School of
Engineering and Computer Science
Te Kura Mātai Pūkaha, Pūrorohiko

Prescription

This course builds on and extends the principles of modern control systems engineering introduced in ECEN 315 to enable students to develop mathematical models and use these to design optimal control systems for real-world multivariable engineering systems. Kalman filters and linear quadratic regulators will be introduced and the principles and benefits of modern model-based predictive control systems will be outlined. Methods will be developed for continuous time system descriptions but techniques for converting to discrete time descriptions and for designing controls for discrete time systems will also be presented.

Course learning objectives

Students who pass this course should be able to:

1. Produce state-space models of a variety of linear and nonlinear electronic and mechanical systems (BE graduate attributes 3(a),3(c)),
2. Design continuous and discrete time controllers using state-space techniques, including optimal control methods such as LQR (BE graduate attributes 3(a),3(b)),
3. Design Luenberger state observers and Kalman filters, (BE graduate attributes 3(a),3(b),3(e)),
4. Use the Matlab software package to solve practical problems in control engineering (BE graduate attributes 3(d),3(f)).

Course content

The course is primarily offered in-person, but there will also be a remote option and there will be online alternatives for all the components of the course for students who cannot attend in-person.

Students taking this course remotely must have access to a computer with camera and microphone and a reliable high speed internet connection that will support real-time video plus audio connections and screen sharing. Students must be able to use Zoom; other communication applications may also be used. A mobile phone connection only is not considered sufficient. The computer must be adequate to support the programming required by the course: almost any modern windows, macintosh, or unix laptop or desktop computer will be sufficient, but an Android or IOS tablet will not.

If the assessment of the course includes tests, the tests will generally be run in-person on the Kelburn campus. There will be a remote option for students who cannot attend in-person and who have a strong justification (for example, being enrolled from overseas).
The remote test option will use Zoom for online supervision of the tests and you must be able to use Zoom with a camera, microphone, and screen-sharing. Students who will need to use the remote test option must contact the course coordinator in the first two weeks to get permission and make arrangements.

Withdrawal from Course

Withdrawal dates and process:

https://www.wgtn.ac.nz/students/study/course-additions-withdrawals

Lecturers

Christopher Hollitt (Coordinator)

christopher.hollitt@vuw.ac.nz 04 4636965

223 Alan MacDiarmid Building, Kelburn

Teaching Format

This course will be offered in-person and online. For students in Wellington, there will be a combination of in-person components and web/internet based resources. It will also be possible to take the course entirely online for those who cannot attend on campus, with all the components provided in-person also made available online.

The course will include three weekly in person sessions, that will include both lecture material and tutorial questions. These sessions will be recorded and available online for students unable to attend the classes in person. There will additionally be a series of short unassessed Matlab based exercises for students to work through.

Student feedback

Student feedback on University courses may be found at:
www.cad.vuw.ac.nz/feedback/feedback_display.php

Dates (trimester, teaching & break dates)

- Teaching: 05 July 2021 - 08 October 2021
- Break: 16 August 2021 - 29 August 2021
- Study period: 11 October 2021 - 14 October 2021
- Exam period: 15 October 2021 - 06 November 2021

Class Times and Room Numbers

05 July 2021 - 15 August 2021

- **Wednesday** 15:10 - 17:00 – 407, Alan MacDiarmid Building, Kelburn
- **Friday** 11:00 - 11:50 – 407, Alan MacDiarmid Building, Kelburn

30 August 2021 - 10 October 2021

- **Wednesday** 15:10 - 17:00 – 407, Alan MacDiarmid Building, Kelburn
- **Friday** 11:00 - 11:50 – 407, Alan MacDiarmid Building, Kelburn

Set Texts and Recommended Readings

Required

The text below is available online, via the link on Talis. We will not follow the the text closely, but the text will be useful for providing extra examples and for an alternative explanation of various topics. The text will likely prove to be most useful for the first half of the course.

