Johns Hopkins
Engineering for Professionals

605.767 Applied Computer Graphics

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Module 8F
Other Shadow Techniques

Using Textures for Lighting and Shadowing

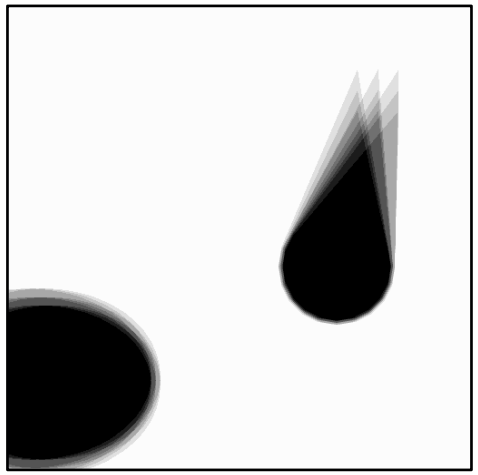
- Lighting can be precalculated and stored as a texture map
  - Including shadows
  - Can be stored as a modulated texture map of the surface
    - **Light map** or **Shadow Map**
- Shading is reduced to indexing a modulated texture or a light map
  - Light map texture is blended with the surface texture
  - Usually requires **multitexturing**
- Advantage
  - Very complex lighting computations can be performed during modeling stage
  - Ray-tracing and radiosity
    - Can produce soft shadows
- Disadvantage
  - Generally works best for static lights and objects, not dynamic scenes

Shadows as Projective Texture

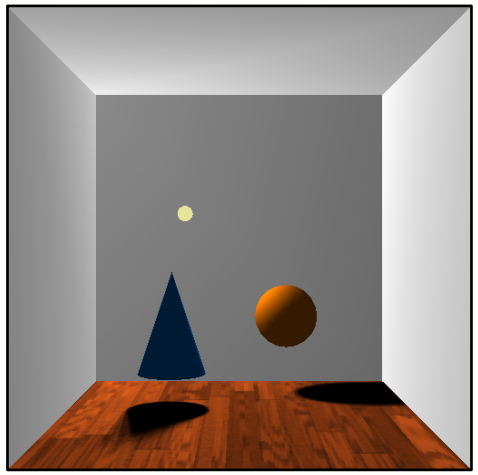
- Extends the idea of planar shadows to curved surfaces
- Imagine the occluder is rendered in black from the light source point of view
  - Into otherwise white texture
  - Project the texture onto the receiving surfaces
- Each vertex on the receivers has u,v computed for it
  - By the application or by texture projection functionality
- Known as a **shadow texture**
  - Differentiated from shadow mapping previously discussed
- Useful when silhouette of shadowing object does not change shape
  - Can reuse texture
- Downside: need to identify which objects are occluders and receivers

Rendering Soft Shadow Textures

- Fast soft shadows [Heckbert & Herf 96]
  - http://stereopsis.com/shadow/sig/cookbook.html
- Render a shadow texture
  - For each shadowed polygon, project all light-source-occluding polygons into the shadowed polygon's plane
    - Similar to projected shadow textures
    - Model area light sources as multiple jittered points
    - Use additive blending to accumulate all contributions
  - Copy resulting image to the shadow texture
  - Draw polygon in final scene with shadow texture



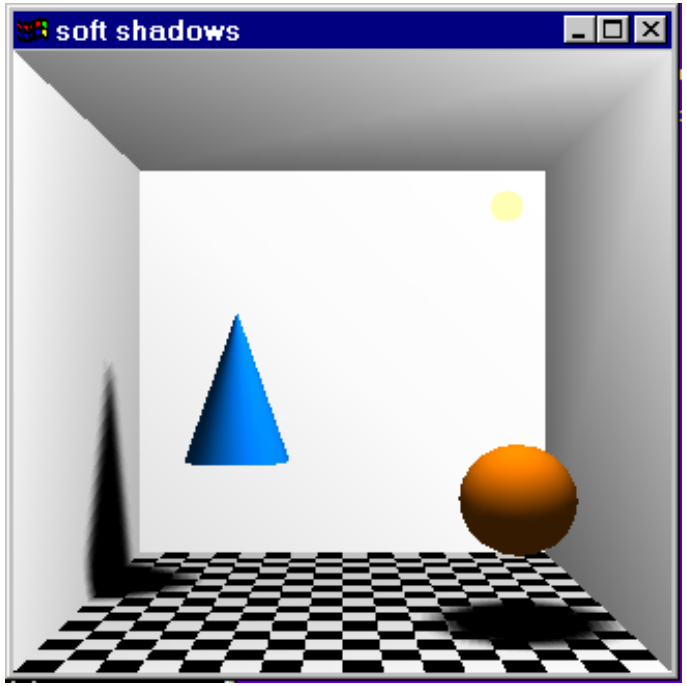
Shadow texture, accumulation of nine jittered occluder projections



Final resulting scene, shadow texture modulated with wooden floor

Soft Shadows or Shadows from Area Light Sources

- Make soft shadows (from area light sources)
  - Model an area light source as a collection of point light sources [Brotman & Badler 84]
  - Use accumulation buffer or additive blending to accumulate soft shadow



Multiple passes with shadow volumes and the light source slightly jiggled between passes. Accumulation buffer sums up the passes.

Shadow Summary

- Generally rendering system add-ons
  - Shadow map easiest to implement and works for complex scenes
    - API and hardware support is ubiquitous
  - Shadow volumes are less commonly used
  - Shadows on a ground plane - simple but works only for simple scenes
- Algorithms lack hardware implementation
  - Shadow map beginning to be supported in hardware
  - Requires 2 pass rendering though
- Computer graphics API standards lack standard support
  - Most do not support shadow generation
    - Other than through custom software and special tricks
  - OpenGL provides shadow map support using projective texture mapping

References

- Haines and Moeller
  - Chapter 7 (Section 9.1 in 3rd Edition)
- Watt
  - Chapter 9
- Watt and Watt (Advanced Animation and Rendering Techniques)
  - Chapter 5 is excellent
- NVidia web site
  - Many articles and slide presentations by Mark Kilgard
- OpenGL Web page
  - https://www.khronos.org/opengl/wiki/Code_Resources