Yuwei Wu

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RESEARCH OVERVIEW

My research explores physically grounded AI for autonomous robots, together with dynamics-aware trajectory optimization and control to ensure safe, high-performance interaction with real-world environments. Key themes:

- Learning with embedded physical constraints and energy optimality
- Scalable motion planning and trajectory generation for heterogeneous teams
- Deployments in exploration, tracking, navigation, and embodied foundation-model settings

EDUCATION

University of Pennsylvania — Philadelphia, PA
Ph.D. in Electrical and Systems Engineering — *May 2022 - Present*
M.S.E. in Systems Engineering — *Sep 2019 - May 2022*
Adviser: **Vijay Kumar**
Thesis Committee: Vijay Kumar, Jonathan How, Pratik Chaudhari, Nikolai Matni

Beijing Jiaotong University — Beijing, China
B.E. Transportation Engineering — *Sep 2015 - Jun 2019*

The Hong Kong Polytechnic University — Hong Kong, China
Exchange Program in Industrial and Systems Engineering — *Sep 2018 - Dec 2018*

PUBLICATIONS

Journals

* co-first authors

[1]. **Yuwei Wu**, Igor Spasojevic, Pratik Chaudhari, Vijay Kumar, "Towards Optimizing a Convex Cover of Collision-Free Space for Trajectory Generation", in IEEE Robotics and Automation Letters, vol. 10, no. 5, pp. 4762-4769, May 2025, [paper] [video], present at 2025 GRASP Lab Summit , and will present at ICRA 2026

[2]. **Yuwei Wu**, Xiatao Sun, Igor Spasojevic and Vijay Kumar, "Deep Learning for Optimization of Trajectories for Quadrotors," in IEEE Robotics and Automation Letters (RA-L), vol. 9, no. 3, pp. 2479-2486, March 2024, [paper] [video], present at IEEE ICRA@40

[3]. Zhichao, Han*, **Yuwei Wu***, Tong Li, Lu Zhang, Liuao Pei, Long Xu, Chengyang Li et al. "An efficient spatial-temporal trajectory planner for autonomous vehicles in unstructured environments." in IEEE Transactions on Intelligent Transportation Systems (T-ITS), vol. 25, no. 2, pp. 1797-1814, Feb. 2024 [paper] [video]

[4]. Ankit Prabhu, Xu Liu, Igor Spasojevic, **Yuwei Wu**, Yifei Shao, Dexter Ong, Jiuzhou Lei, Patrick Corey Green, Pratik Chaudhari, Vijay Kumar, "UAVs for forestry: Metric-semantic mapping and diameter estimation with autonomous aerial robots." Mechanical Systems and Signal Processing 208 (2024): 111050 [paper]

[5]. **Yuwei Wu**, Ziming Ding, Chao Xu and Fei Gao, "External Forces Resilient Safe Motion Planning for Quadrotor," in IEEE Robotics and Automation Letters (RA-L), vol. 6, no. 4, pp. 8506-8513, Oct. 2021 [paper] [video]

Conferences

[1]. Zhehui Huang, Guangyao Shi, **Yuwei Wu**, Vijay Kumar, and Gaurav S. Sukhatme. "Compositional Coordination for Multi-Robot Teams with Large Language Models," 2025 IEEE International Symposium on Multi-Robot & Multi-Agent Systems [preprint]

[2]. **Yuwei Wu**, Yuezhan Tao, Peihan Li, Guangyao Shi, Gaurav S. Sukhatme, Vijay Kumar, Lifeng Zhou, "Hierarchical LLMs In-the-Loop Optimization for Real-Time Multi-Robot Target Tracking Under Unknown Hazards," 2025 IEEE International Symposium on Multi-Robot & Multi-Agent Systems [preprint]

[3]. Peihan Li, **Yuwei Wu**, Jiazhen Liu, Gaurav S. Sukhatme, Vijay Kumar, Lifeng Zhou, "Resilient Multi-Robot Target Tracking with Sensing and Communication Danger Zones," 2025 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS) (Best Paper Award Finalist) [preprint] [video]

