David Salesin, 418 Sieg
Head TA: Doug Zongker

Week 7 study sheet: Surfaces

Problem 1 (5 points) Suppose that a swept surface is created by moving a 2-dimensional profile curve along a trajectory curve, and that the profile curve is oriented statically as it moves along the trajectory. Suppose also that the trajectory curve is given by $x^2 + y^2 = 1$. Draw an example of a profile curve for which the resulting surface is a surface of revolution. Specify the static frame you assume is being used to orient the profile curve.

Problem 2 (35 points)

We described Bézier tensor product surfaces as follows. Given a matrix V of control points V_{ij}, $i, j = 0, \ldots n$, we construct a surface $S(u, v)$ by treating the rows of V as control points for Bézier curves $C_0(u), \ldots, C_n(u)$, and then treating $C_0(u), \ldots, C_n(u)$ as control points for Bézier curves parameterized by v.

a) (15 points) Suppose that $n = 3$, and consider the resulting surface $S(u, v)$, $0 \leq u \leq 1,\ 0 \leq v \leq 1$. Give pseudocode for an adaptive subdivision algorithm for displaying $S(u, v)$. Your algorithm should output quadrilaterals in 3D, and should have the following property: For every u, v, $|D(u, v) - S(u, v)| \leq \epsilon$, where $D(u, v)$, $0 \leq u \leq 1,\ 0 \leq v \leq 1$ is the surface your algorithm displays.

Problem 1 (continued)

b) (10 points) One problem with using adaptive subdivision for displaying surfaces is that it is possible to inadvertently produce "cracks" between the quadrilaterals. Describe why such cracks occur and how you might fix your algorithm so that it no longer produced them.

c) (10 points) Write an expression for the normal to a tensor product cubic Bézier surface at $S(u, v)$.