

The background features a dark blue gradient with faint, light blue geometric patterns. A prominent circular scale with numerical markings from 40 to 260 is visible on the left side. Other elements include dashed circles, solid circles, and curved lines, some with arrows indicating direction.

Introduction to Digital Geometry Processing

USTC, 2024 Spring

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<https://qingfang1208.github.io/>

What is (Digital) Geometry Processing?

The background is a dark blue gradient with faint, light blue geometric patterns. On the right side, there is a large circular scale with tick marks and numbers from 0 to 210. There are also several concentric circles and dashed lines scattered across the background, some with arrows indicating direction.

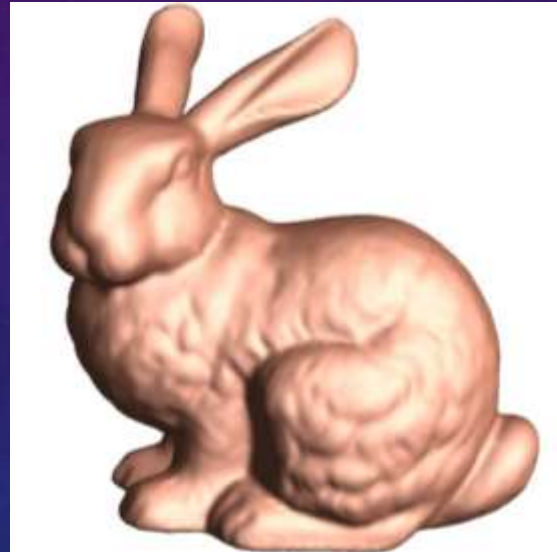
Geometry Processing from wikipedia

- Geometry processing is an area of research that uses concepts from applied mathematics, computer science and engineering to design efficient algorithms for the acquisition, reconstruction, analysis, manipulation, simulation and transmission of complex 3D models.

3D Graphics



Real 3D object



Digital representation



- Rendering
- Animation
- Interaction
- ...

