Advanced Topics in Computer Graphics II

Universität Bonn
Institut für Informatik II
27.10.2025

Winter term 2025
Prof. Dr. Reinhard Klein
Domenic Zingsheim
zingsheim@cs.uni-bonn.de

Sheet G03 - Mesh Navigation and Subdivision

Solutions for the theoretical and practical part via eCampus by Mo, 03.10.2025, **10:00**.

Practical Part

Please download the zip file `framework_g03.zip` from eCampus and unzip them into the `exercises` folder. Configure the project like last time.
Submit this exercise by uploading the complete source file (source.cpp) onto eCampus!

Assignment 1) Mesh Navigation *(3Pts)*

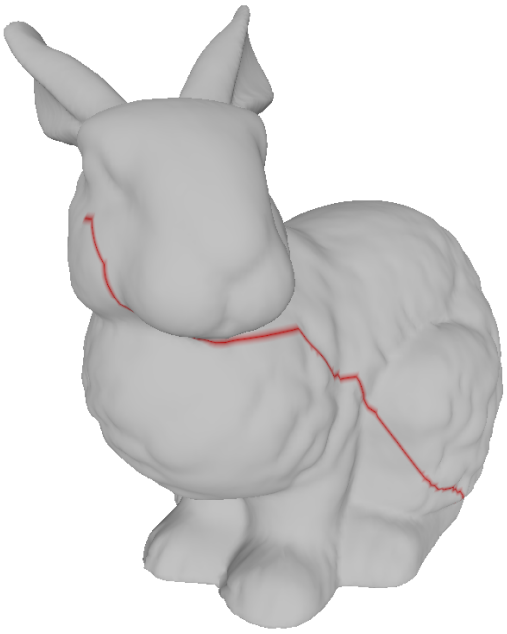

Figure 1: Shortest Path on the Mesh.

Your task is to finish the functions `distance_on_mesh(...)` and `trace_back(...)`.

- Read the introduction to OpenMesh[1] and the documentation about mesh iterators in OpenMesh.
- Read about Dijkstra's algorithm if you don't know it yet.
- Calculate the mesh distance from a source point to a target point.
- Store the previous vertex handle as a vertex property and trace back the path.

If the calculated distances is incorrect, the program will print an error message. If you implemented everything correct, your output should look like Figure 1.

[1] `https://www.graphics.rwth-aachen.de/software/openmesh/intro/`

Assignment 2) Subdivision Surfaces - Sqrt3 *(4Pts)*

In the file `exercises/exercise03Subdivision/source.cpp`, you will find the exercise for this assignment.

- In the function **subdivide_mesh**(...), please implement the computation of the new positions of the old vertices.
- In the same function **subdivide_mesh**(...), please implement the face splits.
- In the same function **subdivide_mesh**(...), please implement the edge flips.

Theoretical Part

Assignment 3) Subdivision Curves *(2 + 1*Pts)*

Let $\mathcal{P} = \left\{(0,0)^\top, (1,0.5)^\top, (1.4,1)^\top, (0.8,1.2)^\top, (0.3,0.8)^\top\right\}$ be a control polygon starting at $(0,0)^\top$ and ending at $(0.3,0.8)^\top$. Subdivide this polygon using

a) Corner-cutting with weights (3/4, 1/4) and (1/4, 3/4).
b) the odd rule (0.5, 0.5) and even rule (1/8, 6/8, 1/8).

Bonus: Implement both variants of the subdivision and iterate them until convergence.

Assignment 4) Subdivision Surfaces *(4Pts)*

a) Describe how the **sqrt3**-subdivision algorithm works. Go through every step and describe how you can subdivide a mesh using this approach.
b) What problems can you find using a subdivision approach? Are there solutions to these problems?
c) What are the main differences between **loop/catmull-clark/sqrt3**-subdivision approaches?

Good luck!