

Amin Yazdanshenas

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Status: Open Work Permit Holder

Research Interests

Embodied AI and Physical AI, Robot Learning, Vision-Language and Multimodal Systems, Reinforcement Learning and Imitation Learning, Spatial AI, Autonomous Robotic Systems, World Models and Reasoning for Robotics, Simulation-to-Real Transfer, Motion Planning and Low-Level Control, State Estimation and Sensor Fusion

Education

- May 2022 – May 2026 PhD, Aerospace Engineering**
Department of Aerospace Engineering, Toronto Metropolitan University, Canada
GPA: 4.3/4.3 (A⁺)
Thesis: Unwinding-Free Quaternion-Based Sliding Mode Control for Agile Quadrotor Flight
Advisor: Dr. Reza Faieghi
- Sep 2019 – Jan 2022 MSc, Aerospace Engineering**
Department of Aerospace Engineering, Amirkabir University of Technology (Tehran Polytechnic)
GPA: 4.0/4.0
Thesis: Design and Implementation of Guidance Algorithms for Quadrotor Formation Flight in Indoor Environments
Advisor: Dr. Abolghasem Naghash
- Sep 2015 – Sep 2019 BSc, Aerospace Engineering**
Department of Aerospace Engineering, Amirkabir University of Technology (Tehran Polytechnic)
GPA: 3.4/4.0
Thesis: Intelligent Multi-Rotor Racing Simulation in ROS/Gazebo Using Deep Reinforcement Learning

Selected Projects in Embodied AI and Robot Learning

Local LLM-Driven 6-DoF Robotic Manipulation with ROS2 and 3D Vision

Implemented a ROS2-based robotic manipulation pipeline that integrates a locally deployed LLM via Ollama with 3D vision perception to interpret natural-language commands, reason about object-level tasks, and generate executable motion commands for a robotic arm for pick-and-place tasks.

Autonomous Drone Racing with Isaac Sim and Isaac Lab

Developed an end-to-end reinforcement learning pipeline for autonomous drone racing in NVIDIA Isaac Sim / Isaac Lab using PPO. Designed simulation environments,

reward functions, observation and action spaces, and evaluation protocols for high-speed navigation through racing gates.

Dual-Arm Space Robotic Manipulation with Deep Reinforcement Learning

Developed a PyBullet-based dual-arm robotic manipulation framework using PPO and SAC for coordinated target reaching, collision avoidance, and noisy-observation robustness. Designed task-specific reward functions, multi-objective evaluation metrics, and randomized test scenarios.

Photorealistic SITL Pipeline for Spatial AI and Autonomous Navigation

Built Unreal Engine / AirSim / PX4 SITL simulation infrastructure for autonomous UAV navigation, integrating visual-inertial SLAM (ORB-SLAM3) and sensor-realistic simulation for evaluating perception, localization, and control algorithms in GPS-denied environments.

Professional Experience

Jan 2022 – Present

Graduate Research Assistant

Autonomous Vehicles Laboratory (AVL), Toronto Metropolitan University

Advisor: Dr. Reza Faieghi

- Designed and implemented advanced flight control architectures for autonomous multirotor and tiltrotor UAVs; see Research Experience for full technical detail.
- Built high-fidelity simulation infrastructure (Unreal Engine, AirSim, PX4 SITL) for rigorous validation of navigation and control algorithms.

Sep 2019 – Jan 2022

Graduate Research Assistant

Micro Air Vehicle Laboratory, Amirkabir University of Technology

Advisor: Dr. Abolghasem Naghash

- Developed guidance, navigation, and control pipelines for quadrotor formation flight, integrating computer vision, SLAM, and reinforcement learning; see Research Experience for full technical detail.
- Validated algorithms in MATLAB/Simulink and ROS/Gazebo simulation environments.

Sep 2022 – Present

Teaching Assistant

Aerospace Engineering & Mathematics Departments, Toronto Metropolitan University

- Supported undergraduate instruction in Aerodynamics, Thermodynamics, Flight Dynamics, and Probability.
- Led laboratory sessions, tutorials, and **evaluated student performance** in core engineering courses.

Sep 2019 – Jun 2021

Aerospace Engineer

HANA Systems Co., Tehran, Iran

- Applied **system identification techniques** (output-error, Kalman filtering) for aerodynamic parameter estimation.
- Implemented **secure communication protocols** using ChaCha20–Poly1305 (AEAD) in Python and C.

Research Experience

May 2022 – May 2026 **PhD Candidate**

Toronto Metropolitan University, Toronto, ON

Advisor: Dr. Reza Faieghi

- **Autonomous Drone Racing:** Developed an autonomous drone racing agent in NVIDIA Isaac Sim using Isaac Lab, trained end-to-end with Proximal Policy

Optimization (PPO) reinforcement learning for high-speed navigation through racing gates.

