Keshav Bagri

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Summary

Experienced graduate student interested in applications of controls, AI, & optimization for vehicle dynamics and safety

Education

The Ohio State University — **Columbus, OH**
*Master of Science in Mechanical Engineering [GPA: **4.0/4.0**]* — *Aug'22 – May'24 (Expected)*
Graduate Specialization in Automotive Systems and Mobility

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

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

Awards and Achievements

- **Gold Medal** in Inter IIT Tech Meet 10.0 (2022) in the event "Powered Bonnet for EVs" by Jaguar Land Rover India
- **1st** place in Combustion category & Engineering Design among **31 teams** globally at Formula Bharat Virtuals 2021-22
- **Gold Medal** in Inter IIT Tech Meet 9.0 (2021) in the event "Bosch's Electric Vehicle Simulation" by Robert Bosch India
- **5th** place in Formula Student Electric Vehicle Concept Challenge 2020 among **37 teams** internationally by Ather Energy

Industry Experience

Revolute Robotics — **Tucson, AZ**
Controls Engineer | [Website] — *Mar'22 – July'22*

- Modified the **min. jerk trajectory** planner for smooth navigation using a dynamic window of 3 waypoints per time step
- Formulated the cost-based **path planning & obstacle avoidance** approach using min. jerk planner & A* search algorithm
- Identified multiple methods to enable **data-logging over cloud** from the flight controller thus reducing manual intervention

KPIT Technologies Ltd. — **Pune, India**
Summer Intern, CTO – Deep Learning — *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 used in automotive applications

Ati Motors — **Bengaluru, India**
SLAM Intern, Autonomy Team | [Website] — *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

Research Experience

Buckeye AutoDrive (SAE AutoDrive Challenge II) — **Columbus, OH**
Co-Captain | Co-Lead, Planning & Controls team — *Aug'22 – Present*

- Currently working on establishing a **Hardware-in-Loop** testing setup by deploying the controller on the target hardware
- Developed the **behavioral planning** module for decision-making & maneuvering using Stateflow for a **level 4 autonomous vehicle** considering multiple possible scenarios and safety requirements
- Formulated the logic for **lane changing maneuver** in a highway setup & performed simulation-based testing for the same

Warwick Manufacturing Group, University of Warwick — **Coventry, UK**
Research Collaborator, Verification and Validation Team | [Website] — *Jan'22 – July'22*

- Developed the Java-based translation framework between levels of **Scenario Description Language** for ADS simulation
- Formulated the mapping between environmental features and language variables using the taxonomy from **PAS 1883**
- Defined the **boundary conditions** for the agents' maneuver to describe the **Synchronised Serial Maneuver Sequences**

OSU Centre for Automotive Research — **Columbus, OH**
Undergraduate Research Assistant, Driver Dynamics Lab | [CAR] — *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

Indian Institute of Technology, Bombay — **Mumbai, India**
Research Intern, Autonomous Robots and Multi-robot Systems Lab | [Website] — *July'20 – Oct'20*

- Formulated the **Markov Decision Process** representation of the scenarios considering different state and action spaces
- 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

Powertrain Development for Formula Student prototype | [**TeamKART**] — **IIT Kharagpur**
Supervisor: Dr. Dhananjay Kumar Srivastava, Department of Mechanical Engineering — *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 modeling 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 modeling of Li-ion batteries focusing on Si anode particles — **IIT Kharagpur**
Supervisor: Dr. Jeevanjyoti Chakraborty, Department of Mechanical Engineering — *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 — *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**

Relevant Coursework

University: Simulation Techniques for Dynamic Systems, Powertrain Dynamics, State Space Control Systems, Embedded Control Systems, Embedded Sensing, Actuation & Interfacing System, Principles of Automotive Dynamics & Controls

Online: 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

Leadership

Co-captain — **The Ohio State University**
Buckeye AutoDrive, SAE AutoDrive Challenge II — *Sept'22 – Present*

- Assisting the captain & faculty advisors in the project's activities and managing the **competition deliverables** & deadlines
- Coordinating with safety, controls, CAN, and perception teams to establish the **overall pipeline** on the system-level

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** freshmen 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