Siming He

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Education

Master of Science in Engineering, Robotics *Philadelphia, PA*

SCHOOL OF ENGINEERING AND APPLIED SCIENCE, UNIVERSITY OF PENNSYLVANIA, GPA 3.97/4.0 *Aug. 2022 - May 2025*

Selected Courses: Probability Theory, Advanced Linear Algebra, Convex Optimization, Principles of Deep Learning, Learning in Robotics, Machine Learning, Linear System Theory, Computer Vision, Game-theoretic Learning, Calibration and Conformal Prediction.

Bachelor of Science in Engineering, Computer Science with Math Minor *Philadelphia, PA*

SCHOOL OF ENGINEERING AND APPLIED SCIENCE, UNIVERSITY OF PENNSYLVANIA, GPA 3.96/4.0 *Aug. 2020 - May 2025*

Selected Courses: PDE, Real Analysis, Discrete Math, Algorithms, Operating Systems, Information Theory, Algorithmic Fairness and Privacy.

Bachelor of Science in Economics, Statistics *Philadelphia, PA*

WHARTON SCHOOL, UNIVERSITY OF PENNSYLVANIA, GPA 3.86/4.0, STATISTICS-GPA 4.0/4.0 *Aug. 2020 - May 2025*

Selected Courses: Probability, Statistical Inference, Mathematical Statistics, Bayesian Statistics, Math Foundation for RL.

Research Experience

Active Perception Researcher. Advisor: Dr. Pratik Chaudhari, Dr. Vijay Kumar *Philadelphia, PA*

THE GENERAL ROBOTICS, AUTOMATION, SENSING AND PERCEPTION (GRASP) LABORATORY, UPenn *May 2021 - Current*

- Developed algorithms that enable robots to **autonomously and robustly collect information** from an initially unknown environments.
- Formalized active perception using the **mathematical principle of maximizing predictive information**. Deduced three essential components for implementing this principle. Developed an algorithm to actively **select dynamically feasible trajectories** for information collection and the reconstruction of **fine-grained semantic neural radiance fields** (NeRF).
- **Formulated a game-theoretic approach** to address the suboptimality of active perception algorithms. **Developed an online optimization algorithm** to enhance predictive information estimation, **providing theoretical guarantees** for the estimation algorithm and active perception performance. **Conducted real robot experiments** using a customized Jackal ground robot.
- First-authored two papers: one published in the American Control Conference and another under review.

Robotics Perception Researcher. Advisor: Dr. Pratik Chaudhari, Dr. Vijay Kumar *Philadelphia, PA*

THE GENERAL ROBOTICS, AUTOMATION, SENSING AND PERCEPTION (GRASP) LABORATORY, UPenn *Jan. 2023 - Current*

- Initiated a project to **extract economical and ecological insights of forests** using vision and IMU sensors, which, if successful, **would reduce costs by tenfold** compared to classical methods using LiDAR.
- **Engineered hardware and software** to enable large-scale, multimodal tree data collection. **Created a dataset** of urban and forest trees in Philadelphia and Virginia using LiDAR, RGB cameras, IMU, and GPS.
- Created geometric, photometric, and semantic maps for detailed forestry studies. Designed an efficient procedure to **interconvert neural radiance fields and 3D Gaussian splatting**, leveraging the strengths of both approaches.
- First-authored a paper presented at the Embodied AI Workshop, CVPR 2024.

Research Assistant. Advisor: Dr. Christopher Fang-Yen *Philadelphia, PA*

DEPARTMENT OF BIOENGINEERING, UPenn *Sep. 2021 - Jan. 2022*

- Participated in developing **a robotic platform** capable of conducting and analyzing experiments on C. Elegans, **accelerating scientific discovery** and freeing researchers from time-consuming, repetitive tasks.
- **Designed a vision algorithm to decode barcode labels** on Petri dishes, allowing the robot to record and organize experiments.
- **Created an automatic lens calibration algorithm** to ensure the cameras' focus on C. Elegans for accurate detections and operations.
- Co-authored a paper published in the National Academy of Sciences (PNAS) Nexus.

Selected Projects

Information Theory and Learning Theory *Philadelphia, PA*

DIRECTED READING WITH DR. SANTOSH VENKATESH *2023 Spring*

Engaged in guided reading and discussions on **information theory, Vapnik–Chervonenkis theory, and probability theory**. Participated in weekly problem-solving sessions and presented proofs.

Stereo Visual SLAM with Factor Graph Optimization using Symforce *Philadelphia, PA*

ESE 6500 LEARNING IN ROBOTICS WITH DR. PRATIK CHAUDHARI *2023 Spring*

Developed a **Stereo Visual SLAM** system incorporating feature-based visual odometry and backend optimization.

Conformal Risk Control in Generalist Cellular Segmentation *Philadelphia, PA*

CIS 7000 UNCERTAINTY QUANTIFICATION WITH DR. AARON ROTH *2022 Fall*

Developed **conformal risk control** to manage false negative rates in cellular semantic segmentation tasks with two classmates.

Preventing the Transfer of Spurious Features in Transfer Learning   *Philadelphia, PA*

ESE 5460 PRINCIPLES OF DEEP LEANRING WITH DR. PRATIK CHAUDHARI   *2022 Fall*

Identified a method to largely **prevent spurious feature in transfer learning** by minimizing the transfer distance on the statistical manifold of neural networks.

