System Identification – Bonus Lab 4b
Transient Analysis of a DC Motor Impulse Response

Organizare

Students must first finish the main Lab 4. After the lab was validated, if they have enough time, they can optionally do this bonus lab 4B. A correct solution for 4B, validated by the lab assistent, warrants a 0.25 point bonus on the final grade.

Assignment Description

We will analyse the impulse response of a DC motor in the time domain, using data obtained from the real system.

As a preliminary step, familiarize yourself with the real system and the ways in which input signals can be applied and output signals can be read, using the guide at the following link:

> https://busoniu.net/teaching/sysid2023/dcguide.pdf

To confirm that you're interacting with the system correctly, apply a step signal with a value of $u = 0.5$ and a length of 100 time samples, and then plot the response. You should obtain a plot similar to the following (note the sequence of zeros initially applied, as explained in the guide):
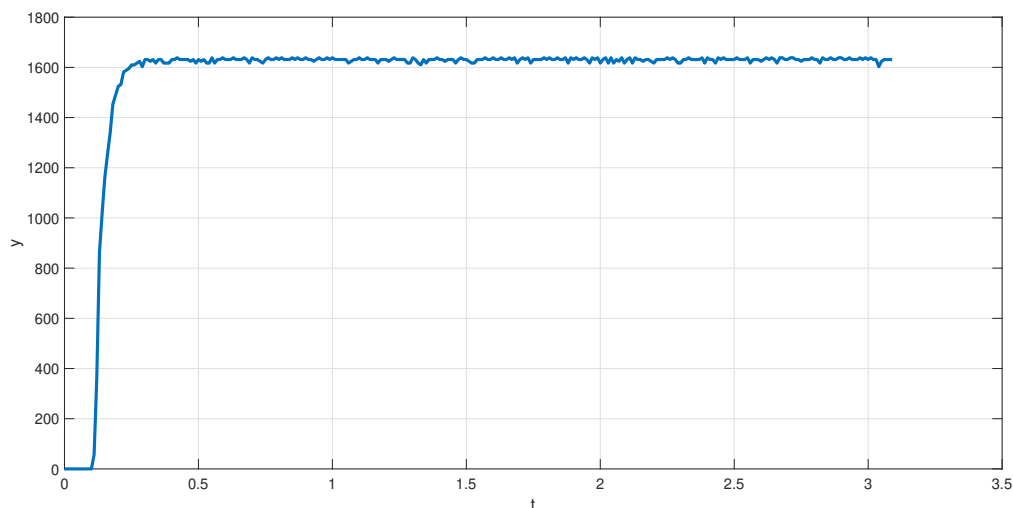
Each student will obtain a data set using the DC motor and will identify the system, as detailed in the following instructions:

- Apply a small signal with a value $u = 0.1$ and let the system reach steady state (we therefore have non-zero initial conditions for the impulse response).

- Apply a sequence of 3-4 impulses with value $u = 1$ and each of length 1-2 time samples; after each impulse let the system reach steady state again.

- How much larger should the impulses be for these to be conidered a correct practical implementation of an ideal impulse? Let's name this factor α.

- Identify the transfer function. It is best to use y_{ss} for obtaining the gain rather than y_{max} (using y_{max} would require the use of α).

- Validate the identified model using the `lsim` function applied on the complete input signal previously generated. Important observation: the time vector used in lsim needs to be equidistant, unlike the real time vector obtained from the system, in which the sampling time is not perfect.

- The system has a small time delay. Tune it by hand to get a better response.