

Shadows

- Seen in Ray Tracing and Radiosity
- Historical polygon algorithms
 - Appel, Bouknight-Kelley, Weiler-Atherton
- Shadow polygons/volumes
 - Crow, Bergeron, Brotman, Chin
 - Hardware use
- Z-buffer algorithm
 - Williams, Reeves
- Soft shadows, Fake Shadows, etc.

Historical polygon algorithms

- Appel - 1968, IBM
 - Drawing on plotter, symbols used for shading
 - Shading, shadows fill in line drawing by...
tracing rays
 - Contour lines
 - Quantitative invisibility

Historical polygon algorithms

- Bouknight and Kelley - 1970 - U. of Illinois
 - Scanline algorithm (ref. Evans, Warnock, G.E.)
 - Y then X then Z sorting of edges
 - stop where each edge crosses scan in order
 - Polygons projected on sphere around light to find potential occluders
 - Vertices of occluding polys projected on active polygons

Historical polygon algorithms

- Weiler-Atheron - cookie cutter approach
 - Sort front-to-back, clip by visible edges
 - Do from light source view, modify polygons
 - Do for each light source
 - Sector space if light source in view
 - Re-do with modified data from view point
 - Very hard to get cookie cutter right

Shadow Polygons/Volumes

- Sutherland/Crow
 - Polygons projected from polygon edges
 - Limited to silhouettes to cut work
 - Silhouettes at back/front shared or unshared edges
 - Polygon neighbors data structure used
 - “Quantitative shadowing” by counting frontfacing (+1) and backfacing (-1) shadow polygons
- Bergeron
 - Extended to non-planar polygons by treating them separately
 - Introduced “Sphere of influence”

Shadow Polygon Hardware

- Apple Quickdraw 3D accelerator
 - Scanline depth buffer
 - Shadow polygons counted in separate pass
- PixelPlanes
- PowerVR
 - Videologic/NEC
 - in Dreamcast
 - Plane evaluation scheme allows large polygons

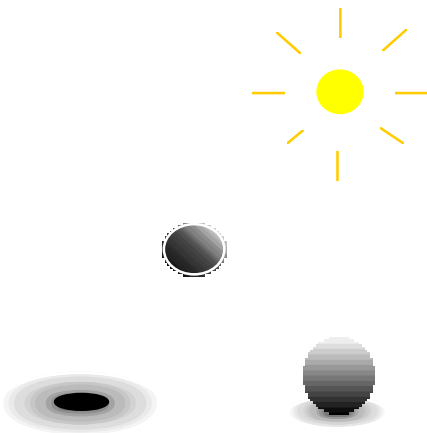


Shadow Polygon Extensions

- Extended to curved surfaces by Blinn ('78)
- Soft Shadows (Brotman)
 - Tiled 64x64 deep frame buffer (more data)
 - Volumes cast from multiple samples of light source
 - Effect of volumes summed to define shadow
- BSP tree shadow volumes (Chin/Feiner)
 - Scene BSP traversed from light source to build Shadow polygon BSP

Fake Shadows

- Objects projected on ground plane (Blinn)
 - Added to geometry or texture maps or added to scene as polygon, dark or transparent
- Really fake shadows
 - Hint of darkness



Z-Buffer Shadows

- Williams ('78)
 - Get depth image from light source
 - Create viewpoint image
 - Map from view space to light source space, check if depth same as in shadow depth buffer
 - Major sampling problems, Self-shadowing?
Object Tags?
- Reeves et al ('87)
 - Percentage closer filtering averages shadow state over a small region to soften edges

Other Hacks

- Using Texture mapping hardware
- Convolution of shadow maps

Tough issues

- Self shadowing on bump-mapped or displacement-mapped surfaces
- Shadows in particle systems, under trees, etc.
- Fur, etc.



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