- **Robust Control Synthesis:** Engineered advanced flight control architectures, including Adaptive Robust Dynamic Tube MPC and Terminal Sliding Mode Control (TSMC), for 6-DOF autonomous quadrotors under aerodynamic disturbances.
- **Novel Controller Development:** Synthesized and implemented Adaptive Quaternion-based Terminal Sliding Mode Control (AQTSMC) achieving finite-time convergence and enhanced robustness against parametric uncertainties.
- **Hybrid Architectures:** Designed a Composite LMPC-SMC and NLMPC-SMC architecture for trajectory tracking, leveraging Model Predictive Control for optimal path planning and Sliding Mode Control for disturbance rejection.
- **Optimal Control & Allocation:** Formulated a Nonlinear Model Predictive Control (NMPC) strategy for tiltrotor quadrotors, integrating a feasible control allocation algorithm to manage over-actuation and actuator constraints effectively.
- **High-Fidelity Simulation:** Developed a UAV simulation framework using Unreal Engine and AirSim, integrated with PX4 SITL for realistic flight dynamics and visual-inertial SLAM (ORB-SLAM3).
- **Fault-Tolerant Control:** Conducted comparative analyses of LQR, MPC, and NLMPC methods for attitude control, optimal control allocation, and actuator/sensor fault scenarios.
- **State Estimation:** Implemented Descriptor Adaptive observers to estimate sensor faults and observe spacecraft states in non-ideal conditions.
- **Swarm Intelligence:** Investigated swarm flight capabilities of nano-quadrotors in indoor environments for collaborative task execution.

Sep 2015 – Sep 2021

Research Assistant

Amirkabir University of Technology (Tehran Polytechnic), Tehran, Iran

Advisor: Dr. Abolghasem Naghash

- **Guidance Laws:** Formulated and implemented guidance algorithms for quadrotors' formation flight in complex indoor environments.
- **Computer Vision:** Integrated Lucas-Kanade and Dense optical flow techniques to detect moving objects and estimate relative velocities.
- **Dynamic Modeling:** Modeled nonlinear dynamics and implemented position/attitude control using sliding mode control in MATLAB/Simulink and ROS/Gazebo.
- **Navigation Algorithms:** Simulated proportional navigation (TPN, ATPN, IPN), command guidance (CLOS), and beam-riding (LOSBR) algorithms for aerial interception.
- **Trajectory Optimization:** Optimized lunar soft landing trajectories using the direct collocation method for fuel-efficient descent.
- **Stabilization Systems:** Developed dynamics modeling and control for an unmanned bicycle utilizing a gyroscopic stabilizer for lateral balance.
- **Reinforcement Learning:** Applied Deep Deterministic Policy Gradient (DDPG) reinforcement learning for robust line-following quadrotors.
- **Target Tracking:** Trained and deployed YOLOv3 models for real-time human detection and following scenarios.
- **SLAM & Mapping:** Developed 2-D SLAM for quadrotor navigation and modeled physical platforms within the ROS/Gazebo environment.
- **Vehicle Design:** Designed quadrotor airframes and performed multi-disciplinary CAD modeling for VTOL aerial vehicles.
- **Flight Simulation:** Developed high-fidelity 6DOF simulations for Boeing 737

aircraft in MATLAB/Simulink.

- **Numerical Methods:** Built finite-element numerical algorithms for 2D Poisson's equations and fourth-order ODE solvers using Python and MATLAB.

Academic Service

- Sep 2023 – Aug 2024** **PhD Student Representative, Graduate Program Council**
Represented PhD student interests in program development and policy discussions
Aerospace Engineering Department, Toronto Metropolitan University
- Feb 2024 – Jun 2024** **Member, Equity, Diversity, and Inclusion (EDI) Committee**
Collaborated on initiatives to promote equity and inclusion within the department.
Aerospace Engineering Department, Toronto Metropolitan University
- Winter 2026** **Chairperson, AER870 Undergraduate Seminar**
Aerospace Engineering Department, Toronto Metropolitan University
- Peer Reviewer**
IEEE International Conference on Robotics and Automation (ICRA 2026)
IEEE International Conference on Automation Science and Engineering (CASE)
IEEE Access, IEEE Transactions on Field Robotics

Publications

Bibliometrics (Google Scholar): 29 citations | h-index: 3 | i10-index: 1

Peer-Reviewed Journal Papers

Selected Highlights: First-author publications in *IEEE Transactions on Robotics* (2025) and *IROS* (2024)

