Khagesh Bhardwaj

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Education

University of California, San Diego **Sep 2023 – Dec 2024 (exp)**
Master of Science in Robotics (GPA – 3.79/4.0) *San Diego, CA*

Indian Institute of Space Science & Technology, India **Aug 2015 – May 2019**
Bachelor of Science in Aerospace Engineering (GPA – 3.71/4.0) *Trivandrum, India*

Relevant Coursework

- Motion Planning
- Machine Learning
- Control Systems Theory
- Robot Dynamics
- Safety in Autonomous Systems
- Convex Optimization
- Sensing & State Estimation
- Probability & Statistics
- Data Structures & Algorithms

Technical Skills

Languages and Platforms: Python, C++, MATLAB, ROS 2, Gazebo, Linux, Simulink, Git, Jira, Azure DevOps
Libraries and Frameworks: OpenCV, GTSAM, Numpy, Pandas, Scikit-learn, PCL, PyTorch, Tensorflow, Eigen, MoveIt

Experience

Ansys Inc. **June 2024 – Sept 2024**
Software Engineer Intern *Irvine, CA, USA*

- Developed new optimization algorithms for CAD preprocessing, focusing on automation to reduce computational time.
- Automated geometry processing for mesh generation, improving computational efficiency and enhancing the pre-processing phase for finite element analysis.
- Validated code functionality through ARM, emphasizing regression testing to improve code robustness and quality.
- Contributed to scalable and modular software, optimizing overall workflow and reducing manual processing time by 95%.

Indian Space Research Organization (ISRO) **August 2019 – August 2023**
Mission Analysis Software Engineer - Spacecraft Propulsion *Bengaluru, India*

- Developed and implemented the Attitude and Orbit Control System (AOCS) for a tethered EVA robot on the PSLV PS4 stage, focusing on attitude stabilization, sensor fusion (gyroscopes, accelerometers), and control algorithms for thruster and reaction wheel management in microgravity.
- Developed algorithms, implemented bug fixes, and conducted functional tests in INPAS software to simulate in-flight propulsion conditions across 8 spacecraft missions, including the NASA-ISRO SAR (NISAR) satellite.
- Performed real-time and system integration testing of INPAS software for CH-3 (Lunar Lander), Gaganyaan (Human Space Flight), and NVS-01 (Navigation) missions.
- Conducted risk analysis and developed contingency plans for potential propulsion system failures during flight.
- Monitored real-time health, predicted performance, executed maneuvers, performed orbit corrections, and analysed the profile for all CH-3 mission maneuvers.
- Tested INPAS software in RHEL 7.6 user environment, ensuring hot redundancy with prime and backup chains.

Projects

YouBot Mobile Manipulator Robot Controllers | *MATLAB, CoppeliaSim* **March 2024**

- Developed software for controlling youBot, comprising of Kinematics Simulator, Reference Trajectory Generator, Feedforward plus Feedback Controller.
- Applied the software to the task of mobile manipulation, demonstrating the robot's ability to move to an object, pick it up, and place it in a target position within the CoppeliaSim simulator.

Visual-Inertial SLAM using Extended Kalman Filter (EKF) | *Python, transforms3d* **March 2024**

- Developed an EKF prediction step using IMU measurements to estimate the pose of the IMU over time.
- Implemented an EKF update step for landmark mapping, observed in visual features of stereo-camera images.
- Integrated IMU pose update and landmark update steps to develop a visual-inertial SLAM algorithm.

Door & Key Problem using Dynamic Programming (DP) | *Python, gymnasium, minigrid* **April 2024**

- Developed a DP solution for autonomous navigation in environments with dynamic obstacles.
- Formulated the problem as a Markov Decision Process (MDP) to derive optimal navigation policies.
- Demonstrated effectiveness in both known and randomly generated environments, optimizing pathfinding and resource consumption for industrial robotics and autonomous vehicles.

3D Motion Planning with A* and RRT Algorithms | *Python, A*, RRT* **May 2024**

- Developed and implemented A* and RRT algorithms for efficient 3D path planning for unknown environments.
- Enhanced A* with custom heuristics for optimal pathfinding, ensuring high precision in complex environments.
- Performed a comparative analysis of A* and RRT, focusing on trade-offs between path optimality, computational efficiency, and scalability in dynamic spaces.

Infinite Horizon Stochastic Optimal Control Strategies for Autonomous Robots | *Python, Casadi* **June 2024**

- Developed and evaluated Certainty Equivalent Control (CEC) and Generalized Policy Iteration (GPI) for stochastic optimal control of a differential-drive robot.
- Implemented CEC as a deterministic approach and GPI with iterative policy refinement.
- Achieved insights into computational efficiency, robustness, and practical applicability in complex environments.

3D Orientation Tracking of a rotating body using IMU measurements | *Python, JAX, JAXNumPy* **Jan 2024**

- Conducted IMU calibration and utilized Python libraries (JAX, JAXNumPy) to implement a Gradient Descent algorithm for optimizing quaternion trajectory.
- Constructed panoramic image by stitching RGB camera images over time using the optimized quaternions.

LiDAR-based SLAM | *Python, GTSAM, scipy, cv2* **Feb 2024**

- Implemented encoder and IMU measurements for initial odometry estimation, enhanced through LiDAR scan matching using the Iterative Closest Point (ICP) algorithm. Developed algorithms to generate 2-D occupancy maps and texture maps of the environment using LiDAR scans and Kinect RGBD images.
- Further optimized robot trajectory estimates with loop-closure constraints using the GTSAM library.

Leadership / Extracurricular

IIST Alumni Association **Sept 2022 – Sept 2023**

Secretary *IIST*

- Organized and led mentorship programs, connecting students with industry professionals and fostering a culture of continuous learning.
- Coordinated large-scale alumni gatherings, significantly enhancing alumni engagement and supporting collaboration on institutional initiatives.

Indian Space Research Organization **Aug 2021 – Aug 2023**

Convener *Data Management Review Committee*

- Led a cross-functional team to review and validate the Integrated Data Management System, ensuring accuracy and efficiency across ISRO's critical operations.
- Streamlined data management processes, increasing system reliability and significantly reducing data handling time by implementing innovative review strategies.