

ECE 595 / CS 491 / CS 591
**Real-Time Rendering &
Graphics Hardware**

Pradeep Sen
Advanced Graphics Lab

Class 15
March 21, 2007

Announcements

- This Friday, GFX Café kickoff!
12 noon, ECE 237
- HW#3 handed out soon

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Last time

- Went over the midterm

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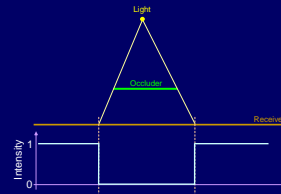
Today

- Real-time soft shadow algorithms

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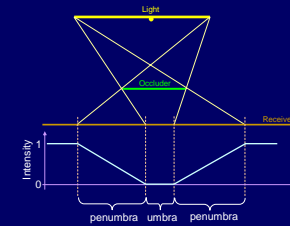
Hard shadow configuration



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Soft shadow configuration

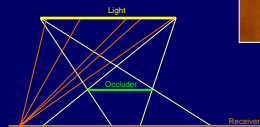


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How's it handled in offline algorithms?

- Distributed ray tracing



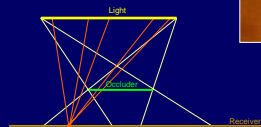
Cook et al. 1984

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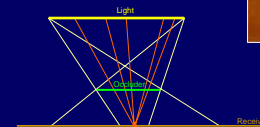
Cook et al. 1984

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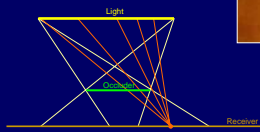
Cook et al. 1984

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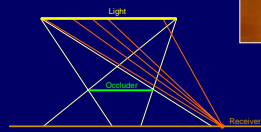
- Distributed ray tracing



Cook et al. 1984

How's it handled in offline algorithms?

- Distributed ray tracing



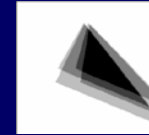
Cook et al. 1984

Heckbert and Herf (1997)

Multiple hard-shadow textures are generated, registered and averaged together to emulate a soft shadow. This is done by projecting the occluding polygons onto the receiving surface and blended together.

Drawback: need to render from a lot of samples or else banding artifacts are highly noticeable. Receivers can only be planar.

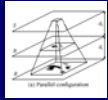
A 2x2 sampling on the light source gives a highly banded "soft" shadow



From Heckbert et al.

Soler and Sillion (1998)

In certain configurations, shadowing process can be modeled by convolution of light source and occluders.



From Soler et al.

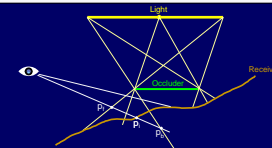
Soler and Sillion (1998)

Drawback: single convolution kernel per shadow image. Thus need to break down images into many clusters and has trouble handling objects with very distinct distances to the light.



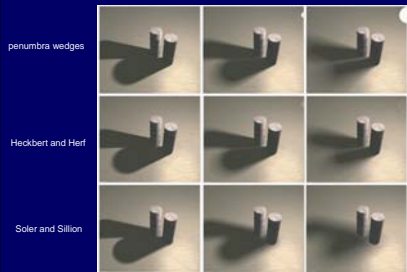
From Akenine-Moller et al.

Penumbra Wedges – Akenine-Moller et al. (2002)



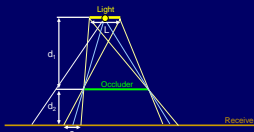
```
void rasterizeWedge() {
    for each visible fragment (x,y) on front-facing triangle of wedge {
        pr = computeEntryPoint(x,y);
        po = computeExitPoint(x,y);
        p = point(x,y,z);
        p1 = choosePointClosestToEye(po, p);
        sr = computeLightIntensity(pr);
        s1 = computeLightIntensity(p1);
        addToIBuffer(round(255 * (s1 - sr)));
    }
}
```

Penumbra Wedges – Akenine-Moller et al. (2002)

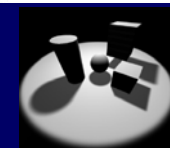
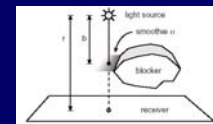


from Akenine-Moller et al.

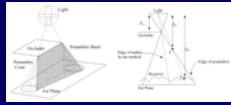
Approximation



Smoothies – Chan et al. (2003)

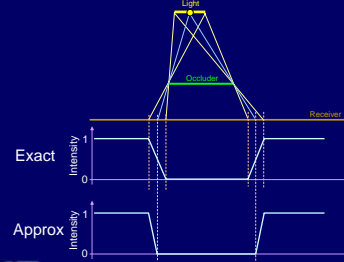


Penumbra maps – Wyman et al. (2003)



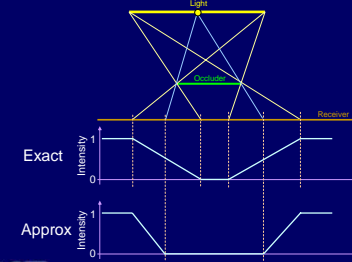
Smoothie approximation

Reasonable approximation when light is small.



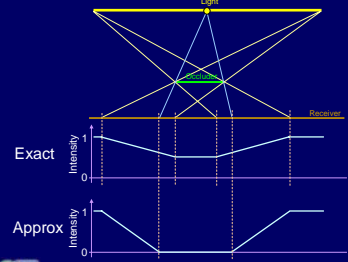
Smoothie approximation

Approximation gets worse as light gets bigger.

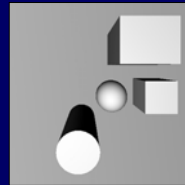


Smoothie approximation

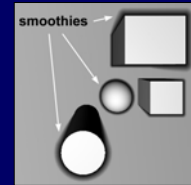
Cannot handle case in which umbra disappears!



Overview of smoothie algorithm



light's view (blockers only)



light's view (blockers + smoothies)

Next slides courtesy of Eric Chan

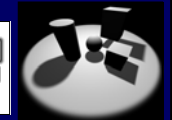
Overview of smoothie algorithm



depth map

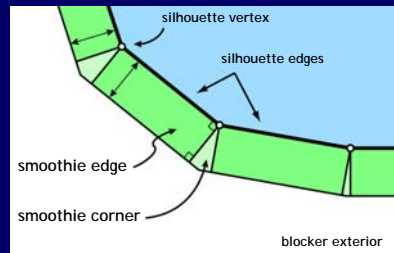


smoothie buffer

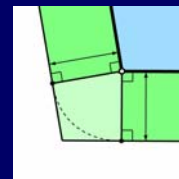


final rendering

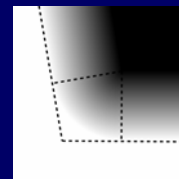
Construction of smoothie geometry



Smoothie shading



geometry



shading

Reading

- STAR report Soft Shadows