WM9SB-15 Intelligent Vehicle Sensors

27/28

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

Description

Introductory description

The Intelligent Vehicle Sensors module analyses the main working principles and limitations of automotive sensors, particularly focusing on perception sensors and their relationship with assisted and automated driving functions. The role of sensor modelling and testing is highlighted through all the module, with real case studies and tutorials. Moreover, the module explains what are the main advantages and challenges when combining and fusing the data from different sensor technologies.

Module aims

The module aims to provide the students with a comprehensive knowledge of different types of sensors used in autonomous vehicles, their relevance for assisted and automated driving (AAD) functions, and the architectures for the fusion of information coming from the plethora of sensors available. The module aims to systematically analyse industry motivations, legislations, roadmaps and customer requirements. Key parameters to critically compare different sensors are discussed, and issues related to sensor limitations and different performance are evaluated with an emphasis on system architecture and control. Topics are introduced from a practical viewpoint thus allowing the students undertaking this module to be able to critically evaluate key design parameters and independently apply the learning to a wide range of practical electronic sensors and systems deployed to achieve smart connected and autonomous vehicles.

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.

- Introduction to sensors, their function, properties and classifications; · Introduction to automotive sensors and their classification (general sensing, perception, virtual sensors); · Automotive sensors: key design attributes and limitations; · Automotive sensors: working principles and interaction with the environment; · Role of automotive sensors in different ADASs and in autonomous vehicles; · Introduction to actuators, their classification and their use in advanced driving assistance systems; · ADAS architecture and control theory; · Use of control theory in automotive electronics systems with sensors and actuators; · Introduction to sensors fusion; · Sensor fusion and its relationship with automotive electronic system architecture and different strategies for sensor fusion; · Challenges related to automotive sensor fusion and connected vehicles; · Automotive sensors and advanced driving assistance system testing: state of the art, research trends and challenges; · Latest trends in research on sensors and sensor fusion for autonomous vehicles.

Learning outcomes

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

- Discuss and analyse different automotive sensors, their working principles, advantages, disadvantages, limitations in Advanced driver-assistance systems (ADAS) and autonomous vehicles deploying them [AHEP4, M1, M2, M3, M4, M5, M6]
- Interpret the role of the sensors in an advanced driving assistance system (e.g. adaptive cruise control) and independently evaluate the impact of sensors' limitations on the system limitations [AHEP4, M2, M3, M4, M5, M16, M17]
- Critically compare and evaluate different strategies for sensor fusion on autonomous vehicles [AHEP4, M2, M3, M4, M6, M16, M17]
- Evaluate and practically represent the coverage of automotive sensors and analyse the effects of different external factors [AHEP4, M2, M3, M5]

Indicative reading list

Reading lists can be found in Talis

Specific reading list for the module

Subject specific skills

Students will develop a deep understanding of the role and functionality of various automotive sensors, focusing on their performance metrics, classification, and practical applications in intelligent vehicle systems. They will explore the basic principles behind these sensors, gaining insights into their limitations, strengths, and how they contribute to overall system reliability and safety. Additionally, students will learn to evaluate and model sensor behaviours, and understand

the process of sensor fusion, integrating multiple data sources to improve system accuracy and decision-making in automotive contexts. Practical exercises will enable students to assess the real-world performance of different sensor types, contributing to a broader understanding of sensor optimization in dynamic driving environments.

Transferable skills

Team work; Work effectively in a group or team to achieve goals; Personal Motivation, Organisation and Time Management skills; Research and Analytical Skills; presentation skills; Oral and written communication skills.

Study

Study time

Type	Required
Lectures	18 sessions of 1 hour (12%)
Tutorials	3 sessions of 1 hour (2%)
Supervised practical classes	9 sessions of 1 hour (6%)
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

In-depth reading around the subject, completing activities and journal club preparations.

Costs

No further costs have been identified for this module.

Assessment

You must pass all assessment components to pass the module.

Assessment group A

	Weighting	Study time	Eligible for self-certification
Assessment component			
Problem set	70%	42 hours	Yes (extension)
Set of problems to be solved and solutions to be justified and/or reflection. Max 10 pages to be submitted, excluding figures, appendices, and references.			
Reassessment component			
Problem set			No
Set of problems to be solved and solutions to be justified and/or reflection. Max 10 pages to be submitted, excluding figures, appendices, and references.			
Assessment component			
Lab report and analysis.	30%	18 hours	Yes (extension)
Lab activity in groups with assessments marked individually. Evidence of experiments and analysis conducted in lab sessions.			
Reassessment component			
Proposal report and analysis.			No
Proposed experimental designs and analysis of example data.			

Feedback on assessment

All summative assessments: Individual written feedback and overall mark.
Formative feedback is provided verbally during lectures, tutorials, labs etc.

Availability

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