Keshav Bagri

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Education

Indian Institute of Technology, Kharagpur — *July'18 – May'22*
*B.Tech (Hons.) in Mechanical Engineering [CGPA: **9.20/10** (upto 6 semesters)]* — *Kharagpur, India*
*Micro Specialization in Embedded Control, Software, Modelling and Design [CGPA: **9.64/10**]*

Aditya Academy Secondary — *2016 – 2018*
*AISSCE (Grade: **93.6%**) | CBSE Class X (CGPA: **9.8/10**)* — *Kolkata, India*

Research Interests

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

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 & Liebmann'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 Electric Vehicles — *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

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

Inter IIT Tech Meet 9.0 | [Problem Statement] | [Design Presentation] *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**

Relevant Coursework

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

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