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Image-Based Modeling, Rendering, and Lighting

Texture Mapping ++

How do we give complex experiences to the user?

How do we give complex experiences of real objects and places to the viewer?

How do we give elements of the real world into our synthetic experiences?

Plenoptic modeling, High-Dynamic range image

Plenoptic Function

$$p = f(\underset{\substack{\uparrow \\ \text{WAVE LENGTH}}}{\lambda}, \underset{\substack{\uparrow \\ \text{time}}}{t}, \underset{\substack{\uparrow \\ \text{Viewer's position}}}{V_x, V_y, V_z}, \underset{\substack{\uparrow \\ \text{view direction}}}{\theta, \phi})$$

If you knew the plenoptic function, you could create any image

Problem: very high dimensional function need approximations

How to use real data?

A camera gives samples of the plenoptic function

Each pixel gives many points -

this "pixel" tells us the value at lots of places

IDEA: ① Simplify the sampling

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

λ → use RGB

t → static scenes

$$f(V_x, V_y, V_z, \theta, \phi) \Rightarrow R, G, B$$

FIXED VIEWPOINT

$f(\theta, \phi) \Rightarrow RGB$ ← Environment Map

limit ϕ, so can use cylinder

or use cube or sphere

How do you capture it?

QUICKTIME VR (Apple '94 or so)

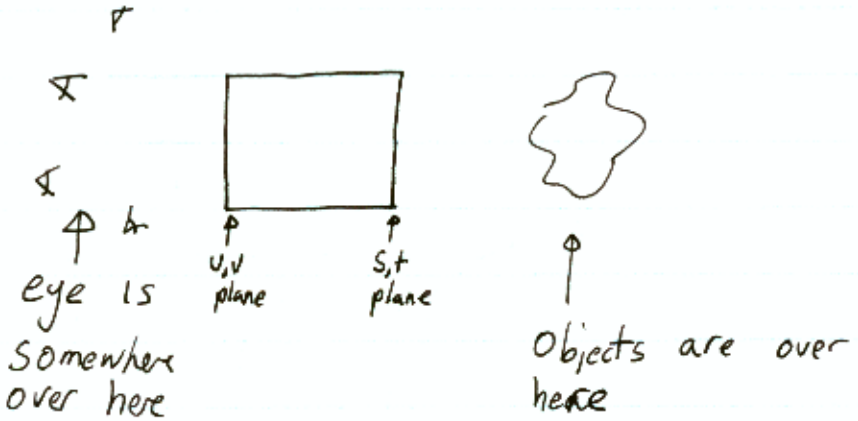
1st commercial environment system based on images - 2D function (image, easy to render)

jump from place to place

can't move head

Plenoptic SIMPLIFICATION #2

Suppose you limit V to be such that you are looking through a box



All rays go through the box

only 4D worth of rays: u, v, s, t

any image is made up of these rays

$f(u, v, s, t) \Rightarrow r, g, b$ lightfield

Hanrahan and Levoy '96

Lumigraph

Folks at Microsoft '96

Why haven't light fields caught on?

4D space is a lot of data
can only sample space

- hard to create - need to figure out where camera is <u>accurately</u>
- need to figure out which rays you got from image
- hard to store (need massive compression)
- resampling gives blurry results

Why not just reconstruct the geometry?
- it may or may not be easier than lightfield
- can throw hardware at the problem
  scanners - laser, lightstripe
- doesn't capture lighting
  (unless, you do something)

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Capturing Lighting -

NEED <u>HIGH Dynamic range</u> images for environment maps

take pictures with several exposures, put them together

gives you an environment map you can use for lighting - you know how much light comes to a point from all directions.

Capturing environments:

1. stitch
2. wide angle
3. mirror balls (smaller the ball, smaller blind spot) (wierd resampling)

sphere has wierd geometry - there are theoretically better shapes