

Games with Texture Mapping

CS 4620 Lecture 15

Recall first definition...

Texture mapping: a technique of defining surface properties (especially shading parameters) in such a way that they vary as a function of position on the surface.

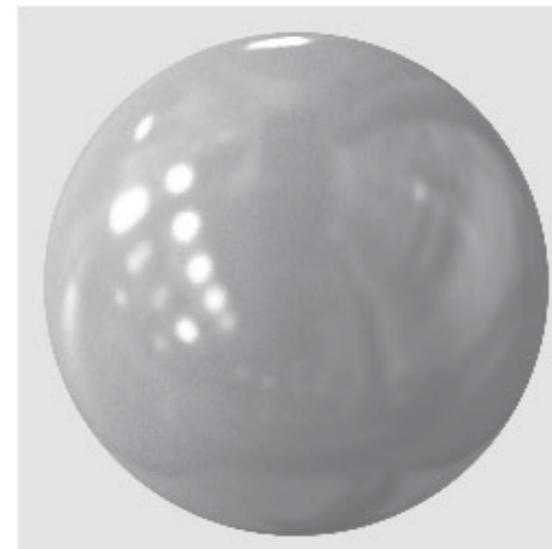
A refined definition

Texture mapping: a set of techniques for defining functions on surfaces, for a variety of uses.

- Let's look at some examples of more general uses of texture maps.

Reflection mapping

- Early (earliest?) non-decal use of textures
- Appearance of shiny objects
 - Phong highlights produce blurry highlights for glossy surfaces.
 - A polished (shiny) object reflects a sharp image of its environment.
- The whole key to a shiny-looking material is providing something for it to reflect.



(a)



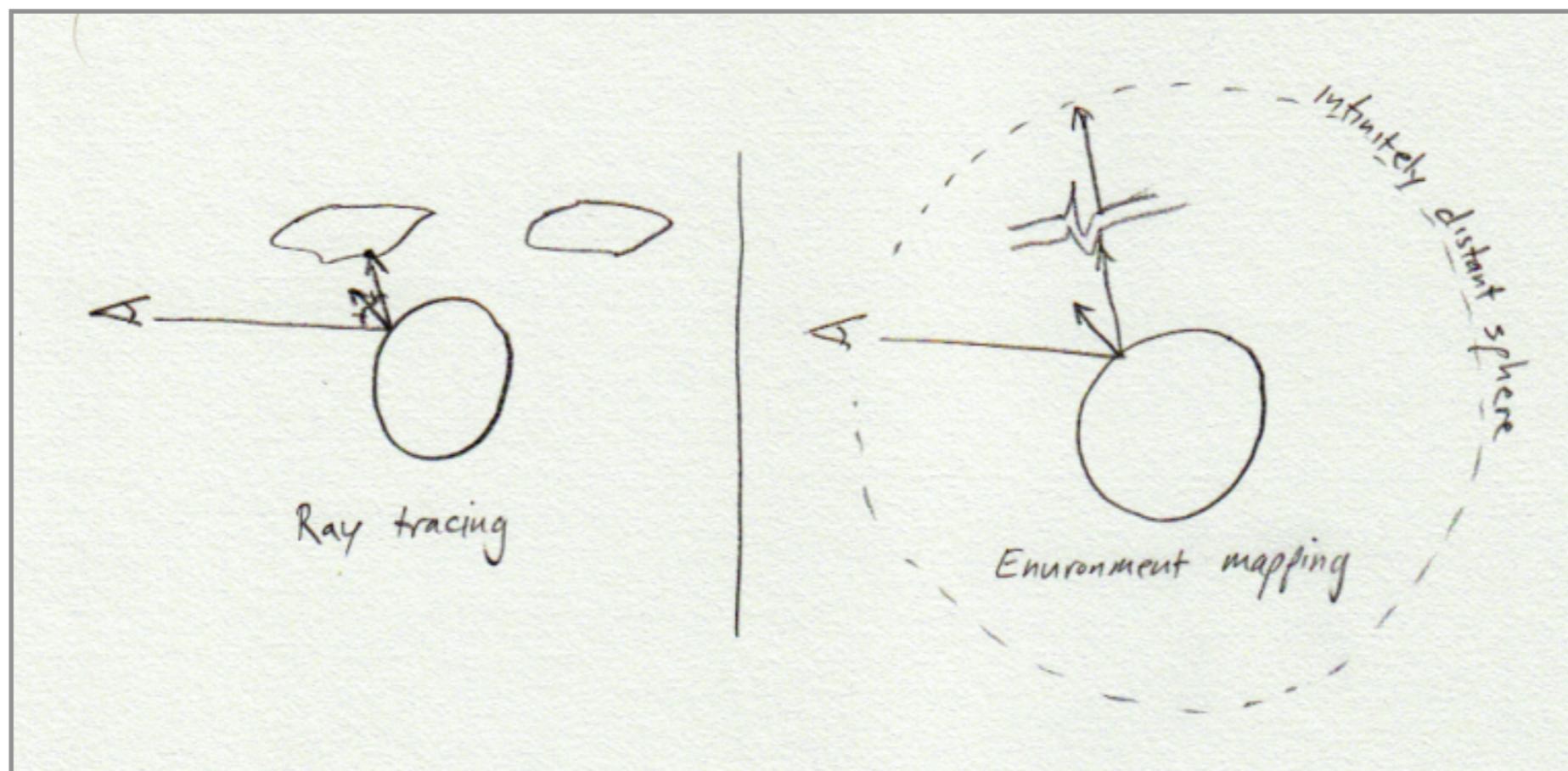
(b)

[Dror, Willsky, & Adelson 2004]

Figure 2. (a). A shiny sphere rendered under photographically acquired real-world illumination. (b). The same sphere rendered under illumination by a point light source.

Reflection mapping

- From ray tracing we know what we'd like to compute
 - trace a recursive ray into the scene—too expensive
- If scene is infinitely far away, depends only on direction
 - a two-dimensional function



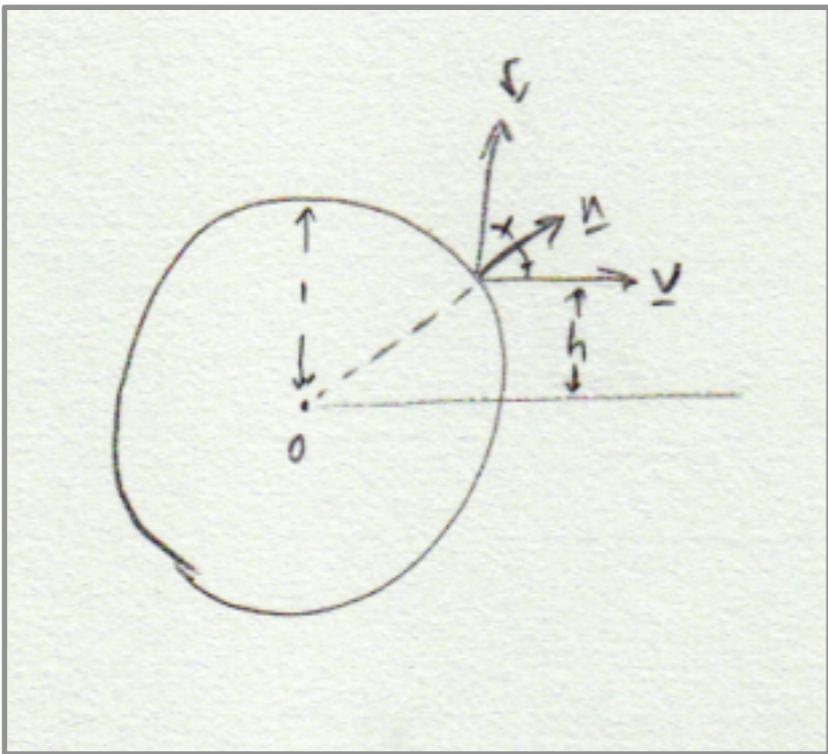
Environment map

- A function from the sphere to colors, stored as a texture.



