ECEN 4413
Automatic Control Systems
Spring 2005
Computer Project- Part A

Objective:

Using MATLAB to analyze and control the systems.

Requirement:

Show all your steps, plots (responses) and clearly state your comments and explanations if required. Include all the MATLAB code lines and programs (with documentation).

Problem Description

Given that the equation of motion for the system is as below:

$$\dddot{y}(t) + 52\,\ddot{y}(t) + 104\,\dot{y}(t) + 200\,y(t) = 50u(t)$$

a. Compute the transfer function (*full model*) of the equation of motion, where $u(t)$ is the input and $y(t)$ is the output of the system. Assume all initial conditions are zero.

b. Plot the pole-and-zero map of the system. Is the plant open-loop stable?

c. Plot the response to the system to:
1. an impulse
2. a sin wave ($u(t) = \sin(t)$)
3. a step signal. For the step response, obtain the settling time, overshoot percentage and steady state error.

d. Using the sisotool, design a controller through the root-locus procedure. The designed controller should have one pole, two zeros and be able to achieve the following specifications:
- zero steady state error
- settling time less or equal to 1.5s
- overshoot less or equal to 20%.

Plot the step response of the controlled system (r to y), the final root-locus diagram, and provide the transfer function of the designed controller.

e. The controller you developed in the item **d** is giving good simulation results, however it is not possible to implement it in the real world. What is the reason for that?

f. Add another pole to the controller and make the necessary adjustments to maintain the specifications you achieved in item **d**. Plot the step response of the controlled system (r to y), the output of the controller (r to u), the final root-locus diagram, and provide the transfer function of the designed controller.

g. For additional credit, explain why the sisotool's design constraints were not useful in item **e**.