System Simulation of Leaf-Sized Electric Vehicle

A driver and Nissan Leaf-sized electric vehicle are defined as given in the files contained in **EVModel_hw2.zip**, including model parameters

- r_w = 0.4 m
- M_v = 1620 kg
- C_d = 0.29
- C_r = 0.01
- A_v = 2.75 m^2
- K_e = 0.407 Nm/A
- P_{e_max} = 80 kW
- V_{base} = 32 MPH
- K_v = 650 Ns
- T_i = 50 s
- $\eta_{DC\text{-}DC}$ = 98%
- η_{inv} = 95%
- *Battery:* 24 kWh

The file **MotorEff.mat** defines the efficiency of the electric motor as a function of both motor angular speed and motor torque. These curves can also be produced using the generating function defined by the file **motoreff_func_leaf.p**. To view these curves, you can run the script file **PlotMotorEff.m**. Additionally, the file **PlotEVData.m** has been modified so that the motor torque T_m vs angular speed ω_m path of the vehicle is shown for the simulated driving cycle, along with contours of efficiency for the motor.

a) For the vehicle cruising in steady-state with velocity V_{cruise} = 50 mph on a flat road,
   - Calculate the vehicle power P_v required to maintain cruise velocity
   - Compute the gear ratio, g_{ratio} that results in optimal motor efficiency for this operating point
   - Compute the power P_{batt} that must be supplied by the battery for operation with the solved optimal g_{ratio} as well as efficiencies of the motor, inverter, and DC-DC converter. Compare this to the battery power required when the Nissan Leaf's 7.94 gear ratio is used.

b) Run the driving cycle **eudc** with t_{stop}=1200 at two gear ratios, g_{ratio} = 7.94 and version from (a).
   - Measure and report the total energy taken from the battery over the course of the entire driving cycle with your optimal g_{ratio}
   - Compare the two gear ratios in terms of ending SOC and MPGe
   - Turn in the plots of the motor torque T_m vs angular speed ω_m path of the vehicle over the drive cycle overlaid on the motor efficiency contours