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PE Assignment 2

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Battery System Simulation

a) Value of SOC_0

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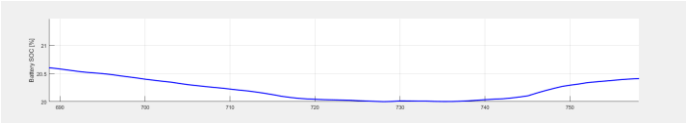
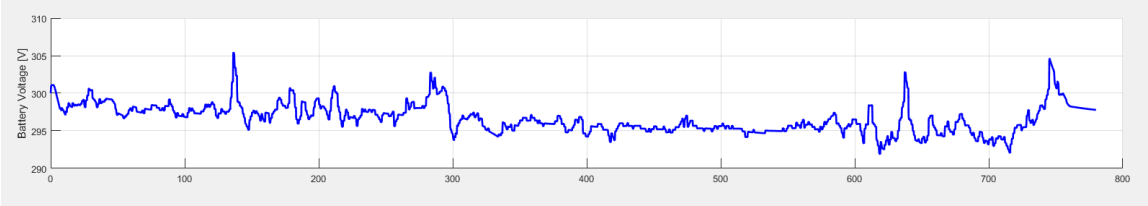
%% Battery Model Parameters
Mp = 7; % number of cells in parallel
Ns = 85; % number of units in series
% Cell model parameters [room temperature]
load batt_V_SOC.mat % Voc(SOC) look-up table
Cnom = 10; % cell capacity [Ah]
Crate = 5*Mp*Cnom; % Max battery pack charge/dischar
SOC0 = 0.2757; % initial SOC [0-1]
Rp = .005; % discharge series resistance for Ibat >
Rn = 0.005; % charge series resistance for Ibat < 0
R1 = 0.005; % diffusion series resistance
tau1 = 240; % diffusion time constant [s]
VM = 15e-3; % hysteresis voltage [V]
tauH = 40; % hysteresis time constant [s]
etaC = 0.995; % Coulomb efficiency
```



SOC0 = **0.2757**

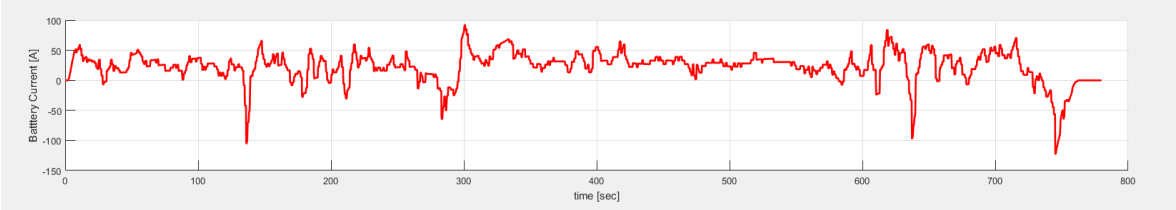
b) Values of the minimum and the maximum battery voltage over the drive cycle



Minimum Battery Voltage = **291.896 v**

Maximum Battery Voltage = **305.45 v**

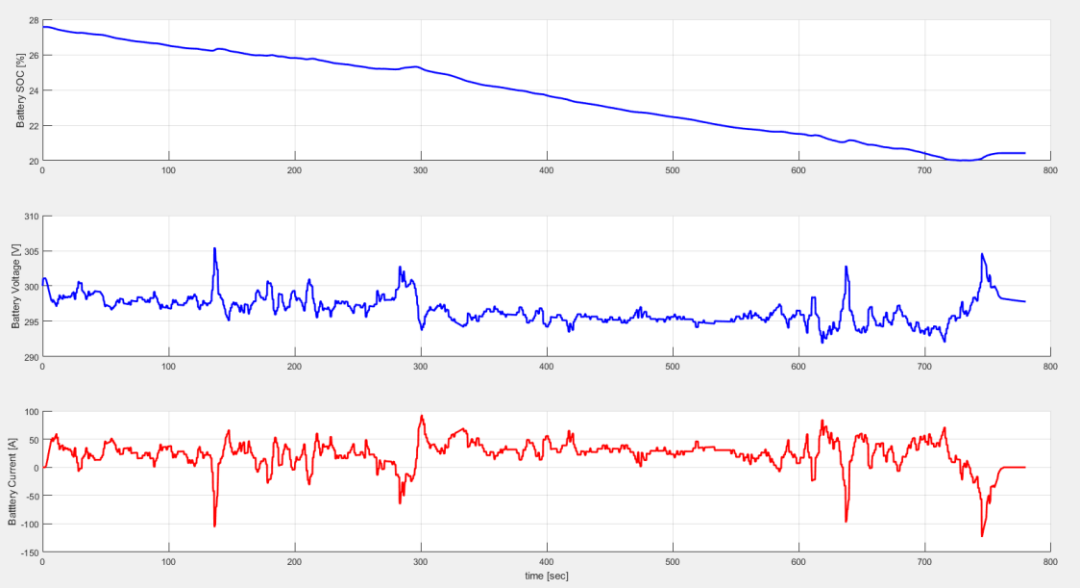
c) Values of the maximum battery charging current and the maximum battery discharging current over the drive cycle



Maximum current discharging = **92.87 A**

Maximum current charging = **-123.38 A**

d) Plots of the battery SOC, battery voltage, and battery current as functions of time.



Active balancing of battery ce4lls using DC-DC converter

a) What is the system Capacity C_{system} ?

$$active\ balancing\ of\ battery\ cells$$
$$C_{sys} = C_{nom}$$
$$C_{sys} = \mathbf{20\ Ahr}$$

b) What should the power rating of each DC-DC converter be?

$$Power\ Rating = V_{celli\ max} * I_{Ci\ max} = 4.133 * 2 = \mathbf{8.267\ w}$$

c)

$$at\ SOC = 50\% \longrightarrow V_{cell} = 3.6\ v$$
$$I_{cell}\ 20\ a \quad I_x = 19A$$
$$I_c = I_{cell} - I_x = 20 - 19\ 1A$$
$$\eta_{DC-DC} = 100\%$$
$$I_c\ V_{cell} = I_b\ V_{bat} \longrightarrow I_b = \mathbf{0.01\ A}$$

d)

$$I_b - I_x = \sum I_{bi} = 1A$$
$$P_{DC-DC} = v_{batt} \sum I_{bi} = 100 * 3.6 * 1 = \mathbf{360\ w}$$