

# 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. 2021 - Dec. 2023

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

### 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: Algorithms, Discrete Math, PDE, Real Analysis, Computer Organization & Design, Operating Systems.

### Bachelor of Science in Economics, Statistics

Philadelphia, PA

WHARTON SCHOOL, UNIVERSITY OF PENNSYLVANIA, GPA 3.77/4.0, STATISTICS-GPA 4.0/4.0

Aug. 2020 - May 2025

Selected Courses: Statistical Inference, Stochastic Process, Mathematical Statistics, Bayesian Statistics, Math of RL.

## Research Experience

### General Robotics, Automation, Sensing and Perception (GRASP) Laboratory, UPenn

Philadelphia, PA

ADVISOR: PROF. PRATIK CHAUDHARI, DEAN VIJAY KUMAR

Jan. 2023 - Present

- **Spearheading a project** using a monocular camera and IMU to extract forest geometry and semantics, aimed at advancing forestry research by reducing equipment costs 100x compared to LiDAR methods. Leading a team of three students.
- **Engineered hardware and software** for large-scale, multimodal forest data collection. Developing simultaneous localization and mapping (**SLAM**) and neural radiance field (**NeRF**) methods for accurate forest reconstruction.
- Conducting **statistics thesis on semantic scene understanding** (e.g., ecosystems), with a focus on developing a minimal yet sufficient representation of the rich attributes and relationships within a scene, using category theory and formal logic.
- Presented an algorithm combining the strengths of NeRF and Gaussian splatting at a workshop in the 2024 Conference on Computer Vision and Pattern Recognition.

### General Robotics, Automation, Sensing and Perception (GRASP) Laboratory, UPenn

Philadelphia, PA

ADVISOR: PROF. PRATIK CHAUDHARI, DEAN VIJAY KUMAR

May 2021 - Sep. 2024

- **Formalized active perception using information theory.** Designed algorithms to enable an autonomous quadrotor to effectively reconstruct **semantic NeRFs** from initially unknown environments.
- Conducted computer science thesis to address the suboptimality of active perception algorithms through a **novel game theoretical formulation**. Developed an online optimization algorithm for active perception with **theoretical guarantees**. Performed **real robot experiments** using a Jackal ground robot.
- First-authored two papers: one published at the American Control Conference 2024, and another under review for the International Conference on Robotics and Automation 2025.

### Institute for Dynamic Systems and Control, ETH Zürich

Zürich, Switzerland

ADVISOR: PROF. ANDREA CENSI, PROF. EMILIO FRAZZOLI

Jul. 2024 - Sep. 2024

- Designed a **bio-inspired navigation algorithm with guarantees** based on differential geometry and control theory.
- Developed an online graph clustering algorithm for 3D object segmentation in Gaussian splatting with streaming data.
- Studied **category theory and sheaf theory** by reading 1 book and 5 math research papers.

### Department of Electrical and Systems Engineering, UPenn

Philadelphia, PA

ADVISOR: PROF. SANTOSH VENKATESH

Jan. 2023 - Jul. 2023

- Engaged in guided reading and problem-solving of 2 books on **information theory and learning theory**. Studied 6 math research papers and presented proofs on concentration inequalities, neural network generalization, and channel capacity.

### Department of Bioengineering, UPenn

Philadelphia, PA

ADVISOR: PROF. CHRISTOPHER FANG-YEN

Sep. 2021 - Jan. 2022

- Participated in developing a robotic platform that autonomously processes C. Elegans, accelerating scientific discovery.
- Designed vision algorithms to **decode barcodes in challenging lighting conditions**, allowing robots to organize experiments. Developed an **automatic lens calibration algorithm** to ensure camera focus on C. Elegans for accurate operation.
- Co-authored a paper published in the National Academy of Sciences (PNAS) Nexus.

## Publications & Preprints

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

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

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2024	Active Perception using Neural Radiance Fields, American Control Conference (Oral)	Toronto, ON
2024	Low-cost Forest Mapping Using a Single Omnidirectional Camera, Internet of Things for Precision Agriculture NSF Site Visit (Poster)	Philadelphia, PA
2024	Leveraging Robotics for Forest Environment Monitoring, Penn Climate Week 2024 (Poster)	Philadelphia, PA
2024	Game-theoretic Robust Active Perception, Northeast Systems and Control Workshop (Poster)	Philadelphia, PA
2024	Active Perception using Neural Radiance Fields, Penn Undergraduate Research Symposium (Oral)	Philadelphia, PA
2023	Active SLAM with a Quadrotor, Penn Undergraduate Spring Research Symposium (Poster)	Philadelphia, PA
2021	Control, Learning, and Perception for Robotics, Penn Undergraduate Research Expo (Poster)	Philadelphia, PA

## Honors & Awards

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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	Philadelphia, PA
2024	ETH Robotics Student Fellowship — CHF 4,000, ETH RobotX	Zürich, CH
2024	Honorable Mention, Outstanding Undergraduate Researcher, Computing Research Association	Philadelphia, PA
2023	Vagelos Undergraduate Research Grant — \$500, Penn Center for Undergraduate Research	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	Philadelphia, PA

## Selected Projects

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<b>ESE 6500 LEARNING IN ROBOTICS WITH PROF. PRATIK CHAUDHARI</b>	2023 Spring
Developed a stereo visual SLAM system incorporating feature-based visual odometry and Symforce backend optimization.	
<b>CIS 7000 UNCERTAINTY QUANTIFICATION WITH PROF. AARON ROTH</b>	2022 Fall
Developed conformal risk control algorithm to manage false negative rates in cellular semantic segmentation tasks.	
<b>ESE 5460 PRINCIPLES OF DEEP LEARNING WITH PROF. PRATIK CHAUDHARI</b>	2022 Fall
Identified a way to reduce spurious features in transfer learning based on information geometry.	

## Teaching & Community Involvement

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<b>COURSE DEVELOPMENT ASSISTANT FOR <i>Mathematical Foundations for Machine Learning</i></b>	Mar. 2024 - Present
Organized and created weekly content and homework for graduate-level courses in probability theory and linear algebra.	
<b>ROBOTICS EDUCATION OUTREACH FOR UNDERREPRESENTED STUDENTS</b>	Sep. 2023 - Present
Taught Arduino and robotics fundamentals to a total of 90 middle and high school students from the local community, many of whom typically lack access to robotics education opportunities.	
<b>UPENN UNDERGRADUATE PEER RESEARCH ADVISOR</b>	Sep. 2022 - Present
Advised 40 undergraduates from diverse backgrounds on finding research opportunities and grants. Designed and led annual <i>Python Programming for Research</i> workshops, fostering an inclusive environment for students across all research fields.	
<b>TEACHING ASSISTANT FOR GRADUATE COURSES</b>	Sep. 2022 - Present
Developed 70 pages of recitation materials for courses in probability theory, machine learning, deep learning, and convex optimization. Led 18 sessions for a total of 50 students. Held weekly office hours. Created and graded homework and exams.	
<b>RESIDENT ADVISOR OF A FIRST-YEAR STUDENTS' DORM</b>	Aug. 2023 - May 2024
Organized cultural weeks promoting diversity and inclusion through interactive showcases of global cultures. Hosted faculty-student sessions on academic and research topics. Awarded the Excellence in Academic & Intellectual Life.	
<b>FOUNDER OF RYKERT AFTER SCHOOL SCIENCE OUTREACH PROGRAM</b>	Sep. 2018 - May 2020
Designed and led 11 hands-on experiments, including water rockets and microscope observations, for 30 primary school students from underrepresented communities, offering them laboratory experiences beyond their regular school access.	