KHAI NGUYEN

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EDUCATION

Carnegie Mellon University, Pittsburgh, PA, US — May 2024

Master of Science in Mechanical Engineering – Research Program

- GPA: 4.0/4.0; Vingroup Scholar

ETH Zürich, Zürich, Switzerland — Summer 2023

Robotics Summer School and Robotics Student Fellowship Programs

Hanoi University of Science and Technology, Hanoi, Vietnam — Oct 2021

Bachelor of Science in Control Engineering and Automation – Talent Program

- GPA: 3.85/4.0 (top 1% university)

SELECTED PUBLICATIONS [Google Scholar]

- S. Schoedel*, **K. Nguyen***, E. Nedumaran, B. Plancher, Z. Manchester, "Code Generation for Conic Model-Predictive Control on Microcontrollers with TinyMPC," in review, *Conference on Decision and Control (CDC), 2024*. [arxiv][website]
- **K. Nguyen***, S. Schoedel*, A. Alavilli*, B. Plancher, Z. Manchester, "TinyMPC: Model-Predictive Control on Resource-Constrained Microcontrollers," *International Conference on Robotics and Automation (ICRA)*, 2024. [arxiv][website][video][poster]
- **K. Nguyen**, V. T. Dang, D. D. Pham, and P. N. Dao, "Hierarchical Formation Control Scheme with Reinforcement Learning for Multi-Vessel Systems," *International Journal of Robust and Nonlinear Control (IJRNC),* 2023. [html]

HONORS AND AWARDS

- **Best Paper Award in Automation,** at ICRA 2024, Yokohama, Japan.
- **Finalists of Best Conference Paper Award and Best Student Paper Award,** at ICRA 2024, Yokohama, Japan.
- **Best Poster Award,** at MS Research Symposium, 2024, by CMU MechE Department.
- **ETH Zürich Robotics Student Fellowship, 2023:** Awarded to 8 world-wide students for summer research.
- **ETH Zürich Robotics Summer School, 2023:** Awarded to 50 world-wide students for summer school.
- **Vingroup Scholarship, 2022,** by Vingroup: Full-ride scholarship for graduate studies.
- **Honda Scholarship, 2021,** by Honda Foundation: Awarded to 100 outstanding students nation-wide.
- **Top 15 Finalists of The Honda Young Engineer and Scientist's Award, 2021,** by Honda Foundation.
- **University Academic Scholarship, 2018, 2019, 2020, 2021,** by HUST: Awarded to top 1% GPA students.
- **Global Project-Based Learning Program, 2020,** by Shibaura Institute of Technology, Japan.
- **Acecook Happy Scholarship 2020,** by Acecook Vietnam: Awarded to outstanding students.
- **Top 2 Best Oral Presentation Award,** at the Student Forum 2020 – Renewable Energy.
- **Best Poster Award,** at the 37th Student Research Conference, 2020, by HUST.

RESEARCH AND WORK EXPERIENCE

Robotic Exploration Lab, CMU, Pittsburgh, PA, US — Sep 2022 – Present

Graduate Research Assistant, advised by Prof. Zachary Manchester

- Investigating local planning and control frameworks for autonomous driving using model-predictive control (MPC) to ensure safe and efficient trajectory, while respecting control limits and avoiding obstacles.
- Co-leading TinyMPC, a high-speed and low-memory-footprint MPC solver, outperforming existing solvers and demonstrating real-world efficacy on compute-limited robotic platforms; collaborated with Prof. Brian Plancher.
- Developing a novel iterative decision-making framework leveraging implicit neural networks and differentiable constrained optimization for flexible representation and efficient inference.
- Building a pipeline to auto-generate multi-threaded robot dynamics, obtaining high efficiency on CPU and GPU.

Robotic Systems Lab, ETH Zürich, Zürich, Switzerland Jul 2023 – Aug 2023

Research Assistant, advised by Dr. Jesus Tordesillas and Prof. Marco Hutter

- Proposed a framework to enforce changing hard constraints on neural networks through differentiable modules.
- Employed the proposed framework to learn to solve constrained optimization problems with different types of constraints; aiming to realize safe learning-enabled control on robotic systems.

Advanced Control and Robotics Group, HUST, Hanoi, Vietnam Mar 2019 – Aug 2022

Research Assistant, advised by Prof. Phuong Nam Dao

- Explored motion/force robust controller for multiple mobile manipulators to accomplish cooperative tasks.
- Integrated control theory to boost the adaptability and robustness of reinforcement learning algorithms by 66%.
- Developed hierarchical formation control for multi-agent systems; scaled up and simulated with Matlab/Simulink.

