Programming #3: Part III (4190.410)

Due: November 10, 2014

Using a cubic Bézier curve $C(t) = \sum_{l=0}^{3} \mathbf{b}_l B_l^3(t)$, $0 \le t \le 1$, a polygonal chain $L^h(t)$ can be constructed by connecting a sequence of curve points $C(t_i^h) = C(i/2^h)$, for $i = 0, \cdots, 2^h$. Each line segment $L_i^h(t)$, $(t_{i-1}^h \le t \le t_i^h)$ connects the two endpoints of the corresponding curve segment $C_i^h(t) = C(t)$, $(t_{i-1}^h \le t \le t_i^h)$.

Part I: Design an interactive system that can show the BVH structure (i.e., the AABB tree and the OBB tree) for the polygonal chain $L^{10}(t)$. You may assume the pricipal direction of each OBB is along the line segment $L_i^h(t)$, for the levels $h = 0, 1, 2, \cdots 10$.

Part II: Design an interactive system that can control the shape of two cubic Bézier curves $C(t)$ and $D(s)$ by dragging their control points. Moreover, implement an algorithm for computing the intersection points between the two curves. Display the bounding volumes that have been used in the search for the intersection points.

Part III: Extend the algorithm of Part II to an algorithm that computes the self-intersection points for each curve. Display the bounding volumes that have been used in the search for the self-intersection points.