



Module Guide

Automotive Software Engineering

Faculty Computer Science
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ASE-01 Computervision

Module code	ASE-01
Module coordination	Prof. Dr. Patrick Glauner
Course number and name	Computervision
Lecturer	Prof. Dr. Patrick Glauner
Semester	1
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	Undergraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	project work
Weighting of the grade	5/210
Language of Instruction	English

Module Objective

The aim of this class is to discuss Computer Vision (CV), which allows computers to process visual inputs. We deal every day dozens of times with CV, such as facial recognition, real-time translating camera input or auto-tagging friends in photos. Modern CV algorithms are strongly based on machine learning methods, in particular deep neural networks. Students will acquire knowledge in CV and be able to elaborate it further in the future, for example in projects or further studies. Overall, CV is a cutting-edge field, with many high-pay opportunities for graduates.

Specifically, students will have achieved the following learning outcomes upon completion of the module:

Subject competency



Students will understand the concepts of the most common methods in computer vision. (2 - Understanding)

Methodological competency

Students will have the ability to develop high-quality programs using computer vision technologies. (3 - Apply)

Personal competency

Students will be able to implement their own algorithms and defend them against competing approaches. (6 - Create)

Social competency

Programming exercises take place as part of the course. Students are thus able to understand, critique, and complement programs of other students. (5 - Assess)

Applicability in this and other Programs

Including, but not limited to, the following modules:

- AI Project
- Deep Learning/Big Data

Entrance Requirements

- Programming, ideally in Python
- Algorithms and data structures
- (Some) mathematics

Learning Content

- Introduction: applications, computational models for vision, perception and prior knowledge, levels of vision, how humans see
- Pixels and filters: digital cameras, image representations, noise, filters, edge detection
- Regions of images and segmentation: segmentation, perceptual grouping, Gestalt theory, segmentation approaches, image compression
- Feature detection: RANSAC, Hough transform, Harris corner detector
- Object recognition: challenges, template matching, histograms, machine learning
- Convolutional neural networks: neural networks, loss functions and optimization, backpropagation, convolutions and pooling, hyperparameters, AutoML, efficient training, selected architectures
- Image sequence processing: motion, tracking image sequences, Kalman filter, correspondence problem, optical flow



- Foundations of mobile robotics: robot motion, sensors, probabilistic robotics, particle filters, SLAM
- Outlook: 3D vision, generative adversarial networks, self-supervised learning, vision transformers

Teaching Methods

- Lectures
- Projects

Recommended Literature

- C. Bishop and H. Bishop, " Deep Learning: Foundations and Concepts ", Springer, 2024.
- R. C. Gonzalez and R. Woods, " Digital Image Processing ", Pearson, 4th edition, 2018.
- I. Goodfellow, Y. Bengio and A. Courville, " Deep Learning ", MIT Press, 2016.
- S. Russell and P. Norvig, " Artificial Intelligence: A Modern Approach ", Pearson, 4th edition, 2021.



ASE-02 Digital Car / Innovation Management & Customer Design

Module code	ASE-02
Module coordination	Prof. Dr. Markus Straßberger
Course number and name	ASE-02 Digital Car / Innovation Management & Customer Design
Lecturer	Prof. Dr. Markus Straßberger
Semester	1
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	Postgraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	Portfolio
Weighting of the grade	5/90
Language of Instruction	German

Module Objective

Die Studierenden erhalten einen Einblick in die Herausforderungen und Anforderungen der aktuellen digitalen und vernetzten Automobiltechnik sowie in deren technologischen Ansätze und Lösungen. Darüber hinaus werden die methodischen Grundzüge des Innovationsprozesses in der Automobilindustrie, des nutzerorientierten Designs und des Lean-Development vermittelt.

Die Studierenden erreichen die folgenden Lernziele bzgl. Fach- und Methodenkompetenzen



Die Studierenden sind in der Lage, die Komplexität einer digitalen Fahrzeugfunktion, deren Abhängigkeiten und die wesentlichen Kostenfaktoren sowie die größten Fallstricke bei der Realisierung der jeweiligen Funktionalität im automobilen Umfeld zu verstehen. Sie können sich leicht in jedes digitale Fahrzeugprojekt einarbeiten.

Entrance Requirements

Learning Content

- Grundlagen des digitalen und vernetzten Fahrzeugs
- Abhängigkeiten und Komplexität in der Fahrzeugentwicklung
- Methoden des Innovationsmanagements im Automobilsektor
- Nutzerorientiertes Design und Lean Development im Kontext digitaler Fahrzeuge

Teaching Methods

Lehre in Form von seminaristischem Unterricht und Gastvorträgen aus der Automobilbranche.

Hands-On Gruppenarbeiten mit dem Ziel der Erarbeitung neuer Produktideen auf Basis nutzenorientierten Designs.

