MTRN4110

Robot Design

Term Two // 2021

School of Mechanical and Manufacturing Engineering // UNSW Engineering

Course Overview

Staff Contact Details

Convenors

Name	Email	Availability	Location	Phone
Liao Wu	liao.wu@unsw.edu.au	9:00 am - 5:00 pm, Monday - Friday	Room 301C, Ainsworth Building J17	02-93856548

School Contact Information

Location

UNSW Mechanical and Manufacturing Engineering

Ainsworth building J17, Level 1

Above Coffee on Campus

Hours

9:00–5:00pm, Monday–Friday*

*Closed on public holidays, School scheduled events and University Shutdown

Web

School of Mechanical and Manufacturing Engineering

Engineering Student Support Services

Engineering Industrial Training

UNSW Study Abroad and Exchange (for inbound students)

UNSW Future Students

Phone

(+61 2) 9385 8500 – Nucleus Student Hub

(+61 2) 9385 7661 – Engineering Industrial Training

(+61 2) 9385 3179 – UNSW Study Abroad and UNSW Exchange (for inbound students)

(+61 2) 9385 4097 – School Office**

**Please note that the School Office will not know when/if your course convenor is on campus or available

Email

Engineering Student Support Services – current student enquiries

- e.g. enrolment, progression, clash requests, course issues or program-related queries

Engineering Industrial Training – Industrial training questions

UNSW Study Abroad – study abroad student enquiries (for inbound students)

UNSW Exchange – student exchange enquiries (for inbound students)

UNSW Future Students – potential student enquiries

- e.g. admissions, fees, programs, credit transfer

School Office – School general office administration enquiries

- NB: the relevant teams listed above must be contacted for all student enquiries. The School will only be able to refer students on to the relevant team if contacted

Course Details

Credit Points 6

Summary of the Course

The course is aimed at developing skills on how to design and implement the capabilities of a robotic platform. Half of the course is lecture-based and deals with the following contents: Introduction to robot design. Mechanisms and kinematic of wheeled robots. Sensors used for the perception capabilities of the robot. Perception applied to allow the robot to understand the context of operation. Motion planning and control of the robot in complex contexts. Optimal planning (Dynamic Programming approach).

In the practical component of the course, the students implement perception and control modules and test them in actual robots.

Course Aims

This course enables students to explore relevant aspects of autonomous robotic systems. These include the implementation of functions such as selecting, understanding, and installing the sensing capabilities of the robot, processing of the sensor measurements for performing perception, and applying low- and high-level control processes to enable the robotic platform to operate in complex contexts.

This course allows students to apply the concepts introduced in the course, in combination with previously acquired knowledge (from subjects related to Programming, Mathematics, Control, Mechanics, Electronics), in order to solve the complex course projects that involve tasks such as the full design and implementation of a small robotic platform to give it the intelligence to operate in an unknown context. The intelligence of the platform involves performing perception tasks such as obstacle detection, mapping, planning and visualization for human interaction with the intelligent agent. All these components of the agent are implemented by the students.

Course Learning Outcomes

After successfully completing this course, you should be able to:

Learning Outcome	EA Stage 1 Competencies
1. Apply relevant theoretical knowledge pertaining to mobile robots including locomotion, perception and localization utilising onboard sensors, navigation and path planning, for complex problem-solving	PE1.1
2. Apply general computer vision techniques for feature/object detection and tracking, for complex problem-solving	PE1.1
3. Demonstrate hands-on skills in mechatronics design, fabrication, and implementation by completing practical activities	PE2.1
4. Collaborate effectively within a team via participation in a problem-solving competition	PE3.6

Teaching Strategies

Lectures in the course are designed to cover theory and practical matters. Students are able to appreciate that the knowledge acquired in many of the previous subjects has an effective application for properly solving real problems.

Laboratory work and projects are designed to provide students with the opportunity to create a real complex robotic system.

