National Institute of Technology Karnataka - Surathkal

Odd Semester Report 2021-22

BAJA NITK RACING

Introduction

BAJA SAE India is a student competition that follows the standards of the international BAJA SAE competition held all over the World. BAJA is one of the biggest and most prestigious engineering events in India in which over 350 teams compete against each other.

The team functions as different Special Interest Groups namely Design and Analysis, Vehicle Dynamics, Power Train and Marketing and Operations which work throughout the year. The primary objective is to build a race car, the process of which serves to boost the entire team's understanding of automotive engineering.

BAJA Preliminary Round

The BAJA Preliminary round was held on the 10th of October . The Preliminary round is the first event that takes place in each BAJA season. Teams are expected to present their Preliminary prototype ATV to a panel of judges who assign points based on the the design of the prototype, project plan, design methodology and design evaluation plan. The judges also check the adherence of the ATV design to the mBAJA rulebook. The team performed admirably amassing 74.2 points and securing 7th place out of the 150 teams participating.

Click here to view the presentation

Virtual Event

The mBaja virtual event was broken down into Statics events and Dynamic events. The event was held from the 5th of November to the 12th of December 2021. Static events included submission of detailed reports and a presentation of the same to a panel of distinguished judges. The static events included the Design event, Manufacturing event, CAE event, Cost event and the Sales event. The Dynamic events involve simulation of the team's ATV’s on different virtual tracks in a virtual environment called IPG carmaker. Teams are awarded points based on the

performance of their ATV in the various simulation events. The Dynamic events included Braking performance, Acceleration event, Hill Climb, manoeuvrability, suspension & traction and Endurance.

Static Event

Design Event

The design report was created to document the team's design and validation approach for constructing a single seater four wheeled off-road vehicle to compete in the annual BAJA Event. Performance, Ergonomics, Safety, Reliability, and Cost of manufacturing were the five main factors that drove all the decisions taken in the design of the ATV.

Along with the design report, design comparison, design validation and DFMEA was performed to contribute to the design docket.

Click here to view the design report

Manufacturing Event

Manufacturing is a crucial phase of product development, where a lot of practical decisions are taken with regards to the design. It is in this phase that most of the cost functionality trade-off decisions are made. This decision becomes even more important when it involves large scale production of parts. This document focuses on the various manufacturing processes used in mass manufacturing and development of drivetrain of a 4WD buggy in detail. Furthermore, we discuss the improved methods for mass-producing the steering gear system, aiming for cost reduction while maintaining quality. The submission report for the manufacturing report was on 1st December 2021.

Click here to view the Manufacturing report

CAE Event

The aim of this event is to evaluate the team's depth of knowledge in CAE Analysis, optimization study, and its application to build a light and durable vehicle. The CAE report should contain details of each analysis such as the objective, methodology used, modelling,

pre-processing parameters, constraint, boundary conditions, solver setting, and result outcome with contours, diagrams, plots, and graphs, etc. The CAE report was to be submitted on 5th November and the presentation was held on the 26th November 2021.

Click here to CAE Report

Cost Event

Cost is one of the most critical aspects of any commercial entity but the event here, is to not only report the most optimum cost of the component in the prototype or production stage but instead focus on how well the team understands what has gone into their part and applying their learning of procurement and manufacturing techniques to optimize the cost, labour, time, material wastage and various overhead costs.

Cost Event consists of two related sections:

1. Cost Report: The cost report provides all the background information to verify the vehicle's actual cost and also if the teams want to present any design features or fabrication processes that are innovative or are expected to result in significant cost savings.

2. Prototype Cost: The prototype cost is the actual cost gone in the fabrication of the vehicle and the points related thereto.

The Cost report was to be submitted on 3rd December 2021.

Click here to Cost Report

Sales Event

The objective of the Sales Presentation is for the team to convince the "executives" of a hypothetical manufacturing company to purchase the team's Baja SAEINDIA vehicle design and put it into production at the rate of 4000 units per year.

