Segmentation based on Skeleton

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Summary

Description

Segmentation is an important topic in computer graphics as it gives a kind of shape abstraction which helps geometric processing and human understanding of 3D shapes. Segmentation can provide fundamental information for geometric modeling, deformation, mesh simplification and skeleton extraction. So many methods have been come up to mesh segmentation. And more specifically, segmentation can lead to skeleton and vice the same. I'd like to combine the double way to get a better segmentation iteratively.

Previous Work

Segmentation methods mainly involve two kinds of thinking to measure meshes[A. Shamir 08]. One is to use features on faces to partition meshes into patches where each patch holds some common properties. It only use geometric information on surfaces and ignore the volume. While another one adopt cognition method to split meshes into meaningful parts to humans. It treats mesh as 3D shape and analysis the shape in semantic parts.

Clustering is a type of methods to partition a mesh. It uses the triangle or other element as initial units and then cluster the units to larger one so that to get the segmentation. HFP [M. Attene 06] and the work using feature point [S. Katz 05] are good methods.

A skeleton can be easily pick out from a mesh with its part-level segmentation. Also a segmentation can be made by a skeleton[D. Reniers 07]. And there is a relationship between skeleton and segmentation[L. Shapira 08]. Many standalone methods can extract skeleton without segmentation like using Voronoi diagram[R. L. OGNIEWlCZ 95]. However, this project won't focus on how to extract skeleton from meshes directly. It will only use skeleton for segmentation.

Proposal

In this project, I'd like to combine the work of segmentation and skeleton extraction. The final goal is to find a iterative method to optimize the segmentation and its skeleton.

First I'd like to implement some stand segmentation algorithms and compare the results. A method with good compatible to skeleton may be studied more for next step. For skeleton, part-level segmentation would be more suitable than patches.

Then I will focus on the algorithm to get a part-level segmentation from a given skeleton. A map between a skeleton and a segmentation may be constructed. However, it may not be bijective map.

Finally I plan to use the map above to iteratively optimize the segmentation.

List of Goals

Update 1

Implement and compare existing segmentation algorithms.

Update 2

Construct segmentation aided by calculating its skeleton.

Final

For each manifold mesh, find a segmentation using the iterative method above.