Assessment

Assessment Tasks

Assessment task	Weight	Due Date	Student Learning Outcomes Assessed
Quiz	45%	Week 2, 4, 7, 9, 10	1, 2
Individual Project	36%	Week 4, 7, 10	1, 2, 3
Group Project	19%	Week 12	1, 2, 3, 4

Assessment Details

Assessment 1: Quiz

Start date: Week 2, 4, 7, 9, 10

Length: Up to 30 minutes

Details:

Description:

Quizzes on general theories of mobile robots and computer vision that are covered in lectures.

Number of assessments:

Five quizzes in total.

Group/Individual:

Individual

Assessment criteria:

Quizzes are online via Moodle Quiz activity.

Deadline for absolute fail:

N/A

Release of marks:

Within 1 week of the test date.

Submission notes: via Moodle

Turnitin setting: This is not a Turnitin assignment

Assessment 2: Individual Project

Start date: Week 1, 4, 7

Details:

Description:

Assignments focusing on different aspects relevant to robot design.

Number of assessments:

Three assignments in total.

Group/Individual:

Individual

Assessment criteria:

Refer to each assignment description.

Deadline for absolute fail:

50 hours after the due date (each late hour reduces the maximum achievable marks by 2%).

Release of marks:

Within 2 weeks of the due date.

Submission notes: via Moodle

Turnitin setting: This assignment is submitted through Turnitin and students do not see Turnitin similarity reports.

Assessment 3: Group Project

Start date: Week 10

Length: N/A

Details:

Description:

Final assignment that integrates the three modules developed previously and explores new capabilities relevant to robot design.

Number of assessments:

One assignment in total.

Group/Individual:

Group of 3 (up to 4) students. 50% of the total 19% is adjusted based on Team Evaluation results.

Assessment criteria:

Refer to the assignment description.

Deadline for absolute fail:

50 hours after the due date (each late hour reduces the maximum achievable marks by 2%).

Release of marks:

Within 2 weeks of the due date.

Submission notes: via Moodle

Turnitin setting: This is not a Turnitin assignment

Attendance Requirements

Students are strongly encouraged to attend all classes and review lecture recordings.

Course Schedule

View class timetable

Timetable

Date	Type	Content
O Week: 25 May - 28 May		
Week 1: 31 May - 4 June	Lecture	Introduction, Locomotion, Perception
	Workshop	Assignment 1 demonstration
Week 2: 7 June - 11 June	Lecture	Localisation I
	Online Activity	Assignment 1 Progress Check (optional)
Week 3: 14 June - 18 June	Lecture	Kinematics
	Online Activity	Assignment 1 Help Session
Week 4: 21 June - 25 June	Lecture	Planning I
	Workshop	Assignment 2 Demonstration
Week 5: 28 June - 2 July	Lecture	Planning II
	Online Activity	Assignment 2 Progress Check (optional)
Week 6: 5 July - 9 July		
	Online Activity	Assignment 3 Help Session
Week 7: 12 July - 16 July	Lecture	Vision I
	Workshop	Assignment 3 Demonstration
Week 8: 19 July - 23 July	Lecture	Vision II
	Online Activity	Assignment 3 Progress Check (optional)
Week 9: 26 July - 30 July	Lecture	Localisation II
	Online Activity	Assignment 3 Help Session
Week 10: 2 August - 6 August	Lecture	Summary
	Online Activity	Assignment 4 Progress Check (optional)

Resources

Recommended Resources

Lecture notes and assignment specifications will be available to students via Teams.

There will be no textbook required for this course. The students are suggested to read the following if they want to expand their learning:
• R. Siegwart, I. R. Nourbakhsh, D. Scaramuzza. Introduction to autonomous mobile robots. The MIT Press. Second edition. 2011.

UNSW Library website: https://www.library.unsw.edu.au/
Moodle: https://moodle.telt.unsw.edu.au/login/index.php

Course Evaluation and Development

Feedback on the course is gathered periodically using various means, including the UNSW myExperience process, informal discussion in the final class for the course, and the School's Student/Staff meetings. Your feedback is taken seriously, and continual improvements are made to the course based, in part, on such feedback.

