Rishabh Bhattacharya

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Education

University of California San Diego — Sept 2021 - Jun 2023
Master of Science (MS) in Mechanical Engineering — *GPA 3.97/4.0*

Indian Institute of Technology Gandhinagar — July 2015 – July 2019
Bachelor of Technology (B.Tech) with Honours in Mechanical Engineering — *GPA 8.53/10*

Experience

Research Assistant — Jan 2023 - present
Existential Robotics Laboratory — *UC San Diego*

- Successfully assembled a fully functional **PX4 quadrotor** by integrating hardware and software components including frame assembly, motor/IMU calibration, and software installation and dependency management. (Python, C++, ROS)

Robotics Research Intern — Jul 2022 - Sept 2022
OMRON Research Center of America (ORCA) — *San Ramon, CA*

- Designed a **collision-free trajectory planner** for a 7 DOF Franka-Emika Panda robot that accounts for dynamic obstacles, achieving sub-200ms performance. (Python, C++, ROS)

Technical Skills

Languages: Python, C++, SQL, MATLAB
Tools: ROS, Git, Jupyter, Bash, LaTeX

Projects

Motion planning — Python

- Computed optimal open-loop policy using **dynamic programming** in a doorkey environment, utilizing resulting policy to instruct the agent to pick key, unlock doors, avoid obstacles and reach goal. (Github link)
- Employed **weighted A*** path planning algorithm to determine shortest path and intercept moving target in an obstacle-laden environment. (Github link)
- Applied CEC controller to solve infinite horizon discounted stochastic **optimal control** problem for reference trajectory tracking. (Github link)

Sensing and estimation — Python

- Utilized **Gaussian Discriminant Analysis** to train a probabilistic color model, enabling recognition and classification of recycling-bin specific blue color. (Github link)
- Employed **particle filter SLAM** utilizing odometry, 2-D LiDAR scans, and stereo camera measurements from an autonomous car, to localize the robot and generate a 2-D occupancy grid map of the environment. (Github link)
- Implemented **visual-inertial SLAM** using **Extended Kalman filter**, with synchronized measurements from an inertial measurement unit (IMU) and stereo camera, to localize the robot and map its environment. (Github link)

Robot motion control — MATLAB

- Implemented **trajectory generation and motion control** on a KUKA youBot 5 arm robot for a pick-and-place task, utilizing coppeliaSim simulation package. (Github link)

Safety for autonomous systems — MATLAB

- Enhanced **safety guarantees** in path planning algorithms using Hamilton-Jacobi reachability. (Report link)

Neural networks and pattern recognition — Python

- Attained **92.37%** accuracy on MNIST classification via training a single layer neural network. (Github link)
- Achieved **30%** accuracy on CIFAR-100 classification utilizing a neural network with one hidden layer. (Github link)
- Implemented image segmentation on PASCAL VOOC 2007, using **Unet** and **ResNet**. (Github link)
- Obtained **69.65%** BLUE1 score for caption generation on COCO 2015, leveraging **RNN** and **LSTM**. (Github link)
- Achieved **91.50%** BLUE1 score for LaTeXcode generation on Image2Latex-140K dataset, using **visual transformers**. (Github link)

Computer vision Python

- Employed **SIFT feature detection** and matching for image registration and object recognition, followed by **RANSAC outlier rejection** algorithm to improve feature matching accuracy. (Github link)
- Implemented **optical flow** estimation using the Lucas-Kanade algorithm for motion analysis. (Github link)
- Estimated **camera projection** matrix for image-based 3D reconstruction (traingulation), **camera pose** for image alignment and, planar projective transformation for image rectification and perspective correction. (Github link)
- Estimated fundamental matrix using **Shi-Tomasi/Forstner corner detection**, feature matching, **MSAC outlier rejection**, Direct Linear Transform linear estimate, and Levenberg-Marquardt non-linear estimate for image registration and stereo vision. (Github link)

Relevant Coursework

Robotics: Planning and learning, Robotics (A+), Sensing and estimation, Robot manipulation and control, Mathematics for Robotics (A+), Safety in Autonomous Systems

Controls: Non-Linear Systems, Linear Systems Theory (A+), Linear Control Design (A+), Non-linear control (A+)

Computer Vision: Neural networks and pattern recognition, Computer Vision (I/II)

Work Experience

Business Analyst Jan 2020 - May 2021
SIM Advisory *Bangalore, Karnataka*

- Improved report generation efficiency by 85% through creation of an automated dashboard utilizing PowerBI.
- Utilized k-Means clustering to identify geographical hotspots in the United States for price optimization, resulting in improved turnover.

Operations Officer Jul 2019 - Jan 2020
Indian Oil Corporation Ltd. *Barauni, Bihar*

- Oversaw daily fuel receipt and dispatch from the refinery control room for batches of approximately 1850 Kgal worth $6.5M.
- Optimized daily truck loading schedule for a fleet of around 500 trucks, totaling 1600 Kgal, while minimizing employee overtime.