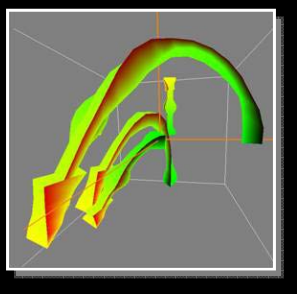
Visualization Using Shaders

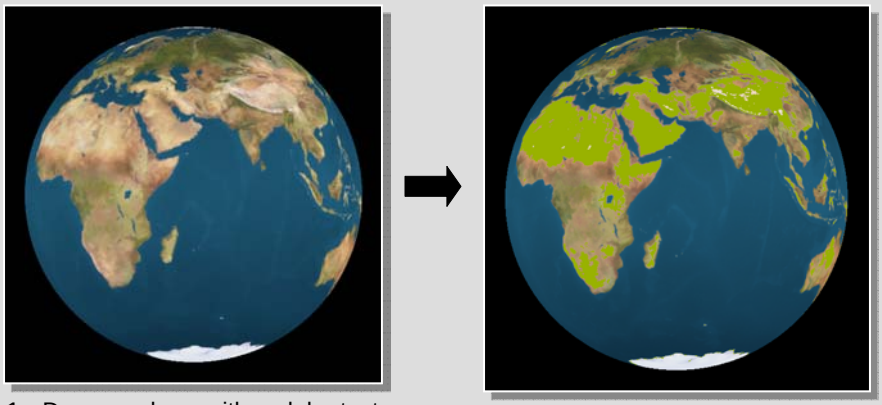
Mike Bailey
CS 519

Oregon State University



May 31, 2006

Image Manipulation Example – Identify the Deserts



1. Draw a sphere with a globe texture

```
Texture2D  6  worldtex.bmp
Program Desert  Min <0. 1. 1.>  Max <0. 0. 1.>  TexUnit 6
```

2. Read the texture

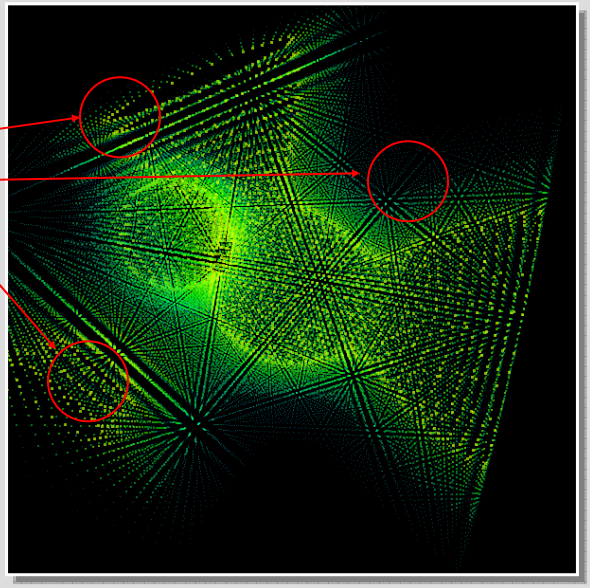
```
uniform sampler2D TexUnit;
uniform float Min, Max;
vec3 newcolor = texture2D( TexUnit, gl_TexCoord[0].st ).rgb;
```

3. Determine weights for Red, Green, and Blue that identify the deserts

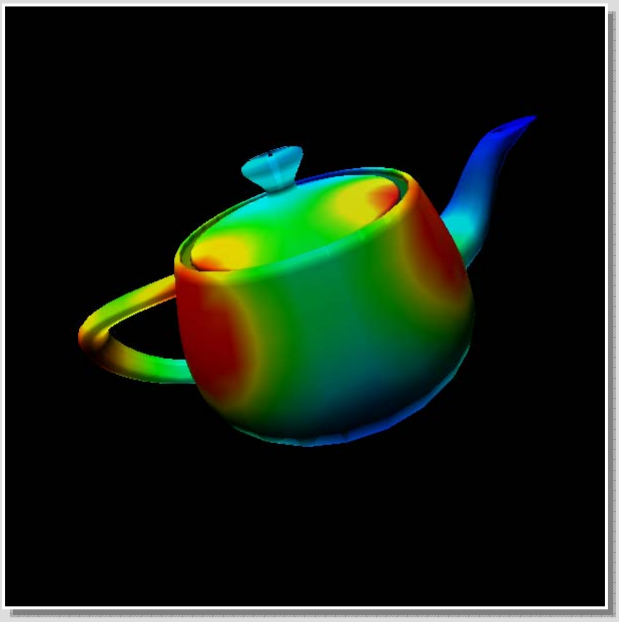
Point Clouds

Can change:

- Color
- Alpha
- Pointsize



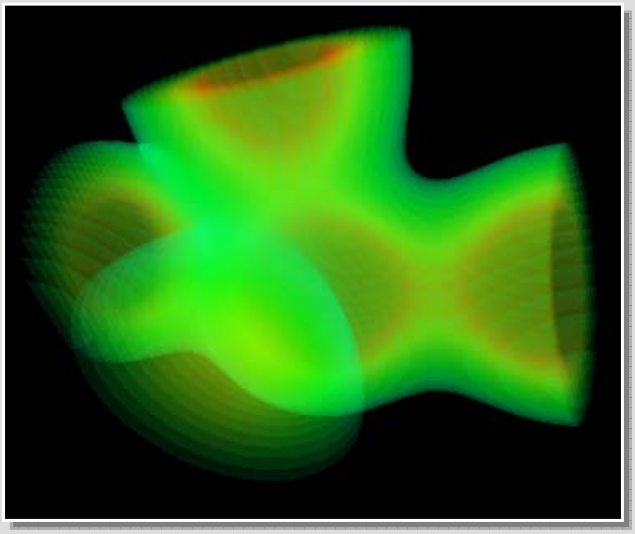
3D Probe



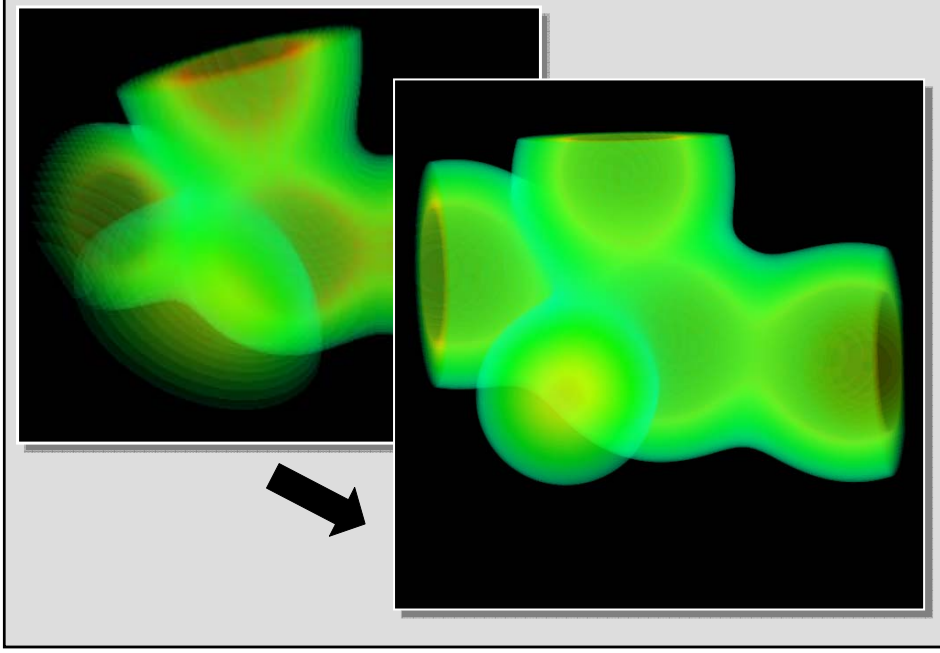
Volume Rendering

Can change:

- Color
- Alpha



Aligning the Planes with the Viewing Vector



Line Integral Convolution

At each fragment:

1. Find the flow field velocity vector there
2. Follow that vector in both directions
3. Blend in the colors at the other fragments along that vector

Extruding Shapes Along Flow Lines

Parameterize the shape and re-cast it into T-N-B coordinates along the flowline, P(t)

Tangent:

$$T(t) = \frac{\dot{P}(t)}{\left\|\dot{P}(t)\right\|}$$

Binormal:

$$B(t) = \frac{\dot{P}(t) \times \ddot{P}(t)}{\left\|\dot{P}(t) \times \ddot{P}(t)\right\|}$$

Normal:

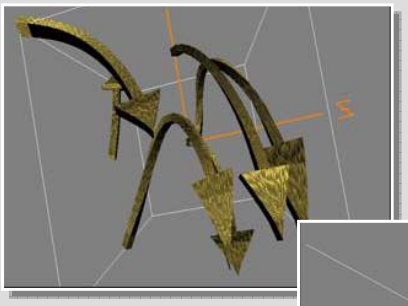
$$N(t) = B(t) \times T(t)$$

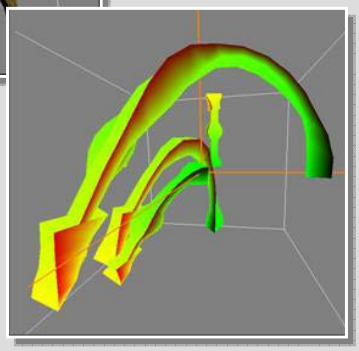
This are known as the three *Frenet Equations* and are very useful for geometrically characterizing what is happening on a curve

$$\begin{Bmatrix} x' \\ y' \\ z' \\ 1 \end{Bmatrix} = \begin{bmatrix} Tx & Nx & Bx & X \\ Ty & Ny & By & Y \\ Tz & Nz & Bz & Z \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{Bmatrix} x \\ y \\ z \\ 1 \end{Bmatrix}$$

Extruding Shapes Along Flow Lines:
As long as you are writing a shader anyway, …

Add bump-mapping to aid in understanding the orientation





Add moving “humps” to create a peristaltic effect