Image Based Rendering: Introduction and Theory

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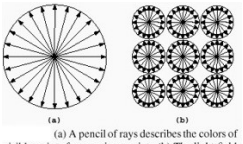
What is Image-Based Rendering?

- All we usually care about in rendering is generating images from new viewpoints.
- In geometry-based methods, we *compute* these new images
  - Projection
  - Lighting
  - Z-buffering
- But, why not just *look-up* this information?

Theoretical Foundations: The Light Field

- The Light Field representation (Levoy and Hanrahan -- also Pulli, et. al.) is a complete model of a scene.
- Radiance at every point, in every direction



(a) A pencil of rays describes the colors of visible points from a given point. (b) The light field function describes the colors of all rays starting from any point.

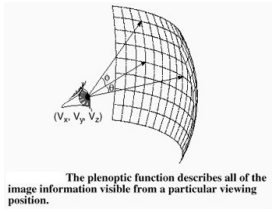
- Very large representation
- Implies a dense grid of images (and is usually implemented this way)

Theoretical Foundations: The Plenoptic Function

- The Plenoptic Function (Adelson and Bergen) is also a complete model.

$$p = P(\theta, \phi, \lambda, V_x, V_y, V_z, t)$$

- Input parameters:
  - Camera position
  - Camera orientation
  - Time
  - Wavelengths



The plenoptic function describes all of the image information visible from a particular viewing position.

- Output: an image of the scene

Simplifications

- Some IBR systems limit the dimensionality of the Plenoptic function
  - Spherical Maps (fixed position)
  - Cylindrical Maps (Quicktime VR) (fixed position, limited rotation)
  - Branching movies (Fixed position and limited rotation).
- Most general is translation and rotation.

IBR as an Interpolation Problem

- Problem: The functions described earlier are far too large to reasonably compute or store (4-D, 5-D vector spaces).
- In practice, a finite number of samples is taken.
- The problem becomes identifying and interpolating "close" images to create a resulting image