Patanjali Maithani About Me

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Professional Experience

Research Intern, Gen Auto AI *September 2024 – Present*

- Developing safety-critical Control laws for Autonomous Systems.
- Studied Vehicle Dynamics and implemented Model Predictive Control.

Researcher, New York University, New York, USA *July 2024 – September 2024*

- Worked on Control Barrier Function based safe obstacle avoidance algorithms for robotic manipulators such as the UR16e and **Franka Research.**
- Conducted a literature survey on various control barrier function-based obstacle avoidance algorithms.

Robotics Software Engineer, Omnipresent Robot Tech, New Delhi, India *September 2020 - September 2021*

- Improved the security, traceability, and integrity of the company's Remotely Piloted Aircraft Systems (RPAS)by augmenting the open-source software **PX4** with **Public Key Infrastructure (PKI)** to meet Indian regulatory requirements.
- The aforementioned augmentation was directly applied to the PX4 source code (Pixhawk), which had previously been implemented on a Raspberry Pi (companion computer), thereby **increasing the flight time** and **reducing the power consumption** of the company's RPAS.
- Developed and documented the company's **NPNT (No Permission, No Take-off)** architecture to ensure compliance with Indian regulations.
- Assisted in the assembly and configuration of drones.

Projects

Modified Rodrigues Parameters based Non Linear Disturbance Observer Control of Quadrotor(MATLAB) *Project Link*

- Designed a **robust global full degree of freedom discontinuous trajectory tracking controller** for a quadrotor using **control-lyapunov function** in MATLAB.
- Demonstrated the stability of the proposed control scheme through a rigorous **Lyapunov stability proof**, ensuring asymptotic convergence.
- Innovated a novel algorithm for the **upside-down orientation** of the quadrotor, making the take-off condition more versatile.
- Incorporated Non-linear Disturbance observer to make the controller robust to **exogenous disturbances**

Trajectory Tracking Controller for SCARA Manipulator(MATLAB) *Project Link*

- Generated **trapezoidal velocity profile** of the end-effector with anticipation time in the robot's operational space
- Deployed **Second order inverse kinematics** to compute desired joint position, velocity and acceleration.
- Derived **equations of motion** of the SCARA manipulator using first principles.
- Implemented **Inverse Dynamics Controller** in MATLAB/SIMULINK.
- Augmented a **safety filter** to the above control signal to avoid obstacle usinig **Control Barrier Function**.

Pose and Velocity Estimation of a Drone Using Onboard Downfacing Camera and IMU (UKF Implementation) *Project Link*

- Created a VIO pipeline to extract FAST features from images, perform Optical Flow, and return the estimated pose changes.
- Implemented an Unscented Kalman Filter to fuse IMU readings with estimated pose changes, obtaining robust pose estimates.

Safe Control of UR16e-Universal Robot(ROS2/c++/python/ZED2i) *Video Link*

- Human pose estimation using **ZED2i camera.**
- Calibrated ZED2i camera for Eye-On-Base scenario.
- Implemented **time-varying control barrier function** to prevent collisions with humans near the manipulator using **ROS2**.

Maze Navigation with Monocular Visual Odometry and VLAD(C++,Python) *Video Link*

- Implemented **Monocular Visual Odometry** in C++ for maze navigation and scene image tracking.
- Utilized **Vector of Locally Aggregated Descriptors (VLAD)** for efficient query image matching in the maze.

Education

New York University, Masters in Mechatronics and Robotics *(GPA: 3.8/4.00)* *September 2022 – May 2024*

Related Courses: Simulation Tools and Software for Robotics, Kinematics and Dynamics of Robotics, Robot Localization and Navigation, Robot Perception

Netaji Subhas Institute of Technology (NSIT), University of Delhi *(GPA: 7.85/10)* *July 2016 – May 2020*

Bachelor of Engineering, Manufacturing Processes and Automation Engineering (MPAE)

Related Courses: Control Systems, Linear Algebra, Data Structures and Algorithms

Technical Skills

Programming Languages and Development Frameworks: C/C++, Python, MATLAB/Simulink, Docker, GitHub, Sophus, Eigen, g2o, Kalibr calibration, ROS/ROS2, RviZ, Gazebo, Moveit, PX4 Flight Stack(controller), MAVSDK, Linux, Latex

Embedded Systems: Arduino, Raspberry Pi, Nvidia Jetson.