Rendering

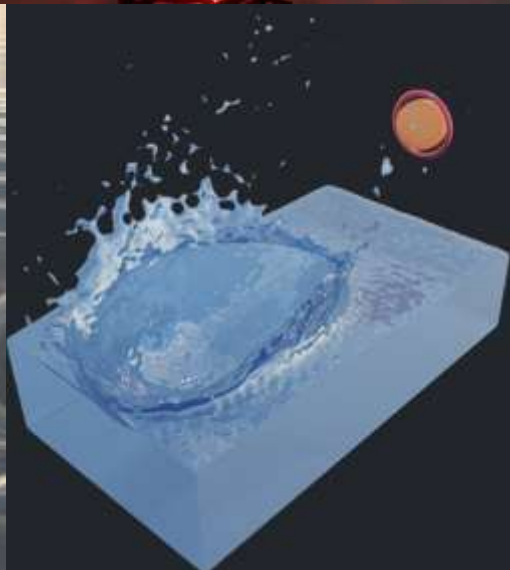
- Geometry
- Material
- Illumination



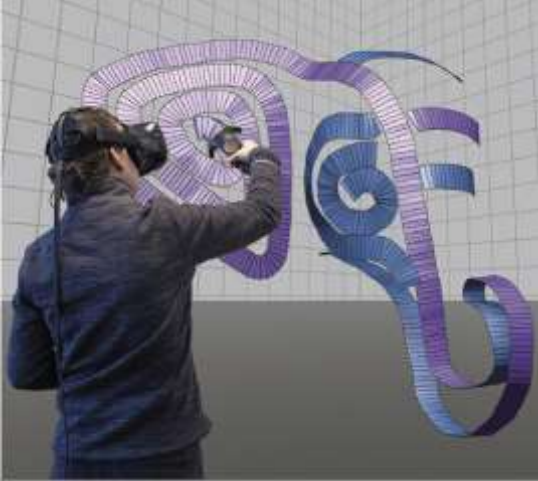
Animation



Animation



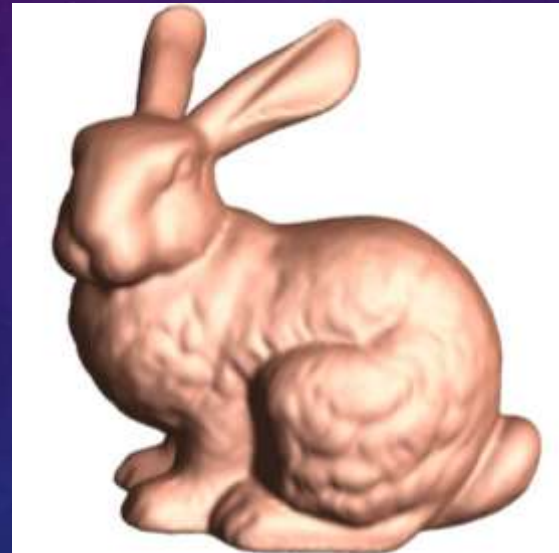
Interaction



3D Graphics



Real 3D object



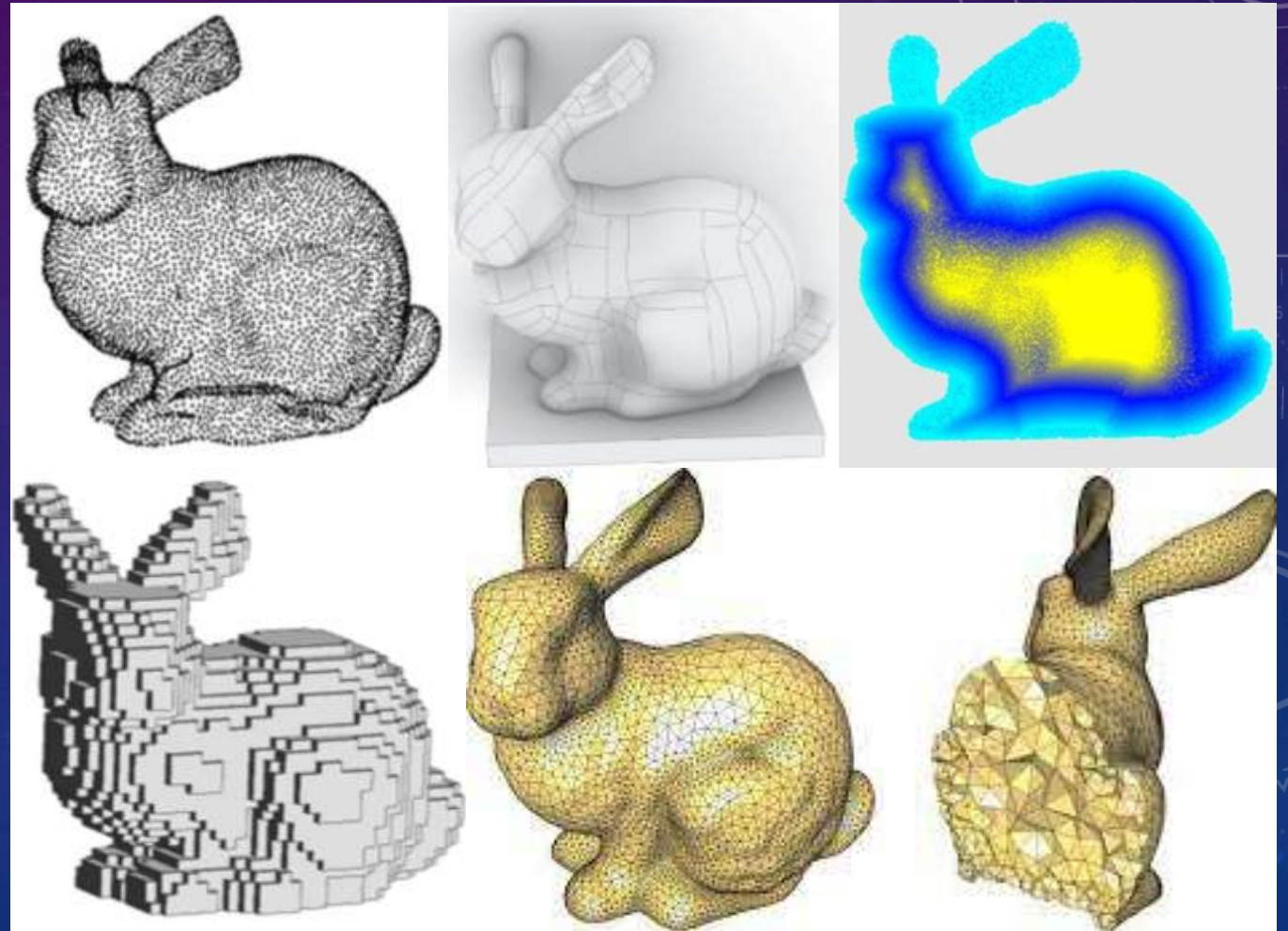
Digital representation



- Rendering
- Animation
- Interaction
- ...

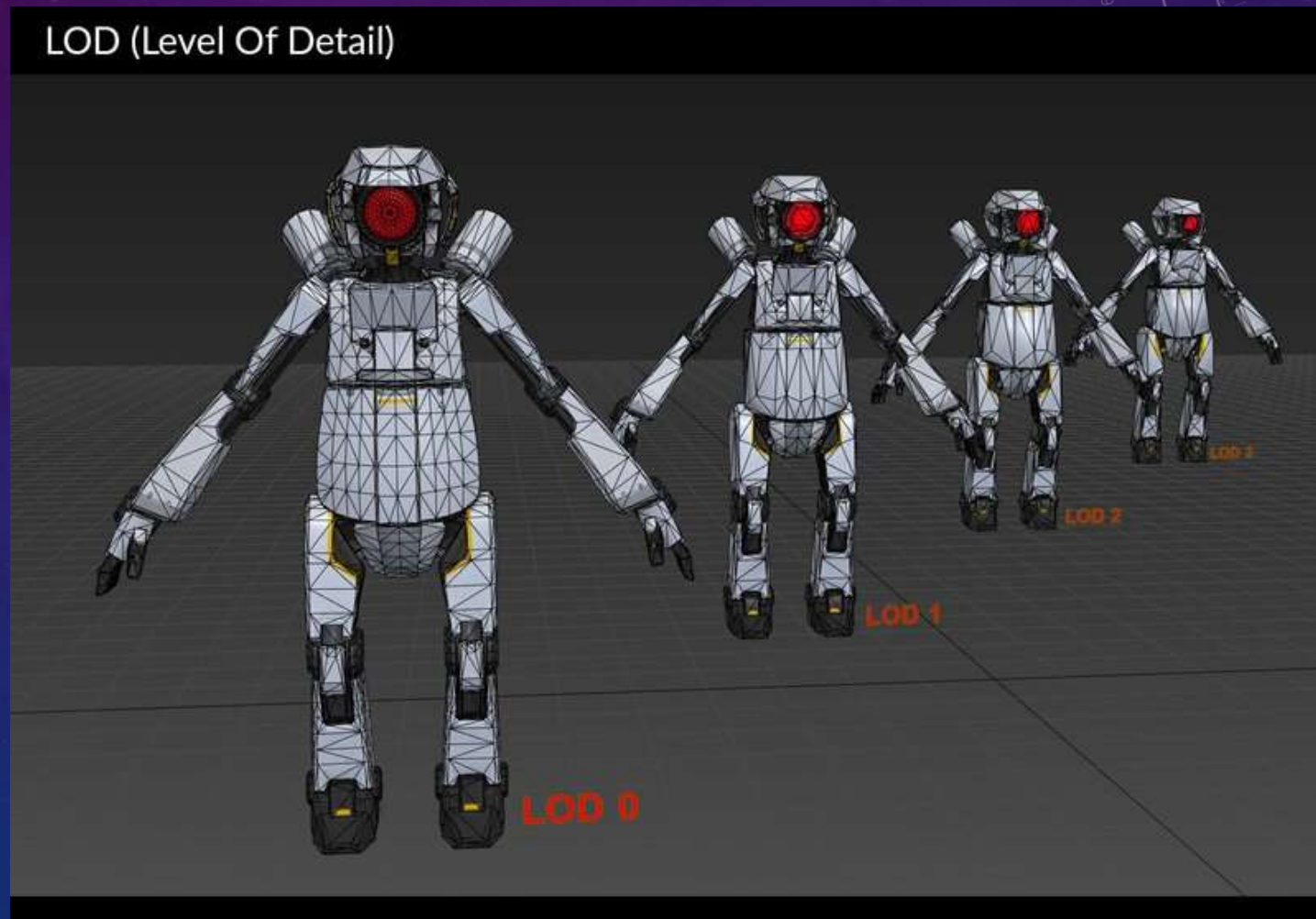
Digital representation

- Point cloud
- Explicit/implicit function
- Grid
- Triangular/tetrahedral Mesh
- ...



