstruction loss to the original objective function
- Abstract original PyTorch implementation via PyTorch Lightning

Abbott Vascular Taiwan *Taipei, Taiwan*
Software Engineering Intern *06/2018 - 07/2019*
- Built an administrative system to share information among marketing, sales, and finance departments, and improved 75% of operation time in the sales database of vascular products, facilitating fast targeting
- Forecasted vascular product marketing trend by digitizing routine documents and incorporated the original database with Power BI to provide interactive visualizations and business intelligence capabilities to create reports and dashboards

Selected Projects
Modeling human clustering ability with experimental data *Spring 2021*
- Simulated humans' response to disperse and clustered dot distributions via Hebbian and Inhibitive Clustering (biologically plausible), resulting in only 12% difference in predicting humans' behavior compared with humans themselves

Modeling Stimulus and Response of Uniform Illusion *Spring 2021*
- Modeled different level of blurs by Gaussian filter with different standard deviations

- Trained a variational autoencoder to mimic humans' response to uniform illusion

Brain Network Mapping for Working Memory [A2] *Fall 2020*

- Utilized network and clustering algorithms to map a brain with behavioral data during resting state
- Investigated how brains react to information load changes during holding and encoding the information via the comparison the representations between resting state and workload required to state

Quantifiable connection between heart and brain *Fall 2020*

- Autoencoded sequentially the physiological time series and then used the hidden state readout as features feeding into a regression model to estimate brain activity with HR-PET

Neural Population Dynamics for Motor Cortex *Fall 2020*

- Constructed PSTHs and neural population state spaces from a monkey performing a motor delayed-reaching task
- Visualized the rotational dynamics pattern via jPCA

Honors and Awards

Computer Science Departmental Fellowship, Duke University *08/2022-05/2024*

Thank a Teacher Program Award (Graduate Teaching Assistant), GaTech *04/2021*

Leadership Growth Award, Cross-strait Innovation and Entrepreneurship Competition, Govt. of China *07/2017*

Finalist (8 out of 91), Stanford Design Challenge Asia, Taipei, Taiwan *12/2016*

Bronze Medal, Material Innovation Award, Material Research Society Taiwan, Hsinchu, Taiwan *10/2016*

Third Prize, NTU Windmill Design and Practice of Competition, Taipei, Taiwan *01/2015*