



Subject card

Subject name and code	Advanced Methods of Point Cloud Processing, PG_00069056						
Field of study	Geodesy and Cartography						
Date of commencement of studies	February 2026		Academic year of realisation of subject		2026/2027		
Education level	second-cycle studies		Subject group				
Mode of study	Full-time studies		Mode of delivery		at the university		
Year of study	1		Language of instruction		Polish		
Semester of study	2		ECTS credits		3.0		
Learning profile	general academic profile		Assessment form		assessment		
Conducting unit	Department of Geodesy -> Faculty of Civil and Environmental Engineering -> Faculties of Gdańsk University of Technology						
Name and surname of lecturer (lecturers)	Subject supervisor		dr hab. inż. Paweł Dąbrowski				
	Teachers						
Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	0.0	30.0	0.0	0.0	45
	E-learning hours included: 0.0						
	eNauczanie source addresses: Moodle ID: 8223 Zaawansowane metody przetwarzania chmur punktów https://enauczanie.pg.edu.pl/2025/course/view.php?id=8223						
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	45		0.0		0.0	45
Subject objectives	Students learn point cloud processing methods. They learn the mathematical foundations of algorithms for estimating object parameters in a three-dimensional coordinate system. They learn how to register (merge) point clouds. They learn how to evaluate the shape and deformation of symmetrical objects using Point Cloud Spatial Expansion method (PCSE). Students develop software in Python.						
Learning outcomes	Course outcome		Subject outcome		Method of verification		
	[K7_W05] has a well-established knowledge of analytical methods and surveying techniques necessary for creating and solving a variety of problems in geodesy and cartography		Student knows the methods of point clouds processing for surveying and construction purposes.		[SW1] Assessment of factual knowledge [SW2] Assessment of knowledge contained in presentation [SW3] Assessment of knowledge contained in written work and projects		
	[K7_U06] creates solutions to complex and unstructured problems taking into account the variability of the environment by synthesising information from different sources, using analytical and simulation methods		The student is able to indicate ways to solve engineering problems related to point clouds and create software.		[SU1] Assessment of task fulfilment [SU2] Assessment of ability to analyse information [SU3] Assessment of ability to use knowledge gained from the subject [SU4] Assessment of ability to use methods and tools [SU5] Assessment of ability to present the results of task		
Subject contents	Course content – lecture						
	Terrestrial laser scanning technology. Properties of point clouds. Least squares method. Singular value decomposition. Principal component analysis. Point cloud registration methods. Point cloud spatial expansion method.						
	Course content – laboratory						
	Matrix algebra. Singular value decomposition. Rotation matrices. Point cloud registration using the reference points method, the iterative method, and the least squares method. Verticalization of point clouds. Expanding point clouds of symmetrical objects using the PCSE method. Determining surface deformations. Geometric analyses in point clouds.						

Prerequisites and co-requisites	Basic Python programming. Knowledge of analytic geometry and matrix algebra.		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Exam	60.0%	50.0%
	Test	60.0%	25.0%
	Projects	80.0%	25.0%
Recommended reading	Basic literature	Zbigniew Wiśniewski - Rachunek wyrównawczy w geodezji (z przykładami). Wydawnictwo Uniwersytetu Warmińsko - Mazurskiego (2016) Paweł Dąbrowski - Przestrzenne rozwinięcia chmur punktów. Podstawy teoretyczne oraz przykłady aplikacyjne. Wydawnictwo Politechniki Gdańskiej (2024) George Vosselman, Hans-Gerd Maas - Airborne and Terrestrial Laser Scanning Whittles Publishing (2010)	
	Supplementary literature	Jerzy Gaździcki - Leksykon Geomatyczny. Polskie Towarzystwo Informacji Przestrzennej (2003) Jie Shan J. & Toth C.K. Topographic Laser Ranging and Scanning Principles and Processing, Second Edition (2018) Riveiro B. & Lindenberg R. Laser scanning an emerging technology in structural engineering (2019) Koch K.R. - Parameter Estimation and Hypothesis Testing in Linear Models (1996)	
	eResources addresses		
Example issues/ example questions/ tasks being completed	Decomposing a rotation matrix using the SVD method and determining rotation angles. Fitting a plane to a set of points using the least squares method. Iterative registration of point clouds. Estimating room volume based on registered point clouds. Creating a spatial unfolding of the point cloud and assessing surface deformation of a symmetrical object.		
Practical activities within the subject	Not applicable		

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