# Chapter II-0

# Introduction

The objective of this lab is to get introduced to the hardware and software you will be working with.

In particular, you will learn how to:

- Connect the K-MCK and the K-ECS boards.

- Setup and run the K-CSP, change the experiment parameters, graph the signals of interest, and interpret the results.

- Use the KST data plotting tool.

**Pre-lab**

P-II-0.1. As explained in Chapter I-2, the K-CSP uses an open source software, (0 pts) called KST, to plot data. To familiarize yourself with this data plotting tool, first watch the following video tutorials from KST's official website https://kst-plot.kde.org/video_tutorials/:

- Kst presentation #2: General presentation of the user interface and most important concepts
- Kst presentation #3: Range tools and live plots with streaming data
- Kst presentation #4: FFTs, equations, filters, fits, plugins

Although the above videos are the most relevant to the labs you will be conducting, it is recommended that you watch the rest of the videos as well.

## II-0.1  Lab Procedure

L-II-0.1. Connect the K-ECS and K-MCK boards, and launch the K-CSP, as explained in Chapter I-2.

**Attention**

**Turning ON the system power button must ALWAYS be the LAST step to do.**

**NEVER handle electronic components that are powered.**

L-II-0.2. Run the system with a step input of $v_r = -4\,\mathrm{V}$. This can be achieved by selecting "Constant" from the Signal Generator pull-down menu and entering $-4$ volts in the unique parameter box. Then, press the Start button (you may leave the rest of the parameters at their default values). After a few seconds, the motor will start turning while 4 signals will be plotted by the KST in a graph matrix. You may stop the experiment at any time by pressing the Stop button.

(0 pts)

**Demo**

D-II-0.1. Demonstrate this step to the TA.

L-II-0.3. Identify the four displayed signals in Fig. I-1.3 (note that you are dealing with an open-loop system in this case).

(0 pts)

**Demo**

D-II-0.2. Demonstrate this step to the TA.

L-II-0.4. Open the data file where the experiment data is stored. Make sure you understand how it is structured and relate data columns to the signals displayed in the graph matrix. The file is a text file (with extension .csv), which you can view with any text editor or spreadsheet editor.

To open the data file, you can either

- browse to the file path indicated in the Data File box and double click the file name within a window manager, for instance; or
- use the K-CSP menu: File > View Data File

L-II-0.5. Try the different interaction types demonstrated in the KST video tutorial "Kst presentation #2: General presentation of the user interface and most important concepts" starting at time 3:05 till the end of the video clip. In particular, use the zoom tool to zoom out and in to certain regions of the plots to visualize them with a higher resolution.

L-II-0.6. Try displaying the data using different ranges. This is illustrated in the video tutorial "Kst presentation #3: Range tools and live plots with streaming data" starting at time 1:20 till the end of the video clip. Note that you don't have to do it while the data is streaming live. You can do it after the experiment is over.

L-II-0.7. Apply a low-pass filter to the raw speed error signal. Then, apply an exponential fit on the raw speed signal. These features are illustrated in the video tutorial "Kst

presentation #4: FFTs, equations, filters, fits, plugins" starting at time 3:00 till time 5:00. You may skip this step if these features are not enabled in the lab computers!

> **Demo** D-II-0.3. Demonstrate this step to the TA. (0 pts)

## II-0.1.1 Experimenting with Different System Setups

The purpose of this part of the lab is to test your understanding of the software/hardware system, explained in Part I.

Configure the K-CSP to run the following experiments:

L-II-0.8. Speed control system in closed-loop mode with a PID controller and a step input of a step time of $5\,\text{s}$, and an initial and final values of $-3\,\text{V}$ and $-5\,\text{V}$, respectively. Do not use filtered signals.

> **Demo** D-II-0.4. Demonstrate this step to the TA. (0 pts)

L-II-0.9. Position control system in closed-loop mode without controller, using a pulse input with a delay of $5\,\text{s}$, an initial value of $-3\,\text{V}$, a period of $20\,\text{s}$, a width of $50\%$, and an amplitude of $-2\,\text{V}$. Set the overall experiment time to $80\,\text{s}$. Do not use filtered signals.

> **Demo** D-II-0.5. Demonstrate this step to the TA. (0 pts)

> **Report** No report is required for this lab.