[Blinn & Newell 1976]

Spherical environment map



Hand with Reflecting Sphere. M. C. Escher, 1935. lithograph

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Environment Maps

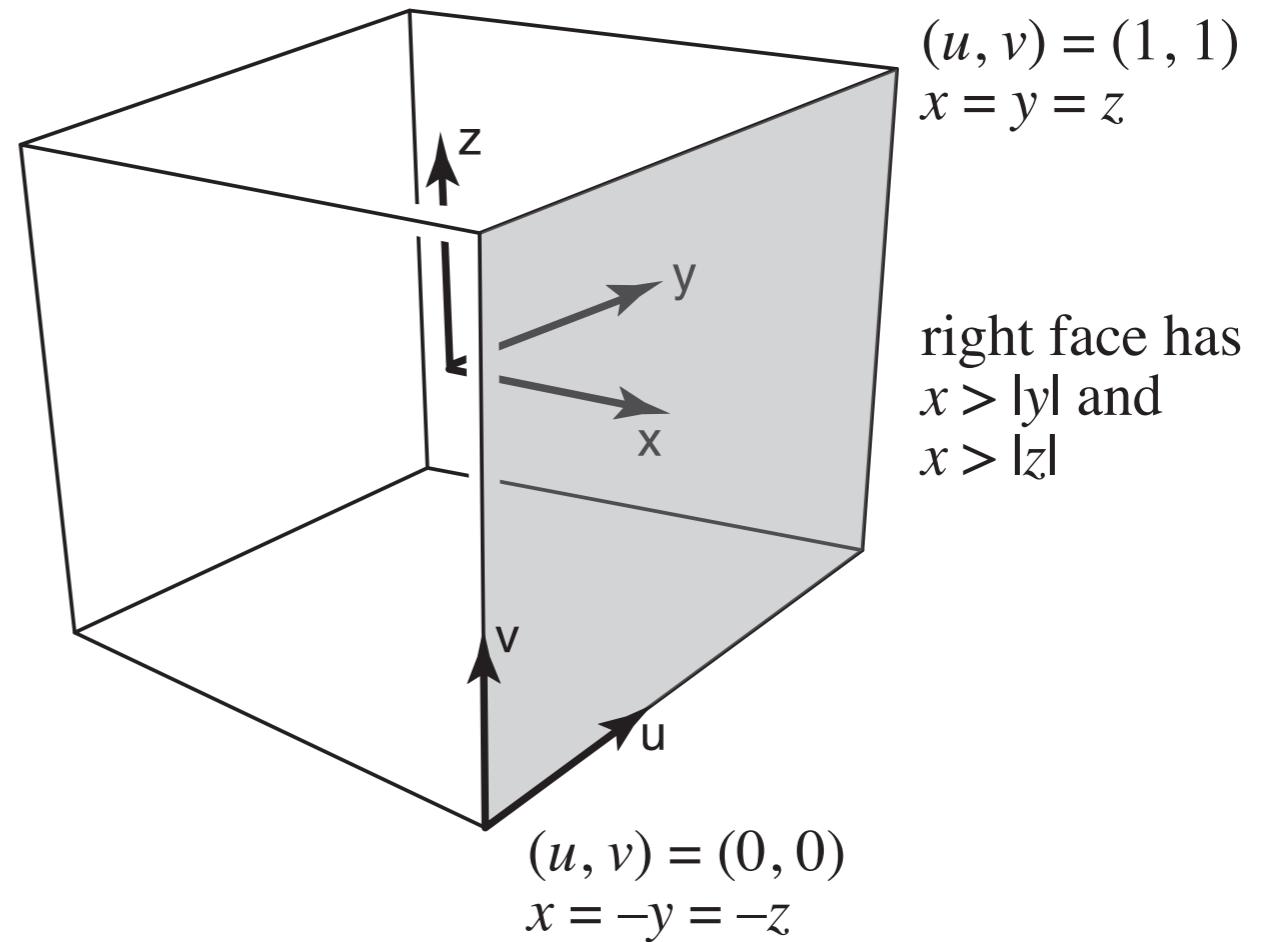
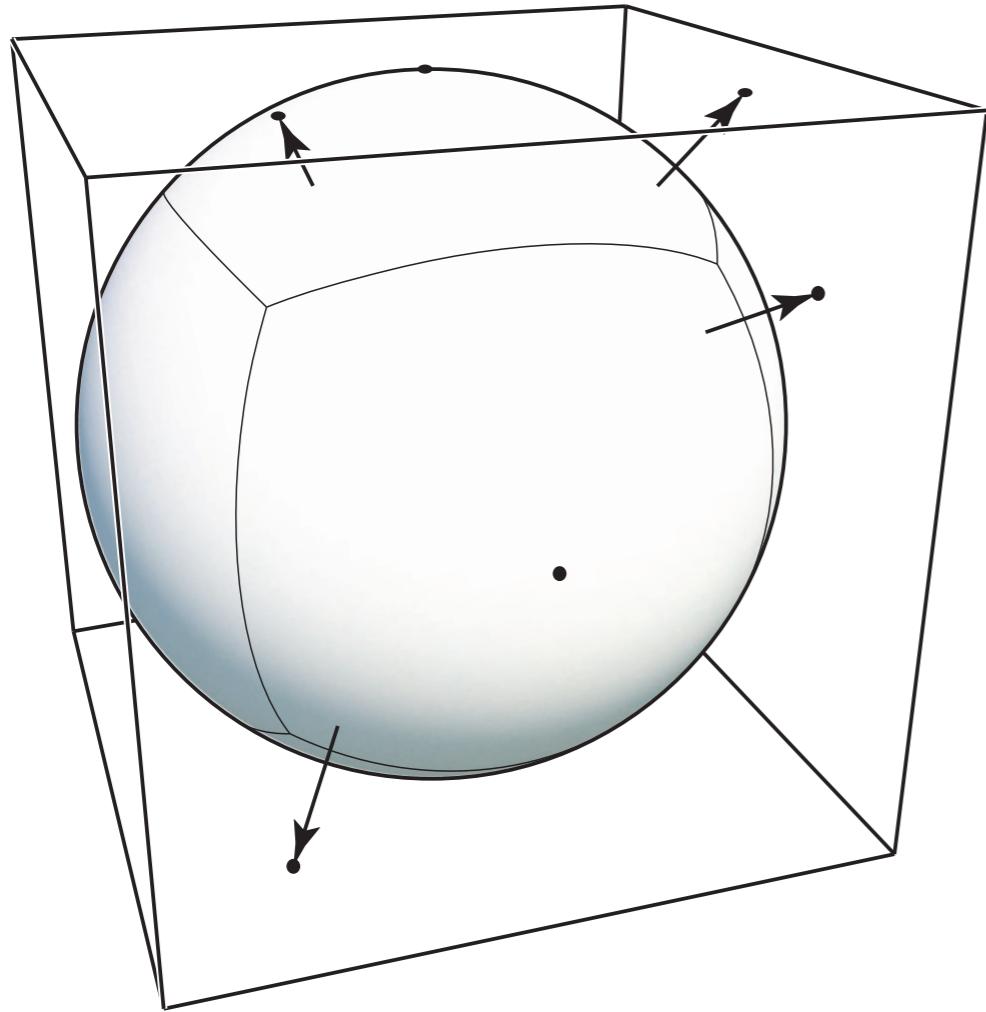


