CSCI 580 - Project
Shadow Mapping

Sijie Bu
Jessi Bustos
Shao Ling Tan

Shadow Mapping

- A natural extension to the z-buffering hidden surface removal
  - If a pixel is in shadow, then the light would not see it
- Need to be able to render 2 images:
  - One from the the perspective of the light source
  - One from the perspective of the viewer (camera)

Algorithm Description

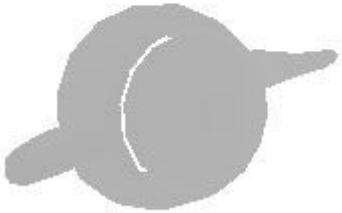
- Create additional renderers for each non-ambient light
  - Set each additional renderer with the view frustum of the given light
  - Render the shadow buffer images as usual
- In the main renderer
  - When computing the color of each visible pixel, do it for each light
    - Project the current pixel to light space
    - Compare the projected z-value with the shadow map z-value
    - If projected z-value is greater than the stored one, then it’s in shadow

Starting Point

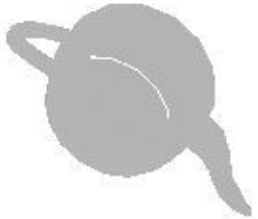
- Extended Gz Library from our homework 6 to allow for shadow mapping capabilities.
- Modified the base code to now include one main renderer and shadow map renderer(s).
    - Details on next slide

Algorithm Implementation (1)

- Modified the GzLight struct to contain a pointer to the corresponding shadow map renderer
- Modified the Application code to initialize the shadow map renderers, and push transformation matrices onto these renderers
- Added a “shadow map” rendering mode to the renderers, which skips color computation, and visualizes the shadow map with the z-value information



Shadow map #1



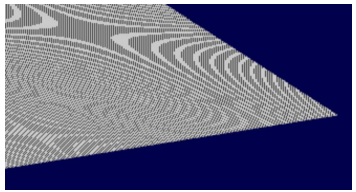
Shadow map #2

Algorithm Implementation (2)

- Shadow lookup and rendering in the rasterization process
- The Ximage of the main renderer is inverted to allow screen-space-to-image-space projections
- Each visible pixel is evaluated for shadow against every light
  - Projected first to image space, then to light space
  - Compare the projected z-value with the shadow map z-value
    - Use nearest-neighbor interpolation
  - Decrease the ambient and diffuse contributions of current light if the projected z-value is greater than the shadow map z-value

Artifacts

- Moiré-like pattern: shadow acne
  - Self-shadowing errors and
  - High frequency in nature
- Low-pass filtering with a bias value:
  - zPixel - zShadowMap > bias
- Note:
  - Bias too small: no effect
  - Bias too large: Peter Panning or no shadows at all



Bias: 8.8×10^6
(Peter Panning)

Bias: 8×10^7
(No shadows visible)

Different Shadow Bias

0 | 5 | 500 | 5×10^4 | 5×10^5

Thank You

Bibliography

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