WM9N9-15 Automated Systems and Control

26/27

Department
WMG
Level
Taught Postgraduate Level
Module leader
Sulakshan Rajendran
Credit value
15
Module duration
4 weeks
Assessment
Multiple
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 of physical systems. (AHEP4, M1, M2, M3)
- Derive and analyse transfer function and state space models for control system design. (AHEP4, M2, M3, M5)
- Critically evaluate different estimation approaches and demonstrate understanding in model linearization and parameter estimation methods. (AHEP4, M2, M3, M4, M5, M6, M17)
- Critically evaluate different adaptive control strategies, ranging from classical to intelligent approaches to attain increased autonomy. (AHEP4, M2, M3, M4, M5, M6, M17)
- Develop skills to design an adaptive control system for automated vehicles. (AHEP4, M4, M5, M6, M17)

Indicative reading list

Reading lists can be found in Talis

Specific reading list for the module

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	18 sessions of 1 hour (12%)
Tutorials	10 sessions of 1 hour (7%)
Demonstrations	2 sessions of 1 hour (1%)
Online learning (scheduled sessions)	(0%)
Online learning (independent)	12 sessions of 1 hour (8%)
Private study	48 hours (32%)
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.

Costs

No further costs have been identified for this module.

Assessment

You must pass all assessment components to pass the module.

Assessment group A1

	Weighting	Study time	Eligible for self-certification
Automated Vehicle Control System Design	70%	42 hours	Yes (extension)

A proposal on adaptive control systems for automated vehicles in the perspective of their design,

	Weighting	Study time	Eligible for self-certification
testing and implementation.			
System Modelling and Analysis	30%	18 hours	Yes (extension)
It consists of a number of questions covering the following: Preliminary System and component level modelling, analysis and control design.			

Assessment group R

	Weighting	Study time	Eligible for self-certification
Automated Vehicle Control System Design	70%	42 hours	No
System Modelling and Analysis	30%	18 hours	No

Feedback on assessment

Written feedback.

Availability

There is currently no information about the courses for which this module is core or optional.