Aryan Varma | MM21B012

Indian Institute of Technology Madras

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Education

Program	Institution	%/CGPA	Completion
B.Tech, Metallurgical and Materials Engg	Indian Institute of Technology Madras, Chennai	8.82/10.0	2025
Class XII, HSC	Dr. Kalmadi Shamarao Jr. College, Pune	90.8%	2021
Class X, ICSE	Ryan International School, Pune	93.3%	2019

Patents and Publications

- **Patent Application No. 202441009801** - Title: "A Modular Suspension Assembly for a Vehicle and a Vehicle Thereof"

Scholastic Achievements

- **Ranked 1st among 57 BTech students** in the Department of Metallurgical and Materials Engineering at IIT Madras
- 2021 - Secured an All India Rank in the **top 0.3 percentile** in IIT-JEE Mains 2021 from over **1.1 million applicants**
- 2021 - Secured an All India Rank within the **top 2 percentile** in IIT-JEE Advanced 2021 among **200,000+** applicants

Skills

- **3D Modelling and Product Design:** Autodesk Inventor, Fusion 360, SolidWorks, AutoCAD, CATIA
- **Mathematical Modelling:** MATLAB, Simulink, Simscape
- **FEA and Multibody Dynamics:** Ansys IDE (Fluent, Structural and Thermal), MSC Adams/Car, Abaqus/CAE
- **Programming Languages:** C, C++, Python, Arduino IDE, TeX, Java, HTML
- **Cricuit Design:** Proteus Design Suite
- **Image Processing and Analysis:** ImageJ

Research Projects and Internships

Research Internship - Max Planck Institute for Sustainable Materials — Jun 2024 - Aug 2024

(Guide: Dr. Rajaprakash Ramachandramoorthy, Group Leader, Max Planck Institute for Sustainable Materials, Düsseldorf)

- Design and Optimization of Rate-Dependant Evolution in Microscale Metal Architectures
  - Investigated **strain rate-dependent behavior** of metal micro-architectures using **nanomechanical instrumentation.**
  - Developed a **Johnson-Cook** material model to analyze the strain-rate-dependent behavior in **copper micropillars.**
  - Performed **finite element simulations** to study out-of-plane buckling at varied strain rates **(0.0005/s - 50/s).**
  - Findings contribute to a wide variety of applications such as **MEMS sensors** and **impact-resistant architectures.**

Bachelor's Thesis — Sep 2024 - Present

(Guide: Prof. Ravi Kumar NV, Department of Metallurgical and Materials Engineering , IIT Madras)

- Design and Development of a Miniaturized 4-point Bend Test Setup
  - Designed and optimized a miniaturized **4-point bend test setup** as per ASTM standards for ceramic material testing.
  - Conducted **FEA in Abaqus** to assess **fixture and sample** dimensions for reliable performance in 4-point bending tests.
  - Tested ceramic samples using the setup to calculate **flexural strength** with the help of **Digital Image Correlation**.
  - Currently working on enabling **controlled crack propagation** using a PID controller for enhanced fracture analysis.

Design and Integration of Vehicle Dynamics Module - Formula Student — May 2021 - Jan 2024

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

- Design of a Mode-Decoupled Suspension
  - Designed safety-critical suspension components, leveraging machining expertise to achieve **40% reduction in cost.**
  - Targeted decoupling of heave and roll body modes to **enhance tunability, control, grip and stability** of the race car.
  - Designed a **unique prototype spring cage** to enable the use of compression-only springs under push-pull loadings.
  - Secured reliability of each component across **multiple load cases** by Ansys-based Finite Element Analyses(FEAs).
- Suspension Linkage Optimization
  - Obtained optimal **camber**, **caster** and **kingpin** values from steering torque calculations and extracted tire data
  - Developed a **cost function** to **quantify the performance** of different control-arm geometries under cornering

- Analysed over **350 geometries** using the cost function with the help of **OptimumKinematics** and **MATLAB**.
- Reduced **steering torque** by **36%** and achieved an **invariant front roll center height** for a **3.1Hz ride frequency**

