

Yung-Ching Sun

☎ +1 (734)312-0641 | ✉ ycs@umich.edu | 📄 yung-ching-sun | 🌐 ycsun2113 | 🏠 https://ycsun2113.github.io

Education

University of Michigan, Ann Arbor

Aug. 2024 - May 2026

M.S. in Electrical and Computer Engineering, Robotics track (GPA: 4.0/4.0)

Ann Arbor, MI

- Recipient of the Rackham International Student Fellowship for the 2025-2026 academic year.
- Coursework: Mathematics for Robotics, Robotic System Laboratory, Intro to Algorithmic Robotics, Mobile Robotics, Self-Driving Cars, Special Topics: Action and Perception, Advanced Multi-Robot Systems.

National Taiwan University

Sep. 2019 - Jun. 2023

B.S.E. in Mechanical Engineering and B.S. in Physics (Major GPA: 3.94/4.3, GPA: 3.64/4.3)

Taipei, Taiwan

- Coursework: Computer Vision, Digital Control System, System Dynamics, Automatic Control, Applied Electronics.

Research Experience

Robotics and Optimization for Analysis of Human Motion Laboratory

Feb. 2025 — Present

Graduate Research Assistant, Advisor: Prof. Ram Vasudevan

Ann Arbor, Michigan

Physically Grounded Digital Twin Reconstruction through Interactive Exploration

- Leading a research project by coordinating a cross-level research team (undergrad and PhD students) with diverse expertise, driving research direction, system development, and experiments design toward a first-author submission.
- Proposed a physically accurate digital twin reconstruction framework by combining SAM3D-based scene reconstruction, multi-modal LLM-based physical property reasoning, and robot-environment interactions.
- Developed the framework in NVIDIA Isaac Sim/Lab with a Franka arm and TidyBot and trained RSL-RL, Diffusion Policy, and OpenVLA policies with the digital twins to demonstrate real-to-sim-to-real transfer capability.

Real-to-Sim Underwater Stereo Reconstruction for Real-Time SLAM

- Built training and evaluation pipelines for underwater stereo depth models by developing modular data processing, augmentation, and self-supervised training workflows, enabling efficient and reproducible model training.
- Reduced underwater stereo depth estimation end-point error (EPE) from 13.34 m to 1.99 m by adapting in-air stereo networks with underwater artifact augmentation, simulated data, and self-supervised learning.
- Established benchmarking pipelines with SOTA stereo models, including FoundationStereo and IGEV++, providing systematic and quantitative evaluation of depth estimation and downstream SLAM performance in underwater scenes.

3D Active Scene Reconstruction via Bayesian Kernel Inference Semantic Mapping

- Investigated and analyzed key research gaps in uncertainty-aware safe robot exploration and 3D scene reconstruction, benchmarking SOTA representations including BKI Maps, ConvONet, NeRF, 3D Gaussian Splatting, and Scene Graphs.
- Developed a frontier-based 3D exploration system for a differential-drive mobile robot using ROS2 and Gazebo simulator, fusing IMU, LiDAR, and RGB-D measurements to actively reconstruct 3D scene with uncertainty via BKI Mapping.
- Demonstrated the critical role of physical factors in enabling robust mapping and localization through ablation studies on varying physical properties and terrains, with analysis of planned path, tracking error, and reconstruction quality.

Barton Research Group

Jan. 2025 — May 2025

Graduate Research Assistant, Advisors: Prof. Kira Barton, Prof. Dawn Tilbury

Ann Arbor, Michigan

Autonomous Inspection and Mobile Manipulation with the Spot Robot in Manufacturing Environments

- Developed an AprilTag-free, vision-based autonomous operation system for Boston Dynamics' Spot with a 6-DOF arm, integrating onboard RGB-D perception, custom vision models, arm kinematics, and frame transformations within the Spot SDK to enable autonomous localization, navigation, and manipulation in cluttered industrial environments.
- Trained and deployed YOLO11-based object detection and orientation estimation models using 300+ real-world images from robot-mounted cameras to mitigate camera domain shift, achieving up to 96% accuracy for robust manipulation.
- Analyzed safety-aware motion planning strategies for mobile manipulators, jointly considering navigation and arm operation constraints to support safe autonomy in dynamic, human-shared manufacturing environments.
- Presented the work at the Late-Breaking Results and the Workshop on The Future of Intelligent Manufacturing at ICRA 2025, recognized as the Runner-up for the Best Poster Award.

