

Keshav Bagri

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EDUCATION

The Ohio State University

Master of Science in Mechanical Engineering [GPA: 4.0/4.0]

Graduate Specialization in Automotive Systems and Mobility

Thesis: Quantitative risk assessment and mitigation through fault diagnostics for automated vehicles

Columbus, OH

August'22 – August'24

Indian Institute of Technology (IIT) Kharagpur

Bachelor of Technology (Hons.) in Mechanical Engineering [CGPA: 9.26/10]

Micro Specialization in Embedded Control, Software, Modelling and Design [CGPA: 9.5/10]

Thesis: Fault Tolerant Control System for Electric Vehicles

Kharagpur, India

July'18 – May'22

PUBLICATIONS AND PEER-REVIEWED CONFERENCES

- ◇ Singh, Y., **Bagri, K.**, Jayakumar, A., Rizzoni, G. Fault Diagnostics for Oscillatory Failure Case in Aircraft Elevator Servos. IFAC World Congress in Yokohama, Japan, July 2023. [[Link](#)]
- ◇ Peer reviewer (upon invitation) for 2024 **American Control Conference (ACC)** held in Toronto, Canada and 2024 **Modeling Estimation and Control Conference (MECC)** held in Chicago, Illinois.

AWARDS AND ACHIEVEMENTS

- ◇ 2nd place in “Aerospace Competition on Fault Detection & Fault Tolerance” at **IFAC World Congress 2023** by **Airbus**
- ◇ **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**

RESEARCH EXPERIENCE

Fault tree analysis

Software Developer | [[Simulink Fault Analyzer](#)]

The MathWorks Inc.

May'23 – August'23

- ◇ Engineered the **full stack development** of a feature to analyze fault trees, reducing safety engineers’ workload by **50%**
- ◇ Incorporated functionalities to enable the precise determination of **failure probability** & identification of **minimal cut sets**
- ◇ Recognized limitations in the existing implementation, proposing actionable solutions to improve the efficiency by **30%**

Planning & controls stack for SAE Level 4 autonomy

SAE - General Motors AutoDrive Challenge II | [[Center for Automotive Research](#)]

The Ohio State University

Graduate Research Associate | Advisor: [Prof. Giorgio Rizzoni](#)

August'23 – Present

- ◇ Developed an optimal graph-based dynamic rerouting algorithm, enabling real-time on-demand computation of a new trajectory for obstacle avoidance in an urban driving environment, ensuring efficient navigation towards the global goal
- ◇ Devised a Finite State Machine - based behavior planner for navigation in an urban environment using object and traffic sign detections for decision-making and collision avoidance
- ◇ Coordinated with the systems safety, perception, & CAN teams to develop testing scenarios, considering key requirements

Co-Lead, Planning & Controls team

August'22 – May'23

- ◇ Devised a polynomial-interpolation-based **trajectory generation** module to sample waypoints for lane change maneuver
- ◇ Formulated the logic for **lane changing maneuver** in a highway environment & performed SIL testing for edge cases
- ◇ Assisted in formulating the **Functional Interface Analysis** & Requirements Traceability Matrix, ensuring safety compliance

Robust translation for Scenario Description Language

Research Collaborator | [[Intelligent Vehicles](#)]

WMG, University of Warwick

January'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 defined in **PAS 1883**
- ◇ Defined the boundary conditions for the agents’ maneuver to describe the **Synchronised Serial Maneuver Sequences**

Control algorithms for a Hybrid Mobility Robot

Controls Engineer | [[Revolute Robotics](#)]

Revolute Robotics

March'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

Performance assessment of Driver-in-Loop simulators

Advisor: [Dr. Jeffrey P. Chrstos](#) | [[Center for Automotive Research](#)]

The Ohio State University

February'21 – March'22

- ◇ Reviewed literature for absolute and relative validity of medium fidelity D-i-L simulators for **physical validation**
- ◇ Proposed the **testing methodology** for the simulator’s platform’s motion and analyzed the results in the essence of OMCT
- ◇ Utilized the output of **LVDTs** for multiple displacement inputs to compute the platform’s roll & pitch angles using MATLAB

SLAM for autonomous cargo delivery vehicles

Autonomy team

Ati Motors, Bengaluru

November'20 – January'21

- ◊ 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

Motion planning of autonomous vehicles

Advisors: *Prof. Leena Vachhani* and *Prof. Arpita Sinha* | *ARMS Lab*

ARMS Lab, IIT Bombay

July'20 – October'20

- ◊ Formulated the **Markov Decision Process** representation for the agent considering different state and action spaces
- ◊ Generated training datasets for a **RL model** for the safe traversal of the vehicle in a **non-signalized** environment
- ◊ Developed a **Finite State Machine** for lane following & 2-way lane intersection (without traffic signals) management

PROJECTS

Powertrain development | TeamKART, Formula SAE | [[Website](#)]

Supervisor: *Prof. Dhananjay Kumar Srivastava*

IIT Kharagpur

June'19 – August'21

- ◊ 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

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

IIT Kharagpur

February'21 – April'22

- ◊ Worked on the modeling of integrated **ABS & regenerative braking** for efficient braking & maximum energy recuperation
- ◊ Engineered a **non-linear state estimator** using vehicle dynamics' equations to generate estimates of the vehicle's conditions
- ◊ 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

Supervisor: *Prof. Jeevanjyoti Chakraborty* | *Mechanical Engineering Department*

IIT Kharagpur

February'20 – January'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

Deep reinforcement learning for autonomous vehicles

[[Description](#)] | [Github](#)

IIT Kharagpur

August'20 – September'20

- ◊ 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

COURSEWORK / TECHNICAL SKILLS

Programming: C/C++, Git, Python, MATLAB, LaTeX, Arduino, ROS, Atmel Studio

Softwares: MATLAB/Simulink, CARLA Simulator, Gazebo, COMSOL

Coursework: Powertrain control, Autonomy in Vehicles, Fault diagnosis, Vehicle dynamics & control, Linear Systems Theory

TEACHING & VOLUNTEERING EXPERIENCE

College of Engineering

GUIDE Peer Mentor

The Ohio State University

August'23 – April'24

- ◊ Responsible for assisting fresh graduate students in navigating the university by guiding them about university resources

Department of Mechanical & Aerospace Engineering

Graduate Teaching Associate

The Ohio State University

January'23 – May'23

- ◊ Courses: ME 3751 (Kinematics & Mechanism Design) and ME 3670 (Design & Analysis of Machine Elements)
- ◊ Responsible for conducting recitations, office hours and doubt clarification sessions for a batch of 60+ UG students weekly

LEADERSHIP EXPERIENCE

Captain

SAE - General Motors AutoDrive Challenge II

The Ohio State University

May'23 – June'24

- ◊ Leading a team of 20+ students from Ohio State to prototype the hardware & software stack for SAE Level 4 autonomy
- ◊ Responsible for coordinating with different sub-teams to establish the pipeline, in accordance with project requirements

Deputy Team Leader

TeamKART, Formula SAE

IIT Kharagpur

July'20 – August'21

- ◊ Leading a dedicated team of **47** students towards the research & development of Formula Student prototype vehicle
- ◊ Prepared the design & manufacturing timeline and procurement plan to ensure a smooth & efficient workflow for project **K6**