

Max Muchen Sun

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EDUCATION

Northwestern University

Ph.D. in Mechanical Engineering (Advisor: Prof. Todd Murphey)

M.Sc. in Mechanical Engineering

Certificate in Management for Scientists and Engineers (Kellogg School of Management)

Certificate in Research Communication (The Graduate School)

Evanston, IL

Jan 2021 – Present

Sep 2019 – Jan 2021

Lanzhou University

B.Sc. in Computer Science

Lanzhou, China

Sep 2015 – Jun 2019

EXPERIENCE

Graduate Researcher | Northwestern University

Sep 2019 – Present

Reference: Prof. Todd Murphey

- Doctoral research on control-induced generative inference for robot learning.
- Developed diffusion-based ergodic control algorithms for unsupervised, automated robot data collection.
- Developed an exploration-based imitation learning algorithm on high-dimensional Riemannian manifolds.
- Developed a robust 3D object tracking algorithm based on differentiable volumetric fields.
- Developed a tabular learning algorithm for online gait identification on a soft quadruped robot.
- Assisted grant writing, with agencies including NSF, Honda Research Institute, and ARPA-H.

Research Collaborator | Honda Research Institute

Jun 2020 – Sep 2024

Reference: Dr. Peter Trautman

- Full-stack development of a social navigation system within dense crowds on an untethered wheeled robot.
- Co-lead the algorithm deployment on hardware for a 5-month crowd navigation field study in Santa Cruz, CA.
- Deployed the social navigation algorithm on a Unitree Go1 quadruped (featured at NVIDIA GTC 2024).
- Developed a game-theoretic intent alignment algorithm for safe human-robot cooperation under uncertainty.
- Developed a game-induced imitation learning algorithm for learning cooperative policies from noisy observations.
- Filed 3 patents during the project.

Lecturer & Teaching Assistant | Northwestern University

2020 – Present

- Co-developed the curriculum and lectures for “ME455: Active Learning for Robotics,” including Bayesian inference, optimal experimental design, and generative models.
- Delivered lectures, designed assignments, and held office hours for “ME314: Machine Dynamics”.

PUBLICATIONS [[GOOGLE SCHOLAR](#)]

Journals

- [1] **M. M. Sun**, A. Gaggari, P. Trautman and T. Murphey, “Fast Ergodic Search with Kernel Functions,” in *IEEE Transactions on Robotics (T-RO)*, vol. 41, pp. 1841-1860, 2025. [[PDF](#) | [Code](#) | [Video](#)]
- [2] **M. M. Sun**, F. Baldini, K. Hughes, P. Trautman, and T. Murphey, “Mixed Strategy Nash Equilibrium for Crowd Navigation,” in *The International Journal of Robotics Research (IJRR)*, vol. 44(7), pp. 1156-1185, 2024. [[PDF](#) | [Code](#) | [Video](#)]

Conferences

- [1] **M. M. Sun**, A. Pinosky, and T. Murphey, “Flow Matching Ergodic Coverage,” in *Robotics: Science and Systems (RSS)*, 2025. [[PDF](#) | [Code](#) | [Video](#)]
- [2] **M. M. Sun**, P. Trautman, and T. Murphey, “Inverse Mixed Strategy Games with Generative Trajectory Models,” in *IEEE International Conference on Robotics and Automation (ICRA)*, 2025. [[PDF](#) | [Code](#) | [Video](#)]
- [3] J. Ketchum, S. Schiffer, **M. Sun**, P. Kaarthik, R. Truby, and T. Murphey, “Automated Gait Generation For Walking, Soft Robotic Quadrupeds,” in *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, 2023. [[PDF](#) | [Video](#)]

- [4] **M. Sun**, A. Pinosky, I. Abraham, and T. Murphey, “Scale-Invariant Fast Functional Registration,” in *International Symposium of Robotics Research (ISRR)*, 2022. [[PDF](#)][[Code](#)]
- [5] **M. Sun**, F. Baldini, P. Trautman, and T. Murphey, “Move Beyond Trajectories: Distribution Space Coupling for Crowd Navigation,” in *Robotics: Science and Systems (RSS)*, 2021. [[PDF](#)][[Code](#)]

PATENTS

- [1] **M. Sun**, P. Trautman, and T. Murphey. “Inverse Mixed Strategy Games With Generative Trajectory Models,” 63/783041. 2025.
- [2] **M. Sun**, A. Gaggar, P. Trautman, and T. Murphey. “Kernel-Based Ergodic Search,” 18/914929. 2024.
- [3] **M. Sun**, F. Baldini, P. Trautman, and T. Murphey. “Game-Theoretic Path Planning for Social Navigation,” 18/316856. 2024.

