Wei-Cheng Huang

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Education

University of Illinois at Urbana-Champaign — **Champaign, IL**
PhD Candidate, Computer Science, GPA: 4.00/4.00 — *Aug. 2024 – Present*

University of Pennsylvania — **Philadelphia, PA**
Master of Science in Engineering, Robotics, GPA: 4.00/4.00 — *Sep. 2022 – May 2024*

Shanghai Jiao Tong University — **Shanghai, China**
*Bachelor of Engineering, Mechanical Engineering, GPA: 3.91/4.00, Ranking: **1**/219* — *Sep. 2018 – Jun. 2022*

Publications

The symbol * indicates equal contribution.

- **Wei-Cheng Huang**, Jiaheng Han, Xiaohan Ye, Zherong Pan and Kris Hauser. "Simulation-Ready Cluttered Scene Estimation via Physics-aware Joint Shape and Pose Optimization." In *Robotics: System and Science (RSS)*, 2026. [PDF] [Website]
- Jiaheng Han, Shaoxiong Yao, **Wei-Cheng Huang** and Kris Hauser. "Dense Robotic Packing of Heterogeneous Deformable Objects." In IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), 2026.
- **Wei-Cheng Huang***, Alp Aydinoglu*, Wanxin Jin and Michael Posa. "Adaptive Contact-Implicit Model Predictive Control with Online Residual Learning." In *IEEE International Conference on Robotics and Automation (ICRA), 2024*. [PDF] [Publisher] [Website]
- Alp Aydinoglu, Adam Wei, **Wei-Cheng Huang** and Michael Posa. "Consensus Complementarity Control for Multi-Contact MPC." *IEEE Transactions on Robotics, 40:3879-3896, 2024*. [PDF] [Publisher]
  2024 Best Paper Award, from IEEE RAS Technical Committee on Model-Based Optimization for Robotics
- **Wei-Cheng Huang***, Miao Feng*, Dezhi Yang and Guoying Gu. "Low-Resistance, High-Force, and Large-ROM Fabric-Based Soft Elbow Exosuits with Adaptive Mechanism and Composite Bellows." *Science China Technological Sciences 66.1 (2023): 24-32*. [PDF] [Publisher]

Research Experience

Simulation-Ready Cluttered Scene Estimation via Physics-aware Optimization — **Champaign, IL**
Advisor: Prof. Kris Hauser, Dr. Zherong Pan — *Apr. 2025 – Present*

- Developed an real-to-sim scene estimation pipeline, which directly produces a simulation-ready, physically plausible cluttered scene from a single-view RGBD image. Validated the framework on 10 novel occluded scenes containing up to 5 interacting objects.
- Proposed a numerical optimization formulation in the joint shape-pose space that supports full physics-constrained reasoning for multi-contact cluttered scenes, including non-penetration constraints and force torque balance with frictional contacts.
- Proposed a structure-aware linear solver that utilizes the low rank property and collision pairwise block sparsity in multi-contact constraints. Achieved 9× speedup when optimizing over thousands of shape and force variables.

Enhancing Exploration in MPPI with Density Estimation and Online Value Learning — **Champaign, IL**
Advisor: Prof. Kris Hauser, Mentee: Taowei Huang — *May 2025 – Present*

- Combined the model predictive path integral (MPPI) framework with density estimation strategies inspired by Expansive Space Trees to improve the exploration capability of the sampling-based predictive control algorithm.
- Proposed an online value learning algorithm inspired by RTAA* and temporal-difference updates to enhance MPPI with the ability to escape deep local minima with a short prediction horizon. Implemented the neural value field as multi-resolution hash grids.
- Validated the proposed framework in various robotic tasks in MuJoCo simulation. The proposed framework enables real-time motion planning for tasks including ant locomotion traversing multiple obstacles and robot arm reaching in cluttered environments.

Adaptive Contact-Implicit MPC with Online Residual Learning — **Philadelphia, PA**
Advisor: Prof. Michael Posa — *Jan. 2023 – May 2024*

- Proposed a real-time adaptive multi-contact model predictive control framework, which utilizes physics-based prior models to accomplish efficient online learning and adaptation for contact-rich robotic manipulation.
- Proposed a state-dependent implicit loss formulation to learn the residual of hybrid dynamics modeled as a Linear Complementarity System. Implemented the algorithm as an adaptive module using CasADi (Python).
- Integrated Anitescu's convex contact model with the real-time multi-contact MPC controller in Drake (C++). Implemented the communication pipeline to integrate the adaptive module and the MPC controller.
- Validated the proposed adaptive MPC framework by conducting contact-rich robotic manipulation hardware experiments. Achieved successful manipulation of unknown objects with non-smooth surface geometries.

Consensus Complementarity Control (C3) for Multi-Contact MPC — **Philadelphia, PA**
Advisor: Prof. Michael Posa — *Jan. 2024 – Jun. 2024*

- Proposed a convex approximation of the nonconvex projection step in the ADMM-based C3 algorithm. Proved theoretically the approximation's limiting behavior and connection to Linear Complementarity Problems.
- Tested the performance of the C3 algorithm on multi-contact numerical examples and high-dimensional contact-rich robotic manipulation tasks. Compared the optimality gap and solve time with the MIQP-based approach.

Skills

- **Programming:** Python, C++, MATLAB, VBA, HTML/CSS, LaTeX
- **Developer Tools:** VS Code, PyCharm, Clion, Git, Bazel
- **Frameworks (Learning/Robotics/Mechatronics):** PyTorch, Warp, Drake, Mujoco, ROS, LCM, Solidworks, AutoCAD
- **Robot Platform:** Franka Panda, UR5, Kinova Gen3

Academic Services

- **Reviewer: 16 manuscripts.**
  Robotics: T-RO (2), RAL (3), ICRA (4), CoRL (3), IROS (1), CASE (2), ROMAN (1),
- **Workshop Organizer:** Learning Meets Model-Based Methods for Contact-Rich Manipulation, ICRA 2025

Honors and Awards

- **IEEE-RAS Technical Committee on Model-Based Optimization for Robotics, Best Paper Award** 2024
  For work on "Consensus Complementarity Control for Multi-Contact MPC".
- **National Scholarships for Students from Taiwan, Hong Kong, and Overseas Chinese** 2020 & 2021
  Special Award, top 0.19%, highest level, the only in Shanghai Jiao Tong University.
- **BaoSteel Scholarship** 2019
  Special Award, top 0.25%, highest level, one of only two recipients in Shanghai Jiao Tong University,