GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Methods of Reconstruction and Analysis of Images, PG_00068237		
Field of study	Biomedical Engineering		
Date of commencement of studies	October 2025	Academic year of realisation of subject	2027/2028
Education level	first-cycle studies	Subject group	Optional subject group Subject group related to scientific research in the field of study
Mode of study	Full-time studies	Mode of delivery	at the university
Year of study	3	Language of instruction	Polish
Semester of study	6	ECTS credits	2.0
Learning profile	general academic profile	Assessment form	exam
Conducting unit	Department of Biomedical Engineering -> Faculty of Electronics Telecommunications and Informatics -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Artur Poliński	
	Teachers	dr Tomasz Neumann dr inż. Artur Poliński dr inż. Anna Węsierska	

Lesson types

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	15.0	0.0	15.0	0.0	0.0	30

E-learning hours included: 0.0

Learning activity and number of study hours

Learning activity	Participation in didactic classes included in study plan	Participation in consultation hours	Self-study	SUM
Number of study hours	30	3.0	17.0	50

Subject objectives

The aim of the course is to familiarize students with selected issues related to image reconstruction and analysis.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K6_U12] can analyze the operation of components, circuits and systems related to the field of study, as well as measure their parameters and examine technical specifications, and plan and conduct experiments related to the field of study, including computer simulations and measurements, and interpret obtained results and draw conclusions	The student is able to conduct selected computer simulations.	[SU1] Assessment of task fulfilment
[K6_W04] knows and understands, to an advanced extent, the principles, methods and techniques of programming and the principles of computer software development or programming devices or controllers using microprocessors or programmable elements or systems specific to the field of study, and organisation of systems using computers or such devices	The student knows selected methods of image analysis	[SU1] Assessment of task fulfilment

Subject contents

Course content – lecture
Lecture

1. Forward Problem (FP): Definition and Examples in Medical Imaging
2. Reconstruction Quality Metrics in Inverse Problems (IP)
3. Existence, Uniqueness, Conditioning, and Stability of Inverse Problems
4. Linear Models in Forward and Inverse Problems with Examples. Radon and Fourier Transforms as Linear Operators
5. Image Reconstruction Methods in CT Overview
6. CT Reconstruction Methods Back Projection (BP)
7. The Fourier Slice Theorem
8. CT Reconstruction Methods Filtered Back Projection (FBP)
9. CT Reconstruction Methods Algebraic Methods
10. Statistical Methods of CT Image Reconstruction
11. MLEM Algorithm (Maximum Likelihood Expectation Maximization)
12. Model-Based CT Image Reconstruction Methods
13. CT Image Reconstruction Methods Using Deep Learning Techniques
14. Inverse Problem and Image Reconstruction Methods in MRI
15. Reconstruction in parallel measurement systems
16. Dynamic and activity examinations
17. FMRI-reconstruction and properties
18. Brain in dymanic MRI and CT
19. Parametric images synthesis in brain perfusion evaluation
20. Fusion of multimodal images
21. Description and analysis of images
22. Selected issues in image classification
23. Representation of regions and contours
24. Parametrization and descriptors, descritpors of geometrical properties
25. Parametrization and descriptors, statistical moments
26. Parametrization and descriptors, intensity abd colour descriptors
27. Parametrization and descriptors, texture descriptors
28. Feature space reduction
29. Application of artificial intelligence in image analysis

Laboratory

1. Image reconstruction in tomography

2. Image segmentation and analysis using mathematical morphology

3. Multimodal image overlay

4. Parametric image synthesis

5. Descriptive description of color, texture and shape

Prerequisites and co-requisites

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Laboratory	51.0%	60.0%
exam	51.0%	40.0%

Recommended reading

Basic literature	B.H. Brown i inn. Medical physics and biomedical engineering, IOP, 2001, L. Chmielewski, J.K. Kulikowski, A. Nowakowski, Biocybernetyka i Inż. Biomed. 2000, t. 8, Obrazowanie Biomedyczne, Exit, 2003 R. B.Buxton, Introduction to functional magnetic resonance imaging, Cambridge University Press, 2002 Z.-H. Cho, J.P. Jones, M.Singh, Foundations of medical imaging, J.Wiley&Sons, 1993
Supplementary literature	No requirements
eResources addresses	

Example issues/ example questions/ tasks being completed

Practical activites within the subject

Not applicable

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