Advanced Mechatronic Engineering 2: Intelligence and Design - Course Outline

ECEN 430: 2012 Trimester 2

This document sets out the workload and assessment requirements for ECEN 430. It also provides contact information for staff involved in the course. If the contents of this document are altered during the course, you will be advised of the change by an announcement in lectures and/or on the course web site. A printed copy of this document is held in the School Office.

Course Description

Mechatronics, unlike traditional engineering techniques, is a multi-disciplinary approach to solving engineering problems. In its simplest form it is the intelligent control of an electromechanical systems, and as such, practitioners must be skilled in electronics, mechanics, and software, and also understand the underlying physics, mathematics and even marketing.

This course provides a guide to advanced techniques in the field of Mechatronics. Design and construction of computer based systems, including the interaction between hardware, software and communication components focuses on embedded systems. Practical examples are drawn from sensors, measurement instruments, robots and cell phones to demonstrate the nature of these interactions. Artificial Intelligence techniques are introduced as a practical method for addressing these complex interactions.

Prerequisites

Prerequisites: ECEN301 (or CSEN 301 or PHYS340)

Restrictions:CSEN 402

Objectives

By the end of the course, students should be able to:

1. Formulate appropriate task solving strategies based on advanced Mechatronic techniques, such as reactive control. Although much of the course will be based on the platforms of simulated and physical autonomous Mobile Robotics, the application will be applicable to a wide range of devices, e.g. orthotics, communication devices, industrial plants and so forth. Apply engineering judgement to design the construction of Mechatronic Devices and critique the final design. Whereas Advanced Mechatronics I focused on the electronic hardware and mechanical construction, this course considers the advanced programming and user considerations required for practical mechatronic devices. 3(b). [Examined in Assessment 1]

2. Integrate wider considerations than functionality, such as role of customer, assembly and construction into designs. Design, demonstrate and present the above aspects of Advanced Mechatronics, including to external customers and important dignitaries. The design school lectures will cover such aspects as human interaction, industrial design and design life cycle 3(f). [Examined in Assessment 2 & 3]

3. Evaluate the impact of mechanical constraints in relation to operation and programming a device, i.e. investigate robotic manipulators. 3(e). [Examined in Assessment 1]

4. Able to implement methods to handle error propagation and uncertainty, including Kalman filters, Markov localisation, as part of Simultaneous Localisation and Mapping. Understand the issues sensing and control at a high level of behaviour. Distinguish between reactive behaviours and higher-ordered deliberative behaviours, including localisation, mapping, path planning and goalsetting. These capabilities are to be encapsulated within an appropriate control architecture. Implement higher-order deliberative control, from simple A* path planning to vector field histogram approaches and beyond to cognitive control, i.e. affective computation 3(f). [Examined in Assessment 4]

5. Synthesise, specify, select and utilise a wide range of artificial intelligence techniques in order to solve complex control problems that would otherwise be impractical using conventional mathematical approaches. 3(f). [Examined in Assessment 5]

Course Material and Textbook

Outline notes will be provided, but students are advised to also take down their own notes in class. These should then be combined with further reading from the recommended reading for the course. The textbook for ECEN 430 is: Siegwart, R., Nourbakhsh, I. D. Scaramuzza (2011) Introduction to Autonomous Mobile Robots. 2nd edition. A Bradford Book, The MIT Press, Cambridge, Massachusetts, London, England.

See Also Rob Callan, Artificial Intelligence (2003) Palgrave Shigley's Mechanical Engineering Design (Hardcover) McGraw-Hill Science/Engineering/Math; 9 edition (January 15, 2010). "Control Systems Engineering" by Norman S. Nise

is also be available in the 3 day reserve section of the library. (Level 3). Any further textbooks to be used for recommended reading will be detailed when appropriate.

Lectures, Tutorials, Laboratories, and Practical work

The following is the material to be covered during the lectures. However, this is subject to change. An approximate lecture schedule is as follows:

Lecture # Topic

Design to Customer Specification

Human Interaction

Industrial Design

Design Life Cycle

Robotic Manipulators

Sensors

Robot Kinematics

World Representation

Localisation

Control Architectures

Path Planning

Reactive Control

Why use AI?

AI Decision making

AI Learning

AI Applications

Note this schedule is subject to change, depending on progress through the material.

Lectures for ECEN 430 are:

Lectures: Jul 16 - Oct 19 2012. Mon, Thu, 1100 - 1150 Kirk [Kelburn] KK202a [Wed 12-1250 Kirk [Kelburn] KK202a used as notified]

Design School (subject to confirmation by design school) Thursday 16th August

9:00 am Room VS 308 Industrial Design as a Collaborative Discipline. Prof. Simon Fraser.

