Aim: To undertake the design of various control configurations under the modern control theory framework for a practical system and to assess the resulting performance.

Tasks:

You will design a number of control configurations for the Buck converter presented in the instructor’s book on page 70 with component and parameter values presented on page 85. The different control configurations are presented in part 2 of the instructor’s book which deals with modern control theory. These configurations are:

1) Full-state feedback (FSF) using measured states (Chapter 9)
2) FSF with integral control, using measured states (Chapter 10)
3) FSF with integral control, using estimated states from a full-order observer (Chapter 11)
4) FSF with integral control, using estimated states from a reduced-order observer (Chapter 11)
5) LQR – same as (1) and (2) above except feedback gain $K$ is determined optimally (Chapter 12)
6) LQG/LTR = LQR + LQE with LTR – same as (3) and (4) except both $K$ and $L$ are determined optimally while optimizing robustness (Chapter 12)

The first task to be performed is to determine open loop performance. Performance can be assessed by examining the rejection of a 1 volt input voltage disturbance in the output. This will also validate the SSA (state-space averaged) model used. This involves the following:

i. Circuit level simulation of the open-loop plant using PECS or other circuit simulator.
ii. Obtain the SSA model to obtain the time-invariant state space model and use Matlab/Simulink to generate the time domain response.

As one progresses through the control configurations (1) through (6) above performance can be assessed by simulation using Simulink.

As a final step the configuration of step (6) should be implemented as a circuit and simulated using a circuit based simulator. Chapter 14 and /or the table of compensators on pages 124 and 125 in the instructor’s book may be helpful in this regard.

Report and Presentation:

Write up a clearly written report presenting your results. Be sure to include all your Matlab/Simulink code. This normally should go into the appendix. The due date for this is at the start of your presentation to the class during finals week. It should be emailed to the instructor (tymerski@ece.pdx.edu).

In your report be sure to present a cogent summary in your conclusion.