

# ABHISHEK NAYAK

4302 College Main St., Bryan, TX-77801 | (979)587-5347 | nykabhishek@gmail.com | nykabhishek.github.io

## INTERESTS

Motion planning, Robot perception, Computer Vision, ADAS, Connected 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

## SOFTWARE SKILLS

**Programming** Python, C++, MATLAB, ROS, git

**Packages** Gazebo, Keras, pyTorch, TensorFlow

**Solvers** CPLEX, Gurobi

**Libraries:** OpenCV, scikit-learn, XGBoost, NetworkX, NumPy

**Design:** CREO Parametric, Solidworks, AutoCAD, CATIA v5

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

## RELEVANT COURSEWORK

Coursera - Deep Learning Specialization, Self-Driving Cars Specialization | Analysis of Algorithms | Robotic Perception | Stochastic optimization | Machine Learning | Applied Random Processes | Design of Non-Linear Control Systems | Robotics and Spatial Intelligence

## EXPERIENCE & PROJECTS

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

**Aug 2017 - present**

*Graduate Research Assistant, Autonomous Systems Laboratory*

*College Station, TX*

- **Planning algorithms for robots in the presence of obstacles**

- Developed algorithms to establish bounds for shortest path problems of motion-constrained agents in the presence of obstacles.

- **Heuristics and reinforcement learning models for motion constrained multi-agent vehicle routing problems**

- Developed graph search heuristics, formulated mixed-integer programs (MIP) for optimization solvers, trained graph neural networks, and reinforcement learning (RL) models for min-max mission planning for a fleet of non-holonomic vehicles.

- **Infrastructure Enabled Autonomy (IEA)**

- Implemented computer vision stacks for object detection, tracking, segmentation, and localization for Vehicle-to-Infrastructure (V2I) connected autonomy in Smart Cities. Modeled the Hardware-In-Loop (HIL) environment using Gazebo.
- Established DSRC network using UDP protocol, calibrated cameras and sensors, performed SLAM by fusing IMU, Camera, GPS/RTK, and odometry data using estimation filters (Monte-Carlo and Extended Kalman Filters (EKF)) on an autonomous Lincoln MKZ.

- **Multi-Agent SLAM, Motion Planning, and Navigation using ROSBots**

- Implemented multi-agent SLAM to obtain neighborhood maps using point clouds from LiDARs and cameras.
- Performed indoor navigation using graph-based (Dijkstra, A\*) and sampling-based (RRT, PRM) planning algorithms.

- **Low-cost drive-by-wire system for Ford focus**

- Developed prototypes of a low-cost drive-by-wire system to control Ford focus car via sensor emulation using Arduino-Mega.

**Texas A&M Transportation Institute**

**Jan 2018 - May 2021**

*Graduate Research Assistant*

*College Station, TX*

- **Response of Autonomous Vehicles towards Emergency Response Vehicles (RAVEV)**

- Generated an Emergency Vehicle (EV) image dataset. Trained object detectors to identify and track EVs in crowded environments.
- Used openCV, Scikit-Learn, xgBoost, Tensorflow and Keras to develop machine learning perception models for EV classification.

- **Reference Machine Vision for ADAS functions**

- Generated a lane detection (LD) dataset to study the relationship between lane markings and LD algorithms used in ADAS.
- Proposed a reference system for state agencies and OEMs to benchmark lane marking quality and its effect on LD performance.

### Other Projects

- **Self-Driving Cars Specialization - Perception, Behavior Prediction and Motion Planning using CARLA Simulator**

**Coursera**

- Implemented a longitudinal (PID) and lateral (Stanley) controller to execute waypoint following for a vehicle at desired speeds.
- Used a semantic segmentation neural network data to implement a derivable space estimator in 3D, lane estimator, and distance to object estimator using a calibrated pinhole camera data.
- Built a functional motion planning stack consisting of a behavioural planner, collision checker, local planner, path optimizer, and velocity planner for a self-driving vehicle that can avoid static and dynamic obstacles and handle stop signs.

- **Simultaneous Localization and Mapping (SLAM) in crowded urban environments using UrbanNav Dataset**

- Implemented a vehicle state estimator by fusing data from Lidar, IMU, GPS/RTK, vehicle odometer, and SPAN-CPT (GNSS INS receiver) sensors to localize vehicles in crowded urban environments using an Extended Kalman filter (EKF).

- **Lyft Motion Prediction for Autonomous Vehicles**

**Kaggle Competitions**

- Performed detailed exploratory data analysis (EDA), data visualization, and trained data-driven deep learning models using ResNet CNN to predict vehicle trajectories and behavior with multi-mode confidence on Lyft's Level 5 dataset.

- **Titanic - Machine Learning from Disaster**

**Kaggle Competitions**

- Performed data analysis, dimensionality reduction, parameter tuning, and prediction using ML models like Random forests, SVM, and Adaboost to predict passenger survival on the Titanic passenger dataset, and achieved an accuracy score of 87.72%.

## TVS Motor Company Ltd, Hosur

Member R&D - Powertrains

Aug 2014 - Aug 2017

Hosur, India

- Developed mathematical models in MATLAB/Simulink; designed and handled change management of TVSM powertrain components.
- Collaborated with cross-functional teams on new product development; handled sensor procurement by interacting with suppliers.

## SELECTED PUBLICATIONS

- Nayak, A., Pike, A., & Rathinam, S. (2022). *Effect of pavement markings on machine vision used in ADAS functions* (No. 2022-01-0154). SAE Technical Paper. 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  
Served as president of this non-profit organization for Kannadigas in Brazos County, Texas, promoting social and cultural activities.
- **Indian Graduate Students Association (IGSA) - TAMU, Advisor** Sep 2021 - present  
**Indian Graduate Students Association (IGSA) - TAMU, Senior Director - Mentoring** Sep 2017 - Aug 2019  
Mentored over 1500 new incoming graduate students and worked towards solving unique issues faced during on-boarding.
- **Mechanical Engineering Graduate Student Organization (MEGSO) - TAMU, GPSG Liaison** Sep 2017 - Dec 2017  
Served as a MEGSO representative at the Graduate & Professional Student Government (GPSG) Senate meetings, voicing concerns of mechanical engineering graduate students to student government.
- **Technical Events at NITK Engineer 2013, Joint-Convenor** Mar 2013 - Oct 2013  
Organized mechanical engineering-related competitions at the annual technical symposium of NITK Surathkal, which has a participation of around 6000 students from over 150 colleges across 65 countries.
- **Flying & Robotics Club - NITK Surathkal, President** Apr 2013 - Apr 2014  
Led a team of 36 robotics and aerial vehicle enthusiasts, initiated a monthly newsletter, and organized 5 collegiate events.

## 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