



# Camera Model Design

Voicu Popescu

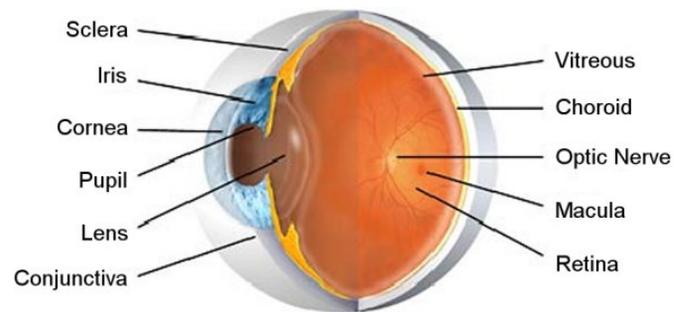
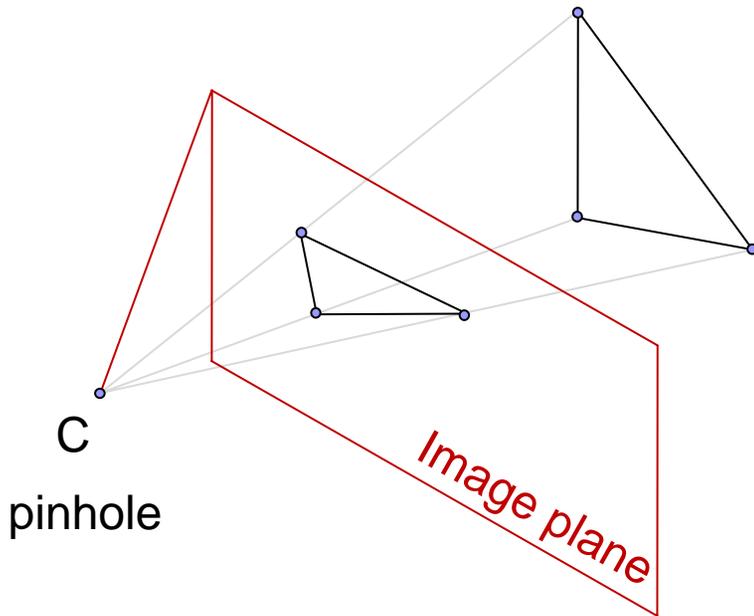
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# Images



- Fundamental primitive in graphics, visualization, vision
- Usually rendered or acquired with a planar pinhole camera

# Planar Pinhole Cameras



# Why Planar Pinhole Cam.?



- Makes images familiar to us
- Simple
  - Efficient SW and HW implementation
  - Efficient physical implementation

# PPHC limitations

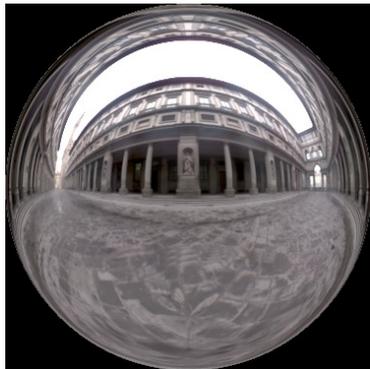


- Field of view

# PPHC limitations



- Field of view
  - Solved problem: panoramas



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# PPHC limitations



- Field of view

- Solved problem: panoramas

- Occlusions

- Image captures only what's visible from pinhole

# Camera Model Design



- Forget about pinhole constraint
- Forget about using the same camera for all applications
- Construct camera that makes image best suited for application and data set at hand
  - A non-pinhole camera (NPHC)

# Does it make sense?

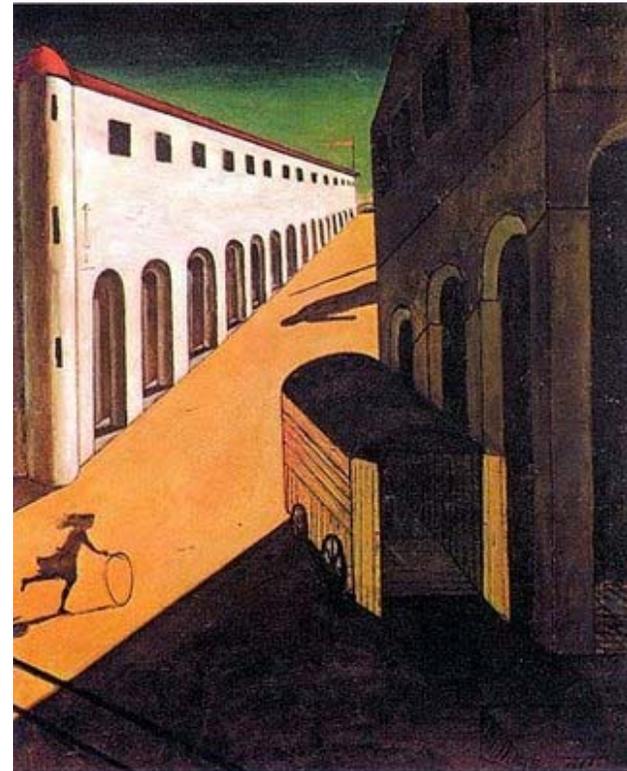


- Can humans understand the image?

