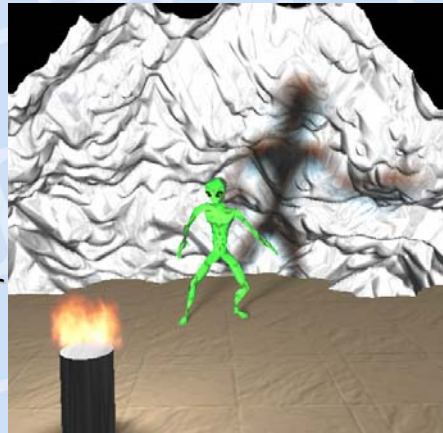


A Geometry-Based Soft Shadow Volume Algorithm Using Graphics Hardware

Ulf Assarsson
and
Tomas Akenine-Möller

SIGGRAPH 2003



We present:

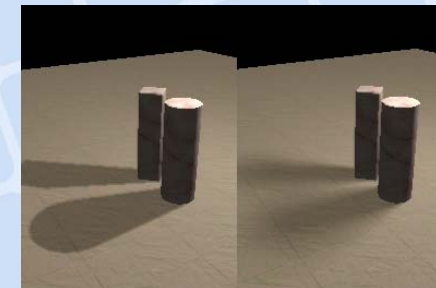
A Soft Shadow Volume Algorithm:

- Area light sources
- Simple volumetric light sources
- Textures and short video textures as lights
- Real-time performance with programmable graphics hardware
- Approximate soft shadows
 - Trade speed vs accuracy

Intro demo



A short recap...

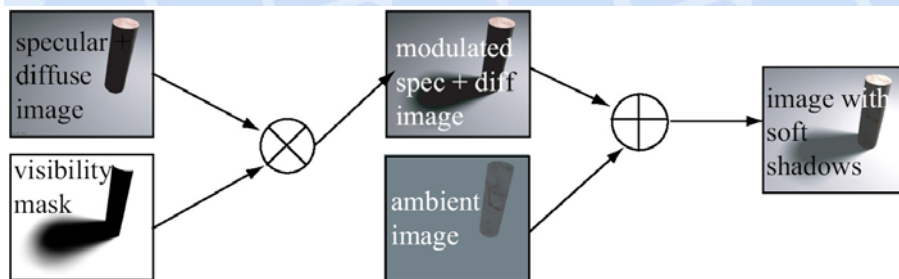


HARD SOFT

Area/volumetric lights give soft shadows

- Real lights have area or volume
- Thus, soft shadows more realistic

Overview

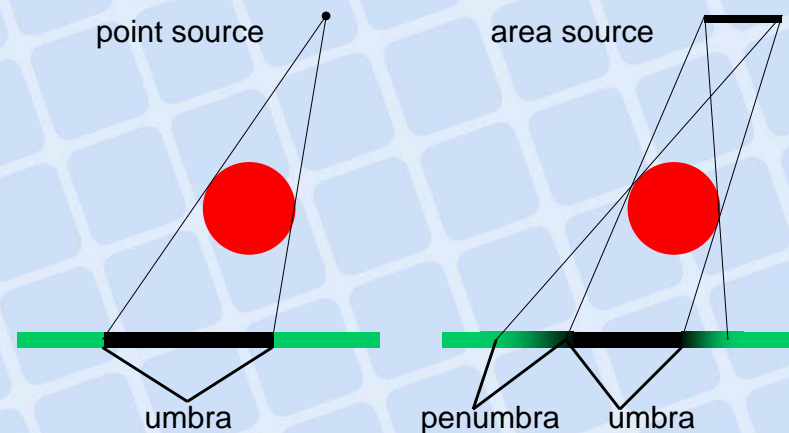


Computation of visibility mask:

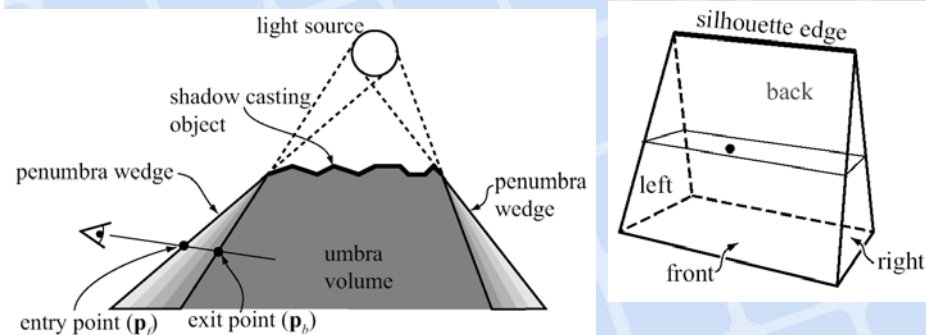
- 1st pass: Render hard shadow
- 2nd pass: compensate for overstated umbra

Hard vs. soft shadows

Two different light source types:



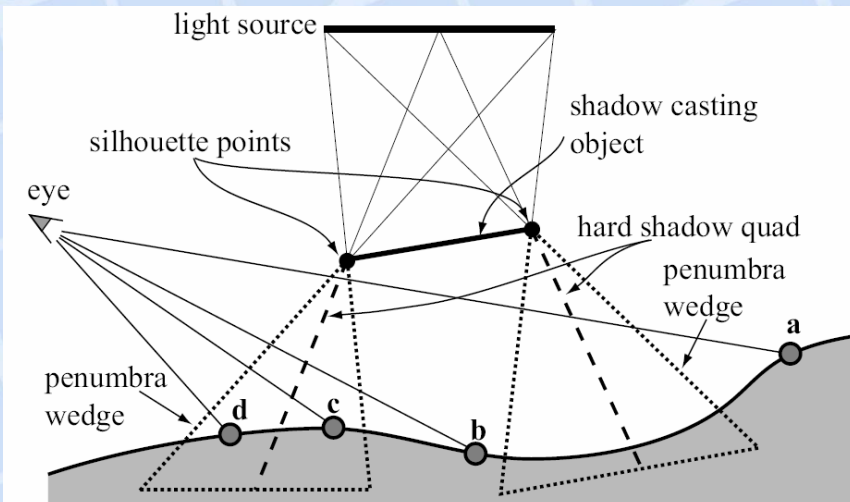
A Real-Time Soft Shadow Volume Algorithm



Wedges

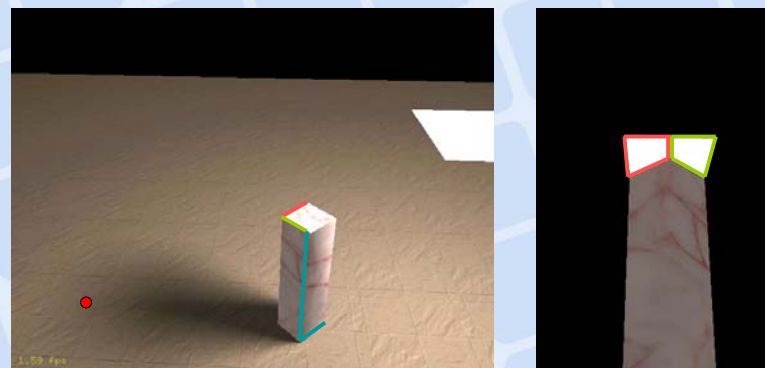
- Each silhouette edge has a corresponding wedge
 - Provides a piece of penumbra contribution
 - Rasterized by pixelshader

