EE3305/ME3243
Robotic System Design
Syllabus of Part 2

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October 2, 2023

1 Course Description

This course introduces the mobile robot systems' architecture and key components such as various sensors and actuator technologies. Various locomotion mechanisms adopted by robotic systems are discussed. The course also introduces basic principles of robot motion control. Robot Operating System (ROS) is utilised for simulation in virtual environments.

2 Course Goals and Learning Outcomes

Upon completion of this course, students should be able to:

1. Analyse motion of different locomotion mechanisms
2. Understand key working principles of selected sensors and actuators used in robots; and select appropriate sensors and actuators for a robot system to achieve a given task
3. Apply basic robot motion control principles (strongly related to Part 2)
4. Utilise ROS for mobile robot simulation in a virtual environment (strongly related to Part 2)

3 References

1. About Robot System Design: Maja J. Mataric, The Robotics Primer, MIT Press, 2007. Chapter 10 - 19. Online sources: http://roboticsprimer.sourceforge.net/wiki/index.php/Main_Page
2. About ROS: http://wiki.ros.org/

4 Assessment

4.1 Project 1 (PID Control)

In this project, students are expected to demonstrate the ability to:

1. Apply a proportional-integral-derivative (PID) control in a ROS simulation
2. Tune PID control gains and explain the rationale
3. Present and analyse the performance of the control system

4.2 Project 2 (Path Planning)

In this project, students are expected to demonstrate the ability to:

1. Apply a control system in a path planning problem
2. Apply a path planning algorithm in a ROS simulation
3. Present and analyse the performance of the navigation system

4.3 Assessment Plan

The assessment plan is presented in Table 1.

Table 1: Assessment Plan

Object of Assessment	Deliverable (Due Date)	Weightage
Project 1 (PID Control)	Demo (to be done by 20 October 2023) Report (22 October 2023) Code (22 October 2023)	20%
Project 2 (Path Planning)	Demo (to be done by 3 November 2023) Report (5 November 2023) Code (5 November 2023)	20%
Presentation	**Submitting PPT for presentation:** 5 November 2023, 23.59, via Canvas **3-minutes presentation on one of these slots:** * 7 November 2022, Tuesday (10.00 am – 12.00 pm) * 9 November 2022, Thursday (12.00 pm – 12.45 pm) * 14 November 2022, Tuesday (10.00 am – 12.00 pm) * 16 November 2022, Thursday (12.00 pm – 12.45 pm)	10%
	TOTAL	50%

4.4 Presentation

The presentation is up to 3 minutes, followed by Q&A. Students are to book the presentation slot. The link to book a presentation slot will be provided in Canvas.

5 Course Outline

The course comprises of classes and lab sessions. Classes are in-person at LT2. Classes are recorded. The recording of the class is available at Canvas > Videos/Panopto. Lab sessions are in-person at Control &

Simulation Lab (E4A-03-04). Lab sessions are not recorded. The project in the lab sessions utilizes ROS Noetic Ninjemys (ROS Noetic). ROS Noetic runs best on Ubuntu 20.04.

The outline of the course is presented in Table 2.

Table 2: Course Outline

Week	Tuesday	Thursday	Lab Sessions
7		5 Oct, 12.00 - 12.45 Introduction to Part 2 ROS	
8	10 Oct, 10.00 - 12.00 ROS Project 1 & Project 2 Control System	12 Oct, 12.00 - 12.45 Control System	Students doing Project 1
9	17 Oct, 10.00 - 12.00 Control System	19 Oct, 12.00 - 12.45 Path Planning	Students wrapping up Project 1
10	24 Oct, 10.00 - 12.00 Path Planning	26 Oct, 12.00 - 12.45 Path Planning	Students doing Project 2
11	31 Oct, 10.00 - 12.00 Turtlebot Trials (tentative)	2 Nov, 12.00 - 12.45 Future of Robots	Students wrapping up Project 2
12	7 Nov, 10.00 - 12.00 Presentation	9 Nov, 12.00 - 12.45 Presentation	
13	14 Nov, 10.00 - 12.00 Presentation	16 Nov, 12.00 - 12.45 Presentation	

For the lab sessions:

1. Students may choose to install ROS in their personal machine/laptop and do the lab sessions independently. Guideline of self-installation of ROS is provided in another document. Students will need to book time for demo. The link to book a time slot for demo will be provided in Canvas.

2. Students may choose to use the machine at the Control & Simulation Lab. Usage of the machine in the Lab requires prior booking. Students may need to share a machine with another student. The link to book a machine in the Lab will be provided in Canvas.

Compliance to Lab's rules and regulations, including wearing covered shoes, is required to gain entry to the Lab.

6 Submission of Work, Student Conduct and Absent Policy

Students are expected to plan and manage their workloads and to ensure they do not lose work through IT malfunction or poor planning. An assignment will be considered late if it misses the deadline without advance permission. Late submissions are reflected in the marks that students receive for the respective assignment.

The Code of Student Conduct promotes an environment that facilitates intellectual pursuits, supports student and community development, and enforces civility and personal responsibility. Information about Code of Student Conduct in NUS can be found in https://nus.edu.sg/osa/resources/code-of-student-conduct.

Students are expected to attend classes, project demonstration and presentations, unless there is a valid reason. Prior approval is required.