COURSE DESCRIPTION CARD - SYLLABUS

Course name
REVERSE ENGINEERING - 3D SCANNING AND DATA PROCESSING [S5IMECH>IOSPD]

Course

Proposed by Discipline
–

Year/Semester
3/6

Level of study
Doctoral School

Course offered in
English

Form of study
full-time

Requirements
elective

Number of hours

Lecture
8

Laboratory classes
0

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

2,00

Coordinators

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Lecturers

Prerequisites

Knowledge: It has a basic knowledge of the following methods: computer aided design - CAD, solid modelling of construction in CAD systems, the basic measurement methods in the field of geometric metrology. Skills: He can plan and carry out measurements, computer simulations and interpreted the results. Social competencies: Understands the need to learn and acquire new knowledge.

Course objective

Acquiring knowledge of the importance and applications of reverse engineering. Introduction to basic methods of three-dimensional scanning of biological and organic objects (e.g. the human body). Introduction to three-dimensional scanning of machine components. Learning methods for processing and manipulating acquired measurement data using specialized reverse engineering software.

Course-related learning outcomes

Knowledge:
Knows the modern methods of engineering computer graphics and the theoretical foundations of engineering calculations using the finite element method. P8S_WG / SzD_W01
Has general knowledge about the types of tests and methods of testing working machines using modern measuring techniques and data acquisition. P8S_WG / SzD_W01
Has structured, theoretically based knowledge of the use of information systems in the design of machines

and technological processes. P8S_WG / SzD_W02
Has detailed knowledge of metrology and measurement systems. P8S_WG / SzD_W02

Skills:
Is able to carry out basic measurements of mechanical quantities on the tested working machine using modern measuring systems. P8S_UW / SzD_U01
Is able to select and apply modeling methods in design for their practical engineering applications. P8S_UW / SzD_U01
Is able to use IT systems in the design of machines and technological processes relevant to mechanics and machine construction. P8S_UW / SzD_U01
Is able to use CAx systems to design machines and simulate engineering issues. P8S_UW / SzD_U01

Social competences:
Is ready to critically assess knowledge and received content. P8S_KK / SzD_K01
Correctly identifies and resolves dilemmas related to the profession. P8S_KK / SzD_K03
Understands the need for lifelong learning; can inspire and organize the learning process of other people. P8S_KO / SzD_K04, SzD_K05

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Final assessment of theoretical knowledge – written form, duration 1.5 hours. The test is conducted after the entire cycle of classes. It covers at least three areas of topics: basic definitions related to reverse engineering, measurement methods used in 3D scanners, the construction and operating principles of a selected spatial scanner (based on the measurement method), methods of 3D geometry reconstruction based on data obtained from 3D scanners. Individual elements of the test are assessed on a point scale. To pass the course, students must obtain at least 50% of the total number of points.
The assessment of individual work related to the operation of a selected 3D scanning system, in particular optical methods (laser or structured light), is based on the completion of at least one full process of measurement data acquisition and the conversion of a point cloud into a triangular surface mesh with texture overlay.
The following grading scale is used to assess learning outcomes:
above 50% - 60.0%: 3.0
above 60% - 70.0%: 3.5
above 70% - 80.0%: 4.0
above 80% - 90.0%: 4.5
above 90% - 100%: 5.0

Programme content

Presentation of basic terms and definitions in the field of reverse engineering.
Presentation of the classification and types of 3D scanners based on the measurement method, operating range, and special purpose.
Presentation of the construction and operating principles of 3D scanners: contact, laser, and structured light.
Introduction to techniques for measuring industrial components using a laser scanner and biological objects (e.g., the human body) using a structured light scanner.
Presentation to students of the process of reconstructing the geometry of scanned objects depending on the type of data obtained.

Course topics

Lecture 1 Introduction to 3D scanning – presentation of basic terms and definitions in the field of reverse engineering and 3D scanning. Presentation of the classification and types of 3D scanners based on the measurement method, operating range, and special purpose. Presentation of the structure and operating principles of 3D scanners: contact, laser, and structured light.
Lecture 2 - Construction and operating principle of a three-dimensional structured light scanner - measurement examples, advantages and disadvantages, measurement limitations.
Lecture 3 - Design and operating principle of a high-aqquracy three-dimensional laser scanner - measurement examples, advantages and disadvantages, measurement limitations.

Lecture 4 - Processing measurement data into a CAD model - introducing students to the process of reconstructing the geometry of scanned objects, depending on the type of measurement data obtained.

Teaching methods

1. Lecture with multimedia presentation.
2. Practical presentation of the use of 3D scanners and specialized reverse engineering software, completion of individual measurement tasks specified by the teacher in the field of mechanical and biological objects (e.g., human body parts).

Bibliography

Basic:
1. Chlebus. E.: Techniki komputerowe CAx w inżynierii produkcji, WNT Warszawa 2000
2. Jakubiec W., Malinowski J.: Metrologia wielkości geometrycznych, WNT Warszawa 2007
3. Butowtt J., Kaczyński R.: Fotogrametria, Wojskowa Akademia Techniczna 2003
4. Gary Confalone, Brett Ellis, John Belding: 3D Scanning for Advanced Manufacturing, Design, and Construction, John Wiley and Sons Ltd, 2023

Additional:
Lecture materials and other thematic articles provided by the lecturer.

Breakdown of average student's workload

	Hours	ECTS
Total workload	50	2,00
Classes requiring direct contact with the teacher	8	0,00
Doctoral student's own work (literature studies, preparation for laboratory classes/tutorials, preparation for tests/exam, project preparation)	42	2,00