



Module name: Vision systems

Academic year: 2013/2014 Code: RMS-1-606-s ECTS credits: 4

Faculty of: Mechanical Engineering and Robotics

Field of study: Mechatronics with English as instruction language Specialty: —

Study level: First-cycle studies Form and type of study: Full-time studies

Lecture language: English Profile of education: Academic (A) Semester: 6

Course homepage: —

Responsible teacher: dr hab. inż. Kohut Piotr (pko@agh.edu.pl)

Academic teachers: dr hab. inż. Kohut Piotr (pko@agh.edu.pl)

Description of learning outcomes for module

MLO code	Student after module completion has the knowledge/ knows how to/is able to	Connections with FLO	Method of learning outcomes verification (form of completion)
Social competence			
M_K001	awareness of the responsibility for own work and readiness to comply with the rules of team work and accepting responsibility for tasks performed collectively	MS1A_K04, MS1A_K05	Presentation, Report, Execution of laboratory classes, Activity during classes, Project, Scientific paper, Participation in a discussion, Involvement in teamwork
Skills			
M_U001	ability to develop documentation related to the completion of an engineering task and prepare text discussing the results of the task, in the form of presentation and reports as well	MS1A_U09, MS1A_U04, MS1A_U03	Presentation, Project, Report, Execution of laboratory classes, Activity during classes, Scientific paper
M_U002	ability to use high-level programming to develop image processing methods and to program vision systems	MS1A_U09, MS1A_U04	Test, Report, Execution of laboratory classes, Activity during classes, Oral answer, Presentation, Project

M_U003	ability to develop image processing algorithms and to program vision systems and sensors as well, to verify its operations experimentally , taking into consideration the required useful criteria and based on using proper methods, techniques and tools	MS1A_U08, MS1A_U07, MS1A_U20, MS1A_U09, MS1A_U12	Test, Report, Execution of laboratory classes, Activity during classes, Oral answer, Presentation, Project, Scientific paper
M_U004	Ability to select appropriate components of vision systems taking into consideration the required useful criteria	MS1A_U12	Project, Report, Execution of laboratory classes, Activity during classes, Test, Oral answer, Presentation, Scientific paper
M_U005	ability to use data sheets and application notes to select appropriate components of the vision systems	MS1A_U01, MS1A_U13	Project, Report, Execution of laboratory classes, Activity during classes, Presentation, Scientific paper
Knowledge			
M_W001	Detailed knowlage of parameters and principle of operation of the selected sensors and vision systems, and basic knowledge of image processing methods	MS1A_W06	Test, Execution of laboratory classes, Report, Activity during classes, Oral answer, Project, Scientific paper
M_W002	well-ordered in current state and recent development trends of sensors and vision systems used in mechatronics and techniques	MS1A_W13	Project, Report, Activity during classes, Presentation, Scientific paper

FLO matrix in relation to forms of classes

MLO code	Student after module completion has the knowledge/ knows how to/is able to	Form of classes										
		Lectures	Auditorium classes	Laboratory classes	Project classes	Conversation seminar	Seminar classes	Practical classes	Others	Fieldwork classes	Workshops	E-learning
Social competence												
M_K001	awareness of the responsibility for own work and readiness to comply with the rules of team work and accepting responsibility for tasks performed collectively	-	-	+	-	-	-	-	-	-	-	-
Skills												

M_U001	ability to develop documentation related to the completion of an engineering task and prepare text discussing the results of the task, in the form of presentation and reports as well	-	-	+	-	-	-	-	-	-	-	-
M_U002	ability to use high-level programming to develop image processing methods and to program vision systems	-	-	+	-	-	-	-	-	-	-	-
M_U003	ability to develop image processing algorithms and to program vision systems and sensors as well, to verify its operations experimentally , taking into consideration the required useful criteria and based on using proper methods, techniques and tools	-	-	+	-	-	-	-	-	-	-	-
M_U004	Ability to select appropriate components of vision systems taking into consideration the required useful criteria	-	-	+	-	-	-	-	-	-	-	-
M_U005	ability to use data sheets and application notes to select appropriate components of the vision systems	-	-	+	-	-	-	-	-	-	-	-
Knowledge												
M_W001	Detailed knowlage of parameters and principle of operation of the selected sensors and vision systems, and basic knowledge of image processing methods	+	-	+	-	-	-	-	-	-	-	-
M_W002	well-ordered in current state and recent development trends of sensors and vision systems used in mechatronics and techniques	+	-	-	-	-	-	-	-	-	-	-

Module content

Lectures

Application of vision systems in mechatronics and techniques. Structure of the vision system and its components characteristics. Role and objectives of a vision systems and its co-operation with mechatronic systems.

Classification of vision technology .

Image formulation, acquisition methods, camera models

Selected image pre-processing methods

Feature detection and tracking methods

Image segmentation and analysis methods
Image features measurement, their representation and appropriate description.
Objects recognition techniques
Camera calibration methods.
Reconstruction techniques of 3D structure and motion
The vision systems of the industrial robots and their programming
Prototyping of image processing algorithms in various development environment and in real time systems
Classification of various visual control systems

Laboratory classes

Image acquisition and processing with the use of openCV libraries, calibration
Image acquisition and processing in Matlab/Simulink environment, calibration
Vision systems of the industrial robots - vision algorithms development and programming. Calibration methods
Objects' reconstruction and motion analysis in 2D and 3D.
Programming of vision sensors and vision systems.
Prototyping of image processing with the use of selected vision libraries and in real time systems.
(Project) Work out of a selected issue/ problem related to vision systems
a) Analysis of current state and selection of a vision sensor (or a vision system) related to a given problem
b) Analysis of current state and work out a given problem with the use of image processing libraries

Method of calculating the final grade

Weighted average marks of laboratory exercises (including colloquium) and project: Assessment of laboratory exercises (including colloquium) (60%) and assessment of a project (40%)

Prerequisites and additional requirements

Knowledge of computer science issues;
Ability to work in a package Matlab / Simulink;
Basics of programming in C;

Recommended literature and teaching resources

Castleman K. R.: Digital Image processing, Prentice Hall, Upper Saddle River, New Jersey, 1996
Gonzales R.C, Woods R.E.: Digital Image Processing using Matlab, Prentice Hall , 2004
Tadeusiewicz R.: Systemy wizyjne robotów przemysłowych, WNT, Warszawa, 1992
Tadeusiewicz R . Korohoda P., Komputerowa analiza i przetwarzanie obrazów, Wyd.FPT, 1997
Hartley R., Zisserman A., Multiple view geometry in computer vision, Cambridge Univ. Press,2003
Jain R., Kasturi R., Schunck B., Machine vision, McGraw-Hill Inc. New York, 1996
Horn B.K.P, Robot Vision, MIT, 1986,
Davies E. R., Computer and Machine Vision: Theory, Algorithms, Practicalities, Academic Press, 2005

Scientific publications of module course instructors related to the topic of the module

Additional scientific publications not specified

Additional information

None

Student workload (ECTS credits balance)

Student activity form	Student workload
Participation in lectures	30 h
Participation in laboratory classes	30 h
Preparation for classes	25 h
Preparation of a report, presentation, written work, etc.	25 h
Completion of a project	10 h
Summary student workload	120 h
Module ECTS credits	4 ECTS