Jihai Zhao

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EDUCATION

Northwestern University **Sep. 2023 - Dec. 2024 (expected)**

M.S. in Robotics *Evanston, IL*

The Ohio State University **Sep. 2019 - Jun. 2023**

B.S. with Honors in Mechanical Engineering and Minor in Computer Science *Columbus, OH*

SKILLS

Software: Python, C++, C, MATLAB/Simulink, Linux, Git, Unit Testing, CMake, TensorFlow, R, Arduino

Robotics: Robot Operating System (ROS/ROS 2), Computer Vision, OpenCV, Simultaneous Localization and Mapping (SLAM), MoveIt, Rviz, Gazebo, Intel RealSense, Robot Kinematics

Hardware: CAD (SolidWorks/Onshape), 3D Printing

WORK EXPERIENCE

Realman-Robotics - Algorithm Engineer Intern **Jun. - Sep. 2024**

- Developed a stereo vision based self-calibration procedure to decrease the absolute positioning errors of a robot only needs a stereo camera mounted to a fixed location and a planar marker attached to the robot end-effector.
- Build the stereo vision system by integrating two industrial cameras and get depth information through disparity.
- Identify the kinematic parameters based on a Denavit-Hartenberg (DH parameters) formulized error model and optimized parameters through the least squares method.

PROJECTS

3D-Bin-Packing With a 7-DOF Robot Arm **Jan. - Mar. 2024**

- Implemented the First-Fit algorithm (In Python) to determine where to place 3D objects in a bin with a known size.
- Used color masking in OpenCV to isolate the 3D objects' color pixels in the camera's view and programmed in Python to identify the location and dimensions of 3D objects.
- Used MoveIt to control the robot to grasp objects and place them in the packing area, according to the location calculated from the First-Fit algorithm.

Simultaneous Localization and Mapping (SLAM) **Jan. - Mar. 2024**

- Implemented Extended-Kalman filter SLAM from scratch in C++ using ROS2 for a Turtlebot3 differential drive robot.
- Developed a C++ package for differential drive kinematics, collision detection, 2D transformations, and odometry.
- Implemented a landmark detection algorithm through supervised learning.
- Used C++ to implement a custom simulation environment for the robot, including lidar, obstacles, and collisions.

Making Coffee With a 7-DOF Robot Arm **Sep. - Dec. 2023**

- Worked in a group of five to develop ROS2 packages to drive the Franka robot arm to brew a cup of coffee.
- Used Computer Vision (OpenCV and AprilTags) to find the location of each object and wrote a custom wrapper package for MoveIt in Python to control the robot.
- My focus was on grasping, and planning trajectory for objects while holding them level (particularly the coffee filter).

KUKA YouBot Manipulation **Sep. - Dec. 2023**

- Planned a trajectory for the end-effector of a mobile base with four mecanum wheels and a 5R robot arm by using feed- forward control and a PI controller.
- Performed feedback control to drive the YouBot to pick up a block at a specified location, carry it to a desired location, and put it down. It was simulated in CoppeliaSim.

Lagrangian Dynamics in Python **Sep. - Dec. 2023**

- Used Lagrangian Dynamics to develop a dynamic simulation of a jack bouncing inside a moving box.
- Used Python NumPy and SymPy libraries for complex calculation and matplotlib for the plot.

RRT Algorithm **Sep. 2023**

- Implemented Rapidly-Exploring Random Tree algorithm to create a collision-free path in a 2D environment.

Vision Transformer for Surface Defect Inspection **Jun. - Oct. 2022**

- Applied Vision Transformer (VT) model to surface defect detection. The VT model combines image linear projection, position embedding as the input, and multilayer perceptron (MLP) as the classifier.
- Achieved 93.3% accuracy and 0.9302 F1 score on the dataset of aluminum surface flaws, demonstrating that it performs better than other CNN baselines (including VGG19, DenseNet, and ResNet).