[4]. Songhao Huang*, **Yuwei Wu***, Yuezhan Tao, Vijay Kumar, "Safe Interval Motion Planning for Quadrotors in Dynamic Environments," 2025 IEEE International Conference on Robotics and Automation (ICRA), pp. 2780-2786. IEEE, 2025. [paper] [video]

[5]. Anish Bhattacharya, Nishanth Rao, Dhruv Parikh, Pratik Kunapuli, **Yuwei Wu**, Yuezhan Tao, Nikolai Matni, Vijay Kumar, "Vision Transformers for End-to-End Vision-Based Quadrotor Obstacle Avoidance," 2025 IEEE International Conference on Robotics and Automation (ICRA), Atlanta, GA, USA, 2025, pp. 1-8 [paper]

[6]. **Yuwei Wu**, Yuezhan Tao, Igor Spasojevic, and Vijay Kumar. "Trajectory Optimization with Global Yaw Parameterization for Field-of-View Constrained Autonomous Flight," 2024 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), Abu Dhabi, United Arab Emirates, 2024, pp. 10590-10596 (Selected Oral Presentation)[paper] [preprint] [video]

[7]. Jiazhen Li, Peihan Li, **Yuwei Wu**, Gaurav S. Sukhatme, Vijay Kumar, Lifeng Zhou. "Multi-Robot Target Tracking with Sensing and Communication Danger Zones," 2024 International Symposium on Distributed Autonomous Robotic Systems (Best Paper Nomination) [preprint] [video]

[8]. Yifei Simon Shao*, **Yuwei Wu***, Laura Jarin-Lipschitz*, Pratik Chaudhari, Vijay Kumar, "Design and Evaluation of Motion Planners for Quadrotors with Varying Complexities," 2024 IEEE International Conference on Robotics and Automation (ICRA), Yokohama, Japan, 2024, pp. 10033-10039 [paper] [preprint] [video]

[9]. Yuezhan Tao, **Yuwei Wu**, Beiming Li, Fernando Cladera, Alex Zhou, Dinesh Thakur, Vijay Kumar, "SEER: Safe Efficient Exploration for Aerial Robots using Learning to Predict Information Gain," 2023 IEEE International Conference on Robotics and Automation (ICRA), London, United Kingdom, 2023, pp. 1235-1241 [paper] [preprint] [video]

Preprints

[1]. Guangyao Shi, **Yuwei Wu**, Vijay Kumar, and Gaurav S. Sukhatme. "PIP-LLM: Integrating PDDL-Integer Programming with LLMs for Coordinating Multi-Robot Teams Using Natural Language," 2025 [preprint].

[2]. Xiaofan Yu, **Yuwei Wu**, Katherine Mao, Ye Tian, Vijay Kumar, Tajana Rosing. "DroneFL: Federated Learning for Multi-UAV Visual Target Tracking," 2025 [preprint]

[3]. Songhao Huang*, **Yuwei Wu***, Guangyao Shi, Gaurav S. Sukhatme, and Vijay Kumar. "SPAR: Scalable LLM-based PDDL Domain Generation for Aerial Robotics," 2025 [preprint]

[4]. Xiatao Sun, **Yuwei Wu**, Subhrajit Bhattacharya, Vijay Kumar, "Multi-Agent Exploration of an Unknown Sparse Landmark Complex via Deep Reinforcement Learning," 2022 [preprint]

[5]. Xingguang Zhong, **Yuwei Wu**, Dong Wang, Qianhao Wang, Chao Xu, Fei Gao, "Generating Large Convex Polytopes Directly on Point Clouds," 2020 [preprint]

Workshops and Posters

[1]. **Yuwei Wu**, Igor Spasojevic, Pratik Chaudhari, Vijay Kumar, Optimal Convex Cover as Collision-free Space Approximation for Trajectory Generation, WAFR 2024 [poster]

[2]. Jiazhen Liu, Peihan Li, **Yuwei Wu**, Vijay Kumar, Lifeng Zhou, Risk-Aware Multi-Robot Target Tracking with Dangerous Zones, 2023 IROS IPPC Workshop