Recommended

- Astrom and Murray "*Feedback Systems: An Introduction for Scientists and Engineers*"

Mandatory Course Requirements

There are no mandatory course requirements for this course.

If you believe that exceptional circumstances may prevent you from meeting the mandatory course requirements, contact the Course Coordinator for advice as soon as possible.

Assessment

This assessment scheme is the 2020 version. It is likely to change somewhat in 2021.

This course will be assessed through four equally weighed assignments.

Each assignment will include problems that will require simulation or control deisgn to be carried out using Matlab. However, only basic Matlab familiarity is required.

Assessment Item	Due Date or Test Date	CLO(s)	Percentage
Assignments (4)	Weeks 5, 7, 9, 13	CLO: 1,2,3,4	100%

Penalties

Work submitted late will be subject to a penalty of 10% of the total mark per day (or part thereof). No work will be accepted once the solutions have been posted. ON occastions the solutions may need to be posted immediately after the due date, and this will be pointed out at the time that affected items are distributed.

Extensions

Individual extensions will only be granted in exceptional personal circumstances, and should be negotiated with the course coordinator before the deadline whenever possible. Documentation (eg, medical certificate) may be required.

Submission & Return

All work should be submitted via the submission page on the course web site. Unless otherwise noted, all work should be submitted as pdf files. Handwritten work that is scanned as a pdf is fine. Submission of matlab code alone will not be adequate.

Marking Criteria

Each assignment will be marked on three broad categories:
1. Clarity of explanation using the formalisms, conventionns and vocabulary of control system engineering.
2. Efficacy of control system designs.
3. Correctness of computational work.

Required Equipment

The course will make use of the Matlab environment (including its Control Toolbox) for simulation and control system design.This software is available free of charge for students. Students should ensure that they download and install a working copy by the end of the first week of class at the latest.

Workload

In order to maintain satisfactory progress in ECEN 415, you should plan to spend an average of 10 hours per week on this paper. A plausible and approximate breakdown for these hours would be:

- Lectures and tutorials: 3 hours
- Reading and Extra Problems: 4 hours
- Assignments: 3 hours

Teaching Plan

See: https://ecs.wgtn.ac.nz/Courses/ECEN415_2021T1/LectureSchedule

Communication of Additional Information

All online material for this course can be accessed at https://ecs.wgtn.ac.nz/Courses/ECEN415_2021T1/

Links to General Course Information

- Academic Integrity and Plagiarism: https://www.wgtn.ac.nz/students/study/exams/integrity-plagiarism
- Academic Progress: https://www.wgtn.ac.nz/students/study/progress/academic-progess (including restrictions and non-engagement)
- Dates and deadlines: https://www.wgtn.ac.nz/students/study/dates
- Grades: https://www.wgtn.ac.nz/students/study/progress/grades
- Special passes: Refer to the Assessment Handbook, at https://www.wgtn.ac.nz/documents/policy/staff-policy/assessment-handbook.pdf
- Statutes and policies, e.g. Student Conduct Statute: https://www.wgtn.ac.nz/about/governance/strategy
- Student support: https://www.wgtn.ac.nz/students/support
- Students with disabilities: https://www.wgtn.ac.nz/st_services/disability/
- Student Charter: https://www.wgtn.ac.nz/learning-teaching/learning-partnerships/student-charter
- Terms and Conditions: https://www.wgtn.ac.nz/study/apply-enrol/terms-conditions/student-contract
- Turnitin: http://www.cad.vuw.ac.nz/wiki/index.php/Turnitin
- University structure: https://www.wgtn.ac.nz/about/governance/structure
- VUWSA: http://www.vuwsa.org.nz

Offering CRN: 18519

Points: 15
Prerequisites: ECEN 315 (or PHYS 422)
Duration: 05 July 2021 - 07 November 2021
Starts: Trimester 2
Campus: Kelburn