

# Keshav Bagri

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## EDUCATION

### Indian Institute of Technology, Kharagpur

*B.Tech (Hons.) in Mechanical Engineering [CGPA: 9.19/10 (upto 7 semesters)]*

*Micro Specialization in Embedded Control, Software, Modelling and Design [CGPA: 9.64/10]*

Kharagpur, India

July'18 – May'22

### Aditya Academy Secondary

*AISSCE (Grade: 93.6%) | CBSE Class X (CGPA: 9.8/10)*

Kolkata, India

2016 – 2018

## WORK EXPERIENCE

### Translation of Scenario Description Language for ADS simulation

*Research Collaborator | Guides: Dr. S. Khastgir & Dr. A. Bruto Da Costa | NAIC*

WMG, University of Warwick

Jan'22 – Present

- ◇ Developing the framework for translation between different levels of SDL for easier integration with ADS simulation softwares

### Performance assessment of Driver-in-Loop Simulators

*UG Research Assistant | Supervisor: Dr. Jeffrey P. Chrstos | CAR | [Description]*

The Ohio State University

Feb'21 – Mar'22

- ◇ Worked on the validation of **IMU data** collected from different locations using physics-based transformation & noise filtering
- ◇ Proposed the **testing methodology** for the simulator's platform's motion and analysed the results in essence of the OMCT
- ◇ Utilized the output of **LVDTs** for multiple displacement inputs to compute the platform's **roll & pitch** angles in MATLAB
- ◇ Reviewed literature for absolute and relative validity of medium fidelity D-i-L simulators for **physical validation**

### Memory footprint & inference time reduction for Deep Learning models

*Summer Intern | Mentors: Ravish Kumar & Rahul Jain | [Description]*

KPIT Technologies Ltd

May'21 – July'21

- ◇ Worked on the comparison between compilers & DL frameworks using pre-trained models for **performance analysis**
- ◇ Generated **deployable executables** using AI compilers like TVM, Glow to substantially reduce memory & inference time
- ◇ Developed a consolidated method of **hardware-specific** deployment of DL models commonly used in automotive applications

### SLAM for autonomous cargo delivery vehicles

*Winter Intern | Mentor: Dr. Naveen Arulsevan | [Description]*

Ati Motors, Bengaluru

Nov'20 – Jan'21

- ◇ Studied the **OctoMap** mapping and implemented open-source datasets to facilitate better visualization of 3D maps
- ◇ Explored multiple **SLAM algorithms** like IMLS, EKF, Gmapping, etc. to select an efficient method for implementation
- ◇ Implemented the **Particle Filter** SLAM algorithm to build maps on a 2D grid using lidar and wheel odometry in Python
- ◇ Analysed the effects of multiple **resampling algorithms** and variation in **hyperparameters** on the map's quality

### Applications of ML methods in motion planning of autonomous vehicles

*Research Intern | Supervisors: Prof. Leena Vachhani & Prof. Arpita Sinha | [Description]*

ARMS Lab, IIT Bombay

July'20 – Oct'20

- ◇ Formulated the **Markov Decision Process** representation of the scenarios considering different state and action spaces
- ◇ Coded an **automatic controller** in Python to collect real-time client data & images from the CARLA Simulator
- ◇ Generated training datasets for a **RL model** for the safe traversal of an autonomous vehicle in a **campus-like environment**
- ◇ Developed a **Finite State Machine** for lane following & 2-way lane intersection (without traffic signals) management

## PROJECTS

### Powertrain Development | TeamKART, Formula SAE | [Description] | [Website]

*Supervisor: Dr. Dhananjay Kumar Srivastava | Mechanical Engineering Department*

IIT Kharagpur

June'19 – Aug'21

- ◇ Worked on the design of a custom **reactive muffler** for noise reduction from a vehicle, with an insertion loss of **25 dB**
- ◇ Designed the **fuel tank** and the mounting arrangement for the vehicle considering the optimal capacity requirement
- ◇ Designed and analyzed the components of the **transmission** and **cooling system** for a standard FSAE electric vehicle
- ◇ Engineered the **intake manifold & crossflow radiator** for a single cylinder engine, producing a power output of **35 HP**
- ◇ Performed **engine simulations** in Ricardo WAVE and **CFD analysis** using Ansys Fluent for designing the intake manifold

### Fault Tolerant Control System for Electric Vehicles | [Bachelor's Thesis Project]

*Supervisor: Dr. Somnath Sengupta | Advanced Technology Development Center*

IIT Kharagpur

Feb'21 – Present

- ◇ Developed a non-linear **state estimator** using equations for vehicle dynamics to produce reliable estimates of vehicle's states
- ◇ Worked on the modelling of integrated **ABS & regenerative braking** for efficient braking & max energy recuperation
- ◇ Prepared the complete **electro-mechanical** model for a RWD EV for analysing the effect of faults & the control strategy
- ◇ Studied various EV and HEV architectures along with powertrain and vehicle dynamics control systems required for modelling