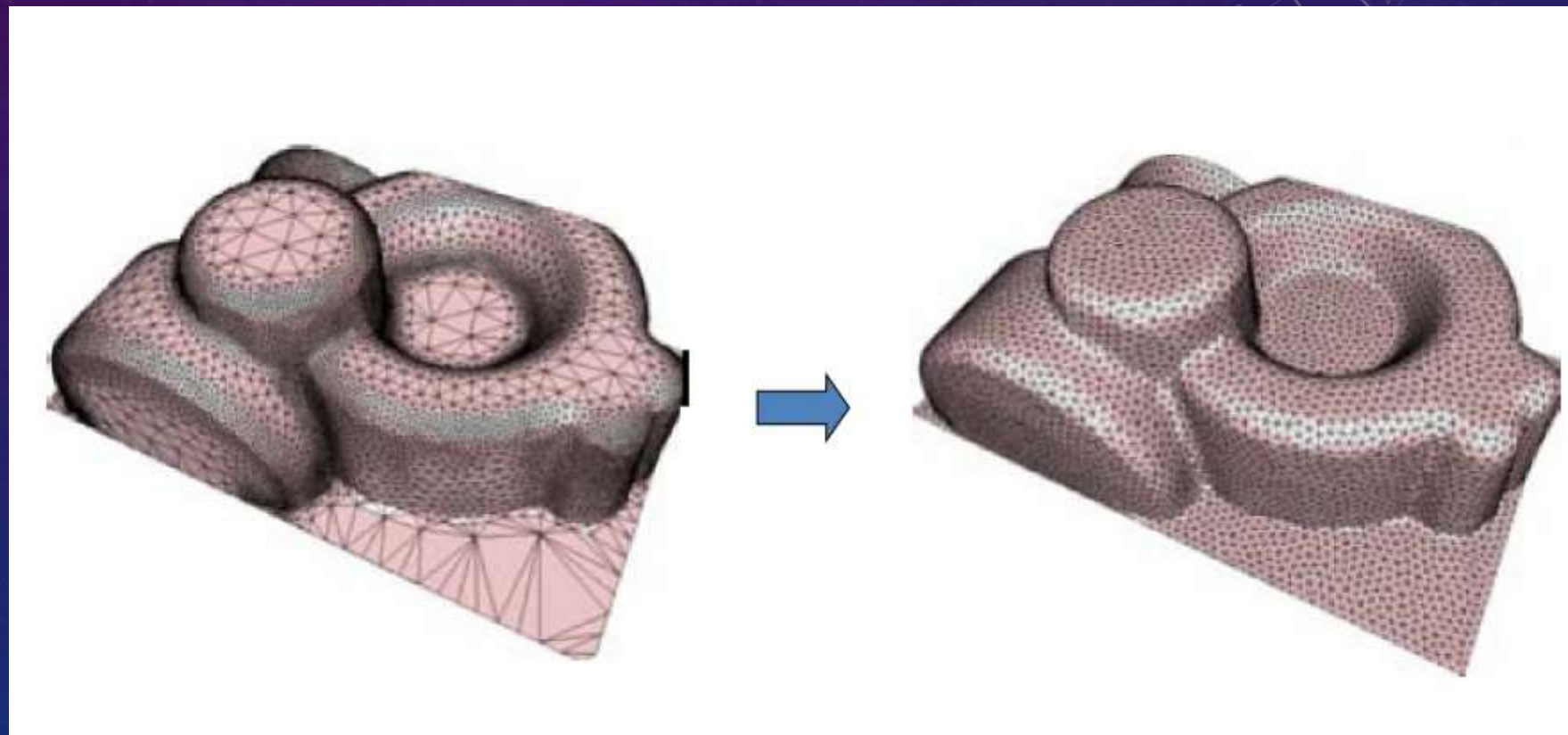
Applications

- Simplification



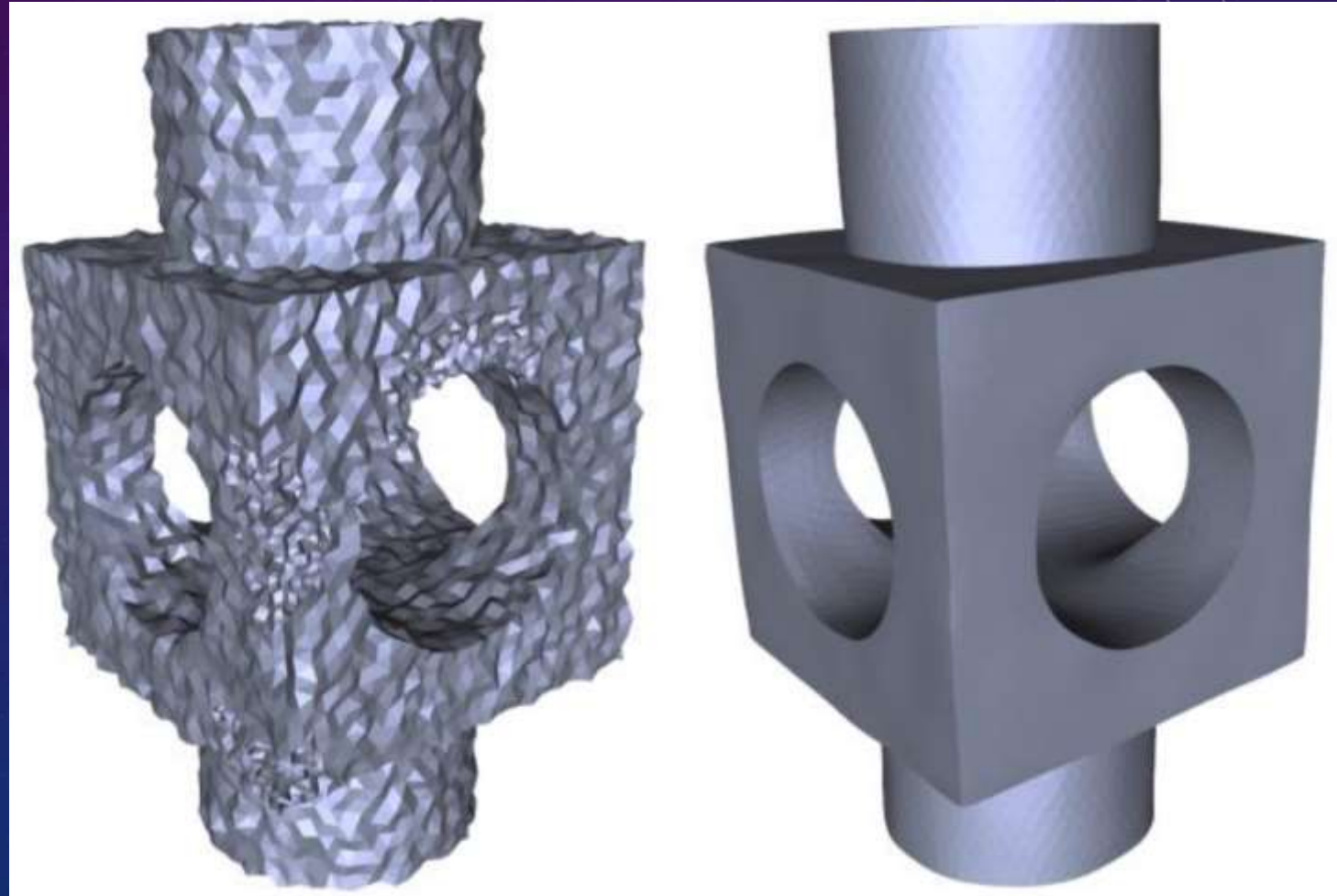
Applications

- Simplification
- Remeshing



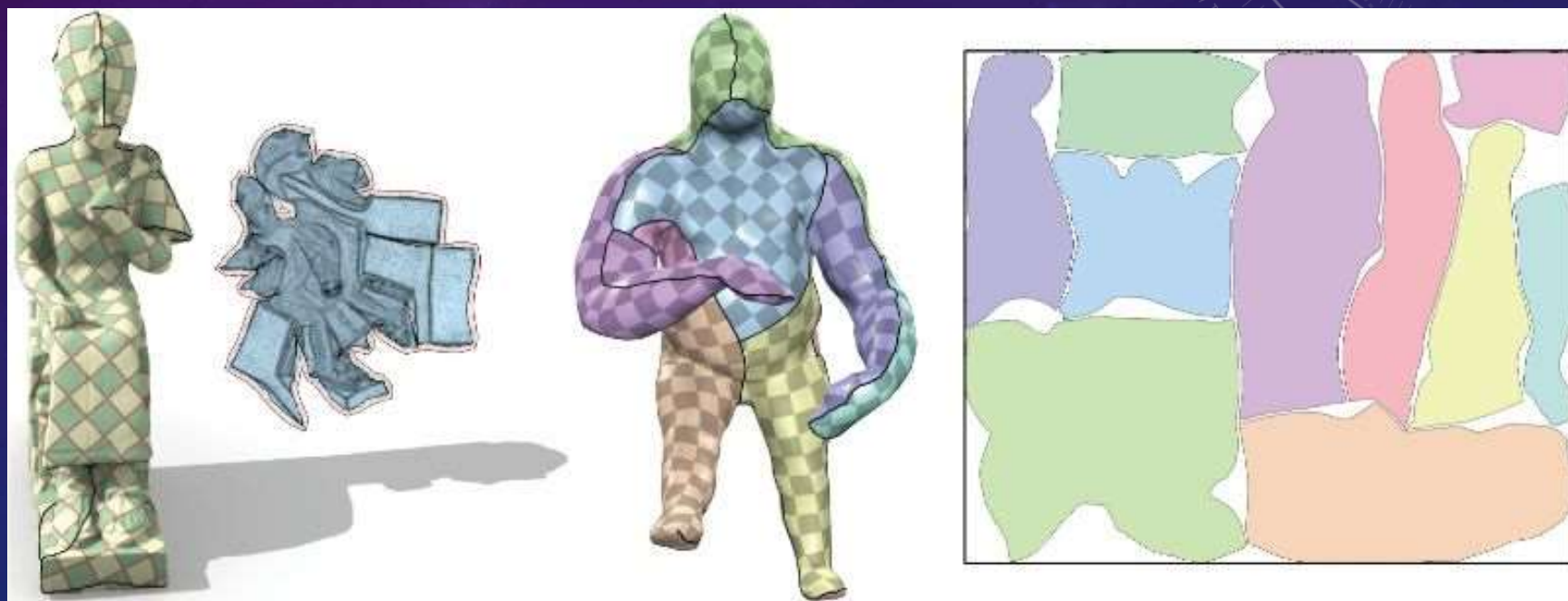
Applications