- Brake System Design
  - Balanced frictional and regenerative braking to **maximise energy recovery** during braking maneuvers.
  - Modelled **brake forces**, **car deceleration** & **brake line pressure** on MATLAB to finalise brake bias.
  - Implemented a proportioning valve enabling upto **44Nm** of **regenerative torque**, recovering **0.7 kWh** over 22km.
  - Carried out a comparative analysis of multiple metal alloys such as **Ti-6Al-4V** and **G30 cast iron** for the brake rotors.
  - Redesigned the rotors through **FEAs**, **CFDs**, Transient & Steady-State **Thermal Analyses** and **Topology Optimization**.
- Vehicle Modelling and Optimization
  - Developed a **4 wheel model** to analyze the cars dynamics while cornering, identified optimal **LLTD** for **neutral steer.**
  - Created a **Lap time simulation tool** to analyze critical design decisions & justify the use of aerodynamic components.
  - Built **evaluation** function to identify optimal **spring stiffness** and **damping coefficient** using a **transient car model.**
  - Developed **Launch Control** using a **PID** with **anti-windup** to target reference **slip ratios**, reduced 0-100 time by **24%**

Hybrid Energy Storage Systems Jun 2023 - Dec 2023

(Guide: Dr. Tiju Thomas, Department of Metallurgical and Materials Engineering , IIT Madras)

- Design and Development of a HESS Test-bed
  - Designed a test-bed for characterisation of **Hybrid Energy Storage Systems** under varying loading conditions.
  - Created a comprehensive **photovoltaic charging circuit** for the Hybrid Energy Storage System (HESS) on **Proteus**.
  - Integrated a motor and a **data-acquisition system** to effectively log multiple parameters for different loading profiles.
  - Modeled the set-up on **MATLAB/Simulink** to analyse system performance under various **load profiles** and topologies.

Relevant Courses

- Advanced Engineering Materials
- Materials in Renewable Energy Technologies
- Deformation and Failure of Materials
- Physics of Materials
- Transport Phenomena in Materials
- Topics in Nanomaterials
- Environmental Degradation of Materials
- Deformation, Processing and Forming

Positions of Responsibility

- Team Captain - **Raftar Formula Racing (Formula SAE)** Feb'24 - Present
  - **Leading a team of 40+ members** in designing, manufacturing, testing a race car for international competitions.
  - **Raised 30L+ in 4 months** along with in-kind sponsorships, bolstering the team's efforts for the world stage.
  - Overseeing sponsor relationships, organising fundraisers, and driving team engagement with industry partners.
  - Led the team to its first international competition in 5 years, handled **team logistics** from India to Germany.
- Vehicle Dynamics Engineer - **Raftar Formula Racing (Formula SAE)** Feb'22 - Jan'24
  - Responsible for **integrating** the full car on CAD with over **1000** components from the chassis & powertrain modules.
  - Supervised development of **Simulink models** for extensive **testing, tuning** and **simulation** of the dynamics of the car.
  - Responsible for **financial management** of a budget of **2.5 Million INR** ($30,400) for procurement & manufacturing.

Co-Curricular and Extra-Curricular Activities

- Formula Student Germany 2024 Aug 2024
  - Successfully competed on the world stage, **representing India at FSG2024** having **qualified at world rank #1**
  - Managed the full logistics and transportation of the RFR24 race car and battery pack to Germany and back to India
  - **Placed 4th** out of 6 finalists from 80 participating teams in the **Mathworks Modeling and Simulation Award 2024**
- Formula Bharat Electric 2024 Jan 2024
  - **Placed 2nd in the overall competition** at Formula Bharat Electric 2024 amongst 27 teams from around the country.
  - **Placed 1st** in the **Mathworks Modeling Special Award** as part of a team of 4, winning a cash prize of 35000 Rs.
  - **Placed 1st** in the Engineering Design Event and awarded the **Best Battery Award**
- Formula Bharat Electric 2023 Jan 2023
  - **Placed 3rd in the overall competition** at Formula Bharat Electric 2023 amongst 21 teams from around the country.
  - **Placed 2nd** in the **Mathworks Modeling Special Award** as part of a team of 4, winning a cash prize of 15000 Rs.
  - **Placed 1st** in Business Plan Presentation, **2nd** in Engineering Design and **4th** in the Cost & Manufacturing events.