Light Field Rendering

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Overview

- Purpose
- Algorithm

  1. representation of light field-4D (u, v, s, t)
  2. creation
  3. compression
  4. display

- Discussion
- Applications

Purpose

- To generate a new view from an arbitrary position
- Previous methods

Environment maps - *depth information*

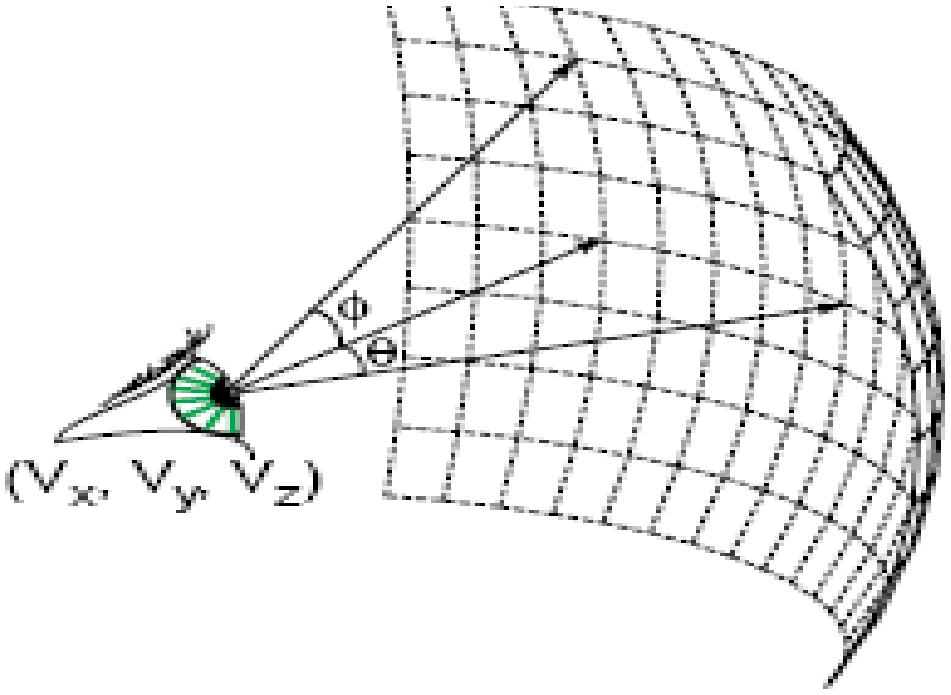
Interpolating - *correspondence points*

Purpose-Cont.

- Limit: “fill in the gaps”, incorrect correspondences
- To avoid these problems, a new method was proposed in this paper by using light field

What is Light Field

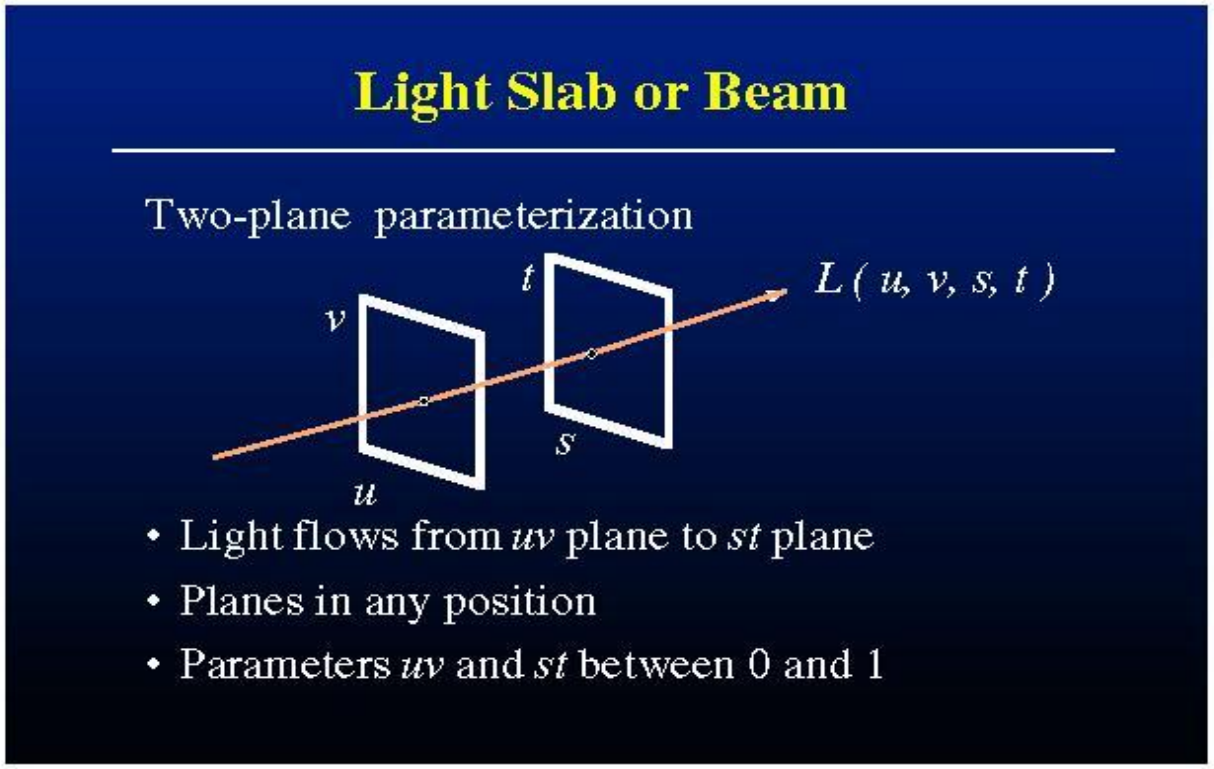
- In the real 3D world, how to represent a ray? Using 5D Plenoptic Function



4D Representation

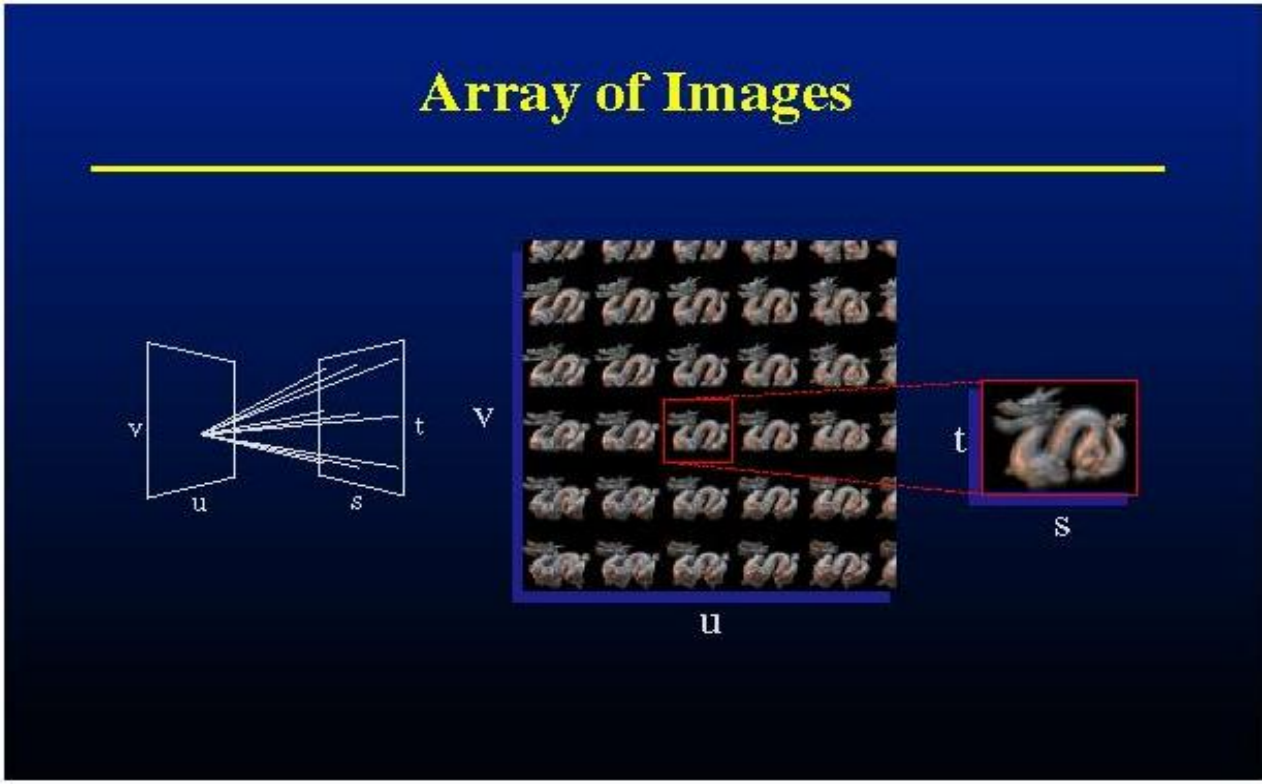
- In free space (no occluders), oriented lines could be represented in 4D