[Paul Debevec]

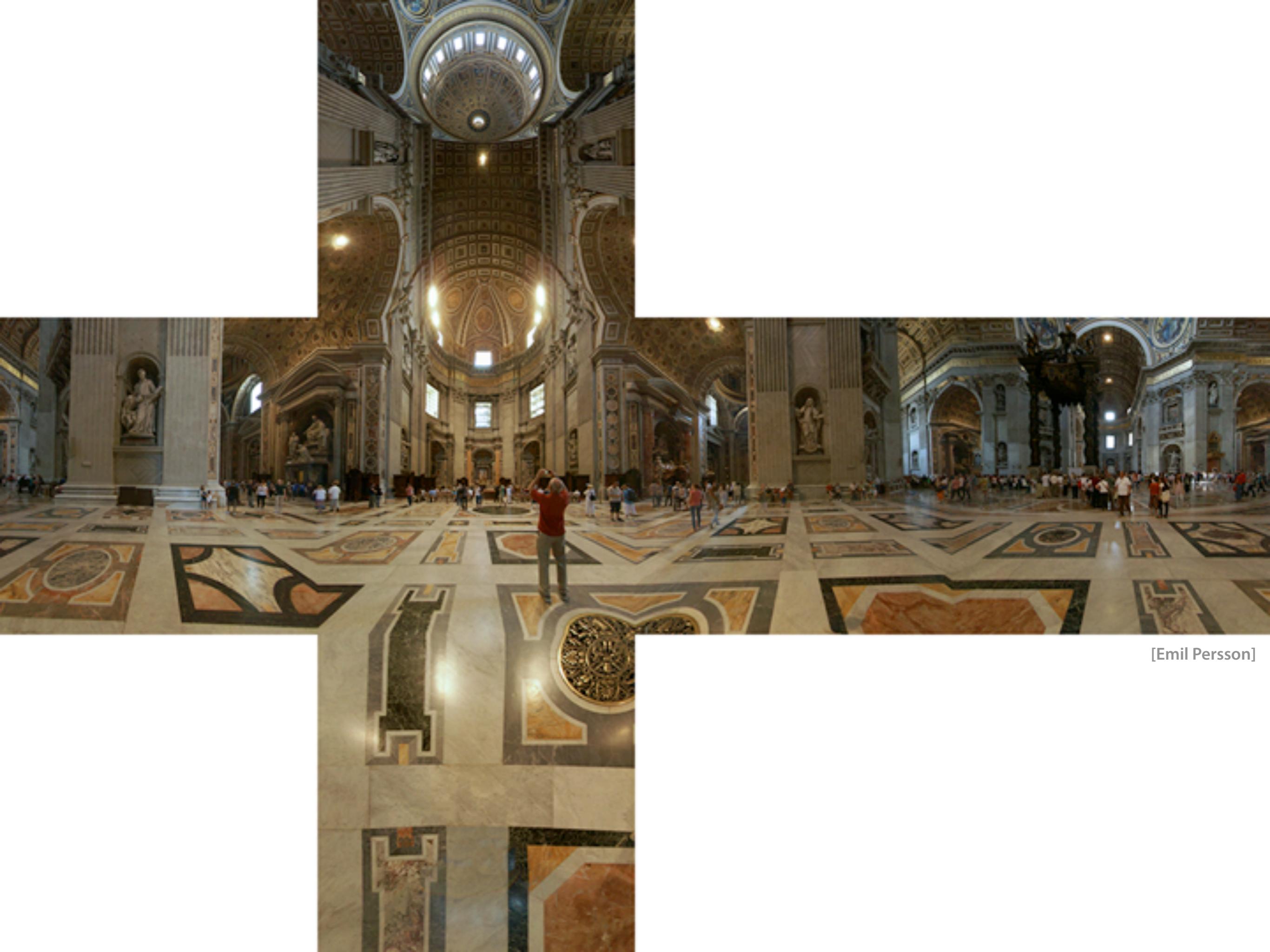


[CS467 slides]

Cube map

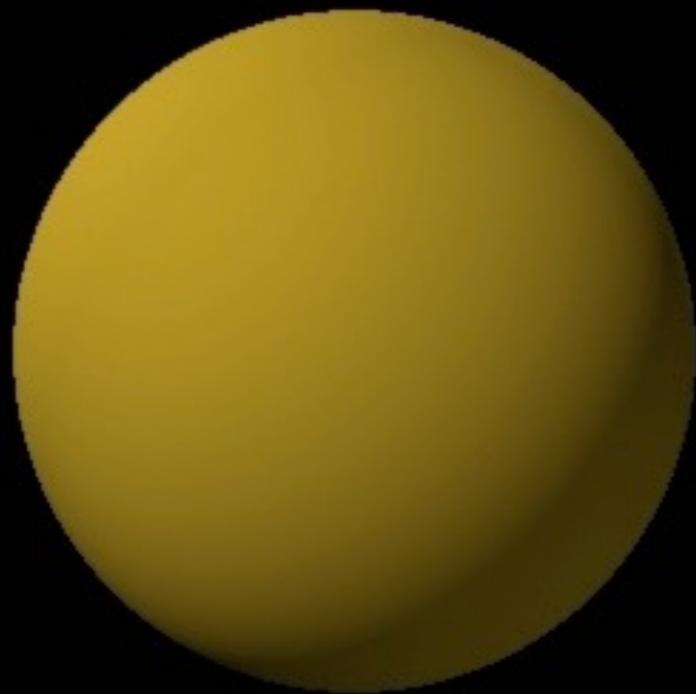


a direction vector maps to the point on the cube that is along that direction.
The cube is textured with 6 square texture maps.

