**Education**

**Carnegie Mellon University** Pittsburgh, PA

Master’s of Science in Electrical and Computer Engineering (Advanced Study) May 2025

**Technical University Munich** Munich, Germany

Bachelor’s of Science in Electrical Engineering and Information Technology May 2023

**Research Experience**

**Carnegie Mellon University, Robomechanics Lab** Pittsburgh PA

*Design of PRM-Based Global Body Planner for Quadruped Ghost Robotics Spirit 40* September 2024 - ongoing

* Implemented lazy PRM based global planner using weighted A\* for dynamic obstacle avoidance and sample efficiency inside of the Quad SDK framework in ROS Noetic using C++ with <30ms planning time

**Technical University Munich, Chair of Information-oriented Control (ITR)** Munich, Germany Bachelor thesis: *Grasp Optimization from Learning-Based Initial Guess* September 2022-April 2023

* Developed optimization algorithms for robotic grasp based on initial guess from reinforcement learning framework in simulation environment MuJoCo
* Divided into contact position optimization (via force and moment residual control) and force optimization (minimizing grasping wrench while satisfying friction cone and external force constraints)
* Successfully reduced average required force for optimized grasp by 60%

**Internship Experience**

**Boardwalk Robotics Inc.**  Pensacola, FL

AI Intern June 2024- August 2024

* Designed reinforcement learning pipeline using PPO for autonomous bi-manipulation tasks for upper body of humanoid robot Alex
* Conducted simulation testing in Isaac Sim to explore and optimize control strategies for manipulation
* Analyzed and interpreted simulation data to refine machine learning models for robust performance
* Achieved successful object handling for pick and push tasks in simulation

**Siemens Healthineers** Forchheim, Germany

R&D Intern in Department: Diagnostic Imaging (DI) X-Ray Products (XP) September 2021-October 2021, March 2022

Research and Development Hardware (HW) Mechatronics (MEC)

* Analyzed damage on electromechanical components of X-Ray machines through automated testing procedures
* Programmed hardware controller on BeagleBoneBlack microPC for automated testing of prototype

**Projects**

**Carnegie Mellon University** Pittsburgh, PA

*Optimizing and testing diffusion based RL* Spring 2025

* Tuned & benchmarked model free diffusion-based RL algorithms (DIPO & QVPO) using seven SDE/ODE samplers (DDPM, Heun, PC, DDIM, k-LMS,RK4, DPM-solver), achieving 13% higher return compared to baseline DDPM for HalfCheetah environment and lower variance in other cases
* Designed unified evaluation framework on MuJoCo and D4RL benchmarks to quantify sampler effects on various environments, showed supervised warm-start pretraining cuts actor MSE by ~15%

*Parallelized Convolutional Neural Network Architecture for faster Inference* Spring 2025

* Implemented hand-tuned CUDA kernels for the game checkers in AlphaZero in team of 2
* Replaced libtorch calls for input, torso and output layers resulting in inference latency reduction of up to 4.9 on NVIDIA Tesla T4 GPUs and 12.7 on CPU
* Designed conflict-free shared-memory tiling & padding schemes unlocking near-peak hardware utilization

*RTAB-MAP SLAM Pipeline Optimization & Evaluation* Spring 2025

* Developed end-to-end SLAM evaluation pipeline for RTAB-Map in team of 4 using Turtlbot with Intel Realsense RGB-D camera, wheel odometry and IMU in ROS Noetic
* Built ground truth alignment pipeline to validate mapping accuracy (<0.5 mm mean error, 10% RMSE improvement)
* Parallelized RTAB-Maps’s Ceres pose-graph solver with OpenMP, reducing average solve time by 17% boosting throughput in large scale mapping scenarios

*Drone Controller for Wind Robustness* Fall 2024

* Implemented various onboard controllers (PID, SMC and LQR) for wind rejection for drone crazyflie 2.0 in group of 4
* Designed dynamics model for cascaded SMC and PID controller and simulation environment in ROS2 + Gazebo
* Achieved stable hovering for three controllers and acceptable performance for wind rejection and trajectory tracking

*Imitation Learning for Bipedal Walker Control* Fall 2024

* Successfully implemented and compared imitation learning methods (Behavior Cloning, DAgger and Diffusion Policies) for training a bipedal walker (BipedalWalker-v3) in OpenAI Gym and achieved training loss less than 0.04
* Leveraged expert trajectories supplied by PPO

*Sampling-Based Planners for multi DoF Robotic Arm* Fall 2024

* Implemented and evaluated sampling-based planners (RRT, RRT-Connect, RRT\* and PRM) to plan motion of a high degree of freedom robotic arm in an 2D environment with static obstacles in C++
* Achieved planning times under 80ms and success rates up to 100% for 4 DoF arm

*Sketch to Image Latent Diffusion Model* Spring 2024

* Designed text conditioned latent diffusion model framework using DDIM with PyTorch in group of 3
* Designed edge-map based dataset augmentation for sketch-image dataset and various training pipelines using different results to achieve image generation
* Generated high-quality images with potential for significant improvement given more compute resources

*Implementation of Decision Transformer for Existing RL Environment* Spring 2024

* Incorporated online decision transformer into TDMPC2 algorithm of RL framework of humanoid robot unitree H1
* Achieved 54% reduction in training time with randomly initialized weights and 27% reduction in training time with pretraining, along with smoother and more natural joint movements in MuJoCo

*Autonomous Vehicle Controller Design* Fall 2023

* Implemented PID and LQR controller with EKF SLAM and A\* planning for autonomous vehicle in Webots
* Achieved 20% faster track speed over PID with < 3.5 meter average distance from road median

*Design of Reaction Time Game on Embedded System* Fall 2023

* Designed reaction time game on STM32 that communicates with mechatronic system to read player signals
* Implemented sensor circuit on KiCAD and low level BDC motor control

**Technical University Munich**  Munich, Germany

# SLAM for Sound-Source Localization Spring 2023

* Simulated search and rescue mission in ROS2 on unknown map in goroup of 3
* Attempted to reach signal source points while creating map of the environment using SLAM toolbox and avoiding collisions using real-time collision monitoring

# Self-balancing and Trajectory Following Robot Spring 2022

* Implemented digital controller on ATmega8 microcontroller for balancing and trajectory following
* Utilized various sensors and components (e.g. accelerometer, gyroscope, ADC, encoder)
* Tasks: robot modelling, sensor communication via SPI, sensor data fusion, designed flatness based controller for trajectory following, designed interrupts for special cases

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# Design of Controller for Buck-Boost Converter Winter 2021

* Designed digital and anaolog controller for buck-boost converter to ensure stable and regulated output voltage during load change
* Implemented analog controller using OpAmp circuits and digital controller on microcontroller
* Simulated and designed buck-boost converter, modulator and noise filter circuits using LT Spice

**Skills**

Programming Languages: MATLAB, C/C++(OpenMP, CUDA, ROS, embedded), Python (PyTorch, Tensorflow, Keras, Jax), Julia

Software: LT-Spice, SolidWorks, MSC Adams, KiCad, Linux, Git, Simulation (ROS ,MuJoCo, Isaac Sim, Gazebo), AWS (E2C), Docker

Hardware: ATmega5, STM32, Raspberry Pi, BeagleBoard

Languages: German, English, Hindi