Submission of Assessment Tasks

Assessment submission and marking criteria

Should the course have any non-electronic assessment submission, these should have a standard School cover sheet.

All submissions are expected to be neat and clearly set out. Your results are the pinnacle of all your hard work and should be treated with due respect. Presenting results clearly gives the marker the best chance of understanding your method; even if the numerical results are incorrect.

Marking guidelines for assignment submissions will be provided at the same time as assignment details to assist with meeting assessable requirements. Submissions will be marked according to the marking guidelines provided.

Late policy

Work submitted late without an approved extension by the course coordinator or delegated authority is subject to a late penalty of 20 percent (20%) of the maximum mark possible for that assessment item, per calendar day.

The late penalty is applied per calendar day (including weekends and public holidays) that the assessment is overdue. There is no pro-rata of the late penalty for submissions made part way through a day.

Work submitted after the ‘deadline for absolute fail’ is not accepted and a mark of zero will be awarded for that assessment item.

For some assessment items, a late penalty may not be appropriate. These are clearly indicated in the course outline, and such assessments receive a mark of zero if not completed by the specified date. Examples include:

1. Weekly online tests or laboratory work worth a small proportion of the subject mark, or
2. Online quizzes where answers are released to students on completion, or
3. Professional assessment tasks, where the intention is to create an authentic assessment that has an absolute submission date, or
4. Pass/Fail assessment tasks.

Examinations

You must be available for all quizzes, tests and examinations. For courses that have final examinations, these are held during the University examination periods: February for Summer Term, May for T1, August for T2, and November/December for T3.

Please visit myUNSW for Provisional Examination timetable publish dates. For further information on exams, please see the Exams webpage.

Special Consideration

If you have experienced an illness or misadventure beyond your control that will interfere with your

assessment performance, you are eligible to apply for Special Consideration prior to submitting an assessment or sitting an exam.

UNSW now has a Fit to Sit / Submit rule, which means that if you attempt an exam or submit a piece of assessment, you are declaring yourself fit enough to do so and cannot later apply for Special Consideration.

For details of applying for Special Consideration and conditions for the award of supplementary assessment, please see the information on UNSW's Special Consideration page.

Please note that students will **not** be required to provide **any** documentary evidence to support absences from any classes missed **because of COVID-19 public health measures such as isolation**. UNSW will **not** be insisting on medical certificates from anyone deemed to be a positive case, or when they have recovered. Such certificates are difficult to obtain and put an unnecessary strain on students and medical staff.

Applications for special consideration **will** be required for assessment and participation absences – but no documentary evidence **for COVID 19 illness or isolation** will be required.

Academic Honesty and Plagiarism

UNSW has an ongoing commitment to fostering a culture of learning informed by academic integrity. All UNSW students have a responsibility to adhere to this principle of academic integrity. Plagiarism undermines academic integrity and is not tolerated at UNSW. *Plagiarism at UNSW is defined as using the words or ideas of others and passing them off as your own.*

Plagiarism is a type of intellectual theft. It can take many forms, from deliberate cheating to accidentally copying from a source without acknowledgement. UNSW has produced a website with a wealth of resources to support students to understand and avoid plagiarism, visit: student.unsw.edu.au/plagiarism. The Learning Centre assists students with understanding academic integrity and how not to plagiarise. They also hold workshops and can help students one-on-one.

You are also reminded that careful time management is an important part of study and one of the identified causes of plagiarism is poor time management. Students should allow sufficient time for research, drafting and the proper referencing of sources in preparing all assessment tasks.

If plagiarism is found in your work when you are in first year, your lecturer will offer you assistance to improve your academic skills. They may ask you to look at some online resources, attend the Learning Centre, or sometimes resubmit your work with the problem fixed. However more serious instances in first year, such as stealing another student's work or paying someone to do your work, may be investigated under the Student Misconduct Procedures.