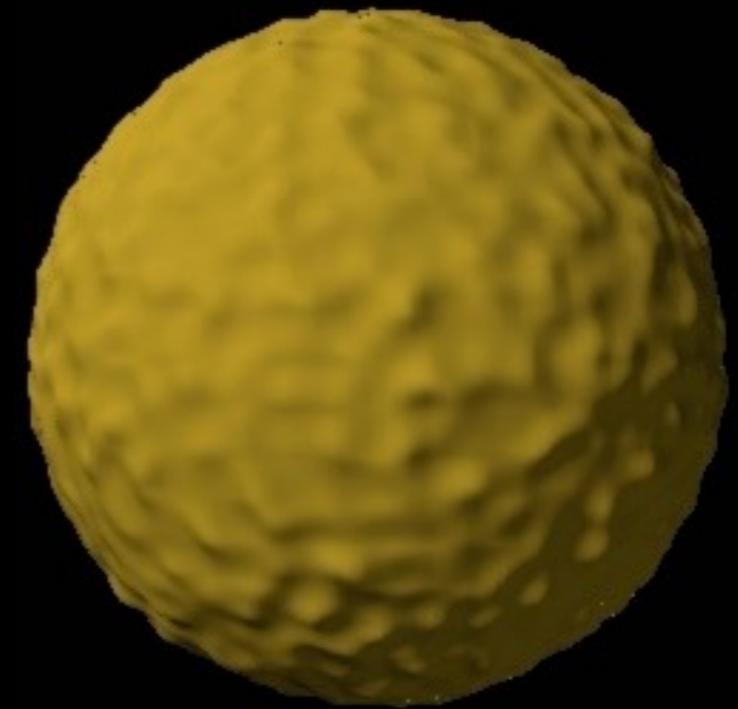


[Emil Persson]

