Homework 1 - Tips

The mass of the vehicle is required to be able to calculate the performance of the car, but on the other hand mass of the vehicle changes with its performance, i.e power levels. Therefore, you need to write an iterative routine to be able to design the car properly. In this routine, you start assuming a minimum mass for the drive system components (can be even 0 kg) and you update your mass after each iteration until the increase required in mass is minimal (for example 5 kg). Follow the steps given below in an iteration cycle.

Steps of Matlab Code:

I. *Calculate the mass of vehicle with assuming zero power specifications.*

II. *Calculate the maximum traction power required at maximum vehicle speed on a flat surface and still weather for an acceleration of 0.05g.* ***Power of your battery needs to be the total of electric machine power and accessories, please consider the component efficiencies. Battery power needs to be determined in this step.***

III. *You have calculated the required maximum power output of the traction electric machine. In this part, calculate the maximum torque in the base speed region considering the required 0-100 km/h acceleration.*

IV. *Calculate the fuel consumption in the given cycle, and calculate the battery energy capacity required for the required range?*

   a. *Reference speed comes from cycle. Form for loop from t=1 to t= 1800, this is the length of the cycle. At the beginning vehicle is at stand still. Calculate the difference in speed and use a proportional control to set the acceleration (Acceleration=K_p (V_{ref}-$V_{vehicle}$)). Try different K_p (0.3-1) until vehicle speed can follow reference speed. If K_p is low, acceleration is slow so vehicle cannot follow the reference speed. What happens when K_p is high? Calculate traction force for this acceleration. Take its limit according to maximum traction effort that is 0.9x0.5xMg* ***and 0.9x0.65xMg for braking****.* ***Calculate torque output of the electric machine required for this acceleration, please consider losses in transmission. In the next step, take the limit of this value according to maximum torque of EM (consider two limits: one in constant torque range, one in constant power range). From the torque of EM, calculate the resultant tractive force on wheels and determine vehicle acceleration. From vehicle acceleration calculate speed of the vehicle at (t+1).***

   b. *Calculate total energy required by adding power coming from battery (consider battery and EM efficiencies). Calculate the distance of the driving cycle given and estimate the battery energy required for the required range.*

V. *Calculate the new mass of the vehicle, if mass difference is larger than minimum requirement and return to 1st step and start your calculation with the new mass.*

VI. *Once you identified the size of the drivetrain components, calculate the specifications of the vehicle.*
