

Max Muchen Sun

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EDUCATION

Northwestern University <i>Ph.D. in Mechanical Engineering (Robotics Specialization)</i> <i>M.Sc. in Mechanical Engineering (Robotics Specialization)</i> <i>Certificate in Research Communication</i>	Evanston, IL <i>Jan 2021 – Aug 2025 (Expected)</i> <i>Sep 2019 – Jan 2021</i> <i>Aug 2021</i>
Kellogg School of Management - Northwestern University <i>Certificate in Management for Scientists and Engineers</i>	Evanston, IL <i>Aug 2023</i>
Lanzhou University <i>B.Sc. in Computer Science</i>	Lanzhou, China <i>Sep 2015 – Jun 2019</i>

EXPERIENCE

Graduate Researcher Northwestern University <i>Advisor: Prof. Todd Murphey</i>	<i>Sep 2019 – Present</i>
<ul style="list-style-type: none">Conduct doctoral study on self-sufficient robotic intelligence with limited onboard and external resources.Developed a fast ergodic search algorithm for Lie groups and high-dimensional space using kernel functions. Tested the algorithm on a Rethink Sawyer robot for learning from human demonstrations.Developed a robust point cloud registration algorithm by constructing continuous volumetric fields. Tested the algorithm for real-time 3D object tracking with CAD models.Developed and prototyped a tree-search algorithm for fast on-board locomotion learning on a soft quadruped.Mentor 1-2 undergraduate or graduate students yearly. Maintain the lab server and the lab website.	
Researcher Northwestern University / Honda Research Institute <i>Advisors: Prof. Todd Murphey, Dr. Peter Trautman</i>	<i>June 2020 – Sep 2024</i>
<ul style="list-style-type: none">Full-stack development (perception, prediction, planning, design) of a human-aware robot navigation system in dense crowds with only onboard perception and computation.Developed algorithms to jointly predict human intent and plan robot paths under behavioral uncertainty, ensuring formal optimality guarantees using game theory. Conducted benchmark studies on real-world human datasets.Deployed the algorithm on a customized wheeled robot for large-scale real-world experiments in Santa Cruz, CA.Deployed the algorithm on an Nvidia Jetson AGX Orin and a Unitree quadruped.Developed an inverse game framework to infer agent objectives from observations, with agent decisions represented using generative trajectory models (conditional variational autoencoders).Co-wrote the white paper for the joint grant. Present at internal seminars. Prepare presentation slides and assist the project manager on the annual project report.	
Lecturer & Teaching Assistant Northwestern University	<i>Fall 2020, Spring 2023, Spring 2024</i>
<ul style="list-style-type: none">Participated in the curriculum and lecture design for “ME455: Active Learning for Robotics”, contents including Bayes filters, Monte Carlo methods, and generative models (Gaussian-mixture models, variational autoencoders).Gave lectures, created and graded homework assignments, and held office hours for “ME314: Machine Dynamics” and “ME455: Active Learning for Robotics”.	

PUBLICATIONS [[GOOGLE SCHOLAR](#)]

- [1] **M. Sun**, P. Trautman, and T. Murphey. “Inverse Mixed Strategy Games with Generative Trajectory Models.” (*Conference submission under review*), 2024.
- [2] **M. Sun**, A. Gaggar, P. Trautman, and T. Murphey. “Fast Ergodic Search with Kernel Functions.” (*Journal submission under review*), 2024. [[arXiv](#)]
- [3] **M. Sun**, F. Baldini, K. Hughes, P. Trautman, and T. Murphey. “Mixed Strategy Nash Equilibrium for Crowd Navigation.” *International Journal of Robotics Research (IJRR)*, 2024. [[Website](#) | [arXiv](#)]