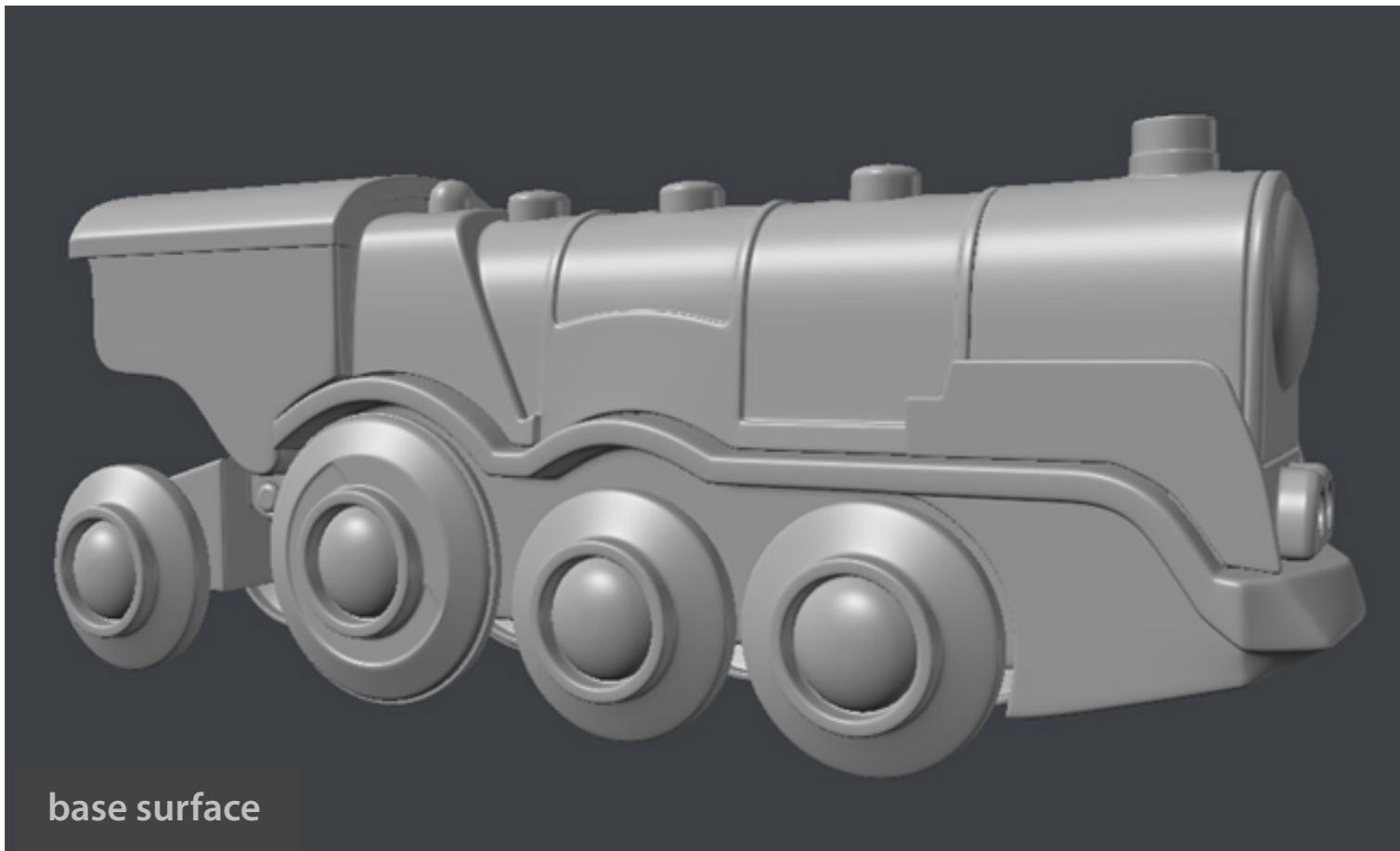
Displacement mapping



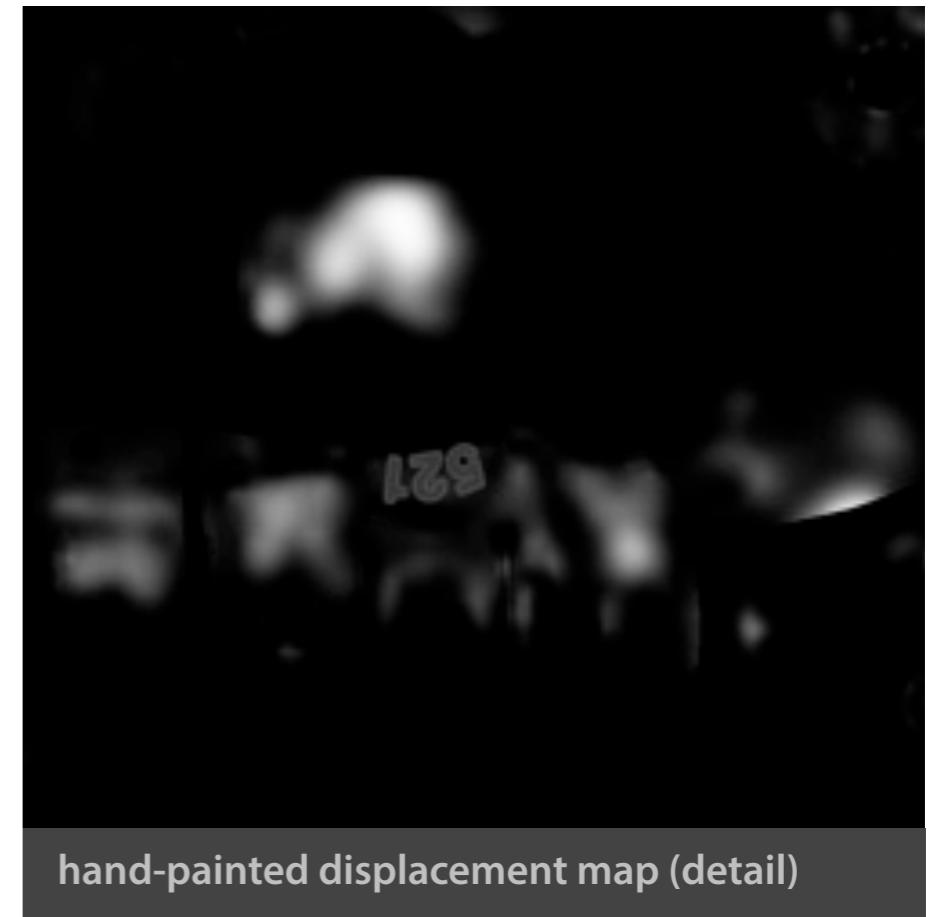
Geometry



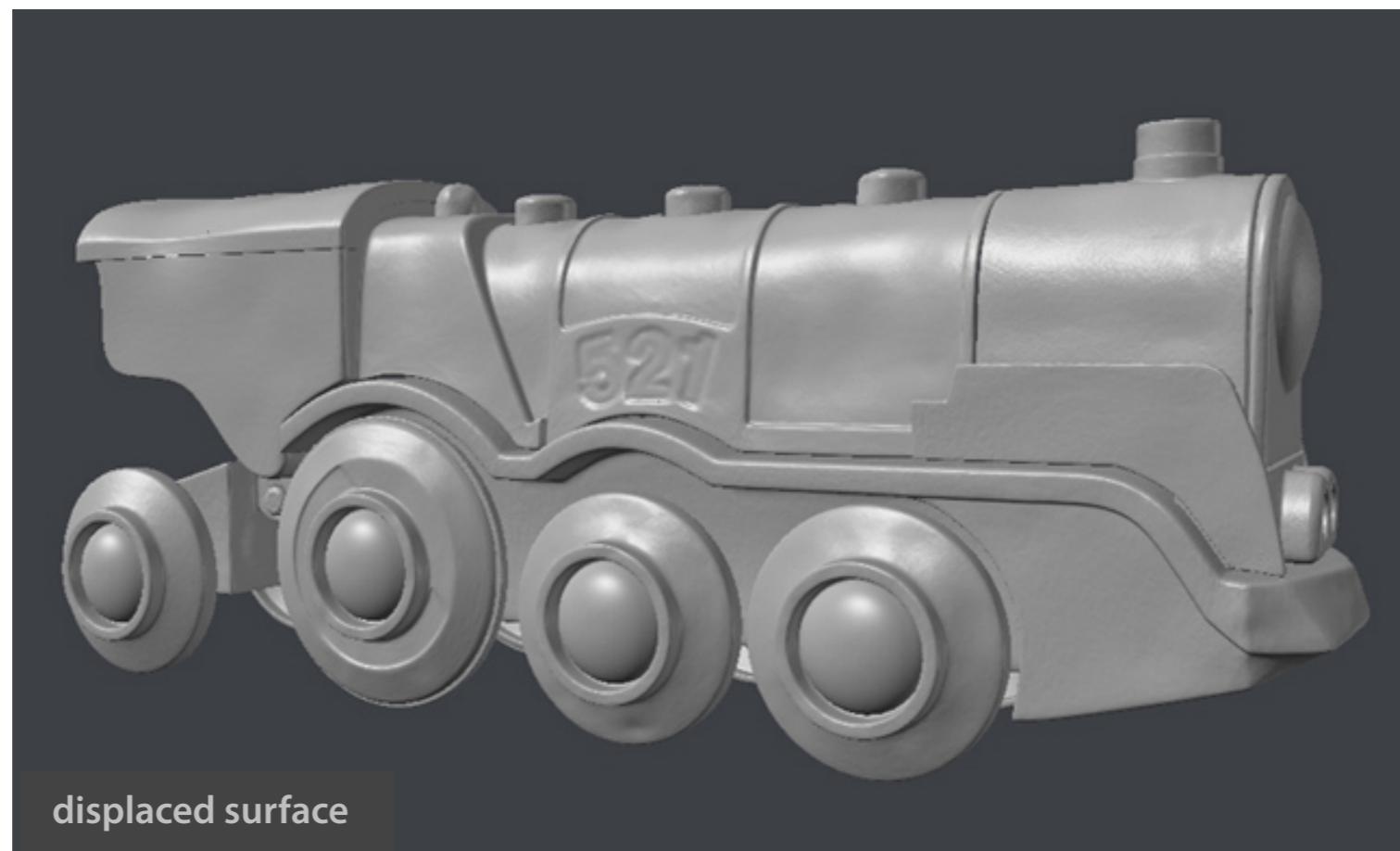
Displacement
mapping



base surface



hand-painted displacement map (detail)



