Fall 2005 EE595S
Homework Assignment Number 4

Note: Since this will not be collected, there is no due date. It is recommended that this be completed before we start the next set of lecture notes.

Information for Problems 1-5

Consider the drive shown in Fig 15.2-1. Consider the following changes. First, remove the stabilizing filter. Second, remove the ac source, rectifier, and inductor L_{dc}. Replace the rectifier source with a battery source, which is governed by the overly simplistic model that the current out of the battery is given by

$$i_r = \frac{v_{batt} - v_{dc}}{r_{batt}}$$

where v_{batt} and r_{batt} are Thevenin equivalent battery source voltage and resistance, respectively.

Problem 1
Derive a nonlinear model similar to (15.4-21) of the text [1].

Problem 2
Derive a linearized model similar to (15.6-1) of the text [1].

Problem 3
Derive an expression for the average dc voltage, similar to (15.5-9) of the text [1].

Problem 4
Consider the parameters shown in Table 15.8-1 of the text [1]. Ignore E, ω_{eu}, L_c, and L_{dc}. Suppose instead that $v_{batt} = 200$ V, and that $r_{batt} = 2\,\Omega$. Assuming the steady-state operating point is with a torque load of 1 Nm and that the speed is 200 rad/s (mechanical), compute the q- and d-axis voltages and currents, as well as the dc voltage and modulation index m. Assume all voltage is injected into the q-axis.

Problem 5
Using the control system shown in Fig. 15.8-1, plot the open loop frequency response with ω_{rm} as an output and d as an input assuming the same operating point as in Problem 3. What is the uncompensated gain and phase margin ?

Reference

[1] *Analysis of Electric Machinery and Drive Systems*