# Does it make sense?



- Can humans understand the image?
  - Artists have played with perspective for increased artistic value



Giorgio de Chirico

# Does it make sense?



- Can humans understand the image?
    - Artists have done it
    - Image needs to be mostly “continuous”
      - Nearby 3-D points map to nearby image locations
  - Images also serve as intermediate representations
    - Not for direct human consumption
-

# Can it ever be fast?

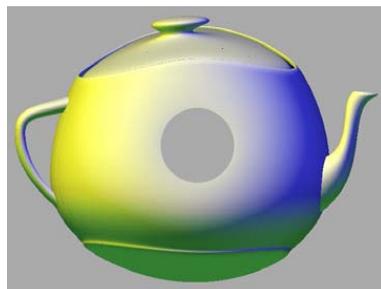


- How do you render with an NPHC efficiently?
  - Make sure the NPHC provides fast projection
  - This enables feed-forward rendering(i.e. you are not stuck with ray tracing)
  - Rasterization is more complicated
    - Parameters do not vary linearly in image plane

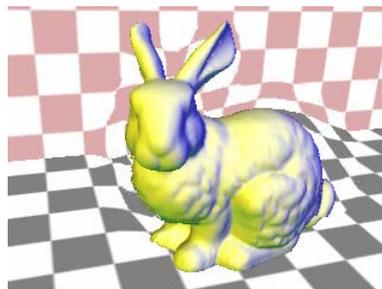
# Designed Camera Models



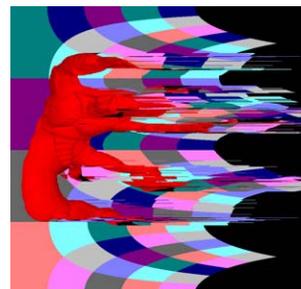
Reverse  
Perspective Camera



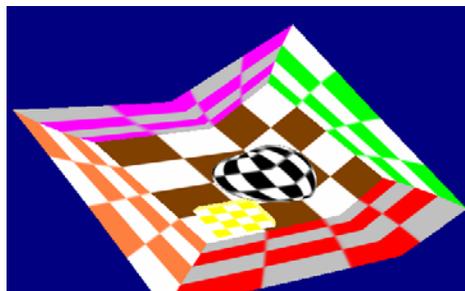
Single-Pole  
Occlusion Camera



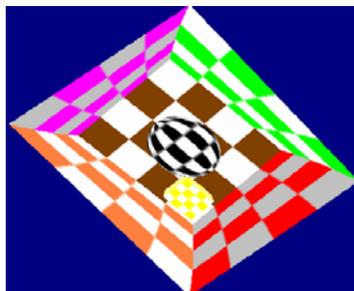
Depth Discontinuity  
Occlusion Camera



Epipolar  
Occlusion Camera

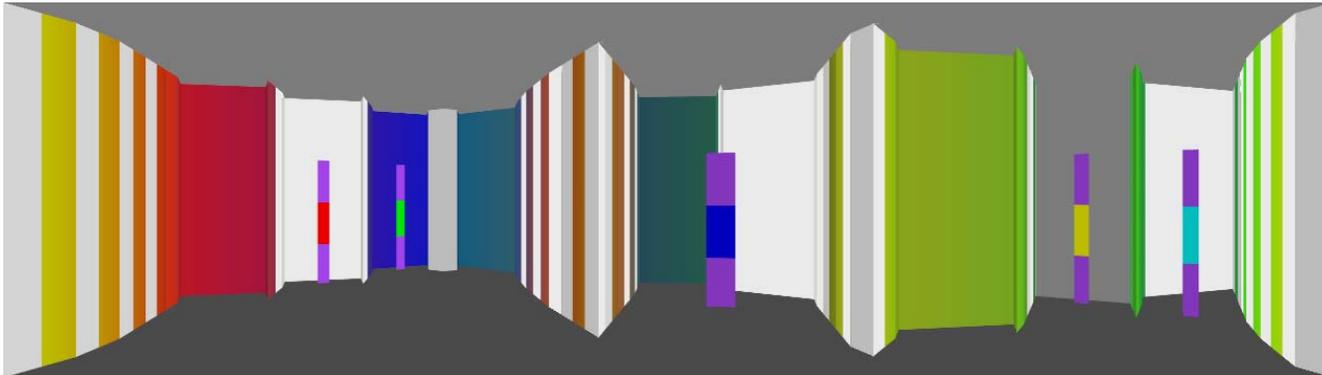


2 adjacent Continuous  
3-Ray Cameras



4-Ray Camera

# Designed Camera Models



Graph Camera

# Designed Camera Models



Physical Graph Camera