Tung Do

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EDUCATION

Master of Science, Electrical and Computer Engineering, emphasis in Robotics Aug 2023 – May 2025
University of Michigan, Ann Arbor, MI, USA GPA: 3.9/4.0

- Publication: *Lucid Dreamer: Multimodal World Model for Zero-Shot Policy Transfer in Multi-Agent Autonomous Racing*
- Supervisors: Prof. Ram Vasudevan, Prof. Katherine A. Skinner, Dr. Elena Shrestha
- Relevant Coursework*:* Embedded Control Systems, Self-Driving Cars, Mobile Robotics, Math for Robotics, Machine Learning, Computer Vision

Bachelor of Science, Electromechanical Systems Engineering Technology – Valedictorian Aug 2018 – May 2023
California State Polytechnic University, Pomona, CA, USA GPA: 3.7/4.0

- Thesis: *Autonomous/Remote Control Mecanum Wheels Tesla Roadster in real-world*
- Advisor: Prof. Scott Boskovich
- Relevant Coursework: Robotics, Autonomous Vehicle, Feedback Control Systems, Machine Elements, Finite Elements, Engineering Graphics, C/C++ Programming, Digital Design FPGA/Verilog, Electronic Systems, Electrical Networks, Dynamics, Strength of Materials, Material Science, Fluid Mechanics, Thermodynamics, Heat Transfer, Thermal Fluids

ACADEMIC RESEARCH EXPERIENCE

University of Michigan, Ann Arbor, MI, USA
Graduate Research Assistant, **Field Robotics Group** Dec 2023 - Present
Intelligent Navigation of Autonomous Maritime Robots
Supervisors: Prof. Katherine A. Skinner, Dr. Elena Shrestha

- **Designed and programmed the URDF model for the Heron Unmanned Surface Vehicle (USV) by Clearpath Robotics** and developed a comprehensive "world" model for the University of Michigan's Marine Hydrodynamics Lab using ROS2 and Gazebo Garden. This setup enabled thorough testing of autonomous control systems and supported reinforcement learning research, emphasizing system dynamics and mechanical response in marine environments.
- **Developed and implemented an object avoidance algorithm using Python and C++,** integrating it with the mechanical control systems of the Heron USV. The algorithm's performance was rigorously tested in real-world and simulated environments, where I refined tuning parameters to enhance accuracy and robustness.
- **Prepared the Heron USV for real-world testing,** including setting up the battery, electrical systems, and mechanical components. I customized and 3D-printed parts to accommodate sensors and connected LIDAR, camera, IMU, and odometry sensors to the robot via ROS, enabling smooth data acquisition and sensor integration.
- **Engineered a solution to fuse sensor data** by aligning the laser/scan frame with the odometry/filtered transform frame, effectively compensating for the absence of the /tf topic across multiple runs. This ensured accurate transformations between critical frames (base_link, velodyne_base_link, and velodyne), maintaining correct timestamp synchronization, which was crucial for using the hector_slam package to run SLAM in RViz for trajectory analysis.
- **Analyzed autonomous trajectories by extracting and plotting data** from LIDAR scans, evaluating the vehicle's navigation performance. I assessed its ability to maintain stable motion during "straight line" tests and to successfully maneuver through obstacles in "2 buoys" tests under varying wave conditions, focusing on the mechanical and control aspects of the system.
- **Led real-world testing to gather critical sensor data**, including LIDAR, camera, odometry, IMU, and velocity measurements, focusing on the mechanical response and navigation control of the Heron USV. I replicated this data in simulation environments, utilizing advanced post-processing techniques in Python to evaluate and optimize system performance. Additionally, I used the collected data to train a reinforcement learning model, both offline and in simulation, to improve the USV's autonomous decision-making capabilities.

Graduate Research Assistant, **Robotics & Optimization for Analysis of Human Motion (ROAHM) Lab** Aug 2023 - Present
Lucid Dreamer: Multimodal World Model for Zero-Shot Policy Transfer in Multi-Agent Autonomous Racing
Supervisors: Prof. Ram Vasudevan, Dr. Elena Shrestha

- **Optimized the performance of the Jetson TX2 board** to improve the efficiency of semantic segmentation tasks, reducing callback duration by fivefold and enhancing real-time processing for autonomous operations in dynamic environments.
- **Developed a waypoint-follower algorithm** for multi-agent experiments, utilizing the cartographer_ros package for map building and localization. This algorithm was crucial to reinforcement learning experiments by enabling precise navigation and path planning for multiple autonomous agents.

- **Configured a teleoperation controller**, conducted LIDAR scans, calibrated IMUs, and implemented SLAM using cartographer_ros, resolving critical frame transformation issues that enhanced system reliability and performance.
- **Prepared the robot hardware for real-world testing**, including setting up the battery, electrical, and mechanical components. I customized and 3D-printed parts to accommodate sensors, then connected and configured the sensors (LIDAR, camera, IMU, and odometry) through ROS for seamless data integration.
- **Assisted in real-world testing**, gathering critical sensor data—such as LIDAR, camera, odometry, IMU, and velocity measurements—focused on the robot's mechanical response and navigation control. This data was used to train and optimize a reinforcement learning model, improving the robot's autonomous capabilities.