Paweł Filip
tolas.wordpress.com

displaced surface



fryrender

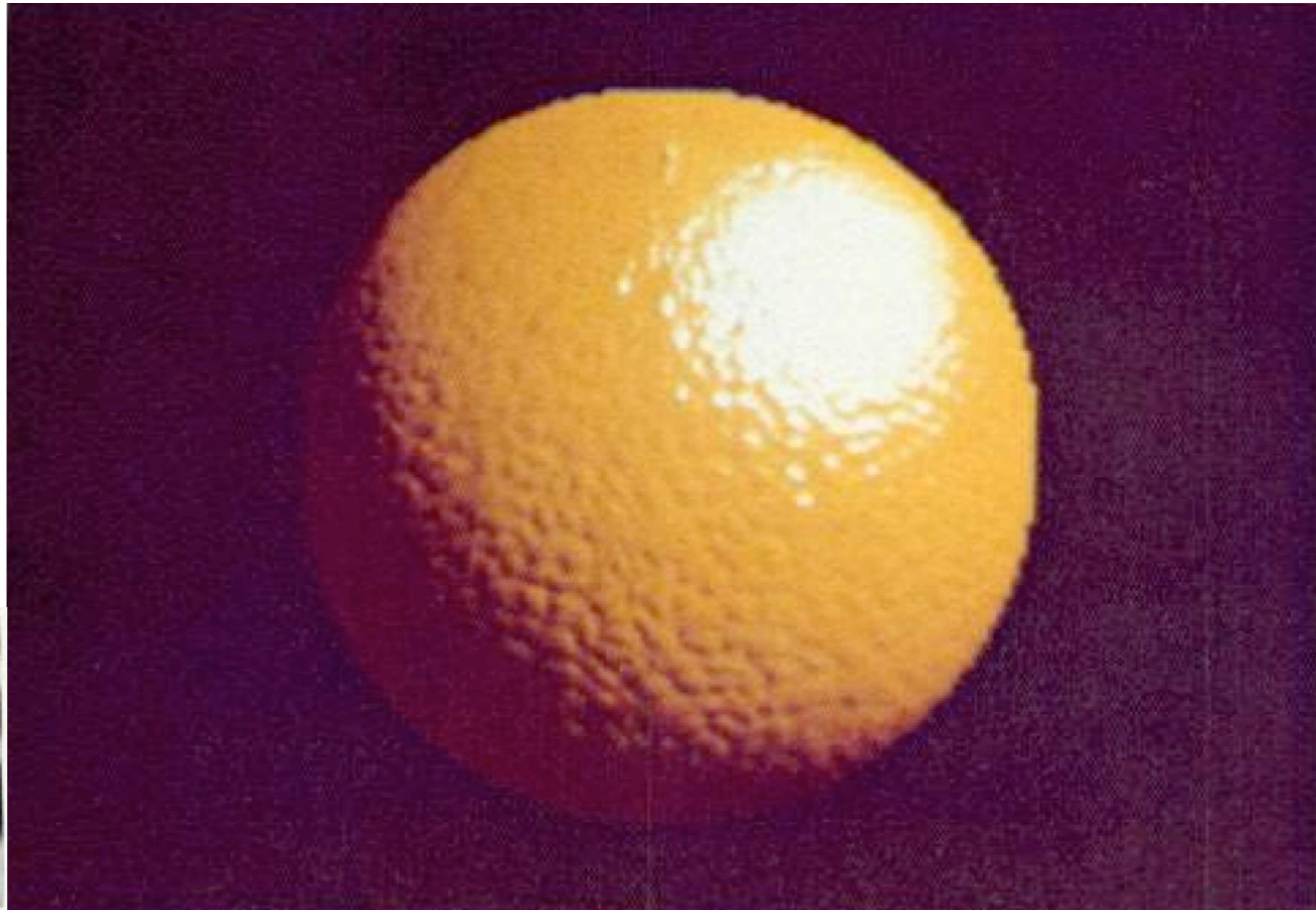
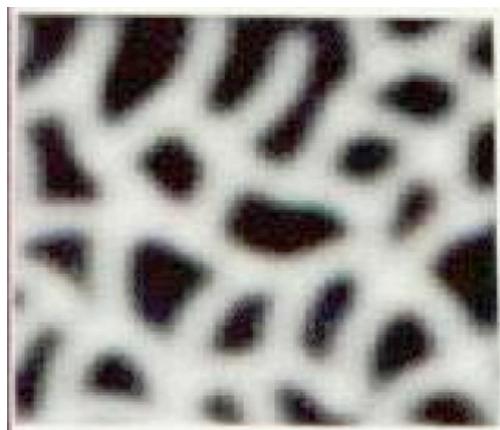
physically-based render engine

©2007 Paweł Filip

Displacement mapping

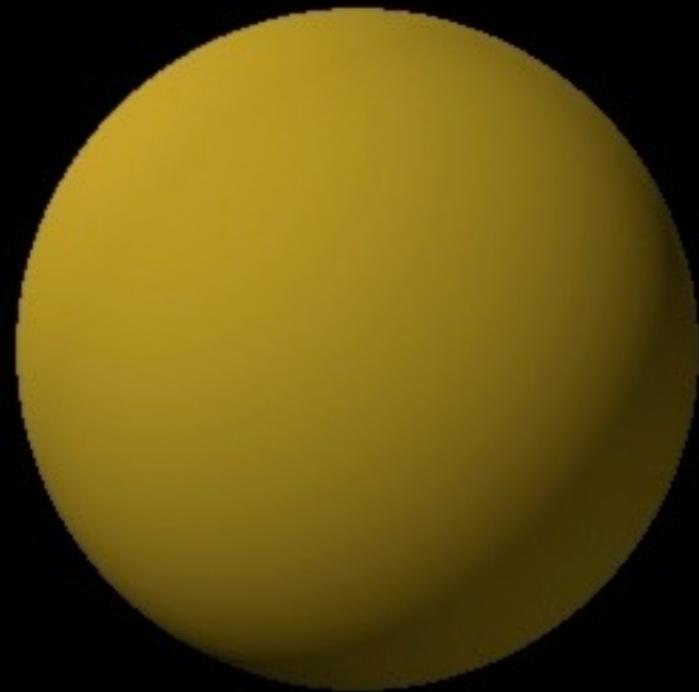
- Geometric prerequisites
 - Texture map representing height field
 - Smooth normals
 - Dense triangulation

Bump mapping

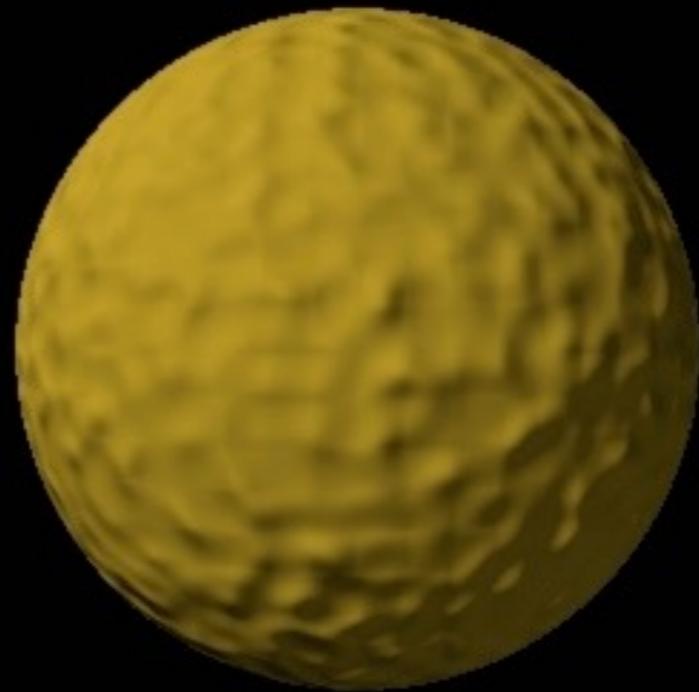


[Blinn 1978]

