Abhyudit Singh Manhas

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Interests and Objectives

My interests lie in robotics, controls, planning, estimation and artificial intelligence. I aim to use my technical skills to contribute to the development of the next generation of autonomous systems, such as self-driving cars and drones.

Education

Stanford University GPA: **4.14/4.00**
Master of Science in Mechanical Engineering (Robotics) *Expected June 2024*
Courses: Robot Autonomy, Collaborative Robotics, Experimental Robotics, Control Design Techniques, State Estimation and Filtering, Reinforcement Learning, Advanced Dynamics, Parallel Computing, Optimization

Indian Institute of Technology, Madras CGPA: **9.63/10**
Bachelor of Technology with Honors in Mechanical Engineering *July 2018 - June 2022*
Achievements: Top 1% of Students in the Class of 2022, Department Rank 2, Merit Scholarship holder

Technical Skills

Languages/Libraries: Python, C/C++, Julia, LaTeX, Bash, NumPy, PyTorch, TensorFlow, OpenCV
Software Tools: Robot Operating System (ROS/ROS2), Linux, Git, redis, CUDA, Mathematica, MATLAB, Simulink

Experience

Stanford GSB & The Hi-Tech Robotic Systems Ltd *July 2023 - Sept. 2023*
SEED Intern. Domains: Machine Learning, Natural Language Processing, Computer Vision
- Implemented end-to-end pipelines using TensorFlow for pre-training and fine-tuning a LLM and video classification model.
- Pre-trained the LLM on a large corpus of data using self-supervised learning and fine-tuned it for question answering tasks.
- Fine-tuned movinets on proprietary fleet driver footage and YouTube videos for streaming action recognition.

Interactive Perception and Robot Learning Lab, Stanford University *March 2023 - June 2023*
Graduate Research Assistant. Domains: Robotics, Controls
- Developed a whole-body control solution for a 7 DOF Kinova Gen3 arm mounted on a powered-caster based platform to enable end-effector tracking. Integrated and extended the OCS2 toolbox using ROS and C++ for this purpose.
- Formulated the optimal control problem by defining the system dynamics, cost functions and constraints, which accounted for self-collision avoidance, arm joint limits, and no-slip/no-slide constraints for the platform wheels. GitHub

TTK Center for Rehabilitation Research and Device Development, IIT Madras *Jan. 2022 - June 2022*
Undergraduate Thesis. Domains: Multi-Body Dynamics, Biomechanics, Robotics
- Project Title: Inverse Dynamics Analysis of Human Walking. GitHub
- Performed inverse dynamics analyses in MATLAB to determine joint forces and moments for human walking.
- Developed a novel formulation to estimate ground reaction forces from just gait data, reducing equipment costs by 15%.

Course Projects

SLAM From Scratch *Jan. 2024 - March 2024*
- Implemented feature-based Extended Kalman Filter and Particle Filter SLAM algorithms with unknown data association on TurtleBot3, using 2D LiDAR sensor data processed through line extraction algorithms.
- Programmed the full ROS package from scratch in Python with object-oriented design, and wrote a 2D kinematics library for differential drive robots, with complete unit testing.

SmartTidyBot *Sept. 2023 - Dec. 2023*
- Extended the functionality of TidyBot by integrating an advanced decision-making system into its cleaning strategy.
- Implemented offline and online reinforcement learning algorithms in Python to compute an optimal cleaning strategy.
- This revised strategy allows SmartTidyBot to accomplish the same tasks faster than TidyBot by around 30%.

Robusser: A Dish Washing Robot *March 2023 - June 2023*
- Developed a robot that could ease the process of retrieving and washing dishes in a restaurant setting, and used a Franka Panda 7 DOF arm mounted on a 3 DOF mobile base for the purpose.
- Built the entire world from scratch by developing models in Onshape, and used the SAI-2 simulation software alongwith Redis to interface different components of the system.
- Implemented joint and operational space controllers in C++ to guide the robot through the entire dishwashing procedure.

Collaborative Resource Gathering *Jan. 2023 - March 2023*
- Implemented algorithms using ROS and Python for locobots to perform collaborative tasks in an unknown environment.
- Leveraged RGB and depth camera data to build an occupancy grid that tracked observed objects in the environment, and determined the highest priority block move (block color, pick-up location, and drop-off station) for a locobot.
- Utilized A* for path planning, PD control for tracking, and MoveIt for arm manipulation and control.

Autonomous Exploration and Rescue Mission using TurtleBot *Sept. 2022 - Dec. 2022*
- Implemented autonomous exploration on a TurtleBot, using ROS and Python for navigation in a mock environment.
- Used Gazebo for simulation, GMapping for SLAM, RRT* for path planning, PID control for tracking, MobileNet for object detection, and RViz for visualization.

Teaching

Stanford University: TA for *Principles of Robot Autonomy I and II* (CS237A and CS237B), and *State Estimation* (AA273)
IIT Madras: TA for *Functions of Several Variables* (MA1101) and *Differential Equations* (MA2020)