Keshav Bagri

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Education

Indian Institute of Technology, Kharagpur — **Kharagpur, India**
*B.Tech (Hons.) in Mechanical Engineering [CGPA: **9.26/10**]* — *2018 – 2022*
*Micro Specialization in Embedded Control, Software, Modelling and Design [CGPA: **9.64/10**]*

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

Work Experience

Development of autonomous features for a hybrid spherical rollocopter — **Revolute Robotics**
Controls Engineer | [Website] — *Mar'22 – Present*
- Developing the software stack for hybrid autonomous motion of a spherical rollocopter using ROS & Gazebo environment

Translation of Scenario Description Language for ADS simulation — **WMG, University of Warwick**
Research Collaborator | Guides: Dr. S. Khastgir & Dr. A. Bruto Da Costa | NAIC — *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 — **The Ohio State University**
UG Research Assistant | Supervisor: Dr. Jeffrey P. Chrstos | CAR | [Description] — *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 — **KPIT Technologies Ltd**
Summer Intern | Mentors: Ravish Kumar & Rahul Jain | [Description] — *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 — **Ati Motors, Bengaluru**
Winter Intern | Mentor: Dr. Naveen Arulselvan | [Description] — *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 — **ARMS Lab, IIT Bombay**
Research Intern | Supervisors: Prof. Leena Vachhani & Prof. Arpita Sinha | [Description] — *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] — **IIT Kharagpur**
Supervisor: Dr. Dhananjay Kumar Srivastava | Mechanical Engineering Department — *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] — **IIT Kharagpur**
Supervisor: Dr. Somnath Sengupta | Advanced Technology Development Center — *Feb'21 – Apr'22*
- Prepared the complete **electro-mechanical** model for a 4WD EV for analysing the effect of faults & the control strategy
- Worked on the modelling of integrated **ABS & regenerative braking** for efficient braking & max energy recuperation
- Developed a non-linear **state estimator** using equations for vehicle dynamics to produce reliable estimates of vehicle's states
- Designed a novel **constraint-aware PI - sliding mode controller** for regulating the stability under all driving conditions
- Explored the possibility of integrating the novel controller with **reconfigurable control allocator** for fault tolerant control

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**

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 10.0 **IIT Kharagpur**

[Problem Statement] | [Design Presentation] *Mar'22*

- Led a team of **10 members** to secure the **Gold Medal** in "Powered Bonnet for Electric Vehicles" by Jaguar Land Rover
- Focused on **energy & cost optimization** by using torsional springs, regenerative braking & lower rated actuators
- Performed an in-depth analysis of **possible failure modes** and justified the effectiveness of our solution against the same

Formula Bharat Virtuals 2021-22 **Curisosum 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 **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 **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

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 **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