AAYUSH RATH | NA20B003

INDIAN INSTITUTE OF TECHNOLOGY, MADRAS

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EDUCATION

Program	Institution	%/CGPA	Completion
B.Tech - **Naval Architecture**	Indian Institute of Technology, Madras	7.16/10.0	2024
Class XII, CBSE	Mother's Public School, Bhubaneshwar	92.8%	2020
Class X, CBSE	Delhi Public School, Guwahati	94.2%	2018

SKILLS

- **Analysis and Simulation:** ROS, Gazebo, MATLAB, Simulink, Ansys IDE (Fluent, Thermal, Structural, Topology), MSC Adams, Vicon Workspace, Qualysis, VS code
- **Modelling:** Fusion 360, Autodesk Inventor, AutoCAD, Solidworks
- **Programming languages:** C, C++, Java, Python, HTML

WORK EXPERIENCE

ROBOTICS ENGINEER - SWAAYATT ROBOTS PVT. LTD.   AUG 2024 - PRESENT
(CEO: Sanjeev Sharma, Autonomous Driving and ADAS - Bhopal, Madhya Pradesh)

⟶ PERCEPTION & SLAM

- Developed an algorithm for publishing stable local occupancy grid to generate more accurate collision avoidance paths by implementing **Lidar clustering** techniques like **Euclidean cluster and DBSCAN** and **IMM**, **UKF** and **PHD** filters
- Worked on programs to generate meshed maps of an environment using both Lidar and Image data while performing localization using **point-to-plane iterative close points** and g2o for **graph-optimization**
- Created a generative machine learning based pipeline using the concepts of **GANs** and **NERF** for data augmentation making the data generation process **500% faster** in comparison to manual data augmentation

RESEARCH PROJECTS

RESEARCH INTERNSHIP - LAB DE BIOMÉCANIQUE ET MÉCANIQUE DES CHOCS   JUN 2023 - JUL 2023
(Guide: Dr. Raphael Dumas, LBMC, Université Gustave Eiffel, Lyon, France)

⟶ GAIT ANALYSIS OF TRANSFEMORAL AMPUTEES

- Developed an algorithm for **motion analysis** on knee amputee gait data from tests conducted on **12 participants**, enhancing rehabilitation methodologies through data-driven insights
- Analyzed ipsilateral and contralateral limb differences using parameters like **power and strut index**, contributing to comprehensive biomechanics analysis to understand the motion characteristics.

⟶ DATA ACQUISITION FOR POSTURAL EFFICIENCY EVALUATION

- Conducted data collection for gait motion experiments employing Treadmetrix and Qualysis systems, ensuring data accuracy, proper calibration and reliability and post-processing using **in-house developed analysis tools**
- Utilized markers for precise limb and muscle motion tracking, leveraging an advanced 18-camera setup, while employing a trackpad to gather comprehensive data on feet location and exerted forces.
- Captured acoustic data from a violin performance and applied a pre-trained machine learning model to evaluate performance efficiency under varying biomechanical postures, encompassing both seated and standing positions.

B.TECH PROJECT - INDIAN INSTITUTE OF TECHNOLOGY, MADRAS   JUL 2023 - MAY 2024
(Guide: Dr. Abhilash Somayajula, Director for Center for Marine Autonomous Systems, DOE, IIT Madras)

⟶ COLLISION AVOIDANCE FOR COLREGS COMPLIANT MAVs

- Built a simulation engine for simulating definite manoeuvring tests like constant rudder angle and zig-zag motion based on the **MMG model**(Maneuvering Modelling Group)
- Simulated **Aritficial Potential Field, Velocity Obstacle and Reciprocal VO** algorithms for collision avoidance while ensuring **COLREGS** compliancy.
- Tested **Probabilistic Road Maps** on a scaled-down model autonomous marine vehicle with a Raspberry Pi and implemented a PID controller for rudder and propeller commands

DESIGN OF VEHICLE DYNAMICS MODULE - FORMULA STUDENT   MAY 2021 - JAN 2024
(Guide: Dr. Satyanarayanan Seshadri, Energy and Emissions Laboratory, IIT Madras)

