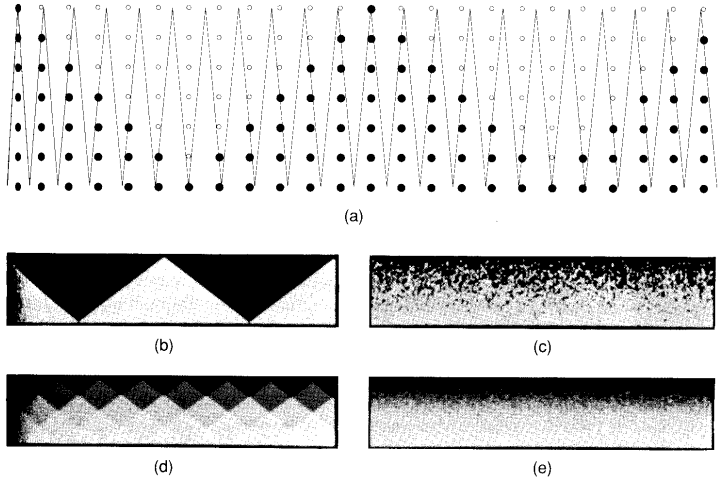
## Lecture Notes #12 - More ray tracing

Reading

- Angel: 10.1-10.4, 10.10
- Foley et al.: 16.3, 16.4, 16.6, 16.11, 16.12



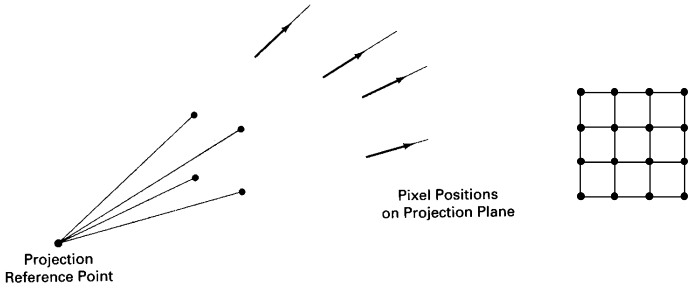
## Aliasing vs. Noise





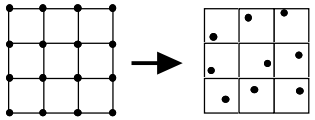

## Antialiasing

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





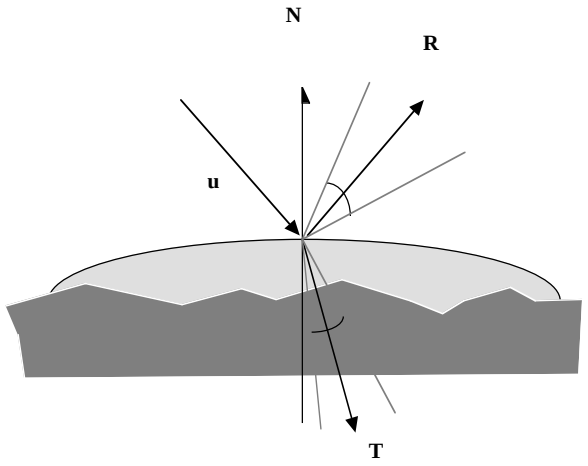

## Distributed (stochastic) ray tracing



Idea:

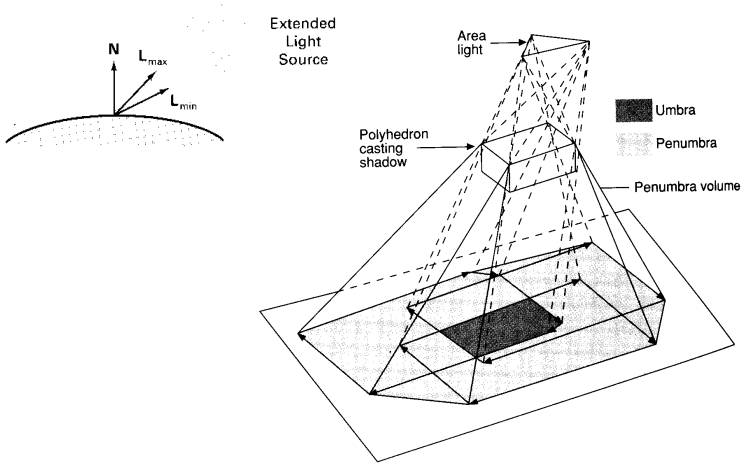
- Use non-uniform (jittered) samples.
- Replace aliasing artifacts with noise.
- Provides additional effects by distributing rays in other dimensions:
  - Reflection and refractions
  - Texture mapping
  - Light source area
  - Camera lens area
  - Time

## Distributing over reflection and refraction



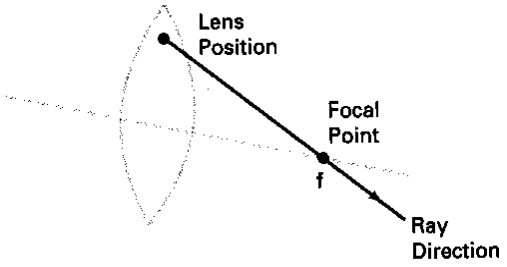



## Distributing over light source area



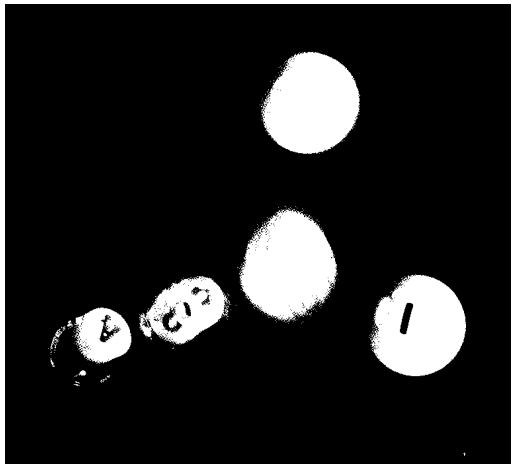



## Distributing over a finite aperture

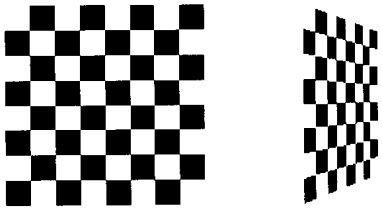





## Distributing over time



## 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



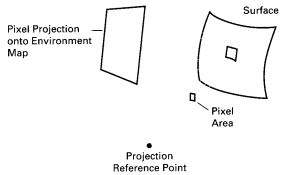
## Displacement mapping

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