Lecture Notes #12 - More ray tracing

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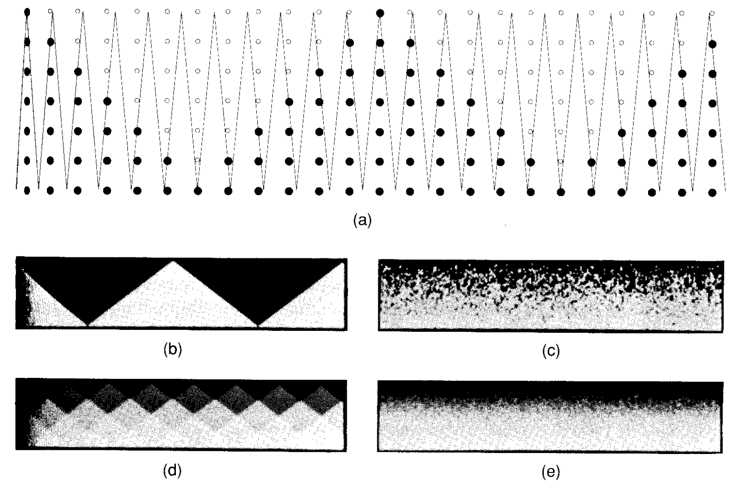
Reading

• Angel: 10.1-10.4, 10.10

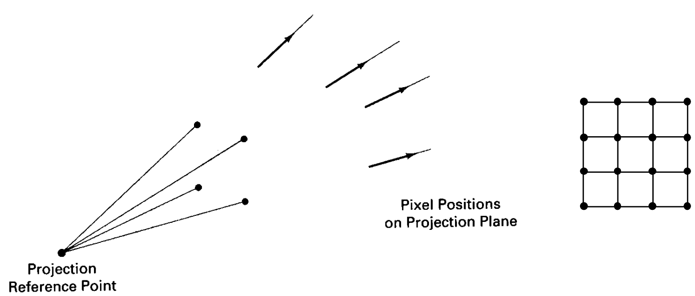
• Foley et al.: 16.3, 16.4, 16.6, 16.11, 16.12

Aliasing vs. Noise

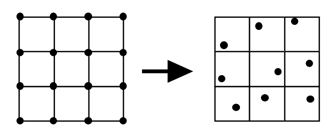


Antialiasing

One straightforward way to do antialiasing is to supersample, either uniformly or adaptively:



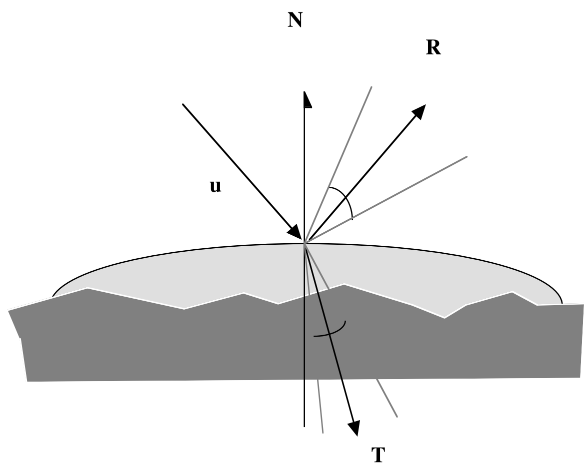
Distributed (stochastic) ray tracing



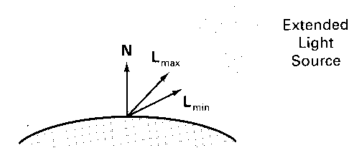
Idea:

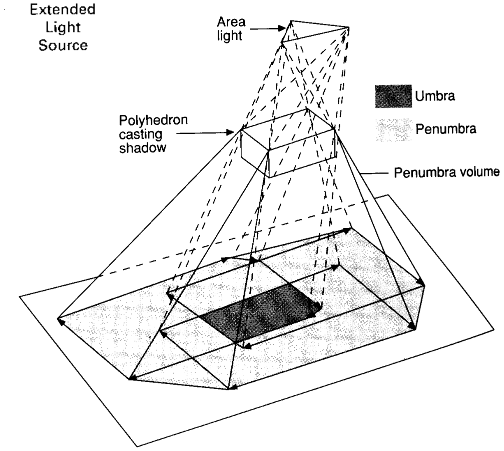
- Use non-uniform (jittered) samples.
- Replace aliasing artifacts with noise.
- Provides additional effects by distributing rays in other dimensions:
  - Reflection and refractions
  - Texture mapping
  - Light source area
  - Camera lens area
  - Time

Distributing over reflection and refraction

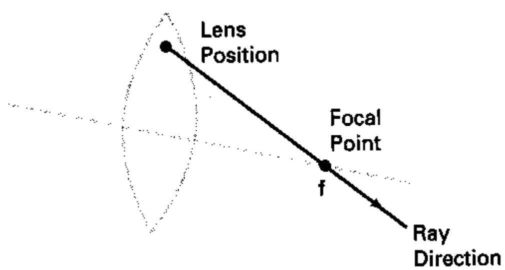


Distributing over light source area

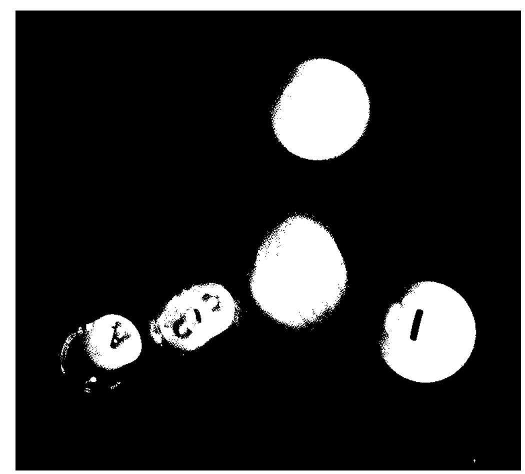




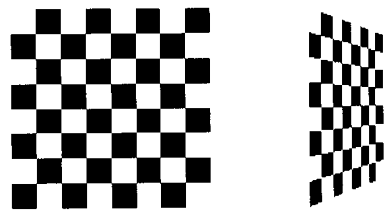
Distributing over a finite aperture



Distributing over time



Texture maps



With parametric texture mapping, texture size and orientation are tied to the polygon.

Idea:

- Separate "texture space" and "screen space"
- Texture the polygon as before, but in texture space
- Deform the textured polygon into screen space

MIP-maps

We need to antialias textures too.

Solid textures

Q: What kinds of artifacts might you see from using a wood-grained veneer instead of real wood?

One solution is to use "solid textures":

- Use model-space coordinates to index into a 3D texture
- Like "carving" the object from the material

One difficulty of solid texturing is coming up with the textures...

Bump mapping

Textures can be used for more than just color.

In "bump mapping," a texture is used to perturb the normal:

- The normal is perturbed in each parametric direction according to the partial derivates of the texture:
- These bumps "animate" with the surface

Q: What artifacts in the images would reveal that bump mapping is a fake?

Example textures

Bump mapping

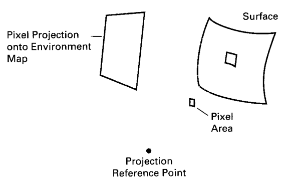
Solid texture

Displacement mapping

In "displacement mapping," a texture is used to perturb the surface geometry itself:

- Gives rounded edges, even on silhouette
- Requires doing hidden surface after shading

Environment mapping



In "environment mapping" (also known as "reflection mapping"), a texture is used to model an object's environment:

- Rays are bounced off objects into environment
- Color of the environment used to determine color of the illumination
- Really, a simplified form of "ray tracing," in which rays bounce around among objects in the scene
- Environment mapping works well when there is just a single object -- or in conjunction with ray tracing

Example environment map