CS 543:
Computer Graphics

Advanced Texture Mapping

Robert W. Lindeman
Associate Professor
Interactive Media & Game Development
Department of Computer Science
Worcester Polytechnic Institute
gogo@wpi.edu

(with lots of help from Prof. Emmanuel Agu :-)

WPI
Texturing

- Created/manipulated using image-processing software...
  - Photoshop
  - Illustrator
- ...or computed from a scene description
  - Radiosity
  - Ambient occlusion
- Mapped to geometry (models)
- Very powerful image enhancing techniques
  - Can be used for fake shadows, fake reflections, much more
Mapping to Models

- Objects are made from
  - Geometry (a.k.a., polygons)
  - Lighting
  - Textures

- Vertices and connectivity
  - Triangles
  - Triangle-strips
  - Meshes
  - Patches/surfaces
Textures

- Images that are applied to geometry
- Many ways to apply textures
  - Decal
  - Blend
  - Layer
- Can use for other things as well
  - Height fields
  - Environment mapping
  - Bump mapping
  - Displacement mapping
  - …
Scenes
Texture Mapping Example
Texture Mapping Example
Texture Detail Settings

Depth of Field

Depth of Field

Problems?
Bump Map Example: Texture
Bump Map Example: Bump Map
Bump Map Example

Advanced Mapping Techniques

- Parallax Mapping
- Ambient Occlusion
- Horizon Mapping
- Baked-on Radiosity
Parallax Mapping Closeup
Parallax Mapping Example

Ambient Occlusion

- Sometimes called “Sky Light”
- Lighting models (e.g., Phong lighting) often consist of three types of lights
  - Ambient
    - Light that is just there because of light bouncing around the scene
  - Diffuse
    - Light that is proportional to the surface direction/distance to light sources
  - Specular
    - Highlights that change depending on the location of the viewer
Ambient Occlusion (cont.)

- Ambient light is often just a constant.
- In “reality”, it is not constant, but rather is influenced by occluders.
  - Light reaching points under a desk or inside a tube will be darker than others.
- Ambient occlusion mapping pre-computes how much a point is blocked (occluded) by other surfaces in a scene, then applies it as a texture layer.
Ambient Occlusion Calculation

- How could you calculate this for a given point $p$ in a scene?
- Can you do it at runtime?
Ambient Occlusion: Example 1

Without Ambient Occlusion

With Ambient Occlusion
Ambient Occlusion:
Example 2 (StarCraft II)

http://starcraft2.hu/2011/01/11/extrame-graphics-options/
Ambient Occlusion: Example 2 (StarCraft II)

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http://starcraft2.hu/2011/01/11/extrame-graphics-options/
Ambient Occlusion: Example 3

Horizon Mapping

- Works like parallax mapping, but takes into account light sources
- Can be done dynamically
Horizon Mapping: Example 1

Horizon Mapping: Example 2

Dynamic Horizon Mapping


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Radiosity

What is it?
Example of Blending
Blending Result
Skybox Rendering

- Create *really big* a cube around the world
- Texture each side with a sky texture
Sources of Textures

- Computer-generated
  - Complete control, might not be realistic
  - Generate a repeating pattern
  - Generate a random pattern (like noise)
  - Simulate physical properties

- Digital camera
  - Realistic, but hard to control
  - Can stitch into mosaic

- Hybrid
  - Start with a photo, edit as necessary