IMGD 4000
Technical Game Development II
Advanced Texture Mapping

Robert W. Lindeman
Associate Professor
Interactive Media & Game Development
Human Interaction in Virtual Environments (HIVE) Lab
Department of Computer Science
Worcester Polytechnic Institute
gogo@wpi.edu
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 Example
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)

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

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

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
Resources

- Nice place for textures (pay)
  - http://shop.3dtotal.com/