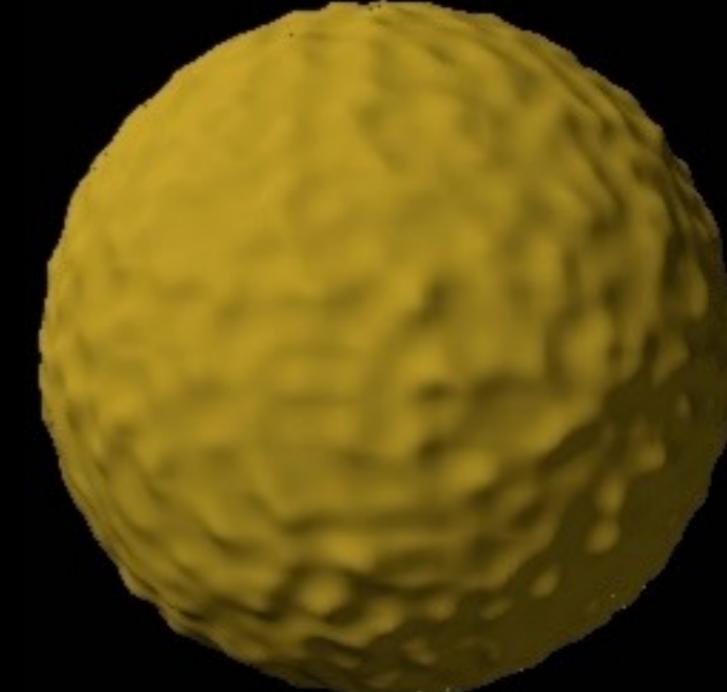
Displacement vs. bump mapping



Geometry



Bump
mapping

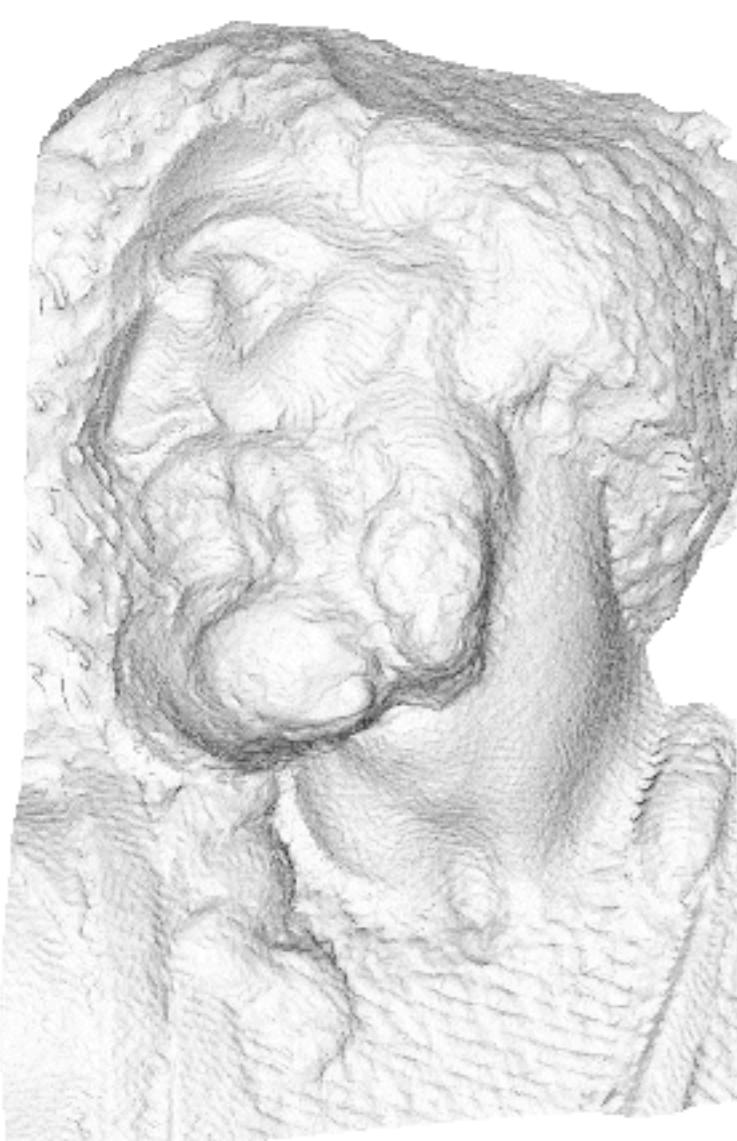


Displacement
mapping

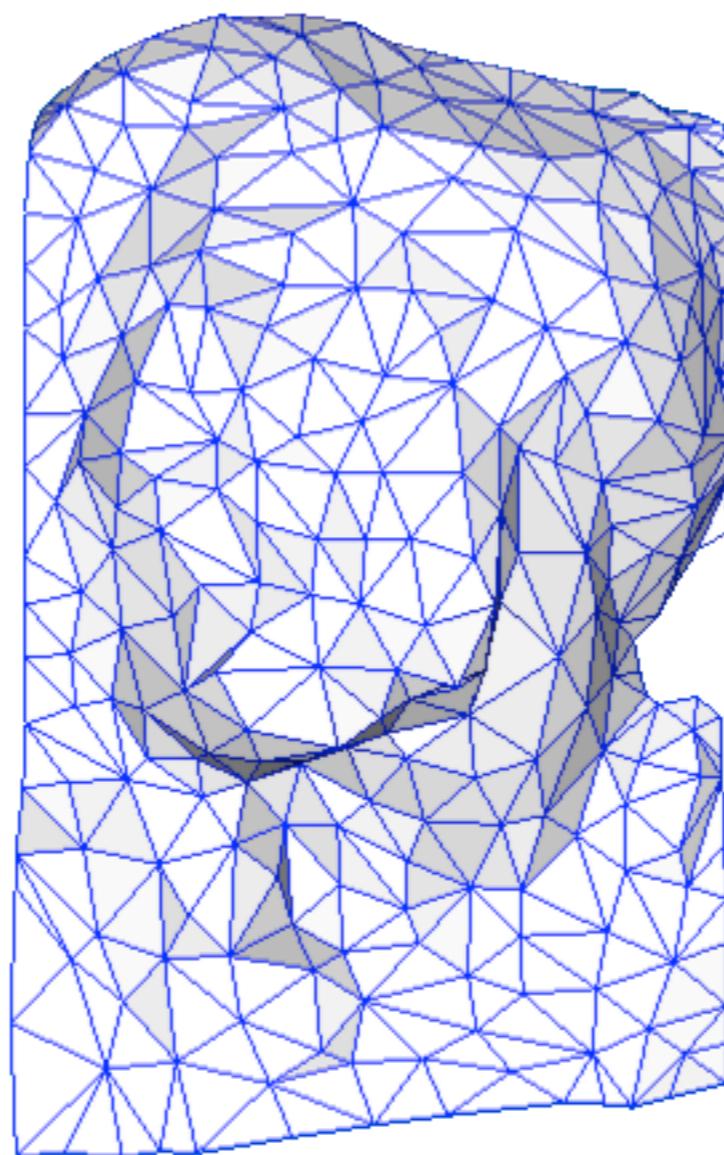
Bump mapping

- Geometric prerequisites
 - Texture map representing height field
 - multiple lookups into height map required
 - numerically differentiate the height map at shade time
 - Smooth normals
 - Tangent vectors
 - No dense triangulation needed