- Simplification
- Remeshing
- **Smoothing**



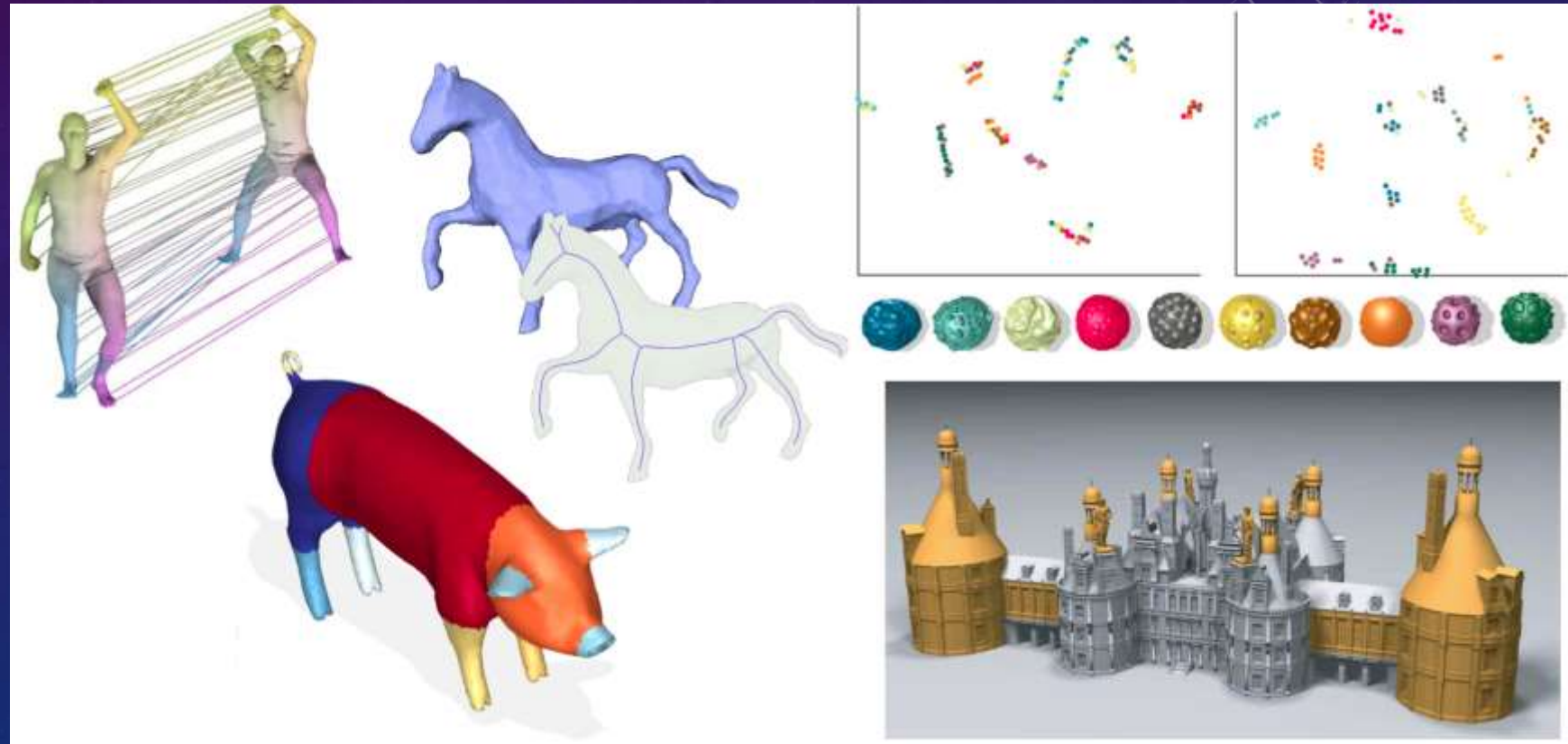
Applications

- Simplification
- Remeshing
- Smoothing
- **Parameterization**



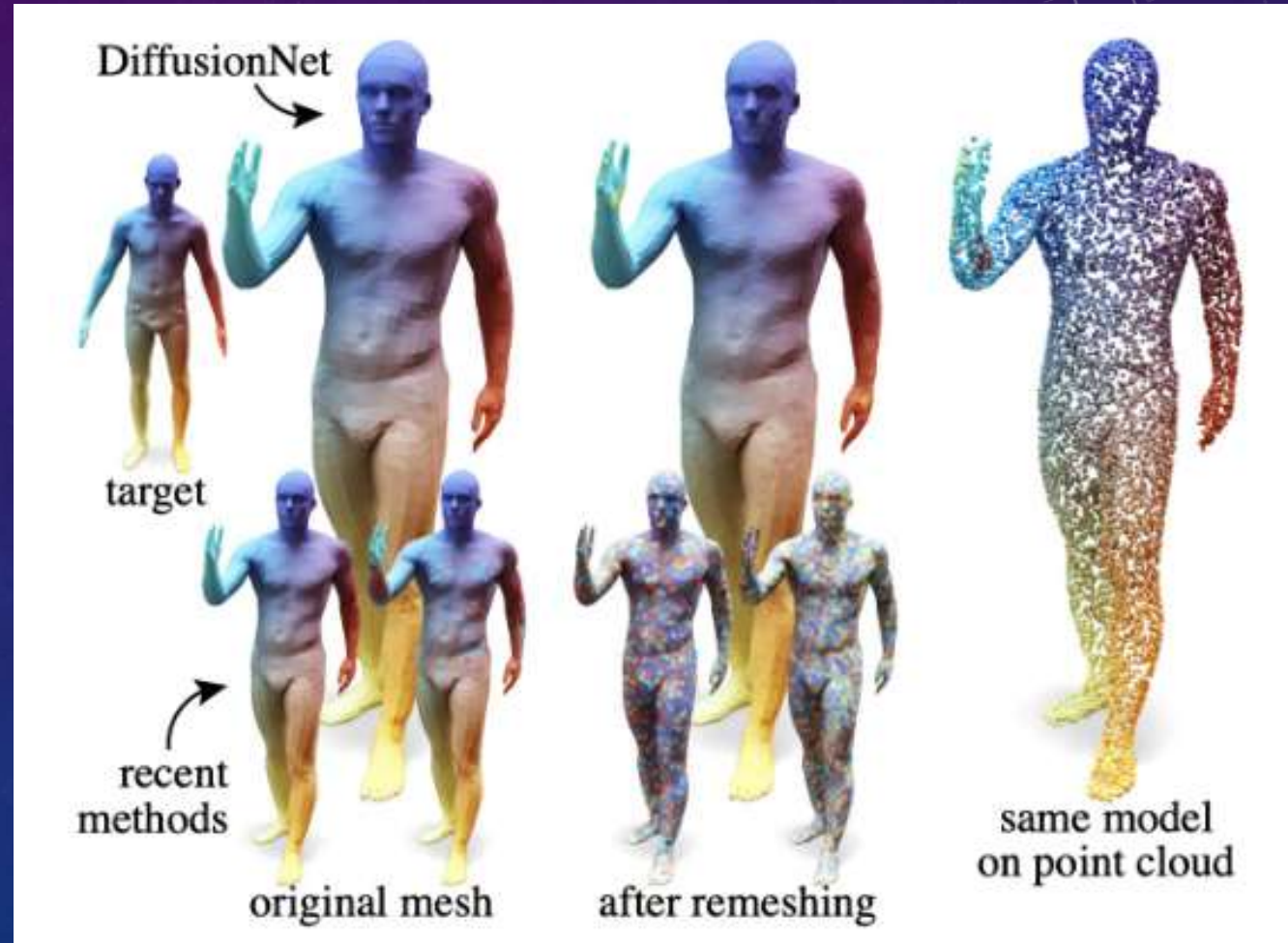
Applications

- Simplification
