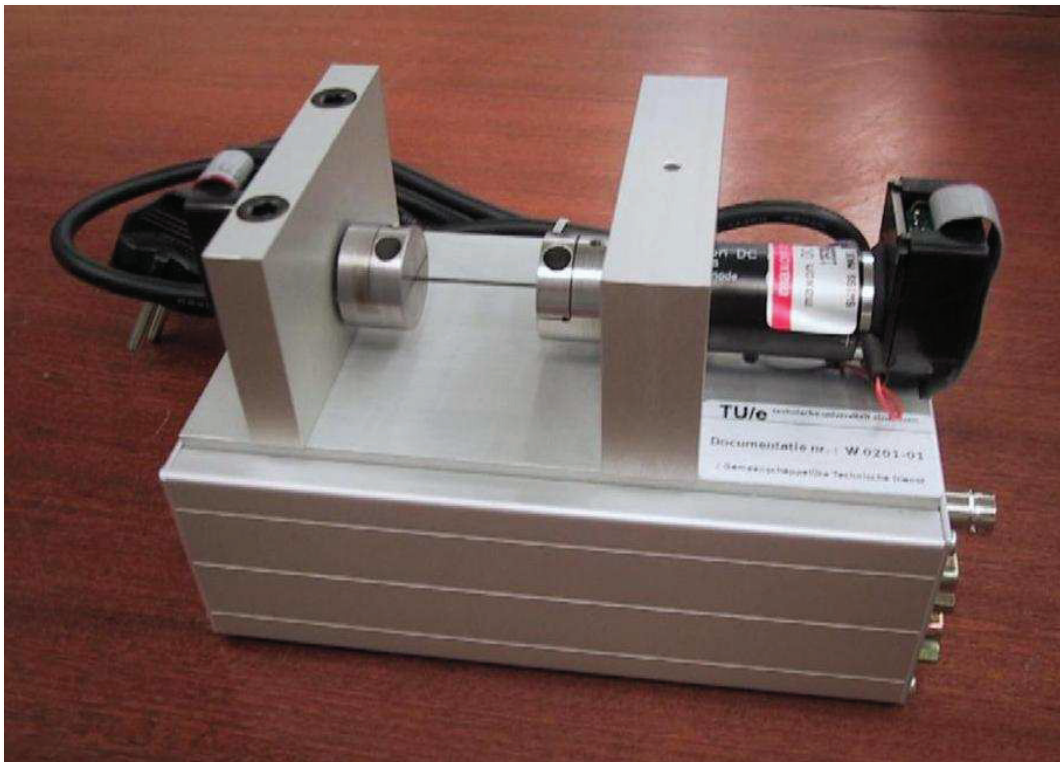


4CM00: Control Engineering



Assignments

Compilation date: September 1, 2015

Before you start, read this first!

This document contains the exercises for the course ‘Control Engineering’ (4CM00). These exercises are meant to prepare yourself for the experiments, which forms the core of this course. It is therefore mandatory to **make them all** before you start your experiments. To finish this course you need to write two reports:

1. Preparation for the experiments, to be handed in at the end of week 5.
It should contain:
 - (a) a report on the exercises marked with **!!*!!**;
 - (b) a detailed measurement plan for the experiments (at most 3 pages);
2. Execution of the experiments, to be handed in a week before your oral exam:
 - a report on the experiments you’ve carried out, the results you’ve obtained and the lessons you’ve learned.

Reports 1 needs to be handed in before the experiment sessions start, and as such is your ‘ticket’ to the experiments. No report means no experiments means no exam! Make sure you demonstrate your knowledge of control theory in both reports, showing the most relevant figures and drawing the right conclusions from them.

The final exam is an oral exam in groups of 2 students. Hence, form a group of 2, do all exercises and experiments together, and write the reports together. For the oral exam there are two possibilities:

- At TNO in Delft at a specific day (probably) in the last exam week. Adjacent to your exam you will be offered a guided tour around some of the TNO laboratories.
- At TU/e at a few specific days in the first two weeks *after* the exam weeks.

Both exams will be taken by Gert Witvoet and will cover both report 1 and 2. Watch your mailbox to be updated on ways to subscribe for either of the two options.

Note: *since this course is given twice a year (in Q1 and Q3) these are the only options to do your exam. In case you fail you thus have to wait until the next time this course is given.*

Hints and tips

Before you continue, consider the following tips.

Using Matlab. Perform and save all your Matlab operations in m-files. Also, consider creating functions for routines you often use. It will save you time!

Prepare your experiments. Many routines you write for the exercises, will be useful for the experiments as well. Hence, try to make scripts you can easily reuse for the experiments. This way you can be well prepared; time for the experiments is limited!

Important Matlab routines. When designing and/or analyzing controllers make use of standard Matlab functions like `tf.m`, `bode.m` and `nyquist.m`. For FRF measurements you will need functions like `cpsd.m`, `tffestimate.m` and `mscohere.m`. Get familiar with these functions, by **reading the corresponding Matlab help files** first!

Making Bode diagrams. You might want to use functions like `freqresp.m`, `abs.m`, `db.m`, `angle.m` and `semilogx.m` instead of `bode.m` to have complete control over your figures. Again, read the help files first! To change the default frequency axis of Bode plots from rad/s to Hz, type `ltiview`, and choose File - Toolbox Preferences.

PD control in Simulink. Implementing a PD controller in Simulink is often done with the ‘*PID Controller*’ block in ‘Simulink Extras’. Since this block contains a pure ‘*Derivative*’ block this could sometimes yield inaccurate time responses. If so, use the ‘*PID Controller (with Approximate Derivative)*’ block instead.

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