Two-pass algorithm

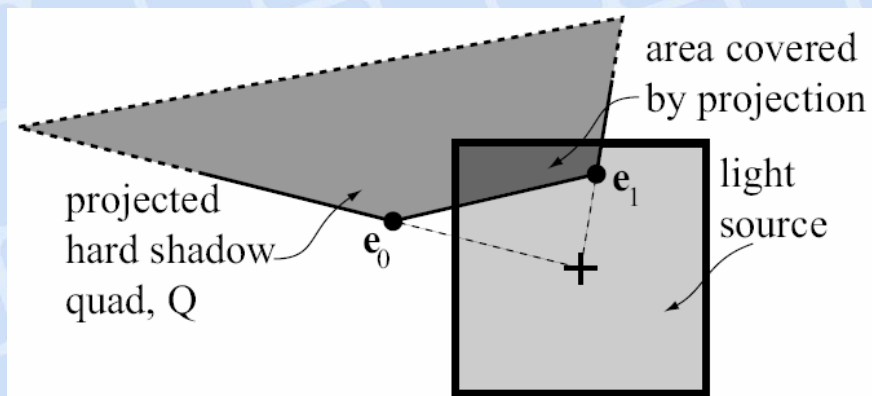


Visibility computation

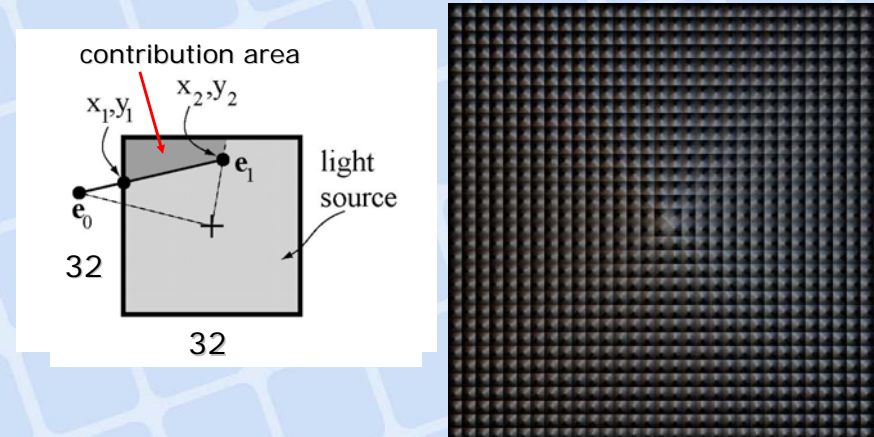
- Really want to compute how much we can see of the light source



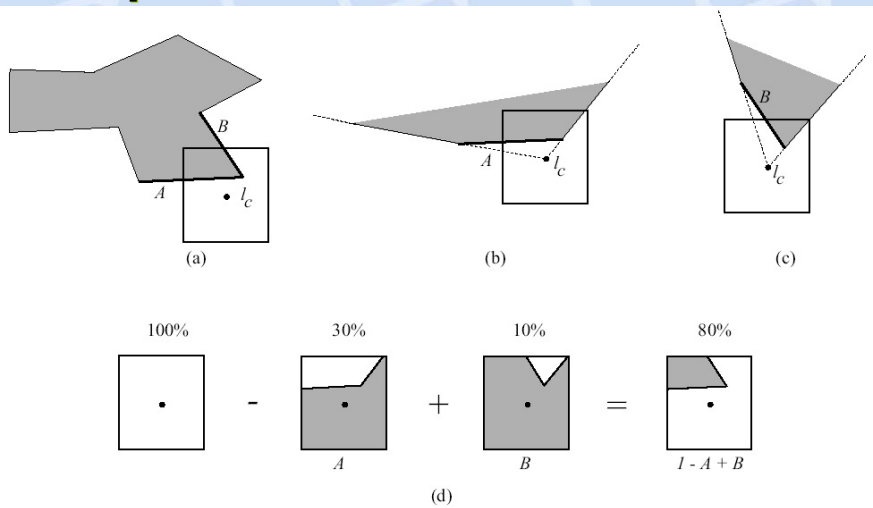
Visibility computation



Precomputed contribution in 4D textures



How the visibility computation works:



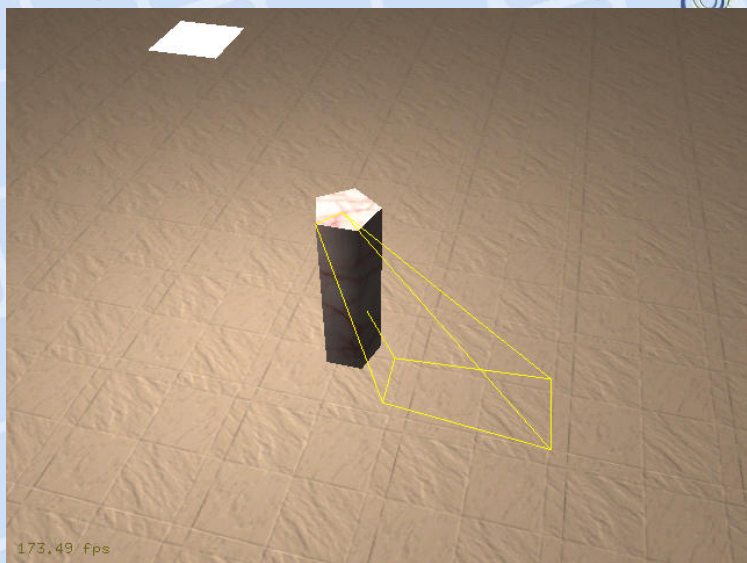
Rasterize a wedge

```

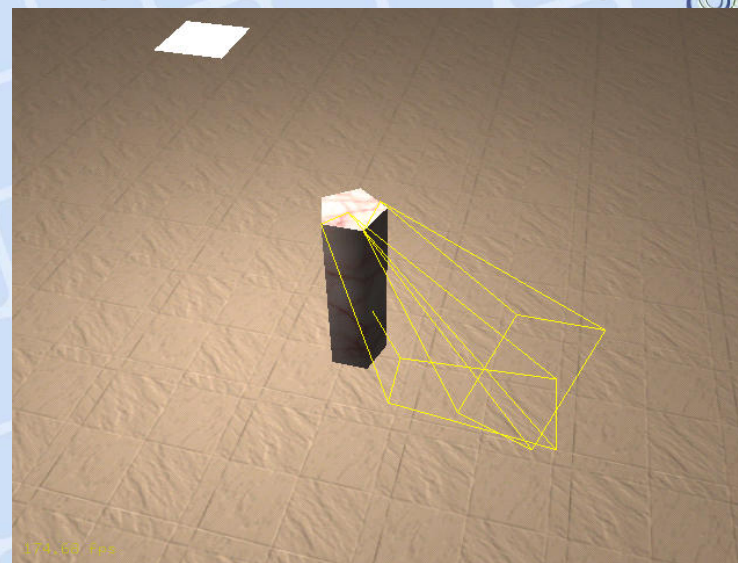
rasterizeWedge(wedge  $W$ , hard shadow quad  $Q$ , light  $L$ )
for each pixel  $(x,y)$  covered by front facing triangles of wedge
   $\mathbf{p} = \text{point}(x,y,z)$ ; //  $z$  is depth buffer value
  if  $\mathbf{p}$  is inside the wedge
     $v_{\mathbf{p}} = \text{projectQuadAndComputeCoverage}(W, \mathbf{p}, Q)$ ;
    if  $\mathbf{p}$  is in positive half space of  $Q$ 
       $\bar{v}(x,y) = \bar{v}(x,y) - v_{\mathbf{p}}$ ; // update V-buffer
    else
       $\bar{v}(x,y) = \bar{v}(x,y) + v_{\mathbf{p}}$ ; // update V-buffer
    end;
  end;
end;

```

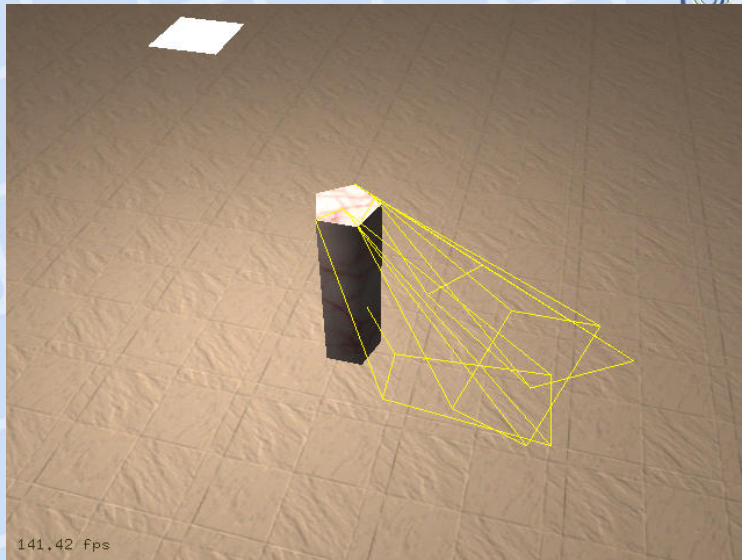
A wedge for each silhouette edge...



