

# Keshav Bagri

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## EDUCATION

### Indian Institute of Technology, Kharagpur

*B.Tech (Hons.) in Mechanical Engineering [CGPA: 9.17/10 (upto 5 semesters)]*

*Micro Specialization in Embedded Control, Software, Modelling and Design*

*July'18 – May'22*

*Kharagpur, India*

### Aditya Academy Secondary

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

*2016 – 2018*

*Kolkata, India*

## RESEARCH INTERESTS

ADAS | Localization & Mapping | Motion/path Planning | Autonomous Vehicles | Automotive Engineering

## RESEARCH EXPERIENCE

### Undergraduate Research Assistant

*Feb'20 – Present*

*Supervisor: Dr. Jeffrey P. Chrstos | CAR | The Ohio State University*

*Ohio, USA*

- ◇ Currently reviewing literature for absolute and relative validity of medium fidelity D-i-L simulators for physical validation

### Winter Intern | [Description]

*Nov'20 – Jan'21*

*Ati Motors | SLAM for autonomous cargo delivery vehicles*

*Bengaluru, India*

- ◇ 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

### Research Intern | ARMS Lab | [Description]

*July'20 – Oct'20*

*Supervisor: Prof. Leena Vachhani and Prof. Arpita Sinha | IIT Bombay*

*Mumbai, India*

- ◇ 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

### Research and Development Intern | [Description]

*June'20 – Aug'20*

*Kanan Park | Autonomous Drone and Rover Prototype development, and automated agriculture*

*Pune, India*

- ◇ Developed the code for ArUco marker based **autonomous landing of a drone** using image processing in Raspberry Pi
- ◇ Formulated the conceptual model with update algorithm & reward function for the **RL based landing** sequence of the drone
- ◇ Devised the code & components of a GSM-based remotely controlled **motorised water flow system** for use in farms

## PROJECTS

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

*June'19 – Present*

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

*IIT KGP, India*

- ◇ Worked on the designing of a **reactive muffler** for noise reduction from a combustion 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** & **downflow radiator** for a single cylinder engine, producing a power output of **35 HP**

### Mathematical modelling of Li-ion batteries focusing on Si anode particles

*Feb'20 – Jan'21*

*Supervisor: Dr. Jeevanjyoti Chakraborty | Mechanical Engineering Department | [Description]*

*IIT KGP, India*

- ◇ 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 & Liebmman's methods**, in Python
- ◇ Established a **two-way coupling** between diffusion & stress, to understand the effect of one parameter on the other

### Fault Tolerant Controller for 4WD Electric Vehicle

*Dec'20 – Present*

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

*IIT KGP, India*

- ◇ Working on **MATLAB/Simulink** model of a 4WD EV to study the longitudinal & lateral behaviours of the vehicle
- ◇ Studied various EV and HEV architectures along with powertrain and vehicle dynamics control systems required for modelling

Self-driving Cars Specialization, Coursera | [\[Description\]](#) | [GitHub](#) Apr'20 – June'20

Supervisors: *Prof. Steven Waslander and Prof Jonathan Kelly, University of Toronto*

- ◊ 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**

Traffic Sign Classification using CNN | [\[Description\]](#) | [GitHub](#) July'20

*[Self Project]*

- ◊ Deployed a CNN model with layers including a dropout rate of **40%** for identifying **43** different classes of **traffic signs**
- ◊ Trained the model for **100 epochs** on a dataset of **32x32 RGB** images with a testing accuracy of **94%** on **12000** images

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

*[Self Project]*

- ◊ 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

**Technical:** 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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Inter IIT Tech Meet 9.0 | [\[Problem Statement\]](#) Mar'21

*Virtual Event hosted by IIT Guwahati* India

- ◊ 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 | [\[Link\]](#) July'20

*Virtual Event hosted by Curiosum Tech* India

- ◊ 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

Formula Bharat 2020 | [\[Link\]](#) Jan'20

*Kari Motor Speedway* Coimbatore, India

- ◊ Secured an **overall 10th Place** in **Combustion Category**, among **50** teams
- ◊ Secured **6th place** in **Engineering Design Event** & **15th place** in **Cost and Manufacturing Event**
- ◊ **1** of the **3** teams to clear the stringent Technical Inspection including mechanical scrutiny and tilt test on **Day 1**

## POSITIONS OF RESPONSIBILITY

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Deputy Team Leader July'20 – Present

*TeamKART | Formula SAE* IIT KGP, India

- ◊ Leading 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 July'19 – July'20

*TeamKART | Formula SAE* IIT KGP, India

- ◊ 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

## 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:** Reinforcement Learning Specialization, Self-Driving Cars Specialization, Real-time Object Detection with YOLOv3, Data Structures\*, Convolutional Neural Networks, Neural Networks and Deep Learning, Machine Learning