

ABHISHEK NAYAK

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INTERESTS

Robotic perception, Path planning & Vehicle routing Algorithms, ADAS, Autonomous vehicles, Sensor Fusion, Machine Learning

EDUCATION

Ph.D. in Mechanical Engineering, Texas A&M University Aug 2017 - present

Thesis: Planning and Vision-based tools for Autonomous Vehicles

Master of Science in Mechanical Engineering, Texas A&M University Aug 2017 - Dec 2019

Thesis: Vision-based response of autonomous vehicles towards emergency vehicles using infrastructure enabled autonomy

B. Tech in Mechanical Engineering, National Institute of Technology Karnataka, Surathkal - India July 2010 - May 2014

SKILLS

Programming Python, MATLAB, ROS, C++, julia (beginner)

Packages Gazebo, pyTorch, Keras, TensorFlow

Solvers CPLEX, Gurobi

Libraries: OpenCV, scikit-learn, NetworkX, numpy, Eigen

Design: CREO Parametric, Solidworks, AutoCAD, CATIA v5

Other \LaTeX , Simulink, AVL Cruise, Linux, Adobe Photoshop

RELEVANT COURSEWORK

Coursera - Deep Learning Specialization | Analysis of Algorithms | Machine Learning | Robotic Perception | Stochastic systems | Applied Random Processes | Design of Non-Linear Control Systems | Reinforcement Learning | Robotics and Spatial Intelligence

EXPERIENCE & PROJECTS

Texas A&M Engineering Experiment Station (TEES), Texas A&M University

College Station, TX

Graduate Research Assistant at **Autonomous Systems Laboratory**

Aug 2017 - present

- **Robotic path planning algorithms in presence of obstacles**
 - Developed bounding approaches for curvature constrained shortest path planning algorithms in presence of obstacles.
- **Heuristics and Reinforcement learning models for curvature constrained vehicle routing problems**
 - Developed heuristics, Mixed-Integer programs (MIP), trained neural networks, and reinforcement learning (RL) models to solve curvature-constrained multi-vehicle routing problems.
- **Infrastructure Enabled Autonomy (IEA)**
 - Implemented object detection, classification, tracking, and semantic segmentation capabilities on roadside infrastructures for Vehicle-to-Infrastructure (V2I) based planning and control. Modelled the same environment in simulation using ROS Gazebo.
 - Performed sensor calibration and SLAM using Monte-Carlo particle filter and Extended Kalman Filters (EKF) to fuse IMU, LiDAR, GPS/RTK, and Odometry data on an autonomous Lincoln MKZ to enable decentralized motion planning and vehicle control.
- **Multi-Agent SLAM, motion planning and navigation using ROSbots**
 - Implemented multi-agent SLAM algorithms to obtain occupancy grid maps using autonomous frontier exploration on ROSbots.
 - Used ROSbots as a demonstration platform to showcase multi-agent path planning and vehicle routing algorithms.
- **Low-cost drive-by-wire system for Ford focus**
 - Worked on developing a low-cost drive-by-wire system using Arduino-Mega to control a Ford focus car via sensor emulation.

Texas A&M Transportation Institute

College Station, TX

Graduate Research Assistant

Jan 2018 - May 2021

- **Response of Autonomous Vehicles towards Emergency Response Vehicles (RAVEV)**
 - Generated a public image dataset for Emergency vehicles (EV); trained object detection, classification and tracking models developed using scikit-learn, TensorFlow, and Keras to identify Emergency vehicles.
- **Reference Machine Vision for ADAS functions**
 - Developed a reference system to benchmark lane marking materials and their effect on lane detection (LD) performance of perception algorithms used in Lane Departure Warning (LDW) and Lane Keep Assist (LKA) modules.

Other Projects

- **Simultaneous Localization and Mapping (SLAM) in a crowded urban environment using UrbanNav Dataset**
 - Fused Lidar, IMU, GPS, vehicle Odometry and SPAN-CPT (GNSS INS receiver) data using an Extended Kalman filter to localize the vehicle in a crowded urban environments and enable navigation.
- **Lyft Motion Prediction for Autonomous Vehicles** **Kaggle Competitions**
 - Performed detailed exploratory data analysis (EDA) and visualization, trained using ResNet CNNs to predict vehicle trajectories with multi-mode confidence.
- **Titanic - Machine Learning from Disaster** **Kaggle Competitions**
 - Performed data analysis, manipulation, parameter tuning and prediction using Random forrests, SVM and Adaboost to predict passenger survival based on the Titanic passenger Dataset on Kaggle. Achieved an Accuracy Score of 87.72%

TVS Motor Company Ltd, Hosur

Hosur, India

Member R&D - Powertrains

Aug 2014 - Aug 2017

- Developed mathematical models using MATLAB, designed powertrain components and performed engineering change management on TVS & BMW powertrain components.

