Hao-Lun Hsu

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Education

Duke University	Durham, NC, USA
Ph.D. Computer Science	*Aug. 2022 – Present*
Medical Robotics Certificate	
Georgia Institute of Technology	Atlanta, GA, USA
M.S. Biomedical Engineering	*Aug. 2019 – May 2021*
National Taiwan University	Taipei, Taiwan
B.S. Mechanical Engineering	*Sep. 2014 – Jun. 2018*

Publications

Preprints (*Equal contribution)

P1. **HL Hsu***, W Wang*, M Pajic and P Xu, "Randomized Exploration in Cooperative Multi-Agent Reinforcement Learning", 2024

P2. J Dong*, **HL Hsu***, Q Gao, V Tarokh, and M Pajic, "Robust Reinforcement Learning through Efficient Adversarial Herding", 2023, available on arxiv

Conference and Journal Papers

J1. P Sarikhani, **HL Hsu**, M Zeydabadinezhad, Y Yao, M Kothare, and B Mahmoudi, "Reinforcement Learning for Closed-loop Regulation of Cardiovascular System with Vagus Nerve Stimulation: A Computational Study", in *Journal of Neural Engineering*, 2024

C1. **HL Hsu**, A Bozkurt, J Dong, Q Gao, V Tarokh, and M Pajic, "Steering Decision Transformers via Temporal Difference Learning", in *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, 2024

C2. A Gazi, M Chan, **HL Hsu**, D Bremner, C Rozell, and O Inan, "StressFADS: Learning Latent Autonomic Factors of Stress in the Context of Trauma Recall and Neuromodulation", in *IEEE International Conference on Wearable and Implantable Body Sensor Networks (BSN)*, 2024

C3. **HL Hsu**, and M Pajic, "Robust Exploration with Adversary via Langevin Monte Carlo", in *Learning for Dynamics and Control Conference (L4DC)*, 2024

C4. **HL Hsu**, H Meng, S Luo, J Dong, V Tarokh, and M Pajic, "REFORMA: Robust REinFORceMent Learning via Adaptive Adversary for Drones Flying under Disturbances", in *IEEE International Conference on Robotics and Automation (ICRA)*, 2024

C5. T Jin, **HL Hsu**, W Chang, and P Xu, "Finite-Time Frequentist Regret Bounds of Multi-Agent Thompson Sampling on Sparse Hypergraphs", in *38th AAAI Conference on Artificial Intelligence (AAAI)*, 2024 (Oral with acceptance rate 2.3 %)

C6. **HL Hsu**, Q Gao, and M Pajic, "ϵ-Neural Thompson Sampling of Deep Brain Stimulation for Parkinson Disease Treatment", in *International Conference on Cyber-Physical Systems (ICCPS)*, 2024

C7. P Sarikhani, **HL Hsu**, and B Mahmoudi, "Automated Tuning of Closed-loop Neuromodulation Control Systems using Bayesian Optimization", in *44rd Annual International Conference of the IEEE Engineering in Medicine & Biology Society (EMBC)*, 2022

C8. **HL Hsu**, Q Huang, and S Ha, "Improving Safety in Deep Reinforcement Learning Using Unsupervised Action Planning", in *IEEE International Conference on Robotics and Automation (ICRA)*, 2022

C9. JH Chen, **HL Hsu**, WH Yang, YC Chen, and HM Hsiao, "New Spherical Stent Concept for Occlusion", in *Annual Scientific Meeting of Taiwanese Society of Biomechanics*, 2017

Workshop Papers

W1. 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", in *NeurIPS Research2Clinics Workshop*, 2021

W2. **HL Hsu**, Q Huang, and S Ha, "Safe Exploration for Reinforcement Learning Using Unsupervised Action Planning", in *RSS Workshop on Integrating Planning and Learning*, 2021