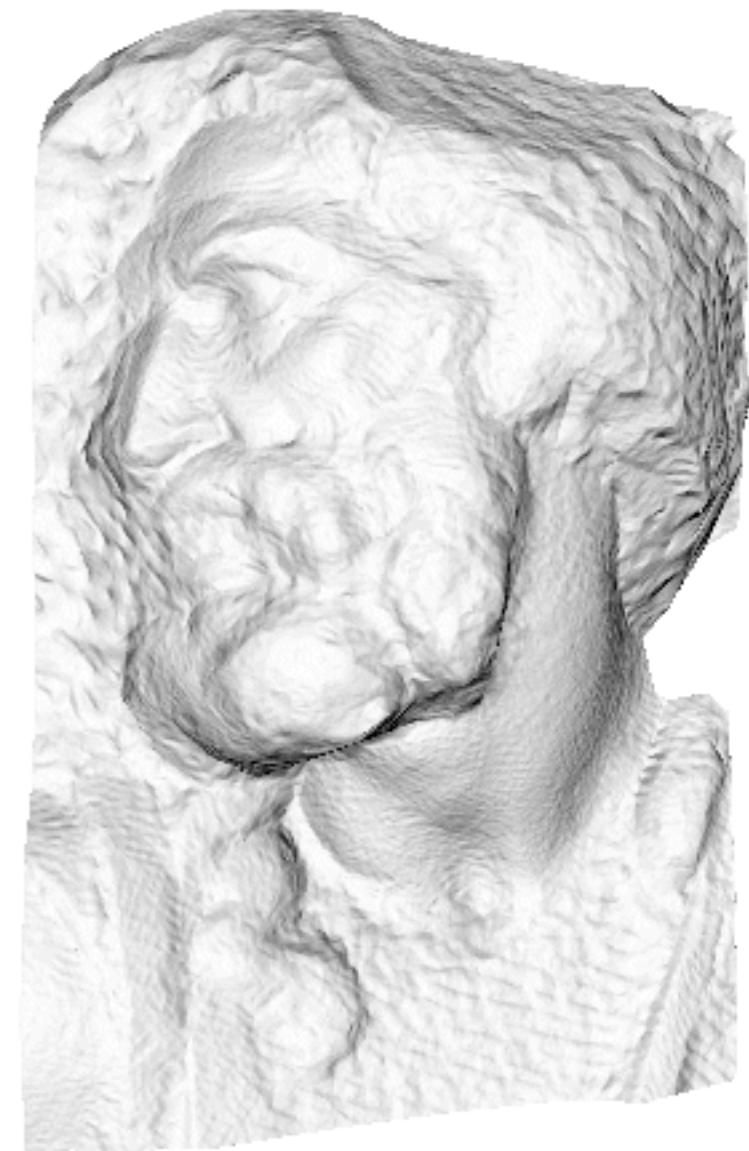
Normal mapping



original mesh
4M triangles



simplified mesh
500 triangles



simplified mesh
and normal mapping
500 triangles

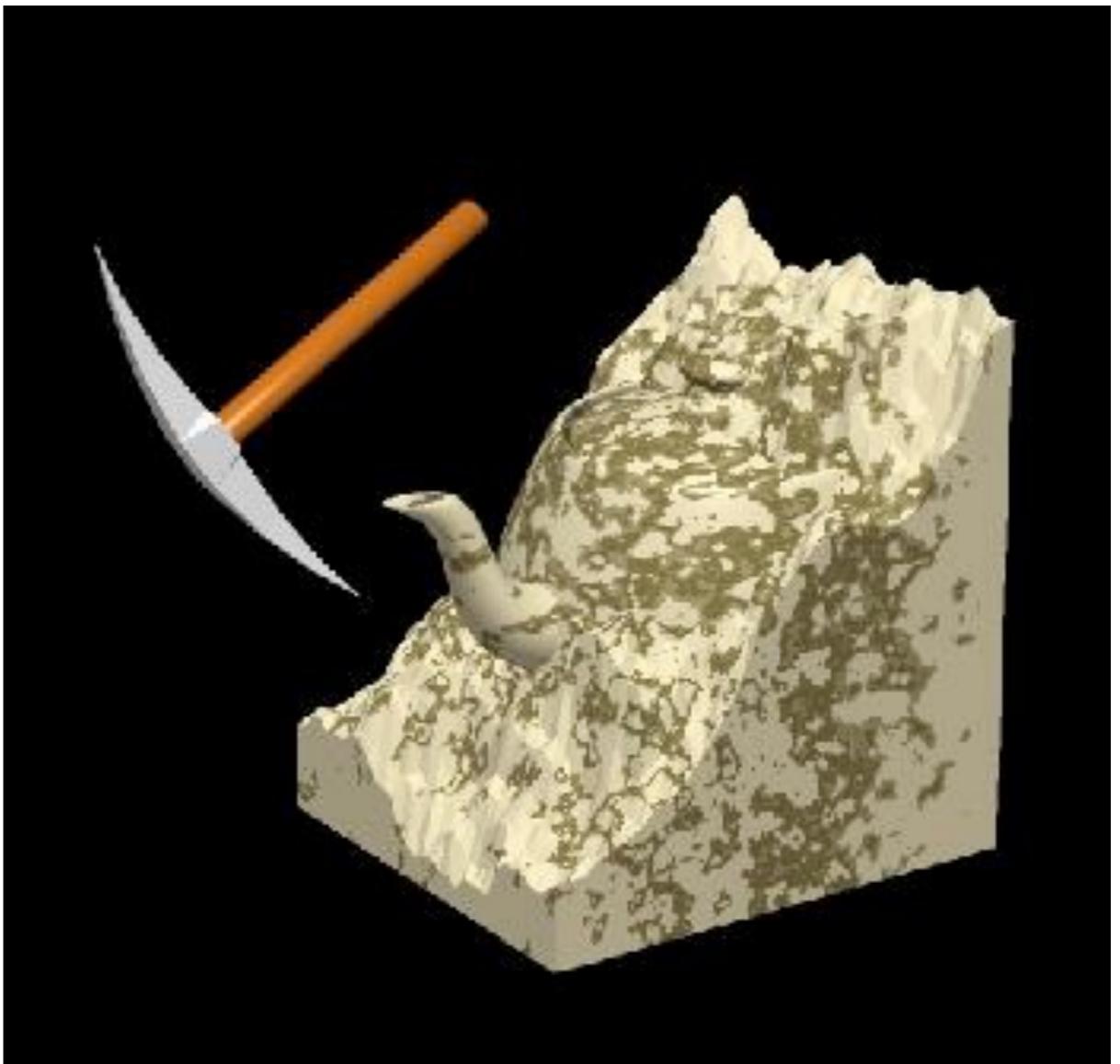
[Paolo Cignoni]

Bump mapping

- Geometric prerequisites
 - Texture map (3 channels) representing normal field
 - single lookups into normal map required
 - Smooth normals
 - Tangent vectors
 - if you want to store normals in tangent space (which you do)
 - No dense triangulation needed

3D textures

- Texture is a function of (u, v, w)
 - can just evaluate texture at 3D surface point
 - good for solid materials
 - often defined procedurally



[Wolfe / SG97 Slide set]