The Hong Kong University of Science and Technology

UG Course Syllabus

Introduction to Robotics: From Mobile Robots to Manipulators

ELEC4220

4 Credits

Pre-requisite: ELEC3200

Name: Fumin Zhang

Email: eefumin@ust.hk

Course Description

In this course, fundamental disciplines of modern robotics are introduced: mechanics, control, and computing. These components are integrated to analysis, design, and control of mobile robots and manipulators to serve engineering or scientific needs.

Students will learn: (1) how to use mathematical methods to model mobile robots and manipulators and to plan their motion; (2) how to process sensor information and design feedback controllers and planners; and (3) how to implement algorithms through computer systems to achieve autonomy. As class projects, students will be encouraged to perform simulations using MATLAB and to carry experiments on mobile robots and manipulators.

1. *Introduction:* Anatomy of a Robot: Classification of Robots; Robot Configurations; Robot Components; Performance Characteristics.

2. *Foundations*: 2D and 3D affine transformations. Jacobian matrices. Simulation tools.

3. *Kinematics:* Modeling kinematic chains, Forward kinematics, Inverse kinematics

4. Reactive Behaviors: Feedback control. Basic navigation algorithms based on recognized landmarks. Obstacle avoidance. Path following and boundary following. Simple reactive behaviors to object detected by computer vision.

5. *Motion and Path Planning:* Distance transform, Breadth first search, the A* algorithm, Potential field based method.

6. *Manipulator Dynamics and Force Control* (if time permit).

Assessments:

Assessment Task	Contribution to Overall Course grade (%)
Mid-Term	25%
Homeworks	30%
Class Project	15%
Final examination	30%

Required Texts and Materials

1. Class Notes by the Instructor. (Available for Free.)

2. Peter Corke, Robotics and Control: Fundamental Algorithms in MATLAB (Required for demos and experiments. Ebook can be purchased or rent from Amazon.)

In addition, there will be assigned readings from the internet regarding the technology advancements for robotics.