GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	, PG_00069056		
Field of study	Zaawansowane metody przetwarzania chmur punktów		
Date of commencement of studies	February 2025	Academic year of realisation of subject	2025/2026
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 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 -> Wydziały Politechniki Gdańskiej		
Name and surname of lecturer (lecturers)	Subject supervisor	dr 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: 1843 Zaawansowane Metody Przetwarzania Chmur Punktów 2025-2026
https://enauczanie.pg.edu.pl/2025/course/view.php?id=1843

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_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.	[SU5] Ocena umiejętności zaprezentowania wyników realizacji zadania [SU4] Ocena umiejętności korzystania z metod i narzędzi [SU3] Ocena umiejętności wykorzystania wiedzy uzyskanej w ramach przedmiotu [SU2] Ocena umiejętności analizy informacji [SU1] Ocena realizacji zadania
[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.	[SW3] Ocena wiedzy zawartej w opracowaniu tekstowym i projektowym [SW2] Ocena wiedzy zawartej w prezentacji [SW1] Ocena wiedzy faktograficznej

Subject contents

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.

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.

<table>
<tr><td>Assessment methods and criteria</td><td colspan="2"><table>
<tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr>
<tr><td>Projects</td><td>80.0%</td><td>25.0%</td></tr>
<tr><td>Test</td><td>60.0%</td><td>25.0%</td></tr>
<tr><td>Exam</td><td>60.0%</td><td>50.0%</td></tr>
</table></td></tr>
<tr><td rowspan="3">Recommended reading</td><td>Basic literature</td><td>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)</td></tr>
<tr><td>Supplementary literature</td><td>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. & Lindenbergh R. Laser scanning an emerging technology in structural engineering (2019)
Koch K.R. - Parameter Estimation and Hypothesis Testing in Linear Models (1996)</td></tr>
<tr><td>eResources addresses</td><td></td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td colspan="2">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.</td></tr>
<tr><td>Practical activites within the subject</td><td colspan="2">Not applicable</td></tr>
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