GITESH GUNJAL

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EDUCATION

University of Michigan, Ann Arbor, MI
Master of Science in Robotics, May 2023
GPA: 3.68 / 4

Vishwakarma Institute of Technology, Pune, India
Bachelor of Technology in Mechanical Engineering, May 2021
GPA: 9.4 / 10

SKILLS

Programming: Python, MATLAB, C++
Software Skills: Linux, Git, ROS, Pytorch, OpenCV, Numpy
Mechanical Skills: Solidworks (CAD), Hypermesh (FEA), TIG Welding, Composites, Fabrication

COURSE-WORK

- Mobile Robotics, Probability Theory, Linear Algebra
- State Estimation, SLAM, Motion Planning
- Convex Optimization, Robot Kinematics and Dynamics

RESEARCH EXPERIENCE

ROAHM Lab (Robotics and Optimization for the Analysis of Human Motion), University of Michigan
Graduate Student Research Assistant   *Apr 2022 - Present*

Multi-modal sensing for terrain map and terrain property estimation
- Implemented a novel Bayesian approach to recursively update a TSDF-based 3D semantic terrain map using multi-sensor data.
- The map infers surface friction by fusing measurements from segmented RGB images and force torque sensor.
- Collaborate on implementing the software architecture in C++ and Python for deployment on a quadruped and a robotic arm.

Bayesian Optimal Experimental Design (BOED) for safe robotic systems
- Co-authored a novel method to perform Bayesian inference over an unknown model parameter (e.g., friction) using BOED.
- Method uses Bayesian optimal experimental design to optimize for the most informative and safe action.
- Compared the method against a baseline in MATLAB using a simulated car model, achieving a 32% higher information gain.

Motion prediction and uncertainty propagation of RC 1/10 car model
- Implemented Gaussian Process Regression and Extended Kalman Filter algorithms in C++.
- Method will be used to verify a novel Risk-Aware MPC based motion planning algorithm for dynamic obstacle avoidance.
- Collaborate on deploying and testing the method on an RC 1/10 car.

Perception pipeline for "Digit" (a humanoid robot by Agility)
- Led team in deploying a comprehensive perception pipeline by integrating diverse algorithms with ROS.
- The resulting perception pipeline included the following capabilities:
  - SLAM using LIO-SAM, a graph based Lidar Inertial odometry method built on GTSAM framework.
  - Semantic Elevation Mapping using Sel-map, a 2.5D mapping method based on RGB image segmentation.
  - 3D Occupancy Mapping using Voxblox, a voxel based mapping library.
  - Real-time object detection using YOLO v2.

ACADEMIC PROJECTS

Wasserstein Safe MPPI - A novel algorithm for motion planning for dynamic obstacle avoidance.   *Apr 2022*
- Implemented an algorithm (link) for measuring risk of collisions by applying the Wasserstein metric to calculate distance between uncertainty distributions.
- Method used Right Invariant EKF for uncertainty propagation to minimize conservativeness in planning.
- Successfully minimized the computation time to 0.82 sec per planning in Python.

Dynamic ORB based In-MSCKF for visual inertial SLAM (Simultaneous Localization and Mapping)   *Apr 2022*
- Supported an implementation of visual inertial SLAM (link) using Right Invariant EKF (RI-EKF).
- Method used ORB SLAM feature detector and YOLACT image segmentation for dynamic environments.
- Implemented the method in C++ and tested on EuRoC and KAIST Urban dataset with varying success.

Autonomous differential drive mobile robot for autonomous exploration and mapping   *Dec 2021*
- Successfully implemented a navigation algorithm in C++ for a mobile robot exploring a 2D maze.
- Navigation stack used A* path planner, Autonomous Frontier Exploration, and SLAM using a Particle Filter.