Programming #3: Part III (4190.410)

Due: November 18, 2016

Part I: Consider several planar cubic Bézier curves $C_i(t)$, $0 \le t \le 1$, $(i = 1, \cdots, 7)$, in the xy-plane, and the sweeping a right circular cone $z = \sqrt{x^2 + y^2}$ with its apex moving along the Bézier curves. Render the swept volume of the circular cone along each curve $C_i(t)$ using different color.

Part II: Consider a planar cubic Bézier curve $C(t)$, $0 \le t \le 1$, in the xy-plane, and 1025 sample points on the curve: $C(\frac{k}{1024}) = (\alpha(\frac{k}{1024}), \beta(\frac{k}{1024}))$, $k = 0, \cdots, 1024$. Render the right circular cones $z = \sqrt{(x - \alpha(\frac{k}{1024}))^2 + (y - \beta(\frac{k}{1024}))^2}$ using different color for each sample. Save the image in a separate frame buffer, and render a plane $z = r$, for $r > 0$, in black. For a query point $\mathbf{p}$, draw a line from the point to the minimum distance point on the curve $C(t)$.

Part III: Consider a planar object A bounded by two cubic Bézier curves $C_i(t)$, $0 \le t \le 1$, $(i = 1, 2)$, in the xy-plane, and similarly another planar object B bounded by five cubic Bézier curves $D_j(t)$, $0 \le t \le 1$, $(j = 1, \cdots, 5)$, in the xy-plane. Compute the image of the Minkowski sum $A \oplus B$ in the xy-plane.