School of Engineering

AERO3600: Embedded Control Systems

Callaghan
Semester 1 - 2024

COURSE OUTLINE

OVERVIEW

Course Description

This course introduces students to embedded control systems design. This encompasses modelling the embedded system, design and implementation trade-offs, and verification and validation. A focus of this course is to provide a unified framework that enables the synthesis of real-time control solutions that accommodate interlocking design trade-offs and conflicting requirements.

Academic Progress Requirements

Nil

Requisites

Students cannot enrol in this course if they have successfully completed ENGG3440.

Assumed Knowledge

ENGG2440 Modelling and Control

Contact Hours

Callaghan

Laboratory
Face to Face On Campus
2 hour(s) per week(s) for 13 week(s) starting Week 1

Lecture
Face to Face On Campus
2 hour(s) per week(s) for 13 week(s) starting Week 1
Two separate lectures will be held each week, on different days, with different content.

Lecture
Face to Face On Campus
2 hour(s) per week(s) for 13 week(s) starting Week 1
Two separate lectures will be held each week, on different days, with different content.

Tutorial
Face to Face On Campus
2 hour(s) per week(s) for 13 week(s) starting Week 1

Unit Weighting Workload

10
Students are required to spend on average 120-140 hours of effort (contact and non-contact) including assessments per 10 unit course.

CONTACTS

Course Coordinator

Callaghan
Dr Alejandro Donaire
Alejandro.Donaire@newcastle.edu.au
(02) 4985 4934
Consultation: Friday, 9am-11am in ES431a

Teaching Staff

Other teaching staff will be advised on the course Canvas site.

School Office

School of Engineering
EAG03
EA Building
Callaghan
SENG-Admin@newcastle.edu.au
9.00am-1.00pm and 2.00pm-5.00pm (Monday to Friday)

SYLLABUS

Course Content

1. Review principles of feedback control and embedded systems2. Multi-domain state-space modelling of embedded control systems3. Design of model-based control solutions, from sensors to actuators4. Reliable and robust implementation of control systems on embedded hardware5. Trade-offs and constraints for control design, computational complexity and certifiability of embedded systems6. Software-, Processor-, and Hardware-in-the-loop testing7. Mapping design requirements into control objectives and problem formulation8. Validation of embedded control solution against control objectives

Course Learning Outcomes

On successful completion of this course, students will be able to:

1. Evaluate the impact of sampling and sampling rate on state-space system models

2. Implement state inference on an embedded system

3. Design and implement a basic control solution on an embedded system

4. Model and accommodate state and actuator constraints into a control solution

5. Evaluate the impact of control system limitations and finite computing capabilities of embedded systems and the design trade-offs between performance, robustness and certifiability

6. Demonstrate the design of embedded control systems as a holistic and synergetic integration of cyber-physical systems

Course Materials

ASSESSMENTS

This course has 4 assessments. Each assessment is described in more detail in the sections below.

	Assessment Name	Due Date	Involvement	Weighting	Learning Outcomes
1	Quiz 1, 2	To be advised on the course Canvas site	Individual	40%	1, 4, 5
2	Laboratory Exercises	To be advised on the course Canvas site	Group	28%	1, 2, 3, 6
3	Laboratory Exercise	To be advised on the course Canvas site	Individual	17%	1, 2, 3, 4, 5, 6
4	Project	To be advised on the course Canvas site	Individual	15%	1, 2, 3, 4, 5, 6

Late Submissions The mark for an assessment item submitted after the designated time on the due date, without an approved extension of time, will be reduced by 10% of the possible maximum mark for that assessment item for each day or part day that the assessment item is late. Note: this applies equally to week and weekend days.

Assessment 1 - Quiz 1, 2

Assessment Type Quiz
Description Quiz 1 (20%) and Quiz 2 (20%) will consist of solving problems and answering questions related to embedded control system design.
Weighting 40%
Due Date To be advised on the course Canvas site
Submission Method Online
Detailed information will be advised on the course Canvas site
Assessment Criteria
Return Method
Feedback Provided
Opportunity to Reattempt Students WILL NOT be given the opportunity to reattempt this assessment.

Assessment 2 - Laboratory Exercises

Assessment Type Tutorial / Laboratory Exercises
Description Assessments will involve the demonstration of working MATLAB code and partial embedded implementations of control systems and the demonstration of your understanding of the lab work in relation to the topics covered in the lectures. Cumulative exercises.
Weighting 28%
Due Date To be advised on the course Canvas site
Submission Method Online
Detailed information will be advised on the course Canvas site
Assessment Criteria
Return Method
Feedback Provided
Opportunity to Reattempt Students WILL NOT be given the opportunity to reattempt this assessment.

Assessment 3 - Laboratory Exercise

Assessment Type Viva Voce
Description Assessments will involve the design and demonstration of a partial and fully embedded control system solution for a physical plant, the demonstration of your understanding of the control design supported by the theory developed in the course, and the validation of the embedded control in experiments. Cumulative exercises.
Weighting 17%
Due Date To be advised on the course Canvas site

Submission Method	Online Detailed information will be advised on the course Canvas site
Assessment Criteria	
Return Method	
Feedback Provided	
Opportunity to Reattempt	Students WILL NOT be given the opportunity to reattempt this assessment.

