System Identification – Practical Assignment 3
Transient Analysis of Step Responses

Logistics

Please reread the logistics part of lab 2, the same rules will apply to this lab. The only thing that changes is the dropbox link, which for this lab is:

    https://www.dropbox.com/request/QNzn1rOG9vUtahpHePtm

Assignment description

In this assignment we will perform transient analysis of step response models – see the course material, *Transient Analysis of Step and Impulse Responses*. We will do this for both first-order and second-order systems.

Each student is assigned an index number by the teacher. Then, the student downloads the Matlab data files that form the basis of the assignment from the course webpage. There are two files: the first contains several step inputs signals and the response of a first-order system, and the second contains similar data for a second-order system. The data is provided as an object called `data` of type `iddata` from the system identification toolbox, see `help iddata`. For convenience, a separate variable `t` holds the time vector of the experiment. Every dataset contains *five* consecutive step signals, each corresponding to 100 time steps; see the figure. The initial conditions are zero. The *first* step should be used for identification; the second step simply brings the system back to zero initial conditions, so that you do not have trouble with initial output mismatches due to nonzero initial conditions; and *the last three steps* should be used for validation.

Work on the following requirements first for the first-order system, and then for the second-order one:

- Develop a transfer function model of the system with the method described in the lectures, using the first step signal and response from the data. Include instructions that output to the console the transfer function, as well as relevant intermediate values when your script is run (e.g. gain K, time constant T for first-order systems, overshoot M and oscillation period T_0 for-second order systems).

- Validate your model using steps three to five (this is the validation data). The validation should consist of: (a) a plot where the system output is compared with the model output on the same graph; (b) and the computation of the MSE. Both of these results should be automatically produced by the Matlab code you provide. Use Matlab function `lsim` to simulate the system response to the validation input.

Some relevant Matlab functions: `load, tf, lsim, plot`.