- J3 **A. Yazdanshenas** and R. Faieghi, "Robust and Agile Quadrotor Flight via Adaptive Unwinding-Free Quaternion Sliding Mode Control," *IEEE Transactions on Robotics*, 2025.
- J2 Z. Shayan, J. Cristobal, M. Izadi, **A. Yazdanshenas**, M. Naderi, and R. Faieghi, "Nonlinear Model Predictive Control of Tiltrotor Quadrotors Using Feasible Control Allocation," *Journal of Intelligent & Robotic Systems*, vol. 111, no. 2, p. 54, 2025.
- J1 S. Mobeen, J. Cristobal, S. Singoji, B. Rassas, M. Izadi, Z. Shayan, **A. Yazdanshenas**, and R. Faieghi, "Neural Moving Horizon Estimation: A Systematic Literature Review," *Electronics*, vol. 14, no. 10, p. 1954, 2025.

Refereed Conference Proceedings

- C6 S. Mobeen, **A. Yazdanshenas**, and R. Faieghi, "Computationally Efficient Moving Horizon Estimator for Linear Time-Invariant Systems," *Proc. IEEE 21st Int. Conf. on Automation Science and Engineering (CASE)*, 2025.
- C5 **A. Yazdanshenas** and R. Faieghi, "Quaternion-Based Sliding Mode Control for Six Degrees of Freedom Flight Control of Quadrotors," *Proc. IEEE/RSJ Int. Conf. on Intelligent Robots and Systems (IROS)*, Abu Dhabi, UAE, 2024.
- C4 **A. Yazdanshenas**, N. Fallahiarezoodar, and R. Faieghi, "Photorealistic Software-in-the-Loop Simulation Framework for Autonomous Navigation of Uncrewed Aerial Vehicles," *Proc. CSME/CFD Joint Conference*, Toronto, Canada, 2024.
- C3 S.H. Mirtajadini, N. Kakhsaaz M., **A. Yazdanshenas**, S. Sutouni, and A. Naghash, "Urban Obstacle Detection and Avoidance Using a Monocular Camera for Delivery Multi-Rotors," *Proc. Iranian Aerospace Society Conf.*, Tehran, Iran, 2020.

- C2 H. Nemati, S.H. Mirtajadini Goki, **A. Yazdanshenas**, and J. Taylor, “Fast Vision-Based Line Following Scheme for a Micro Aerial Vehicle in Nuclear Environments,” *Proc. IEEE NSS/MIC*, Manchester, UK, 2019.
- C1 H. Nemati, S.H. Mirtajadini, and **A. Yazdanshenas**, “Robust Attitude Stabilization of a Track-Follower Micro Aerial Vehicle Using a Vision-Based Sensor,” *Proc. Korolev’s Readings*, Samara, Russia, 2019.

Awards and Honors

- 2024** **TA/GA Equity and Inclusion Award**
Associated with Toronto Metropolitan University, CUPE 3904
- 2019** **1st Place in MathWorks Minidrone Competition**
MATLAB EXPO 2019 UK, Silverstone Circuit, United Kingdom
- 2018** **3rd Place in Drone-Emergency Service**
23rd FIRA RoboWorld Cup 2018, Taichung, Taiwan
- 2017** **1st Place in Virtual Drone Challenge**
9th International Micro Air Vehicle Conference and Competition (IMAV), Toulouse, France

Skills

- Robot Learning / Physical AI** PPO, SAC, DDPG; Isaac Sim, Isaac Lab, PyBullet; reward design, observation/action space design, simulation-to-real evaluation, policy evaluation; reinforcement learning.
- Perception / Spatial AI** ORB-SLAM3, visual-inertial SLAM, optical flow (Lucas–Kanade, Dense), OpenCV, YOLOv3, sensor fusion, RGB-D/stereo simulation.
- Flight Control & Systems** MPC (LMPC/NLMPC), Sliding Mode Control (SMC/TSMC/AQTSMC), LQR, Control Barrier Functions (CBF); fault-tolerant control, state estimation, adaptive observer design.
- Deep Learning & Programming** PyTorch, TensorFlow; C/C++, Python (NumPy, SciPy), Rust, MATLAB/Simulink; Ollama, llama.cpp; Claude Code (AI-assisted development).
- Robotics & Tools** ROS/ROS2, PX4 Autopilot, MAVROS, Crazyflie Firmware, Crazyswarm2; AirSim, Unreal Engine 4/5, Gazebo; Linux (Ubuntu/WSL), Docker, Git, Acados.
- Additional** L^AT_EX, Adobe Creative Suite, Blender, Microsoft Office; Persian (Native), English (IELTS 7.0).