- Remeshing
- Smoothing
- Parameterization
- **Shape analysis**
- ...



Applications

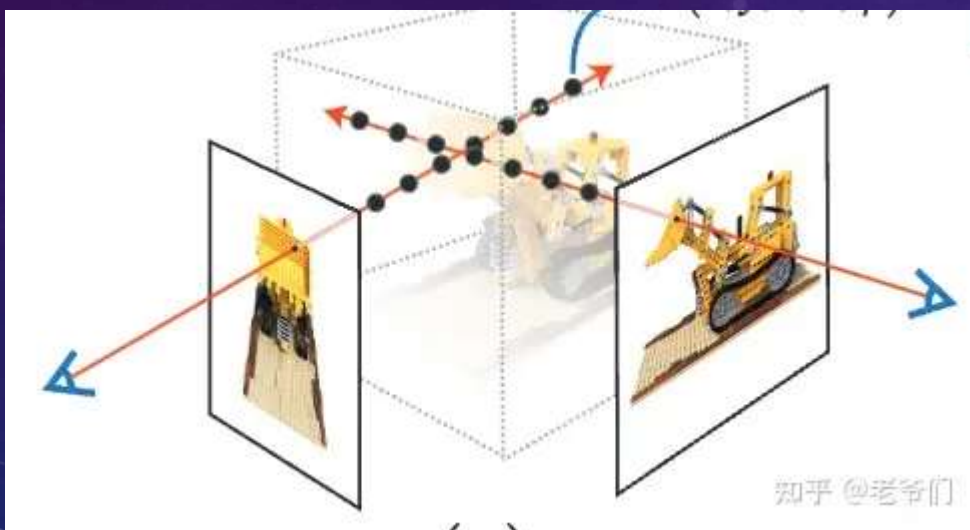
- Simplification
- Remeshing
- Smoothing
- Parameterization
- Shape analysis
- **Geometry learning**