Abstract

A1. P Sarikhani, H Xu, ST Wang, S Kinzer, **HL Hsu**, Y Zhu, J Krasney, J Manns, H Esmaeilzadeh, B Mahmoudi, "Neuroweaver: a translational platform for embedding artificial intelligent in closed-loop neuromodulation systems", in *Neuroscience 2023, 52nd Annual Meeting*, 2023

A2. 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", in *Neuroscience 2021, 50th Annual Meeting*, 2021

A3. P Sarikhani, **HL Hsu**, O Kara, JK Kim, H Esmaeilzadeh, and B Mahmoudi, "Neuroweaver: A Platform for Designing Intelligent Closed-loop Neuromodulation Systems", in *4th International Brain Stimulation Conference*, 2021

A4. **HL Hsu**, "Functional Connectivity Correlates to Individual Difference in Human Brains during Working Memory Task and Resting State", in *IEEE EMBS North American Virtual International Student Conference*, 2021

Honors & Awards

AAAI 2024 Oral, *acceptance rate 2.3 %*	Feb. 2024
NSF TAST-NRT Fellowship, *1 of 6 awardees*	Aug. 2022 - Jul. 2023
Ph.D. Departmental Fellowship, *Computer Science, Duke University*	Aug. 2022 - Jul. 2024
Thank a Teacher Award, *Center of Teaching and Learning, Georgia Tech*	Apr. 2021
Travel Grants for Ph.D. Fellowship workshop, *Hong Kong government*	Jul. 2018
Material Innovation Award, *Material Research Society Taiwan*	Oct. 2016
Third Prize, *Manufacturing Practice Competition, Mechanical Engineering, NTU*	Jan. 2015

Research Experience

Duke University Durham, NC, USA
Cyber-Physical Systems Lab *Aug. 2022 – Present*
Advisor: Prof. Miroslav Pajic

- Robust RL with (1) neuro-symbolic abstraction (2) adversarial herding and (3) non-stationary adaptation (4) transformer-based in-context learning

- Pulse frequency prediction of deep brain stimulation with (1) less exploration via ϵ-Neural Thompson Sampling and (2) robust exploration
- Offline RL (1) using transformer-based supervised learning with guidance via temporal difference on CARLA simulator(autonomous driving systems) (2) for selecting frames with ORB features in SLAM for augmented reality (AR)

Duke University   Durham, NC, USA
Theoretical RL group   *Feb. 2023 – Present*
Mentor: Prof. Pan Xu

- Cooperative framework with randomized exploration for multi-Agent RL via Thompson sampling and Langevin Monte Carlo
- Multi-agent Thompson sampling on sparse hypergraphs with frequentist regret bounds

Duke University   Durham, NC, USA
Topological Learning Lab   *Dec. 2023 – Present*
Mentor: Prof. Tananun Songdechakraiwut

- Fast topological learning with RL for clustering functional brain networks with unknown cluster number

Emory University   Atlanta, GA, USA
Neuroinformatics & Intelligent System Lab   *Jan. 2021 – Jul. 2022*
Advisor: Prof. Babak Mahmoudi

- Deep brain stimulation improvement in (1) computation cost reduction via quantization RL, (2) automated PI controller via Bayesian optimization, and (3) safe RL with penalty for neuron suppression in Parkinson's diseases
- Vagus nerve stimulation with (1) set-point control based RL and (2) Few-shot adaption from healthy to hypertension cardiac model via transfer learning

Georgia Institute of Technology   Atlanta, GA, USA
Robotics & Computer Animation Lab   *Jan. 2020 – Oct. 2021*
Advisor: Prof. Sehoon Ha

- Integrated on-policy RL agent with unsupervised action planning for safe exploration
- RL transfer for power grid control via (1) Augmented Random Search to adapt to less controllable renewables and (2) domain randomization for different power load

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Work Experience

Philips Research   Cambridge, MA, USA
Autonomous Ultrasound AI Research Intern   *Jun. 2024 – Present*
Mentors: Dr. Mohsen Zahiri