Representation of Light Field



Creation of Light Field

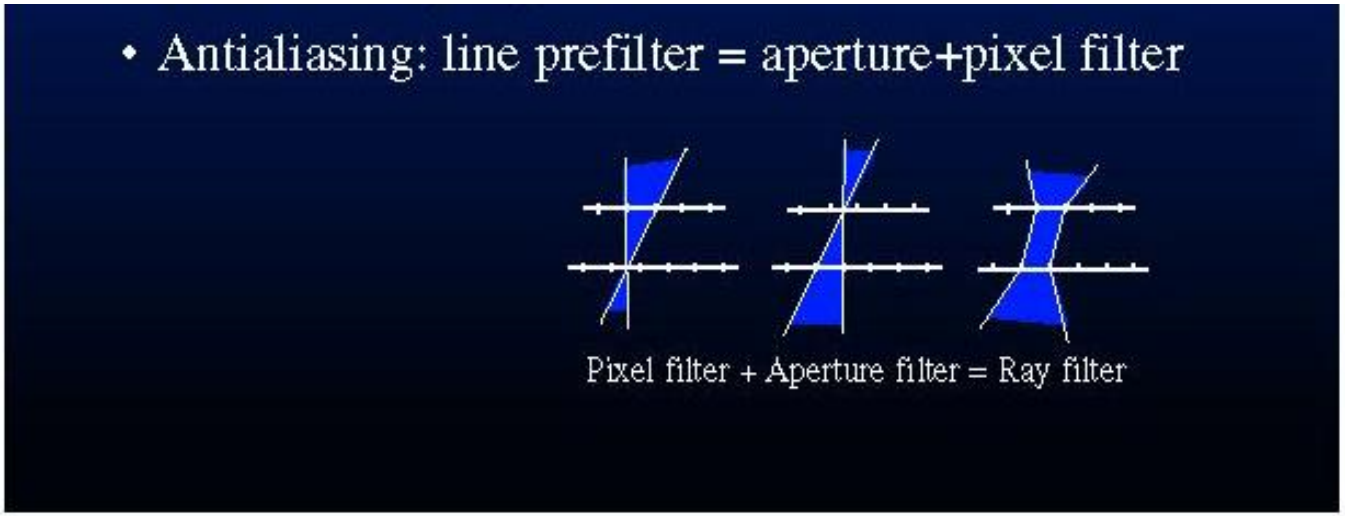
- Rendered Images



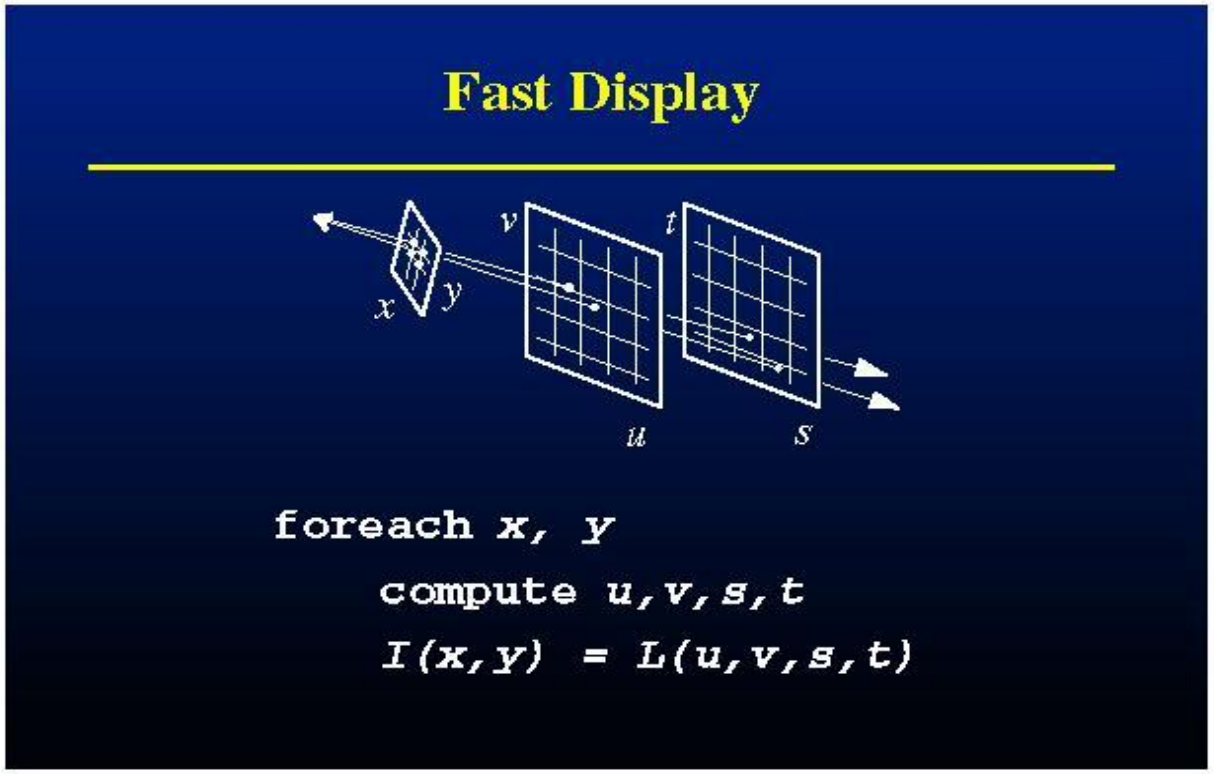
Creation of Light Fields

- Aliasing

  Low-pass filter



Display



Show video

Discussion

- Advantages

  1. easy, robust

  2. fast to create new views -sampling

- Limitations

  Large amount of data

  Building acquisition device

  Fixed focal surface

Discussion