- ...



Frontiers

➤ Reconstruction

- Volume rendering: NeRF -> 3D Gaussian splatting



NeRF



Gaussian Splatting



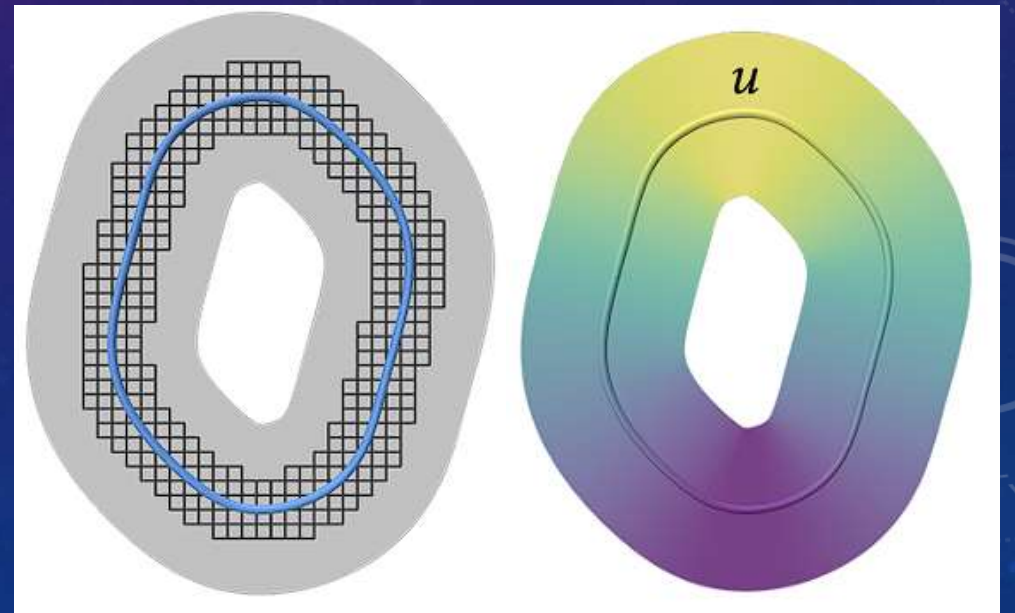
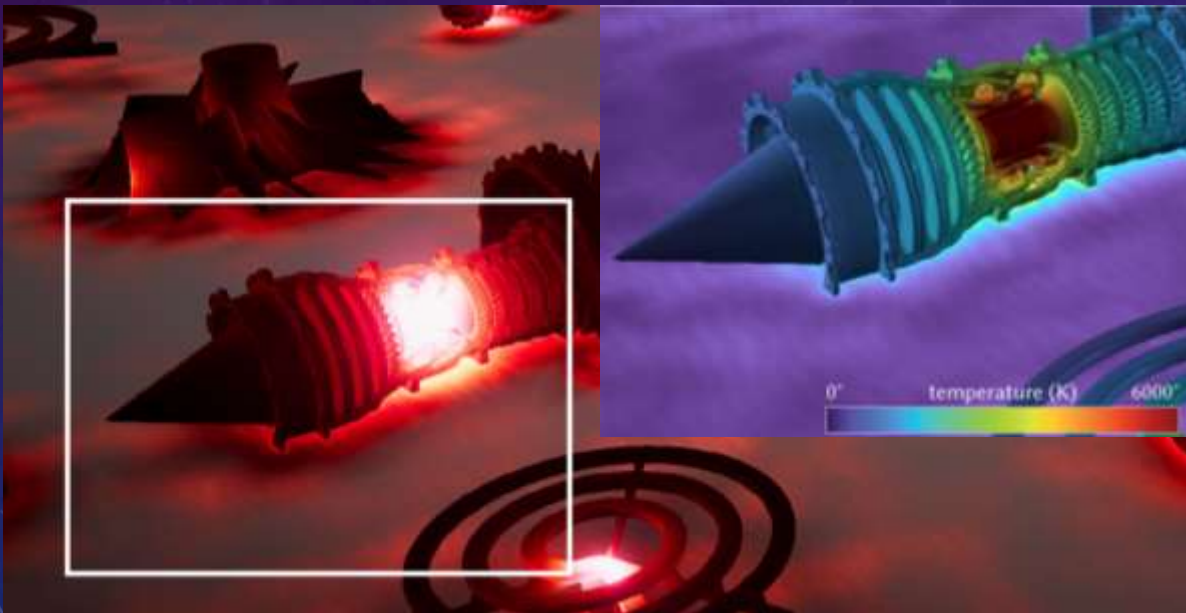
Frontiers

