Yung-Ching Sun

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EDUCATION

University of Michigan, Ann Arbor ***Aug. 2024 — May 2026***
M.S. in Electrical and Computer Engineering (Robotics track) *Ann Arbor, Michigan*
- GPA: 4.0/4.0
- Coursework: Introduction to Algorithmic Robotics, Mathematics for Robotics, Mobile Robotics: Methods and Algorithms, Robotic System Laboratory, Self-Driving Cars, Special Topics: Action and Perception

National Taiwan University (NTU) ***Sep. 2019 — Jun. 2023***
B.S.E. in Mechanical Engineering and B.S. in Physics *Taipei, Taiwan*
- GPA: 3.64/4.3, Last 2 years GPA: 3.91/4.3, Major GPA: 3.94/4.3
- Specialization: System Control and Mechatronics
- Coursework: Computer Vision, Digital Control System, Systems Dynamics, Automatic Control, Applied Electronics, Electronic Circuits, Machine Design Theory, Mechanism, Dynamics

RESEARCH EXPERIENCE

Robotics and Optimization for Analysis of Human Motion (ROAHM) Lab ***Feb. 2025 — Present***
Research Assistant*, Advisor: Prof. Ram Vasudevan* *Ann Arbor, Michigan*
- Investigated key research gaps in robot exploration and the state-of-the-art scene representations (e.g., Bayesian Kernel Inference Map, CovONet, NeRF, 3D Gaussian Splatting, Scene Graphs).
- Built baseline experiments with ROS2 and Gazebo, integrating frontier exploration with BKI Mapping, finding that physical factors (e.g., friction, terrain, mass) are crucial for robust mapping and real-world robot operation.
- Leading a research project on physically grounded digital-twin generation that combines visual priors with robot-environment physical interactions to reconstruct a high-fidelity 3D scene representation with physical properties.
- Proposed and formulated the approach, designed experiments for an intended 2026 RSS first-author submission.
- Developed prototype modules for the closed-loop digital twin reconstruction, including multi-modal Bayesian inference-based property refinement and system identification through robot interaction.
- Built training and evaluation pipelines for underwater stereo depth estimation models, using in-air data with underwater artifact augmentations and simulated underwater data to adapt existing models, achieving significant improvements in depth estimation and neural SLAM performance, preparing for a forthcoming T-FR submission.

Barton Research Group ***Jan. 2025 — May 2025***
Graduate Researcher*, Advisors: Prof. Kira Barton and Prof. Dawn Tilbury* *Ann Arbor, Michigan*
- Developed autonomous robotic inspection and manipulation capabilities for manufacturing scenarios using Boston Dynamics' Spot robot with a 6-DOF arm.
- Integrated YOLO11n OBB detection with robotic arm kinematics and motion planning using the Spot Software Development Kit (SDK) for autonomous bucket and valve manipulation.
- Investigated, proposed, and documented solutions for safe motion planning for mobile manipulators' navigation and manipulation in industrial environments.
- Presented this 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 ***Sep. 2022 — Aug. 2024***

Undergraduate Researcher*, Advisor: Prof. Li-Chen Fu* *Taipei, Taiwan*

- 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 ***Jul. 2022 — Jul. 2024***

Research Intern*, Advisors: Dr. Hsien Shang, Dr. Chien-Chang Yen, and Dr. Yao-Huan Tseng* *Taipei, Taiwan*

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

WORK EXPERIENCE

Advanced Rocket Research Center ***Jul. 2021 — Sep. 2021***

Rocket Avionics Hardware Engineer Intern *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 ***Sep. 2023 — Jul. 2024***

Mentor*, Research Projects on Mobile Robots* *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 ***Sep. 2022 — Apr. 2023***

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

Private Tutor ***Sep. 2019 — Apr. 2023***

Tutor*, High School Mathematics and Physics* *Taipei, Taiwan*

- Provided 1-on-1 math and physics tutoring to 4+ Taiwanese high school students, using creative analogies to clarify complex and abstract concepts, improved their problem-solving skills, and boosted engagement.
- Improved students' long-term academic performance, including raising one student's math and science grades from 20-40% to 60-70% (later achieving straight A's after transferring to a U.S. high school) and supporting another student who was admitted to UCLA.

PUBLICATIONS, PRESENTATIONS, & WORKSHOP PAPERS

[1] Chien-Chang Yen, **Yung-Ching Sun**, Yao-Huan Tseng, Hsien Shang. "A Hybrid Acceleration for Self-Gravity Calculation in Infinitesimally Thin Disks with Adaptive Mesh Refinement." *The Astrophysical Journal Supplement Series*. (Under review.)

[2] **Yung-Ching Sun***, Samantha Staudinger*, Hanna Chapin, Alyssa Carter, Kira Barton, Dawn Tilbury. "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,* Atlanta, GA, May 2025.

PAPERS IN PREPARATION (WITH PROJECTED VENUE)

[1] **Yung-Ching Sun**, Seth Isaacson, Onur Bagoren, Yue Hu, Ram Vasudevan (order TBD). "Combining Visual Priors with Physical Interactions for Physically Grounded Digital Twins Reconstruction." *2026 Robotics: Science and Systems Conference*.

