Mesh Parameterization Demo

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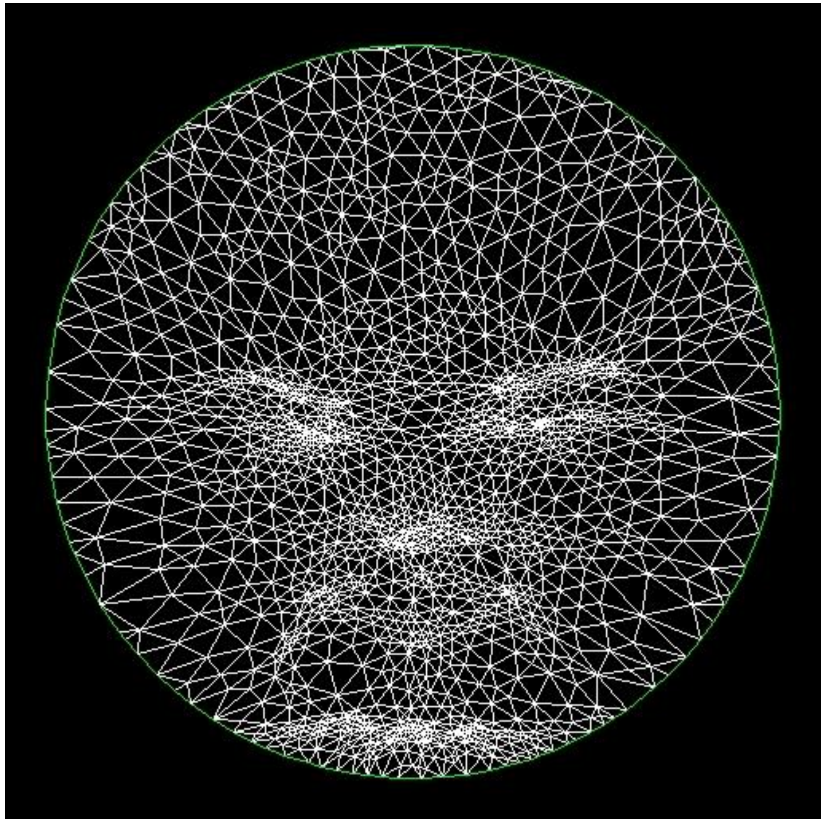
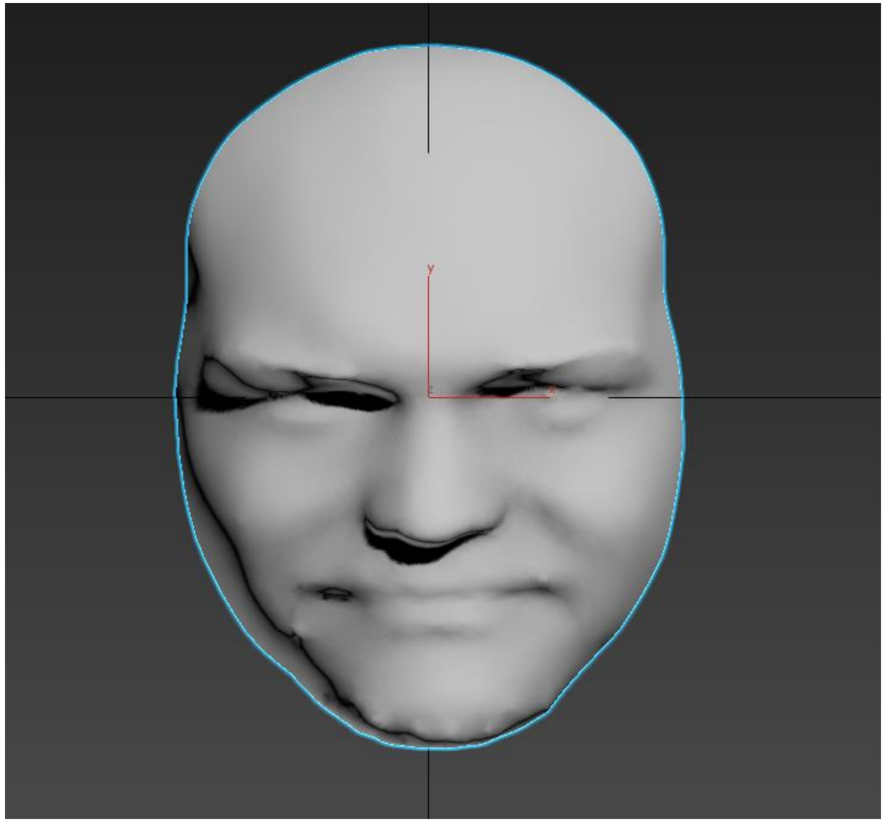
目標

- 將貼圖map到任意模型
- 保持貼圖呈現的完整性，儘量減少扭曲和模糊
- 實作Texture stretch metric
- 以黑白棋盤網格貼圖來確認貼圖的完整

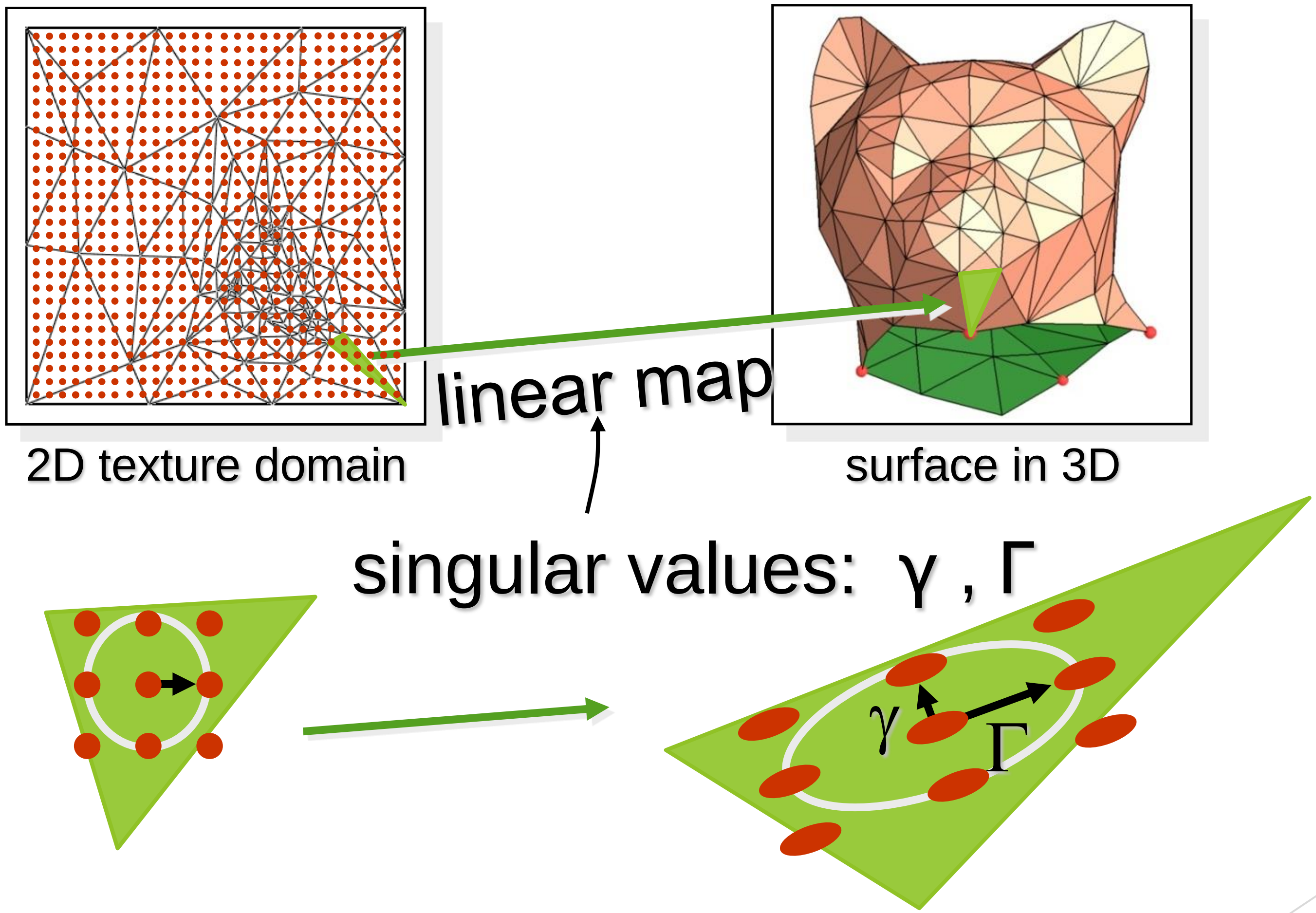
原UV Map



原本效果



Texture stretch metric實作

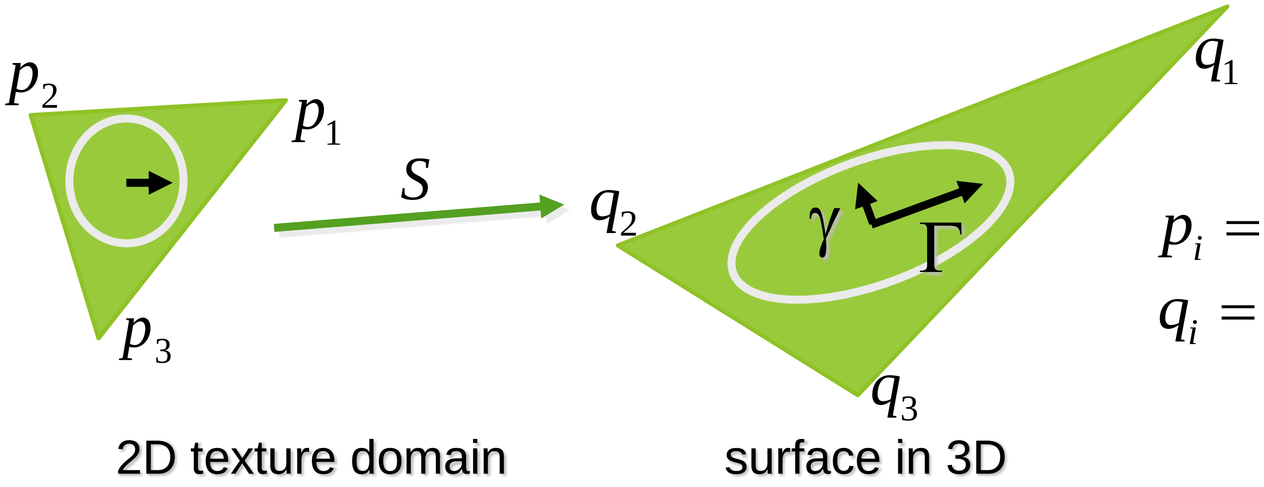


Texture stretch metric實作

$$S_s = \partial S / \partial s = \left(q_1 \left(t_2 - t_3 \right) + q_2 \left(t_3 - t_1 \right) + q_3 \left(t_1 - t_2 \right) \right) / (2A)$$

$$S_t = \partial S / \partial t = \left(q_1 \left(s_3 - s_2 \right) + q_2 \left(s_1 - s_3 \right) + q_3 \left(s_2 - s_1 \right) \right) / (2A)$$

$$A = \langle p_1, p_2, p_3 \rangle = \left(\left(s_2 - s_1 \right)\left(t_3 - t_1 \right) - \left(s_3 - s_1 \right)\left(t_2 - t_1 \right) \right) / 2$$



$$p_i = (s_i, t_i)$$
$$q_i = (x_i, y_i, z_i)$$

Texture stretch metric實作

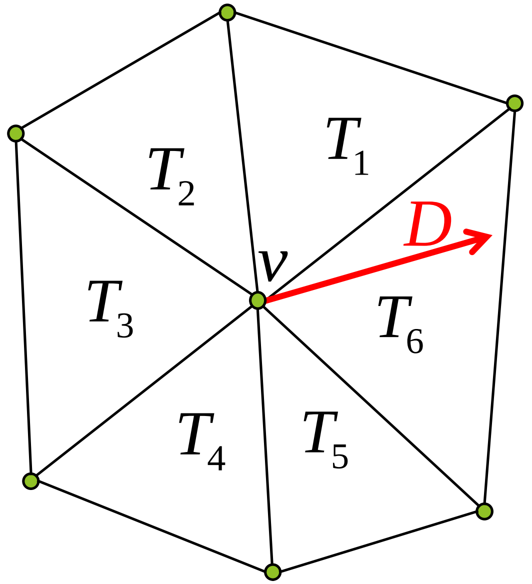
$$\Gamma = \sqrt{1/2\left((a+c)+\sqrt{(a-c)^2+4b^2}\right)}$$

$$\gamma = \sqrt{1/2\left((a+c)-\sqrt{(a-c)^2+4b^2}\right)}$$

$$a = S_s \cdot S_s \qquad b = S_s \cdot S_t \qquad c = S_t \cdot S_t$$

$$L^2(T) = \sqrt{\left(\Gamma^2+\gamma^2\right)/2} = \sqrt{(a+c)/2}$$

Texture stretch metric實作



$$distortion(v) = \sum_{i=1}^{k} L^2(T_i)$$

k : degree of v

- For each vertex *v*, randomly select a direction *D*, move *v* along *D* within 1-ring
- If *distortion*(*v*) is large than the last iteration, restore *v*
- Repeat this process until convergence

找出使distortion最小值的頂點位移

- 暫存頂點(初始為1,0)逆時針旋轉$\pi/8$，此向量乘上單位長度length(初始為1)
- 暫存向量加上原頂點的貼圖座標，作為此頂點的新貼圖座標
- 傳入與此頂點相鄰之頂點資訊來計算$L^2(T)$
- 加總$L^2(T)$成為distortion
- 作16次這樣的頂點位移，比較當前distortion和上一個distortion
- 當前distortion較大就恢復上一個頂點位移，反之則將單位長度length加1

- 假如distortion越來越小，有點接近半徑越來越大的螺旋狀位移

Demo

- 運行程式
- 觀察貼圖，滑鼠操作攝影機面對方向，WSAD操控前後左右
- 確認貼圖完整性

參考資料

- Texture Mapping Progressive Meshes, SIGGRAPH
- http://learnopengl.com/
- http://learnopengl-cn.readthedocs.io/zh/latest/