Honors & Awards

2024   **Wharton Student Research Subsidy — $750**, Wharton School   *Philadelphia, PA*
2024   **Class of 1971 Robert J. Holtz Fund Grant — $1,000**, Penn Center for Undergraduate Research & Fellowships   *Philadelphia, PA*
2024   **ETH Robotics Student Fellowship — CHF 4,000**, ETH RobotX   *Zürich, Switzerland*
2024   **Honorable Mention, CRA Outstanding Undergraduate Researcher Award**, Computing Research Association   *Philadelphia, PA*
2023   **Vagelos Undergraduate Research Grant — $500**, Penn Center for Undergraduate Research & Fellowships   *Philadelphia, PA*
2023   **Wharton Summer Program for Undergraduate Research — $6,000**, Wharton School   *Philadelphia, PA*
2022   **Wharton Summer Program for Undergraduate Research — $6,000**, Wharton School   *Philadelphia, PA*
2021   **Penn Research Mentoring Program — $4,500**, Penn Center for Undergraduate Research & Fellowships   *Philadelphia, PA*

Publications

[5]   **He, S.**, Osman, Z. & Chaudhari, P. *From NeRFs to Gaussian Splats, and Back.* Embodied AI Workshop, CVPR 2024

[4]   **He, S.**, Tao, Y., Spasojevic, I., Kumar, V. & Chaudhari, P. *An Active Perception Game for Robust Autonomous Exploration.* arXiv preprint arXiv:2404.00769 (2024)

[3]   **He, S.**, Hsu, C. D., Ong, D., Shao, Y. S. & Chaudhari, P. *Active Perception Using Neural Radiance Fields* in Proc. of American Control Conference (ACC) (2024)

[2]   Li, Z., Fouad, D.A., Bowlin, D.P., Fan, Y., **He, S.**, Chang, M., Du, A., Teng, C., Kassouni, A., Ji, H., Raizen, M.D., & Fang-Yen, C. *A robotic system for automated genetic manipulation and analysis of Caenorhabditis elegans* in Proc. of the National Academy of Sciences (PNAS) Nexus (2023)

[1]   Lv, Q., Ding, M., Liu, Q., Chen, Y., Feng, W., **He, S.**, Zhou, C., Jiang, J., Dong, Y., & Tang, J.. *Are we really making much progress? revisiting, benchmarking and refining heterogeneous graph neural networks* in Proc. of the 27th ACM SIGKDD Conference on Knowledge Discovery & Data Mining (KDD) (2021)

Presentations

2024   **Active Perception using Neural Radiance Fields**, American Control Conference (Oral)   *Toronto, ON*
2024   **Robust Active Perception: A Game-theoretic Perspective**, Northeast Systems and Control Workshop (Poster)   *Philadelphia, PA*
2024   **Active Perception using Neural Radiance Fields**, Penn Undergraduate Spring Research Symposium (Oral)   *Philadelphia, PA*
2023   **Active Simultaneous Localization and Mapping in Unstructured Environment with a Quadrotor**, Penn   *Philadelphia, PA*
       Undergraduate Spring Research Symposium (Poster)
2021   **Control, Learning, and Perception for an Intelligent Robot**, Penn Undergraduate Fall Research Expo (Poster)   *Philadelphia, PA*

Teaching & Community Involvement

Course Development Assistant   *Philadelphia, PA*

UNIVERSITY OF PENNSYLVANIA   *Mar. 2024 - Current*

- Assisted in developing the course 'Mathematical Foundations for Machine Learning' for Penn Engineering Online. Designed and organized syllabus, weekly content and homework problems for probability theory and linear algebra.

Teaching Assistant   *Philadelphia, PA*

UNIVERSITY OF PENNSYLVANIA   *Sep. 2022 - Current*

- Teaching assistant for graduate-level courses including CIS 5200 Machine Learning (Dr. Lyle Ungar), ESE 5460 Principles of Deep Learning (Dr. Pratik Chaudhari), ESE 6050 Convex Optimization (Dr. Nikolai Matni), and ESE 5300 Probability Theory (Dr. Santosh Venkatesh).
- Developed 51 pages of recitation materials on machine learning with detailed examples. Conducted 14 recitations for 40 students. Held weekly office hours to help students overcome understanding and implementation challenges.

Peer Research Advisor   *Philadelphia, PA*

CENTER FOR UNDERGRADUATE RESEARCH & FELLOWSHIPS, UNIVERSITY OF PENNSYLVANIA   *Sep. 2022 - Current*

- Advised 30 first- and second-year undergraduate students on research opportunities and challenges, faculty mentors, and grants.
- Compiled weekly research seminar lists to keep mentees informed about topics in their areas of interest.
- Designed and conducted annual Python Programming for Research Workshops to introduce Python and common Python packages to researchers from various fields, including biology, architecture, and psychology.

Robotics Education for Underrepresented Students

THE GRASP LAB, UNIVERSITY OF PENNSYLVANIA

Philadelphia, PA

Sep. 2023 - Current

- Presented and demonstrated my robotics research to 30 seventh-grade students.
- Taught Arduino basics to 30 tenth-grade students.
- Taught 30 high school students about mapping and planning in robotics.

Resident Advisor of a First-year Students' Dorm

COLLEGE HOUSES & ACADEMIC SERVICES, UNIVERSITY OF PENNSYLVANIA

Philadelphia, PA

Aug. 2023 - May 2024

- Advised residents on various aspects of academic and residential life, supporting them through the challenges of first-year college life.
- Hosted lunch and dinner sessions with faculty members, facilitating conversations on academic, research, and cultural topics. Organized information sessions to connect residents with research resources on campus.
- Recipient of the **Excellence in Academic & Intellectual Life Award.**

Founder

RYKERT AFTER SCHOOL SCIENCE PROGRAM

St. Catharines, Ontario

Sep. 2018 - May 2020

- Organized a program to engage underprivileged middle school students in science experiments, providing access to laboratory environments beyond their regular experiences.
- Led the development of engaging experiments, including building electric wheels, constructing water rockets, and observing specimens under microscopes.