WM9N9-15 Automated Systems and Control

23/24

Department
WMG
Level
Taught Postgraduate Level
Module leader
Sulakshan Rajendran
Credit value
15
Module duration
2 weeks
Assessment
100% coursework
Study location
University of Warwick main campus, Coventry

Description

Introductory description

This module addresses the challenges in automated systems and control to enable a smooth transition between automated to autonomous vehicles. It gives insight into systems modelling and how the nonlinearities such as tyre-road interaction, actuator dynamics affect the system design from advanced automated control system prospective. Then, details how adaptive strategies including machine-learning based methods could be adopted to design intelligent adaptive systems for improved vehicle autonomy.

Module aims

The aim of the module is to provide a comprehensive understanding and practical experience of automated systems and control within an automotive context. Developing both theoretical and practical understanding of the automated systems and adaptive, self-learning control system design by establishing effective connection with the concepts such as sensor fusion, machine-human interaction and machine learning learnt from other taught modules.

Outline syllabus

This is an indicative module outline only to give an indication of the sort of topics that may be covered. Actual sessions held may differ.

- Multi Physics System Simulation within the electrical, mechanical and hydraulic domains.
- Physical Modelling using ordinary differential equations (ODE's) and state variable block diagram modelling methods for both linear and non-linear systems.
- Eigen-value calculation & transfer-function analysis of physical automotive systems within the frequency domain and time domain.
- Numerical integration methods including solver selection and its impact on simulation stability and accuracy.
- Machine learning-based self-tuning/adaptive strategies for automated systems.
- Design of adaptive control systems for automated vehicles.

Learning outcomes

By the end of the module, students should be able to:

- Demonstrate a comprehensive understanding of the practical application of the different approaches to mathematical modelling and analysis physical systems
- Derive, translate, solve & analyse functional models of physical systems in sequential block diagram & state variable forms.
- Critically evaluate different estimation approaches and demonstrate understanding in model linearization and parameter estimation methods.
- Critically evaluate different adaptive control strategies, ranging from classical to intelligent approaches to attain increased autonomy
- Develop skills to design adaptive control system for automated vehicles.

Subject specific skills

- Understand dynamical systems,
- How to model electrical, mechanical, thermal, fluid systems as analogous systems,
- Numerical methods to solve ordinary differential dynamical systems
- Evaluating different adaptive strategies
- How to design an adaptive control system for an automated vehicle.
- Evaluating the challenges in implementing adaptive strategies in real-time.
- `MATLAB programming`

Transferable skills

- Technology literacy
- Dependability
- Communication
- Adaptability

Study

Study time

Type	Required
Lectures	30 sessions of 1 hour (20%)
Online learning (scheduled sessions)	5 sessions of 2 hours (7%)
Online learning (independent)	10 sessions of 2 hours (13%)
Other activity	10 hours (7%)
Private study	20 hours (13%)
Assessment	60 hours (40%)
Total	150 hours

Private study description

Student is expected to revisit/review required engineering mathematics to understand the building-blocks of system modelling and analysis.

Other activity description

Pre-module activity to understand basics of automated systems and control
Introduction to the module
Industry guest speaker
Module Review and assessment description

Costs

No further costs have been identified for this module.

Assessment

You must pass all assessment components to pass the module.

Assessment group A

Assessment component	Weighting	Study time	Eligible for self-certification
Automated systems and control design	70%	40 hours	Yes (extension)

It consists of a number of questions covering the following:

	Weighting	Study time	Eligible for self-certification
System and component level modelling and analysis A critical evaluation of different adaptive control systems for automated vehicles in the perspective of their design, testing and implementation. Design an adaptive controller for an automated vehicle. if any report-writing question is included then the maximum number of words are 2800.			

Reassessment component is the same

Assessment component

Systems modelling and analysis	30%	20 hours	Yes (extension)
This consists of a two or three parts: A pre-work module assignment to evaluate the basics on system modelling and analysis, and questions to evaluate the understandings of the taught topics such as adaptive control, Kalman filter design during the lectures. (No word count since the questions are problems/calculations/simulations)			

Reassessment component is the same

Feedback on assessment

Scaled ratings for Comprehension, Effort and Presentation, individual written feedback and overall mark following on from WMG feedback sheet templates.

As this is a Model A reassessment only any failed components will be individually reassessed at the same weighting.

Availability

Courses

This module is Optional for:

- TESS-SP Short Programme
  - Year 1 of SCAV Short Course (AV)
  - Year 1 of SCAV Short Course (AV)