

# Yorai Shaoul, Ph.D. Student in Robotics

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## Education

- 2022 – present ■ **Ph.D., Carnegie Mellon University** Robotics Institute, School of Computer Science.  
I am researching algorithmic foundations for multi-robot systems [6], [8] and applying my work to **multi-arm manipulation** [2], [7], [8]. I focus on developing practical algorithms (realized efficiently in C++) and interleaving **data-driven flexible behaviors** with classical techniques for **task and motion planning** [1], [6].  
I am grateful to have Professors Maxim Likhachev and Jiaoyang Li as my advisors.
- 2017 – 2021 ■ **B.Sc. Massachusetts Institute of Technology** Electrical Eng. and Computer Science.  
Minor in mathematics and a focus on robotics via research and coursework. GPA  $\frac{4.9}{5.0}$ .

## Experience

- May-Sep 2025 ■ **Amazon Robotics** Applied Scientist II Intern - Movement Science.
- Researched planning and learning algorithms for multi-robot collaboration.
  - We focused on **discrete-continuous flow-matching co-generation** and anonymous **multi-robot motion planning**. PI: Federico Pecora.
- 2022 – present ■ **Carnegie Mellon Robotics Institute** Graduate Researcher and Teaching Assistant.
- Researching algorithms for multi-robot coordination and multi-arm manipulation.
  - Actively working with **diffusion-models**, MAPF algorithms, and **graph-search techniques for planning** and long-horizon decision making.
  - Assisting with teaching the graduate classes *Planning and Decision-Making in Robotics* (Fall 2024, Professor Maxim Likhachev) and *Multi-Robot Planning and Coordination* (Spring 2025, Professor Jiaoyang Li).
  - During the first year of my PhD, I worked on **large-scale learning** ( $\geq 50$  TB datasets) of fisheye monocular visual odometry under Professor Sebastian Scherer.
- 2021 – 2022 ■ **Indoor Robotics** Algorithm Engineer.
- I developed various aspects of aerial autonomous robots operating in the wild.
- My work spanned across the autonomy stack, including localization, mapping, and trajectory optimization using range, inertial, and visual inputs.
  - I was the technical lead in multiple **mapping** and visual/range **localization** projects. These drastically improved the efficiency of mapping new deployment sites (**minutes instead of days**) and opened up new markets for Indoor (by introducing visual localization signals to state estimation).
- 2018 – 2021 ■ **MIT CSAIL – Robust Robotics Group** Undergraduate Researcher.
- I conducted research under the guidance of Nicholas Roy and his students at MIT. Our projects mostly revolved around **computer vision**, some using deep learning and others with different gradient-based optimization methods. Notable projects:
- *Ellipsoid deformations for continuous and differentiable object shape estimation*, and
  - *Learned object-level visual data-association methods for object tracking and SLAM* [10].
- Jun-Sep 2020 ■ **Amazon Robotics** Research and Software-Development Intern.
- I worked tightly with research scientists and software engineers to develop and test new **large-scale multi-robot planning algorithms** for thousands of robots.
- Developed adaptive cost-map policies to reduce congestion in fulfillment centers.
  - Estimated warehouse efficiency increased by 13%.

## Experience (continued)

Jun-Sep 2019 ■ **Optimus Ride** Robotics Software Development Intern.

At Optimus Ride, an autonomous vehicle startup (acquired since), I developed new **techniques for motion planning and decision-making** in complex traffic scenarios leveraging semantic and geometric information.

- Certain improvements yielded an 80% decrease in planning time.
- My project was later incorporated into Optimus' production autonomy stack.

2019 ■ **MIT Research Laboratory of Electronics** Undergraduate Researcher.

Advised by Yoel Fink and his students.

- Developed and implemented real-time compression algorithms for in-fiber embedded data storage [9].

2016-2017 ■ **Tel-Aviv University Aerodynamics Laboratory** Research Assistant.

Designed, built, and tested active-flow drag-reducing contraptions for trucks.