Robotics Researcher, *Hexapod Robot for Multi-Terrain Exploration* Jun 2023 - Present

- **Developing a Hexapod Robot as an independent project** based on a design from Aecert Robotics, with custom modifications to enhance functionality. I added an extra metatarsus to each leg and am working on stabilizing the robot using a 3-joint leg design.
- **Managed the complete hardware setup**, including battery, electrical systems, and mechanical components. I 3D-printed and assembled the robot, designing custom parts to accommodate additional sensors and structural modifications.
- **Focused on integrating advanced robotics principles**, such as mechanical design, locomotion algorithms, and sensory feedback systems, to improve the robot's adaptability and performance in multi-terrain environments.
- **Leveraging my mechatronics and hardware expertise** to create a robust, autonomous system capable of navigating complex terrains, emphasizing mechanical stability and adaptability.

Robotics Researcher, *Enhancing Vision-based SLAM through Shadow Removal Processing* Feb 2024 – Apr 2024
Advisor: Prof. Maani Ghaffari

- **Applied the SpA-Former algorithm** to the KITTI and FinnForest datasets, evaluating its effectiveness compared to traditional shadow removal methods in dynamic, variable lighting environments. This analysis aimed to improve the reliability of vision-based systems in real-world robotics applications.
- **Integrated and tested advanced machine learning techniques** within vision-based SLAM systems, demonstrating how shadow removal algorithms can enhance object detection, environment mapping, and overall system accuracy in robotics and autonomous navigation. The focus was on improving the robustness of perception systems, which is crucial for real-time decision-making in robotics.

Robotics Researcher, *Enhancing Monocular 3D Object Detection in Foggy Conditions: An Adapted MonoCon Approach for Autonomous Vehicles* Oct 2023 – Dec 2023
Advisor: Prof. Maani Ghaffari

- **Led the enhancement of the MonoCon model** using PyTorch, focusing on transfer learning and advanced image processing techniques to improve 3D object detection in foggy conditions. This work aimed to increase the reliability of autonomous robotics perception systems in challenging environments.
- **Implemented and fine-tuned advanced image augmentation** and pre-processing strategies to boost detection accuracy and robustness under varied weather conditions, ensuring that the system can operate effectively in real-world scenarios involving environmental uncertainties.

California State Polytechnic University, Pomona, CA, USA
Robotics Researcher, *Autonomous/Remote Control Mecanum Wheel Tesla Roadster in real-world* Jan 2022 – Dec 2022
Advisor: Prof. Scott Boskovich

- **Independently designed and fabricated** a 1:6 scale model of a Tesla Roadster, integrating omnidirectional mecanum wheels to explore enhanced mobility solutions for electric vehicles in urban settings.
- **Designed the entire car body from scratch**, using only 2D images of the Tesla Roadster (side, top, front, and rear views) found on Google. I converted these views into a 3D model, which I 3D-printed and assembled entirely, ensuring the scale model's aesthetic precision and mechanical functionality.
- **Utilized SolidWorks** to design and manufacture the mecanum wheels, focusing on the precise creation and assembly of components for optimal functionality. The vehicle was engineered to meet the project's mechanical specifications and aesthetic requirements.
- **Managed the complete hardware setup**, including battery installation, electrical system configuration, and mechanical assembly.
- **Developed autonomous navigation and obstacle avoidance systems** using Arduino, implementing sensors and control algorithms to enable intelligent vehicle functionalities such as self-parking and obstacle detection.
- **Designed a dual-mode control system**, allowing manual remote control and autonomous operations. I conducted extensive testing to evaluate the vehicle's maneuverability and self-parking capabilities.

- **Refined the design through iterative testing**, optimizing the integration of mecanum wheels to improve maneuverability and space-efficient parking in urban environments.

PUBLICATIONS

- Shrestha, E., Wan, H., Do, T., Rawal, M., Singh, S., & Vasudevan, R. (2024). *Lucid Dreamer: Multimodal World Model for Zero-Shot Policy Transfer in Multi-Agent Autonomous Racing*. Submitted to IEEE International Conference on Robotics and Automation (ICRA).
- Wan, H., Kusumadjaja, K., Lee, S.H., & Do, T. (2024). *Enhancing Vision-based SLAM through Shadow Removal Preprocessing*. Unpublished manuscript, University of Michigan, Ann Arbor.
- Do, T., Liu, X., & Swayampakula, R. (2023). *Enhancing Monocular 3D Object Detection in Foggy Conditions: An Adapted MonoCon Approach for Autonomous Vehicles*. Unpublished manuscript, University of Michigan, Ann Arbor.
- Do, T. (2023). *Autonomous/Remote Control Mecanum Wheels Tesla Roadster in real-world*. Unpublished manuscript, California State Polytechnic University, Pomona.

