What is IBR?

September 16, 2004

Top Level Survey

3D Graphics

- Sample-Based Graphics
- Image-Based Rendering & Modeling
- Volume Rendering

Geometry or Surface Based Rendering & Modeling
Traditional Computer Graphics

- Input: Geometry, Material Properties (Color, Reflectance, etc.), Lighting.
- Transformation and Rasterization.
- Computer Vision methods to recover models.

Image-Based Rendering

- Input: Regular Images or "Depth Images."
- No 3D model is constructed.
- Example: 3D Warping.
Another Example

• Reading room of UNC CS department
  – Source images contain depths in each pixel.
  – The depths are obtained from a laser range finder.

Why IBR?

<table>
<thead>
<tr>
<th></th>
<th>Geometry</th>
<th>IBR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modeling</td>
<td>Difficult</td>
<td>Easy</td>
</tr>
<tr>
<td>Complexity</td>
<td>#triangles</td>
<td>#pixels</td>
</tr>
<tr>
<td>Fidelity</td>
<td>Synthetic</td>
<td>Acquired</td>
</tr>
</tbody>
</table>

• Problems of triangle-based graphics:
  – Always starts from scratch.
  – Millions of sub-pixel triangles.
Why is It Possible?

• 5D Plenoptic Function.
  – Color = f(x, y, z, θ, φ)
  – (x, y, z) defines the viewpoint.
  – (θ, φ) defines the view direction.

• 4D Light Field/Lumigraph
  – Color = f(u, v, s, t)
  – (u, v) defines the viewpoint.
  – (s, t) defines the pixel coord.

3D Image Warping

– Each pixel in the source images has coordinates (u₁, v₁), depth info δ₁, and color.
– Warping Equation is applied to each pixel
  
  \[(u₂, v₂) = f(u₁, v₁, δ₁)
  = (a \times u₁ + b \times v₁ + c \times δ₁, e \times u₁ + f \times v₁ + g \times δ₁)
  \]

  \[
i \times u₁ + j \times v₁ + k \times δ₁
  \]

  where variables a to i are fixed for the same view.
– Rendering Time = O(#pixels)
Video