Jiahe Chen

jc3472@cornell.edu (626) 684-6144 ericland.github.io jiahe-chen-67b19585 Ericland

RESEARCH PROFILE

My PhD research focuses on developing scalable error-tolerant algorithms to enable swarms of robots with minimal onboard capabilities to build large-scale complex structures. My approach to this problem involves diverse fields, including optimization, distributed algorithms and systems, physics-based simulation, machine learning (ML), and advanced mathematics, such as optimal transport theory. I have five years of experience in Python and am familiar with Robot Operating System (ROS), version control systems (GitHub), ML frameworks (TensorFlow and PyTorch), reinforcement learning, and statistical modeling. I also have a strong hardware background in integrated circuits (IC) design, embedded systems, and fast prototyping.

Research Focus: Artificial Intelligence (AI), Autonomous Construction, Multi-Robot Systems
Tools: ROS, Linux, AutoCAD, Altium, Cadence, 3D Printing, Arduino, LabVIEW
Programming: Python, C, Verilog, MATLAB, Mathematica
ML Libraries: TensorFlow, PyTorch, OpenAI Gymnasium, Stable Baselines3, scikit-learn, statsmodels

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
- **Core Courses:** Multi-Agent Systems, Machine Learning, Data Mining, Network Systems and Game Theory, Probability Theory and Stochastic Processes, Reinforcement Learning

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]
- **Core Courses:** Analog Mixed-Signal and RF IC Design, Silicon Photonics, VLSI, Digital Signal Processing

Queen's University at Kingston *Sep 2013 - May 2017*

- **Degree:** B.S. in Engineering Physics, Minor in Electrical Engineering, First Class Honours
- **Core Courses:** Solid State Physics, Micro-Electromechanical Systems, Electromagnetic Theory, Thermodynamics, Quantum Mechanics, Mathematical Methods in Physics

PUBLICATIONS

1. **Jiahe Chen** and Kirstin Petersen, *Distributed Coordination of Simple Earthmover Robots for Terrain Modification*, under review in International Conference on Robotics and Automation (ICRA), 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 - Dec 2024*
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.
- Developed a dynamical system model of the robot's interaction with granular material based on real data.
- Built a lightweight simulator in Python based on the proposed model that drastically reduces the computation time of simulating large-scale multi-robot construction with granular material.

Physics Simulation of Robotic Construction with Granules [Link] *Mar 2023 - Dec 2023*
Advised by Prof. Kirstin Petersen, Cornell University

- Built an agent-based physics simulator in Python 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 parallel computing.
- Successfully discovered optimal control policies for several tasks using A2C, PPO, and TRPO algorithms.

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

- Built an agent-based simulator in Python to simulate multiple brick-carrying climbing robots that assemble a user-defined 3D structure at an arbitrary scale.
- Developed a distributed algorithm to resolve deadlocks in large-scale multi-robot construction.
- Developed a distributed error correction algorithm that utilizes stochastic decay processes performed by minimalistic robots to eliminate errors and ensure the long-term performance of large-scale construction.

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

- Discovered the best price prediction method for used cars based on the market dataset of over 400,000 vehicles by training machine learning models, including regression analysis, random forest, and boosting.

Multi-Robot Wireless Charging System [Link] *Sep 2019 - Jul 2020*
Advised by Prof. Kirstin Petersen, Cornell University

- Designed a low-cost programmable wireless power transfer system that can charge multiple modular robots in 6 hours with a high tolerance for coil misalignment and be easily manufactured.

Implantable Chips for Brain-Machine Interface Applications [Link] *Jan 2018 - Jun 2019*
Advised by Prof. Firooz Aflatouni and Prof. Jan Van der Spiegel, University of Pennsylvania

- Worked with a joint team of Penn Engineering and Penn Medicine to design ultra-low-power implantable chips for neural signal processing and safe neurostimulation treatment. Tape-out in 180nm SOI process.