|| 26- 28th March, 2021 ||

INTER IIT TECH MEET'21

IIT Guwahati

LOW PREP EVENT

(150 Points)

DAMPING ENERGY HARVESTING SYSTEM

You know the function of the damper in a car suspension. It dissipates vibrational energy and thereby dampens the oscillations. This helps in reducing occupant discomfort.

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PROBLEM STATEMENT:

Can you think of a practically feasible method and apparatus through which we can harvest the dissipated energy?

Requirements:

Your system must:

1. Not include linear or rotary motors;
2. Not include piezoelectric devices;
3. Be realized through the combination of components and system that are currently available in the world;
4. Not be of size and shape which are impractical to implement in a car;
5. Not employ exotic material such as gold, diamond or radioactive materials;
6. Must recuperate the energy that otherwise gets dissipated through dampers

Calculating Power Output:

The governing equations of your device should be coupled with a traditional 2-DOF Quarter Car Model. Simulate the coupled system with the given initial conditions* in MATLAB/Simulink environment, and demonstrate the energy harvested through your system. Try to maximize the average power output of your system through innovative and efficient design.

NOTE:

1. In case of energy harvested in any form other than electrical, you must also demonstrate how we can use that recovered energy in a typical SUV car (ICE, HEVor EV). It may require you to develop additional peripheral systems such as that the required energy is utilised in a meaningful manner, resulting in overall operational efficiency gain.
2. If you require any support in understanding necessary basic concepts such as 2-DOF Quarter Car Model, ISO roads, etc. please feel free to reach out to us.
3. Details of any electronic component and circuit design used in the proposed solution need to be added to the final documentation.

(*) - see the appendix

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EVALUATION:

You will be evaluated for,
1) (Most important) average power output of your system. Higher the power, more the points! (10 points/watt)
2) Number of working systems proposed and demonstrated. (200 points + 10 points/watt, for each working idea)
3) Number of failed ideas. Considering that some of your initial ideas won't work, you will get additional points for explaining logically and quantitatively why they won't work. (100 points/failed system)

HOW TO SUBMIT YOUR ENTRY:

- Prepare a power point 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, and 'claimed points' based on your self-assessment in it. 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 referenced 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 to us.

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APPENDIX:

1) Quarter car parameters:
Sprung mass = 400 Kg
Unsprung mass = 80 Kg
Suspension stiffness = 33000 N/m
Suspension damping = 1100 N.sec/m
Tyre stiffness = 150000 N/m
Tyre damping = 1000 N.sec/m
Maximum allowed suspension deflection = 0.25 m (hint: use 'saturation' to limit your suspension deflection i.e., Z_sprung – Z_unsprung, where Z is the vertical displacement as a function of time)

2) Road profile: Class C road as per ISO 8608:2016 (see the enclosure.) Program will generate a random road profile of class C every time which might give a different power output. You should consider the average power output of 10 simulation runs.

3) Vehicle speeds: 40 Kmph

4) System dimensions: Must not exceed, 1) length = 0.25 m, 2) diameter = 0.15 m. In case your system has an irregular shape, it must fit in the envelope of volume occupied by a cylinder with above dimensions.

5) System weight: 15 kg. Points penalty for exceeding the weight limit.

6) Simulation time: 120 sec. Generate the road profile for corresponding timespan.

ENCLOSURES:

1)Program for generating road profile time series.
Link to the file: http://bit.ly/JLR_PS_MatlabFile

A maximum of 5 participants (per team) shall be awarded a participation /merit certificate.

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