CS-446

Digital 3D geometry processing

Pauly Mark

Cursus	Sem.	Type
Computational science and Engineering	MA1, MA3	Opt.
Computer science	MA1, MA3	Opt.
Digital Humanities	MA1	Opt.
SC master EPFL	MA1, MA3	Opt.

Language of teaching	English
Credits	5
Session	Winter
Semester	Fall
Exam	Written
Workload	150h
Weeks	14
Hours	**4 weekly**
Courses	2 weekly
Exercises	1 weekly
Project	1 weekly
Number of positions	

Summary

Students study & apply core concepts and algorithms for digital geometry processing & 3D content creation. They create their own digital and physical geometry in a group project that follows the digital 3D content creation pipeline from data acquisition, geometry processing, to physical fabrication.

Content

The course will follow the digital 3D content creation pipeline. We will first discuss the fundamentals of geometry representations and cover continuous and discrete differential geometry concepts. Polygon mesh representations will be at the center of our investigations. We derive the core processing methods for triangle meshes, such as surface smoothing, parameterization, remeshing or deformation. Besides the mathematical concepts and algorithmic foundations, the course puts strong emphasis on implementation and features an extensive project. For the project, students will scan their own 3D models, edit and enhance them with geometry processing algorithms, and finally map their geometric models to digital fabrication processes (3D printing, laser cutting) to create physical realizations of their models.

Keywords

geometry, 3D modeling, polygon meshes, digital fabrication

Learning Prerequisites

Required courses

Linear Algebra, Calculus, Programming

Recommended courses

Introduction to Computer Graphics

Learning Outcomes

By the end of the course, the student must be able to:

- Explain and contrast fundamental geometry representations
- Explain and apply basic concepts from discrete differential geometry
- Analyze the 3D content creation pipeline and understand its limitations
- Implement and evaluate basic geometry processing algorithms, such as smoothing, remeshing, deformation, and constructive solid geometry
- Create digital 3D models from photographs and process the acquired raw geometry to build physical prototypes

- Coordinate a team during a software project

Teaching methods

Lectures, interactive demos, theory and programming exercises, programming project, project tutoring

Expected student activities

The student are expected to study the provided reading material and actively participate in class. They should prepare and resolve the exercises, prepare and carry out the programming project. Exercises in the first half of the course are done in groups of three students. For the second half of the course, the project is done in larger teams.

Assessment methods

Exercises (20%), project (40%), final examination (40%)

Supervision

Office hours	Yes
Assistants	Yes
Forum	Yes

Resources

Bibliography

A list of books will be provided at the beginning of the class

Ressources en bibliothèque

- Polygon Mesh Processing / Botsch

Notes/Handbook

Slides and online resources will be provided in class

Websites

- http://lgg.epfl.ch/DGP