Texture Mapping

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Textbook Appendix A4, Chapter 15

Today

- Texture mapping examples
- Conceptual foundations of texture mapping
An example scene from Pixar’s Bolt

Figure 12: A final production still from “Bolt” using Ptex for all models. (© Walt Disney Animation Studios)

http://ptex.us/ptexpaper.html

Another Example

Source: (result of random web search)
C³ Review: Shading

- Which one of the following factors may affect the colour of a pixel?
  a) Light sources
  b) Surface material
  c) Viewer position
  d) Transport of light
  e) All of the above

C³ Review: Shading

- What is the shading technique used in the following picture?
  a) Phong Shading (per-fragment normal)
  b) Gouraud Shading (per-vertex normal)
  c) Global Illumination
  d) None of the above
Normal mapping

- The data from a texture can also be interpreted in more interesting ways.
- In normal mapping, the r,g,b values from a texture are interpreted as the three coordinates of the normal at the point.
- This normal data can then be used as part of some material simulation.

Environment cube maps

- Textures can also be used to model the environment in the distance around the object being rendered.
- In this case, we typically use 6 square textures representing the faces of a large cube surrounding the scene.
**Projector texture mapping**

- There are times when we wish to glue our texture onto our triangles using a projector model, instead of the affine gluing model.
- For example, we may wish to simulate a slide projector illuminating some triangles in space.

![Projector texture mapping](image1)

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**Shadow mapping**

- The idea is to first create and store a z-buffered image from the point of view of the light, and then compare what we see in our view to what the light saw in its view.

![Shadow mapping](image2)
Understanding Texture Mapping

What is texture mapping?

- Lots of different views….
  - Most common: it’s gluing images onto objects

Understanding Texture Mapping

- Better view: An efficient way to model surface detail using discrete (sampled) data
- Need to understand two surprisingly subtle concepts
  - “Coordinates”
    Parameterization of surfaces
  - “Images”
    Sampled representations of continuous functions
    More details in Chapters 16-18. We’ll be covering this at a high level.

An intuitive example
How to model the earth?
Earth (texture) Map
The simplest, intuitive scenario

Coordinates of Vancouver?

3D

\( u, v \)

\((-123^\circ, 49^\circ)\)

\((-180^\circ, -180^\circ)\)

Coordinate functions

\( (\mathbf{v}) = \Phi(\mathbf{p}) \)

Continuous

2D "Map" or "Chart"

\( I(u, v) \)

Discretize

Discrete Image

\( I[i][j] \)

Generalizations & Issues

- Don't need a single chart, chart can be discontinuous (piecewise continuous) and local
- E.g. Pixar's Ptex - per-face textures
- E.g. Book Fig 15.1
- Discretization of texture image can interfere with rasterized image

Artifacts:
  - aliasing (aka "jaggies")

Need to "filter" the image appropriately