Advanced Control Laboratory, Intelligent Robotics Group

Undergraduate Researcher, Advisors: Prof. Li-Chen Fu

Sep. 2022 — Aug. 2024

Taipei, Taiwan

Autonomous Monitoring and Navigation for Elderly Support Robots in Long-term Care Facilities

- Developed an Elderly Care Robot system with ROS, aimed at monitoring and supporting elders' physical and mental well-being, with the goal of future implementation in long-term care facilities.
- Integrated SLAM, navigation algorithms, machine learning, and computer vision techniques (including real-time human detection and tracking with YOLOv8 and BoT-SORT, facial and emotion recognition with DeepFace, pose estimation with MediaPipe, and GPT-4 API) to enhance the robot's autonomous capabilities.

Institute of Astronomy and Astrophysics, Academia Sinica

Undergraduate Researcher, Advisors: Dr. Hsien Shang, Dr. Chien-Chang Yen

Jul. 2022 — Jul. 2024

Taipei, Taiwan

High-Performance Gravitational Solver Optimization with Adaptive Mesh Refinement

- Developed C++ code for computational astrophysics algorithms and refined the code for better efficiency.
- Explored the Sparse Fast Fourier Transform algorithm to optimize the Adaptive Mesh Refinement (AMR) calculation.
- Optimized gravitational computation with AMR algorithm, reducing time complexity from $O(N^4)$ to $O(N^2 \log^2 N)$, achieving a maximum computational time improvement of 204x compared to the GPU-accelerated direct method.

Work Experience

Advanced Rocket Research Center

Rocket Avionics Hardware Engineer Intern

Jul. 2021 — Sep. 2021

Hsinchu, Taiwan

- Developed STM32 Flash memory control code for optimal data storage during rocket operations.
- Conducted systematic tests to ensure the circuit board components' functionality and performance.

Teaching Experience

Advanced Control Laboratory, National Taiwan University

Research Mentor, Research Projects on Mobile Robots

Sep. 2023 — Jul. 2024

Taipei, Taiwan

- Mentored a UCSB undergraduate in an international summer undergraduate research program, teaching foundational mobile robotics knowledge and development tools, and guiding him from no experience to complete a mobile robot SLAM and navigation project using ROS and Gazebo.
- Guided an NTU undergraduate (now a Robotics Master's student at Georgia Tech) on a research project involving developing an elderly care social mobile robot.

Department of Mathematics, National Taiwan University

Teaching Assistant, Math 1209/4006/4007/4008 Calculus (General Math)/(1)/(2)/(3)

Sep. 2022 — Apr. 2023

Taipei, Taiwan

- Led recitation sessions for 130+ students, elucidated complex concepts, guided problem solving in math, provided detailed explanations, held weekly office hours, and graded assignments and examinations.
- Received 4.51/5.0 in the teaching evaluation, with student feedback praising dedication and responsiveness.

Publications, Preprints, and Workshop Papers

[1] Bagoren, O.*, Isaacson, S.*, Sundar, S., **Sun, Y.C.**, et, al. "SurfSLAM: Sim-to-Real Underwater Stereo Reconstruction for Real-Time SLAM." *arXiv preprint arXiv:2601.10814 (2026)*.

[2] **Sun, Y.C.***, Stadinger, S*, et, al. "Key Capabilities of Autonomous Mobile Platforms for Maintenance and Monitoring in Manufacturing Environments." *Late-Breaking Results & Workshop on The Future of Intelligent Manufacturing, IEEE International Conference on Robotics and Automation (ICRA), May 2025*

[3] Yen, C.C., **Sun, Y.C.**, et, al. "A Hybrid Acceleration for Self-Gravity Calculation in Infinitesimally Thin Disks with Adaptive Mesh Refinement." *The Astrophysical Journal Supplement Series (ApJS)*. (Under review.)

Papers In Preparation (with Projected Venue)

[1] **Sun, Y.C.**, Isaacson, S., Bagoren, O., Vasudevan, R., et, al. "Physically Accurate 3D Reconstruction via Interactive Estimates Refinement" *IEEE/RSJ International Conference on Intelligent Robots and Systems, 2026*. (In preparation.)

Selected Projects

3D Gaussian Splatting Scene Reconstruction for Autonomous Driving Oct. 2025 — Dec. 2025

- Implemented SOTA 3D Gaussian Splatting-based driving scene reconstruction methods, performed a comparative study and analyzed their potential for ADAS simulation and high-fidelity digital twins generation.
- Developed an evaluation pipeline to benchmark Street Gaussians, OmniRe, and GaussianSTORM on real-world large-scale autonomous driving datasets including Waymo and nuScenes using PSNR, SSIM, and LPIPS metrics.

