

# Medical image analysis algorithms - course description

General information	
Course name	Medical image analysis algorithms
Course ID	12.0-WF-FizD-MIAA-S17
Faculty	<a href="#">Faculty of Physics and Astronomy</a>
Field of study	Physics
Education profile	academic
Level of studies	Second-cycle studies leading to MS degree
Beginning semester	winter term 2020/2021

Course information	
Semester	2
ECTS credits to win	7
Available in specialities	Medical Physics
Course type	obligatory
Teaching language	english
Author of syllabus	<ul style="list-style-type: none"><li>dr hab. Jarosław Piskorski, prof. UZ</li></ul>

Classes forms					
The class form	Hours per semester (full-time)	Hours per week (full-time)	Hours per semester (part-time)	Hours per week (part-time)	Form of assignment
Lecture	30	2	-	-	Exam
Laboratory	30	2	-	-	Credit with grade

## Aim of the course

The aim of the course is to become familiar with basic image analysis algorithms as well as gaining practical skills in medical image analysis.

## Prerequisites

The ability to program with the use of the Python programming language. Basic signal analysis course as well as medical diagnostics and instrumentation course.

## Scope

1. Medical image physics, instrumentation and acquisition
2. 2d and 3d image formation, SNR, CNR (signal-to-noise, contrast-to-noise)
3. Image enhancement algorithms
4. Image feature detection
5. Elements of segmentation techniques
6. Backprojection algorithm and Radon theorem
7. Classification and clustering algorithms
8. Image quality and quality validation

## Teaching methods

Lectures and laboratory exercises, discussions, independent work with a specialized scientific literature in Polish and English, and work with the technical documentation and search for information on the Internet.

## Learning outcomes and methods of theirs verification

Outcome description	Outcome symbols	Methods of verification	The class form
They are able to read a digital image and apply transformation to it	<ul style="list-style-type: none"><li>• <a href="#">K2_W02</a></li><li>• <a href="#">K2_W03</a></li><li>• <a href="#">K2_W05</a></li><li>• <a href="#">K2_U05</a></li><li>• <a href="#">K2_U06</a></li><li>• <a href="#">K2_U10</a></li><li>• <a href="#">K2_K03</a></li></ul>	<ul style="list-style-type: none"><li>• a test</li><li>• an exam - oral, descriptive, test and other</li></ul>	<ul style="list-style-type: none"><li>• Laboratory</li></ul>

Outcome description	Outcome symbols	Methods of verification	The class form
The students can name the most important medical image analysis algorithms. They can apply at least one implementation of such algorithms to a medical image.	<ul style="list-style-type: none"> <li>• <a href="#">K2_W05</a></li> <li>• <a href="#">K2_W06</a></li> <li>• <a href="#">K2_U05</a></li> <li>• <a href="#">K2_U06</a></li> </ul>	<ul style="list-style-type: none"> <li>• a discussion</li> <li>• a test</li> <li>• an exam - oral, descriptive, test and other</li> </ul>	<ul style="list-style-type: none"> <li>• Lecture</li> <li>• Laboratory</li> </ul>
Students are able to independently learn the details of new algorithms and their numerical implementations.	<ul style="list-style-type: none"> <li>• <a href="#">K2_W01</a></li> <li>• <a href="#">K2_W03</a></li> <li>• <a href="#">K2_U07</a></li> <li>• <a href="#">K2_U09</a></li> <li>• <a href="#">K2_U10</a></li> <li>• <a href="#">K2_U14</a></li> <li>• <a href="#">K2_K01</a></li> <li>• <a href="#">K2_K02</a></li> </ul>	<ul style="list-style-type: none"> <li>• a discussion</li> <li>• a test</li> <li>• an exam - oral, descriptive, test and other</li> </ul>	<ul style="list-style-type: none"> <li>• Lecture</li> <li>• Laboratory</li> </ul>
Characteristic feature is the expanding awareness of the need to update the technical knowledge on the available techniques and algorithms.	<ul style="list-style-type: none"> <li>• <a href="#">K2_W04</a></li> <li>• <a href="#">K2_U09</a></li> <li>• <a href="#">K2_U11</a></li> <li>• <a href="#">K2_K01</a></li> <li>• <a href="#">K2_K02</a></li> <li>• <a href="#">K2_K05</a></li> </ul>	<ul style="list-style-type: none"> <li>• a discussion</li> <li>• a test</li> <li>• an exam - oral, descriptive, test and other</li> </ul>	<ul style="list-style-type: none"> <li>• Lecture</li> <li>• Laboratory</li> </ul>
Students expand their ability to acquire knowledge in different ways using a variety of sources	<ul style="list-style-type: none"> <li>• <a href="#">K2_W02</a></li> <li>• <a href="#">K2_W05</a></li> <li>• <a href="#">K2_U05</a></li> <li>• <a href="#">K2_U07</a></li> <li>• <a href="#">K2_U09</a></li> <li>• <a href="#">K2_U10</a></li> <li>• <a href="#">K2_U14</a></li> <li>• <a href="#">K2_K01</a></li> <li>• <a href="#">K2_K02</a></li> <li>• <a href="#">K2_K03</a></li> </ul>	<ul style="list-style-type: none"> <li>• a discussion</li> </ul>	<ul style="list-style-type: none"> <li>• Laboratory</li> </ul>
Students understand the structure of a image analysis algorithm and can apply existing solutions to images.	<ul style="list-style-type: none"> <li>• <a href="#">K2_W02</a></li> <li>• <a href="#">K2_W05</a></li> <li>• <a href="#">K2_U05</a></li> <li>• <a href="#">K2_U06</a></li> <li>• <a href="#">K2_U07</a></li> </ul>	<ul style="list-style-type: none"> <li>• a discussion</li> </ul>	<ul style="list-style-type: none"> <li>• Laboratory</li> </ul>

## Assignment conditions

Lecture: positive evaluation of the test.

Laboratory: positive evaluation of the tests, the execution of the project.

The final evaluation of the laboratory: evaluation of tests of 60%, the assessment of the project 40%.

Before taking the exam the student must be credited with the exercises.

**Final grade:** arithmetic mean of the completion of the lecture and in excercises.

## Recommended reading

[1] Klaus D. Toennies, Guide to Medical Image Analysis: Methods and Algorithms (Advances in Computer Vision and Pattern Recognition) 2012th Edition.

[2] Atam P. Dhawan, Medical Image Analysis 2nd Edition

## Further reading

[1] Kathy McQuillen Martensen, Radiographic Image Analysis, 4e 4th Edition.

## Notes

Modified by dr hab. Piotr Lubiński, prof. UZ (last modification: 09-06-2020 22:34)

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