Computer Graphics (4190.410)

Jehee Lee

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Programming Assignment #3

Swept Surface Design

This programming assignment requires the implementation of a simple system for swept surface design. The assignment is intended to let you practice with geometric transformations and spline curves. A swept surface is defined by a sequence of cross section curves. You are required to create cross section curves using either closed B-splines or Catmull-Rom splines. Then, a sequence of geometric transformations (scaling + rotation + translation) is defined to bring cross sections at desired 3D locations and construct a smooth swept surface interpolating the cross sections. You may perform geometric interpolation on scaling factors, orientations, and positions of the cross sections using generalized Catmull-Rom splines.

Requirement

1. (10 points) Describe the control points of the cross section and transformations in the data file. The format is explained at the end of this assignment description. Your system should be able to parse the standard format.

2. (10 points) Construct a closed curve using either B-splines or Catmull-Rom splines depending on what the data file demands.

3. (10 points) Describe a sequence of geometric transformations in the data file. Each transformation represents scaling, followed by rotation, followed by translation.

4. (30 points) Construct three splines for scaling factors, unit quaternions, and 3D positions.

5. (10 points) Visualize the swept surface as a polygonal mesh. The rendering should be styled to present the shape of the surface clearly.

6. (5 points) Allow for the user to rotate the scene so that we can inspect your surfaces at different viewpoints.

7. (10 points) Create your own swept surfaces that are aesthetically pleasing.

8. (5 points) 3D print your model.

9. (10 points) Write and submit a report. This report should describe how you implemented, what you have done, and what you haven't done.

Data file format

```
BSPLINE   # Curve type (BSPLINE or CATMULL_ROM)

7         # The number of cross sections.

5         # The number of control points per cross section

# The first cross section

10 10     # The 2D position of control points

20 15     # The coordinates of the cross section is defined

15 20     # on X-Z plane

50 20

60 30

1.5       # Scaling factor

1.2 1 0 0 # Rotation about axis (1,0,0) by angle 1.2

10 50 30  # Position

…         # Six more cross sections
```