Module Specification

Robot Control Systems

Version: 2027-28, v4.0, Approved

Contents

Part 1: Information

Module title: Robot Control Systems

Module code: UFMFVF-30-2

Level: Level 5

For implementation from: 2027-28

UWE credit rating: 30

ECTS credit rating: 15

College: College of Arts, Technology and Environment

School: CATE School of Engineering

Partner institutions: None

Field: Engineering, Design and Mathematics

Module type: Module

Pre-requisites: Mathematics for Robotics 2026-27

Excluded combinations: None

Co-requisites: None

Continuing professional development: No

Professional, statutory or regulatory body requirements: None

Part 2: Description

Overview: In this module students study kinematics and control principles as applied to robots. Students will learn to simulate and integrate robot hardware to perform tasks, then explore techniques to improve performance by building up feedback control systems. This module builds on prior knowledge and skills to analytically design, analyse, control, and simulate robotic systems.

Features: Not applicable

Educational aims: This module equips students with fundamental knowledge to solve control theory problems of robotic systems. Students will be able to analyse and solve kinematic problems relating to robot motion and control , these are important aspects of most robotic systems.

Outline syllabus: This module focuses on two main topics:
Robotic Systems: the kinematics, software and hardware of fixed-base manipulators; how to model them in simulation, program them to perform tasks and couple simulations to real robots.
Control Systems: fundamental knowledge and practical exercises to solve real control engineering problems based on classical control theory and techniques applied to robotic systems.
Simulation tools are used to verify theoretical calculations and the associated laboratory activities reinforce the lecture material.

Syllabus Outline

Robotic Systems
Describing robots with Denavit-Hartenberg notation.
Simulating robots with URDF.
Manual and automatic solving of up to 6 DoF position and velocity kinematics.
Trajectory planning and generation, including manipulability metrics.
Integration of simulated robot with hardware, including ROS2.

Control Systems
Enhanced classical control system analysis and design.
Control system modelling, and analysis and design using matrix algebra, Laplace transform, Z-transform, differential and difference Equations.
Use of computational packages, such as Matlab to analyse and design control systems
State-space representations, solution of state equations, Controllability and observability, state-feedback, and pole placement control design.
Modelling, Analysis, and design of Multivariable Control Systems.
Digital Control System Analysis and Design Applications.

Part 3: Teaching and learning methods

Teaching and learning methods: In order to ensure that theory, application and engineering practice are properly integrated, a combination of lectures, laboratory experiments and software labs are used to present core topics from the syllabus.

Module Learning outcomes: On successful completion of this module students will achieve the following learning outcomes.

MO1 Apply principles and techniques to model the forward and inverse kinematics of a robot with up to six degrees of freedom

MO2 Integrate software models of robots with appropriate hardware to design, plan and execute tasks

MO3 Apply control engineering knowledge and techniques in the critical design and analysis of general robot system operation

MO4 Conduct computational experimentation and apply theoretical methods to validate the designed robot control system with appropriate control/simulation software/languages

Hours to be allocated: 300

Contact hours:

Independent study/self-guided study = 228 hours

Staff-guided learning = 72 hours

Reading list: The reading list for this module can be accessed at readinglists.uwe.ac.uk via the following link https://uwe.rl.talis.com/index.html

Part 4: Assessment

Assessment strategy: The module comprises two assessment points taking place at the end of each semester. Robotic Systems content is covered in the first semester and Control Systems in the second. Preceding these assessment points

will be formative assessments and exercises (not contributing to module mark) provisioned during the tutorial/lab sessions.

In-class Examination (50% of module mark, end of Teaching Block 1), in which students are required to control a physical robot platform to perform a set of tasks.

In-class Examination (50% of module mark, end of Teaching Block 2), in which students will demonstrate their knowledge of all aspects of control including modelling and design.

Resit is the same as the first sit

Assessment tasks:

In-class test (First Sit)
Description: In class practical computer-based exam: 2 hours
Weighting: 50 %
Final assessment: Yes
Group work: No
Learning outcomes tested: MO1, MO2

Examination (First Sit)
Description: On campus computer-based exam: 3 hours
Weighting: 50 %
Final assessment: No
Group work: No
Learning outcomes tested: MO3, MO4

In-class test (Resit)
Description: In class practical computer-based exam: 2 hours
Weighting: 50 %
Final assessment: Yes
Group work: No

Learning outcomes tested: MO1, MO2

Examination (Resit)
Description: On campus computer-based exam: 3 hours
Weighting: 50 %
Final assessment: No
Group work: No
Learning outcomes tested: MO3, MO4

Part 5: Contributes towards

This module contributes towards the following programmes of study: