# Programming #2: Part 2 (4190.562)

## Due: May 30, 2014

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 bounded by a hierarchy of unions of Tetrahedron Swept Spheres $O_{\epsilon_h}(T_{ij}^h)$, each bounding the surface patch $S_{ij}^h(u,v) = S(u,v)$, where $(i-1)/2^h \le u \le i/2^h$, $(j-1)/2^h \le v \le j/2^h$, for $i,j = 1,\cdots,2^h$. The tetrahedron $T_{ij}^h$ is determined by the four corners of $S_{ij}^h(u,v)$: $S((i-1)/2^h,(j-1)/2^h)$, $S((i-1)/2^h,j/2^h)$, $S(i/2^h,(j-1)/2^h)$, and $S(i/2^h,j/2^h)$. The radius $\epsilon_{ij}^h$ can be taken as

$$\begin{aligned}\epsilon_{ij}^h &= \frac{1}{2^{2h+3}}\cdot\max\{6\max_{k=1,2;0\le l\le 3}\|\mathbf{b}_{k+1,l}-2\mathbf{b}_{k,l}+\mathbf{b}_{k-1,l}\|,\\ &\qquad 6\max_{0\le k\le 3;l=1,2}\|\mathbf{b}_{k,l+1}-2\mathbf{b}_{k,l}+\mathbf{b}_{k,l-1}\|,\\ &\qquad 18\max_{k,l=0,1,2}\|\mathbf{b}_{k+1,l+1}-\mathbf{b}_{k+1,l}-\mathbf{b}_{k,l+1}+\mathbf{b}_{k,l}\|\}\end{aligned}$$

**Part II:** Design a system that can deform the shape of two bicubic Bézier surfaces $S_1$ and $S_2$ by moving their control points. Moreover, implement an algorithm for computing the intersection between the two deformable surfaces.