Lishuo Pan

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I work at the intersection of classical Planning/Control and Robotic Learning, building solutions that operate reliably for large-scale, physical systems.

PROFESSIONAL SUMMARY

- Real-time path and trajectory planning for 140+ robots with safety and optimality guarantees. Hybridize learning and adaptive control theory, improving 38g quadrotor performance in 18km/h wind within seconds.
- Robotic learning: imitation & reinforcement learning, PINN, and computer vision.
- Real-time physical robotic system integration using ROS (see my website for videos). High-performance C++ for search-based algorithms and optimization tools, such as IBM CPLEX, Gurobi for trajectory generation.
- First-authored publications and workshops at leading robotics and AI venues, including ICRA, IROS, RA-L, AAAI, MARS, DARS, and AAMAS.

EDUCATION

Ph.D. in Computer Science, **Brown University** — Providence, RI
Advised by Nora Ayanian — Aug. 2022 - May 2027 (Expected)
Committee: George Konidaris, Lorenzo Sabattini

M.S. in Computer Science, **University of Pennsylvania, GRASP Lab** — Philadelphia, PA
Co-advised by M. Ani Hsieh, Jianbo Shi — Sep. 2019 - May 2021
Activities: RA at GRASP Lab (2020-2022); Head TA for Advanced Computer Vision

B.S. in Statistics, **The Chinese University of Hong Kong** — Shenzhen, Guangdong
Co-advised by Feng Yin, Zhi-Quan Luo — Sep. 2015 - May 2019
Awards: First-class Honor, Undergraduate Research Awards, Dean's List

PUBLICATIONS

[1] Online Learning-Enhanced High Order Adaptive Safety Control, **L. Pan**, M. Catellani, T.C. Silva, L. Sabattini, N. Ayanian
Under Review at RA-L [Paper][Video]

- Continuously learning the residual model during physical quadrotor in-flight with online streaming data.
- Integrating the continuously learned neural network into a 100Hz adaptive CBF control loop, deployed on a physical quadrotor in real-time.
- Learning-hybrid controller captures turbulence within seconds of data, and pilots a 38g nano quadrotor to fly safely near obstacles against 18km/h wind.

[2] Hierarchical Large Scale Multirobot Path (Re)Planning, **L. Pan**, K. Hsu, N. Ayanian
IROS 2024 [Paper][Video]

[3] Hierarchical Trajectory (Re)Planning for a Large Scale Swarm, **L. Pan**, Y. Wang, N. Ayanian
arXiv Preprint 2025 [Paper][Video]

- A hierarchical search-based path planner that runs 200+ times faster than the SOTA MAPF planner with deadlock-free and sub-optimality guarantees.
- A high-level optimal routing constrains the number of robots entering each subspace. Parallel computing applies to each subspace for runtime optimization.
- A decentralized optimization-based motion planner generates Bézier-parametric trajectory, that tolerates optimization-failure and improves the motion planning success rate to near 100% for up 100 robots.
- Plan for 140+ robots in real-time simulation. Physical experiments with 24 quadrotors in an obstacle-rich environment. The algorithm demonstrates a near 100% success rate and runs in real-time for 140+ robots.

[4] Robust Trajectory Generation and Control for Quadrotor Motion Planning with Field-of-View Control Barrier Certification, **L. Pan**, M. Catellani, L. Sabattini, N. Ayanian
RA-L 2025, IROS 2026 [Paper][Video][Code]

* Solving continuous-time trajectory and control concurrently by integrating CBF constraints into one motion planning optimization. Combining the long-horizon planning and robust safe guarantee of CBF.
* Improving the long-tail safety problem in multi-robot system at the control level. The safe control optimization success rate increases from 92.98% to 98.01%.

