Locations L_k

Control points C_{ij} | These are 3 vectors, components subbed by m

u,v estimates U_K

Height func z

$d = \sum_k \| L_{ik} - z(U_{ik}) \|^2$

$$d = \sum_k \| L_k - \sum_i \sum_j C_{ij} \binom{n}{i}\binom{n}{j} u^i (1-u)^{n-i} v^j (1-v)^{n-j} \|^2$$

$$\frac{\partial d}{\partial C_{ijm}} = \sum_k \| L_k - z(U_k) \|$$

$$d = \sum_K \sum_m \left(L_{km} - \sum_i \sum_j C_{ijm}\binom{n}{i}\binom{n}{j} u_K^i (1-u_K)^{n-i} v_K^j (1-v_K)^{n-j} \right)^2$$

call this S_{km}, doesn't depend on i,j

$$\frac{\partial d}{\partial C_{ijm}} = \sum_K \left[L_{km} - \sum_i \sum_j C_{ijm} \binom{n}{i}\binom{n}{j} u_K^i (1-u_K)^{n-i} v_K^j (1-v_K)^{n-j} \right].$$

$$\left[\binom{n}{i}\binom{n}{j} u_K^i (1-u_K)^{n-i} v_K^j (1-v_K)^{n-j} \right]$$

$$\frac{\partial d}{\partial u_K} = -2 \sum_m \left(L_{km} - S_{km} \right) \overbrace{\left[\sum_i \sum_j \binom{n}{i}\binom{n}{j} v_K^j (1-v_K)^{n-j} \right.}^{C_{ijm}} \cdot$$

$$\left. \left((1-u_K)^{n-i} i\, u_K^{i-1} - u_K^i (n-i)(1-u_K)^{n-i-1} \right) \right]$$

v_K is similar