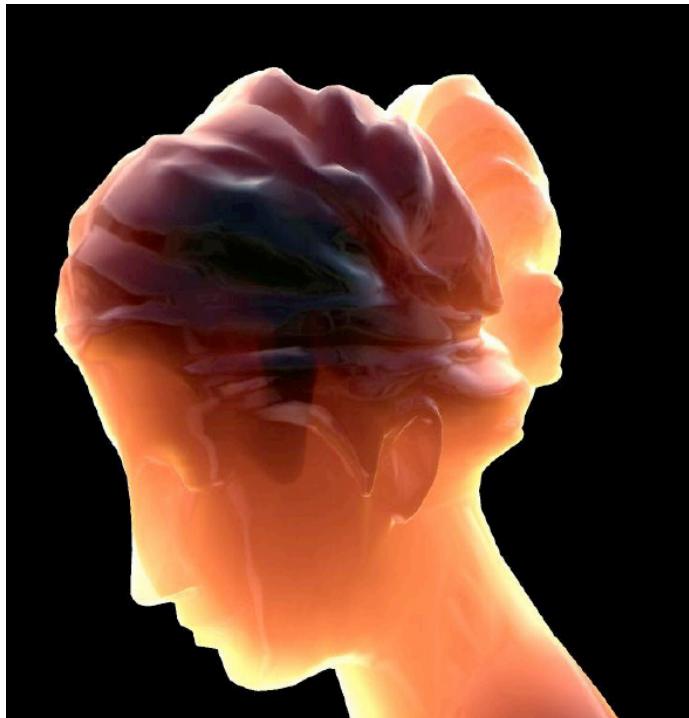




# GPU and Effects

- Graphics pipeline
- Programmable shaders
- Special effects



Jensen et al “A Practical Model for Subsurface Light Transport”

# Graphics pipeline

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- Vertex shader
  - Modeling Transform
  - Vertex illumination
  - View transform
- Clipping
- Scanconversion (rasterization)
  - Fill pixels covered by triangle projection
  - Propagate R,G,B,Z,u,v,N
- Pixel shader
  - Set/test masks (stencils)
  - Read/write/use texture
  - Visibility: if (z OP zbuff) {do this:};
- Display

# Storage per pixel

---

- R,G,B: 8 bits each
- Z: 24 bits
- Stencil planes: 8 bits

# Programming shaders

---

- Cg language (Nvidia), and others
- Data flow architecture
- No loops, limited branching
- Vertex shader and pixel shaders are separated
- No communication between pixels
- Can use texture memory to store/retrieve info

```
void simpleTransform(float4 objectPosition : POSITION,  
                     float4 color : COLOR,  
                     float4 decalCoord : TEXCOORD0,  
                     out float4 clipPosition : POSITION,  
                     out float4 oColor : COLOR,  
                     out float4 oDecalCoord : TEXCOORD0,  
                     uniform float brightness,  
                     uniform float4x4 modelViewProjection)  
  
{  
    clipPosition = mul(modelViewProjection, objectPosition);  
    oColor = brightness * color;  
    oDecalCoord = decalCoord;  
}
```

**Figure 5:** Example Cg Program for Vertex Processor

# Missing effects

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- Shadows
- Reflections
- Color bleeding
- Transparency
- Sub-surface scattering
- Fog
- ... others?

# Shadows

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- Shadows add realism and help disambiguate relative position



# Surface weathering

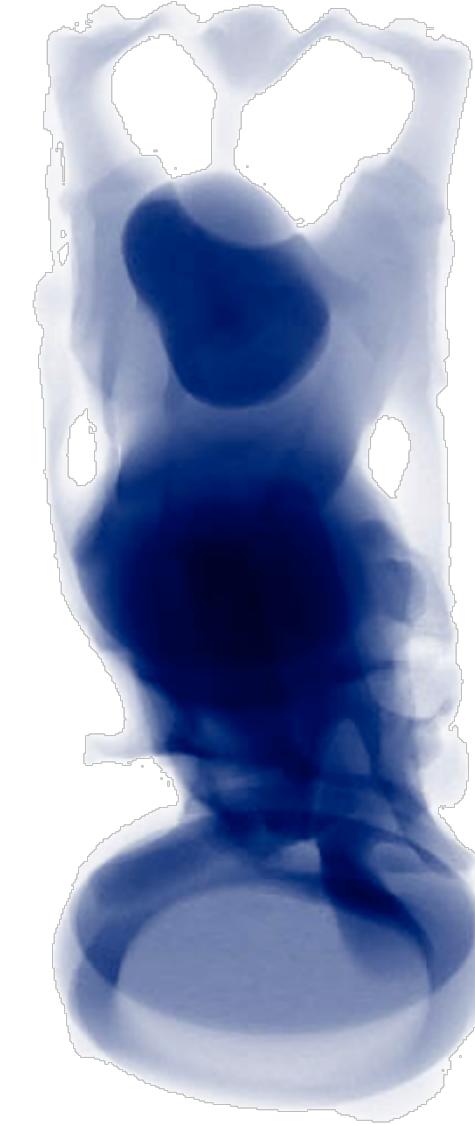
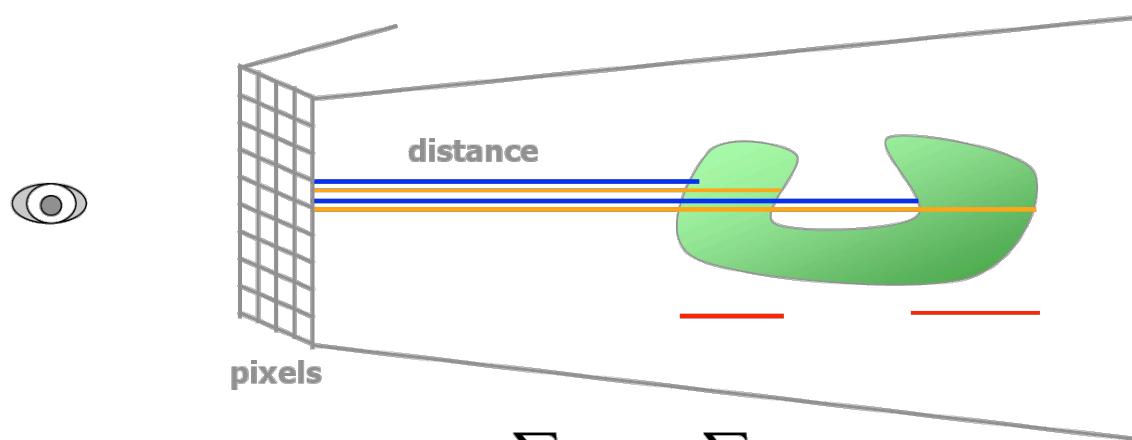
---

- Shaders may be used to implement weathering effects (rust...)



# Transparency (translucency)

- Opacity increases with thickness (volume translucency) or with the number of surfaces stabbed (surface translucency)



# Glass absorption and scattering

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- Low probability of absorption and scattering



# Scattering

- Model the scattering of light inside the object



Light transmission



No light transmission

# Sub-surface diffusion for faces

- Important to add realism



No Diffusion



Subsurface Diffusion

# Fog, smoke

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