ABHINAV KUMAR

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EDUCATION

Northeastern University (NEU), *Boston, MA* **December 2024**
Master of Science in Robotics (**Related Coursework** - Reinforcement Learning, Deep Learning and Pattern Recognition, Mobile Robotics, Computer Vision, Numerical Optimization, Autonomous field Robotics, Control Systems) **GPA: 3.8**

SRM Institute of Science and Technology, *Chennai, India* **May 2022**
Bachelor of Technology in Robotics Engineering (**Related Coursework** – Robotics 101, Machine Vision, Planning and Decision Making in Robotics, AI for Robotics and Vision) **GPA: 9.14**

WORK EXPERIENCE

Helping Hands Laboratory, Northeastern University, *Boston, MA* **Oct 2022 - Current**
Research Assistant (Algorithms/Technologies – *Reinforcement Learning, Deep Learning, Kalman Filter, Pybullet)*
- Developed a Few-shot imitation learning algorithm using Vision Transformers and Deep Learning, enabling robots to understand and manipulate object perspectives via imitation learning from a few demonstrations of unseen tasks
- Fine-tuned a real-time Segmentation Model and a DETR Object Detection Model using Detectron for detecting and segmenting individual objects in cluttered warehouse totes. Achieved a **23%** higher AP-75 score compared to Mask-RCNN baseline
- Implemented planar grasp detection using SE(2)-equivariant convolutional neural networks, significantly improving sample efficiency of grasp learning. and improved on real-time simulation
- Published paper (One shot Imitation Learning via interaction warping) in CoRL 2023, Arxiv - https://arxiv.org/abs/2306.12392

NUVERA FUEL CELLS, *Boston, MA* **Jan 2024 - July 2024**
Robotics/Automation Engineer (Algorithms - *Motion Planning, Opencv, Moveit2)*
- Designed and developed an automated stacking system to categorize Off-Stack Fuel Cells (OFFs) based on thickness, increasing sorting efficiency by **40%**. Also Using Modbus for seamless machine communication, ensuring autonomous coordination
- Programmed a UR10 robot-based pick-and-place system in ROS2 and MoveIt2, integrating the Cognex smart camera with an OpenCV boosting the stacking system's placement accuracy by **35%** and cutting down misplacement errors by **25%**.
- Developed Python scripting on Linux environments to automate system monitoring, logging and debugging tools, improving deployment efficiency on NVIDIA Jetson hardware.

FESTO INDIA, *Chennai, India* **June 2021 - Oct 2021**
Automation and Robotics Internship and Training Program (Algorithms/Technologies - *Codesys, CIROS, MATLAB)*
- Executed modifications on existing Industrial Electro-Pneumatics frameworks that resulted in optimized actuator response times this initiative reduced equipment cycle time from 12 seconds down to just 8 seconds per operation.
- Impelled and imitated diverse Industrial Manipulator Operations utilizing CIROS software and designed Control parameters that helped reduce production time by **11%**

DRDO LAB, *Hyderabad, India* **July 2020 - Dec 2020**
Robotics Software Engineer (Algorithms/Technologies *- Sensor Fusion, EKF, PID controller)*
- Developed a 4WD robot for lane tracking and autonomous path following by implementing a stereo camera tracking system using ROS object detection and Slam algorithms, reducing navigation errors by **50%**.
- Engineered a drone pose estimation system, Integrated IMU and GPS data through an Extended Kalman Filter (EKF), achieving a 15 cm Root Mean Square Error (RMSE) in position estimation, enhancing autonomous navigation accuracy.
- Engineered a real-time autonomous quadcopter landing system utilizing fiducial markers and robot pose estimation, improving landing accuracy by **25%**

ACADEMIC PROJECTS

Structure from Motion using Bundle Adjustment, *NEU* **Sept 2024 - Dec 2024**
Algorithms/Technologies – *Cholesky decomposition, Optical Flow, GTSAM, Non-linear Optimization, Pattern Matching*
- Leveraged a classical 3D reconstruction technique on NVIDIA Jetson nano for over 100 images, optimizing re-projection error from 600 to 3 px through BA.

Image Mosaicing and Depth Estimation, *NEU* **Sept 2023 - Dec 2023**
Algorithms/Technologies – *Feature detection, RANSAC, Homography, Epipolar Geometry, GTSAM, Visual Odometry*
- Formulated an algorithm for panorama generation from 25+ images, enhancing Homography estimation by 2 px through Pose Graph Optimization, and conducting multi-view stereo depth estimation using a monocular camera.

Autonomous Navigation and SLAM (Simultaneous Localization And Mapping), *NEU* **Aug 2022 - Dec 2022**
Algorithms/Technologies – *PRM, RRT, A*, Particle Filters, Non-Holonomic Motion, Iterative Closest Point (ICP). POMDP, Rviz*
- Led the development of an autonomous robot for recon missions in simulated disaster zones, utilized Cartographer-based SLAM and frontier exploration to achieve an 87% success rate in victim detection through extrinsic camera calibration

SKILLS

Programming Languages: C++, Python, MATLAB, JavaScript
Software and Frameworks: ROS, ROS2, Nvidia Isaac Sim, Gazebo, CUDA, GTSAM, Pybullet, Mujoco
Libraries and Tools: OpenCV, Sklearn, Pandas, NumPy, PyTorch, Eigen, Point Cloud Library, YOCTO, Modbus
DevOps & Cloud: AWS Services, Docker, CI/CD Pipelines, MLops