Viettel Aerospace Institute (VTX), Hanoi, Vietnam Aug 2020 – May 2022

Autopilot Engineer and Intern

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 peer-reviewed article in the Institute Journal on modern control design for pneumatic actuators.

Advanced Power Electronic System Lab, HUST, Hanoi, Vietnam Nov 2019 – Feb 2021

Research Assistant, advised by Prof. Trung Kien Nguyen

- Led a team to develop wireless power transfer, static and dynamic wireless charging systems for electric vehicles.
- Tested prototype wireless charging systems (66-80% efficiency); compared it with simulation (90% efficiency).
- Proposed Extended Kalman Filter to dynamically estimate vehicle states and parameters; achieved 90% accuracy.

TALKS

- **TinyMPC: Model-Predictive Control on Resource-Constrained Microcontrollers**
  International Conference on Robotics and Automation (ICRA), Yokohama, Japan May 2024
  Robotic Exploration Lab, CMU, Pittsburgh, PA, US. [slides] Nov 2023
- **Enforcing Non-Fixed Hard Convex Constraints on Neural Networks and Its Applications**
  Robotic Systems Lab, ETH Zürich, Zürich, Switzerland. [slides] Aug 2023
- **Areas with More Motivation to Develop in the Pandemic**
  AOTULE Student Conference (virtual), KAIST, Korea. [event] [slides] Nov 2021

PROFESSIONAL MEMBERSHIP AND SERVICE

- **Member,** *IEEE (since 2023), IEEE Robotics and Automation Society (since 2024).*
- **Reviewer,** *International Journal of Robust and Nonlinear Control (IJRNC), Journal of the Franklin Institute, IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS 2024), IEEE Conference on Decision and Control (CDC 2024).*

TEACHING

- **Assistant,** *CMU 24-774 Advanced Control Systems Integration,* with Prof. Mark Bedillion, graduate level, F2023.
- **Instructor,** *GSTT Initiative:* Taught advanced STEM subjects to students for the talent program exams, 2018.

EXTRACURRICULARS

- **Member,** *Carnegie Autonomous Racing:* Co-led the F1TENTH team finishing at 4/12 in the CPS2023 race, 2023.
- **Member,** *MIT-PITT-RW:* Verified GPU-based MPPI controller on optimal planning and obstacle avoidance, 2023.
- **Organizer,** *European Union:* Organized European music concerts to promote cultural exchanges, Vietnam, 2019.
- **Interpreter,** *Plan International:* Visited remote areas to raise awareness of child rights and safety, Vietnam, 2019.

RELEVANT PROJECTS [blog posts]

- **Viewpoint-Conditioned Legible Motion Planning with Imitation and Reinforcement Learning**
  Python, Gym, RL Baselines3 Zoo, MuJoCo, xArm6 | Machine Learning and Artificial Intelligence – Spring 2024
- **Blasteroids: Blast the Asteroids**
  C++, OpenGL | A Game Development Project within Engineering Computation – Fall 2023
- **Breadth vs Depth: Benchmarking Generalist and Specialist Policies in Robot Agility Learning**
  Python, PyTorch, IssacGym, Unitree Go1 | Introduction to Robot Learning – Fall 2023
- **TinyMPC: A Model-Predictive Control Framework for Embedded Applications**
  C/C++, Julia, Python, Crazyflie, STM32, Teensy | Optimal Control and Reinforcement Learning – Spring 2023
- **Quadruped Locomotion Through Nonlinear Model-Predictive Control**
  C/C++, OCS2, RaiSim | Engineering Optimization – Fall 2022
- **Stability Verification Using Sum-of-Squares Programming**
  Python, Drake, Mosek | Advanced Robot Dynamics and Simulation – Fall 2022
- **Drone Acrobatics: Autonomous Flip**
  C/C++, MATLAB/Simulink, Python, Crazyflie | Advanced Control Systems Integration – Fall 2022

SKILLS

- **Domains:** Optimization**,** Planning and Control, State Estimation, Dynamics, System ID, Machine Learning.
- **Programming:** C/C++, Python, Julia, MATLAB, LaTex.
- **Software:** Git, Simulink, Eigen, ROS 1/2, PyTorch, JAX, Drake, OCS2, MuJoCo, IsaacGym, Gazebo, CARLA, CoppeliaSim, Trello.
- **Robots:** Crazyflie, F1TENTH AVs, SuperMegaBot UGVs, Unitree Go1, ANYmal (sim), INDY AVs (sim).