PROFESSIONAL EXPERIENCE

PACCAR - Peterbilt Motors Company, PACCAR Innovation Center, Sunnyvale, CA, USA
Advanced Mobility Tech Engineering Intern — Jun 2024 – Aug 2024

- **Completed the 3D CAD design, prototyping, and testing** of a fully functional robotic tool changer, ensuring seamless operation, mechanical reliability, and robust integration with automated systems.
- **Designed, prototyped, and tested a self-aligning mechanism** for automatic docking and connecting critical systems in an industrial application, achieving precise alignment and reliable performance in dynamic environments.
- **Collaborated with my manager** to refine design concepts, validate technical feasibility, and complete the bill of materials for industry-grade components, ensuring successful execution of the project.
- **Developed embedded programming and integrated control systems**, utilizing advanced control techniques to automate a critical industrial process, significantly enhancing efficiency and operational precision.

Northrop Grumman Collaboration Project, California State Polytechnic University, Pomona, CA, USA
Embedded Software Engineer, *Unmanned Aerial & Ground Vehicles (UAV & UGV)* — Aug 2022 – May 2023

- **Developed Python scripts for the Jetson Nano** to implement autonomous in-flight control on the Pixhawk controller. Successfully met Northrop Grumman's demonstration requirements by autonomously piloting a UAV at 200 feet for 10 minutes, conducting surveillance to identify wildfires, and locating injured hikers.
- **Programmed embedded software in Embedded C** for the STM32 microcontroller and developed ROS Python scripts to enable wireless communication between two Raspberry Pi systems. This facilitated remote control of a UGV over a 700-foot range, successfully achieving Northrop Grumman's objective of safely transporting an injured hiker to the Ground Control Station.
- **Presented our work** at the Preliminary Design Review meeting at Northrop Grumman's facility in Palmdale, CA, detailing the technical solutions and outcomes of the autonomous UAV and UGV systems for real-world search and rescue operations.

PROJECTS

Advanced Driver Assistant Systems (ADAS) Simulation, University of Michigan, Ann Arbor, MI, USA
Embedded Software Engineer — Aug 2023 – Dec 2023

- **Developed Embedded C code, block diagrams, and S-functions** to implement Manual Control, Adaptive Cruise Control, and Auto-Steering on the NXP S32 board. This system controls a car simulation in Simulink using a haptic wheel connected to an encoder-driven DC motor, demonstrating precise control and feedback integration.
- **Programmed Embedded C code** to enable communication with other car simulations via the CAN network, facilitating the real-time exchange of vehicle positions and displaying them on-screen, contributing to multi-agent coordination and interaction in simulation environments.

Autonomous Robot Competition, California State Polytechnic University, Pomona, CA, USA
Robotics Engineer — Aug 2022 – Dec 2022

- **Led the robot's mechanical design, electronics setup, control programming, and computer vision**, optimizing the front bumper for aerodynamics while ensuring stable contact with the log at high velocities. I spearheaded discussions on design concepts and implementation strategies with my teammates to achieve the best performance.
- **Directed the integration of a Raspberry Pi communicating with an STM32 microcontroller**, where the Raspberry Pi handled sensor data and computer vision processing. At the same time, the STM32 managed motor control and real-time feedback. I oversaw the electronics and wiring, ensuring smooth communication between hardware components and control systems.

- **Collaborated closely with my team** to develop the software, control algorithms, and computer vision systems, guiding the programming efforts to enhance system reliability and functionality.
- **Our teamwork and collaboration** led to a 2nd place finish in the competition, with the robot being praised for its stable and flawless performance. The hardware operated without any issues throughout the competition, demonstrating the effectiveness of our design and system integration.

SKILLS

• Robotics:	ROS, ROS2, Simulation (Rviz, Gazebo), Sensors (LIDAR, Camera, IMU), SLAM, Machine Learning (PyTorch, TensorFlow), Computer Vision (OpenCV)
• Mechanical:	Kinematics & Dynamics, Control Systems (PID), Prototyping and Fabrication (Creo Parametric, SolidWorks, 3D printing, welding, soldering), Mechatronics Integration, ANSYS FEA
• Hardware:	Microcontrollers (STM32, Arduino PLC), GPIO, ADC, PWM, Timer, ISR, RTOS, CAN, I2C, SPI, USART
• Software:	Python, C++, C, Linux, Bash/Shell Scripting, Git, Debugger, Docker

COURSES/TRAINING

• MIT OpenCourseWare	Introduction to Computer Science and Programming in Python
• Udemy	Python Bootcamp 2023 C Programming ROS: Odometry & Control ARM Cortex-M7 STM32F7 Bare-Metal Programming
• LeetCode	8 Easy, 1 Medium

HONORS & AWARDS

- Valedictorian: Electromechanical Systems Engineering Technology, California State Polytechnic University, Pomona (2023)
- International Student Award Scholarship: California State Polytechnic University, Pomona
- Dean’s Honor List: 2019, 2020, 2021, 2022; President’s Honor List: 2020, 2021

ORGANIZATIONS

- Robotics and Optimization for Analysis of Human Motion (ROAHM) Lab
- Field Robotics Group
- Tau Beta Pi - The Engineering Honor Society (TBP)
- Eta Kappa Nu - International Honor Society of Electrical and Electronics Engineers (IEEE-HKN)
- Institute of Electrical and Electronics Engineers (IEEE)