- Limitations

  Large amount of data

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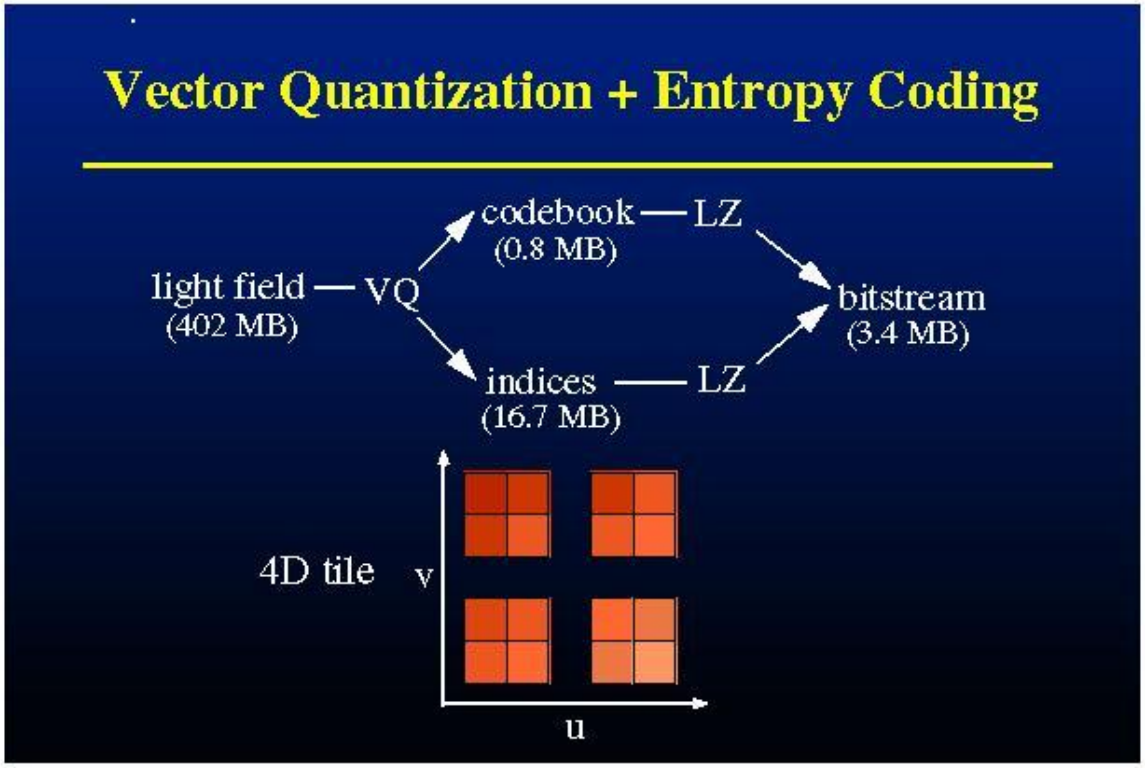
Compression

- VQ
- Lempel-Zic Coding

Compression -Cont.



Discussion

- Limitations

  Large amount of data

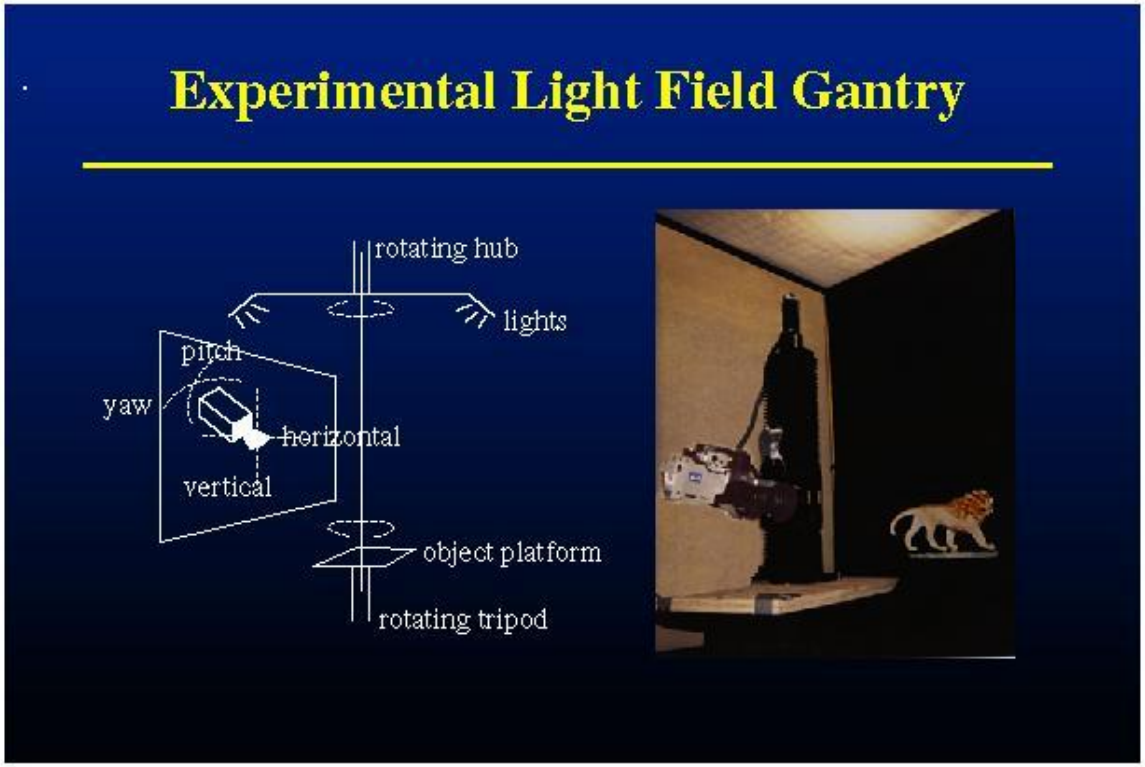
  Building acquisition device

  Fixed focal surface

Acquisition-Option1

- Using a single camera
  -hard to manipulate
  -need refocus
  -aliasing/blurriness

