Part IIA

Cambridge University Engineering Department

DESIGN PROJECT GF1: CONTROL SYSTEM

Introduction

Project leader: Prof. Rodolphe Sepulchre **Prerequisites:** 3F1 and 3F2 useful.

Summary:

The project involves the modelling and control of an 'evaporator', which is a process used in many industries (e.g., dairy products, chemicals). As a first step a simulation model is built and tested. Then a control system is designed for the process, and its performance checked by simulating its operation with the evaporator. Modern simulation and analysis software is used throughout.

Aims

- To take students through the simulate/analyse/design/test cycle for an industrial control system (unfortunately omitting implementation).
- To expose students to state-of-the-art software for control engineering.
- To give students experience of simulating dynamic systems.
- To give students experience of working in teams to achieve a challenging task.

Format

Students work in pairs. All pairs produce similar simulation models and initial control schemes.

In the final week pairs specialize their work on one out of two more advanced controllers (gain scheduling or state-space). Students working on state-feedback should preferably have taken the module 3F2.

During the morning session of Tuesday 7 June, each pair reports on its progress online and hears about the solutions of the other pairs. Each pair must prepare a short presentation (5 to 10') summarising the progress and proposal for a best controller. The final report should include a discussion about the alternative controllers presented during the group meeting.

Attendance is compulsory at the timetabled sessions: Tuesdays 9am to 11am and 2pm to 4pm, and Fridays 11am to 1pm. Absence from these sessions will incur loss of marks, unless it has been previously agreed with the demonstrator. Note that the demonstrator will not be available at any other time than the scheduled session times.

Activities

Week 1: Familiarisation with SIMULINK simulation and MATLAB software. Familiarisation with description and mathematical model of evaporator. Construction of SIMULINK model of the evaporator. First interim report.

Week 2: Completion of testing SIMULINK model of the evaporator. Refining the model. Closing one control loop. Second interim report.

Week 3: Initial control design for the whole model. Investigation of performance when model behaviour changes. Investigation of integrator wind-up.

Week 4: ***Group activity*** Evaluation of controller when operating point changes. Investigation of gain-scheduled controller. Design of state-feedback controller. Final report.

Assessment	Submission date	Marks
Interim report 1	Friday 20 May 2022	20
Interim report 2	Friday 27 May 2022	20
Final report	Friday 10 June 2022	40

Reports **must** be submitted electronically **in PDF format** using Moodle by **4pm** on the indicated dates. There is no possibility of extending the deadline for the final report.

R. Sepulchre 4 May 2022