- Diffusion model
 - Sketch modeling, shape completion, layout generation ...



Frontiers

- PDE with no meshing
 - Monto Carlo, closest point method



Future Trend

➤ Sora



The background features a gradient from dark purple to blue, overlaid with a field of small white stars. On the right side, there are several technical diagrams: a large circular scale with numerical markings from 80 to 210, a smaller circular scale with markings from 100 to 140, and various circular paths with arrows indicating direction. The text "What will we learn?" is centered in a white, sans-serif font.

What will we learn?

About this course

➤ Goal

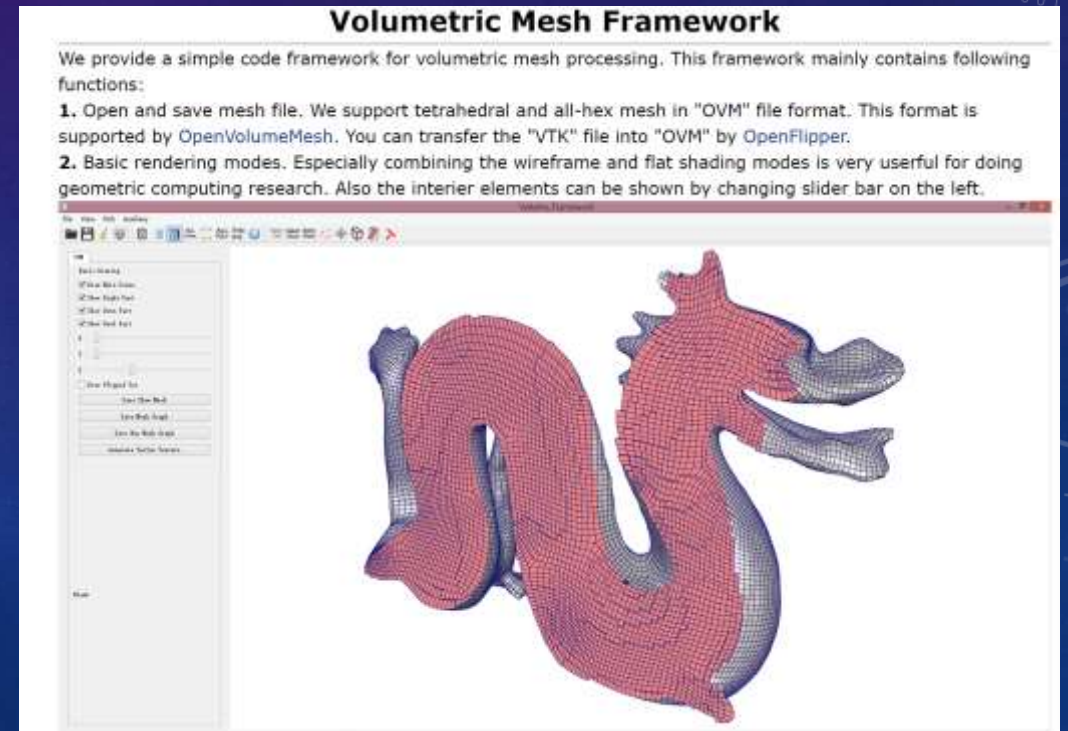
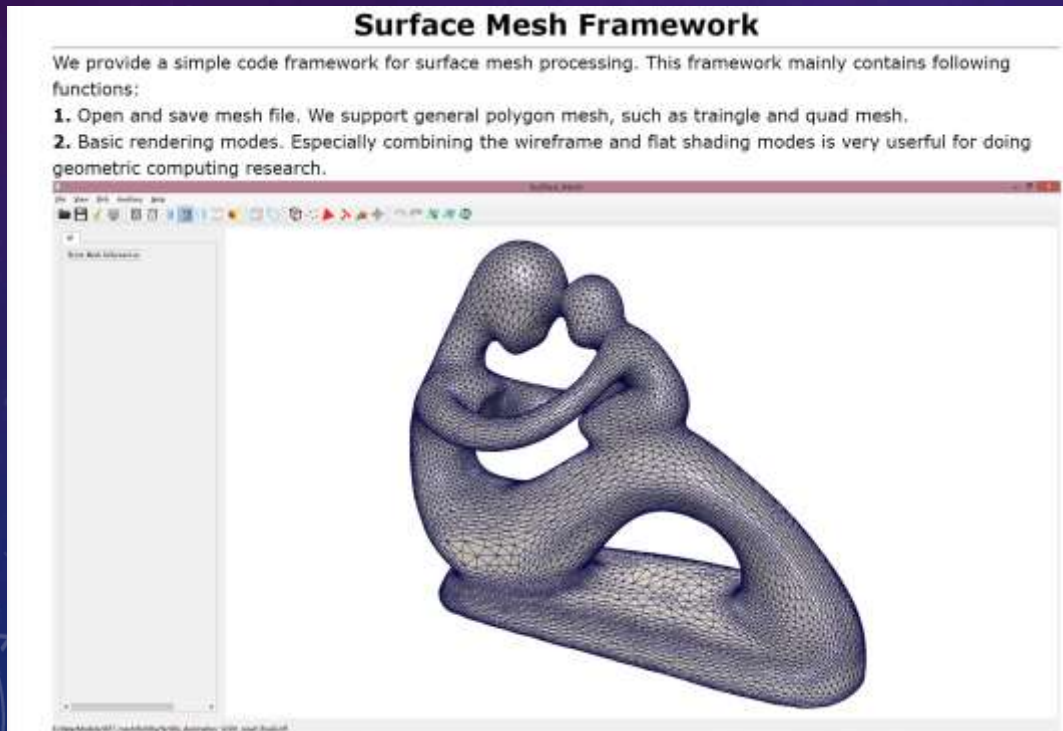
- Digital representation (data structure) and differentials (from smooth to discrete)
- Basic coding for applications (simplification, smoothing, deformation, ...)
- Academic frontiers

