POZNAN UNIVERSITY OF TECHNOLOGY
EUROPEAN CREDIT TRANSFER AND ACCUMULATION SYSTEM (ECTS)
pl. M. Skłodowskiej-Curie 5, 60-965 Poznań

COURSE DESCRIPTION CARD - SYLLABUS

Course name

PO4: Advanced control systems in electromobility - Computer vision for electromobility

Course

Field of study
Electromobility

Year/Semester
3/5

Area of study (specialization)

Profile of study
general academic

Level of study
First-cycle studies

Course offered in
polish

Form of study
full-time

Requirements
elective

Number of hours

Lecture	Laboratory classes	Other (e.g. online)
15	15	
Tutorials	Projects/seminars	

Number of credit points

2

Lecturers

Responsible for the course/lecturer:
Marek Kraft, Ph.D., Eng.
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Faculty of Control, Robotics and Electrical Engineering
Poznan, Piotrowo 3A

Responsible for the course/lecturer:

Prerequisites

Knowledge: The students should have basic knowledge of mathematics appropriate to the level of study - including, mainly, matrix calculation, knowledge of elements of mathematical logic, basics of mathematical analysis and probabilistics.
Skills: The student should have the ability to operate a PC and implement simple algorithms and programming tasks. Additionally, the ability to obtain information from indicated sources is essential.

Course objective

The aim of the course is to learn the theoretical basis of methods of image acquisition and processing for electromobility applications (ADAS, autonomous vehicles). The student should be able to select an algorithm or a set of algorithms that make up a complete vision system and implement and test such a system on their own.

Course-related learning outcomes

Knowledge

1.Has a structured and theoretically underpinned general knowledge of key IT issues in the field of electromobility, including programming and the use of IT tools in modelling, simulation and design

2. Has a structured knowledge of sensors, security systems, comfort and monitoring and communication with users in technical systems specific to the field of study

Skills

1. Can use literary sources, integrate information obtained, evaluate and interpret it and draw conclusions in order to solve complex and unusual problems in the field of electromobility

2. Can properly choose and use methods and tools, including advanced ICT, and can develop simple applications to simulate, analyse and design layouts specific to the field of study

Social competences

1. Understands the importance of knowledge in solving electromobility problems; is aware of the need to use expert knowledge when solving engineering tasks beyond his/her own competence

2. Is aware of the importance of own work and the need to observe the principles of professional ethics, is ready to submit to the principles of teamwork and to take responsibility for jointly performed tasks, as well as to care for the achievements and traditions of the profession

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture - final credit test carried out on the Moodle plaftorm.

Laboratories - assigned project and final practical colloquium of credit.

Programme content

Image acquisition, image encoding methods, video encoding

Colour spaces and histograms.

Image preprocessing - local methods (gamma correction, histogram-based processing, thresholding, etc.).

Contextual methods - convolution, linear and non-linear filtration; morphological operations.

Detection of image features (lines, points).

Description and matching of features.

Segmentation and analysis of shapes.

Visualon odometry.

Deep convolutional neural networks.

Building blocks of neural networks used in image processing.

Example network architectures for image recognition - principle of operation and discussion on examples.

Neural network training - backpropagation, optimization algorithms, loss function, metrics, training control and monitoring, hyperparameters.

Neural networks for image segmentation - binary, semantic and panoptic segmentation, selected architectures and loss functions.
Neural networks for object detection - the difference between classification and detection, discussion of several architectures (RCNN, YOLO, EfficientDet). Description of loss functions. Networks for detection and segmentation (mask-RCNN, Yolact++).
Practical implementation of the listed algorithms and issues during laboratory classes.

Teaching methods

Lectures with multimedia presentations, additionally uploaded to a streaming service to be played later.
Laboratory classes covering the implementation and testing of selected algorithms of image and video processing using Python and solving selected practical problems

Bibliography

Basic
1. R. Szeliski, Computer Vision: Algorithms and Applications, Springer, 2010
2. S. Raschka, V. Mirjalili: Python. Uczenie maszynowe (2nd ed. or later), Helion

Additional
A selection of scientific articles related to the subject

Breakdown of average student's workload

	Hours	ECTS
Total workload	50	2,0
Classes requiring direct contact with the teacher	30	1,5
Student's own work (literature studies, preparation for laboratory classes/tutorials, preparation for tests/exam, project preparation) [1]	20	0,5

[1] delete or add other activities as appropriate