CS 3451 Proj 9 Report

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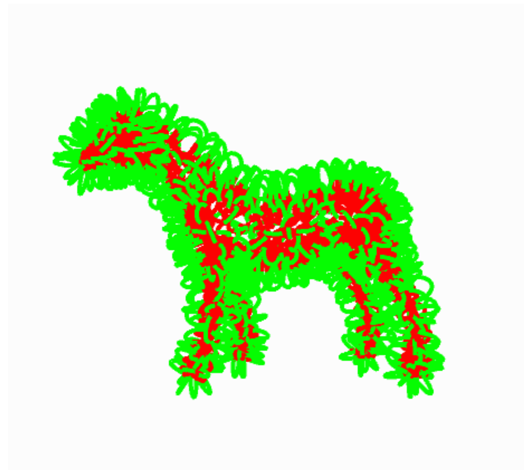
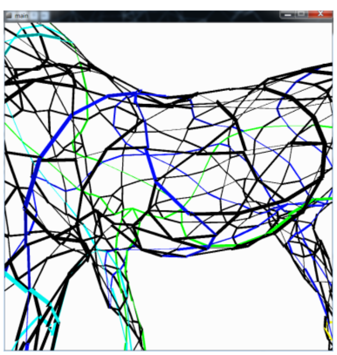
CS 3451 Project 9 Lacing



This project's problem statement is to get a pattern of lacing on the surface of watertight triangle meshes. The pattern can be in ribbons or 4-sided tubes.

In order to do this:

1. One corner of a triangle and a corner of another triangle form a curve either Bezier or Hermite.
2. The loop should be ribbon or 4-sided tubes.
3. The loop should be continuous and closed.



Hermite curve is done by using two points of each corner of two triangles and the tangent of the points, as shown on wiki:

On the unit interval $(0, 1)$, given a starting point $\boldsymbol{p}_0$ at $t = 0$ and an ending point $\boldsymbol{p}_1$ at $t = 1$ with starting tar

$$\boldsymbol{p}(t) = (2t^3 - 3t^2 + 1)\boldsymbol{p}_0 + (t^3 - 2t^2 + t)\boldsymbol{m}_0 + (-2t^3 + 3t^2)\boldsymbol{p}_1 + (t^3 - t^2)\boldsymbol{m}_1$$

where $t \in [0, 1]$.

P0 and p1 are the two points on each side, and m0 and m1 are the tangents of the points. Unlike the Bezier and Neville curves ealier on, Hermite curves are controlled by the two points and the vector of their tangents.

Proof of closed loop:

Each triangle has three edges, and every two triangles share an edge. In the mesh, there is always a way to expand the mesh into a trail of triangles with each triangle having only two shared edges. Also, if we start from one corner x opposite of an unshared edge, then x.n.s.s.n will be corresponding corner in the other triangle to the right. So if there are 2n triangles (even), it can always return to the start. If our mesh has n triangles, then the number of edges will be 3n. Since an edge is always shared by two triangles as mentioned earlier, there is actually 3/2n edges. Since the number of edges has to be only integers, n has to be a multiple of 2. This means the number of triangles is always even, and it will always end up in a closed loop starting from a corner x.