**Mathematical modelling of Li-ion batteries focusing on Si anode particles** **IIT Kharagpur**  
*Supervisor: **Dr. Jeevanjyoti Chakraborty** | Mechanical Engineering Department | [\[Description\]](#)* *Feb'20 – Jan'21*

- ◊ Studied the mechanics behind **crack development** and formation of amorphous lithiated Si with time around the Si anode
- ◊ Solved Ordinary and Partial differential equations, using **Finite Difference & Liebmann's methods**, in Python
- ◊ Established a **two-way coupling** relation between diffusion & stress, to understand the effect of one parameter on the other

**Self-driving Cars Specialization, Coursera** **University of Toronto**  
*Supervisors: **Prof. Steven Waslander and Prof Jonathan Kelly** | [\[Description\]](#) | [GitHub](#)* *Apr'20 – June'20*

- ◊ Implemented & tested control algorithms like **LQR, PID, Stanley, Pure Pursuit & MPC** for autonomous vehicle control
- ◊ Designed an **EKF** for state estimation & localization of an autonomous vehicle using **IMU, GPS & LIDAR** sensor data
- ◊ Estimated the **drivable space, lane and distance to obstacles** using the segmented image from a **CNN model**
- ◊ Developed the **behavioral & local planners** to generate a collision-free path, using **conformal lattice planning**

**Deep Reinforcement Learning for Autonomous vehicles** **[Self Project]**  
*[\[Description\]](#) | [GitHub](#)* *Aug'20 – Sep'20*

- ◊ Deployed a **Dueling DNN** to predict discrete action values & mapped them to continuous signals for vehicle control
- ◊ Used **84x84 RGB** images for the environment perception as the state information collected from the camera sensor
- ◊ Accommodated the wheel odometry, collision & lane invasion sensor data to compute **real-time reward** for the agent

TECHNICAL SKILLS

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**Programming:** C/C++, Git, Python, MATLAB, LaTeX, Arduino, ROS, Atmel Studio  
**Softwares:** SOLIDWORKS, Ansys, MATLAB/Simulink, CARLA Simulator, Autodesk Fusion 360, COMSOL, Ricardo WAVE  
**Libraries:** NumPy, SciPy, Pillow, SymPy, Matplotlib, OpenCV, TensorFlow, Keras, CARLA

COMPETITIONS

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**Formula Bharat Virtuals 2021-22** **Virtual Event hosted by Curisosome Tech**  
*[\[Link\]](#) | [\[Design Presentation\]](#)* *Sept'21*

- ◊ Secured an **overall 1st Place in Combustion Category** by scoring 264.19 out of 275 points, among **31 teams** globally
- ◊ Secured **1st place in Engineering Design Event** & received the **“Best Powertrain Package”** award

**Inter IIT Tech Meet 9.0** **Virtual Event hosted by IIT Guwahati**  
*[\[Problem Statement\]](#) | [\[Design Presentation\]](#)* *Mar'21*

- ◊ Secured the **Gold** medal in the event, **“Bosch’s Electric Vehicle Simulation”** for the proposed solution
- ◊ Proposed the **powertrain architecture** comprising a PMSM motor (self-designed), ABS, VSC, etc.
- ◊ Determined the motor’s requirements & battery pack’s capacity based on target performance parameters using **Simulink**

**4th Annual FSEV Concept Challenge 2020** **Virtual Event hosted by Ather Energy**  
*[\[Link\]](#) | [\[Design Presentation\]](#)* *July'20*

- ◊ Secured an overall **5th place** among **37 teams**
- ◊ Received a Notable mention: **Fresher Team Effort - Engineering Design**
- ◊ Stood **2nd** in **EV Presentation** & **4th** in **Powertrain package design** among **37** participant teams internationally

RELEVANT COURSEWORK

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**University:** Mechanics, Dynamics, Transform Calculus, Probability & Statistics, Embedded Control Systems, Programming & Data Structures, Embedded Sensing, Actuation & Interfacing System, Principles of Automotive Dynamics & Controls  
**MOOC:** Algorithms for Battery Management Systems Spl., Data Structures, Reinforcement Learning Spl., Self-Driving Cars Spl., Convolutional Neural Networks, Neural Networks and Deep Learning, Machine Learning

POSITIONS OF RESPONSIBILITY

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**Deputy Team Leader** **IIT Kharagpur**  
*TeamKART, Formula SAE* *July'20 – Aug'21*

- ◊ Spearheaded a dedicated team of **47** students towards the research & development of Formula Student prototype vehicle
- ◊ Responsible for the project management & sponsorship initiatives to ensure the timely completion of the team’s preset targets
- ◊ Prepared the design & manufacturing timeline and procurement plan to ensure a smooth & efficient workflow for project **K6**

**Powertrain & Corporate Relations Team Member** **IIT Kharagpur**  
*TeamKART, Formula SAE* *July'19 – July'20*

- ◊ Responsible for the design, analysis, and testing of the powertrain components in the FSAE prototype vehicle
- ◊ Involved in the training of **30** freshers in basic automotive engineering, powertrain technology, and aspects of manufacturing
- ◊ Acquired monetary as well as technical sponsorships worth **INR 1,10,000** for the season 2019-20