Signal Camera



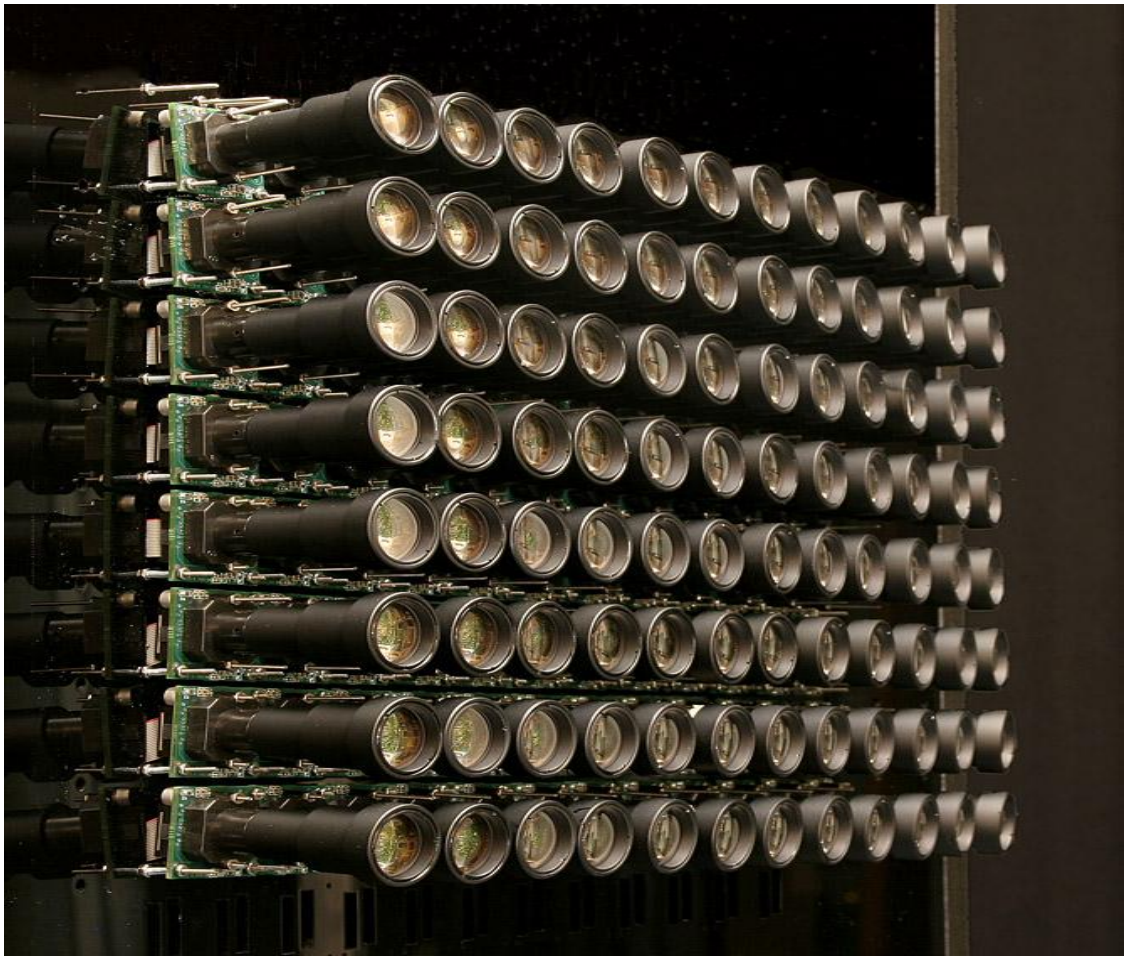
Acquisition-Option2

- Using an array of cameras

  -fixed

  -inflexible

Camera Arrays



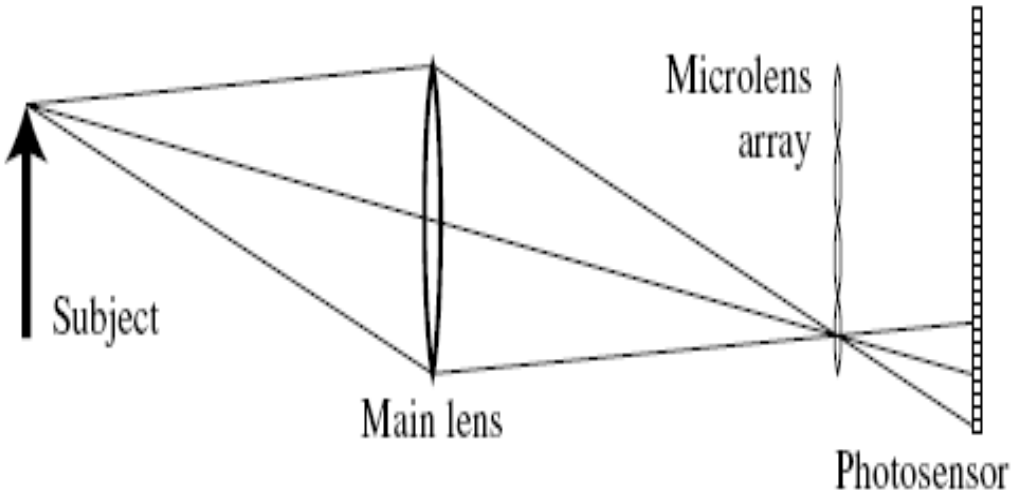
Acquisition-Option3

- Using an microlens array to replace the camera array

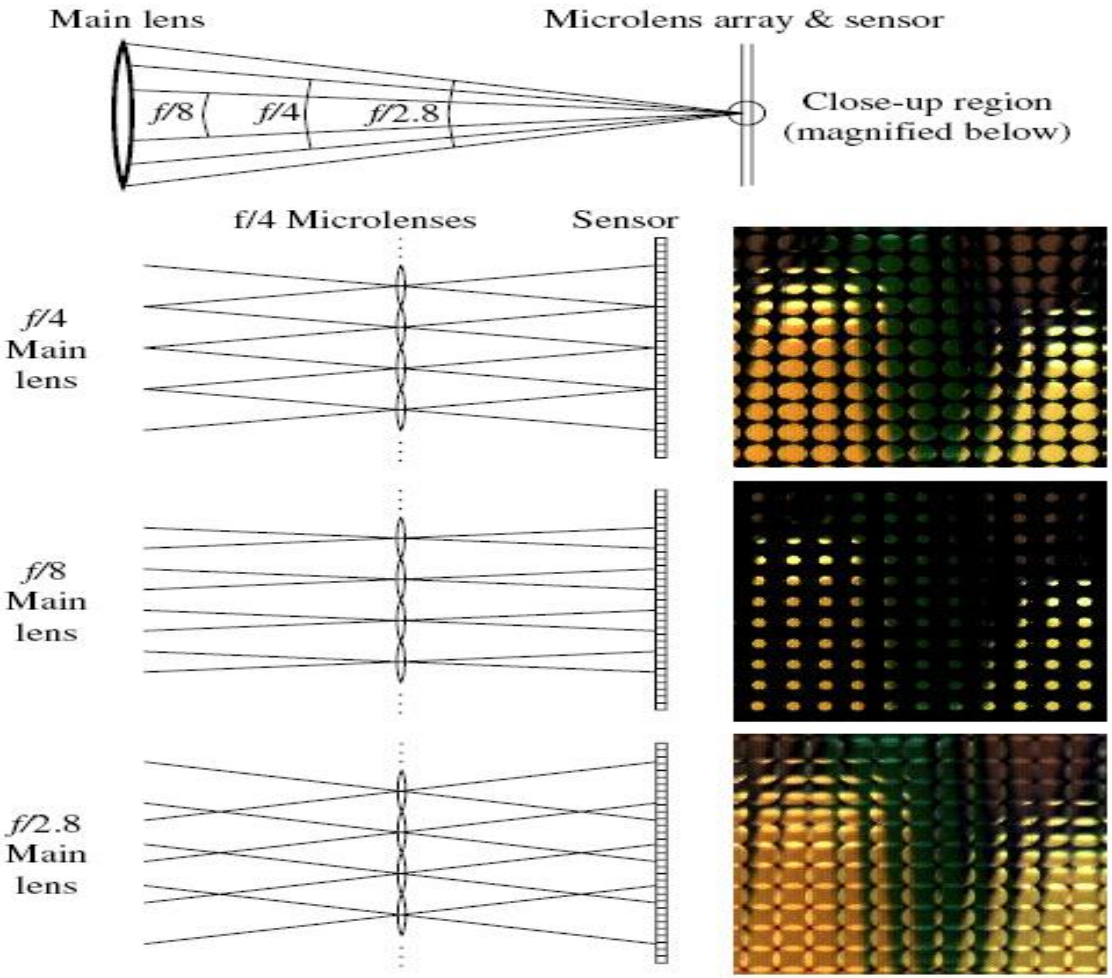
  -easy to use

  -reduce aliasing

Hand-held Plenoptic Camera



Hand-held Plenoptic Camera- Cont.



