Model-based design of rotary speed control for the Qube-Servo 2

Let us assume that we are in October 2025.

You are just graduated from Polytech Nancy and you work for a company as a Control Engineer.

Your first project is to answer an industrial customer who requests from your company a rotary speed control of a DC motor that will actuate a new robot arm which is programmed to move at a given speed when performing a task such as welding or painting.

Here we investigate the model-based rotary speed control for the Qube-Servo 2 platform equipped with the inertia disk, as shown in Figure 1.1, that was used during one of the labs last year.

Figure 1.1: Qube-Servo 2 platform equipped with the inertia disk

The input of the system to be controlled is the voltage of the motor in V while the output is the angular velocity or rotary speed in rad/s.

By working in group of 3 to 4 students, the goal of this lab is to determine of mathematical model of the Qube-Servo 2 that will be used to design a rotary speed control.

You are free to use any method or strategy you like.

The general methodology for the design of a feedback control is detailed in Figure 1.2[1].

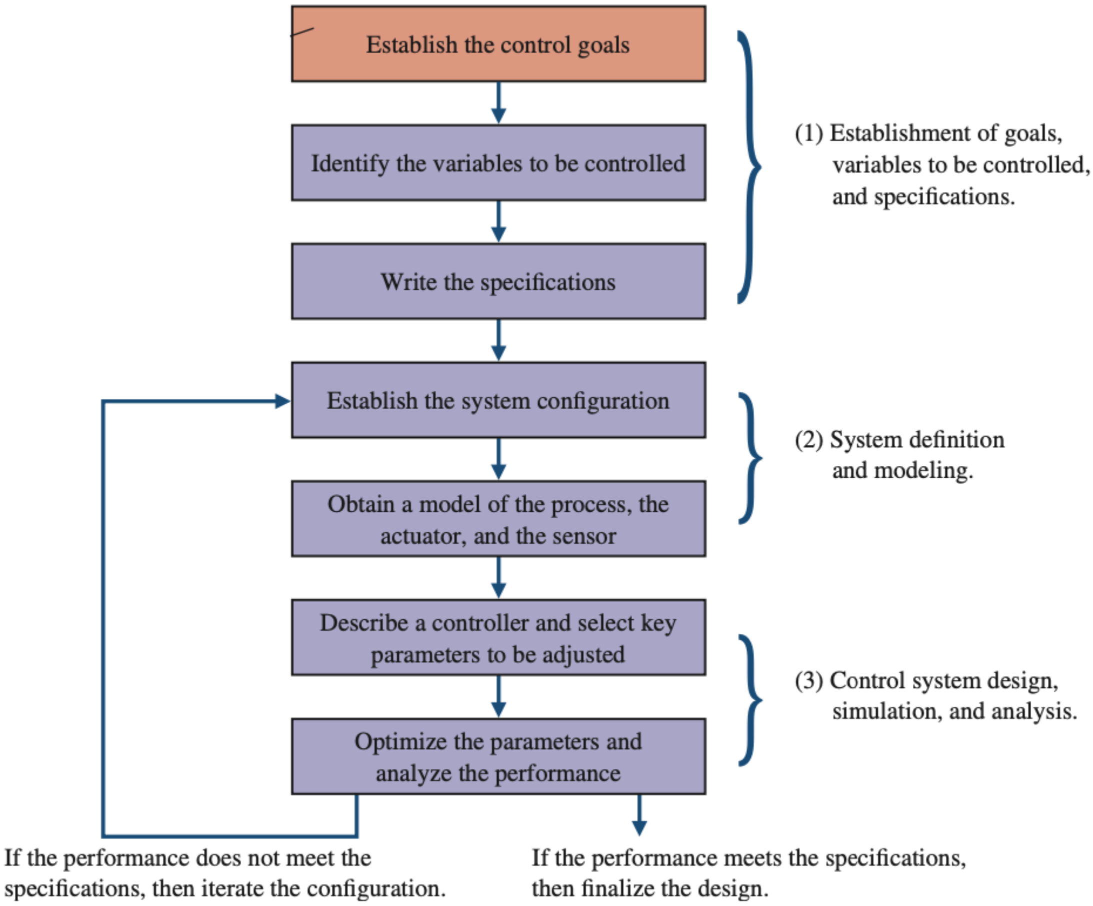

Figure 1.2: The control system design methodology

From Figure 1.2, the controller design problem can be summarized as follows:

Given a model of the system to be controlled (including its actuators and sensors) and a set of design goals, find a suitable controller (or determine that none exists!).

As with most of engineering design, the design of a feedback control system is an iterative process.
A successful designer must consider the underlying physics of the plant under control, the control design strategy, the controller design architecture (that is, what type of controller will be employed), and effective controller tuning strategies.
One key stage in the model-based control system design methodology is to obtain a model of the system.

The lab is designed to make you reflect on the following theoretical and practical aspects:

1. How to choose a suitable structure for the model ?
2. How to collect data. What type of input to be sent to the plant ?
3. How to compute the chosen model parameters from the collected data ?
4. How to evaluate the quality/validate the model ?
5. How to use the model to design a control ?

[1]From Richard Dorf and Robert Bishop, Modern Control Systems, Pearson, 2022