➤ Score

- Coding ($5 \times 10 = 50$) + exam (20)
- Survey + presentation (30)

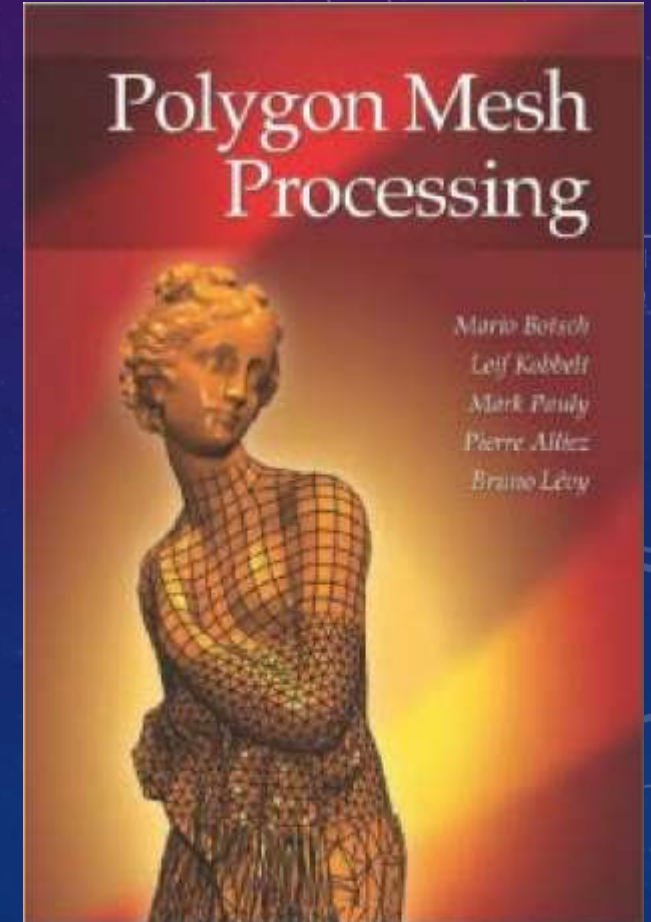
Prerequisites

- Math: calculus, linear algebra, differential geometry, PDE ...
- Coding: C++ (https://ustc-gcl-f.github.io/code/index.html#sec_surface_framework)



References

- Book: Polygon mesh processing
- Papers: <https://www.kesen.realtimerendering.com/>
- Other resources:
 - Siggraph courses
 - GAMES webinar
 - ...



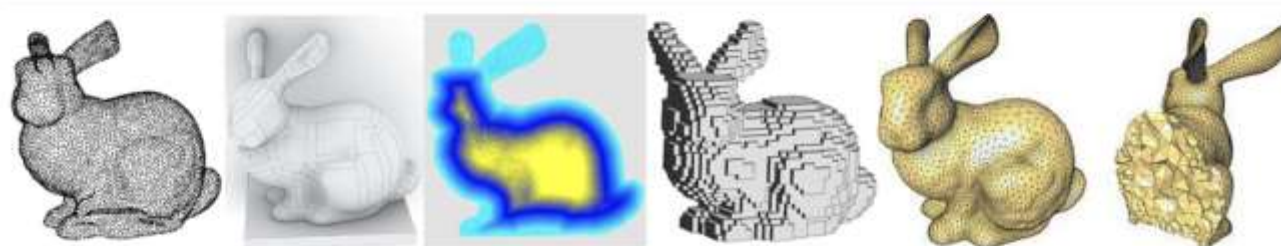
Course info

- Webpage: https://qingfang1208.github.io/Course/2024_spring_DGP/index.html
- QQ group: 852534294

[Introduction] — [Course Info] — [Schedule] — [Assignments]

Digital Geometry Processing

(MATH6419P.01, 2024 Spring)



Introduction

This course will introduce the basic mathematical foundation of 3D surfaces from the perspective of discrete differential geometry. In detail, we will introduce the complete geometric processing pipeline, including mesh representation, mesh smoothing, mesh parameterization, mesh deformation, mesh repairing, mesh mapping, remeshing, mesh simplification, and direction field generation. We will learn the representation method, data structure, modeling method, shape editing and analysis method of polygon mesh in the computer by many programming tasks.



DGP2024
群号: 852534294



扫一扫二维码, 加入群聊。

Q&A

The background is a dark blue gradient with a field of small white stars. On the right side, there are several technical diagrams. At the top right, a large circular gauge with a scale from 0 to 210 and a white arrow pointing to approximately 195. Below it, a smaller circular diagram with concentric circles and a white arrow. At the bottom right, another circular diagram with concentric circles and a white arrow. On the left side, there are faint circular diagrams, including one with a dashed arrow pointing left.