[3]. Peihan Li, Jiazhen Liu, **Yuwei Wu**, Vijay Kumar, Lifeng Zhou, Resilient multi-robot target tracking with dangerous zones, 2023 IROS Workshop: Robotics for Climate Resiliency

[4]. Fernando Cladera*, **Yuwei Wu***, Xu Liu, Yuezhan Tao, Ian D. Miller, Camillo Jose Taylor, Vijay Kumar, Open Source Tools for Deployment of GPS-Denied Autonomous UAVs in Real-World Application, ICRA 2023 Workshop Lab-to-Real Gap [abstract]

Invited Talks

[1]. *Implicit Learning of Riemannian Polynomials for Quadrotor Trajectory Optimization* — *Oct 2025*
2025 INFORMS Annual Meeting

[2]. *Building Resilient and Efficient Robot Autonomy* — *Sep 2025*
RGSO - CARS Seminar, University of Delaware

[3]. *Real-Time Spatiotemporal Motion Planning for Autonomous Robots* — *Mar 2025*
ESE PhD Colloquium, University of Pennsylvania [abstract]

[4]. *Learning Optimal Trajectories for Quadrotors* — *Jan 2024*
Invited Talk, Nikolai Matni Group, University of Pennsylvania

Media

[1]. *Summit for AI Institutes Leadership (SAIL) 2025, two early career representatives to showcase their work* — *Nov 4, 2025*
TILOS Newsletter, Fall 2025

[2]. *Research Showcase to the HCE Academy* — *Aug 18, 2025*
GRASP Social Media

[3]. *The GRASP Lab Goes to ICRA 2025* — *May 16, 2025,*
GRASP Lab Presents

[4]. *The GRASP Lab Goes to RSS 2025* *June 9, 2025*
GRASP Lab Presents

[5]. *Robots in the Reading Room: GRASP Lab Brings Hands-On STEM to Roxborough Library* *April 14, 2025*
Penn Engineering Today

PROFESSIONAL ACTIVITIES

Research Involvement in Grants

- U.S. National Science Foundation (NSF) Institute for Learning-enabled Optimization at Scale *2022 -*
- Semiconductor Research Corp. (SRC) Jump C-BRIC - Center for Brain-inspired Computing *2021-2022*

Academic Service

- Editor:
  - Topical Collection in Autonomous Robots (Guest Editor): Leveraging Implicit Representations for Learning-Enabled Autonomous Flight *2025*
- Session Chair:
  - INFORMS Annual Meeting: Invited session on Intelligent and Safe Autonomy for Aerial Systems under the Air Transportation Section (ATS) track *2025*
- Workshop Organizers:
  - Robotics: Science and Systems (RSS): 1st Workshop on Leveraging Implicit Methods for Aerial Autonomy *2025*
- Journals Reviews:
  - Autonomous Robots *2025 -*
  - Journal of Field Robotics *2025 -*
  - *IEEE Transactions on Vehicular Technology (T-VT)* *2025 -*
  - The Journal of Supercomputing *2025 -*
  - The Journal of the Astronautical Sciences *2025 -*
  - IEEE Transactions on Robotics (T-RO) *2024 -*
  - IEEE Transactions on Automation Science and Engineering (T-ASE) *2024 -*
  - IEEE Robotics and Automation Letters (RA-L) *2022 -*
  - IET Cyber-Systems and Robotics (CSR) *2021 -*
- Conference Reviews:
  - Robotics: Science and Systems (RSS) *2025 -*
  - IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS) *2024 -*
  - IEEE International Conference on Robotics and Automation (ICRA) *2023 -*

Public Service

- Gave a talk on "Flying Robot Swarms" at Roxborough Library *Apr 2025*
- Gave a talk on "How robots find their way" at Roxborough Library "Fun With Robots" program *Apr 2024*
- Judge for VEX Robotics Competition *Feb 2020*
- Assistant referee in 2nd World Robot Conference *Aug 2018*

