WM993-15 Modelling and Simulation of Systems

20/21

Department
>WMG

Level
>Taught Postgraduate Level

Module leader
>Dhammika Widanalage

Credit value
>15

Module duration
>2 weeks

Assessment
>80% coursework, 20% exam

Study location
>University of Warwick main campus, Coventry

Description

Introductory description

40 hours over 2 weeks consisting of interactive presentations, question and answer sessions, talks from industrial practitioners and discussion, videos, and hands on computer simulation sessions.

Module aims

In this module the student will gain a comprehensive understanding and practical experience of the modelling and simulation of physical systems within an automotive context. Developing both theoretical and practical understanding of the derivation of ordinary differential equations, applicable numerical methods and the construction of models to solve problems in both time and frequency domains.

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.

- 1-D 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.
- Understanding and application of data-driven modelling
- Numerical integration methods including solver selection and its impact on simulation stability and accuracy.
- The use of simulation methods, including Co-Simulation/Embedded/Real Time Application
- The role of verification and validation techniques within systems modelling and simulation analysis.

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 one-dimensional physical systems
- Derive, translate, solve & analyse 1D functional models of physical systems in sequential block diagram & state variable forms.
- Critically evaluate a range of numerical solver methods and evaluate the correct usage and errors for each within the context of simulation efficiency and accuracy. Demonstrate understanding in model linearization and parameter estimation methods.
- Critically evaluate different methods of model verification and validation and synthesise a framework for data driven modelling within the context of model aims and objectives.
- Develop integrated models of automotive systems to gain a practical understanding of multi-physics simulation techniques.

Indicative reading list

[View reading list on Talis Aspire](#)

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
- Implement data-driven modelling
- Validating and verification of dynamical models
- How industries use such models and approaches
- `Matlab programming`

Transferable skills

- Technology literacy
- Dependability
- Communication

- Adaptability

Study

Study time

Type	Required
Lectures	30 sessions of 1 hour (20%)
Supervised practical classes	5 sessions of 2 hours (7%)
Other activity	10 hours (7%)
Assessment	100 hours (67%)
Total	150 hours

Private study description

No private study requirements defined for this module.

Other activity description

Pre-module activity to understand basic modelling and simulation concepts
Introduction to the module
Two industry guest speakers
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 D

	Weighting	Study time
Modelling framework report	50%	70 hours

A written essay based question focusing on customer and vehicle level requirement simulation (ILOs 1,3 and 4).

Computer model and simulation question	30%	20 hours

	Weighting	**Study time**

Two questions related to:
System and component level modelling (ILOs 2,4 and 5) and
Data-driven simulations of vehicle components (ILOs 2 and 4).

The students will need to solve the problems through mathematical derivation and computer simulation and show the written solution and simulation results.

Online assessed quiz	20%	10 hours

Online based assessment quiz including multiple-choice and text-based answers to assess ILOs 1 and 2. Duration 60 minutes.

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.

[Past exam papers for WM993](#)

Availability

Courses

This module is Core optional for:

- Engineering Competence (Sustainable Automotive Electrification) [New Course]
- MSc in Sustainable Automotive Electrification (FT) [New Course]
- MSc in Sustainable Automotive Electrification (PT) [New Course]