Module Specification

Robot Control Systems

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Contents

Part 1: Information

Module title: Robot Control Systems

Module code: UFMFVF-30-2

Level: Level 5

For implementation from: 2023-24

UWE credit rating: 30

ECTS credit rating: 15

Faculty: Faculty of Environment & Technology

Department: FET Dept of Engineering Design & Mathematics

Partner institutions: None

Field: Engineering, Design and Mathematics

Module type: Module

Pre-requisites: None

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 about the mechanics and dynamics of robot bodies. This module builds up on the knowledge and skills developed in previous modules to analytically design, analyse and control 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:
Robot kinematics: the mechanics and dynamics of robot bodies; how to make robots move efficiently and accurately to achieve desired aims.
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

Kinematics
Forward and Inverse kinematics solutions for manipulators with more than 4 degrees of freedom, Denavit Hartenberg notations.
Manipulator trajectories, velocities and static forces.
Dynamics basics, Manipulator dynamics, Newton Euler and Lagrange methods.
Control techniques for manipulators.
Mobile robot motion kinematics (ground, water, and aerial robots)

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 Describe and explain of theories and techniques required to design robot systems and control their movement. [SM1b] {[SM1m]}

MO2 Apply used tools and techniques to enable the efficient solution for design problems of the robot mechanics. [D2] {D2m}

MO3 Identify and describe the performance of control systems using analytical methods and modelling tools. [EA1b, EA2] {EA1m, EA2m}

MO4 Apply appropriate theoretical and practical methods to the analysis and solution of control engineering problems. [EA3b] {EA3m}

Hours to be allocated: 300

Contact hours:

Independent study/self-guided study = 228 hours

Face-to-face learning = 24 hours

Total = 300

Reading list: The reading list for this module can be accessed at readinglists.uwe.ac.uk via the following link

Part 4: Assessment

Assessment strategy: The module comprises two assessment points taking place at the end of each semester. Kinematics is covered in the first semester and Control in the second. Leading to these exams will be formative assessments (not contributing to module mark) provided via support during the tutorial/lab sessions.

Practical Examination: Assessed via a computer-based open-book Exam (50%, end of teaching block 1) in which students will solve kinematics problem.

End of semester Exam (50%, 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:

Examination (Online) (First Sit)
Description: Practical computer based examination
Weighting: 50 %
Final assessment: Yes
Group work: No
Learning outcomes tested: MO1, MO2

Examination (Online) (First Sit)
Description: Online end of semester exam
Weighting: 50 %
Final assessment: No
Group work: No
Learning outcomes tested: MO3, MO4

Examination (Online) (Resit)
Description: Practical computer based examination
Weighting: 50 %
Final assessment: Yes
Group work: No
Learning outcomes tested: MO1, MO2

Examination (Online) (Resit)

Description: Online end of semester exam

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:

Robotics [Frenchay] BEng (Hons) 2022-23

Robotics {Foundation}[Sep][SW][Frenchay][5yrs] BEng (Hons) 2021-22

Robotics {Foundation}[Sep][FT][Frenchay][4yrs] BEng (Hons) 2021-22