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, Motion planning & Vehicle routing Algorithms, Machine Learning, Reinforcement Learning

SKILLS

Programming	Python, MATLAB, ROS, julia (beginner)
ML Packages	scikit-learn, pyTorch, Keras, TensorFlow
Libraries	openCV, NetworkX (graphs), numpy, Pandas
Design	CREO Parametric (certified Sep 2015), Solidworks, AUTOCAD, CATIA v5
PLM	PTC Windchill
Other	LaTeX, SIMULINK, AVL Cruise, Linux, Adobe Photoshop

PROJECTS

Heuristics and Reinforcement learning for Combinatorial Optimization **Mar 2020 - present**
Autonomous Systems Laboratory - College Station, TX

- Developed heuristics for NP-hard problems like Dubins Travelling Salesman Problem (Dubins TSP), and its variants.

- Trained recurrent neural network (RNN) models to generate feasible tours for the Dubins TSP problem and simultaneously predict tour costs using reinforcement learning techniques.

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 performance with different neural-network based 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 control response methods like curbside parking 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 scenarios.

- Developed vision-based EV detection, tracking and localization capabilities for the smart road-side infrastructure using Python and ROS. Developed RAVEV image dataset as a part of this project for EV detection and classification.

- Developed an EV classification neural network using Keras, and evaluated its performance on RAVEV dataset against ML classifiers like SVM, kNN, AdaBoost, Random Forrest, XGBoost for Image pixel array, Color Histogram and HOG feature vectors.

- Implemented EV detection algorithms on a FORD Lincoln MKZ autonomous vehicle and integrated it with vehicle control for safe curbside 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.

Development of a VVT Mechanism for a 125cc engine   Jan 2016 - Aug 2017
TVS Motor Company, Hosur

- Developed mathematical models to evaluate the cam dynamics of a complete VVT design concept based on a crank rocker 4 bar mechanism for a 125cc engine using MATLAB.
- Involved in end-to-end engine development from suggesting Engineering Changes to the design concepts, fabrication, and Engine ECU control optimization to meet target performance, fuel economy & EU IV emission standards.

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 TALKS & PRESENTATIONS

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

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*

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.
- Supervised the procurement of Sensors & Test equipment worth 20,000,000INR to enhance TVS testing facilities.
- Developed concept VVT engines, Cam-phaser camshafts & 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 — Machine Learning — Control System Design — Design of Non-Linear Control Systems — Applied Random Processes — Intro. to Classical Analysis — Survey Optimization — Modeling and analysis of Mechanical systems

Deep Learning Specialization Sep 2020
deeplearning.ai, **Coursera**

POSITION OF RESPONSIBILITY

Graduate Peer Mentor - College of Engineering Academic and Student Affairs Aug 2020 - present
Texas A&M University - College Station

- Assisted new graduate students as a helpful guide, providing experience and advice about research, networking, time management, relationships with advisors and faculty, and much more.

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

- Served as core member of the team that oversaw the mentoring of about 1000 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 (GPSC) - 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 25000 INR.

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 held at ENGINEER '12 (Annual technical symposium of NITK)   Oct. 2012
- Participated in the **10th National Budokan Karate Championship**   Nov. 2007

PROFESSIONAL ACTIVITIES & AFFILIATIONS

Peer Reviewer: IEEE Transactions on Intelligent Transportation Systems (https://bit.ly/2EH6ja1)
Affiliations: SAE, IEEE

AWARDS & ACHIEVEMENTS

- Reed Tool Company Fellowship
  J. Mike Walker '66 Dept. of Mechanical Engineering, Texas A&M University.   Aug 2020
- Graduate Summer Research Grant 2020 (GSRG)
  J. Mike Walker '66 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
  J. Mike Walker '66 Dept. of Mechanical Engineering, Texas A&M University.   Oct 2019
- Learning Facilitator Award, *TVS Motor Company*   Feb 2017
- MHRD Scholarship, *Ministry of Human Resource Development, Govt. of India*   Jun 2010