# Keshav Bagri

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## Education

**The Ohio State University** — **Columbus, USA**
*Master of Science in Mechanical Engineering* — *Aug'22 – May'24 (Expected)*

**Indian Institute of Technology, Kharagpur** — **Kharagpur, India**
*Bachelor of Technology (Hons.) in Mechanical Engineering [CGPA: **9.26/10**]* — *July'18 – May'22*
*Micro Specialization in Embedded Control, Software, Modelling and Design [CGPA: **9.5/10**]*

## Professional Experience

**Development of autonomous features for a hybrid spherical rollocopter** — **Revolute Robotics, USA**
*Controls Engineer | [Website]* — *Mar'22 – July'22*

- 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 – July'22*

- 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 | [Description]* — *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**

## 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

## Technical Skills

**Programming**: C/C++, Git, Python, MATLAB, LaTex, Arduino, ROS, Atmel Studio
**Softwares**: SOLIDWORKS, Ansys, MATLAB/Simulink, CARLA Simulator, Gazebo
**Libraries**: NumPy, SciPy, Pillow, SymPy, Matplotlib, OpenCV, TensorFlow, Keras, PyTorch, CARLA

## 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