More on Plenoptic Camera

- Higher image resolution, increased sharpness of the refocused photographs.
- Shorter exposures and lower image noise

Discussion

- Limitations

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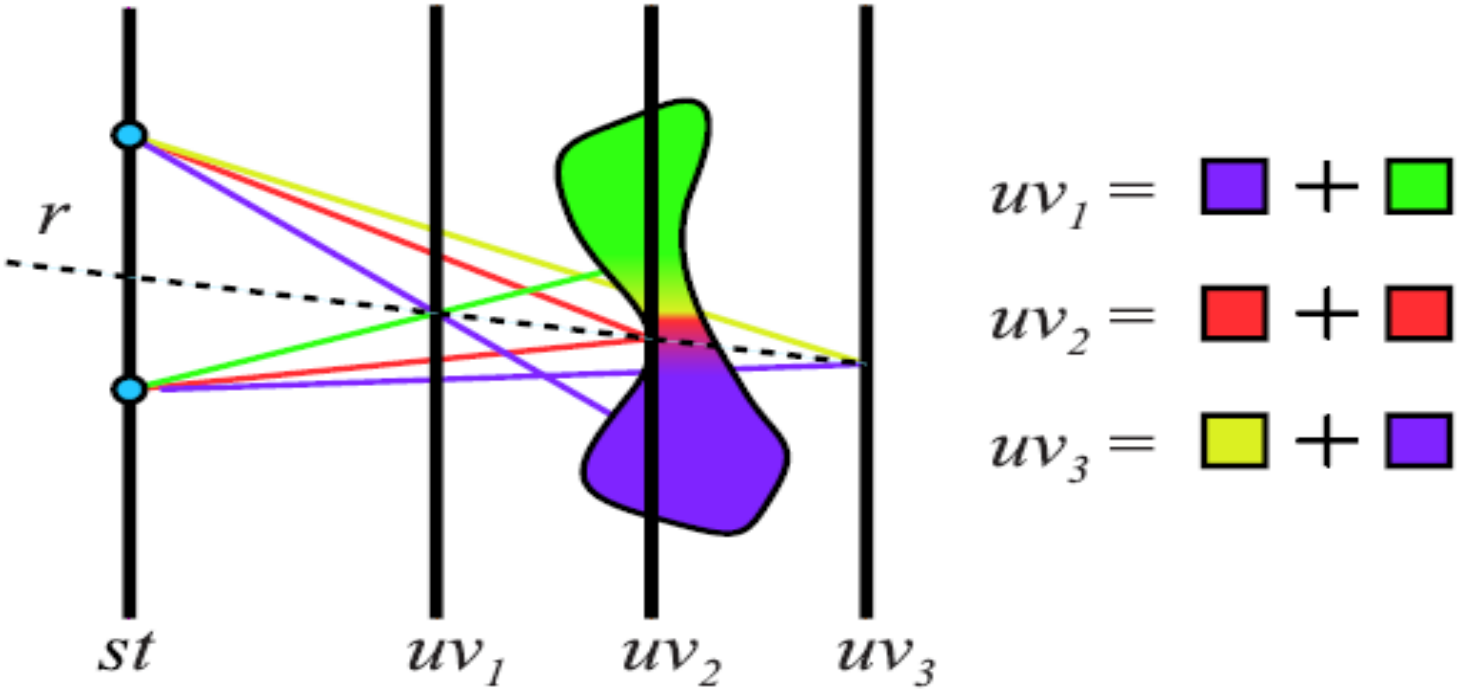
  Building acquisition device

  Fixed focal surface

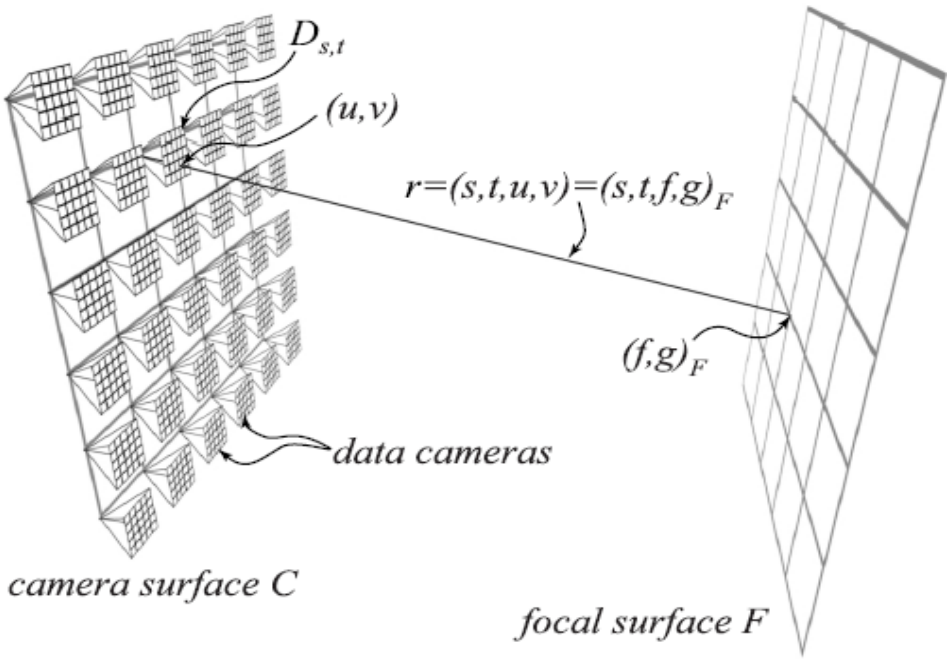
Dynamic Reparameterized Light Fields

- Focal Surface is fixed when create light fields
- What if recover pixels that are not on the focal surface
- Reparameterize to required focal surface



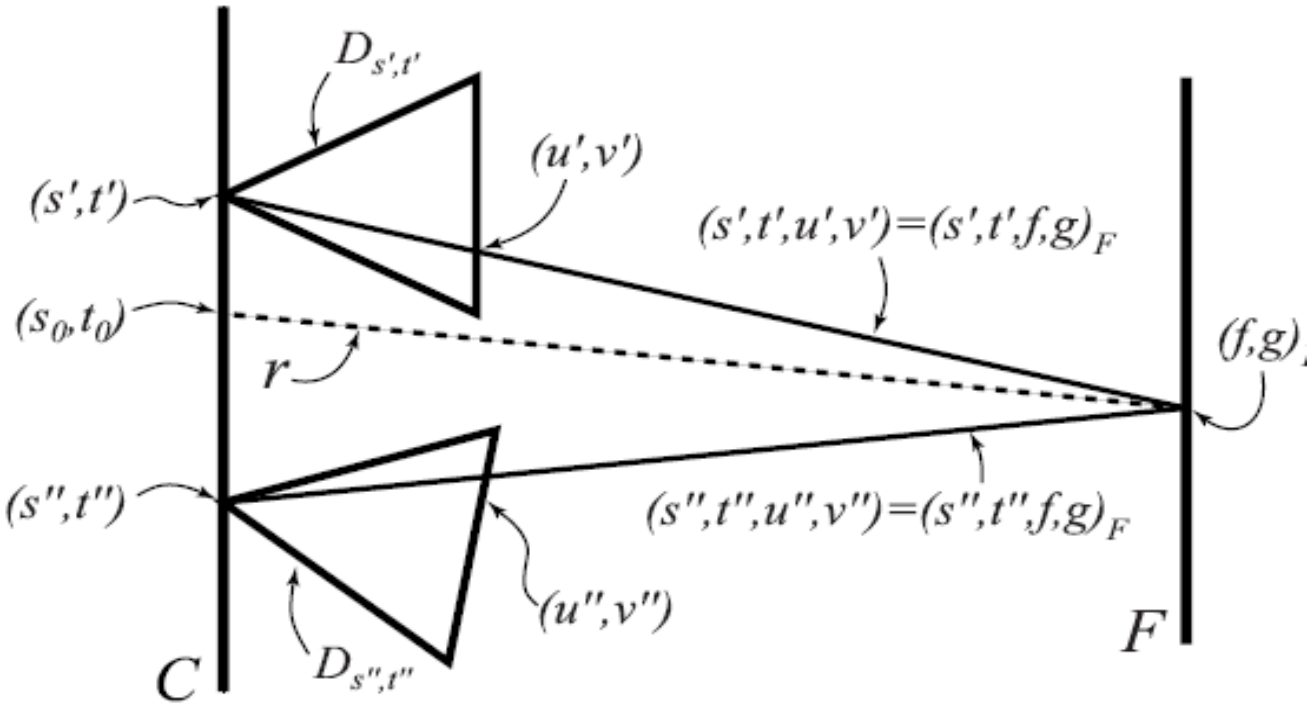
Dynamic Reparameterized Light Fields

- Move to desired new focal surface
- Create a new 4D space with new focal surface
- Recove ray with Reparameterization
- (u, v, s, t) => $(u, v, f, g)_F$