SELECTED PUBLICATIONS

- Nayak, A., Pike, A., & Rathinam, S. (2022). *Effects of pavement markings on machine vision used in ADAS functions* (No. 22-xx-xxxx). SAE Technical Paper. (Under Review) 2022
- Nayak, A., Rathinam, S., Pike, A., & Gopalswamy, S. (2020). *Reference Test System for Machine Vision Used for ADAS Functions* (No. 2020-01-0096). SAE Technical Paper. 2020
- S. K. K. Hari, A. Nayak and S. Rathinam, *An Approximation Algorithm for a Task Allocation, Sequencing and Scheduling Problem Involving a Human-Robot Team*, in IEEE Robotics and Automation Letters, vol. 5, no. 2, pp. 2146-2153. 2020
- Krishna Hari, S., Nayak, A., & Rathinam, S. *An Approximation Algorithm for a Task Allocation, Sequencing and Scheduling Problem involving a Human-Robot Team*. In 2020 IEEE International Conference on Robotics and Automation (ICRA). 2020
- Ravipati, D., Chour, K., Nayak, A., Marr, T., Dey, S., Gautam, A., ... & Swaminathan, G., *Vision Based Localization for Infrastructure Enabled Autonomy*. In 2019 IEEE Intelligent Transportation Systems Conference (ITSC) (pp. 1638-1643). IEEE. 2019
- Nayak, A., Gopalswamy, S., & Rathinam, S. (2019). *Vision-Based Techniques for Identifying Emergency Vehicles* (No. 2019-01-0889). SAE Technical Paper. 2019
- Nayak, A., Chour, K., Marr, T., Ravipati, D., Dey, S., Gautam, A., Gopalswamy, S., and Rathinam, S., 2018. *A Distributed Hybrid Hardware-In-the-Loop Simulation framework for Infrastructure Enabled Autonomy*, arXiv preprint arXiv:1802.01787. 2018

LEADERSHIP

- **Brazos Valley Kannada Sangha, President** Sep 2021 - Present
- **Indian Graduate Students Association (IGSA) - TAMU, Advisor** Sep 2021 - present
- **Indian Graduate Students Association (IGSA) - TAMU, Senior Director - Mentoring** Sep 2017 - Aug 2019
- **Mechanical Engineering Graduate Student Organization (MEGSO) - TAMU, GPSG Liason** Sep 2017 - Dec 2017
- **Hobby & Flying Enthusiasts Club - NITK Surathkal, Convenor** Apr 2013 - Apr 2014

PROFESSIONAL ACTIVITIES & AFFILIATIONS

- **Robotics Club, Southwest Innovation Research Lab (SwIRL) - College Station** Sep 2021 - present
- **Judge - Robotics and Intelligent Machines, 2021 Virginia State Science and Engineering Fair (VSSEF)** Apr 2021
- **Peer Manuscript Reviewer - IEEE Transactions on Automation Science and Engineering, IEEE ITS**

AWARDS

- **Reed Tool Company Fellowship, Dept. of Mechanical Engineering, Texas A&M University** Aug 2020
- **Graduate Summer Research Grant 2020 (GSRG), Dept. of Mechanical Engineering, Texas A&M University** Apr 2020
- **Featured SAFE-D Student Researcher, SAFE-D UTC at Texas A&M Transportation Institute** Jan 2020
- **Graduate Student Travel Fellowship Award, Dept. of Mechanical Engineering, Texas A&M University** Oct 2019
- **Learning Facilitator Award, TVS Motor Company** Feb 2017

INVITED TALKS AND PRESENTATIONS

- **Safe-D Webinar on Reference Machine Vision for ADAS Functions, College Station - TX** Oct 2021
- **Safe-D UTC Graduate Student Leadership Development Seminar Series, College Station - TX** Oct 2019
- **Texas Mobility Summit, Arlington - TX** Oct 2018
- **Seminar on Intelligent Transportation Systems, NITK - Surathkal** Feb 2014