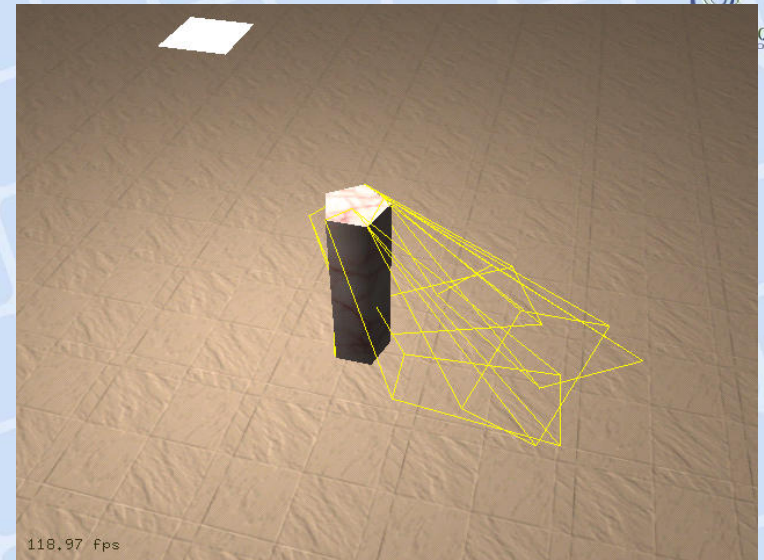
A wedge for each silhouette edge...



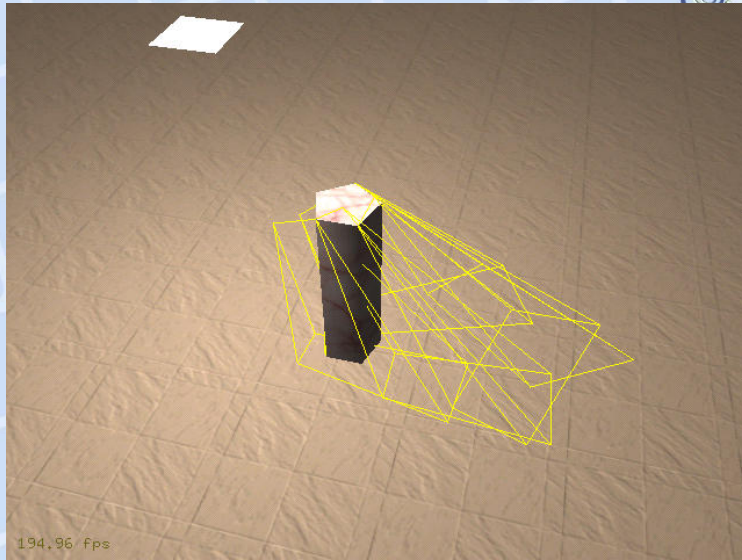
A wedge for each silhouette edge...



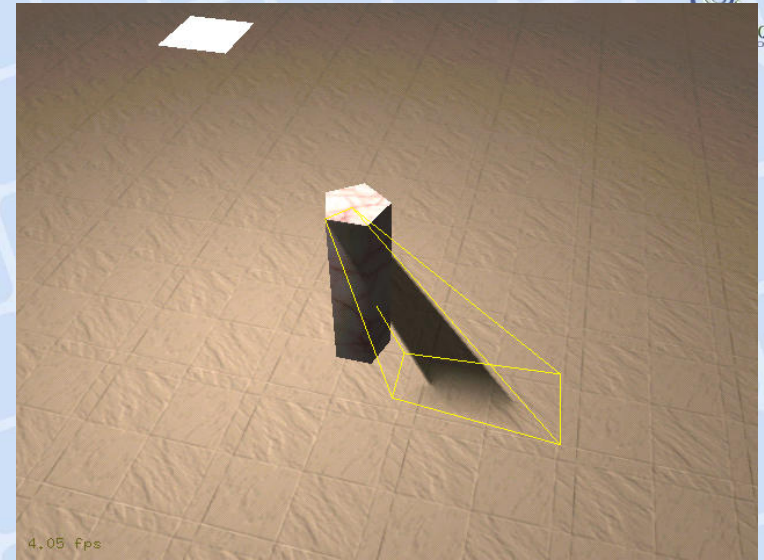
A wedge for each silhouette edge...



