OTTO VON GUERICKE UNIVERSITÄT MAGDEBURG

FACULTY OF ELECTRICAL ENGINEERING AND INFORMATION TECHNOLOGY

Temperature Control Lab 1 (TCL 1)

Institute for Automation Engineering
Chair for Automation/Modeling

October 6, 2021

1 Objectives

In the Temperature Control Lab 1 (TCL 1) identification of the systems transfer function for one Heater-Sensor-System will be performed using two simple identification methods. The general objectives for this lab are:

- Acquiring knowledge about parameter estimation methods for linear systems.

- Gaining piratical experience by applying model identification methods to independently obtained real world data.

2 Model identification with aperiodic test signals

2.1 Preparation

In order to perform the practical part successfully, complete the following tasks:

1. Identify qualitatively the associated system behaviour (PT1, PT2 with oscillation, PT2 without oscillation, I) of each step response in Figure 2a-d.

2. Using literature such as [1, 2], acquire knowledge about identification methods used for dynamical systems mentioned above. State three typical methods and explain two of them in detail by answering the following questions:

   - What are the requirements for the applicability of the identification method?

   - What kind of input signal is required?

- How are the specific parameters of the dynamical system obtained from its response to the input signal?

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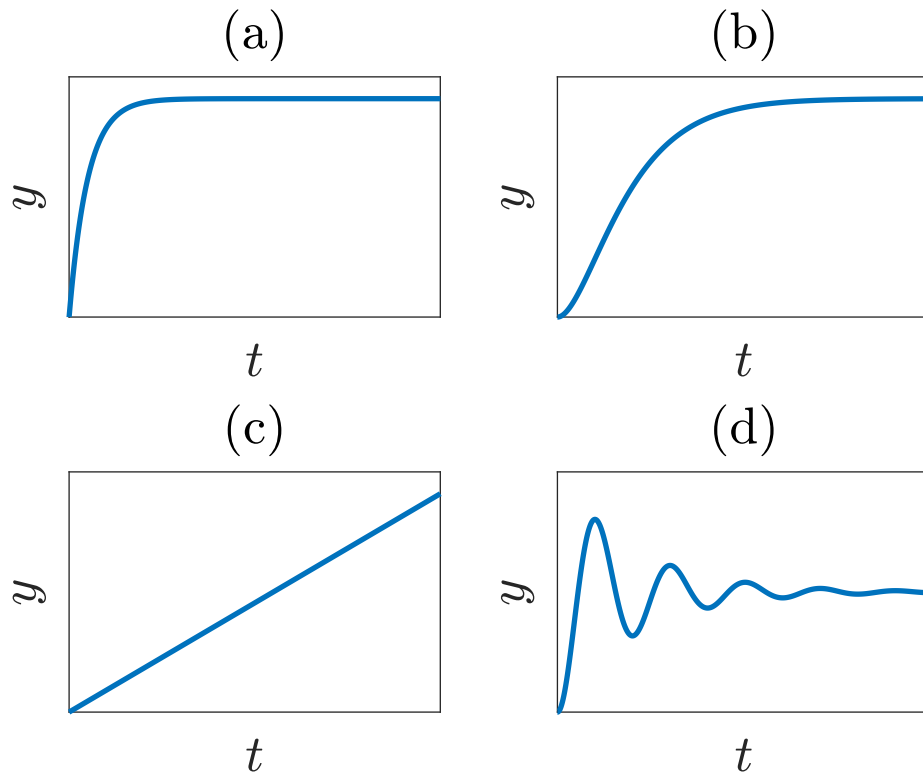

Figure 1: Step responses of four basic dynamical systems.

2.2 Practical part

First, a successful installation of the device is required to continue with the practical part. Afterwards, connect the ARDUINO to a computer and to an external power supply. Finally, open the Matlab/SIMULINK file step response arduino lab.

1. After a pre-heating phase of 5 min using 20% of the maximal power output regarding Heater 1, apply a step input to Heater 1 from 20% to 60% of the maximal power output and save the temperature profile obtained with Sensor 1.

2. Identify the system behavior of the Heater-Sensor-System. Use the tangent method

[3] as well as the method of Schwarze [3] to determine the transfer function of the Heater-Sensor-System.

3. Validate the identified transfer function in Matlab/SIMULINK by replacing the corresponding TCL-block with this transfer function and simulate the temperature response of the Heater-Sensor-System using the same step input.

4. Compare the experimental step response with the simulated step response.

3 Deadline

Please upload your final report including answers to the questions from the preparation section and your solution of the practical part as pdf file in the e-learning platform:

https://elearning.ovgu.de/course/view.php?id=11281

Submission deadline: 17th November 2021

References

[1] R. C. Panda and T. Thyagarajan, *An Introduction to Process Modelling Identification and Control for Engineers*, Alpha Science International, Hoboken, 2012.

[2] D. E. Seborg, *Process Dynamics and Control*, John Wiley & Sons, Oxford, 2017.

[3] Handout TCL 1.