The Sales Presentation Event presents students with the opportunity to gain real-world experience in taking a concept proposal and presenting it for support, be it funding or otherwise. It is focused on providing students with an entrepreneurial outlook to manufacturing their ATVs. An extensive presentation on the non-technical aspects of a business plan combined with technical skills & hypotheses makes for an interesting and experimental event that tests students'

presentation skills, creative thinking, managerial perspective, and aptitude to business essentials such as forecasting, financing, marketing, management, etc.

The Sales report was to be submitted on 12th November.

Click here to view the Sales report

Dynamic Event

The simulation event involves stimulation of the vehicle designed by teams on virtual tracks in a simulation environment called IPG carmaker. Teams are supposed to input all the parameters of the designed vehicle including the CAD Model in IPG Carmaker. These vehicles are then tested on virtual tracks to gauge their performance and points are allocated accordingly.

Events

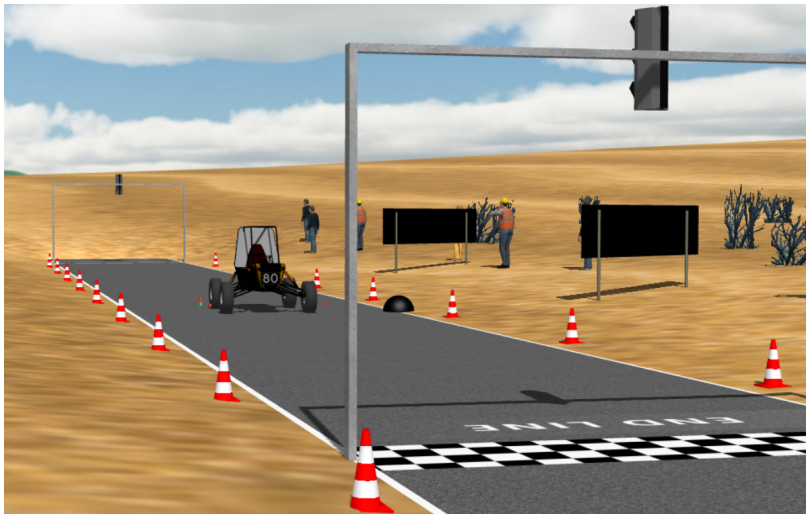
1. **Brake Performance**

   The brake event is designed to measure the minimum distance it takes for the vehicle to come to a complete stop from a speed of 40km/hr. The distance is measured from the designated point of braking to the final resting position of the vehicle on a flat and straight course. The maximum number of available points for the acceleration event is 50 points.

2. **Acceleration**

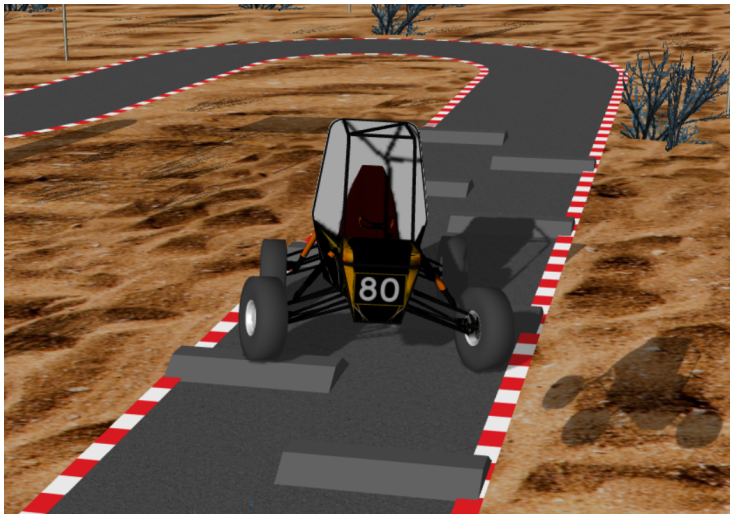
   The Acceleration Event is designed to measure each vehicle's ability to come up to speed quickly from a standing start. Acceleration is measured as the time to complete a 30.48 m (100 ft.) or 45.72 m (150 ft.) flat, straight course from a standing start. The course surface may vary from pavement to loose dirt. The choice of course length and surface is at the

