Ankush Singh Bhardwaj

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Domain : Deep Learning, Robot Controls/ Dynamics, Computer Vision, Legged Robotics, Manipulation, Motion Planning

EDUCATION

Worcester Polytechnic Institute (WPI), *Worcester, MA* **Aug 2022 – May 2024**

Masters in Robotics Engineering

Coursework: Deep Learning, Motion Planning, Robot Dynamics & Control, Legged Robotics, Aerial Robotics.

Jawaharlal Nehru Technological University, *India* **Aug 2016 – Sep 2020**

Bachelor of Technology in Mechanical (Mechatronics) Engineering

Honors: University Gold Medal -2020, Sri Andhra Kesari Tanguturi Prakasam Pantulu Gold Medal 2016-19.

TECHNICAL SKILLS

ROS/ ROS 2, GAZEBO, Python, C++, PyTorch, Computer Vision, MATLAB, Control Systems, Behavioural Trees

PROFESSIONAL EXPERIENCE

Research Assistant - Manipulation & Environmental Robotics Lab, *WPI* **May 2023 – Present**

Benchmarking Grasp

- Conducting benchmark study and experimenting with grasping algorithms utilizing Point Cloud Libraries (PCL), learning based methods (GG-CNN, ResNet) on Franka Emika coupled with Zed 2i/ Real sense camera.
- Designed and implemented the benchmarking pipeline using Behavioural Trees by engineering individual states in ROS, ensuring consistent, high-quality results in a complex robotic system.

Dexterous Picking ***(Amazon Grant Project, Collaborations – Harvard University and UMass Lowell)***

- Working on Dextrous three finger underactuated gripper (Model O) to perform intricate picking operations.
- Extensively researching on strategies to reconfigure the gripper pose during an ongoing grasp by developing its kinematics, Jacobian and joint controller.

Assistant System Engineer, Tata Consultancy Services Ltd (TCS), *India* **Feb 2021 – Feb 2022**

- Created and optimized mainframe codes for partner integration, database updates, and credit file generation.
- Collaborated with clients to resolve production issues, understand requirements, and deliver results.

PROJECTS

Real Time Instance Segmentation using Modified YOLACT

- Deployed real time instance segmentation model (YOLACT) by modifying the ResNet backbone with Channel Attention Models, resulting in improved instance segmentation capabilities, especially in complex scenarios.
- Incorporated a contextual loss function to refine segmentation accuracy and increased the mean average precision (mAP) metric by 12 percent and obtained a better MaskIOU.

Robust Sliding Mode Control for Precision Trajectory Tracking

- Developed sliding mode controller for a quadrotor to track trajectories in the presence of external disturbances.
- Formulated boundary layer-based sliding mode control laws for the altitude, roll, pitch, and yaw of UAV.
- Implemented and tested the control design within the Gazebo simulation environment on quintic trajectories.

SIM2REAL Window Navigation in Autonomous Drone Racing

- Transitioned from Blender-based U-Net window detection simulations to real-world application, employing Sim2Real strategies in dynamic racing scenarios using NVIDIA Jetson Orion Nano and DJI Tello Drone.
- Leveraged drone's monocular camera for detection, followed by PnP to ascertain 3D coordinates for a safe waypoint and applied RRT* to generate quintic trajectories enabling navigation through identified points.

Unknown Gap Traversal for Mobile Robots: Real-Time Detection and Precision Maneuvering

- Computed optical flow for real time gap detection using light weight FlowNet on NVIDIA Jetson Orin Nano.
- Executed Visual Servoing to manoeuvre through the identified gap; successfully validated it on a Tello drone.

IMU Pose Estimation: Integrating Complementary, Madgwick, and Unscented Kalman Filters

- Applied Complementary, Madgwick and Unscented Kalman Filter on data from 3-axis accelerometer and gyroscope to estimate the pose of IMU; in comparison with Vicon data, UKF outperformed the others.

Optimization-Based Calibration of Hexapod Stewart Platform

- Calibrated a hexapod Stewart platform through strategic configuration selection and least squares optimization, reduced position and measurement errors by using just 11 measurement configurations.
- Formulated and validated kinematic models, incorporating Velocity Jacobian analysis and workspace boundary evaluation for comprehensive accuracy verification.