Rapid Motor Adaptation (RMA) for RL-Based Quadruped Locomotion Sep. 2025 — Nov. 2025

- Built a two-phase Rapid Motor Adaptation (RMA) pipeline for Unitree Go1 quadruped locomotion in MuJoCo/Brax with JAX-based simulation by extending RLS-RL PPO to consume privileged observations and learn an environment latent, enabling adaptation beyond naive domain randomization.
- Trained a teacher-student adaptation module via DAgger-style distillation, promoting sim-to-real transfer capabilities, enabling robust locomotion on unseen rough terrains without privileged information at deployment.

Real-Time Visual SLAM for Dynamic Environments Mar. 2025 — May 2025

- Designed a modular, real-time dynamic SLAM system by extending ORB-SLAM3 with dynamic features detection and masking, enabling robust real-time camera tracking in dynamic environments.
- Developed dynamic detection and masking pipelines using FastSAM, YOLO11n-seg, and optical flow analysis, removing open-vocabulary dynamic features, and improving localization accuracy in dynamic scenes.
- Reduced localization absolute trajectory error (ATE) by 97.34% while maintaining real-time tracking through optimized feature filtering and multi-threaded processing, systematically benchmarking against ORB-SLAM3 and DynaSLAM, validated on TUM and Bonn dynamic RGB-D datasets.

Autonomous Exploration and SLAM for an Autonomous Mobile Vehicle Mar. 2025 — May 2025

- Designed wheel-speed PID and pure pursuit motion controllers for a differential-drive mobile robot, achieving < 3 cm positional error and $< 15^\circ$ heading error after completing two laps of a 7.308 m trajectory.
- Developed a real-time C++ localization and occupancy grid mapping pipeline using 2D LiDAR, IMU, and wheel odometry, achieving 0.0369 m RMS pose error through Particle Filter-based Monte Carlo localization.
- Integrated SLAM, A* algorithm, and frontier-based exploration to enable autonomous navigation, mapping, and localization in previously unknown environments.

End-to-End Vision-Based Manipulation with RGB-D and 5-DOF Arm Jan. 2025 — Mar. 2025

- Built an end-to-end vision-guided robotic manipulation system using ROS2, a RealSense L515 RGB-D camera, and a 5-DOF RTX200 robotic arm, enabling autonomous perception-to-action pipelines.
- Improved 3D perception accuracy for manipulation by reducing depth estimation error from 4.5 mm to 0.375 mm through camera calibration and homography transformation, achieving an autonomous pick-n-place position error of 3.79 mm.
- Developed end-to-end autonomous block sorting, aligning, and stacking pipelines by integrating OpenCV-based detection (shape, size, color), robotic kinematics (FK/IK), and motion planning, enabling precise and repeatable manipulation tasks.

ANA*: Anytime Nonparametric A* Algorithm Nov. 2024 — Dec. 2024

- Implemented and systematically compared A* and ANA* algorithms in PyBullet simulation to solve navigation tasks for the PR2 robot, demonstrating ANA*'s efficiency in converging to optimal solutions across varied environments.
- Developed an evaluation pipeline in custom 3D environments within PyBullet, verifying ANA*'s capability to rapidly find suboptimal solutions and iteratively achieve optimality, outperforming A* in diverse scenarios.
- Designed heuristic functions and evaluated their admissibility and impact on the performance of A* and ANA* algorithms.

Honors and Awards

Rackham International Student Fellowship, *Rackham Graduate School, University of Michigan* Nov. 2025

Undergraduate Research Scholarship, *Institute of Astronomy and Astrophysics, Academia Sinica* Sep. 2022

Technical Skills

Programming/Software: C/C++, Python, MATLAB/Simulink, C#, LabView

Hardware: Raspberry Pi 5, RGB-D camera, 2D/3D LiDAR, IMU, Boston Dynamics Spot, Kinova, RX200 robotic arm

Simulators: NVIDIA Isaac Sim/Lab, Habitat Sim/Lab, PyBullet, ManiSkill, MuJoCo, Gazebo

Tools/Packages: ROS, ROS2, Git, Docker, Linux, OpenCV, PyTorch, CUDA, JAX, Eigen, CVXPY, CasADi, GTSAM