10:00am Room VS 308 Physical interaction design. Rhazes Spell

Thursday 23rd August 9:30am Room VS 308 The Project Bernard Guy

10:30am Room VS 226 Creative Applications Tim Miller

Assignments and Projects

Critical dates: July 17 : First lecture

Five + one assignments will be spaced throughout the trimester:

1. Autonomous robotics (Lego Mindstorms assignment) [20%]

2. Real world design to customer specification [20+5%]

3. Design build [15%]

4. Cognitive Robotics (practical test of theory) [25%]

5. Artificial Intelligence application (autonomous simulated racing car) [15%]

Item	Weight	Avg. Hrs.	Due Date
AR	20%	26	28 August
RW	25%	7 + 26	23 July + 14 August
DB	15%	19	tbc
CR	25%	33	27 September

AI	15%	19	11 October

note AR handout will be 7th of August

Workload

On average, students should plan to spend a minimum of 10 hours per point i.e. 150 hours for a 15 point course, or 10-12 hours per week, in order to achieve an average grade in this course. A further time of approximately 30 hours will be required during the study and examination period.

School of Engineering and Computer Science

The School office is located on level three of the Cotton Building (Cotton 358).

The notice board for ECEN 430 is located on the second floor of the Cotton Building.

Staff

Coordinator and lecturer: Dr. Will Browne, Office: Cotton 341, Telephone: ext 8489, Email: will.browne@vuw.ac.nz

Lecturer: Professor Dale Carnegie, Office: AM224, Telephone: 463-7485, Email: dale.carnegie@vuw.ac.nz.

Announcements and Communication

This course uses Blackboard. Course materials and other information will be posted on Blackboard. Students should check Blackboard regularly. Email will also be used for communication, so please ensure that your email address is correct in the VUW system.

Assessment

Your grade for ECEN 430 will be determined based on the following assessment weightings: 100% assignment. Many of the assessment items are practical ones to be undertaken in the laboratory. There will not be dedicated laboratory session times assigned. You are to work on this in your own time in one of the available labs. Co218 should generally be available for this.

Bachelor of Engineering students should be aware that copies of their assessed work may be retained for inspection by accreditation panel.

Tests and Exams

None

Practical Work

Description of assignments / projects / etc, including rough dates and submission processes

All work is due in on the due date. Work will not be marked if more than 1 week late. Assignments and laboratory reports need to be handed in on the assigned dates - typically one week after the experiment was performed or the assignment was handed out. Work submitted after the due date will incur a penalty. Marks will be deducted at a rate of 10% of the full mark for each working day late. Any work handed in after the model solutions have been made available will not be graded at all. Extensions will be given only in exceptional circumstances, and if agreed before the due date. In the event of an aegrotat application, regular submission and performance in assignments and laboratories will contribute substantially to the outcome.

Plagiarism

Working Together and Plagiarism

We encourage you to discuss the principles of the course and assignments with other students, to help and seek help with programming details, problems involving the lab machines. However, any work you hand in must be your own work.

The School policy on Plagiarism (claiming other people's work as your own) is available from the course home page. Please read it. We will penalise anyone we find plagiarising, whether from students currently doing the course, or from other sources. Students who knowingly allow other students to copy their work may also be penalised. If you have had help from someone else (other than a tutor), it is always safe to state the help that you got. For example, if you had help from someone else in writing a component of your code, it is not plagiarism as long as you state (eg, as a comment in the code) who helped you in writing the method.

Mandatory Requirements

To obtain a pass, a student must obtain a minimum of 50% of the possible marks for the course while submitting at least 80% of the assignments and tests.

Passing ECEN 430

To pass ECEN 430, a student must satisfy mandatory requirements and gain at least a **C** grade overall.

Withdrawal

The last date for withdrawal from ECEN 430 with entitlement to a refund of tuition fees is Friday, 22nd July 2012 (the end of week 2 of trimester). The last date for withdrawal without being regarded as having failed the course is Friday, 9th Sept. 2012 (the end of week 9) -- though later withdrawals may be approved by the Dean in special circumstances.

Rules & Policies

Find key dates, explanations of grades and other useful information at http://www.victoria.ac.nz/home/study.

Find out about academic progress and restricted enrolment at http://www.victoria.ac.nz/home/study/academic-progress.

The University's statutes and policies are available at http://www.victoria.ac.nz/home/about/policy, except qualification statutes, which are available via the Calendar webpage at http://www.victoria.ac.nz/home/study/calendar (See Section C).

Further information about the University's academic processes can be found on the website of the Assistant Vice-Chancellor (Academic) at http://www.victoria.ac.nz/home/about/avcacademic

All students are expected to be familiar with the following regulations and policies, which are available from the school web site:

Grievances
Student and Staff Conduct
Meeting the Needs of Students with Disabilities
Student Support
Academic Integrity and Plagiarism
Dates and Deadlines including Withdrawal dates
School Laboratory Hours and Rules
Printing Allocations
Expectations of Students in ECS courses

The School of Engineering and Computer Science strives to anticipate all problems associated with its courses, laboratories and equipment. We hope you will find that your courses meet your expectations of a quality learning experience.

If you think we have overlooked something or would like to make a suggestion feel free to talk to your course organiser or lecturer.