Derek Fan

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Education

University of California, Irvine – Irvine, CA Sept. 2020 – June 2024
Bachelor of Science in Mechanical Engineering *GPA: 3.6/4*

Anticipated Master of Science in Robotics & Control Aug. 2024 – June 2026

Technical Skills

Relevant Languages and Frameworks: Python, MATLAB, C++, ROS
Developer Tools and Platforms: Git, Linux, Windows
Engineering Tools: SolidWorks, Pixhawk, Ardupilot, PX4
Additional Relevant Skills: Model-Based Control, Classical Control, Dynamics, State Estimation, CAD

Experience

Safety-Critical Adaptive Control Research – Multirotor-Payload Trajectory Tracking May 2023 – Present
Undergraduate Researcher *Irvine, CA*

- Benchmarking adaptive control barrier function (aCBF) against L1 for quadrotor trajectory tracking with unknown payloads. Investigating aCBF's adaptation and safety guarantees in the context of drone package delivery.
- Formulated nonlinear quadrotor dynamics model from Newton-Euler and Euler-Lagrange equations.
- Applied a SQP approximation of nonconvex optimization for fast real-time nonlinear model predictive control.
- Developed a lightweight Python quadrotor simulator to expedite controller prototyping and verification. Utilized it to debug and tune a custom controller 5x faster than with more cumbersome simulators (Gazebo, Nvidia Isaac).

Johnson & Johnson Robotics and Digital Solutions June 2023 – Sept. 2023
Systems Engineering Intern *Santa Clara, CA*

- Built and deployed a CAN analysis Python package that allowed engineers to interpret CAN frames, catch missing frames, and generate timestamped logs in real time. Accelerated robot troubleshooting efforts by 300%.
- Designed and manufactured a weighted fixture within specified constraints for robot arm verification. Verified the fixture with finite element analysis and formalized the arm acceptance test that did not previously exist.
- Introduced parallel processing, more efficient matrix computations, and code refactorization for the in-house vision verification app in Python. Effectively increased its usability for offline image signal processing analysis by 300%.

UAV Forge Autonomous Drone Team Oct. 2021 – Sept. 2023
Lead GN&C Engineer *Irvine, CA*

- Architected the team's first software framework for online planning using ROS2, Python, and C++. Demonstrated its use in simulation and real-life flight, increasing the team's relevance in the SUAS competition by 200%.
- Developed an algorithm to transform RealSense depth images to points in an inertial coordinate frame. Applied camera intrinsic on depth images to generate 3D point clouds. Executed DBSCAN clustering to obtain cluster centroids and dimensions. Utilized sensor feedback to observe the camera's orientation and rotate points into the inertial coordinate frame. Optimized point cloud processing parameters to decrease runtime by 50%.
- Created a heading control obstacle avoidance algorithm to take in 3D point cloud input. Integrated the avoidance algorithm into the online planning framework and optimized calculations to decrease runtime by 90%.
- Improved the drone's performance by tuning sensor/Kalman filter parameters and PID controller, bringing stability and control to all 3 types of orientation.

3D Infotech Oct. 2022 – Jan. 2023
Automation Engineering Intern *Irvine, CA*

- Assembled robot arms, controllers, and sensors into robotic platforms to run demos for prospective customers.
- Troubleshooted and integrated individual components into robot systems for system-level verification.
- Controlled robotic arms manually and programmatically to validate functionality for customer use.

Motion Planning and Control Testbed Apr. 2022 – Oct. 2022
Research Assistant *Irvine, CA*

- Implemented a linear quadratic regulator (LQR) velocity controller on mobile robots for optimal trajectory tracking.
- Deployed a scalable OptiTrack server client that sends position feedback to a distributed ROS network.
- Introduced multiprocessing to the server client to parallelize position feedback visuals with ROS communication.

Relevant Coursework

Linear Systems, Classical Control, Robotic Motion Planning and Algorithms, Machines and Mechanisms

Computer-Aided Design, Dynamics, Statics, Differential Equations, Multivariable Calculus, Linear Algebra