COURSE DESCRIPTION CARD - SYLLABUS

Course name
Autonomization of vehicles [S1MiBP1>AP]

Course

Field of study
Mechanical and Automotive Engineering

Year/Semester
3/6

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
polish

Form of study
full-time

Requirements
elective

Number of hours

Lecture
30

Laboratory classes
30

Other (e.g. online)
0

Tutorials
0

Projects/seminars
0

Number of credit points

4,00

Coordinators

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Lecturers

Prerequisites

KNOWLEDGE: The student has basic knowledge of computer-aided engineering methods, computer graphics, programming in engineering applications. SKILLS: The student is able to plan and carry out experiments, including measurements and computer simulations, interpret the obtained results and draw conclusions. SOCIAL COMPETENCES: The student is able to interact and work in a group.

Course objective

Getting to know the techniques and applications of computer-aided and virtual engineering in the design of autonomous vehicles. Learning the basic techniques of automatic image processing and analysis, enabling the detection, counting and identification of objects, detection of shapes (e.g. obstacles, specific objects) and determination of their contours, size, position and orientation in space. Mastering the skills of creating software that allows the processing of data from sensors such as cameras and distance sensors. Getting to know the issues of machine vision occurring during the design of autonomous vehicles. Acquiring knowledge about the meaning and possibilities of computer-aided analysis of human-machine interaction (human-machine interface). Acquainting with the basic elements of a computer system of virtual ergonomics and systems of capturing human body movements. Computer-aided design of objects taking into account the user and ergonomic elements using CAD systems, Motion Capture devices, as well as 3D scanning. Planning, preparing and carrying out a computer simulation with the use of virtual ergonomic systems.

Course-related learning outcomes

Knowledge:
M1_W12 Has knowledge of the basics of computer science, i.e. general knowledge of low, medium and high level languages used in computer programming, computer graphics and computer vision methods, operating systems , databases, RAD development environments, and typical engineering applications.
M1_W16/W18 Is aware of the latest trends in machine construction, i.e. the use of modern construction materials, automation and mechatronization, automation of machine design and construction processes. Has elementary knowledge of automation systems, microcontrollers, control algorithms and wireless communication systems. Is aware of the methods leading to increased safety and comfort of operation of machines and vehicles. Has knowledge of the principles of safety and ergonomics in the design and operation of machines. Has a general knowledge of the types of research and methods of testing working machines with the use of modern measurement techniques and data acquisition.
M1_W22 Has elementary knowledge of the impact of technology changes on the organization of social life as well as the health and psyche of individuals in human-machine contact.

Skills:
M1_U04 Can properly use modern equipment for measuring major physical quantities, used in machine research (including ergonomics) and autonomous vehicles.
M1_U14 Can plan and carry out the process of constructing uncomplicated machinery units or machines and formulate requirements for electronic components and automatic control systems in mechatronic systems.
M1_U18 Can use popular packages for editing technical drawings and 3D modeling to the extent enabling the creation of drawing documentation in accordance with applicable drawing standards and models of virtual machines in three-dimensional space.
M1_U26 Can interact with other people as part of teamwork (also of an interdisciplinary nature).

Social competences:
M1_K01 Is ready to critically assess his knowledge and received content.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Learning outcomes presented above are verified as follows:
Assessment of individual work related to the operation of various systems and data processing in specialized software. Oral and written tests. Assessment of individually made projects..

Programme content

Computer (machine) vision - theory and examples of applications; data sources for machine vision, object detection and recognition. Programming languages and numerical libraries. Fundamentals of computational geometry. Basics of work in the OpenCV environment - image transformations, detection of objects and contours, matching simple shapes to drawn contours, identification of shapes. Tracking objects on a video signal. Introduction to data processing and analysis. The basics of machine learning.

Image segmentation for robots and autonomous vehicles.
Discussion of basic concepts and definitions in the field of virtual engineering systems, Motion Capture systems and human computer models. Presentation of the basic functions of virtual analysis of human-machine interaction. Acquainting with the construction of a computer model of a human, simulation of human-machine interaction and posture analysis. Controlling a computer model of a human with the use of a virtual "skeleton". Development of a virtual study plan (scenario), preparation and implementation of a computer simulation using a virtual ergonomic system. Overview of the principles of operation of the Motion Capture system and its use on a project example.

Teaching methods

Lecture using a multimedia presentation, case study, laboratory with elements of project.

Bibliography

Basic
A. Kaehler, G. Bradski. OpenCV 3. Komputerowe rozpoznawanie obrazu w C++ przy użyciu biblioteki OpenCV. Helion, 2017. ISBN: 978-83-283-1656-0
J. Howse. OpenCV Computer Vision with Python. Packt Publishing Limited, 2013. ISBN: 9781782163923
M. Gągolewski, M. Bartoszuk, A. Cena. Przetwarzanie i analiza danych w języku Python. PWN, Warszawa, 2016. ISBN: 9788301189402
Jabłoński J.: Ergonomia produktu. Ergonomiczne zasady projektowania produktów. Wydawnictwo Politechniki Poznańskiej, Poznań 2006
Additional
M. Dawson: Python dla każdego. Podstawy programowania. Helion, 2014. ISBN: 978-83-246-9358-0
Winkler T.: Komputerowo wspomagane projektowanie systemów antropotechnicznych, WNT Warszawa 2005
Jabłoński J.: Ergonomia produktu. Ergonomiczne zasady projektowania produktów. Wydawnictwo Politechniki Poznańskiej, Poznań 2006
Chlebus E.: Techniki komputerowe CAx w inżynierii produkcji, WNT Warszawa 2000

Breakdown of average student's workload

	Hours	ECTS
Total workload	100	4,00
Classes requiring direct contact with the teacher	60	2,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	40	2,00