IIT KHARAGPUR

INTER IIT TECH MEET 10.0

25-27TH MARCH 2022

POWERED BONNET FOR ELECTRIC VEHICLE

We all are aware of the growing popularity of Electric Cars. They easily offer a trunk on the front (Frunk). This is made possible because there is no engine (unlike the case with ICE based vehicles), and the styling of cars hasn't changed radically. Hence that extra space can be given to the customers in the form of a Frunk. The manual opening and closure of the front boot/trunk is somewhat inconvenient. Similar to the tailgate of mid to high-end luxury cars, the powered bonnet could be opened or closed automatically through the press of a button by the user. Thus, we reckon that a 'powered bonnet' could constitute an exciting feature in luxury cars.

JAGUAR LAND ROVER | LOW PREP

PROBLEM STATEMENT

Physical System Requirements:

Devise a system to actuate the bonnet of a car. Simulate the system in Simscape for the following requirements:

- The bonnet should open by 60° from the initial position with a tolerance of ±1°
- The bonnet should open within 4 sec in a safe manner (the system shouldn't jerk open the bonnet)
- The bonnet should remain in its open position without the need for any manual latch
- The bonnet should close within 4 sec in a safe manner

Using your calculations and MATLAB simulations for the bonnet specifications mentioned below, select the components from the existing marketplace in India and prepare a Bill of Material (BOM) for the system. Cost and power consumption should be kept in mind while selecting the components such as motors and actuators (the lesser, the better).

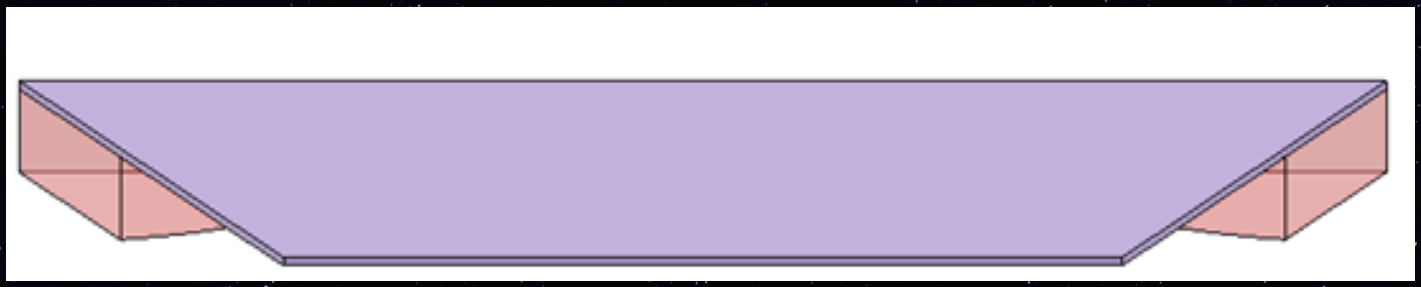
Note: Your system should be simple and deployable in a production vehicle. Customers should be able to access the boot when the bonnet is open. The use of any exotic material/mechanisms will need to be justified correctly.

Packaging Requirements:

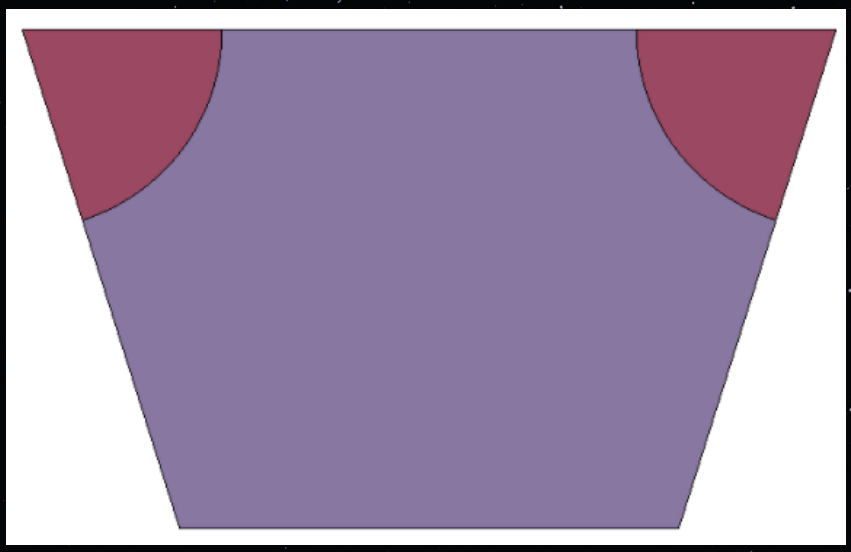
The shape and the dimensions of the bonnet are as follows:

Bonnet can be considered to be a **trapezoid** with

- Smaller width equal to **1000 mm**
- Larger width equal to **1630 mm**
- Height of **1000 mm**
- Thickness can be assumed to be **4mm**
- The bonnet is angled to the horizontal at **12°**
- The overall mass of the bonnet is **14 kg.** Although, it may range between **9 to 14 kg** depending on the vehicle
- As shown in the diagrams below, your assembly components should all be fitted in the **orange area when the bonnet is closed.** The dimensions of which are: **400mm** radius with both vertices on the longer side of the trapezoid as centers and the depth of **150mm** perpendicular to the bonnet. Components like hydraulic struts or mechanical lead screws can come outside the orange area, provided you are able to justify it with a clear advantage on some other parameter, and they take up a minimal amount of space
- The purple part in the diagrams below is the actual bonnet, and the orange part represents the suggested space you can work with for your actuation assembly. The hinges are fixed at the longer length of the bonnet



FRONT VIEW OF THE BONNET IN CLOSED POSITION



NORMAL VIEW OF THE BONNET (NOT TO SCALE)

SUBMISSION REQUIREMENT

- Governing equations of the complete system
- A working MATLAB/Simulink (Simscape) model which consists of all the physical actuation components
- Plots of the angle of opening of the Bonnet vs time for a single cycle for different weights (Single cycle: Opening of the Bonnet -> Remaining open for 3 seconds -> Closing the Bonnet)
- BOM of all the components you have used in your design
- Power consumption of your system for one cycle
- A front, side, and isometric view of your designed CAD geometry, within the suggested constraints

Submission Details:

- Prepare a PowerPoint presentation containing all the details of your proposed system(s). You should include literature survey (if any), working principle, methodology, system layout, governing equations, simulation results, packaging data, and 'claimed points' based on your self-assessment in it. The reason behind the use of a component has to be properly mentioned. Do not forget to add bibliography at the end; all the referenced content in your presentation (including equations, theory, etc.) must carry citations. Add your presentation and reference documents (papers, patents, etc.) to a folder and zip it.
- Prepare a zipped folder containing your programs and models along with the instructions to use them. We will review and simulate the system model and verify your claims. Write comments liberally, and make sure your programs and models are comprehensible.
- Send both zipped folders.

Submission Timeline:

- Zipped folder containing PowerPoint presentation and reference documents and zipped folder containing programs and models along with the instructions submission:
  Due Date: 21st March 11:59 PM
- Top 10 teams will be shortlisted based on the submission
- Announcement of Top 10 shortlisted teams: Due Date: 23rd March
- Refined PowerPoint presentation submission of shortlisted teams:
  Due Date: 25th March 11:59 PM
- Final presentation: Due Date: 26th-27th March
- The top ten teams will give a presentation (not exceeding 10 minutes), followed by a Q&A (5 minutes) session

Send your submissions at this email: submissions@interiit-tech.org

JAGUAR LAND ROVER | LOW PREP

EVALUATION

- 20 points for valid plots of bonnet's opening angle vs time from MATLAB model
- 25 points for simplicity and versatility of your system (Less moving parts in your BOM, Minimum cost of components, Easily adaptable in different vehicle lineups)
- 15 points for Ergonomics (Ease of access to the boot for the customer)
- 15 points for Power consumption of your system
- 25 points for Packaging of your system ("The lower volume you use, the more volume you have remaining for the boot space")
- 10 points for a generalized model/equations that can be used to select components including motors and actuators with weight of the bonnet, moment of inertia of the bonnet, opening time, and closing time as the variables
- 40 points for final presentation (Knowledge, Understanding of the system from OEM perspective, Design strategy used) (for top 10 shortlisted teams)

Note: Power Tailgate system is electro-mechanical/electro-hydraulic system that can automatically open and close the tailgate by using a local switch (push button switch inside of the tailgate and outside handle switch) and wireless remote key (FOB). You can have a look at the system used in powered tailgates to get inspiration for your system.

Team size for this event is maximum 5 participants.
Participation awards shall be awarded to all participants.

JAGUAR LAND ROVER | LOW PREP