CS-457 **Geometric computing**

Pauly Mark

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

Language of teaching	English
Credits	6
Session	Winter
Semester	Fall
Exam	Written
Workload	180h
Weeks	14
Hours	**5 weekly**
Lecture	3 weekly
Practical work	2 weekly
Number of positions	

Summary

This course will cover mathematical concepts and efficient numerical methods for geometric computing. We will explore the beauty of geometry and develop algorithms to simulate and optimize 2D and 3D geometric models with an emphasis towards computational design for digital fabrication.

Content

- Overview of modern digital fabrication technology
- Discrete geometric models for curves, surfaces, volumes
- Basics of finite element modeling
- Physics-based simulation methods
- Forward and inverse design optimization methods
- Shape Optimization

Keywords

geometry, simulation, shape optimization, digital fabrication

Learning Prerequisites

Recommended courses

CS-328 Numerical Methods for Visual Computing and ML

Important concepts to start the course

Undergraduate knowledge of linear algebra, calculus, and numerical methods; programming experience (e.g.
Python, C/C++, Java, Scala)

Learning Outcomes

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

- Model and formalize geometric shape design & optimization problems
- Design and implement computational methods for shape processing, physics-based simulation, and numerical optimization based on discrete geometry representations
- Apply geometric abstraction principles to reduce the complexity of shape optimization problems
- Assess / Evaluate geometry processing algorithms for their suitability for specific digital fabrication technologies

Transversal skills

- Demonstrate a capacity for creativity.
- Continue to work through difficulties or initial failure to find optimal solutions.
- Use both general and domain specific IT resources and tools
- Evaluate one's own performance in the team, receive and respond appropriately to feedback.

Teaching methods

Lectures, interactive demos, exercises, practical work sessions

Expected student activities

Attend and participate in lectures, study provided reading material, solve theory exercises and implementation homeworks, design and fabricate (with support) physical models

Assessment methods

Graded homeworks, final exam

Supervision

Office hours	Yes
Assistants	Yes
Forum	Yes

Resources

Moodle Link

- https://go.epfl.ch/CS-457