

Sample Test 3: Surfaces, Textures, Pipeline

August 24, 2024

- State any simple, reasonable assumption used to arrive at your answer.
- A ‘yes’ or ‘no’ answer without reasoning is worth 0 points.
- Zero points if the writing is hard to decipher. Use a black pen if in doubt.
- Indicate with arrow if you use the back of the previous page (last page for page 1).

1 Surface Patches

A patch \mathbf{p} in Bernstein-Bézier form has coefficients

$$\begin{bmatrix} 0 \\ 2 \\ 0 \end{bmatrix} \quad \begin{bmatrix} 2 \\ 2 \\ 0 \end{bmatrix}$$

$$\begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix} \quad \begin{bmatrix} 2 \\ 0 \\ 2 \end{bmatrix}$$

1. What is the degree? (1/2 point)
2. evaluate \mathbf{p} at $u = v = 0.5$ using DeCastejau’s algorithm. (1 point)
3. compute the normal \mathbf{p} at $u = v = 0.5$. (1 point)
4. A second patch in Bézier form has coefficients

$$\begin{bmatrix} -1 \\ 1 \\ b \end{bmatrix} \quad \begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix}$$

$$\begin{bmatrix} -1 \\ 0 \\ c \end{bmatrix} \quad \begin{bmatrix} a \\ 0 \\ 0 \end{bmatrix}$$

Determine a, b and c so that the two patches join smoothly. (1.5 points)

2 Texture Mapping

([3] points) Generalized subdivision algorithms, such as ‘subd’ in ‘blender’ work by repeatedly cutting off (sharp) edges and refining the polyhedron. How would you texture map a subdivision surface? That is, what is a good choice of texture coordinates?

3 Techniques and Concepts

[6] Describe, in a sentence or two, or using a sketch, the relationship of each of the following pairs of terms.

- (A) Clipping and the viewing frustum.

- (B) Painter’s algorithm and z-buffering.

- (C) Bump mapping and surface normals.

- (D) Bresenham’s algorithm and NURBS curves.

- (E) Global Illumination and the OpenGL lighting model.

(F) Scan line processing and the flood fill algorithm.