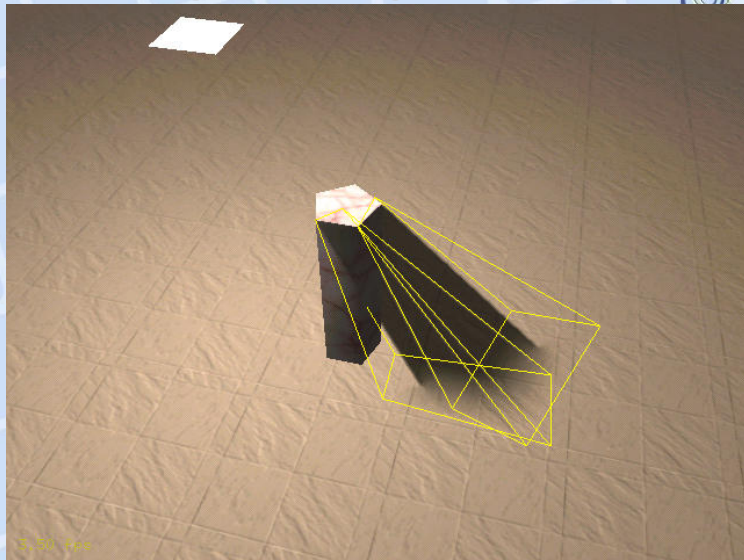
A wedge for each silhouette edge...