⟶VEHICLE MODELLING

- Devised and implemented a highly effective launch control algorithm with a focus on optimizing slip ratio, yielding a **23% reduction** in the **0-100 km/h acceleration time** of 4 seconds and a top speed of **150 kmph**

- Designed and implemented a **Lap time simulation tool**, facilitating critical design decisions for dynamical and aerodynamical parameters and validating overall powertrain performance.
- Constructed an advanced **Four-wheel car model** that excels in constant radius turns, identifying and optimizing key parameters to achieve neutral steer.

⟶ STEERING SYSTEM DESIGN

- **Filtered & analyzed tire data** to find the tire's limit and obtained the conditions for **maximum lateral force**
- Calculated the **ideal Ackermann setup** to make turns and maximise lateral force considering mechanical constraints.
- Switched to a bevel gear system instead of a universal joint for **ergonomic comfort of the driver**.

⟶ BRAKE ROTOR DESIGN

- Estimated the thermal and mechanical loads present on the brake rotor for a given track layout
- Performed FEA static structural simulations to design a rotor with a satisfactory safety factor
- Obtained the wall heat transfer coefficient of the rotor at various velocities using ANSYS Fluent
- Generated the temperature profile of the rotor over the course of one lap, using MATLAB

AERODYNAMICS AND CFD - FORMULA STUDENT   MAY 2021 - JAN 2024

(Guide: Dr. Satyanarayanan Seshadri, Energy and Emissions Laboratory, IIT Madras)

⟶ AUTOMATIC DRAG REDUCTION SYSTEM

- Designed a **6-bar** mechanism for the actuation of the DRS using a single servo motor
- Generated an algorithm to automate the DRS actuation on track and simulated it via **Simulink**
- Obtained a dynamic **drag** reduction of **40%** allowing reduction in laptime of 0.2 seconds every lap

⟶ POWERED AERODYNAMIC PACKAGE

- Introduced fan towards the end of the diffuser to **accelerate airflow** and **increase downforce** on the undertray
- Used system impedance curve with fan performance curve to find **optimal fan** while within **geometric constraints**
- Optimised **fan location** across the undertray to **obtain maximum mass-flow rate** using iterative **CFD** Simulations
- Modified **diffuser geometry** to **prevent formation of vortices** and thus **maximizing performance gain**
- Increased **downforce generated** by the undertray by **upto 5kg** and resulting in an even dirstribution of downforce

⟶ AERODYNAMICS PACKAGE VALIDATION

- Fabricated a neural network for validating the aerodynamic simulation results using the previous year's test data
- Employed shock potentiometers for dynamic load data collection, enhancing vehicle performance analysis.
- Prepared a **Convulation Neural Network** to predict the load from the shocks' deflection with an **RMSE** of 3%

⟶ DESIGN OF FRONT WING

- Designed a 100% carbon fibre multi-element front wing to improve aerodynamic downforce by 30%.
- Composed a cost-effective front wing by removing 6 aerofoils without comprising on optimal performance
- Implemented angled-in (5°) endplates, drastically reducing lateral load transfer to a 1%, enhancing stability.
- Gained a 440 N downforce substantially reducing the vehicle's track time in lap simulations by 3.1 seconds

THERMAL MANAGEMENT SYSTEM DESIGN - FORMULA STUDENT   MAR 2022 - PRESENT

(Guide: Dr. Satyanarayanan Seshadri, Energy and Emissions Laboratory, IIT Madras)

⟶ DRIVETRAIN SYSTEM COOLING DESIGN

- Implemented **fan control** for accumulator **push fans** to ensure even distribution of airflow in each module
- Mapped airflow versus duty cycles and current drawn for push fans using pulse width modulation
- Built a **fan testing setup** with multiple fans connected to study the effect of downstream fans on **airflow distribution**
- Constructed an algorithm mapping **fan rpm** with car speed and cell temperature to ensure **maximmum performance**