- [4] 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)*. Detroit, MI, USA, 2023. [[arXiv](#)]
- [5] **M. Sun**, A. Pinosky, I. Abraham, and T. Murphey. “Scale-Invariant Fast Functional Registration.” In *The International Symposium of Robotics Research (ISRR)*. Geneva, Switzerland, 2022. [[Website](#) | [arXiv](#) | [Code](#)]
- [6] **M. Sun**, P. Trautman, and T. Murphey. “Human-Robot Pacing Mismatch.” In *RSS Workshop in Close-Proximity Human-Robot Collaboration*. New York City, NY, USA, 2022. [[arXiv](#)]
- [7] **M. Sun**, F. Baldini, P. Trautman, and T. Murphey. “Move Beyond Trajectories: Distribution Space Coupling for Crowd Navigation.” In *Robotics: Science and Systems (RSS)*. Virtual, 2021. [[arXiv](#) | [Code](#) | [Video](#)]

AWARDS & ACHIEVEMENTS

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

SERVICE & LEADERSHIP

- Reviewer** | Peer-Reviewed Academic Journals and Conferences *2021 – Present*
 • IJRR, T-RO, RA-L, IROS, ICRA, RO-MAN, ITSC
- Volunteer Museum Presenter** | Chicago’s Museum of Science and Industry *2022 – Present*
 • Presented current robotics research projects to the public during national robotics week.
- Volunteer Lab Tour Presenter** | Career Day for Girls at Northwestern University *2022 – Present*
 • Presented current robotics research projects to middle school and high school students from the Chicagoland area.
- Student Administrator** | Center of Robotics and Biosystems, Northwestern University *2021 – 2022*
 • Organized monthly meetings and communicated between faculty and students on administrative affairs.
- Chair of Career Development** | ME Graduate Student Society, Northwestern University *2021 – 2022*
 • Organized the monthly alumni talk to discuss career development with current graduate students.
 • Communicated graduate student feedback with the department and the advisory board.

SELECTED TALKS

- Hands-on Introduction to Ergodic Control** [[Website](#)] Yokohama, Japan
Tutorial on Ergodic Control at ICRA 2024 *May 2024*
- Social Crowd Navigation with NVIDIA Jetson** [[Recording](#)] San Jose, CA
NVIDIA GTC, Jetson Community Projects Showcase (Co-Presenter) *March 2024*
- Reasoning Over Flexibility for Social Navigation** [[Recording](#)] New York City, NY
Workshop of Close-Proximity Human-Robot Collaboration, Robotics: Science and Systems (RSS) *July 2022*
- Distribution Space Coupling for Crowd Navigation** [[Recording](#)] Virtual
Robotics: Science and Systems (RSS) Spotlight Talk *June 2021*

PATENTS

- [1] **M. Sun**, F. Baldini, P. Trautman, and T. Murphey. “Game-Theoretic Path Planning for Social Navigation.” (Provisional Patent Filed). Serial Number: 18/316856. 2023.

OPEN SOURCE SOFTWARE

- BRNE** [[GitHub](#)] Human-aware navigation with mixed strategy Nash equilibrium (PyTorch, C++, NVIDIA Jetson)
- DistNav** [[GitHub](#)] Toolbox for Game-Theoretic Distribution Space Crowd Navigation (Numba, JAX)
- FLS** [[GitHub](#) | [Demos](#)] 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)

SKILLS

Programming: Python (NumPy, Matplotlib, JAX, PyTorch, Numba), C++ (Eigen, Sophus, OpenMP, Ceres, PCL)

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

MENTORING

- Maia Traub (B.S. student in mechanical engineering, currently at Universal Creative) *2024*
- Srikanth Schelbert (M.S. student in robotics, currently at Carnegie Mellon University) *2024*
- Katie Hughes (M.S. student in robotics, currently at Boston Dynamics AI Institute) *2023*
- Tommy Li (B.S. student in mechanical engineering, currently at University of Pennsylvania) *2023*
- Meg Sindelar (M.S. student in robotics, currently at Applied Research Associates, Inc.) *2023*
- Sophia Schiffer (B.S. student in mechanical engineering) *2023*
- Bowen Feng (M.S. student in robotics, currently a Ph.D. student at Princeton University) *2022*
- Tianyu Li (M.S. student in robotics, currently a Ph.D. student at the University of Pennsylvania) *2022*