AWARDS & ACHIEVEMENTS

ICRA Doctoral Consortium (2025) Invited PhD forum for research presentation, expert mentorship, and career development at IEEE International Conference on Robotics and Automation (ICRA).

Martin Outstanding Doctoral Fellowship (2022) Awarded to mid-career Ph.D. candidates for outstanding scholar and research achievements in mechanical engineering by Northwestern University.

MEDIA COVERAGE

A roboticist’s journey with JAX: Finding efficiency in optimal control and simulation
Google AI Developers Blog [[Article](#)]

INVITED TALKS & WORKSHOPS

Structured Imitation Learning of Interactive Policies through Inverse Games <i>Workshop on Generative Modeling Meets Human-Robot Interaction at Robotics: Science and Systems</i>	<i>Jun 2025</i>
Scalable Coverage Trajectory Synthesis on GPUs as Statistical Inference <i>Workshop on Fast Motion Planning and Control in the Era of Parallelism at Robotics: Science and Systems</i>	<i>Jun 2025</i>
Hands-on Introduction to Ergodic Control <i>Tutorial on Ergodic Control at International Conference on Robotics and Automation</i>	<i>May 2024</i>
Social Crowd Navigation with NVIDIA Jetson <i>NVIDIA GTC, Jetson Community Projects Showcase (Co-Presenter)</i>	<i>Mar 2024</i>
Reasoning Over Flexibility for Social Navigation <i>Workshop on Close-Proximity Human-Robot Collaboration at Robotics: Science and Systems</i>	<i>Jul 2022</i>

SERVICE & LEADERSHIP

IEEE Student Member	<i>2024 – Present</i>
Reviewer IJRR, T-RO, RA-L, IROS, ICRA, RO-MAN, ITSC	<i>2021 – Present</i>
Volunteer Museum Presenter Chicago’s Museum of Science and Industry	<i>2022 – Present</i>
Chair of Career Development MechE Graduate Student Society at Northwestern University	<i>2021 – 2022</i>

OPEN SOURCE SOFTWARE [[COMPLETE LIST](#)]

LQRax [[GitHub](#)]: GPU-friendly, auto-differentiable LQR solver (JAX)

BRNE [[GitHub](#)]: ROS package for real-time, human-aware navigation (PyTorch, C++, NVIDIA Jetson)

FLS [[GitHub](#)]: Functional Least-Squares Optimization for Point Cloud Registration (C++, OpenMP, Ceres)

Ergodic Control Sandbox [[GitHub](#)] Sandbox Code for “Tutorial on Ergodic Control” at ICRA 2024 (JAX)

BoxGPT [[Demo](#)]: Interactive game of data collection for embodied agents (JavaScript, Python)

SKILLS

Programming: Python (JAX, PyTorch, Numba), C++ (Eigen, Sophus, OpenMP, Ceres), CUDA, JavaScript

Software: Linux, Robot Operating System (ROS), Vim, L^AT_EX, Adobe Premiere Pro, Adobe Illustrator

ML: VAEs, diffusion models, flow matching, Gaussian processes, differentiable optimization, optimal transport

Robots: Unitree Go1, Jackal, AgileX Scout Mini, Franka Emika Panda, Rethink Sawyer, Trossen WidowX, TurtleBot3

MENTORING

- Olivia Li (B.S. student in Mechanical Engineering at Northwestern) *2025*
- Maia Traub (B.S. student in Mechanical Engineering at Northwestern, currently at Google) *2024*
- Srikanth Schelbert (M.S. student in Robotics at Northwestern, currently at Carnegie Mellon University) *2024*
- Katie Hughes (M.S. student in Robotics at Northwestern, currently at Boston Dynamics AI Institute) *2023*
- Meg Sindelar (M.S. student in Robotics at Northwestern, currently at Applied Research Associates, Inc.) *2023*
- Sophia Schiffer (B.S. student in Mechanical Engineering at Northwestern, currently at Focal Point) *2023*
- Bowen Feng (M.S. student in Robotics at Northwestern, currently at Princeton University) *2022*
- Tianyu Li (M.S. student in Robotics at Northwestern, currently at University of Pennsylvania) *2022*