RELEVANT COURSEWORK

- Introduction to Robotics
- Multi-Body Dynamics
- Principles of Guidance of Autonomous Vehicles
- Control of Automotive Systems
- Guidance and Control of Marine Vessels
- Introduction to Motion Planning
- Probability and Statistics
- Dynamics and Control of Rotorcraft
- Marine Robotics
- Marine Autonomous Vehicles

POSITIONS OF RESPONSIBILITY

CHASSIS LEAD - RAFTAR FORMULA RACING   MAR 2023 - PRESENT

- Directed an engineering vertical for the RFR23 & RFR24 car overseeing overall design and manufacturing
- Enhanced team motivation and effective knowledge sharing, ensuring cohesive subsystem functioning
- Managed integration of CADs from diverse subsystems to create the comprehensive full-car CAD model.

- Organized events and cultivated partnerships with enterprises such as Brakes India, Bosch, Tubes India, etc.

AERODYNAMICS SYSTEM DESIGN ENGINEER - RAFTAR FORMULA RACING ·· MAY 2021 - MAR 2023
- Responsible for design, documentation, assembly and CAD integration of the Aerodynamic package
- Ensured that the Aerodynamics Subsystem adheres to the design timeline decided upon by the team
- Coordinated with the Vehicle Dynamics department to improve driveability by complementing the car performance

FRAMES AND COMPOSITES MANUFACTURING ENGINEER - RAFTAR FORMULA RACING ·· MAY 2021 - MAR 2023
- Responsible for design and documentation of the entire frame along with the cockpit components
- Ensured that the Frame and Composites Subsystem adheres to the design timeline decided by the team
- Designed a frame based on powertrain requirements and assembled over 600 components within the frame
- Responsible for managing juniors in the team by guiding them and ensuring proper knowledge transfer

ACHIEVEMENTS AND CO-CURRICULARS

FORMULA BHARAT 2024 - COIMBATORE ·· JAN 2024
- Major Improvement in the vehicle design and performance helped up the **2nd position** in the overall event
- Secured the first place in **Engineering Design Competition** & received the **Best Battery Design Award**

FORMULA BHARAT 2023 - COIMBATORE ·· JAN 2023
- Obtained a podium-finish backing the third place in the on-site competition in Coimbatore in the EV category
- Secured the first place in Business Planning Presentation & second in Engineering Design Competition

PI-EV CONCEPT CHALLENGE - ONLINE COMPETITION ·· JUL 2022
- Emerged as **Overall Champions** out of over **25** teams from India and abroad, and improved on previous performance
- Winner of the **Engineering Design** Event, **Team Management** Event, **Best Battery** Design and **Best Powertrain**
- Presented and defended the design of **Thermal Systems** module before a panel of **judges** and **industry experts**
- Performed **Failure Models and Effects Analysis** on the entire Powertrain package to ensure **reliability** of design

FORMULA BHARAT VIRTUALS 2021 (ELECTRIC CLASS) - ONLINE COMPETITION ·· SEP 2021
- Emerged as **Overall Champions** at Formula Bharat Virtuals 2021, the team's 1st ever competition in the electric class
- First team in India to win both the **Best Battery Design** and **Best Powertrain Design** awards in the same year

FORMULA STUDENT ELECTRIC VEHICLE CONCEPT CHALLENGE - ONLINE COMPETITION ·· JUL 2021
- Secured a **2nd place** finish Overall in the event conducted by Formula Bharat - Our **first podium** in the electric class
- Placed **2nd** in the **Engineering Design** Event and adjudged as the **2nd** best **Procurement Strategy**

TECHSOC INNOVATUS CHALLENGE ·· FEB 2021
- Competed as a team of 5 members conducted virtually by TechSoc and secured the **2nd position**
- Developed a novel secure system architecture for storing **Medical Health Records** in cloud storage
- Created a simple **convolutional deep learning neural network** to estimate discrepancies in records

TENSORS VOLUNTEER ·· JAN 2021
- Mentored more than 30 students to make a rightful college decision after their JEE examination