- RL with Langevin Monte Carlo and Foundation Models (segmentation) as reward function for ultrasound active guidance in Focused Assessment with Sonography in Trauma (FAST)
- Offline actor-critic framework with marginalized importance sampling and diffusion model for incomplete trajectories and perturbed observations

Curai Health   Palo Alto, CA, USA (Remote)
Machine Learning Research Intern   *May 2022 – Sep. 2022*
Mentors: Dr. Anitha Kannan and Dr. Ilya Valmianski

- Built Decision Transformer for sequence modeling in high dimensional medical history taking
- Interpreted connection between queries and diagnosis with scalability and generalization

Reazon Holdings, Inc.   Tokyo, Japan (Remote)
Machine Learning Research Intern   *Oct. 2021 – Dec. 2021*
Mentors: Shubham Gupta MD. and Dr. Daijro Mori

- Built ShuffleNet and GhostNet for gaze estimation and eye moving tracking on mobile devices improving upon published accuracy
- Adapted a Capsule Network to gaze estimation problem including eyes, face, and gray frame models and incorporated reconstruction loss to the original objective function
- Abstracted original PyTorch implementation via PyTorch Lightning

Abbott Vascular Taiwan   Taipei, Taiwan
Software Engineering Intern   *Jun. 2018 – Jul. 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 for creating reports and dashboards

Academic Service

Paper Review: L4DC'24, ICRA'23-24, IROS'23, NeurIPS'23, ICLR'24, AISTATS'24, ICML'24, ICML'23 Frontiers4LCD, NeurIPS'23 AI4Science, NeurIPS'23 GenBio, ICML'24 AI4Science, ICML'24 SPIGM

Research Proposal Review: PURA (President's Undergraduate Research Award) Fall 2022

Teaching Assistant: Algorithmic Game Theory (Expected Spring 2024), Data Science (Spring 2023), Network Science (Spring, Summer, and Fall 2021), Clinical Application of Medical Electronic Device (Fall 2017), Clinical Observation & Demands Exploration (Summer 2017)

Research Mentoring (RL for Science): Stefan Dragos (St. Augustine Preparatory School): RL for robotic navigation, (Summer'24) Weisheng Jin (Duke): LLM with RL for robotics (Fall'23-Spring'24), Yang Chen (UC Berkeley): safe surgical robotics (Fall'23), Alexander Wang (West Windsor Plainsboro High School North): fake news detection (Fall'23), Nirav Jaiswal (Foothill High School): cloud computing (Summer'23), Indu Arimilli (Redmond High School): diagnosis prediction (Summer'23), Ian Choe (St. Mark's School): deep brain stimulation (Summer'23)

Talks & Presentations

CS 370: Introduction To AI Spring'24 Course (Guest Lecture)   *Expected Apr. 2024*
Robust Reinforcement Learning via Adversarial Training

AFOSR Center "Assured Autonomy in Contested Environments" (Poster)   *Dec. 2023*
Robust Reinforcement Learning with Structured Adversarial Ensemble

NCTPASS 2022 Annual Symposium (Young Scholar Presentation)   *Nov. 2022*
AI for Dynamical and Safety-critical Systems

Curai Health ML paper club (Invited Talk)   *Jul. 2022*
Possible Reinforcement Learning Approaches to History Taking

Georgia Tech Robotics Research Showcase (Poster)   *Mar. 2022*
Improving Safety in Deep Reinforcement Learning Using Unsupervised Action Planning

Artificial Intelligence Medicine Organization weekly webinar (Invited Talk) *Mar. 2021*
Applications of Reinforcement Learning in healthcare and power grid control

Technical Skills

Programming: Python, MATLAB, C++, C#, Julia, VBA
Software: AutoCAD, SolidWorks, Creo Parametric, ABAQUS, Qblade
OS: Linux (Ubuntu), Microsoft Windows, iOS
ML: Tensorflow, PyTorch, Keras, Scikit-learn, PyTorch Lightning
Simulation Environment: OpenAI Gym, Mujoco