ASE-02 Digital Car / Innovation Management & Customer Design

Type of Examination

project work



ASE-03 Advanced Driver Assistance Systems

Module code	ASE-03
Module coordination	Prof. Thomas Limbrunner
Course number and name	ASE-03 Advanced Driver Assistance Systems
Lecturer	Prof. Thomas Limbrunner
Semester	1
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	postgraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	Portfolio
Weighting of the grade	5 ECTS
Language of Instruction	English

Module Objective

Students are given a basic overview of the systematics of driver assistance systems and the interaction of the components involved. The aim is to gain an overall system understanding of the topology in the vehicle and to highlight the key aspects of the development and function of driver assistance systems.

Entrance Requirements

Undergraduate studies



Learning Content

- Overview of driver assistance systems (definition, classification of relevant terms, classification, areas of application, legal aspects, NCAP, ...)
- System overview of the vehicle from the perspective of driver assistance, understanding the functional chains, K-matrix, mapping of signals
- Sensor technology, measurement and functional principle, such as camera (mono, stereo), lidar, radar, ultrasound, EGO data
- Central vehicle computer, domain controller, sensor fusion

Note: The content of the course may change over time and will be continuously adapted to current technological developments

Teaching Methods

Seminar based teaching combined with practical blocks, as well as some group work or research with presentation of results

Recommended Literature

- [1] Winner, H.; Hakuli, S.: "Handbuch Fahrerassistenzsysteme"
Springer Vieweg Verlag 2012, 2015, 3. Auflage, ISBN: 978-3-658-05733-6
- [2] Reif, K.: "Automobil Elektronik", Vieweg Verlag 2006, 1. Auflage, ISBN 3-528-03985-X
- [3] Streichert, T.; Traub, M.: "Elektrik/Elektronik Architekturen im Kraftfahrzeug",
Springer Vieweg Verlag 2012, ISBN: 978-3-642-25478-9
- [4] Schäufele, J.; Zurawka, T.: "Automotive Software Engineering",
Vieweg Verlag 2003, ISBN: 3-528-01040-1

ASE-03 Advanced Driver Assistance Systems

Type of Examination

Portfolio



ASE-04 Mobile applications & interaction design in vehicle

Module code	ASE-04
Module coordination	Prof. Dr. Goetz Winterfeldt
Course number and name	ASE-04 Mobile applications & interaction design in vehicle
Lecturer	Prof. Dr. Goetz Winterfeldt
Semester	1
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 90 hours self-study: 60 hours Total: 150 hours
Type of Examination	Portfolio
Language of Instruction	English

Module Objective

ASE-04 Mobile applications & interaction design in vehicle

Type of Examination

Portfolio



ASE-05 Compulsory Language: German or other foreign language

Module code	ASE-05
Module coordination	Tanja Mertadana
Course number and name	ASE-05 Compulsory Language: German or a other foreign language
Lecturer	Dozierende für AWP und Sprachen
Semester	1
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Semester periods per week (SWS)	4
ECTS	4
Workload	Time of attendance: 60 hours self-study: 60 hours Total: 120 hours
Type of Examination	See examination schedule AWP and languages
Language of Instruction	Course dependent
	*Internationale Studierende erhalten ECTS ab der Niveaustufe Deutsch B1/ 1. + 2. Teil. Deutsch-Muttersprachler oder internationale Studierende mit



Deutschkenntnissen der Niveaustufe C1 gemäß dem Gemei

Module Objective

ASE-05 Compulsory Language: German or a other foreign language

Type of Examination

See examination schedule AWP and languages



ASE-06 Compulsory optional subject 1

Module code	ASE-06
Module coordination	Prof. Dr. Andreas Grzemba
Course number and name	ASE-06 Compulsory optional subject 1
Lecturer	Prof. Dr. Andreas Grzemba
Semester	1
Duration of the module	1 semester
Module frequency	annually
Course type	elective course
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 90 hours self-study: 60 hours Total: 150 hours
Type of Examination	Examination form of the chosen module
Language of Instruction	English

Module Objective

ASE-06 Compulsory optional subject 1

Type of Examination

Examination form of the chosen module



ASE-07 Artificial Intelligence and Software Development

Module code	ASE-07
Module coordination	Prof. Dr. Cezar Ionescu
Course number and name	ASE-07 Artificial Intelligence and Software Development
Lecturer	Prof. Dr. Cezar Ionescu
Semester	2
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	Portfolio
Language of Instruction	English

Module Objective

ASE-07 Artificial Intelligence and Software Development

Type of Examination

Portfolio



ASE-08 Automotive Software Engineering

Module code	ASE-08
Module coordination	Prof. Dr. Andreas Wöfl
Course number and name	ASE-08 Automotive Software Engineering
Lecturer	Prof. Dr. Andreas Wöfl
Semester	2
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	written ex. 90 min.
Duration of Examination	90 min.
Language of Instruction	English

Module Objective

ASE-08 Automotive Software Engineering

Type of Examination

written ex. 90 min.



