GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Digital Image Processing Methods in Remote Sensing, PG_00063911						
Field of study	Informatics						
Date of commencement of studies	February 2025		Academic year of realisation of subject	2024/2025			
Education level	second-cycle studies		Subject group	Optional subject group Specialty 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	1		Language of instruction	Polish			
Semester of study	1		ECTS credits	4.0			
Learning profile	general academic profile		Assessment form	assessment			
Conducting unit	Department of Geoinformatics -> Faculty of Electronics, Telecommunications and Informatics						
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. Marcin Ciecholewski					
	Teachers	dr hab. Marcin Ciecholewski					
Lesson types and methods of instruction	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		8.0	62.0	100	
Subject objectives	The aim of the course is to familiarise students, both theoretically and practically, with the methods and algorithms ofdigital image processing in remote sensing using optical and radar apparatus.						

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_W10] knows and understands, to an increased extent, the basic processes occurring in the life cycle of equipment, objects and technical systems, as well as methods of supporting processes and functions, specific to the field of study	The student knows and understands the principles of software using digital image processing. The student understands the interrelationships between the processing steps.	[SW1] Assessment of factual knowledge
[K7_W03] knows and understands, to an increased extent, the construction and operating principles of components and systems related to the field of study, including theories, methods and complex relationships between them and selected specific issues - appropriate for the curriculum	The student is able to explain the operation of digital image processing algorithms and methods. Including being able to give the advantages and limitations of the presented approaches.	[SW1] Assessment of factual knowledge
[K7_U07] can apply advanced methods of process and function support, specific to the field of study	The student is able to use advanced libraries during the development of proprietary software.	[SU4] Assessment of ability to use methods and tools
[K7_U04] can apply knowledge of programming methods and techniques as well as select and apply appropriate programming methods and tools in computer software development or programming devices or controllers using microprocessors or programmable elements or systems specific to the field of study, making assessment and critical analysis of the prepared software as well as a synthesis and creative interpretation of information presented with it	Students is be able to write, run and test programmes implementing algorithms and methods for processing digital images.	[SU1] Assessment of task fulfilment

Subject contents

1 Introduction to imaging methods used in remote sensing. 2. Point transformations of digital images 3. Filtering: convolution and discrete correlation.4. Noise in optical and radar images, methods of reducing noise: filtering based on arithmetic and geometric mean, median filtering, adaptive filtering. 5. Methods and applications of mathematical morphology for greyscale and binary images: noise reduction, edge and shape extraction, image reconstruction. 6.Gradient approximation methods in digital images. 7.Application of gradient methods in shape extraction in digital images. 8.Selected topics in segmentation of digital images as applied to remote sensing: global and local binarization methods, area growing method, segmentation using clustering and superpixels, segmentation using graph cuts, watershed segmentation.

Prerequisites and co-requisites

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Collection of laboratory tasks	50.0%	50.0%
Written colloquium	50.0%	50.0%

Recommended reading

Basic literature	1. Gonzalez R.C., Woods R.E.: Digital Image Processing, 4rd ed.,Pearson, 2018. 2. Parker, Jim R. *Algorithms for image processing and computer vision*. John Wiley & Sons, 2010. 3. Szeliski, R. (2022). Image Processing. In: Computer Vision. Texts in Computer Science. Springer, Cham 4. Serra, J., & Soille, P. (Eds.). (2012). *Mathematical morphology and its applications to image processing* (Vol. 2). Springer Science & Business Media.
Supplementary literature	No requirements.
eResources addresses	Adresy na platformie eNauczanie:

Example issues/ example questions/ tasks being completed	1. Explain and derive relationships for point operations in digital images such as equalization, normalization and histogram adjustment.2. Computationally efficient algorithms for determining dilation and erosion for binary and greyscale images.3. Implement morphological reconstruction methods for binary and greyscale images.4. Give global and local binarization methods and explain their operation. For which image classes is it best toapply the specified methods?5 Explain the operation of k-means and superpixel methods for segmentation of digital images.6. Implement and compare the results of watershed segmentation and graph cut methods.
Work placement	Not applicable

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