[2] Onur Bagoren*, Seth Isaacson*, Sacchin Sundar, **Yung-Ching Sun**, Anja Sheppard, Haoyu Ma, Abrar Shariff, Ram Vasudevan, Katherine A. Skinner. "SurfSLAM: Sim-to-Real Stereo Underwater Reconstruction For Neural SLAM." *IEEE Transactions on Field Robotics.*

HONORS AND AWARDS

- *Rackham International Student Fellowship,* Rackham Graduate School, University of Michigan ***Nov. 2025***
- *Academia Sinica Scholarship,* Inst. of Astronomy and Astrophysics, Academia Sinica ***Sep. 2022 — Jun. 2023***
- *Galactic 3rd Prize Winner & Gender Innovation Award,* NASA International Space Apps Challenge at Taoyuan City in Taiwan, American Institute in Taiwan. ***Oct.2022***

SELECTED PROJECTS

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

- Implemented 4 state-of-the-art 3D Gaussian Splatting (3DGS) based driving scene reconstruction methods, DrivingGaussian, Street Gaussians, OmniRe, and GaussianSTORM, on the nuScenes and Waymo datasets.
- Conducted quantitative and qualitative analyses to evaluate reconstruction fidelity and robustness and identified key limitations and future research opportunities for 3D driving scene reconstruction.

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

- Developed a modular, real-time SLAM framework that enhances ORB-SLAM3 for dynamic environments.
- Integrated FastSAM, YOLO11n-seg, and optical flow analysis to detect and mask open-vocabulary dynamic feature points, enabling robust and efficient tracking in dynamic scenes.
- Achieved a maximum of 97.34% reduction in absolute trajectory error compared to the ORB-SLAM3 baseline while maintaining real-time performance, evaluated on TUM and Bonn datasets.

Action, Perception, and Planning for a Differential-Drive Mobile Robot ***Mar. 2025 — May 2025***

- Developed wheel speed PID controller and pure pursuit motion controller for a differential-drive wheeled robot, achieving positional error < 3 cm and heading error < 15° after completing two laps of a 7.308 m path.
- Implemented a SLAM system using occupancy grid mapping and Monte Carlo localization with 2D LiDAR, odometry, and IMU data, achieving a 0.0369 m RMS pose error in simulation.
- Integrated SLAM, A* path planning, and frontier-based exploration algorithms to enable autonomous navigation, mapping, and localization in unknown environments.

Vision-Guided Robotic Manipulation ***Jan. 2025 — Mar. 2025***

- Built a vision-guided robotic manipulation system using an RGB-D sensor and a 5-DOF robotic arm.
- Developed OpenCV-based block detection (shape, size, and color) integrated with robotic arm kinematics and control for autonomous block manipulation.
- Designed motion planning strategies for block sorting, stacking, and alignment based on size and color.

Search-Based Path Planning ***Nov. 2024 — Dec. 2024***

- Implemented and compared A* and ANA* algorithms in Python to solve 2D navigation problems for the PR2 robot, demonstrating ANA*'s efficiency in finding optimal solutions in different environments.
- Designed heuristic functions and analyzed their admissibility and performance impact on the A* and ANA* algorithms.
- Created 3D environments in PyBullet and conducted experiments, verifying ANA*'s ability to rapidly find suboptimal solutions and iteratively achieve optimality, surpassing A* in diverse scenarios.

3D Reconstruction from Road Marker Feature Points ***Feb. 2023 — Jun. 2023***

- Developed advanced image processing solutions using Python and OpenCV to enhance the navigation system of autonomous vehicles.
- Devised algorithms to identify key feature points from road markers via the vehicle's onboard cameras.
- Reconstructed 3D point clouds of road markers utilizing the pinhole camera model, applied the quaternion transformation to transform the results from multiple angles, and optimized the error rate from 0.4 to 0.2.

SERVICE, LEADERSHIP, & ADDITIONAL ACTIVITIES

- *International Students Reception Volunteer*, National Taiwan University ***Aug. 2022 — Dec. 2022***
- *International Companions for Learning Volunteer*, National Taiwan University ***Feb. 2022 — Jun. 2022***
- *Bicycle Maintenance Volunteer & Group Leader*, National Taiwan University ***Feb. 2021 — Apr. 2021***
- *Badminton Varsity Team Member*, National Taiwan University ***Sep. 2019 — Jun. 2022***

MEMBERSHIPS

- *Institute of Electrical and Electronics Engineers (IEEE), Student Member* ***2025 — Present***
- *IEEE Robotics and Automation Society (RAS), Member* ***2025 — Present***
- *Society of Women Engineers (SWE), Collegiate Member* ***2025 — Present***

SKILLS & CERTIFICATIONS

- **Programming Languages and Tools:** C/C++ (5 years), C# (1 year), Python (4 years), MATLAB & Simulink (3 years), ROS (4 years), ROS 2 (2 years), LabVIEW, Git, Docker, VS Code
- **Software/Hardware:** AutoCAD, Inventor, Solidworks/ Arduino, ESP32, STM32, Raspberry Pi
- **Simulators:** Isaac Sim/Lab, Habitat Sim/Lab, Gazebo, PyBullet, ManiSkill, MuJoCo Playground
- **Libraries & Packages:** OpenCV, PyTorch, Pandas, NumPy, SciPy, FFTW, Eigen, CVXPY, CasADi, GTSAM
- **Languages:** Chinese (Native), English (Fluent), Japanese (Basic)
- **Certifications:** Robotics: Aerial Robotics, Computational Motion Planning, Mobility (University of Pennsylvania, Coursera, 2024); Introduction to Algorithms, Introduction to Data Structures, Introduction to Machine Learning (National Taiwan University, Information System Training Program, 2022-2023)