[5] Learning to swarm with knowledge-based neural ordinary differential equations, T.Z. Jiahao*, **L. Pan***, M.A. Hsieh (*co-first authors)
ICRA 2022 [Paper][Video]

* Learning a decentralized controller that captures the underlying dynamics of a swarm using Neural ODEs via demonstration data from swarms.
* The learned controller is able to scale up to 50 agents and emerge Boids and SPP swarm behaviors.

[6] Marlas: Multi Agent Reinforcement Learning for Cooperated Adaptive Sampling, **L. Pan**, S. Manjanna, M.A. Hsieh
DARS 2022 [Paper][Video][Code]

* Propose a CTDE multi-agent reinforcement learning based decentralized policy that integrates the map geometrical *aprior* for a team of collaborative USVs for a collaborative sampling task.
* The collaborative controller reduces the trajectory overlap by 42.9% - 84.6% in different maps compared to baseline RL policy. The controller is robust to communication and robot failures and generalizes to unseen large-scale maps.

[7] Distributed Connectivity Maintenance and Recovery for Quadrotor Motion Planning, Y. Wang, Y. Qu, T. Wang, **L. Pan**, N. Ayanian
Under Review [Paper][Video]

[8] Developing the surgeon-machine interface: using a novel instance-segmentation framework for intraoperative landmark labelling, J.J. Park, N. Doiphode, X. Zhang, **L. Pan**, R. Blue, J. Shi, V.P. Buch
Frontiers in Surgery 2023 [Paper]

[9] Linear multiple low-rank kernel based stationary Gaussian processes regression for time series, F. Yin, **L. Pan**, T. Chen, S. Theodoridis, Z.Q. Luo, A.M. Zoubir
Transactions on Signal Processing 2020 [Paper]

[10] Sparse structure enabled grid spectral mixture kernel for temporal Gaussian process regression
F. Yin, X. He, **L. Pan**, T. Chen, Z.Q. Luo, S. Theodoridis
FUSION 2018 [Paper]

WORKSHOPS

[11] Robust Trajectory Generation and Control for Quadrotor Motion Planning with Field-of-View Control Barrier Certification, **L. Pan**, M. Catellani, L. Sabattini, N. Ayanian
AAMAS 2025

[12] Online Hierarchical Trajectory (Re)Planning for a Large Scale Swarm, **L. Pan**, Y. Wang, N. Ayanian
AAAI 2025

[13] Hierarchical Trajectory (Re)Planning for a Large Scale Swarm, **L. Pan**, Y. Wang, N. Ayanian
DARS 2024

[14] Rapid Large-scale Multi-Robot Path Replanning using Geometric Partitioning, **L. Pan**, K. Hsu, N. Ayanian
MRS 2023

TALKS

* **Brown IRL Lab** — Learning-hybrid Control Barrier Functions (Oct. 2025).
* **MIT SPARK Lab** — *Online Learning-enhanced Adaptive Control Barrier Functions* (Oct. 2025).
* **Drexel University** — *Integrating Trajectory Generation with Control Barrier Certification* (Mar. 2025).

* **Amazon Robotics** — *Hierarchical Trajectory (Re)Planning for a Large Scale Swarm* (Nov. 2024).
* **Brown Robotics Lab** — Learning Scalable Strategies for Swarm Robotic Systems (Sep. 2022).

REVIEW SERVICE

* International Journal of Robotics Research (IJRR)	2023
* IEEE Transactions on Robotics (T-RO)	2024, 2025
* IEEE Robotics & Automation Letters (RA-L)	2022, 2023, 2024, 2025
* IEEE International Conference on Robotics and Automation (ICRA)	2023, 2024, 2025
* IEEE International Conference on Intelligent Robots and Systems (IROS)	2024, 2025

SKILLS

Programming	C++, Python, MATLAB, LaTeX
APIs & Tools	PyTorch, CPLEX, Gurobi, CasADi, OpenCV, Git
Robotics Tools & Platforms	ROS, Bitcraze Crazyfile, Boston Dynamics Spot, custom-built quadrotors
Languages	Fluent in English, Native Speaker in Chinese