Spring 2003 10.450 Process Dynamics, Operations, and Control
Problem Sets - 5

In an effort to get a better idea of the behavior of dynamic systems, we should put the computer to work. Get these Matlab files:

- sim450 - a script that maintains running arrays of a disturbance variable, a manipulated variable, a set point, and a controlled variable. It also plots these on scrolling axes, resembling a monitor in a plant control room.
- f_moni - a function that sets up the monitor window
- f_dist - a function that sets up a GUI to deliver the disturbance variable to sim450. The disturbance can be input with a slider, or supplied from a suite of standard disturbances.

Running sim450 as received will show changes you make to the disturbance variable. Your job is to adapt sim450 to calculate the controlled and manipulated variables, as well.

1. Code in a first order process that responds to the disturbance variable. Explore its response for various disturbances. Can you observe the expected behavior of amplitude and phase shift with changing disturbance frequency? Vary the gain and time constant. Verify to your satisfaction that your code is calculating correctly. Submit 1 or 2 plots that you find most interesting.

2. Do a similar thing for a second order process. Vary the time constant and damping factor. Submit the best plots.

3. Now, add feedback control. Use only proportional control mode at this point. Modify each of the processes in 1. and 2. to include a manipulated variable input in addition to the disturbance variable input you have already used. Start the simulation with zero error, and then introduce a disturbance. Document how the manipulated and controlled variables respond.

Note:

- Because this simulation should respond to input from the GUI, these are to be simple numerical calculations from each time step to the next, not the analytical solutions, and not the Matlab ODE solvers. Appendix F in Marlin is helpful with the coding. The controller coding is discussed in Marlin Section 11.4.
- Also, while we do a lot of our analysis in deviation variables, remember that real processes do have real reference values. Therefore, use references that are somewhere in the middle of the variable domains - you should show your control variable deviating from, for example, 50, not zero.