ECE 398GG Prof. George Gross
Spring 2023

Homework 1 on Prof. Krein's Lecture on *EV* Dynamics

Date due: Friday, February 3, 2023

1. **State** the reasons why a typical tractor-trailer combination consumes nearly ten times as much energy per unit distance as a typical passenger car. **Describe** steps that can be implemented to reduce the multiples of energy consumption by the tractor-trailer combination.

2. To explore the impact of drag on a vehicle, **consider** a passenger car with a frontal area of 2.5 m^2 that cruises at 75 *mph*. **Determine** the ratio of the energy consumed by this car with a drag coefficient of $C_d = 0.32$ to that with a drag coefficient of $C_d = 0.21$?

3. Many vehicle designers recommend that the share of the mass of the batteries be, at most, 30 % of the total vehicle mass. Consider a small car with a target maximum mass of 2,000 *kg*, a frontal area of 2.3 m^2, $C_d = 0.25$ and tire resistance coefficient of 0.008. **Calculate** the range this car can attain on a cruising speed of 75 *mph* on a level road.

4. Experts warn that it is easy to leave out critical aspects of vehicle design. For example, roads are not totally level, in general. A drive into a headwind adds to the drag resistance as if the car were moving with the headwind speed added to its actual speed. **Determine** the power required for the small car in problem 3 to cruise at 75 *mph* with no wind on a level road. **Determine** the power required for the same small car to cruise at 75 *mph* with a 10-*mph* headwind on a road with 2 % slope? [Note: A slope of *s %* means that for each unit of horizontal distance covered, the elevation changes by *s %* of that unit, i.e., the ratio of the amount of elevation change to the amount of horizontal distance covered is *s %*.]

5. If we double the battery mass in an *EV*, can its range be doubled, with all other parameters kept fixed? Why or why not?