ABHISHEK NAYAK

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

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)
Libraries: OpenCV, ROS, NetworkX, numpy, Pandas
Packages scikit-learn, pyTorch, Keras, TensorFlow, CPLEX
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 - Dec 2017), Sep 2021 - present*

- ***Robotic path planning algorithms in presence of obstacles***
  - Developed new bounding approaches for curvature constrained shortest path problems in presence of obstacles.
- ***Heuristics and Reinforcement learning models for curvature constrained vehicle routing problems***
  - Developed heuristics, and Trained reinforcement learning (RL) models, recurrent neural networks (RNN's), LSTM networks, and Encoder-Decoder neural networks to learn combinatorial optimization problems and graph networks using PyTorch.
  - Formulated Mixed-Integer programs (MIP) to solve large-scale motion planning problems using CPLEX and Gurobi solvers on high-performance computing servers.
- ***Infrastructure Enabled Autonomy (IEA)***
  - Modelled 3D robotic simulation environments to test perception algorithms, vehicle SLAM, and control for IEA distributed intelligence architecture using ROS Gazebo Sim.
  - Setup Vehicle-to-Vehicle (V2V) and Vehicle-to-Infrastructure (V2I) communication for remote planning and control using DSRC.
  - Performed semantic segmentation, object detection, classification, pose estimation, tracking, and visual Simultaneous Localization and Mapping (vSLAM) by fusing Lincoln MKZ vehicle data and camera data from 30ft high roadside infrastructures.
  - Implemented Monte-Carlo particle filter, Kalman filter, and Extended Kalman Filter (EKF) methods for SLAM using distributed sensor-fusion data to achieve decentralized motion planning and vehicle control.
- ***Low-cost drive-by-wire system for Ford focus***
  - Developed a low-cost drive-by-wire system on 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)***
  - Trained computer vision models for detecting Emergency vehicles (EV) using deep learning; developed object tracking algorithms, and localization for autonomous vehicles and smart road-side infrastructures using Python and ROS.
  - Generated an EV detection and classification public dataset to address the lack of specialized datasets for emergency scenarios.
  - Developed classification models using scikit-learn, and neural networks using Keras and Tensorflow to identify EV.
  - Implemented high-speed response protocols and controllers for autonomous vehicles during emergencies.
- ***Reference Machine Vision for ADAS functions***
  - Created Lane detection (LD) datasets for road infrastructure development to support Autonomous Vehicles and ADAS.
  - Investigated the effect of lane marking material properties on LD performance and proposed a reference system to benchmark lane marking materials and perception algorithms to improve Lane Departure Warning (LDW) and Lane Keep Assist (LKA).

Other Projects

- ***Multi-Agent SLAM and navigation using ROSBots*** **Kaggle Competitions**
  - Implemented multi-agent slam algorithms to obtain occupancy grid maps using multiple car-like robots (ROSbot 2.0).
  - Used ROSBots as a demonstration platform to showcase the path planning / vehicle routing algorithms I developed.
- ***Lyft Motion Prediction for Autonomous Vehicles*** **Kaggle Competitions**
  - Performed detailed exploratory data analysis (EDA) and data visualization using Lyft's L5Kit module, Bokeh and matplotlib.
  - Trained the Lyft Motion prediction dataset using ResNet CNNs to predict vehicle trajectories with multi-mode confidence.
  - Alternatively, also explored Extended Kalman filters to predict vehicle trajectory confidence scores on the Lyft dataset.

- ***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 - Engines group *Aug 2014 - Aug 2017*
- Designed powertrain components, investigated system dynamics, and performed performance testing on TVS & BMW Engines.
- Performed engineering change management and PLM for engines on vehicles with a sale count > 200,000/month
- Developed mathematical models of engine valve-train components using MATLAB, AVL cruise and performed HIL verification.

SELECTED PUBLICATIONS

- Nayak, A., Pike, A., & Rathinam, S. (2022). *Effects of pavement markings on machine vision used in ADAS functions* (No. 2020-01-0096). 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
  Served as the president of this social and cultural non-profit organization for Kannadigas in Brazos County, Texas - USA
- **Indian Graduate Students Association (IGSA) - TAMU**, *Advisor* Sep 2021 - present
  Indian Graduate Students Association (IGSA) - TAMU, *Senior Director - Mentoring* Sep 2017 - Aug 2019
  Served as a core team member in mentoring over 300 incoming graduate students and worked for their advancement.
- **Mechanical Engineering Graduate Student Organization (MEGSO) - TAMU**, *GPSG Liason* Sep 2017 - Dec 2017
  Represented MEGSO at the Graduate & Professional Student Government (GPSG) Senate meetings, voicing concerns of mechanical engineering graduate students to the student government.
- **Hobby & Flying Enthusiasts Club - NITK Surathkal**, *Convenor* Apr 2013 - Apr 2014
  Led a team of 36 UAV enthusiasts; initiated a monthly newsletter and organised 5 intra-college events.

PROFESSIONAL ACTIVITIES & AFFILIATIONS

- **Robotics Club, Southwest Innovation Research Lab (SwIRL) - College Station** Sep 2021 - present
  - Mentored young Aggies interested in Robotics, to learn and innovate at this non-profit space.
- **Judge - Robotics and Intelligent Machines**, *2021 Virginia State Science and Engineering Fair (VSSEF)* Apr 2021
- **Peer Manuscript Reviewer**
  (`https://publons.com/researcher/2046900/abhishek-nayak/peer-review/`)
  - IEEE Transactions on Intelligent Transportation Systems
  - IEEE Transactions on Automation Science and Engineering

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