Texture Mapping

Dinesh K. Pai

Textbook Appendix A4, Chapter 15

1

Today

- Announcements
  - Assignment 3, 1(c) had a typo in the formula. Now fixed in the repo. (Thanks for catching that!)
  - Q2 and A2 marks available on Monday
- Wrap up transforming normal
  - Repeat after me: “Normals are not normal”
- Introduction to Texture Mapping

2

Transforming Normals (wrapup)

October 27, 2017 9:56 AM

Important special cases

- If A is a pure translation

$$A = \left[\begin{array}{c|c} I & p \\ \hline & 1 \end{array}\right]$$

$$A\vec{v} = A \begin{pmatrix} v \\ 0 \end{pmatrix} = \begin{pmatrix} v \\ 0 \end{pmatrix}$$

Translations have no effect normal

- If A is a pure rotation

$$A = \left[\begin{array}{c|c} R & \\ \hline & 1 \end{array}\right]$$

$$(A^{-1})^T = A$$

Rotations affect tangents & normals in the same way

- A combination of these "Rigid Motion"

Also OK

Others, e.g. scaling (non-uniform) a big problem ⇒ source of hidden bugs

$(A^{-1})^T$ is sometimes called 'Normal matrix'

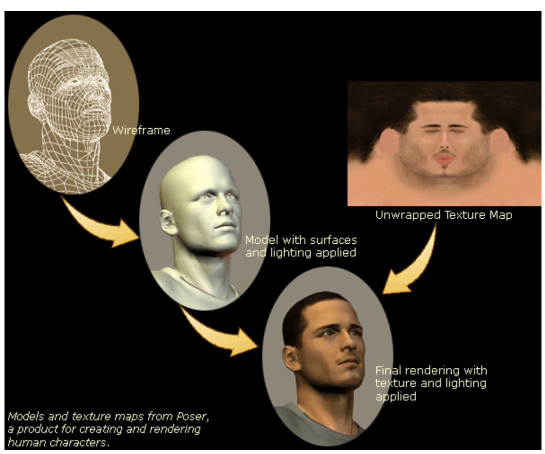
An example scene from Pixar's Bolt

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

http://ptex.us/ptexpaper.html

3

Another Example



Source: (result of random web search)
http://blog.gamerdna.com/2007/03/27/anatomy-of-an-mmorpg/

4

Texel ≡ texture Element

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. Variations: "bump maps" & 'displacement maps"

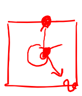
Slide courtesy of Min Kim, KAIST

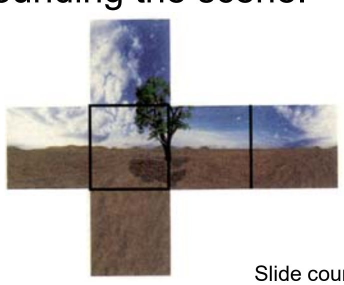
5

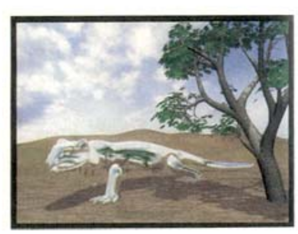
More important now with availability of "360°" Cameras and VR/AR

Environment cube maps

- Textures can also be used to model the environment in the distance around the object being rendered. Variations: 'Spherical Env. Maps'
- In this case, we typically use 6 square textures representing the faces of a large cube surrounding the scene.







Slide courtesy of Min Kim, KAIST

6

Was old fashioned but now important as a way to color objects imaged with "RGBD" Cameras eg. Kinect, iPhone X

Projector texture mapping

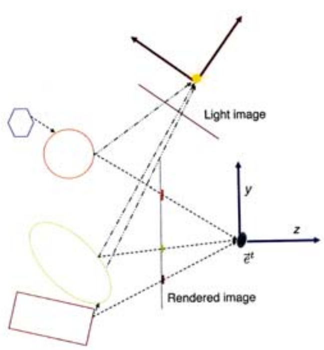
- There are times when we wish to glue our texture onto our triangles using a *projector* model, instead of the affine gluing model.
- For example, we may wish to simulate a slide projector illuminating some triangles in space.

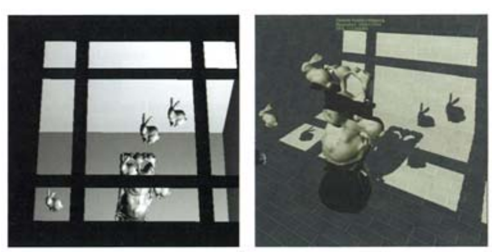
Slide courtesy of Min Kim, KAIST

7

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.





Slide courtesy of Min Kim, KAIST

8

Understanding Texture Mapping

What is texture mapping?

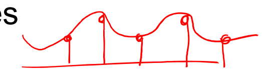
- Lots of different views….
  - Most common: it's gluing images onto objects

http://en.wikipedia.org/wiki/File:Blind_men_and_elephant3.jpg

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

    "Curvilinear"



  - “Images”
    Sampled representations of continuous functions
    More details in Chapters 16-18. We’ll be covering this at a high level.

11