Repeated plagiarism (even in first year), plagiarism after first year, or serious instances, may also be investigated under the Student Misconduct Procedures. The penalties under the procedures can include a reduction in marks, failing a course or for the most serious matters (like plagiarism in an honours thesis) even suspension from the university. The Student Misconduct Procedures are available here:

www.gs.unsw.edu.au/policy/documents/studentmisconductprocedures.pdf

Academic Information

Credit points

Course credit is calculated in Units-Of-Credit (UOC). The normal workload expectation for one UOC is approximately 25 hours per term. This includes class contact hours, private study, other learning activities, preparation and time spent on all assessable work.

Most coursework courses at UNSW are 6 UOC and involve an estimated 150 hours to complete, for both regular and intensive terms. Each course includes a prescribed number of hours per week (h/w) of scheduled face-to-face and/or online contact. Any additional time beyond the prescribed contact hours should be spent in making sure that you understand the lecture material, completing the set assignments, further reading, and revising for any examinations.

On-campus class attendance

Public distancing conditions must be followed for all face-to-face classes. To ensure this, only students enrolled in those classes will be allowed in the room. No over-enrolment is allowed in face-to-face classes. Students enrolled in online classes can swap their enrolment from online to a **limited** number of on-campus classes by Sunday, Week 1. Please refer to your course's Microsoft Teams and Moodle sites for more information about class attendance for in-person and online class sections/activities.

Your health and the health of those in your class is critically important. You must stay at home if you are sick or have been advised to self-isolate by NSW health or government authorities. Current alerts and a list of hotspots can be found here. **You will not be penalised for missing a face-to-face activity due to illness or a requirement to self-isolate.** We will work with you to ensure continuity of learning during your isolation and have plans in place for you to catch up on any content or learning activities you may miss. Where this might not be possible, an application for fee remission may be discussed. Further information is available on any course Moodle or Teams site.

In certain classroom and laboratory situations where physical distancing cannot be maintained or there is a high risk that it cannot be maintained, face masks will be considered **mandatory PPE** for students and staff.

For more information, please refer to the
FAQs: https://www.covid-19.unsw.edu.au/safe-return-campus-faqs

Guidelines

All students are expected to read and be familiar with UNSW guidelines and polices. In particular, students should be familiar with the following:

- Attendance
- UNSW Email Address
- Special Consideration
- Exams
- Approved Calculators
- Academic Honesty and Plagiarism

Important Links

- Moodle
- Lab Access
- Computing Facilities
- Student Resources
- Course Outlines
- Faculty Transitional Arrangements for COVID-19
- Makerspace
- UNSW Timetable
- UNSW Handbook
- Equitable Learning Services

Image Credit

Synergies in Sound 2016

CRICOS

CRICOS Provider Code: 00098G

Acknowledgement of Country

We acknowledge the Bedegal people who are the traditional custodians of the lands on which UNSW Kensington campus is located.

Appendix: Engineers Australia (EA) Professional Engineer Competency Standard

Program Intended Learning Outcomes	
Knowledge and skill base	
PE1.1 Comprehensive, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline	✓
PE1.2 Conceptual understanding of the mathematics, numerical analysis, statistics, and computer and information sciences which underpin the engineering discipline	
PE1.3 In-depth understanding of specialist bodies of knowledge within the engineering discipline	
PE1.4 Discernment of knowledge development and research directions within the engineering discipline	
PE1.5 Knowledge of engineering design practice and contextual factors impacting the engineering discipline	
PE1.6 Understanding of the scope, principles, norms, accountabilities and bounds of sustainable engineering practice in the specific discipline	
Engineering application ability	
PE2.1 Application of established engineering methods to complex engineering problem solving	✓
PE2.2 Fluent application of engineering techniques, tools and resources	
PE2.3 Application of systematic engineering synthesis and design processes	
PE2.4 Application of systematic approaches to the conduct and management of engineering projects	
Professional and personal attributes	
PE3.1 Ethical conduct and professional accountability	
PE3.2 Effective oral and written communication in professional and lay domains	
PE3.3 Creative, innovative and pro-active demeanour	
PE3.4 Professional use and management of information	
PE3.5 Orderly management of self, and professional conduct	
PE3.6 Effective team membership and team leadership	✓