Jiahe Chen

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PROFILE

My PhD research involves optimization, swarm intelligence, and machine learning (ML). More specifically, I develop scalable fault-tolerant algorithms to enable swarms of simple robots to build large-scale complex structures. I have five years of hands-on experience with Python, object-oriented programming (OOP), version control systems (GitHub), deep learning frameworks (TensorFlow and PyTorch), reinforcement learning (RL), data mining, and statistical modeling (data regression, decision trees, random forest, hypothesis test, SVM, KNN, PCA, etc.). **I do not need H-1B sponsorship as I am a permanent resident's spouse.**

Research Focus: Robotics, Artificial Intelligence (AI), Reinforcement Learning
Tools: ROS, Linux, MATLAB, Jupyter Notebook, GitHub
Scripting Languages: Python, Bash, PowerShell
Libraries: TensorFlow, PyTorch, Scikit-learn, Statsmodels, OpenAI Gymnasium, Stable Baselines3, Optuna, Pandas, NumPy, SciPy, Seaborn, CVXOPT, NetworkX

EDUCATION

Cornell University *Sep 2019 - Dec 2024*
- **Degree:** Ph.D. in Electrical Engineering, GPA 3.82/4.0
- **Thesis:** Error-Tolerant Decentralized Robotic Construction
- **Committee:** Kirstin Petersen (Advisor), Nils Napp, Francesca Parise

University of Pennsylvania *Sep 2017 - May 2019*
- **Degree:** M.S. in Electrical Engineering, GPA 3.97/4.0
- **Thesis:** An Ultra-Low-Power Implantable Chip for Safe Neurostimulation [Link]

Queen's University at Kingston *Sep 2013 - May 2017*
- **Degree:** B.S. in Engineering Physics, Minor in Electrical Engineering, First Class Honours

COURSEWORK

Machine Learning: CS 5780 Machine Learning for Intelligent Systems, ORIE 5741 Learning with Big Messy Data, CS 6780 Advanced Machine Learning, CS 5789 Introduction to Reinforcement Learning, CS 6784 Machine Learning in Feedback Systems

Robotics: ECE 4770 Foundations of Robotics, ECE 6680 Bio-inspired Coordination of Multi-Agent Systems

Applied Mathematics: ECE 6970 Network Systems and Game Theory, MATH 4740 Stochastic Processes

PUBLICATIONS

1. **Jiahe Chen** and Kirstin Petersen, *Distributed Coordination of Simple Earthmover Robots for Terrain Modification*, under review in Autonomous Robots (AURO), 2025.
2. **Jiahe Chen** and Kirstin Petersen, *2D Construction Planning for Swarms of Simple Earthmover Robots*, International Symposium on Distributed Autonomous Robotic Systems (DARS), 2024.
3. Danna Ma, **Jiahe Chen**, Sadie Cutler, and Kirstin Petersen, *Smarticle 2.0: Design of Scalable, Entangled Smart Matter*, International Symposium on Distributed Autonomous Robotic Systems (DARS), 2022.
4. **Jiahe Chen** and Kirstin Petersen, *Decay-Based Error Correction in Collective Robotic Construction*, IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), 2022.
5. **Jiahe Chen**, Yifang Liu, Adam Pacheck, Hadas Kress-Gazit, Nils Napp, and Kirstin Petersen, *Errors in Collective Robotic Construction*, International Symposium on Distributed Autonomous Robotic Systems (DARS), 2021.

6. Han Hao, **Jiahe Chen**, Andrew G. Richardson, Jan Van der Spiegel, and Firooz Aflatouni, *A 10.8 μW Neural Signal Recorder and Processor with Unsupervised Analog Classifier for Spike Sorting*, IEEE Transactions on Biomedical Circuits and Systems, 2021.

PROFESSIONAL SERVICES

Reviewer for RA-L and ICRA

Teaching Assistant for ECE 4160 Fast Robots (Cornell), ECE 2300 Digital Logic & Computer Organization (Cornell), ESE 568 Mixed Signal Design and Modeling (UPenn), ESE 570 Digital Integrated Circuits and VLSI-Fundamentals (UPenn)

Member of Cornell Computer Systems Laboratory Student Steering Committee in 2021-2022

AWARDS

Jacobs Fellowship (Cornell) *Aug 2020 & Aug 2021*
Merit-Based Fellowship (Cornell) *Aug 2019*
Outstanding Academic Award Honorable Mention (UPenn) *May 2019*
Dean's Scholar (Queen's) *May 2015 & May 2017*
Excellence Scholarship (Queen's) *Sep 2013*

PROJECTS

Collective Robotic Terrain Transformation [Link] *Mar 2022 - Present*
Advised by Prof. Kirstin Petersen, Cornell University

- Developed an error-tolerant distributed algorithm based on optimal transport theory to coordinate a swarm of minimalistic robots to build complex continuous terrains under motion noise and constraints.
- In progress: compare the proposed algorithm with the state-of-the-art reinforcement learning methods.

Learning to Construct with Granules [Link] *Mar 2023 - Dec 2023*
Advised by Prof. Kirstin Petersen, Cornell University

- Built a physics simulator in Python from scratch to simulate multi-robot construction with granular material using Pymunk as the physics engine and Pygame for visualization.
- Developed a reinforcement learning environment for robot learning using OpenAI Gymnasium. Deployed the environment on Google Cloud to accelerate the training process through multiprocessing.
- Trained different RL algorithms, including advantage actor-critic (A2C), proximal policy optimization (PPO), and trust region policy optimization (TRPO), to find the optimal control policy for construction tasks. Applied reward shaping to allow faster convergence. Tuned the hyperparameters through Optuna.

Large-Scale Distributed Robotic Construction [Link] *Apr 2020 - Mar 2022*
Advised by Prof. Kirstin Petersen, Cornell University

- Built a highly efficient simulator in Python from scratch for large-scale 3D robotic construction. Developed a scalable error correction algorithm that significantly boosts the system's reliability. Performed time complexity analysis and verified the algorithm's efficacy through statistical hypothesis testing.

Price Prediction of Used Cars [Github] *Sep 2021 - Dec 2021*
ORIE 5741 Learning with Big Messy Data, Cornell University

- Performed data curation (data visualization, missing value imputation, data cleaning, feature encoding, and normalization) to a massive dataset containing 420k data points and 25 features.
- Applied supervised machine learning algorithms, including linear, Ridge, Lasso, Huber regression, random forest, and boosted decision trees to predict used car pricing.

Distributed Optimization and Machine Learning over Networks [Link] *Sep 2020 - Dec 2020*
ECE 6970 Network Systems and Game Theory, Cornell University

- Surveyed state-of-the-art distributed machine learning and optimization algorithms. Examined how network topology, communication bandwidth, constraints, and noises affect the performance.