AGH UNIVERSITY OF SCIENCE AND TECHNOLOGY

Module name: Vision techniques

Academic year: 2013/2014 Code: RMS-1-607-s ECTS credits: 4

Faculty of: Mechanical Engineering and Robotics

Field of study: Mechatronics with English as instruction languagege 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, Oral answer, 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 techniques and program vision systems	MS1A_U09, MS1A_U14	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 image processing methods taking into consideration the required useful criteria	MS1A_U08, 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 image processing methods and algorithms	MS1A_U01, MS1A_U13	Project, Report, Execution of laboratory classes, Activity during classes, Presentation, Scientific paper
Knowledge			
M_W001	Detailed knowledge of image processing methods, and basic knowledge of parameters and principle of operation of the selected sensors and vision systems	MS1A_W06	Test, Report, Execution of laboratory classes, Activity during classes, Oral answer, Project, Scientific paper
M_W002	well-ordered in current state and recent development trends of vision systems and vision techniques 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 techniques and 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 image processing methods taking into consideration the required useful criteria	-	-	+	-	-	-	-	-	-	-	-
M_U005	ability to use data sheets and application notes to select image processing methods and algorithms	-	-	+	-	-	-	-	-	-	-	-
Knowledge												
M_W001	Detailed knowledge of image processing methods, and basic knowledge of parameters and principle of operation of the selected sensors and vision systems	+	-	+	-	-	-	-	-	-	-	-
M_W002	well-ordered in current state and recent development trends of vision systems and vision techniques used in mechatronics and techniques	+	-	-	-	-	-	-	-	-	-	-

Module content

Lectures

Basic definitions related to digital image processing. Human’s sense of sight.
Application of vision techniques and systems in mechatronics and techniques.
Structure of the vision system and its components characteristics.
Image acquisition methods and image formulation.
Image pre-processing methods (point and local operation).
Image pre-processing methods (local and global 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.
Motion analysis and reconstruction techniques of 3D object structure.
The vision systems of the industrial robots, their programming and developing of image processing methods.
Software tools and devices for objects reconstruction and motion analysis
Prototyping of image processing algorithms in various development environment and in real time systems

Laboratory classes

Image processing with the use of selected libraries and packages dedicated vision techniques.
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.
Prototyping of image processing algorithms in real time systems.
Objects' reconstruction and motion analysis in 2d and 3D.
(Project) Work out of a selected issue/ problem related to vision techniques.
a) Analysis of current state and selection of vision methods 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 projects: 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 . Korohoda P., Komputerowa analiza i przetwarzanie obrazów, Wyd.FPT, 1997
Wróbel Z., Koprowski R.: Praktyka przetwarzania obrazów w programie Matlab, EXIT, 2005
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
Ma Y., Soatto S., Kosecka J., Sastry S., An Invitation to 3D Vision, Springer-Verlag NY, 2004
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