CSC305 Assignment Two and Three

Assignment 2 Due 20 October 2014 Assignment 3 Due 12 November 2014

1 Outline

This assignment is intended to get you to understand viewing in 3D, and Catmul-Rom Splines.

1. **Assignment 2** We start with building a viewing interface for a simple cube. Add viewports to look at 2D orthographic views of your scene for input of a parametric curve control points, or input points directly into the perspective viewport (conversion from 2D to 3D is necessary). Build a user editable Catmul Rom spline through the input points.

2. **Assignment 3** Calculate Frenet frames at regular intervals. Add a cube at each frame origin to show that the Frenet frames are orientated correctly, then move the cube along the spline.

3. **Assignment 3** Build a cylinder along the curve using a circular or other cross section.

2 Guidance

2.1 Assignment 2: Viewing interface

When you use a program to view the cube (or any 3D object) orientating the user with respect to the 3D environment is very important so it is easy to find where the object is in space. Draw a ground plane grid and axes to help the user.

Use the mouse buttons to control the virtual camera. For example imagine the cube is in the centre of a virtual sphere and the camera moves on the surface of the surface. To control the camera "View From" position; left button held and mouse moves left-right controls azimuth angle and up-down controls elevation. Middle button could control the point on the object the camera is looking at ("View To"), but this is a little tricky as it requires finding a point in 3D. It would be easier to have a list of points that the user might want to view on the object, and let the user choose which is the "View To" point by cycling through them every time the user clicks the middle mouse button for example. These points could be the vertices of the cube and cube centre, or the control points on the spline. The right button could control the position of the camera along the line from the camera to the "View To" point (dolly or trolley).

Note that the above is just an example of how you might control the camera, or use your own camera interface.

2.2 Assignment 2: Catmul Rom

The Catmul-Rom spline interpolates the user supplied control points. The tangent vector at a control point are found by averaging the points before and after and weighting, usually by an amount called the tension. This value can default to 0.5.

Control points can be input in either the 3D perspective viewing window or, if you prefer, in a 2D window showing one of the elevations. Selecting a point to edit it can be tricky in the 3D window. Display the curve and the control points by drawing perhaps a small coloured cube around each control point.

Assignment 3: Additions to the generalized cylinder

Modelling

A Frenet frames can be calculated at the starting control point and drawn as a small set of axes. If you use the incremental technique described in class it is straightforward to calculate the frame at intervals along the curve. Align the cube to the Frenet frame (essentially the same rotation calculations you used to find the axes).

- Build a series of regular polygons orthogonal to the direction of the curve (aligned with frame) and place them at regular intervals, join up successive polygons to form a cylinder.
- make there cross sections different radii
- make the cross section an arbitrary polygon - e.g smiley face or heart shaped.

Appearance

- add Phong shading
- add texture
- allow the user to move the lights