

Practical Assignment 1

(Mesh and Surface Analysis and Surface Registration)

Task 1 (Mesh and Surface Analysis).

Create a tool for mesh analysis that computes

1. the genus of the surface,
2. the volume enclosed by the surface,
3. the number connected components of the mesh, and
4. (optional) the number boundary loops.

Task 2 (Rigid Registration).

Create a tool that offers a basic iterative closest point registration of two meshes P and Q . The tool should first select a random set of vertices $\{p_1, p_2, \dots, p_n\} \subset P$ (experiment with different values n). Then iterate the following steps until convergence or stopped.

1. For every p_i , find the closest vertex q_i in Q . It is fine to use brute force search for your implementation.
2. Compute the median distance of the set of pairs $S = \{(p_i, q_i) | 1 \leq i \leq n\}$. Remove the all pairs $\{p_i, q_i\}$ whose distance is larger than k times the median distance from S . Find a good value for k in your experiments.
3. Compute the optimal rigid transformation for the set S (from which the pairs have been removed in Step 2) and transform the mesh P .

Extend the basic implementation by offering the user to select the point-to-plane distance instead of the point-to-point distance.

(Optional) Explore more variants of the ICP algorithm, such as those discussed in the lecture.

Task 3 (User Manual and Summary of Experiences).

Write a report that describes and illustrates

- the algorithms and functionality implemented
- how the implementation can be used
- your tests for correctness of the implemented algorithms
- your evaluation (parameter settings, comparing alternatives, discussion of benefits and limitations) of the implemented methods

In addition, you can report on the division of labor amongst the group members.

Required deliverables on Brightspace.

- For Tasks 1 and 2, provide the source files and example meshes. Pack all the files in one ZIP archive.
- The report should be one PDF file

Deadline: May 17, 20:00.