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https://utat-adr.github.io/

Autonomous Drone Racing

Autonomy Team Profile

2024 - 2025

UNIVERSITY OF TORONTO | Robotics Institute

About Us

Autonomous Drone Racing (ADR) is a robotics team within the University of Toronto Aerial Team (UTAT). Formed by passionate roboticists, drone enthusiasts, graduate/undergraduate engineering students with a shared ambition: to build the fastest autonomous racing drone in the world capable of reliability outflying human pilots.

We compete at international autonomous drone racing competitions including the upcoming one hosted by A2RL, the Abu Dhabi Autonomous Racing League, in April 2025, which requires an FPV drone equipped with camera and onboard computer to autonomously pass through a sequence of gates in clustered environments with shortest time possible.

We're affiliated with UofT Institute for Aerospace Studies (UTIAS), Flight Systems and Control Lab (FSC), Learning System and Robotics Lab (LSY), and UofT Robotics Institute.

Meet Our Team Members

Hugh H.-T. Liu
Professor
Team Supervisor

Chao Qin
PhD Student
Control & Planning

Longhao Qian
Postdoctoral Fellow
Control & Planning

Joshua Choi
BASc EngSci 2T7
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Jessica Liu
MASc
Business & Media

Angela Schoellig
Professor
Team Supervisor

Ivan Lin
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Localization & Infrastructure

Wenda Zhao
PhD Student
Perception & Localization

Harry Chen
BASc EngSci 2T6
Simulation & Perception

Aoran Jiao
MASc Student
Perception & Localization

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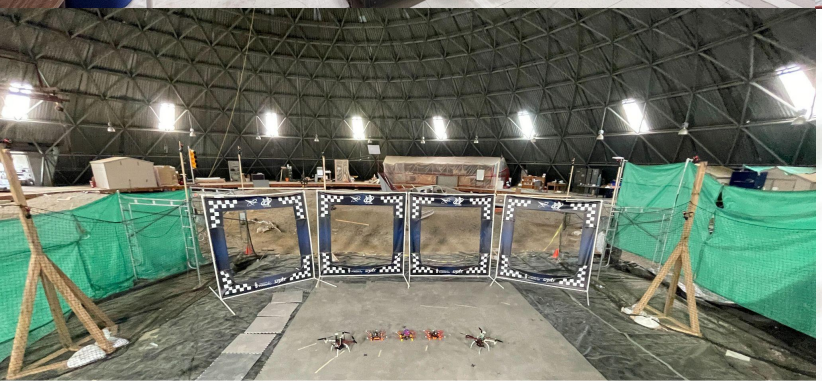
UTAT UAS



Our Resources

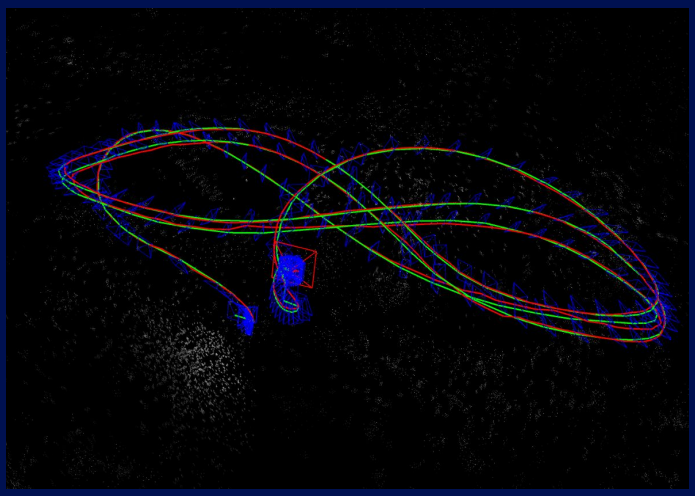
- Drone assembly and testing facility provided by FSC at UTIAS and UTAT at Myhal.
- Motion capture room equipped with VICON system provided by LSY at UTIAS and Myhal provided by Robotics Institute.
- Large-scare flight testing arena at the UTIAS Mars Dome featuring Optitrack motion capture system.
- Four autonomous racing drones equipped with latest NVIDIA Jetson Orin computers and cameras for intelligent flight.
- Access to GPU clusters for machine learning provided by Digital Research Alliance of Canada.

Past & Current Projects

Time-Optimal Gate-Traversing Planner

We developed a time-optimal planner that can faithfully model gate constraints with various configurations and thereby generate a more time-efficient trajectory while considering the single-rotor-thrust limits.

ICRA 2024 Best Paper Award on UAV.



Direct Sparse Odometry at High Speed

We optimize Direct Sparse Odometry (DSO) specifically for high-speed drone racing, focusing on improving both performance and accuracy in dynamic, fast-paced environments. Reliable VIO is crucial for achieving precise navigation and stability during intense racing conditions

Model Predictive Contouring Control

We utilize model-based optimal control algorithms to ensure reliable navigation amid wind disturbances. By combining model-based strategies with real-world data, the controllers should effectively handle high-speed maneuvers and unpredictable wind conditions.

Past & Current Projects

3D Reconstruction using Gaussian Splatting

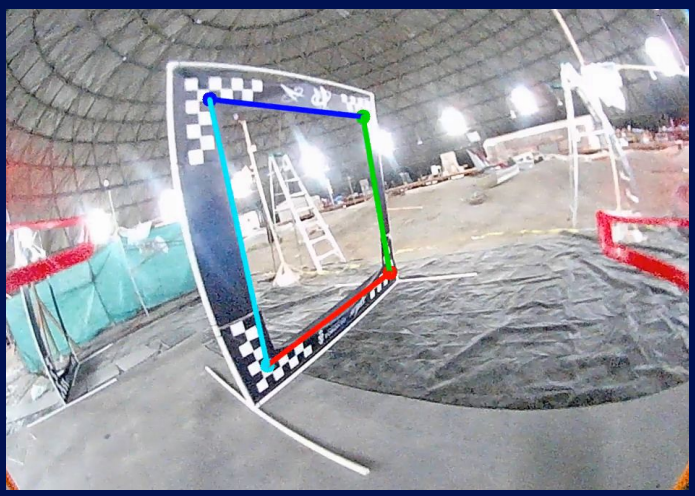
We develop deep learning-enhanced gate perception methods specifically for high-speed drone racing. Effective and real-time gate detection during rapid maneuvers presents a significant challenge, and we need to provide robust solutions to meet this need.

High Fidelity Drone Racing Simulator

We develop a high fidelity photorealistic drone racing simulation environment based on the FlightGoggles simulator. This virtual-reality environment enables us to develop and validate our algorithms and learning methods.

Learning-Enhanced Gate Perception

We utilize Convolutional Neural Network to detect gate corners and estimate the pose of the gate using Infinitesimal Plane-Based Pose Estimation. This fused with VIO result using an Error State Kalman Filter helps us reduce drift in localization.



CONTACT US

Looking to reach out?
We're looking forward to hearing from you!

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