KHAI NGUYEN

(412) 909-6045 | xkhai@cmu.edu | linkedin.com/in/khainx | xkhainguyen.github.io

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)

PUBLICATIONS

* denotes alphabetical authorship

- A. Alavilli*, **K. Nguyen***, S. Schoedel*, B. Plancher, Z. Manchester, "TinyMPC: Model-Predictive Control on Resource-Constrained Microcontrollers," **in review**, *International Conference on Robotics and Automation (ICRA)*, 2024. [arxiv][website][video]
- **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,* 2023. [online]
- P. N. Dao, D. D. Pham, **K. Nguyen**, and T. C. Nguyen, "Adaptive Reinforcement Learning Motion/Force Control of Multiple Uncertain Manipulators," *Intelligent Systems and Networks*, 2021. [online]
- **K. Nguyen**, A. Le, T. D. Nguyen, and K. T. Nguyen, "Output DC Voltage Stabilizer and Efficiency Improvement in Wireless Power Transfer Systems," *Measurement, Control, and Automation*, 2021. [online]

HONORS AND AWARDS

- **ETH Zürich, Robotics Summer School, 2023**: Awarded to 50 world-wide students for summer school.
- **ETH Zürich, Robotics Student Fellowship, 2023**: Awarded to 8 world-wide students for summer research.
- **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.
- **CCU Virtual Internship Program, 2021**, by National Chung Cheng University, Taiwan.
- **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 MPC to ensure safe and efficient trajectory, while handling control limits and obstacles.
- Co-leading TinyMPC, a high-speed MPC solver based on ADMM with low memory footprints, outperforming existing solvers and demonstrating real-world efficacy on nano-quadrotors; collaborated with Prof. Brian Plancher.
- Developing a differentiable MPC framework embedding implicit neural networks, enabling joint inference and input optimization for solving complex robotic problems.
- Exploring a new navigation stack from a learned library of perceptive low-level skills for agile quadruped robots.

Robotic System Lab, ETHz, Zürich, Switzerland Jul 2023 – Aug 2023

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

- Proposed a framework to enforce hard convex constraints on neural networks through differentiable optimization.
- Employed the proposed framework to learn control barrier function-based safety filters with various constraints (linear, quadratic, and second-order cone).

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%.
- Formulated 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"** Nov 2023
  Robotic Exploration Lab, CMU, Pittsburgh, PA, US
- **"Enforcing Non-Fixed Hard Convex Constraints on Neural Networks and Its Applications"** Aug 2023
  Robotic System Lab, ETH Zürich, Zürich, Switzerland

TEACHING

- **Assistant,** *CMU 24-774 Advanced Control Systems Integration*, with Prof. Mark Bedillon, graduate level, F2023.
- **Tutor,** *GSTT Initiative*: Taught advanced STEM subjects to students for the Talent Program entrance exam, 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.

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.
- **Computing Platforms**: Teensy, Arduino, STM32, FPGAs, Jetson TX2, Intel NUC.
- **Robots**: Crazyflie, F1TENTH AVs, SuperMegaBot UGVs, Unitree Go1, ANYmal (sim), INDY AVs (sim).