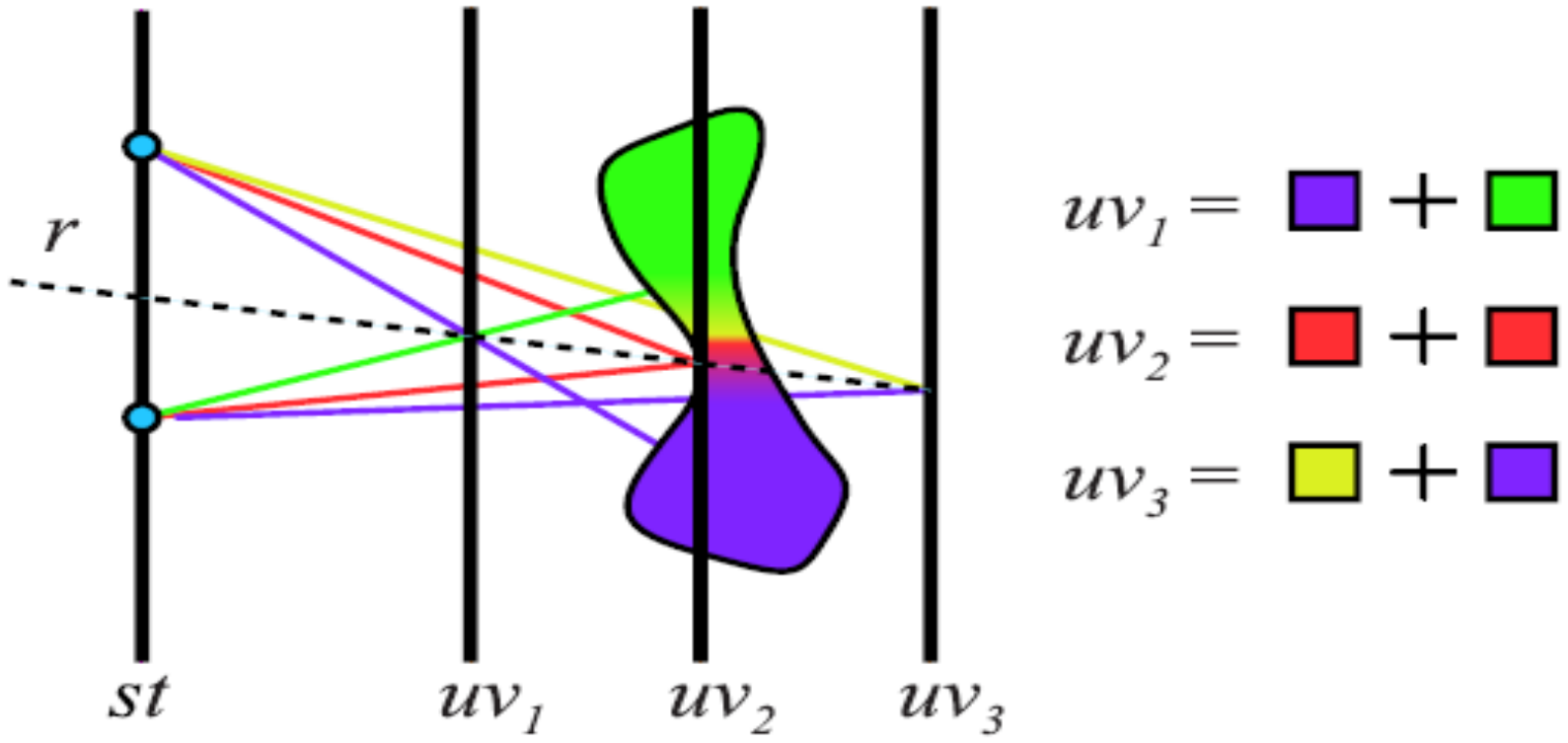


Dynamic Reparameterized Light Fields

- Recover ray r
- Resample from ray (s', t', f, g) and (s'', t'', f, g)
- Interpolation, reconstruction with filter, … , etc

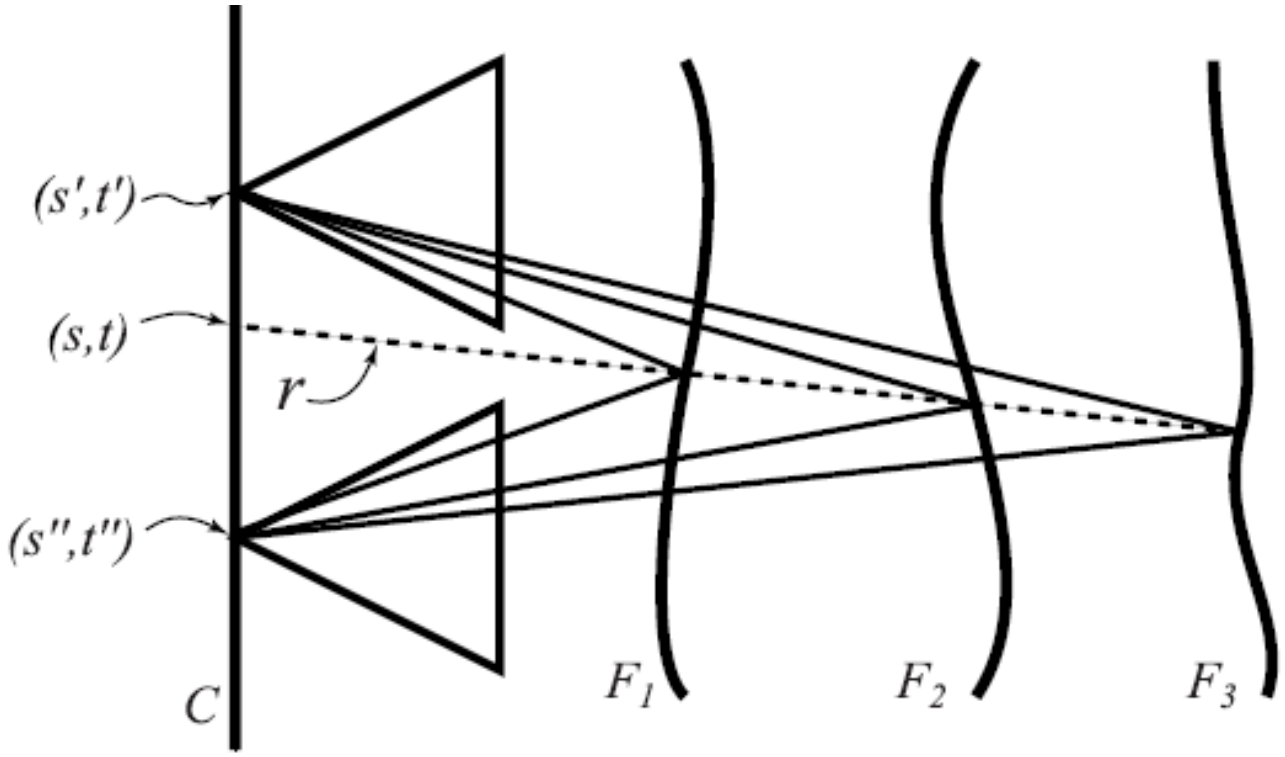


Dynamic Reparameterized Light Fields



Dynamic Reparameterized Light Fields

- Change the shape of focal surface
- Gives focus on 3D object rather than planes



