# COURSE DESCRIPTION CARD - SYLLABUS

Course name
Image Processing and Vision Systems

## Course

Field of study
Automatic Control and Robotics

Year/Semester
1/1

Area of study (specialization)
Control and Robotics Systems

Profile of study
general academic

Level of study
Second-cycle studies

Course offered in
polish

Form of study
full-time

Requirements
compulsory

## Number of hours

| Lecture | Laboratory classes | Other (e.g. online) |
|---|---|---|
| 30 | 30 | 0 |
| **Tutorials** | **Projects/seminars** | |
| 0 | 0 | |

## Number of credit points

3

## Lecturers

Responsible for the course/lecturer:
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Responsible for the course/lecturer:
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## Prerequisites

Knowledge: The student starting this course should have basic knowledge of linear algebra and digital signal processing.

Skills: Should have the ability to use engineering tools for technical calculations, programming and the ability to obtain information from indicated sources. He should also understand the need to expand his competences.

Social Competences: In addition, in terms of social competences, the student should represent attitudes such as honesty, responsibility, perseverance, cognitive curiosity, creativity, personal culture, respect for other people.

## Course objective

1. Provide students basic knowledge of image processing and analysis in the field of image preprocessing, segmentation, recognition and interpretation of image information.

2. Provide students with knowledge about the elements of vision systems, their construction and application in automation and robotics.

3. Developing students ability to choose appropriate image processing methods depending on the problems posed and the ability to apply vision systems in automation and robotics.

## Course-related learning outcomes

### Knowledge

1. has extended and in-depth knowledge of selected mathematics domains necessary to formulate and solve complex tasks in the field of image processing - [K2_W1]

2. has a structured and in-depth knowledge of artificial intelligence methods and their application in automation and robotics systems - [K2_W2]

3. has detailed knowledge of the strutcure and use of vision sensory systems - [K2_W6]

4. has theoretically founded detailed knowledge related to vision control and measurement systems - [K2_W11]

5. knows and understands the principle of human vision - [-]

6. knows and understands the methods of image processing and analysis in the field of image preprocessing, segmentation, recognition and interpretation of image information - [-]

### Skills

1. can use advanced methods of processing and analyzing images obtained from a video signal and extract information from the analyzed signals - [K2_U11]

2. is able to critically assess and select appropriate methods and tools to solve tasks and problems in the field of automation and robotics, using the knowledge of vision systems; can constitute the properties of vision measurement systems - [K2_U22]

### Social competences

1. is aware of the need for a professional approach to technical issues, detailed reading of documentation, knowning environmental conditions in which devices and their components may function, is aware of the responsibility for decisions made - [K2_K4]

2. is aware of the complexity of image processing methods and algorithms and the need for an individual approach to solving tasks and problems - [-]

## Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

In the field of lectures, verification of the assumed learning outcomes is carried out through the assessment of knowledge on the basis of a written multiple choice test with 25-30 questions, to pass 50% of points are required.

In the field of laboratories, verification of learning outcomes is carried out by assessing the skills related to the implementation of laboratory exercises and selected problem tasks, and on the basis of the assessment of the report prepared partly during the classes, and partly after their completion; this assessment also includes teamwork.

## Programme content

The lecture covers the following topics:

Human perception of light. The concept of digital image, image representations, color space models, transformations between models. Image preprocessing and correction techniques: point operations, image histogram, brightness and contrast correction, image thresholding, LUT in point operations. Context operations, image correlation, image filtering in the spatial domain, nonlinear filtering, statistical filters. Morphological transformations in image processing: erosion and dilation, complex operations and image morphological filters. Image processing with frequency methods, image filtering in the frequency domain, cosine transform in image compression. Selected techniques of image segmentation. Basic methods of representation and analysis of shapes in images. Complex image recognition techniques, SIFT algorithm, convolutional neural networks. Camera model and camera calibration procedure. Characteristics of components of vision systems, industrial vision systems and intelligent cameras. Image acquisition techniques, tools for image acquisition and processing. Applications of vision feefback in robotics and control.

Laboratory classes are conducted in the form of fifteen 2-hour exercises, held in the laboratory. Classes are carried out by 2-person teams of students. During the classes, teams carry out laboratory exercises and solve selected problem tasks. The laboratory program covers the following topics:

Types and representations of digital images, color models, conversions between color models. Point operations, determination and manipulation of a histogram, image quality correction, image binarization. Context operations on an image, linear and non-linear image filtering, median filter, logical filtering. Morphological operations in the processing of binary and monochrome images. Image compression using DCT. Image acquisition and marker recognition. Programming of an industrial vision system.

## Teaching methods

1. Lecture: in the form of a presentation with examples using the Matlab package and other applications demonstrating selected image processing methods and vision systems applications

2. Laboratory classes: practical exercises and solving problems by teams

## Bibliography

Basic

1. Gonzalez R.C., Woods R.E., Digital Image Processing, Prentice Hall, SE, 2002

2. Tadeusiewicz R., Korohoda P., Komputerowa analiza i przetwarzanie obrazów, WFPT 1997

3. Malina W., Ablameyko S., Pawlak W., Podstawy cyfrowego przetwarzania obrazów, EXIT

Additional

1. B. Siciliano, O. Khatib (Eds.) Springer Handbook of Robotics, Springer-Verlag 2008

## Breakdown of average student's workload

| | Hours | ECTS |
|---|---|---|
| Total workload | 75 | 3,0 |
| Classes requiring direct contact with the teacher | 60 | 2,5 |
| Student's own work (literature studies, preparation for laboratory classes, laboratory reports preparation, solving problem tasks, preparation to pass the lecture)[1] | 15 | 0,5 |

[1] delete or add other activities as appropriate