Topological Mesh Modeling

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Abstract

This workshop presents Topological Mesh Modeling with hand-on experiments using our topological modeler, TopMod. Our modeler provides a wide variety of interactive techniques that allow to create unusual and interesting shapes by changing the topology of 2-manifold meshes.

1. Introduction

This workshop presents Topological Mesh Modeling with hands-on experiences using TopMod, a manifold mesh modeling system that includes most of the work presented in our Topological Mesh Modeling papers. We provide TopMod to all the audience and we have interactive demonstrations.

TopMod allows interactively changing the topology of 2-manifold polygonal meshes. It guarantees topological consistency of polygonal meshes. TopMod is based on minimal and complete operations: insert/delete edge and create/remove vertex. Using these operations, handles can be created and deleted, holes can be opened or closed, polygonal meshes can be connected or disconnected. These minimal operations are also highly consistent with subdivision algorithms. In particular, these operations can easily be included into a subdivision modeling system such that the topological changes and subdivision operations can be performed alternatively during model construction.

TopMod provides wide variety of ways to create high genus shapes such as rind modeling, curved handles, connected and manifold Sierpinsky polyhedra, wire and column modeling. It also provides probably the most complete set of subdivision schemes available. It's subdivision categorization helps to understand mesh topological properties of remeshing schemes of subdivision surfaces. Figure 1 shows some models created using TopMod and printed with a Fused Deposition Machine in 3D. For more information about TopMod see Topological Mesh Modeling page:
http://www-viz.tamu.edu/faculty/ergun/research/topology/

2. Intended Audience and Presentation Requirements

The course is intended for all Bridges attendees who are interested in the creation of interesting shapes and sculptures; and teaching how to create those sculptures. The software is also useful to teach topology to students. We provide software to all participants and the participants who bring their laptops have hands-on experience. We encourage the participants to bring their laptop. They can also download TopMod from our web-page before workshop: http://www-viz.tamu.edu/faculty/ergun/research/topology/index.html

Figure 1: 3D prints of the models created in TopMod. For each sculpture, we took two photographs from slightly different point of views. The sculptures are photographed on a mirror. Background is eliminated. These shapes are made from ABS plastic and printed using a Fused Deposition Machine (FDM). They are later painted using an acrilic paint. The ribbon shape on the left is really a genus-1 surface, but, during the construction of this surface, genus changed several times.

3. Workshop Schedule

The workshop will cover how to use TopMod while intuitively teaching Topological Mesh Modeling with hands-on experiences in two hours. Artistic aspects of topological mesh modeling will also be covered. The following is the schedule of the workshop.

1. **Introduction:** In this section, we introduce speakers and present a short overview. The attendees who bring their laptop will install software.
2. **Operations:** In this section, we introduce minimal and complete operations for mesh modeling which are insert/delete edge & create/remove vertex operations. We also cover splice operation and Euler operators. We also show cubical handles.
3. **High Genus Modeling:** This section introduces high genus modeling operators, namely multi-segment curved handles, rind modeling, wire modeling, column modeling.
4. **Subdivision & Remeshing:** This section introduces subdivision schemes and provides a taxonomy for subdivision scheme, namely primary conversion schemes, dual conversion schemes, primary preservation schemes, dual preservation schemes.
5. **Others:** In this section, we cover subjects such as generalized extrusions, generalized handles, generalized & manifold fractals.