

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,
4. the number of boundary loops.

Task 2 (Iterative Closest Point).

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 . Brute force search is ok for our 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 .

Task 3 (User Manual and Summary of Experiences).

Write one short user manual for all the two tools. Apply your tools to analyze and register 3D meshes and write a short summary of your experiences (2-3 pages). Both, the manual and the summary, should contain images as illustrations.