

Lab 3: Compensator Design

Overview

In this lab, you will get the chance to do what you couldn't do last time around with proportional control and design a first-order compensator for your kitticopter that better satisfies the specifications.

Compensator Design

The specifications are the same as in the previous lab. Once again, it might not be possible to meet all of them – even with the upgraded controller. It is up to you as the engineer to decide which ones are feasible within the limits of your system, the available components and the power supply. You may also add specifications that you feel would add to the quality of the design or should be considered in the given scenario.

As usual, the lab is marked according to your ability to do the best with what you're given and explain your decisions logically – not your ability to work a control systems miracle.

To reiterate the specifications from lab 2, here they are:

- Tracking of position inputs with >90% accuracy (i.e. the tracking error and effects of disturbances must be <10%).
- 2) Settling time improvement of at least 20% compared to the performance of the uncompensated closed-loop system.
- 3) Overshoot of less than 5%.
- 4) Robustness to uncertainty of up to 10% in the aerodynamic constant of the system. (Since you are determining this parameter experimentally, you should make sure your design works even if you don't get it precisely "correct".)
- 5) Robustness to a tolerance of 10% in the components used to assemble the controller.

BONUS: You may also attempt to improve the system's performance even further by designing a third controller consisting of multiple first-order stages. Instructions for how to build this are included in the manual in case, but half the extra marks are still available if you only get as far as the simulation stage.

Preparation

Ensure your controller is designed and built **on Veroboard** before you arrive at the lab to test it. Instructions for how to construct the compensator are attached.

Instructions

The aim of this session is to just to evaluate the performance of your controller. You may perform any suitable tests to do so.

Report

Use the provided template to write a brief report on your findings.

EEE3094S Lab 3 Report

The same general report-writing advice from the previous lab applies here. Please try to present your work clearly and professionally. If you wouldn't have a good time reading your report, the person marking it definitely won't.

Controller Design

This section should include:

- A brief description of the system model you derived previously for context
- An explanation of why you have selected the specific type of controller you are going for.
- A description of your controller design process, supported by calculations and figures.
- Tests of your controller in simulation.
- Details of the physical design of your controller e.g. a schematic, and photos of your final board.

Controller Tests

This section should include:

- A description and plots of the tests you performed to evaluate your controller experimentally
- An evaluation of your controller's performance against the given specifications, and the performance of your previous controller, culminating in an ultimate conclusion about whether your controller worked as intended (or at least improved upon the last one.)
- Recommendations of how to improve the performance of your system (if applicable).
- If you attempt the bonus third controller, you will either compare the experimental results to those of the first and second controller, or use the simulated results to indicate whether it is possible to produce further improvements with a more complicated controller as part of your recommendations for future work.