School of Electrical and Information Engineering
University of the Witwatersrand, Johannesburg
ELEN5007 Control II

Control Project Brief

Modelling and Simulation of a Linear DC Machine

Contents

1 Preamble

This project is computer-based and is to be conducted individually in your own time. Laboratory time is to be used to consult laboratory assistants and the Course Coordinator if advice or direction is needed. The postgraduate students who are assigned to Control II as assistants/demonstrators are also available at reception by prior arrangement.

Any of the software MATLAB/SIMULINK, SCILAB or OCTAVE may be used for conducting numerical experiments. The final date for submission of project reports is as prescribed by the School of Electrical and Information Engineering. One report per individual has to be submitted. Reports must comply with the school's guidelines as contained in the Blue Book. After submission of these reports it is up to the discretion of the laboratory assistants and the course lecturer to decide whether or not, in addition to marking these reports, specific individuals need to be further interviewed about the project.

2 Purpose

The purpose of this project is to expose the students to advanced modelling techniques applied to lumped, complex and interlinked subsystems, rapid prototyping, and discretisation effects as well as the design of state-feedback and MIMO controllers for such systems.

3 Objectives

On completion the student should be able to:

- Understand the derivation of a model for the given plant or system.
- List explicitly the assumptions needed to formulate performance criteria.
- Determine representations (e.g. state-space, transfer function etc.) for lumped parameter systems.
- Design and develop state-feedback and/or intelligent controllers to control the system.
- Formulate and implement controllers and plant combinations in MATLAB/SIMULINK, SCILAB or OCTAVE or similar software.
- Interpret the results produced by the complete simulation.
- Critically analyse controller performance,
- Contrast various controllers for any given system.

4 Reference topics

4.1 Review topics

- System modelling
- Nonlinear MIMO system
- Computational intelligence

4.2 Exploratory topics

- Modelling techniques and interconnected subsystems.
- Plant nonlinearities and their impact on design.
- Uncertainties in plant control.

5 Overview

Various systems require the use of feedback control based on the concept of measuring certain variables of the plant and then adjusting actuators to bring about a desired state trajectory in the plant.

Students are required to model the components of a tandem linear DC (TLDC) machine. The linear DC (LDC) machine typically consists of a rail and magnetic field and a conductor bar and a voltage source. Typically a current flows through the conductor bar the closed loop circuit resistance. Find a suitable TLDC but do bear in mind that the focus is on modelling a TLDC and not finding the most complicated TLDC.

6 Project Task

6.1 Project Specification

The objective of the project assignment is to ensure that students can generate results in Simulink for various modes of operation of the TLDC. In particular the following must be done

a) ***Model the TLDC using any two modelling techniques***
b) ***Use Simulink to generate a model of the TLDC machine***
c) ***Implement any controller to move the TLDC machine from one end of the rails to the other end. Use parameters approved by the lecturer.***
d) ***Submit all deliverables as detailed below in a zip file for submission by the Submission Deadline***

6.2 Simulation software

You need to develop your own models in MATLAB/SIMULINK, SCILAB or OCTAVE code to simulate the system. Use the parameter values approved by the lecturer. All initial conditions and the required final - near rest conditions must be specified at runtime. Your code must be able to plot the complete response over any user defined time interval. Your code or models (e.g. Simulink block diagram) has to be included in the Appendix of your report and also on zip file that is to be submitted as part of the project deliverables.

6.3 Submission

The individual report is to be submitted by the submission deadline as specified for the project for ELEN4016 in the School's Submissions deadline for all Course Projects. Like all project reports should detail the design and implementation process as well as detailed results and critical analysis of the controllers employed. Your Simulink code has to be included in the Appendix of your report and also on zip file that is to be submitted as part of the project deliverables by the project report submission deadline (See School Submission deadline, Rule G13, Rule G15 etc).

6.4 Overall Considerations

The report and lab sessions are **meant to reinforce course material**. Students should focus on control concepts highlighted in the course rather than trying to employ more sophisticated controllers whose theory they do not understand. Only after the carefully chosen controller concepts covered in the course have been exhausted can students consider other controllers. This is to avoid confusion of what constitutes minimum acceptable criteria. Furthermore students are urged to plan their time well in advance to avoid rushing over the project and lab aspects. The above tasks have been carefully chosen to streamline the work to be done and it is hoped that students will experience the joy of modelling systems, controller design and implementation. Good luck and enjoy.