Assessment 4 - Project

Assessment Type	Project
Description	The assessment will consist of the design and demonstration of a fully embedded control system solution for a physical plant using methods that were not implemented in the lab exercises. You should also demonstrate your understanding of the control design and performance supported by the theory developed in the course, and the validation of the embedded control in experiments.
Weighting	15%
Due Date	To be advised on the course Canvas site
Submission Method	In Class Detailed information will be advised on the course Canvas site
Assessment Criteria	
Return Method	
Feedback Provided	
Opportunity to Reattempt	Students WILL NOT be given the opportunity to reattempt this assessment.

ADDITIONAL INFORMATION

Grading Scheme

This course is graded as follows:

Range of Marks	Grade	Description
85-100	High Distinction (HD)	Outstanding standard indicating comprehensive knowledge and understanding of the relevant materials; demonstration of an outstanding level of academic achievement; mastery of skills*; and achievement of all assessment objectives.
75-84	Distinction (D)	Excellent standard indicating a very high level of knowledge and understanding of the relevant materials; demonstration of a very high level of academic ability; sound development of skills*; and achievement of all assessment objectives.
65-74	Credit (C)	Good standard indicating a high level of knowledge and understanding of the relevant materials; demonstration of a high level of academic achievement; reasonable development of skills*; and achievement of all learning outcomes.
50-64	Pass (P)	Satisfactory standard indicating an adequate knowledge and understanding of the relevant materials; demonstration of an adequate level of academic achievement; satisfactory development of skills*; and achievement of all learning outcomes.
0-49	Fail (FF)	Failure to satisfactorily achieve learning outcomes. If all compulsory course components are not completed the mark will be zero. A fail grade may also be awarded following disciplinary action.

*Skills are those identified for the purposes of assessment task(s).

Communication Methods

Communication methods used in this course include:

- Canvas Course Site: Students will receive communications via the posting of content or announcements on the Canvas course site.

Information will be also provided during Lectures, Tutorials and Lab activities.

Course Evaluation	Each year feedback is sought from students and other stakeholders about the courses offered in the University for the purposes of identifying areas of excellence and potential improvement.
Oral Interviews (Vivas)	As part of the evaluation process of any assessment item in this course an oral examination (viva) may be conducted. The purpose of the oral examination is to verify the authorship of the material submitted in response to the assessment task. The oral examination will be conducted in accordance with the principles set out in the Oral Examination (viva) Procedure. In cases where the oral examination reveals the assessment item may not be the student's own work the case will be dealt with under the Student Conduct Rule.
Academic Misconduct	All students are required to meet the academic integrity standards of the University. These standards reinforce the importance of integrity and honesty in an academic environment. Academic Integrity policies apply to all students of the University in all modes of study and in all locations. For the Student Academic Integrity Policy, refer to https://policies.newcastle.edu.au/document/view-current.php?id=35.
Adverse Circumstances	The University acknowledges the right of students to seek consideration for the impact of allowable adverse circumstances that may affect their performance in assessment item(s). Applications for special consideration due to adverse circumstances will be made using the online Adverse Circumstances system where: 1. the assessment item is a major assessment item; or 2. the assessment item is a minor assessment item and the Course Co-ordinator has specified in the Course Outline that students may apply the online Adverse Circumstances system; 3. you are requesting a change of placement; or 4. the course has a compulsory attendance requirement. Before applying you must refer to the Adverse Circumstance Affecting Assessment Items Procedure available at: https://policies.newcastle.edu.au/document/view-current.php?id=236
Important Policy Information	The Help button in the Canvas Navigation menu contains helpful information for using the Learning Management System. Students should familiarise themselves with the policies and procedures at https://www.newcastle.edu.au/current-students/respect-at-uni/policies-and-procedures that support a safe and respectful environment at the University.

Graduate Profile Statements

This course builds students' capacity in the following University of Newcastle Bachelor of Engineering Graduate Profile Statements (based on 2011 Engineers Australia revised Stage 1 Competency Standards for Professional Engineers):

UON Att.	University of Newcastle Bachelor of Engineering Graduate Profile Statements/ Engineers Australia Stage 1 competency statements	Taught	Practised	Assessed	Skill Level (1-4)
	Professional Attributes				
11	3.1. Ethical conduct and professional accountability	x	x	x	3
12	3.2. Effective oral and written communication in professional and lay domains.		x	x	3
13	3.3. Creative, innovative and pro-active demeanour.	x	x	x	3
14	3.4. Professional use and management of information.				
15	3.5. Orderly management of self, and professional conduct.	x	x	x	3
16	3.6. Effective team membership and team leadership.		x		3
	Engineering Ability				
7	2.1. Application of established engineering methods to complex engineering problem solving.	x	x	x	3
8	2.2. Fluent application of engineering techniques, tools and resources.	x	x	x	3
9	2.3. Application of systematic engineering synthesis and design processes.	x	x	x	3
10	2.4. Application of systematic approaches to the conduct and management of engineering projects.	x	x	x	3
	Knowledge Base				
1	1.1. Comprehensive, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline.	x	x	x	3
2	1.2. Conceptual understanding of the, mathematics, numerical analysis, statistics, and computer and information sciences which underpin the engineering discipline.	x	x	x	3
3	1.3. In-depth understanding of specialist bodies of knowledge within the engineering discipline.	x	x	x	3
4	1.4. Discernment of knowledge development and research directions within the engineering discipline.	x			3
5	1.5. Knowledge of contextual factors impacting the engineering discipline.				
6	1.6. Understanding of the scope, principles, norms, accountabilities and bounds of contemporary engineering practice in the specific discipline.				

This course outline was approved 6/02/2024 by the Head of School. No alteration of this course outline is permitted without Head of School approval. If a change is approved, students will be notified and an amended course outline will be provided in the same manner as the original.