ACS336/6336 Oral Assessment Guidelines

January 18, 2019

1 Introduction

Professional engineers are frequently required to present the outcomes of their work to others in a timely fashion. Therefore, in this assessment, you will be required to present your helicopter controller in action to a member of staff. The member of staff will assess the performance of the helicopter controller and also ask a series of questions to probe your knowledge of the modelling, simulation and control aspects of the course. This assessment constitutes 35% of the overall module mark.

2 Specifics

- The oral assessments will take place in the PC Laboratory in the Stephenson Building in week 12.
- Each student will be required to bring their complete lab kits to the assessment.
- Each student has been assigned an arrival time and a workstation (see timetable in the Assessment folder on MOLE). Please turn up on time, early arrivals will not be permitted entry to the lab and latecomers can not be accommodated.
- Upon entry to the PC Laboratory, you will have 15 minutes to set-up your hardware at your designated workstation. After this time, a member of staff will approach you, and your assessment will begin. *It is your responsibility to be ready for assessment after the 15 minute setup period.* The assessment will take approximately 15 minutes.
- You will be expected to demonstrate a controller in SIMULINK, and also demonstrate a controller upon your helicopter hardware. The two controllers need not necessarily be the same, but if they are different then you may get asked to explain your reasons for employing different controllers.
- If you wish to use your own laptops, as opposed to the desktop PCs in the PC Laboratory, then please feel free to do so.
- Students will obtain marks in two ways. Firstly, by demonstrating effective control of their simulated and actual helicopters (approximately 5/35 of available marks - see next section on performance assessment), and secondly by correctly answering the examiner's questions (approximately 30/35 of available marks - see Section 5).

- At the end of the assessment, please hand your lab-kit back to the examiner for inspection and collection.

3 Feedback

At the end of your assessment you will be given brief verbal feedback by your examiner. At this stage your examiner will not be in a position to provide you with your final mark, but will tell you the grade band that you have achieved for both the performance assessment and examiner question assessments. Once all the vivae are completed, the examiners will meet to discuss their allocated marks with a view to obtaining consistency across all students. In practice, this rarely causes a shift of more than a few percent to the marks of any one student.

4 Performance Assessment

When assessing the performance of your helicopter control system, the examiners will award marks on the following basis:

- 0%. The hardware is completely unresponsive and the student is unable to demonstrate any form of control on their Simulink model.
- 0-20%. The hardware is unresponsive, but the student is at least able to demonstrate open-loop control upon their Simulink model.
- 20-40%. The student can demonstrate open-loop control of the actual helicopter. Specifically, control signals can be written to both fans, with more marks awarded if the measured signals are also displayed. In addition, the student can demonstrate open-loop control of the simulated helicopter, but has failed to synthesise a stabilising feedback controller.
- 40-60%. Upon their simulation model, the student is able to demonstrate a stabilising feedback controller that achieves regulation of steady, hovering flight, but with poor dynamic response. Specifically, the helicopter lifts from rest, but displays large overshoot ($> 20°$) about the elevation axis, with significant oscillations around any of its axes of motion. No reference tracking and frequent saturation of control signals. Upon the hardware, the student can demonstrate open-loop control and can provide evidence of implementing their feedback controller.
- 60-80%. Upon their simulation model, the student is able to demonstrate a stabilising feedback controller capable of tracking small ($10°$) step reference commands about the elevation axis, and small ($45°$) step reference commands about the travel axis. Dynamic response is reasonable, i.e. overshoots in response to step commands are less than 50% for both the elevation and travel axes. The helicopter displays small but persistent steady state errors about the elevation ($< 5°$) and travel ($< 20°$) axes, and the control signals may occasionally saturate. Upon the hardware, the student can demonstrate a similar level of performance from their closed-loop controller.
- 80-100% Upon their simulation model, the student can demonstrate a stabilising feedback controller capable of tracking large ($20°$) step reference commands about the elevation axis,

and large (90°) step reference commands about the travel axis. Dynamic response is exceptional, i.e. overshoots in response to step commands are less than 20% for both the elevation and travel axes. The helicopter displays offset-free control about the elevation and travel axes, with the settling time to achieve offset-free control being less than 20 and 60 seconds for motion about the elevation and travel axes, respectively. In addition, the control signals rarely, if ever, experience saturation. Upon the hardware, the student can demonstrate a similar level of performance from their closed-loop controller.

5 Examiner Questions

Whilst demonstrating your controller, the examiner will ask a series of questions to probe your general understanding of the modelling, simulation and control aspects of this course. There is no fixed list of questions, but typical questions might include the following:

- *Explain the structure of your controller.*
- *Explain how you designed your controller.*
- *Why does the helicopter crash for large step references about the travel axis?*

Marks will be awarded on the following basis:

- 0-40%. Extremely poor understanding and a lack of coherent responses to questions (0 for not attending).
- 40-50%. Poor responses and understanding indicating low level grasp of topic and work done.
- 50-60%. Satisfactory responses and understanding that indicates an adequate grasp.
- 60-70%. Good, well thought out responses. Shows a clear understanding of the topic and work done.
- 70-100%. Excellent, concise and well argued answers, with few or no mistakes, displaying a first class understanding of the course material and work done.

Lastly, after finishing your oral assessment, please do not discuss your questions with students awaiting their assessment.