ENMT482: Robotics

Objective

This course is structured as two parts: (1) autonomous mobile robotics and (2) articulated robot manipulators. The autonomous mobile robotics part of the course is an introduction to the probabilistic robotics techniques that underpin self-driving cars and other autonomous robots. This includes concepts such as Kalman and particle filters.

Articulated manipulators form an important class of robots that are commonly used in industrial situations. The purpose of this part of the course is to introduce you to fundamental concepts of geometry, kinematics, dynamics, and control of robotic systems, allowing you to model and analyse a robot manipulator.

This course is project-based and you will be given the opportunity to apply the material in both simulation and with real industrial and research robots through project work.

Lecturers

Michael Hayes (Course Coordinator) MPH
Link A504, Email:michael.hayes@canterbury.ac.nz
Chris Pretty CGP
Mechanical E513, Email:chris.pretty@canterbury.ac.nz

Learning outcomes

- Develop and apply forward kinematics to obtain the end-effector position and orientation in the base coordinate frame as a function of the joint parameters for an articulated manipulator
- Apply inverse kinematics to calculate all possible sets of joint parameters that result in a given end-effector position and orientation relative to the base coordinate frame
- Construct the Jacobian matrix for an articulated manipulator and use it to calculate static forces and torques and derive dynamic equations for each link
- Apply simple linear interpolative path planning techniques to control end-effector motion for an articulated manipulator
- Implement a particle filter and an extended Kalman filter for robot sensor fusion
- Understand the principles of simultaneous localisation and mapping
- Understand navigation and path planning algorithms to control an autonomous robot

Topics

Autonomous robots (Hayes)	**Num. Lectures**
Introduction to sensor fusion	5
1-D Bayes filters (Kalman, histogram, and particle)	4
Multivariate Bayes filters	3
Motion models	2
Mapping/Localisation/SLAM	2
Navigation and path planning	2

Articulated manipulators (Pretty)	**Num. Lectures**
Spatial descriptions and transformations	4
Forward kinematics	4
Inverse kinematics	4
Jacobians	4
Motion planning	2

Assessment

- Autonomous robot assignment (25%) 10 September at 5 pm.
- Robot manipulator assignment (25%) 15 October at 5 pm.
- Exam (50%)

Dishonest Practice

Plagiarism, collusion, copying, and ghost writing are unacceptable and dishonest practices.

- Plagiarism is the presentation of any material (test, data, figures or drawings, on any medium including computer files) from any other source without clear and adequate acknowledgment of the source.
- Collusion is the presentation of work performed in conjunction with another person or persons, but submitted as if it has been completed only by the named author(s).
- Copying is the use of material (in any medium, including computer files) produced by another person(s) with or without their knowledge and approval.
- Ghost writing is the use of another person(s) (with or without payment) to prepare all or part of an item submitted for assessment.

Do not engage in dishonest practices. The Department reserves the right to refer dishonest practices to the University Proctor and where appropriate to not mark the work.