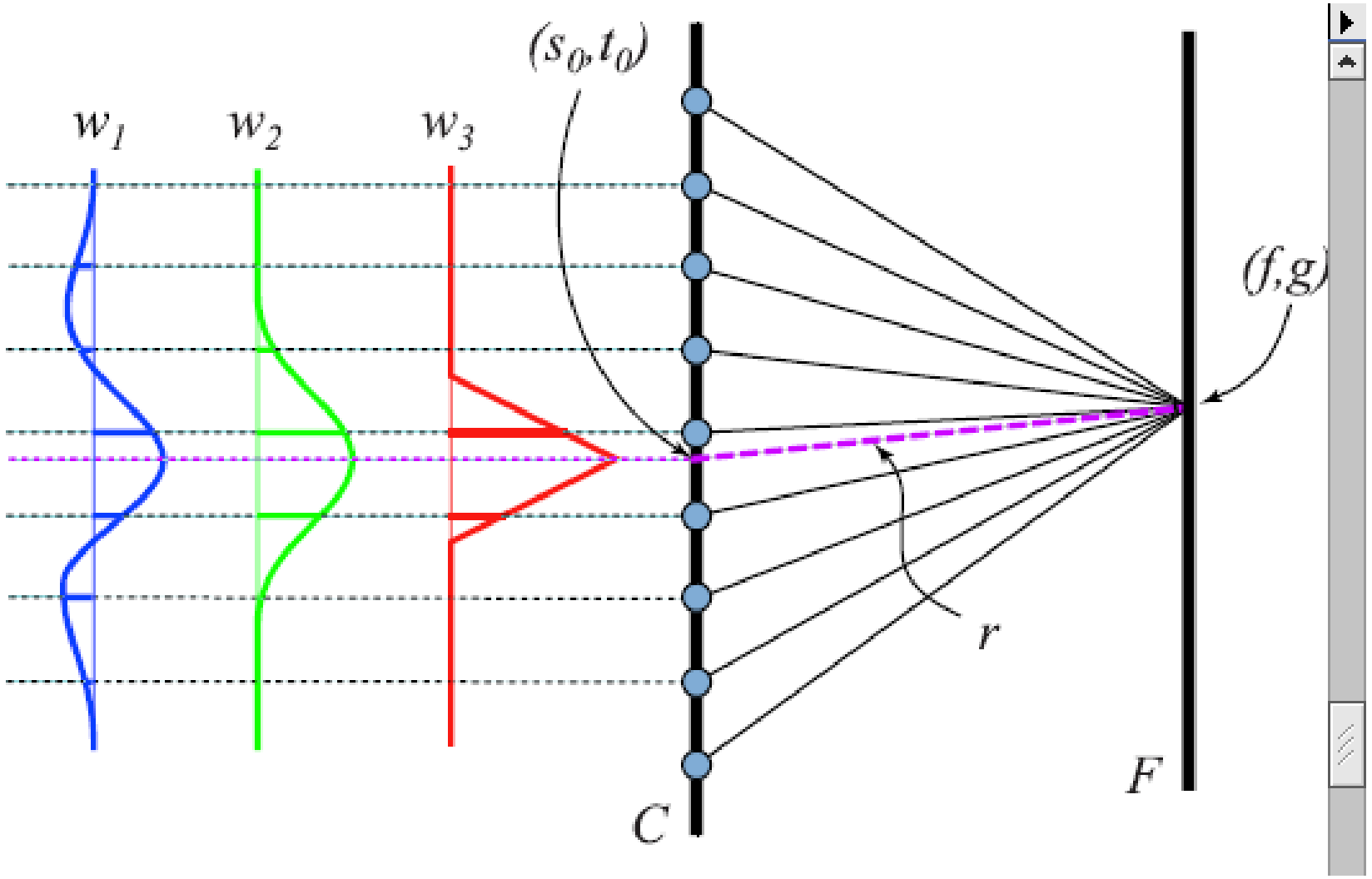
Dynamic Reparameterized Light Fields

Dynamic Reparameterized Light Fields

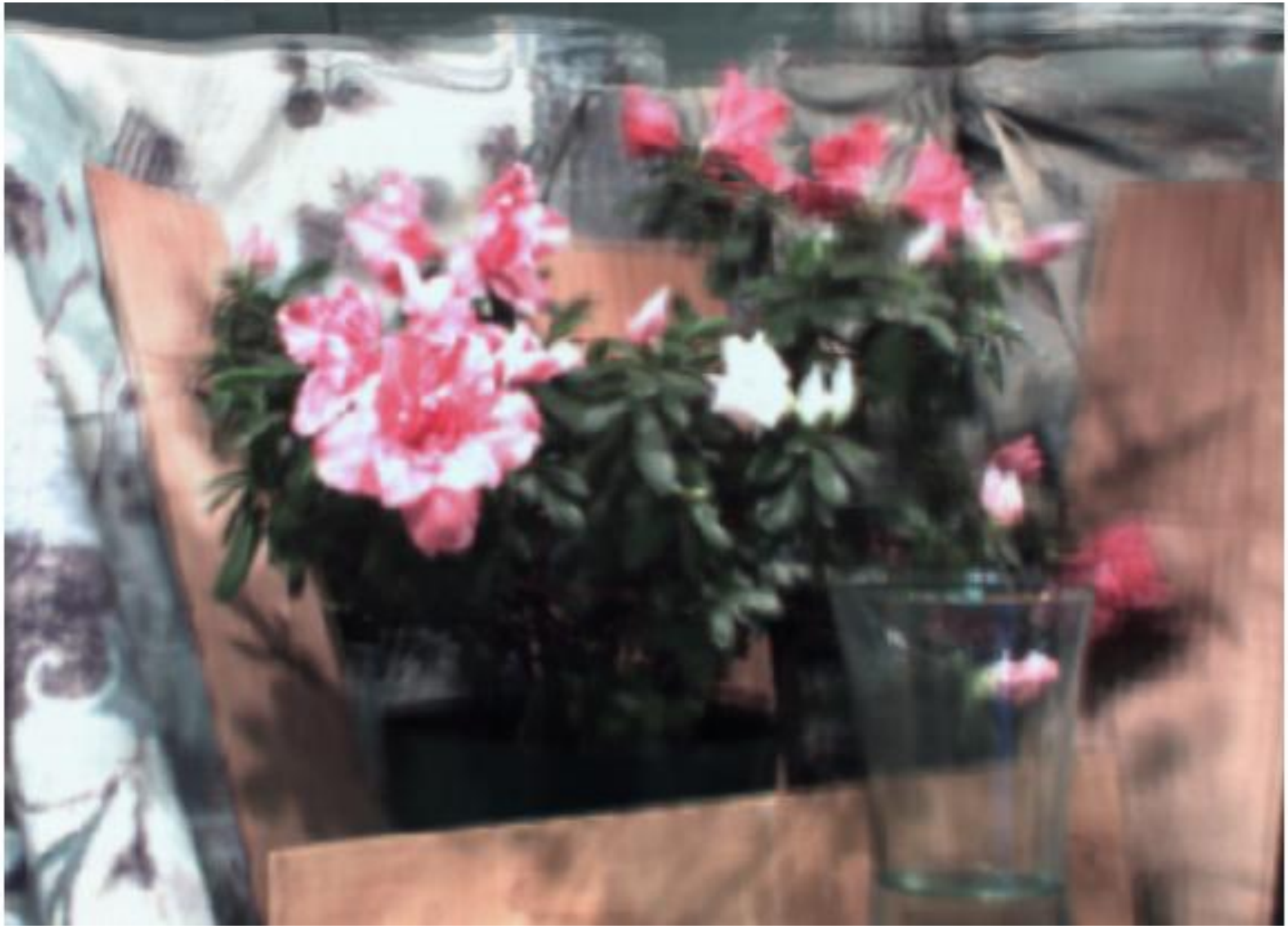
Variable Apertures

- Also can generate variable aperture
- Aperture
  - Control amount of light
  - Control depth of fields
- Aperture Filter:
  - Control how many cameras are used to resample a required ray
  - Larger apertures produce images with narrow range of focus

Aperture Filters



Variable Apertures



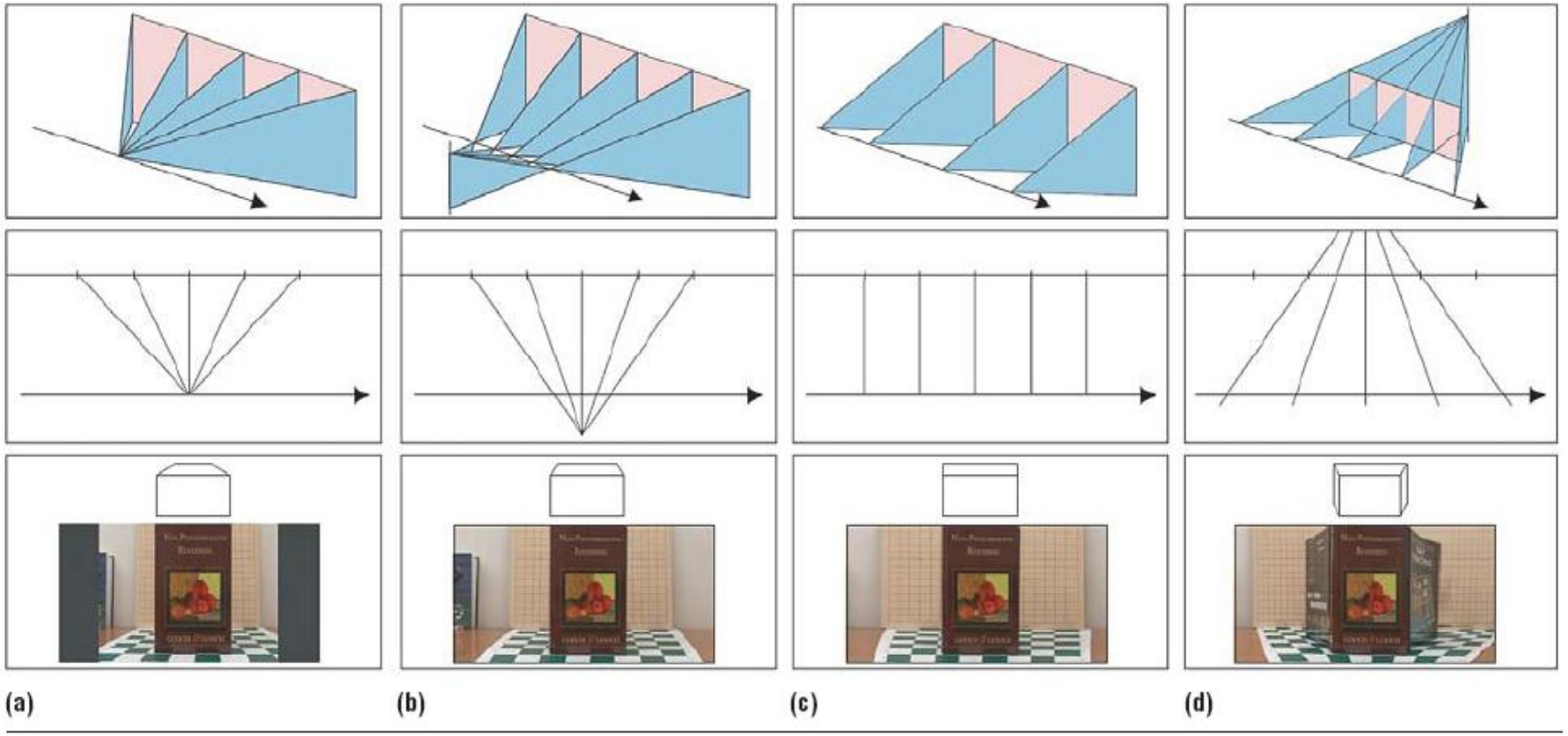
