ENERGY-HARVESTING SHOCK ABSORBER

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Advisor: Dr. Lei Zuo (VT)

Motivation

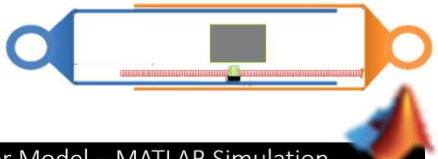
Stony Brook University:

Energy-harvesting shock absorbers have great potential to recover energy otherwise dissipated in automobile suspension systems

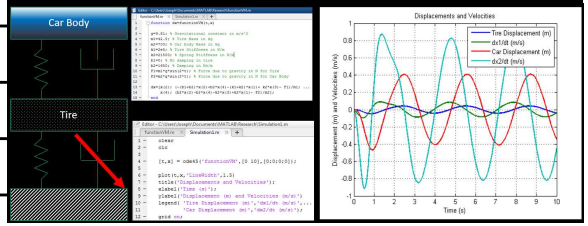
*pictures obtained from https://www.cehms.com/our-research/ and google images for "Hummer H2"

Modeling, Simulation, and Mechanical Design

Concept	Predicted Efficiency, η_t
Roller Screw	87.3%
Axial Piston Pump	87.3%
"Scotch & Yoke"	82.2%
Modified MMR	84.9%
Modified R&P	94.1%
"Socket Wrench"	89.4%



Quarter-Car Model – MATLAB Simulation



Technical Approach

1. **Bottom-Up Concept Generation**
   - Catalogued mechanical components
   - Evaluated their predicted efficiencies based on literature review
2. **Refinement**
   - Criterion established for incorporation on Hummer vehicle
   - Mechanical efficiency established as dominant feature for design
   - Discarded unfeasible concepts
3. **Down-selection**
   - Identified gearbox, motor, and ball-screw mechanisms that fit within tolerances for a vehicle shock absorber

Results

- Preliminary designs captured for project continuation
- Research was translated into senior capstone project proposal for mechanical engineering students
- A team of 6 undergraduates continued this research as their 2015-2016 Senior Design Project

Virginia Tech 2015-2016 Project:

Center for Energy Harvesting Materials and Systems

ME 4015-4016 Senior Design Project

Advisor: Dr. Lei Zuo, Mechanical Engineering

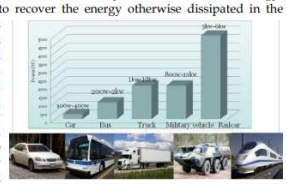
Team Size: 4-5

Project Title: Energy-Harvesting Shock Absorber

Sponsor: Center for Energy Harvesting Materials and Systems

Project Description:

Only 10-16% of fuel energy is used to actually drive vehicles. An energy-harvesting shock absorber is able to recover the energy otherwise dissipated in the suspension vibration. Innovations include recovered energy from suspension vibrations, self-powered semi-active suspension control, system-level design, analysis, and control to meet the multifunctional objectives with high energy efficiency and reliability, and a lightweight design retrofit-able to passenger cars, trucks, military vehicles, etc. This senior design team will seek and research further exploration into these innovations.



The main technical goals for this project are to recover energy from suspension vibrations in cars and develop a design to be retrofitted onto a Hummer H2 vehicle. Based on previous experience, we recognize that the design and implementation of these shock absorbers with have technical challenges included but not limited to electro-mechanical issues, hydraulic fluid issues, etc. Therefore, this project will require students who wish to work with challenging systems. A respectable work ethic and ability to complete tasks on time is required, as the end goal of this project is to produce publication(s).

If you are interested, please send resumes and/or questions to the following address as soon as possible to Dr. Lei Zuo: leizuo@vt.edu