## Research Publications

### Under Review

- 1 I. Mishani, **Y. Shaoul**, and M. Likhachev, "MOSAIC: A skill-centric algorithmic framework for long-horizon manipulation planning," under review, 2025. 🔗 URL: <https://arxiv.org/pdf/2504.16738>.
- 2 I. Mishani\*, **Y. Shaoul\***, R. Natarajan\*, J. Li, and M. Likhachev, "Srmp: Search-based robot motion planning library," under review for ICRA 2026. 🔗 URL: <https://srmp-lib.github.io>.
- 3 **Y. Shaoul**, Z. Chen, N. G. Mohamed, F. Pecora, M. Likhachev, and J. Li, "Collaborative Multi-Robot Non-Prehensile Manipulation via Flow-Matching Co-Generation," 2025. 🔗 URL: <https://gco-paper.github.io>.
- 4 R. Veerapaneni, A. Tang, H. He, *et al.*, "Conflict-based search as a protocol: A multi-agent motion planning protocol for heterogeneous agents, solvers, and independent tasks," 2025. arXiv: 2510.00425 [cs.MA]. 🔗 URL: <https://rishi-v.github.io/CBS-Protocol/>.

### Conference Proceedings

- 5 P. Huang, **Y. Shaoul**, and J. Li, "Benchmarking Shortcutting Techniques for Multi-Robot Arm Motion Planning," in *Proceedings of the IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, 2025. 🔗 URL: <https://philip-huang.github.io/mr-shortcut/>.
- 6 **Y. Shaoul\***, I. Mishani\*, S. Vats\*, J. Li, and M. Likhachev, "Multi-Robot Motion Planning with Diffusion Models," in *The Thirteenth International Conference on Learning Representations (ICLR)*. Also presented at the AAAI-25 Workshop on Multi-Agent Path Finding, **ICLR Spotlight (top 4%)**, 2025. 🔗 URL: <https://multi-robot-diffusion.github.io/>.
- 7 **Y. Shaoul\***, I. Mishani\*, M. Likhachev, and J. Li, "Accelerating Search-Based Planning for Multi-Robot Manipulation by Leveraging Online-Generated Experiences," in *Proceedings of the International Conference on Planning and Scheduling (ICAPS)*, **Winner: Best Student Paper**, 2024. 🔗 URL: <https://x-cbs.github.io>.
- 8 **Y. Shaoul\***, R. Veerapaneni\*, M. Likhachev, and J. Li, "Unconstraining Multi-Robot Manipulation: Enabling Arbitrary Constraints in ECBS with Bounded Sub-Optimality," in *Proceedings of the International Symposium on Combinatorial Search (SoCS)*, 2024.

### Journal Articles

- 9 G. Loke, T. Khudiyev, B. Wang, S. Fu, S. Payra, **Y. Shaoul**, J. Fung, I. Chatziveroglou, P.-W. Chou, I. Chinn, *et al.*, “Digital electronics in fibres enable fabric-based machine-learning inference,” ***Nature Communications***, vol. 12, no. 1, p. 3317, 2021.

## Other Papers

- 10 **Y. Shaoul**, K. Liu, K. Ok, and N. Roy, *Online Descriptor Enhancement via Self-Labeling Triplets for Visual Data Association*, 2020.

## Invited Talks

- 08-2025 ■ **Amazon Robotics** Multi-Robot Coordination and Collaboration with Generative Models.  
Host: Dr. Marcelo Kallmann.
- 04-2025 ■ **Technion** Multi-Robot Motion Planning with Diffusion Models.  
Host: Prof. Oren Salzman.
- 03-2025 ■ **University of Southern California** Multi-Robot Motion Planning with Diffusion Models.  
Host: Prof. Sven Koenig (online).

## Miscellaneous

- 2005-2021 ■ **Track and Field:** MIT team captain and triple jump record holder, NCAA (DIII) Indoor/Outdoor national champion, National team (ISR).

Code ■ C++, Python, PyTorch, ROS, ROS2, Docker, Java ...

CAD ■ Autodesk Inventor/Fusion 360, SolidWorks, Autodesk Eagle (PCB Design), 3D printing.