WM9RY-15 Fundamentals of Future Vehicle Communication Systems

27/28

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

Description

Introductory description

This module seeks to provide students with up-to-date and comprehensive insights into the key wired and wireless communication technologies currently in use, as well as those expected to be implemented in future vehicle production. This includes an in-depth exploration of communication protocols, standards, and architectures that enable seamless data exchange within and between vehicles. Additionally, the module will examine emerging trends such as V2X (Vehicle-to-Everything) communication and the role of 5G and beyond in advancing automotive connectivity.

Module aims

By establishing a foundational knowledge of core telecommunications theories, students are guided towards understanding the practical applications of various wired and wireless technologies within the automotive sector. The module explores the interplay between theoretical principles and real-world applications, focusing on the performance of these technologies at both component and system levels. Key theoretical concepts are presented alongside practical case studies to foster independent critical analysis, allowing students to evaluate the subject matter from both an academic and applied perspective.

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.

Indicative outline

Communications Theory:

- Pulse Modulation
- Baseband Modulation
- Passband Modulation
- Coding Theory
- Multiple Access

Wireless Technologies

- Antennas
- Link Budget and Channel Path Loss
  -Wireless Channels
- 5G
- V2X (Vehicle to Anything)

Wired Technologies

- CAN/CAN-FD (Controller Area Network)
- LIN (Local Interconnect Network)
- Automotive Ethernet

Learning outcomes

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

- Critically assess communication components and apply relevant techniques to analyse system performance and support informed decision-making. [AHEP:4, M1, M2, M3, M4, M5, M7, M16, M17]
- Analyse complete communication systems within the broader automotive context, with consideration for future developments. [AHEP:4, M1, M4, M5, M7, M16, M17]
- Design communication systems to enable connectivity in connected and autonomous vehicles. [AHEP:4, M1, M2, M3, M4, M5, M7, M16, M17]
- Demonstrate proficiency in using channel modelling tools and techniques to predict system performance. [AHEP:4, M1, M2, M3, M4, M5, M7, M17]

Indicative reading list

Reading lists can be found in Talis

Specific reading list for the module

Subject specific skills

1. Communication System Design and Evaluation:
   Students will acquire the ability to design, implement, and critically assess communication systems, focusing on both wired and wireless technologies used in the automotive sector.

2. Practical Application of communication systems:
   Through lab sessions, students will gain hands-on experience to simulate and predict the performance of communication channels in real-world scenarios. This involves analysing impact of noise level in the performance of a communication system.

3. Autonomous Systems Connectivity:
   Students will develop the skills to design communication frameworks that enable reliable and secure connectivity in autonomous systems, taking into account emerging technologies and protocols to future-proof automotive communication networks.

Transferable skills

1. Critical Thinking and Problem-Solving:
   Students will develop the ability to critically evaluate complex communication systems and technologies, identifying challenges and applying problem-solving techniques to address them—skills highly valued in any industry.

2. Data Analysis and Interpretation:
   Through lab work and simulations, students will learn how to analyse data effectively, draw conclusions, and make informed decisions based on quantitative and qualitative insights. This skill is transferable to various fields, including research, engineering, and technology development.

3. Technical Communication:
   The ability to communicate complex technical concepts clearly and concisely will be enhanced, particularly through reports, presentations, and discussions of lab results. Effective communication is crucial in both technical and non-technical roles, including project management and consulting.

4. Teamwork and Collaboration:
   Many lab-based activities and group projects will involve collaboration, helping students build the interpersonal skills necessary for working effectively in multidisciplinary teams. Teamwork is essential in most professional environments, particularly in project-based work.

5. Project Management and Organisation:
   Through the management of lab experiments, simulations, and project deadlines, students will enhance their organisational and time management skills, preparing them for managing larger projects in their future careers.

6. Adaptability and Lifelong Learning:
   As communication technologies evolve rapidly, students will cultivate adaptability and a mindset of lifelong learning—skills that are critical for success in dynamic fields such as

automotive technology, telecommunications, and beyond.

Study

Study time

Type	Required
Lectures	24 sessions of 1 hour (16%)
Practical classes	6 sessions of 1 hour (4%)
Private study	60 hours (40%)
Assessment	60 hours (40%)
Total	150 hours

Private study description

1. Reading and Research:
   Students are expected to review lecture notes, textbooks, academic journals, and relevant articles on communication systems, wireless technologies, and their applications in connected and autonomous vehicles. This self-directed research helps students develop a comprehensive understanding of the subject and keeps them updated on the latest developments.
2. Preparation for Labs and Practical Work:
   Before attending lab sessions, students would be required to familiarise themselves with the technical tools and software that will be used. This preparation ensures that they can make the most of their hands-on experiences.
3. Preparation for Assessments:
   Time will be spent revising for assignments. This could include practising problem-solving techniques, reviewing key communication theories, and synthesising different aspects of the course material.

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			
Written Assignment	70%	44 hours	Yes (extension)
3 to 5 problems depending on their length and complexity to be solved by students.			
Reassessment component			
Written Assignment			No
3 to 5 problems depending on their length and complexity to be solved by students.			
Assessment component			
Communication building blocks	30%	16 hours	Yes (extension)
Questions pertaining to the performance evaluation and comparative analysis of communication systems.			
Reassessment component			
Communication building blocks			No
Questions pertaining to the performance evaluation and comparative analysis of communication systems.			

Feedback on assessment

1. Written Feedback :
   Students will receive detailed written feedback that highlights strengths, areas for improvement, and suggestions for how to deepen their understanding. This feedback will focus on the quality of technical analysis, the application of communication system theories.
2. Oral Feedback in Lab Sessions:
   During lab-based practical sessions, immediate oral feedback will be given as students work on tasks such as simulations and system design. This real-time feedback will help students adjust their approach and refine their technical skills as they progress through the module.
3. Formative Feedback through Quizzes:
   Quizzes will be used as a formative assessment tool throughout the module. These quizzes will be designed to test students' understanding of core concepts. Immediate feedback will be provided, allowing students to identify gaps in their knowledge and revisit key areas before progressing further in the module. This method encourages self-assessment and active engagement with the material.

Availability

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