

EITA50 Signal Processing

Lab Report Instructions VT 2021

General Instructions

The lab exercises in Signal Processing are usually performed physically in a lab room, with a teaching assistant helping the students and also approving them. In the Spring of 2021, the labs will instead be performed by each student at home. It will be done in the following way.

- Look at all the information on the course home page under the tab "Laboratory Lessons."
- Download and install Matlab on your computer.
- Download the Lab Manual, the data files, and the zip archive from the course home page.
- Read through the lab manual, perform all the steps of the lab, and document it in an electronic document.
- Upload your lab report in Canvas.
- Questions can be asked in your Canvas group.
- Note that there are hard deadlines for each lab, see the course home page.
- The lab reports must be in PDF and as short as possible.
- If you have an English-speaking teacher, the report must be written in English. Otherwise it may also be written in Swedish.
- If your lab report is approved, you can see the result on the course home page about one week later, on the tab "Results."
- If your lab report is not approved, your teaching assistant will contact you via e-mail.

The lab reports should be as brief as possible, but you must provide answers to all questions, and the answers should contain motivations. When the task involves a plot, it should be included in the report.

All information and data can be found on the course home pages, which have the web address www.eit.lth.se/course/eita50 and www.eit.lth.se/kurs/eita50.

On the following pages, there are specific tasks and questions for each lab.

Lab 1 – A System for Recording

Read the entire lab text first. Then work yourself through the lab text again, perform all the tasks described, and write down answers for all the questions. Please make sure to answer all the following questions, and give short motivations. Download the signal file ekg1.mat from the course home page.

Exercise 1

- Does the signal come from the real world or is it a simulation?
- Does the signal contain any noise?
- Include the plot of the raw signal.

Exercise 2

- Does the file itself contain data that allows you to calculate the time interval of the recording?
- What is missing for you to know that the recording is ten seconds?
- Include the plot with time scale on the t axis.

Exercise 3

- Does the signal mainly contain low, medium, or high frequencies?
- What are the maximum frequencies that are interesting?
- What causes the higher frequencies?

Exercise 4

- What kind of filter are you implementing?
- What is the filter called?
- Does the filter work as expected?
- How can you see this?

Motivate all answers briefly and include all plots. Upload your report in Canvas as a PDF document.

Lab 2 – Delay Processor

Lab 2 is not part of the course.

Lab 3 – IIR Filter Design

Read the entire lab text first. Then work yourself through the lab text again, perform all the tasks described, and write down answers for all the questions. Please make sure to answer all the following questions, and give short motivations. This lab uses the mkiir program, which is part of the zip archive that can be downloaded from the course home page.

Preparation Tasks

- Match the plots and give short motivations.
- Scan and include your plots.

Exercise 1

- Explain what happens when you move the pole and zero around.
- Explain the relationship between frequency response and angle and radius.
- Include one or two example plots.

Exercise 2

- Use mkiir to design a good low pass filter.
- Include the plot.
- You may do the optional exercises, but do not include them in the lab report.

Exercise 3

- Listen to the signals and explain how the disturbances sound.
- Include the plots of the spectra and explain how you can see the disturbances.

Exercise 4

- Design a notch filter to remove the disturbances.
- Does the filter work as expected?
- How can you see it in the spectra?
- How does the signal sound after being filtered?

Motivate all answers briefly and include all plots. Upload your report in Canvas as a PDF document.

Lab 4 – Image Filtering

Read the entire lab text first. Then work yourself through the lab text again, perform all the tasks described, and write down answers for all the questions. Please make sure to answer all the following questions, and give short motivations. Download the file `grace-hopper.tif` from the course home page.

Exercise 1

- Look at the signal in Matlab.
- Apply the moving average filter.
- What effect does it have on the signal?
- What kind of filter is it?

Exercise 2

- Apply the modified filter.
- What effect does it have on the signal?
- What kind of filter is it?

Exercise 3

- What type are the two filters?

Exercise 4

- Look at the image in Matlab.
- Apply the two-dimensional moving average filter and look at the picture.
- What type of filter is this?
- What effect does it have on the picture?

Exercise 5

- Apply the filter to the picture and look at it.
- What type of filter is this?
- What aspects of the picture does this filter bring out?
- For what type of applications can edge detection be useful?

Exercise 6

- What type are the two filters?

Motivate all answers briefly and include all plots and pictures. Upload your report in Canvas as a PDF document.