

# ABHISHEK NAYAK

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## EDUCATION

**Texas A&M University, College Station, Texas**

Aug 2017 - Dec 2021 (expected)

Doctor of Philosophy in Mechanical Engineering

Advisor: Dr. Sivakumar Rathinam

**Texas A&M University, College Station, Texas**

Aug 2017 - Dec 2019

Master of Science in Mechanical Engineering

GPA:3.125

Thesis: Development of vision-based response of autonomous vehicles towards emergency vehicles using IEA

Advisor: Dr. Sivakumar Rathinam

**National Institute of Technology Karnataka, Surathkal - India**

July 2010 - May 2014

Bachelor of Technology in Mechanical Engineering

## RESEARCH INTERESTS

Autonomous vehicles, Computer-Vision, Algorithms, Motion planning & Vehicle routing, Machine Learning

## SKILLS

<b>Programming</b>	Python, MATLAB, ROS, OpenCV
<b>ML Packages</b>	scikit-learn, TensorFlow, Keras, numPy, Pandas
<b>Analysis</b>	SIMULINK, CREO Simulate, CREO Mechanism, AVL Cruise
<b>Design</b>	CREO Parametric (certified Sep 2015), Solidworks, AUTOCAD, CATIA v5
<b>Other</b>	L <sup>A</sup> T <sub>E</sub> X, Linux, Adobe Photoshop

## PROJECTS

**Reference Machine Vision for ADAS functions**

Feb 2019 - present

*Texas A&M Transportation Institute (TTI) - College Station, TX*

- The objective of this project is to develop a reference Lane Detection (LD) system to be used by transportation agencies and OEM's as a benchmark for evaluating different lane markings, sensors and perception algorithms.
- Collected an extensive video dataset by driving on various roads in Central Texas comprising of different weather conditions, time of day, pavement markings and road marking luminance values.
- Measured various pavement marking material performance, and evaluated their LD performance with different LD algorithms like SCNN, Lanenet, E-Net, and other state-of-the art LD systems and algorithms.

**Response of Autonomous Vehicles to Emergency Response Vehicles (RAVEV)**

Jan 2018 - Jun 2019

*Texas A&M Transportation Institute (TTI) - College Station, TX*

- Developed methods for an autonomous vehicle (AV) to safely respond to different classes of emergency vehicles (EV) using sound, vision and other on-board sensors in emergency response scenarios.
- Developed vision-based EV detection, tracking and localization capabilities for the smart road-side infrastructure using Python and ROS. Developed a RAVEV image dataset as a part of the project for identifying emergency vehicles.
- Developed an EV classification neural network using Keras, and evaluated its performance against SVM, kNN, AdaBoost, Random Forrest, XGBoost for Image pixel array, Color Histogram and HOG feature vectors on RAVEV dataset.
- Implemented the EV detection algorithm on a FORD Lincoln MKZ autonomous vehicle and integrated it with vehicle control for safe curb-side parking of the AV by simulating emergency scenarios.

**Infrastructure Enabled Autonomy (IEA)**

Sep 2017 - Jun 2019

*CAST Program, Texas A&M University - College Station, TX*

- Part of the 3 person team that developed a distributed intelligence architecture for connected autonomous vehicle control by offloading core computational functionalities to the infrastructure.
- Setup the DSRC communication network based on UDP protocol for V2V, V2I, and I2I between intelligent road-side units and drive-by-wire enable vehicles.

- Developed machine vision capabilities including object detection, tracking and localization for on-road objects on smart road-side infrastructures using ROS architecture.

#### **Development of autonomous driving capability on a Ford Focus**

**Sep 2017 - Dec 2017**

*CAST Program, Texas A&M University - College Station, TX*

- Developed low-cost drive-by-wire control capabilities for a Ford focus car via sensor emulation using Arduino Mega.

#### **Stability analysis of a powered 2-wheeler vehicle**

**July 2013 - May 2014**

*Undergraduate thesis Project, National Institute of Technology Karnataka - Surathkal*

- Analyzed the factors affecting stability of a motorcycle during curve negotiation and developed a Hardware in Loop feedback 'controller to enhance vehicle stability on a real-time basis.

