Vignesh Ravikumar

+1 (617) 447-6585 | E-Mail | LinkedIn | Portfolio | Github

Education

Northeastern University, Boston, MA *May 2023*
Master's in Electrical and Computer Engineering ***GPA: 3.73/4.0***

SSN College of Engineering, Chennai, India *Apr 2020*
Bachelor of Engineering in Electrical and Electronics Engineering

Relevant Courses: Advanced Computer Vision, Deep Learning, Robot Sensing & Navigation, Algorithms, Mobile Robotics, Applied Probability and Stochastic Processes, Applied Soft Computing

Technical Skills

Languages: C/C++, Python, SQL
Tools: Git, ROS, ROS2, Gazebo, CARLA, MATLAB
Frameworks: PyTorch, Tensorflow, Scikit, Gym
Libraries: Eigen, NumPy, SciPy, GTSAM, PCL, OpenCV

Experience

Research & Advanced Development Intern, Vecna Robotics *May 2022 – Aug 2022*

- Worked on pose estimation using ArUco markers for the Autocharge Stewart platform to charge autonomous forklifts and achieved **1-millimetre** level pose accuracy
- Integrated Zephyr RTOS with micro-ROS and ROS2 for communicating between vision, kinematics and firmware of the system and developed a code structure that aided Unit Testing and faster debugging
- Applied a Kalman Filter to denoise the position values from motors that drastically improved the pose accuracy from the order of centimetres to millimetres
- Developed a simple solution to reduce autonomous truck wait-time by **8 secs** and boosting robot productivity in a work-cell by adding a multi-frequency IR sensor to the sensor suite which got pushed to production

Research Assistant, SSN College of Engineering *Jun 2020 – July 2021*

- Modeled the inverted pendulum system using Lagrangian Mechanics, designed a double PID controller and deduced a novel Force-Voltage Parameter Correlation experiment that reduced settling time by **0.2 secs**
- Designed and studied an inertial sensor IMU-based and vision-based motion tracking system to control a 3 DOF robotic arm using Arduino Nano Microcontroller
- Implemented A* algorithm for a multi-robot system with waypoints generated using OpenCV; devised a novel priority scheduling algorithm and encoder-based motion feedback to reduce robot drift by **48%**

Projects

SegMask Frustum-PointPillars for 3D Object Detection *Dec 2022*

∗ Modified the Frustum-PointPillars architecture by replacing the gaussian mask with a PSPNet-based segmentation mask that achieved **mAP** score of **78.01** for cars class in KITTI-Hard
∗ Established real-time detection by adding a YOLOv7 2D detection layer instead of using KITTI ground truths

Multi-Task Learning HydraNet for Autonomous Driving *Nov 2022*

∗ Executed a multi-task learning network that can learn tasks like semantic segmentation and depth estimation at once in real-time using PyTorch that reduced the overall GPU usage by **50%**
∗ Trained a LightWeight RefineNet built on top of MobileNetv2 and applied a Cross-Entropy loss for segmentation and Inverse Huber loss for depth estimation that resulted in a frame rate of **15 FPS**

Structure from Motion using Unsupervised Learning *Oct 2022*

∗ Improved SfMLearner that estimates monocular depth and egomotion in KITTI dataset using Tensorflow
∗ Adjusted the loss function to include Structural Similarity Metric (SSIM) and changed the backbone model to ResNet that improved the depth accuracy and depth error by **5%**

Multi-Object Tracking using DeepSORT *Sep 2022*

∗ Implemented Deep Simple Online Realtime Tracking (SORT) to track multiple objects in a scene using PyTorch
∗ Utilized YOLOv5 for detection, Kalman filter for estimation and Hungarian algorithm for association
∗ Altered the architecture to include a Siamese Network with contrastive loss for deep appearance descriptor that resulted in **MOTA** accuracy of **61.4** in MOT16 dataset

PoseSLAM with Iterative Closest Point *Apr 2022*

∗ Formulated the Iterative Closest Point (ICP) algorithm for simultaneous localization and mapping (SLAM) using GTSAM library on LIDAR scans from Argo AI car dataset
∗ Utilized a factor graph to estimate the pose of a vehicle using ICP transforms between frames and GTSAM library to construct the factor graph and perform optimization for the vehicle's poses in world coordinates.

Structure from Motion using Classical Computer Vision *Mar 2022*

∗ Implemented the SfM pipeline involving the 8-point algorithm, Triangulation, Perspective-n-Point, Bundle Adjustment to reconstruct a building with a set of images utilizing Python and OpenCV
∗ Applied Levenberg-Marquardt optimization with a reprojection error cost function to optimize for depth and pose estimates

Publications

- **Ravikumar, V.**, Shreedharan, S. & Mahadevan, S.K. Design and control of real-time inverted pendulum system with force-voltage parameter correlation. *Int. J. Dynam. Control* 9, 1672–1680 (2021) [Link]
- H. Gokul, S. V. Kanna, H. Akshay Kumar and **V. Ravikumar**, "Design of Imitative Control Modalities for a 3 Degree of Freedom Robotic Arm," *2020 4th International Conference on Computer, Communication and Signal Processing (ICCCSP)*, 2020, pp. 1-6 [Link]
- **V. Ravikumar**, S. Shreedharan and M. S. Kumaran, "Priority Scheduling based Dynamic Path Planning System with Motion Feedback," *2020 First IEEE International Conference on Measurement, Instrumentation, Control and Automation (ICMICA)*, 2020, pp. 1-5 [Link]