Programming #4: Part II (4190.410)

Due: November 27, 2013

A bicubic Bézier surface $S(u,v) = \sum_{k=0}^{3}\sum_{l=0}^{3} \mathbf{b}_{kl} B_k^3(u) B_l^3(v)$, $0 \le u, v \le 1$, can be approximated by a dense mesh sampled at the uniform parameters: $u_i = i/511, v_j = j/511$, for $i, j = 0, \cdots, 511$. Implement a spherical environmental mapping to the Bézier surface $S(u,v)$. The partial derivatives of the Bézier surface $S(u,v)$ can be computed as follows:

$$S_u(u,v) = \sum_{k=0}^{2}\sum_{l=0}^{3} 3(\mathbf{b}_{k+1,l} - \mathbf{b}_{k,l}) B_k^2(u) B_l^3(v),$$
$$S_v(u,v) = \sum_{k=0}^{3}\sum_{l=0}^{2} 3(\mathbf{b}_{k,l+1} - \mathbf{b}_{k,l}) B_k^3(u) B_l^2(v),$$

The unit normal $N(u,v)$ can be computed using the two partial derivatives:

$$N(u,v) = \frac{S_u(u,v) \times S_v(u,v)}{\|S_u(u,v) \times S_v(u,v)\|}.$$

Design an interactive system that can control the shape of $S(u,v)$ by dragging its control points projected onto the xy, yz, and zx-planes. The connected network of 16 control points can be displayed as a wireframe of 24 edges, each connecting two adjacent control points.