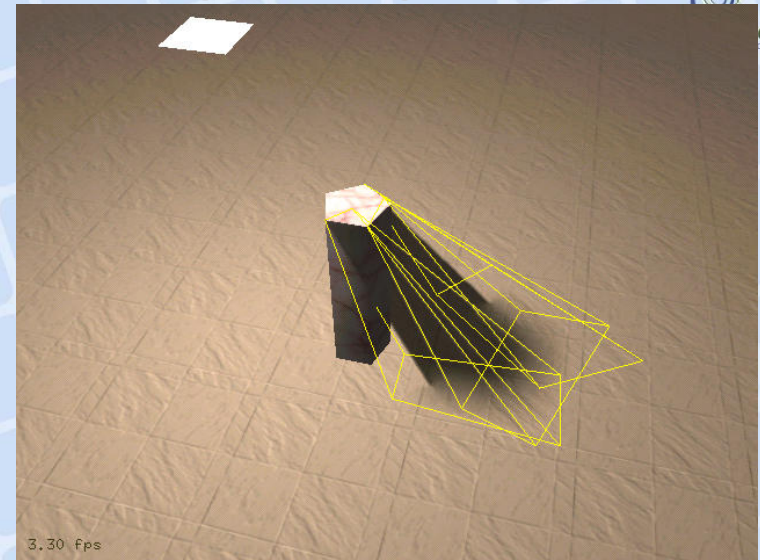
Rasterizing the wedges



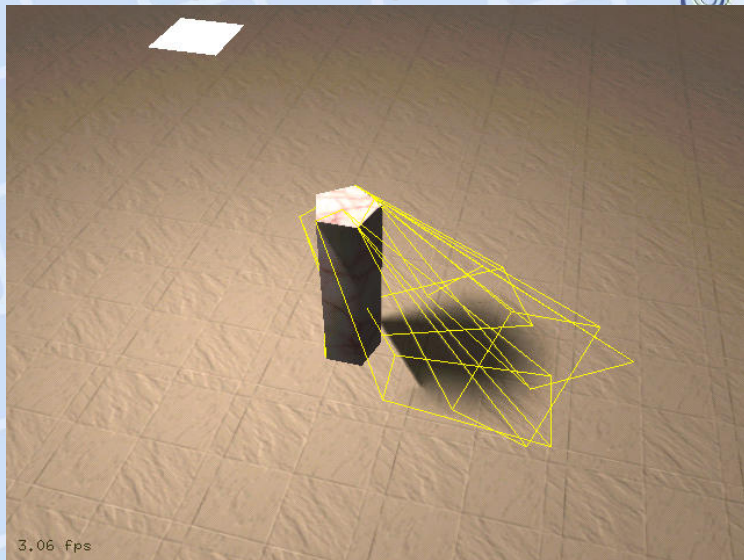
Rasterizing the wedges



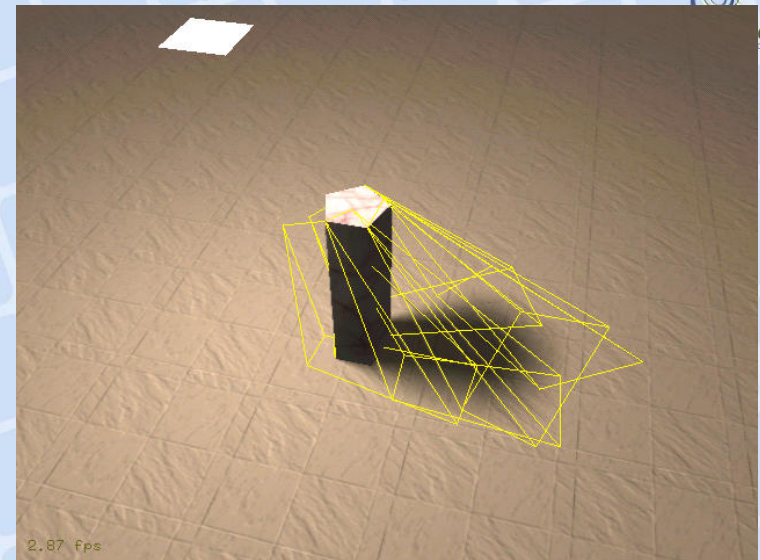
Rasterizing the wedges



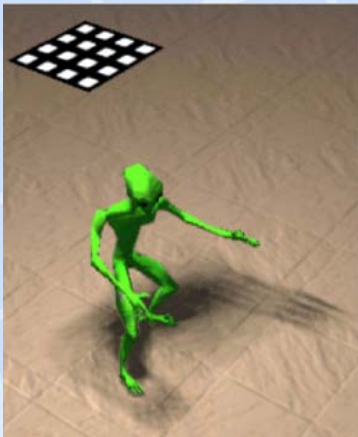
Rasterizing the wedges



Rasterizing the wedges



Examples using textured lights



Texture of 16 area lights

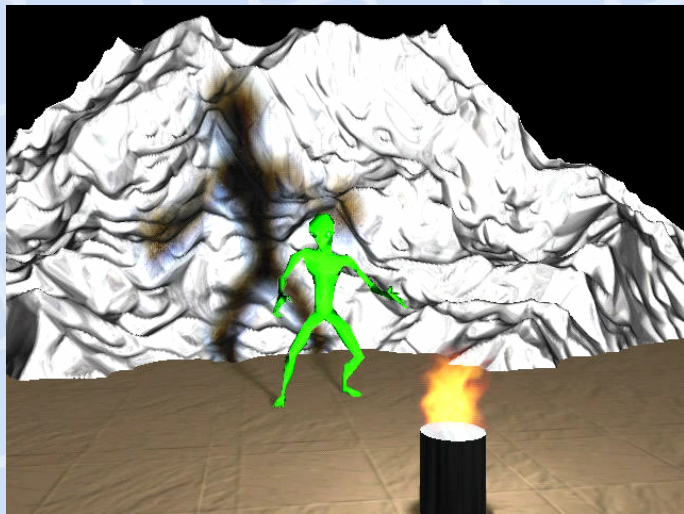


Texture of two colors

Fire Demo