### **RESEARCH PUBLICATIONS**

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), Auckland, New Zealand, 2019, pp. 1638-1643. 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

Abhishek Nayak, Ashwin H.S and Dr. S M Murigendrappa *Stability Enhancement of a Powered Two-Wheeler Vehicle under Curve Negotiation*, Vol. 7 - Issue. 4, International Journal of Mechanical Engineering and Technology (IJMET), 2016, ISSN Print: 0976-6340 and ISSN Online: 0976-6359. 2016

### **INVITED PRESENTATIONS**

**Safe-D UTC Graduate Student Leadership Development Seminars** **October 10, 2019**  
*Reference Machine Vision for ADAS Functions* *Seminar*

**Automated Vehicles Symposium 2019, Orlando FL** **July 16, 2019**  
*Reference Machine Vision for ADAS Functions* *Poster*

**CSCRS Safe Systems Summit, Durham NC** **Apr 23-24, 2019**  
*Response of Autonomous Vehicles to Emergency Vehicles* *Poster*

**4th Annual Texas A&M Transportation Technology Conference, College Station TX** **April 30, 2019**  
*Response of Autonomous Vehicles to Emergency Vehicles* *Posters*  
*Reference Machine Vision for ADAS Functions*

**3rd Annual Texas A&M Transportation Technology Conference, College Station TX** **May 8, 2018**  
*Response of Autonomous Vehicles to Emergency Vehicles* *Poster*

**Texas Mobility Summit - Demo Day, Arlington TX** **October 28, 2018**  
*Response of Autonomous Vehicles to Emergency Vehicles* *Poster*

### **WORK EXPERIENCE**

**Texas A&M Transportation Institute (TTI), College Station, TX** **Jan 2018 - Present**  
*Graduate Research Assistant*

**Texas A&M Engineering Experiment Station (TEES), College Station, TX** **Aug 2017 - Jan 2018**  
*Student Technician*

**TVS Motor Company Ltd, Hosur** **Aug 2014 - Aug 2017**  
*Member R&D (Design & Development Engineer Engine Valvetrain & Timing Drive)*

- Involved in CAD design & development of Valvetrain & timing drive components for TVS & BMW power-trains including Apache RTR200 4V, Apache RR310, Victor, BMW G310R and its life-cycle management.
- Developed mathematical models of Valvetrain and Timing drive using MATLAB, and conducted experiments to improve engine dynamics in Jupiter, Victor, Apache RTR200, Apache RR310 and BMW G310R models.
- Involved in design & development of concept VVT engines, Cam-phaser camshaft & Internal-EGR Concepts for 125cc to 200cc capacity engines to achieve target performance, improve fuel economy (about 10%) and meet EU IV emission standards.

**TVS Motor Company Ltd, Hosur**

June - July 2013

*Research Intern*

- Mathematical modeling & experimental validation of timing drive dynamics in a 110cc engine.

**Bharath Fritz Werner Ltd. (BFW), Bangalore**

June 2012

*Student Intern*

- Tact-time reduction and assembly optimization of CNC Machines in SMD (Special Machines Division).

## RELEVANT COURSEWORK

Analysis of Algorithms — Control System Design — Design of Non-Linear Control Systems — Applied Random Processes — Intro. to Classical Analysis — Survey Optimization — Modeling and analysis of Mechanical systems

## POSITION OF RESPONSIBILITY

**Senior Director - Mentoring, Indian Graduate Students Association (IGSA)**

Sep 2017 - Aug 2019

*Texas A&M University*

- Served as core member of the team that oversaw the mentoring of about 2000 new incoming graduate students every year, by recognizing the unique issues faced by them and helping them acclimatize to graduate school at Texas A&M.

**Graduate and Professional Student Government (GPSG) - Liaison**

Sep 2017 - Dec 2017

*Mechanical Engineering Graduate Student Organization (MEGSO) - TAMU*

- Represented MEGSO at the GPSG Senate meetings, voicing concerns of the mechanical engineering graduate students to the student government.

**Convenor - Hobby & Flying Club**

April 2013 - April 2014

*National Institute of Technology Karnataka, Surathkal*

- Administrative in-charge and signing authority of the UAV enthusiasts club at NITK consisting of 36 members, and with an annual budget of 25000INR.

**Joint-Convenor - Mechanical Events at ENGINEER 13**

Apr 2013 - Oct 2013

*National Institute of Technology Karnataka, Surathkal*

- Joint Administrative in-charge of organizing competitions on Mechanical engineering at the Annual Technical Symposium of NITK Surathkal with over 6000 student participants from 150 colleges across 65 countries

**Executive member, SAE INDIA NITK Chapter**

Sep 2011- May 2014

*National Institute of Technology Karnataka, Surathkal*

## EXTRA-CURRICULAR

- Seminar on **Intelligent Transportation Systems**, discussing Vision-based Lane & Vehicle detection techniques in modern vehicles, *NITK - Surathkal* Feb 2014
- Secured 2nd place in **VELOCITY** - A national level IC engine based RC car competition at ENGINEER '12 (Annual technical symposium of NITK) Oct. 2012
- Participated in the **10th National Budokan Karate Championship** Nov. 2007

## AWARDS & ACHIEVEMENTS

- Graduate Summer Research Grant 2020 (GSRG)  
*Department 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
- Learning Facilitator Award, *TVS Motor Company* Feb 2017
- MHRD Scholarship, *Ministry of Human Resource Development, Govt. of India* June. 2010