ABHISHEK NAYAK

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EDUCATION

Texas A&M University, College Station, Texas Aug 2017 - Aug 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
Thesis: Development of vision-based response of autonomous vehicles towards emergency vehicles using IEA
Advisor: Dr. Sivakumar Rathinam

National Institute of Technology Karnataka, Surathkal July 2010 - May 2014
Bachelor of Technology in Mechanical Engineering

RESEARCH INTERESTS

Autonomous vehicles, Computer-Vision, Algorithms, Multi-Agent Path Planning, Machine Learning

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

SKILLS

Programming	Python, MATLAB, ROS, OpenCV
ML Packages	scikit-learn, TensorFow, Keras, numPy, Pandas
Analysis	SIMULINK, CREO Simulate, CREO Mechanism, AVL Cruise
Design	CREO Parametric (certified Sep 2015), Solidworks, AUTOCAD, CATIA v5
Other	LaTeX, 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 that will provide 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.
- Evaluated the dataset on different state-of-the art LD algorithms like SCNN, Lanenet, E-Net, and ranked their performance based on a set of metrics specifically developed for evaluating the LD effectiveness.
- The goal is to create a system that can be used by transportation agencies and OEM's to validate the effectiveness of pavement markings and vision algorithms through a systematic development of LD metrics, and testing procedures.

Response of Autonomous Vehicles to Emergency Response Vehicles (RAVEV) **Jan 2018 - Jun 2019**
Texas A&M Transportation Institute (TTI) - College Station, TX

- The objective of this project was to explore how an autonomous vehicle must safely respond to different classes of emergency vehicles using sound, vision and other on-board sensors.
- Developed vision-based emergency vehicle detection, tracking and localization capabilities for the smart road-side infrastructure using Python and ROS.
- Implemented YOLO-v3 for object detection. Developed a RAVEV image dataset as a part of the project for detecting emergency vehicles and trained it on YOLO-v3 and achieved 84% accuracy.
- Developed a TensorFlow-based 3-layer neural network using Keras for object classification, and evaluated its performance against SVM, kNN, AdaBoost, Random Forrest, XGBoost for Image pixel array, Color Histogram and HOG feature vectors on RAVEV dataset.

Infrastructure Enabled Autonomy (IEA) **Sep 2017 - Jun 2019**
CAST Program, Texas A&M University - College Station, TX

- The objective of this project was to develop a distributed intelligence architecture for connected autonomous vehicles by offloading core computational functionalities to the infrastructure.
- I 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 like 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

- Implemented a low-cost drive-by-wire control capabilities on a Ford focus 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.

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)

- 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.
- Experienced in Product management and development techniques like Design Reviews (TDR), Engineering Change Management (ECM), Product Benchmarking, DFX, DFMEA, Patent Survey, Value Engineering (VA/VE).
- 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).

RESEARCH PUBLICATION

Nayak, Abhishek, Adam Pike, Sivakumar Rathinam, and Swaminathan Gopalswamy. *Reference test system for machine vision used for ADAS functions.* No. 2020-01-0096. SAE Technical Paper 2020

Hari, Sai Krishna, Abhishek Nayak, and Sivakumar Rathinam. *An Approximation Algorithm for a Task Allocation, Sequencing and Scheduling Problem involving a Human-Robot Team*, 2020 IEEE International Conference on Robotics and Automation (ICRA) 2020

Deepika Ravipati, Kenny Chour, Abhishek Nayak, Tyler Marr, Sheelabhadra Dey, Alvika Gautam, Sivakumar Rathinam, Swaminathan Gopalswamy, *"Vision Based Localization for Infrastructure Enabled Autonomy"*, 2019 IEEE Intelligent Transportation Systems Conference (ITSC), Auckland, New Zealand, 2019, pp. 1638-1643. 2019

Nayak, Abhishek, Sivakumar Rathinam, and Swaminathan Gopalswamy. *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
Reference Machine Vision for ADAS Functions *Posters*

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*

POSITION OF RESPONSIBILITY

Senior Director - Mentoring, Indian Graduate Students Association (IGSA) Sep 2017 - Aug 2019
Texas A&M University

- Mentor the new incoming graduate students and help in their orientation at Texas A&M

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

ACHIEVEMENTS

- Learning Facilitator Award, *TVS Motor Company* Feb 2017
- MHRD Scholarship, *Ministry of Human Resource Development, Govt. of India* June. 2010