Animated Textured Light Sources

Fire Demo



Comparisons

CUBIC CUBIC

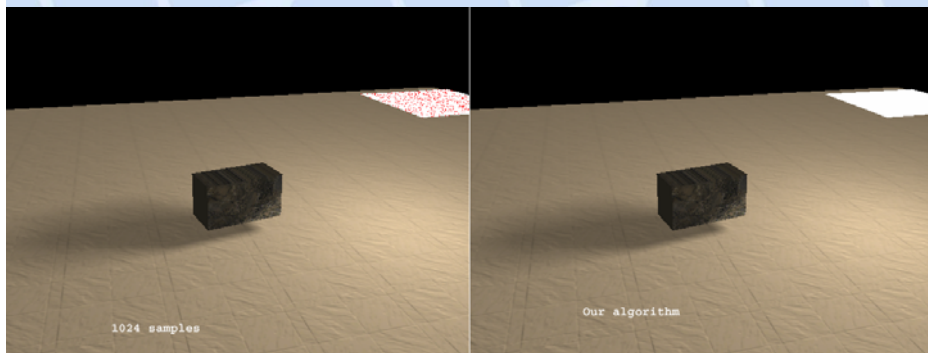
1024 samples

our algorithm

Reference image

Our algorithm

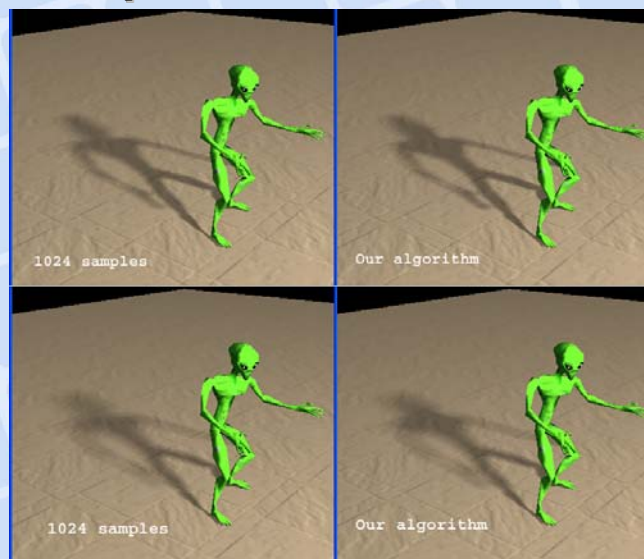
Comparisons



Reference image

Our algorithm

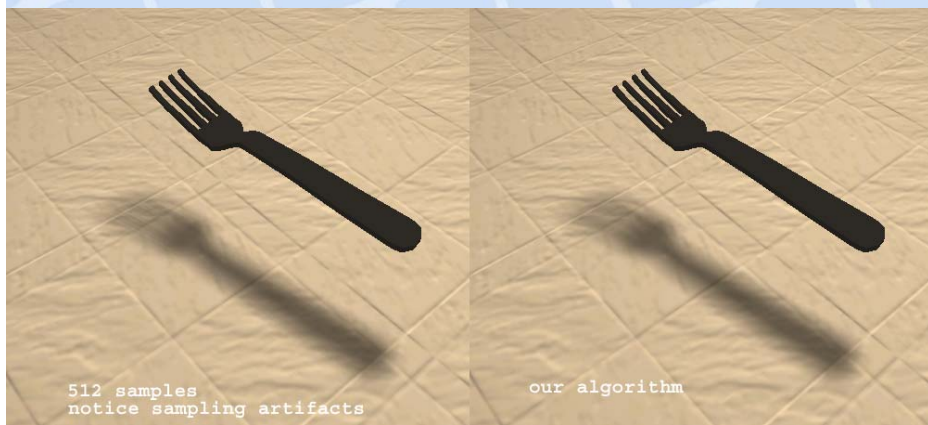
Comparisons



Small light source

Large light source

Comparisons



512 point lights

Our algorithm

The Last Demo



Multiple Light Sources