Department Service

- Leader of ESE PhD Association *Aug 2023 -*
- Multi-robot Planning Demo Experiments for ICRA 2022 GRASP Lab Tour *May 2022*
- Kumar Lab Demo for PhD Open House GRASP at PERCH Tour *Mar 2022*

EXPERIENCE

Teaching Assistant
School of Engineering and Applied Science, University of Pennsylvania *Jul 2020 - May 2024*

- MEAM 620: Advanced Robotics (Spring 2022, 2023, 2024), design final projects with local motion planners for quadrotors using replanning strategies.
- ESE 542: Statistics for Data Science (Fall 2021).
- MEAM 520: Introduction to Robotics (Summer 2020, Fall 2025), with a focus on manipulator.

Graduate Research Assistant
Kumar Lab, GRASP, University of Pennsylvania *Aug 2021 – May 2022*

- Work on motion planning for heterogeneous swarms in the dense environment, and multi-agent planning framework with coordination localization and drift elimination using semantic information.

Field Autonomous System & Computing Lab (FAST), Zhejiang University *Jul 2020 – Aug 2021*

- Implemented a sum-of-squares trajectory optimization for quadrotors based on the application of safe flight corridors directly generated on point clouds.
- Proposed a systematic (re)planning framework that considers estimated external forces on quadrotors. Developed an online nonlinear model predictive control with safe ellipsoid boundaries constrained in a safe flight corridor to enforce reliable obstacle avoidance.
- Research on whole-body safe trajectory generation for autonomous vehicles in the urban traffic environment. The back-end optimization is based on a differential-flat system while encoding dynamic obstacle avoidance with surrounding vehicles.

LiDAR Algorithm Engineer Internship
UISEE Technology (Beijing) Ltd *Dec 2018 - Apr 2019*

- Improved a multiple objects assignment algorithm for tracking trajectories in autonomous driving
- Developed an evaluation tool for the performance of different MOT methods with leak detection on daily logs
- Implemented feature analysis on point cloud to repair errors on parameters and keep consistency of object IDs

HONORS AND AWARDS

Oral Highlights at the ICRA 2025 Doctoral Consortium	*2025*
The Dean's Fellowship	*2022*
Outstanding Undergraduate Student (*by Beijing Jiaotong University*)	*2019*
Honorable Mention of 2018 Mathematical Contest in Modeling	*2018*
Science Innovative Talent (*by Beijing Jiaotong University*)	*2018*
First Prize of the 10th Undergraduate Physical Experiment Competition of Beijing	*2017*
Second Prize of the 8th China Undergraduate Physicists' Tournament	*2017*
Second Prize of the 7th Transportation Technique Competition of Beijing	*2017*
First Prize of the 8th Undergraduate Mathematics Competition of China	*2016*
First Prize of the 33rd Undergraduate Physical Competition in China	*2016*

MENTORING

Graduate Student
Jinyuan Zhang, ROBO MSE, UPenn *Jun 2025 -*

- (Ongoing) Research on "Adaptive Multi-Robot Formation Planning in Constrained Environments"

Songhao Huang, MEAM MSE, UPenn → Ph.D, The Hong Kong Polytechnic University *Oct 2023 - Jul 2025*

- Dynamic obstacle avoidance project with a paper titled "Safe Interval Motion Planning for Quadrotors in Dynamic Environments" published at ICRA 2025.

Xiatao Sun, ROBO MSE, UPenn → Ph.D, Yale University *May 2022 - Aug 2023*

- Master Thesis on "Imitation Learning for Autonomous Quadrotor Flight"
- Learning trajectory with optimization layers with a paper titled "Deep Learning for Optimization of Trajectories for Quadrotors" published at RA-L.
- Research on "Multi-Agent Exploration of an Unknown Sparse Landmark Complex via Deep Reinforcement Learning".

TECHNICAL SKILLS

Languages: C++, Python, Matlab
Tools: ROS, Pytorch, JAX, VLM/LLM, Git, Linux, Docker
Simulations: Gazebo, Airsim, Unity, Carla