Lighting and Rasterization - Visible Surface Determination

Intended Learning Outcomes

- Understand the goal of visible surface determination
- Describe the method of back-face detection
- Describe the method of Z-buffer method
- Describe the m
- Able to progra ination techniques

Visible Surface Detection

- Also called Hidden Surface Elimination
- Only visible surfaces should be rasterized
- The problem is dle partially visible scenarios –
  - Concave objects
  - one object partially in front of each other

Three Methods

- Back-face detection (also called Culling)
- Z buffer (also called depth buffer)
- Ray Casting

- Back-face detection is always a preliminary test. It is fast and reduces about half of the workload before further processing.

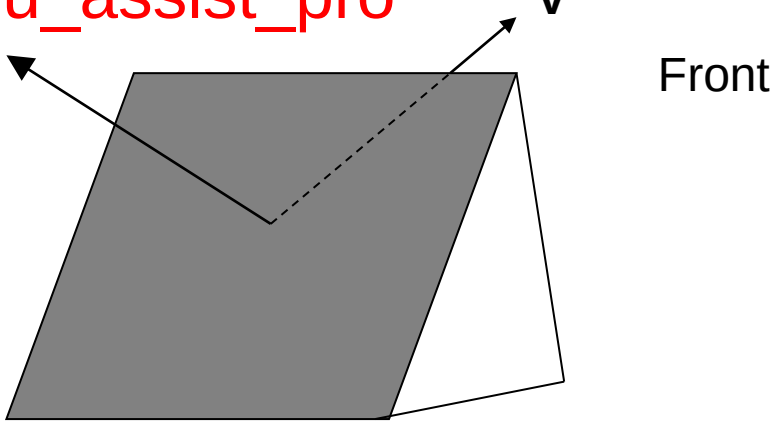
- Other methods also exist: e.g. painter's algorithm, A buffer method, …

Back-Face Detection /Culling

- Fast and simple
- Use as a preliminary step before more sophisticated visibility tests
- Eliminates ≈ 50% of faces from further consideration

$\mathbf{N}\cdot\mathbf{V} < 0 \Rightarrow$ b

$\Rightarrow$ eliminate



- Sometimes, **v** is replaced by the **VPN** for faster approximate processing

- Disadvantage: cannot handle concave object or partially overlapping object

Z Buffer

- Also called depth buffer method
- Two buffers
  - *Z* /Depth buffer : store depth values for each (x, y) position
  - *Frame* /*Refr* values for each (x,y) position

- Buffer stores the current visible surface information, values are updated as soon as new visible information found

Z buffer algorithm

Algorithm

1. Initialize the depth buffer and frame buffer so that for all buffer positions (x, y)

   depthBuff (x, y) = 1.0, frameBuff (x, y) = backgndColor

2. Process each p ime.
   a. for each proje polygon, calculate the depth z (if not
   b. If z < depthBuff(x, y), compute colour at that position and set

   depthBuff (x, y) = z, frameBuff (x, y) = surfColor (x, y)

   After all surfaces have been processed, the depth buffer contains depth values for the visible surfaces and the frame buffer contains the corresponding colour values for those surfaces.

Ray Casting

- retrace the light paths of the rays that arrive at the pixel
- for each pixel, send a ray from PRP that goes through the pixel
- find all intersec surfaces
- the nearest intersections is th rt of the surface for that pixel

Ray casting

Comparison of Z buffer and Ray Casting

Method	Good for situations
Z b	at cannot quately by simple ns
Ray casting	Objects that can easily be described by simple equations

OpenGL Functions

- Back face removal

  glEnable (GL_CULL_FACE);

  glCullFace (GL_BACK);

- Z Buffer

  glutInitDisplayMode (GLUT_ GLUT_RGB | GLUT_DEPTH);

  glClear (GL_DEPTH_BUFFER_BIT);

  glEnable (GL_DEPTH_TEST);

References

- Text: Ch. 16.1- 16.3, 16.10-11 for various visibility determination methods
- Text: Ch. 16.14 for OpenGL commands