Methods of 3D visualisation in CAD

Course description sheet

Basic information

Field of study Geospatial Computer Science **Major** - **Organisational unit** Faculty of Geo-Data Science, Geodesy, and Environmental Engineering **Study level** First-cycle (engineer) programme **Form of study** Full-time studies **Profile** General academic	**Didactic cycle** 2023/2024 **Course code** DIGPS.li20.14173.23 **Lecture languages** English **Mandatoriness** Elective **Block** Elective Modules in Foreign Language **Course related to scientific research** Yes

Course coordinator	Paulina Lewińska
Lecturer	Paulina Lewińska

Period	**Method of verification of the learning outcomes**	**Number of ECTS credits**
Semester 6	Completing the classes **Activities and hours** Lectures: 10 Workshop classes: 20	3

Goals

C1	Allowing the students to learn various 3D modeling techniques

Course's learning outcomes

Code	Outcomes in terms of	Learning outcomes prescribed to a field of study	Methods of verification
Knowledge – Student knows and understands:			
W1	Knows how to create basic 3D models	GI1A_W04, GI1A_W07	Case study, Confirmation of completion of practical placement programme
W2	Knows how to create mesh models	GI1A_W01, GI1A_W03, GI1A_W07	Case study, Confirmation of completion of practical placement programme
Skills – Student can:			
U1	Clean a point cloud (taking away unnecessary or mistaken information), create resections and extract important elements. He is capable of visualizing results both as a 3D visualization and 3D animation.	GI1A_U04, GI1A_U07, GI1A_U08	Case study, Confirmation of completion of practical placement programme
U2	Create a wireframe model and/or mesh type model basing on TLS point clouds or SfM data	GI1A_U04, GI1A_U07, GI1A_U14	Case study, Confirmation of completion of practical placement programme
Social competences – Student is ready to:			
K1	Working in a team on 3D projects. They are capable of fulfilling their tasks as a team. Student is capable of using internet and software English tutorials in order to find additional data	GI1A_K02, GI1A_K03, GI1A_K04	Case study, Confirmation of completion of practical placement programme

Program content ensuring the achievement of the learning outcomes prescribed to the module

As part of the course, the student will acquire the ability to use terrestrial laser scanners products and dedicated software, both at the level of registration and preliminary data processing. They will also become familiar with the methods of making 3D models in Bentley Microstation.

Student workload

Activity form	Average amount of hours* needed to complete each activity form
Lectures	10
Workshop classes	20
Contact hours	5
Examination or final test/colloquium	2
Preparation for classes	20
Realization of independently performed tasks	10
Preparation of project, presentation, essay, report	10

Student workload	Hours 77
Workload involving teacher	Hours 30

* hour means 45 minutes

Program content

No.	Program content	Course's learning outcomes	Activities
1.	Introduction to laser scanning: Planning of laser scanning survey, types of products, limitations. Information on how a survey of chosen object (a building) should take place. Choose of the instruments and methods of connecting scans. SfM algorithms – how to do a SfM survey.	W1, U1	Workshop classes
2.	Introduction to laser scanning. Information on specifics of file formats containing point clouds. Usage of commercial and free software for transforming formats of point clouds. Introduction to 3D modelling, examples of wireframe models. Means of obtaining 3D models from discreet data and from point clouds. Editing 3D wireframe models. Usage of build-in textures in modelling software. Editing existing textures. Methods of creating realistic textures. Introduction to MicroStation and Pointools. Animations. Introduction to SfM	W1, W2, U1, U2, K1	Lectures
3.	Obtaining spatial data with laser scanning: Laser scanning survey, connecting point clouds. Survey of additional surrounding objects. Obtaining discreet data, including edges of buildings, windows, doors or similar. Simultaneous SfM survey.	U1	Workshop classes
4.	Introduction to point cloud formats, preparation of point clouds.: Changing the format of the obtained point cloud with regard to the size of the point cloud capabilities of computers amount of information colour and intensity. Elimination unnecessary information from obtained cloud. Introduction to Pointools. Creating a 3D animation of a point cloud.	U1	Workshop classes
5.	Analyse of obtained 3D data: Introduction to Bentley MicroStation and Pointools. Inputting coordinates obtained data in to 3D MicroStation layout. Isolating data, means of visualisation. Basic animation modules. Introduction to open source software for creating animations. Mesh models. SfM versus TLS point cloud.	W1, W2, U1, U2, K1	Lectures
6.	Creating a wireframe model.: Creating a 3D model basing on data from survey and point cloud. Comparing the results.	W2, U1, U2	Workshop classes
7.	Textures: Texturizing the wireframe model with the use of standard textures. Editing and creating individual textures.	U1, U2	Workshop classes
8.	Visualisation of the results: Creating animation of a 3D model.	K1	Workshop classes

Extended information/Additional elements

Teaching methods and techniques :

Project Based Learning, Group work, E-learning

Activities	Methods of verification	Credit conditions
Lectures	Confirmation of completion of practical placement programme	
Workshop	Case study	

Method of determining the final grade

Evaluation of the presentation

Manner and mode of making up for the backlog caused by a student justified absence from classes

Additional task

Prerequisites and additional requirements

Basic knowledge on TLS (terrestrial lasers scanning products) and SfM (Structure-from-Motion) products.

