Programming #4: Part I (4190.562)

Due: May 14, 2018

Given a bicubic Bézier surface

$$S(u,v) = \sum_{i=0}^{3}\sum_{j=0}^{3} \mathbf{b}_{ij} B_i^3(u) B_j^3(v) = \sum_{i=0}^{3}\sum_{j=0}^{3} (x_{ij}, y_{ij}, z_{ij}) B_i^3(u) B_j^3(v),$$

for $0 \leq u, v \leq 1$, let $N(u,v)$ denote the unit normal vector field of $S(u,v)$:

$$N(u,v) = \frac{S_u(u,v) \times S_v(u,v)}{\|S_u(u,v) \times S_v(u,v)\|},$$

where $S_u(u,v)$ and $S_v(u,v)$ are the u- and v-partial derivatives of $S(u,v)$.

Part I: From an RGB image of size $(m+1)\times(n+1)$, convert the image into a discrete height field $h(i,j)$, $(i = 0, \cdots, m$ and $j = 0, \cdots, n)$, and generate a quad mesh of mn quadrangles and $(m+1) \times (n+1)$ vertices:

$$Q(i,j) = S\left(\frac{i}{m}, \frac{j}{n}\right) + h(i,j) \cdot N\left(\frac{i}{m}, \frac{j}{n}\right).$$

When we edit the bicubic Bézier surface $S(u,v)$, each point of the quad mesh $Q(i,j)$ should move to the corresponding new position under the shape deformation of $S(u,v)$.