

KHAI NGUYEN

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EDUCATION

Carnegie Mellon University

Pittsburgh, PA

Master of Science in Mechanical Engineering - Research Program (GPA: 4.0/4.0, Vingroup Scholar)

May 2024

- Courses: Optimal Control and Reinforcement Learning (S23), Engineering Optimization (F22), Advanced Control Systems Integration (F22), Advanced Robot Dynamics and Simulation (F22).

Hanoi University of Science and Technology

Hanoi, Vietnam

Bachelor of Science in Control Engineering and Automation (GPA: 3.85/4.0, Class rank: 01/31)

Oct 2021

SKILLS

Programming: Python, C/C++, Julia, MATLAB, LaTeX

Software & Tools: VSCode, Linux, Git, Simulink, ROS, Gazebo, CoppeliaSim, CARLA, Ipopt, CasADi, Trello

Knowledge: Motion Planning and Control, State Estimation, System ID, Machine Learning.

WORK EXPERIENCE

Viettel Aerospace Institute

Hanoi, Vietnam

Autopilot Engineer and Intern

Aug 2020 - May 2022

Designed, built, and operated a prototype autopilot system for high-speed aerial vehicles with multiple teams.

- Investigated guidance and control; tuned attitude controller to reduce settling time and overshoot by 30% and 35%.
- Implemented controllers in embedded systems including STM32 ARM (C/C++) and Altera/Xilinx FPGA (VHDL).
- Authored one article in the Institute Journal (internal, peer-reviewed) on modern control design for pneumatic actuators; achieved 98% modeling accuracy and improved 50% control performance.

RESEARCH EXPERIENCE

Robotic Exploration Lab

Pittsburgh, PA

Research Assistant (Advisor: Prof. Zachary Manchester)

Sep 2022 - Present

- Employing ALTRO, an augmented Lagrange iLQR algorithm, to solve constrained trajectory optimization problems for autonomous driving applications, using bicycle models.
- Developing local planning and control frameworks, such as time-varying LQR and model predictive control (MPC) using OSQP, to ensure safe and efficient operation, while handling control limits and obstacles.
- Creating TinyMPC, a lightweight, dependency-free MPC framework, designed for embedded applications, enabling faster computation times and reducing resource consumption.

RECENT PROJECTS

Drone Acrobatics: Autonomous Flip | C/C++, MATLAB/Simulink, Python, Crazyflie

- Led a team to derive an autonomous multi-flip pipeline for nano-quadrotors and successfully verified it in simulation.
- Introduced a new LQR controller onto Crazyflie (C/C++ on STM32); accomplished robust hovering performance.
- Implemented flip planner, flip controller and re-stabilizing controller; delivered single-flip maneuver with Crazyflie.

Nonlinear MPC on Quadruped | C/C++, ROS

- Collaborated to establish nonlinear MPC formulation of quadruped robots, considering tracking errors, centroidal dynamics, joint limits and friction constraint; achieved dynamic walking gait.
- Analyzed MPC implementation on ANYmal from an optimization perspective including SQP and sensitivity analysis.

Self-Driving Cars Project | Python, CARLA

- Applied longitudinal and lateral (Stanley, Pure Pursuit) tracking controller for vehicles; gained 99% accuracy.
- Formulated Error-State EKF for sensor fusion localization (IMU, GPS and LIDAR); examined sensor miscalibration and dead-reckoning effects; all reached 99% confidence.
- Implemented behavior planning (state machine), path generation (conformal lattice), collision avoidance, and optimal path selection; task scenarios were 100% completed.

Modern Robotics Project | MATLAB/Simulink, Python, CoppeliaSim

- Solved inverse kinematics and forward dynamics of UR4/5 industrial robot; created a simulator and Matlab GUI.
- Generated trajectories using trapezoidal velocity profiles and designed PD controllers to attain 95% tracking accuracy.
- Performed motion planning using grid-based (A*) and randomized sample-based (RRT, PRM) searches.