Rules of participation in given classes, indicating whether student presence at the lecture is obligatory

The student must be present at the practical classes

Literature

Obligatory

1. http://www.bentley.com/en-US/Promo/Pointools/videos.htm
2. http://communities.bentley.com/

Optional

1. HBIM (heritage Building Information Modell) of the Wang Stave Church in Karpacz : case study / Dominika Sztwiertnia, Agnieszka OCHAŁEK, Alicja TAMA, Paulina LEWIŃSKA // International Journal of Architectural Heritage ; ISSN 1558-3058. — 2021 vol. 15 no. 5, s. 713–727

Scientific research and publications

Research

1. Methods of data integration and 3D models integration

Publications

1. Analiza metody konstruowania quadratur w Kościele Przemienienia Pańskiego w Krakowie na podstawie materiałów uzyskanych ze skanera laserowego — Analysis of method of constructing quadrature in the Church of the Transfiguration in Cracow on the basis of data obtained by laser scanner / Pałka Ada, LEWIŃSKA Paulina, Kubiak Sławomir // W: Badania i rozwój młodych naukowców w Polsce : architektura, T. 1 / red. nauk. Jędrzej Nyćkowiak, Jacek Leśny. — Poznań : Młodzi Naukowcy, 2015. — (Monografie ; 2015 (1)). — ISBN
2. A usage of 3D modeling for visualizing problems with GPS measurements on urbanized area / Paulina LEWIŃSKA // Geomatics and Environmental Engineering ; ISSN 1898-1135. — Tytuł poprz.: Geodezja oraz Inżynieria Środowiska. — 2010 vol. 4 no. 1/1, s. 101–106. — Bibliogr. s. 106.
3. HBIM (heritage Building Information Modell) of the Wang Stave Church in Karpacz : case study / Dominika Sztwiertnia, Agnieszka OCHAŁEK, Alicja TAMA, Paulina LEWIŃSKA // International Journal of Architectural Heritage ; ISSN

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Learning outcomes prescribed to a field of study

Code	Content
GI1A_K02	jest gotów do aktywnego i kreatywnego współdziałania w zespole
GI1A_K03	rozumie potrzebę popularyzowania korzystania przez społeczeństwo z danych i danych przestrzennych
GI1A_K04	ma świadomość dynamicznego rozwoju i postępu w dziedzinie geoinformatyki oraz znaczenia i roli danych w rozwoju społeczeństwa informacyjnego
GI1A_U04	potrafi formułować i rozwiązywać zadania przestrzenne, posługując się zaawansowanymi funkcjami analitycznymi, w tym implementować adekwatne algorytmy obliczeniowe dla danych
GI1A_U07	umie komunikatywnie prezentować wyniki analiz stosując raporty, grafiki, wizualizacje i metody kartograficzne
GI1A_U08	potrafi wykorzystać metody analityczne, symulacyjne oraz eksperymentalne do formułowania i rozwiązywania zadań inżynierskich
GI1A_U14	potrafi pracować indywidualnie i w zespole; umie oszacować czas potrzebny na realizację zleconego zadania; potrafi opracować i zrealizować harmonogram prac zapewniający dotrzymanie terminów
GI1A_W01	ma uporządkowaną wiedzę w zakresie matematyki, obejmującą algebrę liniową, analizę, geometrię analityczną, logikę, rachunek prawdopodobieństwa, statystykę, w tym metody matematyczne i metody numeryczne, niezbędne do formalnego opisu i analizy problemów algorytmicznych i ich rozwiązań oraz opisu i analizy działania systemów informatycznych w aspekcie oprogramowania
GI1A_W03	ma podstawową wiedzę z zakresu nauk o ziemi i nauk technicznych pozwalającą na zrozumienie, opis i analizę wybranych zjawisk
GI1A_W04	zna podstawowe zasady pozyskania i źródła danych przestrzennych oraz środowiskowych
GI1A_W07	ma podstawową wiedzę w zakresie konstruowania algorytmów z wykorzystaniem technik algorytmicznych oraz analizy złożoności algorytmów