Variable Apertures

Application of Light Fields

- Multipersepective panorama
- Lens simulation

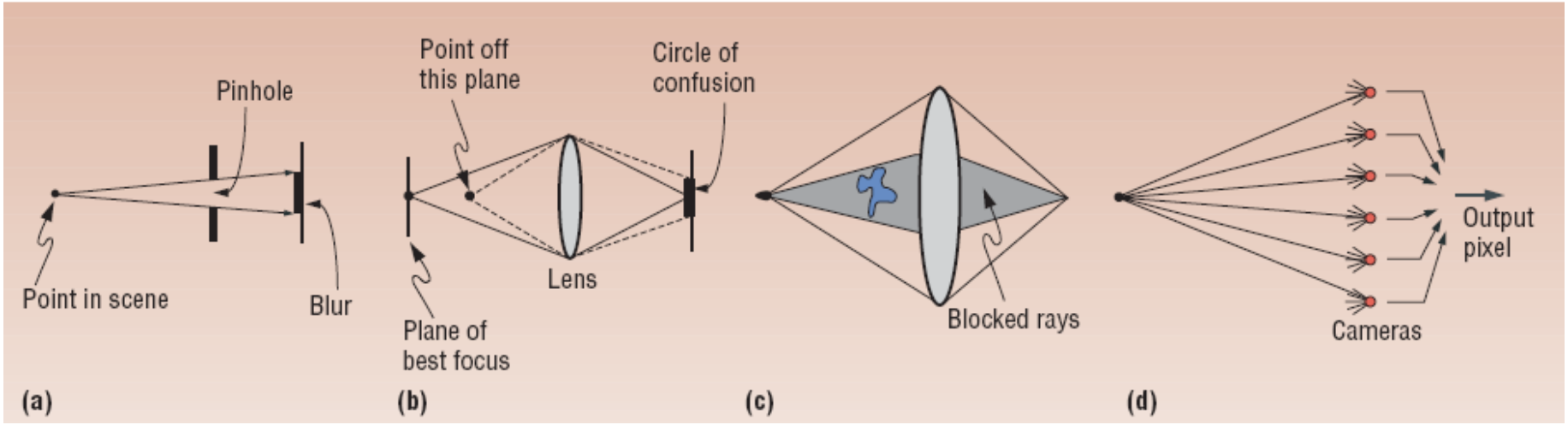
Applications of Light Field

- Multipersepective panorama



Applications of Light Field

- Lens simulation
  - Simulate lens with large aperture



Future of Light Field

- Need better ways to capture larger collection of viewpoints
- Reconstruct 3D shape with vision algorithms
- More images captured allow peeking arround occlusions

Thank you!

Questions?