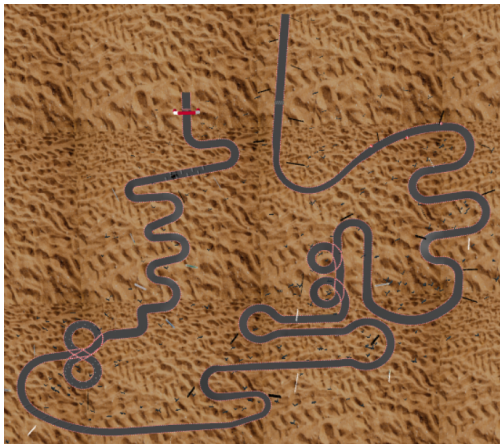
organizer's discretion. The maximum number of available points for the acceleration event is 50 points.



3. **Maneuverability**

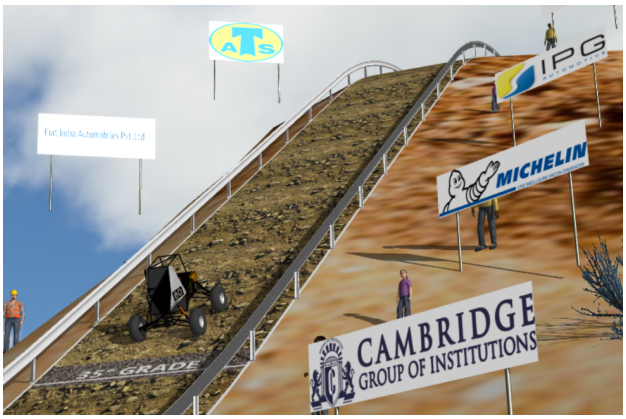
Maneuverability is designed to assess each vehicle's agility and handling ability over off-road terrain. Teams will attempt to maneuver through the course with a minimum time. The course may consist of a variety of challenges at the organizer's option, possibly including tight turns, pylon maneuvers, ruts, bumps, drop-offs, sand, rocks, gullies, logs, and inclines.





4. **Gradeability**

This event tests the vehicle's relative ability to climb an incline from a standing start or pull a designated object, e.g. progressive weight skid, vehicle, or chain along a flat surface. The traction event may take place on a straight or curved course. The organizer will determine the hill elevation (height), hill inclination (grade), and hill surface or object to be pulled. This year the gradient was set in 2 stages with a 30° and 35° inclination. The maximum number of available points for the traction event is 75 points.



5. **Endurance Performance**

The endurance event assesses each vehicle's ability to operate continuously and at speed over rough terrain with obstacles. The endurance course is a closed loop measuring approximately 1.0 km to 4.0 km. The endurance course may feature different surfaces (e.g. dirt, grass, sand, mud, gravel, stone, and asphalt). The endurance course will feature various obstacles and terrain to test the vehicle's durability, traction, and speed.

Fabrication

The team was unable to participate in the offline BAJA SAE INDIA 2022 Event due to the pandemic. The team has started the KEPs for manufacturing and handing over responsibilities to the new recruits to aim for the top spot in the BAJA SAE INDIA 2023 event to be held in January 2023. According to the timelines set, BAJA NITK RACING plans to bring the first 4 wheel drive offroading vehicle to life by November 2022.

Conclusion

With the endless dedication and effort of every member, the team could successfully construct all the reports meeting all the deadlines. **As a result, the team secured the 7th position in the preliminary rounds of the BAJA SAE INDIA 2022**. The team performed exceptionally well in the competition and is expecting a good rank for the virtual static and simulation event.