ASE-09 Project

Module code	ASE-09
Module coordination	Prof. Dr. Andreas Grzemba
Course number and name	ASE-09 Project
Lecturer	Prof. Dr. Andreas Grzemba
Semester	2
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Semester periods per week (SWS)	4
ECTS	6
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	Portfolio
Language of Instruction	English

Module Objective

ASE-09 Project

Type of Examination

Portfolio



ASE-10 Compulsory optional subject 2

Module code	ASE-10
Module coordination	Prof. Dr. Andreas Grzemba
Course number and name	ASE-10 Compulsory optional subject 2
Lecturer	Prof. Dr. Andreas Grzemba
Semester	2
Duration of the module	1 semester
Module frequency	annually
Course type	elective course
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	Examination form of the chosen module
Language of Instruction	English

Module Objective

ASE-10 Compulsory optional subject 2

Type of Examination

Examination form of the chosen module



ASE-11 Wireless and Car2X-Communication

Module code	ASE-11
Module coordination	Prof. Dr. Andreas Kassler
Course number and name	ASE-11 Wireless and Car2X-Communication
Lecturer	Prof. Dr. Andreas Kassler
Semester	2
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	postgraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	Portfolio
Weighting of the grade	
Language of Instruction	English

Module Objective

The module learning objective is to understand the fundamental concepts of vehicular networking. Students understand the following concepts and their application:

- explain the principles and limitations of wireless communication with focus on vehicular networking,
- explain important technical aspects of current wireless and vehicular networking technologies,
- explain the principles of medium access control and routing in the context of vehicular networking,
- summarise key functions and principles behind different architectures for wireless and car-2-X communication systems,



- critically evaluate different properties of a car-2-X communication system using vehicular networking simulations.

Entrance Requirements

Students should have basic understanding of computer networks.

Learning Content

The automotive industry is increasingly relying on computer science and wireless communication. The vision of the car of tomorrow is to be fully connected with the environment. Indeed, connected cars have the capabilities to connect not only to the internet but also to other moving cars and infotainment systems. This lecture teaches important concepts from these domains, starting with wireless networks in general (from wireless signal characteristics to propagation of signals and medium access schemes), to wireless network architectures. The lecture then moves to networks of moving cars (from communication technology and system architectures, to the design of advanced traffic information systems, security and safety). Topics include

- Radio signals and propagation
- Coding, modulation, and multiplexing
- Car-2X communication pattern, use cases and requirements
- UMTS, LTE, 5G and their use for car-2X
- 802.11p and WAVE
- IEEE 1609
- ETSI ITS G5
- Broadcast, Geocast, Routing
- Beaconing and Traffic Information systems
- Simulating Car2X systems

Teaching Methods

- Interactive Lectures
- Interactive Exercise Sessions

Recommended Literature

Vehicular Networking by Christoph Sommer and Falko Dressler, published in December 2014 by Cambridge University Press.



Hannes Hartenstein and Kenneth Laberteaux (Eds.), *VANET - Vehicular Applications and Inter-Networking Technologies*, Intelligent Transport Systems, Chichester, United Kingdom, John Wiley & Sons (Wiley), 2010

ASE-11 Wireless and Car2X-Communication

Type of Examination

Portfolio



ASE-12 Automotive Microcontroller

Module code	ASE-12
Module coordination	Prof. Dr. Andreas Grzemba
Course number and name	ASE-12 Automotive Microcontroller
Lecturer	Prof. Dr. Andreas Grzemba
Semester	2
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	Portfolio
Language of Instruction	English

Module Objective

ASE-12 Automotive Microcontroller

Type of Examination

Portfolio



ASE-13 Automotive Communication Architecture (inCar)

Module code	ASE-13
Module coordination	Prof. Dr. Andreas Grzemba
Course number and name	ASE-13 Automotive Communication Architecture (inCar)
Lecturer	Prof. Dr. Andreas Grzemba
Semester	3
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	Portfolio
Language of Instruction	English

Module Objective

ASE-13 Automotive Communication Architecture (inCar)

Type of Examination

Portfolio



ASE-14 Master thesis

Module code	ASE-14
Module coordination	Prof. Dr. Andreas Grzemba
Course number and name	Master's colloquium ASE-14 Master thesis
Lecturer	Prof. Dr. Andreas Grzemba
Semester	3
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Semester periods per week (SWS)	2
ECTS	25
Workload	Time of attendance: 0 hours Total: 0 hours
Type of Examination	colloquium, master thesis
Language of Instruction	English

Module Objective

Master's colloquium

Type of Examination

colloquium



ASE-14 Master thesis

Type of Examination

master thesis

