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
Visualization and processing of medical data

Course

Field of study	Year/Semester
Biomedical Engineering	3/7
Area of study (specialization)	Profile of study
-	general academic
Level of study	Course offered in
First-cycle studies	Polish
Form of study	Requirements
full-time	elective

Number of hours

Lecture	Laboratory classes	Other (e.g. online)
15	15	0
Tutorials	Projects/seminars	
0	0	

Number of credit points

3

Lecturers

Responsible for the course/lecturer:

dr hab. inż. Witold Stankiewicz

email: Witold.Stankiewicz@put.poznan.pl

tel. 665 2167

Wydział Inżynierii Mechanicznej

ul. Jana Pawła II 24, 60-965 Poznań

Prerequisites

KNOWLEDGE: the student has basic knowledge of information technology and biomedical engineering

SKILLS: the student is able to integrate the obtained information and interpret it

SOCIAL COMPETENCES: the student is able to cooperate in a project team, is aware of the responsibility for the tasks performed, understands the need to acquire new knowledge

Course objective

Students gain knowledge about systems and techniques for the visualization and analysis of medical data. They will learn about the basic problems of segmentation and recording of medical imaging data. They will learn selected techniques of data analysis, such as principal component analysis (PCA), support

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vector machines (SVM) and others in the field of machine learning and machine vision, in order to further interpret medical data and create patient-specific 3D tissue models.

Course-related learning outcomes

Knowledge

Has a basic knowledge of computer science that allows to use the basics of algorithmics, compilers and programming languages, multimedia techniques, software and Internet tools, computer-aided engineering systems in biomedical engineering and technology.

Knows the basic methods of techniques and tools in the area of computer graphics, thanks to which he can understand and describe: processing real images into digital form, digital image processing, binary images, methods of creating color images, real image acquisition devices, methods of improving the quality of digital images; knows what the psychology of media coverage is and what animation and virtual reality are for; has knowledge of three-dimensional graphics based on the mathematical foundations of three-dimensional computer graphics, realism in computer graphics - lighting models, textures.

Has detailed knowledge of digital image processing, thanks to which he can describe: images and signals, observations and measurements, digital image processing, image analysis methods, reduction of feature space dimensionality - cluster analysis, classification and recognition; can recognize images; present selected classification problems, IT tools for image processing, analysis and recognition.

Skills

Can use the methods of image analysis and processing to carry out tasks in the field of biomedical engineering.

Can plan computer simulations, interpret the obtained results and draw conclusions. He can use computer aids to solve technical tasks, in particular in the field of visualization and analysis of data from medical imaging, segmentation, registration and detection of shapes and their contours.

Has the ability to self-educate.

Social competences

Understands the need for lifelong learning; can inspire and organize the learning process of other people.

Can properly define priorities for the implementation of a task set by himself or others.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Oral and written tests. Assessment of individually made tasks.

Programme content

Visualisation. Techniques of data presentation - scalar and vector fields, sections, isosurfaces, streamlines / ribbons, glyphs / vectors, volumetric visualization.

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Data sources in medical diagnostics.

Overview of the possibilities of visualization systems on the example of selected software (eg ParaView). Data processing pipeline.

Basics of working in the Python + OpenCV environment. Image transformations.

Detection of objects and contours. Segmentation and registration. Creation of 3D models based on DICOM data.

Low-dimensional (modal) analysis of medical data. Principal Component Analysis (PCA).

Fundamentals of Machine Learning in Biomedical Engineering.

Teaching methods

Information / problem lecture, case study, multimedia presentation, computer lab.

Bibliography

Basic

U. Ayachit. The ParaView Guide. Community Edition. http://paraview.org/paraview-guide/

A. Kaehler, G. Bradski. OpenCV 3. Komputerowe rozpoznawanie obrazu w C++ przy użyciu biblioteki OpenCV. Helion, 2017. ISBN: 978-83-283-1656-0

M. Gągolewski, M. Bartoszuk, A. Cena. Przetwarzanie i analiza danych w języku Python. PWN, Warszawa, 2016. ISBN: 9788301189402

Additional

M. Dawson: Python dla każdego. Podstawy programowania. Helion, 2014. ISBN: 978-83-246-9358-0

B. Menze, G. Langs, Z. Tu, A. Criminisi. Medical Computer Vision. Recognition Techniques and Applications in Medical Imaging. Springer, 2011.

J. Howse. OpenCV Computer Vision with Python. Packt Publishing Limited, 2013. ISBN: 9781782163923

Breakdown of average student's workload

	Hours	ECTS
Total workload	75	3,0
Classes requiring direct contact with the teacher	40	1,5
Student's own work (literature studies, preparation for laboratory classes, preparation for tests, project preparation) [1]	35	1,5

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[1] delete or add other activities as appropriate