PEI-AN HSIEH

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Education

GRASP Lab, University of Pennsylvania (Penn)   *Philadelphia, USA*

M.S.E. IN ROBOTICS   *Sep. 2023 - May 2025*

- Current GPA: 4.0/4.0

Department of Electrical Engineering, National Taiwan University (NTU)   *Taipei, Taiwan*

B.S. IN ELECTRICAL ENGINEERING   *Sep. 2018 - June 2022*

- GPA: 4.09/4.3 (3.94/4.0)

Research Interests

My research interests center on the safe integration of **machine learning** into **robotics** and **control**. I aim to validate these methods on **real-world robotic systems** to ensure their effectiveness and reliability.

Publications

[1] K. Y. Chee*, **P. A. Hsieh***, G. J. Pappas, and M. A. Hsieh, **"Flying Quadrotors in Tight Formations using Learning-based Model Predictive Control"**, *Submitted to IEEE International Conference on Robotics and Automation (**ICRA**)*, May 19-23, 2025, Atlanta, USA

[2] P. C. Chen, **P. A. Hsieh**, J. Y. Huang, S. C. Huang, and C. W. Chen, **"Design and Evaluation of the infant Cardiac Robotic Surgical System (iCROSS)"**, *IEEE/RSJ International Conference on Intelligent Robots and Systems (**IROS**)*, October 23-27, 2022, Kyoto, Japan

Research Experience

Scalable Autonomous Robots (ScalAR) Lab, Penn   *Philadelphia, USA*

ADVISOR: PROF. M. ANI HSIEH

- **Learning-based Control for Flying Quadrotors in Tight Formations**   *Jan. 2024 - Now*

  This research aims to enable safe and stable close-proximity formation flights of quadrotor teams by integrating precise, data-driven models into model predictive control(MPC).

  1. Proposed a novel data-driven model for downwash airflow combing first-principles and **Neural ODE**.
  2. Proposed the **KNODE-DW MPC** framework, which integrates the data-driven model into a **Nonlinear MPC** framework implemented using **CasADi** and **Acados**.
  3. Achieved over **40%** improvement in tracking error in both simulations and physical experiments.
  4. Successfully demonstrated the **first** stacked formation flight of two Crazyflies with a vertical separation of **12 cm** in real-world experiments.

Pappas Research Group, Penn   *Philadelphia, USA*

ADVISOR: PROF. GEORGE J. PAPPAS

- **Multi-Target Tracking using Conformal Prediction**   *Oct. 2023 - May 2024*

  This research focuses on developing a multi-target tracking algorithm for quadrotors and utilizing conformal prediction to ensure coverage guarantees.

  1. Trained **Gaussian Process** trajectory predictors and obtained **conformal prediction** regions for taxi and unicycle motion.
  2. Experimented **RRT*** to plan target tracking trajectories on self-designed objective functions that maximize expected coverage.

Next-generation Automated Surgical Apparatus (NASA) Lab, NTU *Taipei, Taiwan*
ADVISOR: PROF. CHENG-WEI CHEN

- **Design and Evaluation of infant Cardiac Robotic Surgical System (iCROSS)** *Sep. 2020 - Jan. 2023*
  This research developed a dual-arm surgical robot system to assist infant PDA closure through teleoperation. This includes mechatronics, system integration, and both mechanical and software design.
  1. Evaluated a **rapid collision detection algorithm**, an improved version of the oriented bounding box (OBB) method. It consists of more intricate geometries and conditional statements.
  2. Implemented the algorithm using LabVIEW, achieving a **60 Hz** execution speed.
  3. Rendered **haptic feedback** forces by the **artificial potential method**.

Teaching Assistantship

2024
Fall · **Teaching Assistant**, MEAM 5170: Control and Optimization w/ Applications in Robotics, Penn

Award

2022
Spring · **Dean's List Award**, Department of Electrical Engineering, NTU

Selected Projects

Reinforcement Learning for Autonomous Drone Racing *May 2024 - June 2024*
FINAL PROJECT OF **LEARNING IN ROBOTICS**

- Applied **Reinforcement Learning** with **Proximal Policy Optimization** on various simulated racecourses for autonomous drone racing.
- Revealed action and reward configurations that enhance policy robustness and adaptability.

Obstacle Avoidance in Dense Environments using MPC *Nov. 2023 - Dec. 2023*
FINAL PROJECT OF **CONTROL & OPTIMIZATION W/ APPLICATIONS IN ROBOTICS**

- Experimented **Model Predictive Contouring Control (MPCC)** and **Dynamic Window Approach** in dynamic and obstacle-rich environments in simulation.
- Proposed **Obstacle Window Filtering** and decreased **44%** of collisions of MPCC in extreme cases.

Technical Skills

Programming Languages	C/C++/C#, Python, LabVIEW, MATLAB/Simulink
Engineering Softwares	ROS, Acados, Casadi, PyTorch, Git, SolidWorks, Qt, Unity
Operating Systems	Linux, LinuxCNC, Windows

Volunteer & Extracurricular Activities

Captain of the NTUEE Soccer Team *Sep 2020 - June 2021*

- **Leaded 20 teammates** to participate in intramural competitions.

NTU Kind Kids Student Social Service *Oct 2019*

- Held a 5 day camp with **28 club members** for **35 elementary students** in Pingxi.

NTUEE Orchestra First & Second Violin *May 2019 & Dec 2019*

- Performed with **34 musicians** twice in the NTUEE Orchestra concerts.