COURSE DESCRIPTION CARD - SYLLABUS

Course name
Visualization and processing of medical data [S1IBio1>WiPDM_1]

Course

Field of study
Biomedical 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
15

Laboratory classes
15

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

2,00

Coordinators

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Lecturers

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 of medical data. They will learn about the basic problems of segmentation and registration of medical imaging data. They will learn selected techniques of data processing and analysis, including basics of modal analysis, 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 numerical 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 rendering, methods of improving the quality of digital images; 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, 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:

Test / colloquium and evaluation of tasks performed during the laboratory classes. Points are awarded for both items. The condition for receiving a positive evaluation is obtaining at least 50% of the possible points.

Programme content

Visualisation. Techniques of data presentation. Overview of the possibilities of visualization systems on the example of selected software. Basics of working in the Python environment. Integration with visualization software. Image transformations. Detection of objects and contours. Segmentation and registration. Creation of 3D models based on DICOM data. Fundamentals of Machine Learning.

Course topics

Visualisation. Techniques of data presentation - scalar and vector fields, sections, isosurfaces, streamlines / ribbons, glyphs / vectors, volumetric visualization.
Sources and form of data in visualisation and in medical diagnostics.
Overview of the possibilities of visualization systems on the example of selected software (eg ParaView).
Data processing pipeline.
Visualisation of fluid flows.
Basics of working in the Python environment. Integration with visualization software. Image transformations. Detection of objects and contours. Segmentation and registration. Creation of 3D models based on DICOM data.
Processing and analysis of data in Biomedical Engineering. Modal decomposition on the example of PCA (Principal Component Analysis. Fundamentals of Machine Learning.

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	50	2,00
Classes requiring direct contact with the teacher	30	1,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	20	1,00