Programming #3: Part IV (4190.410)

Due: November 11, 2015

Design an interactive system that can control the shape of two bicubic Bézier surfaces:

$$S_1(u,v) = \sum_{i=0}^{3}\sum_{j=0}^{3} \mathbf{p}_{ij} B_i^3(u) B_j^3(v),\ \ S_2(s,t) = \sum_{k=0}^{3}\sum_{l=0}^{3} \mathbf{q}_{kl} B_k^3(s) B_l^3(t), \quad 0 \le u,v,s,t \le 1,$$

and a line segment $L(\tau) = (1-\tau)\mathbf{r}_0 + \tau\mathbf{r}_1$, $0 \le \tau \le 1$, by dragging their control points.

Part I: Implement an algorithm for approximating the surfaces using quadrangles within a given error bound.

Part II: Implement an algorithm for intersecting the surface $S_1(u,v)$ and the line segment $L(\tau)$ using the AABB tree of the surface.

Part III: Implement an algorithm for intersecting the two surfaces $S_1(u,v)$ and $S_2(s,t)$ using the AABB trees of the two surfaces, where each leaf node is an AABB of size smaller than a given error bound.

Part IV: Implement a cubic environmental mapping to the Bézier surfaces $S_1(u,v)$ and $S_2(s,t)$.