YULUN ZHUANG

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EDUCATION

University of Michigan - Ann Arbor (UMich) ***Apr. 2024***
- Master of Science in Robotics | GPA: 4.00/4.00 Ann Arbor, MI

Southern University of Science and Technology (SUSTech) ***Jun. 2022***
- Bachelor of Engineering in Robotics | GPA: 3.77/4.00 (Top 6%) Shenzhen, China

RESEARCH EXPERIENCE

Implicit Model Based Reinforcement Learning (RL) via HJB Inductive Bias ***Sep. 2023 – Present***
Research Assistant *Prof. Maani Ghaffari, UMich*
- Proposed a new physics informed RL method with the capability of efficient value prediction convergence and quantitative measurement of simulation to reality gap for complex robot platforms.
- Implicitly informed the value network with learned system dynamics, and applied the first-order HJB optimality conditions to compute the value loss with Jacobian of value and dynamics in forward propagation.
- Demonstrated its performance in pendulum and cartpole environments, work on transferring to quadruped.

World Model Based RL for Multimodal Perception of Car Racing ***Sep. 2022 – Apr. 2023***
Research Assistant *Prof. Ram Vasudevan, UMich*
- Proposed a self-supervised sensor fusion technique for LiDAR and RGB camera by variational autoencoder.
- Trained world-model-based Dreamer agent to solve autonomous racing tasks through latent imagination.
- Evaluated the resulting agent on F1TENTH car and achieved the best racing time and obstacle avoidance performance on unseen tracks against other Dreamer based agent architectures.

Hierarchical RL for Model Predictive Control (MPC) of Legged Locomotion ***Oct. 2021 – May 2022***
Undergraduate Research Assistant *Prof. Wei Zhang, SUSTech*
- Proposed a hierarchical controller for quadruped, composed of a policy network and a MPC controller.
- Developed a convex MPC controller (200 Hz) and enabled dynamic locomotion gaits like trot and gallop.
- Trained a MLP policy using PPO algorithm in Isaac Gym to predict the weight parameters of states in MPC controller, and achieved 20% improvement of trajectory tracking in comparison to a pure MPC controller.
- Released the project source code and received more than 140 stars on GitHub.

WORK EXPERIENCE

PlusAI Inc. ***May 2023 – Aug. 2023***
Software Engineer Intern on Motion Planning *Santa Clara, CA*
- Improved the target speed planner module, merged 15 pull requests to the main codebase and solved 5 issue tickets from road tests in collaboration with motion planning team and localization team.
- Redesigned and implemented a target speed regulation algorithm for speed limit changes on map using online trapezoidal velocity planning on distance domain and performed edge-case analysis using road data.

PUBLICATIONS

- Shrestha, E., Reddy, C., Wan, H., Zhuang, Y., & Vasudevan, R. (2023). **Sense, Imagine, Act: Multimodal Perception Improves Model-Based Reinforcement Learning for Head-to-Head Autonomous Racing**. *arXiv preprint*
- Zhuang, Y., Xu, Y., ... & Fu, C. (2021). **Height Control and Optimal Torque Planning for Jumping with Wheeled-Bipedal Robots**. *2021 6th IEEE International Conference on Advanced Robotics and Mechatronics (ICARM)*

TECHNICAL SKILLS

Languages & Tools: *C++, Python, MATLAB, Git, Linux, ROS, Docker, PyTorch, OpenCV*
AI & Robotics: *Reinforcement Learning, Computer Vision, Motion Planning, Convex Optimization*

Projects Experience

Mobile Robot Planning, Localization and Maze Exploration [code]

- Developed a SLAM system in C++ for a mobile robot to autonomously explore an unknown maze and travel to the given location. Applied A* path planning algorithm for obstacle avoidance. Implemented occupancy-grid based mapping and particle filter localization by fusing data from LiDAR and wheel odometry.

Blocks Detecting and Palletizing with Robot Arm and Depth Camera [code]

- Implemented a visual detection system through OpenCV which can identify 3D poses and colors of blocks in real time (25 FPS) with 99.5% accuracy. Derivated the forward/inverse kinematics of a 5-DOF robot arm and plan the end effector path to pick randomly placed blocks and palletizing them into desired arrangements.

Bayesian Optimization for Model Predictive Path Integral (MPPI) Planar Pushing [code]

- Implemented Bayesian Optimization Algorithm library in PyTorch, and specialized it for autonomously tuning the parameters of a MPPI controller to solve a 2D box pushing task with a Franka robot arm under non-trivial obstacles. The optimized parameters increased the success rate by 19.4%.

Dynamic Object Removing SLAM [code]

- Deployed a pixel-level dynamic object detection NN module and integrated it with ORB-SLAM3 to obtain the enhanced frames without dynamic objects. Reduced the average absolute pose error (APE) by 6.03% on the KITTI dataset with the ability to generate (10 FPS) dynamic object masks in real-time.

Honors & Awards

- Outstanding Undergraduate Thesis — ***Jun. 2022***
- Outstanding Graduates of SUSTech — ***May 2022***
- First Class of the Merit Student Scholarship (Top 5%) — ***Nov. 2020 & 2021***
- Top Ten Volunteers of SUSTech — ***Jan. 2021***
- Outstanding Student Leaders — ***May 2020***