Camera Basics

Using a Camera

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Types of Cameras

- Still Cameras
  - Fixed Lens Cameras
    - Lens is not interchangeable (removable)
    - Variable zoom, controlled by servo controller
    - User friendly, less manual features
    - Less expensive (<$500)

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Types of Cameras

- Still Cameras
  - Single Lens Reflex (SLR)/Digital SLR
    - Lens is interchangeable (removable)
    - Professional quality, more manual features
    - More expensive ($500+)
    - Lenses often sold separately

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Types of Cameras

- Video Cameras
  - Studio Camera
    - Designed for studio use *only*
      - Very expensive ($50,000+)
      - Very high quality
      - Not used to record audio
      - No built-in recorder
      - Camera Control Unit separate
        - Color balance, iris and other controls not adjusted on camera
      - Heavy and difficult to transport
        - Requires a pedestal mount

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Types of Cameras

- Video Cameras
  - Camcorder
    - Used for field production (outside studio)
      - Portable and durable
      - Records to tape, card, or built-in hard drive
      - Records audio
        - Built-in microphone
        - High quality audio inputs
      - Various types of camcorders
        - Professional (ENG) – ($10,000+)
        - Consumer – ($300+)
        - Prosumer – ($3000-10,000)

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Types of Cameras

- HDSLR Cameras
  - Growing popularity of using DSLR cameras for shooting HD video
    - Lens is interchangeable (removable)
      - Lenses give more cinematic look
    - Cameras often shoot multiple frame rates
    - Requires more accessories for quality video capture
      - Audio capture (microphone)
      - Mounting device (video rig)
      - Follow focus
      - External video screen

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Resolution

- Digital images are made up of pixels
  - The more pixels, the higher quality the image
  - Higher resolution images take up more digital space on the storage device (memory card, videotape, hard drive, etc.)
  - Measured in pixel columns by pixel rows
    - 640x480 – analog standard definition video
    - 1920x1080 – high definition (HD) video
    - 2048x1536 – 3,145,728 pixels (3.1 megapixels)
  - DPI – dots per inch
    - Measures the density of dots per inch in a digital print
    - The higher the dpi, the better quality the print
      - Examples: 72, 96, 150, 300 dpi
      - Images for print should be created at 300 dpi, text at 400 dpi

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Resolution

72 dpi **300 dpi**

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Camera Controls

- Cameras have a number of different functions.
- Some settings are found only on still cameras, some on video cameras or some on both
- The following controls may be automatically or manually adjusted
  - Manual means the operator adjusts the camera
  - Automatic means the camera selects the best setting for the given conditions.

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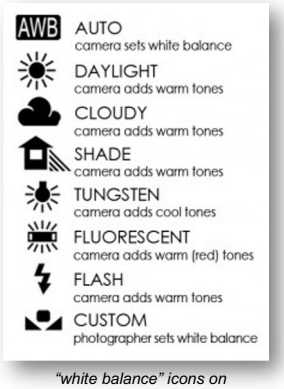
Camera Controls

- White balance (still and video cameras)
  - Gives the camera a "true white", adjusting all other colors accordingly.
  - As lighting changes from one location to another, WB should be adjusted
  - May have multiple modes for white balance
    - Auto WB
    - Indoor WB
    - Outdoor WB
    - Manual (custom) WB
      - When in manual mode the symbol often blinks when it needs setting and is solid when WB is set
      - Manually set WB by zooming in or focusing on a white surface



"white balance" icons on many still cameras

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White Balance

The picture (right) shows an outdoor scene with indoor white balance settings. (Note the blue tint)

The picture (left) shows an outdoor scene with proper outdoor white balance settings.

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Camera Controls

- ISO aka “Film Speed” (still cameras)
  - Determines how sensitive the camera’s image sensor is to light
    - The lower the ISO, the slower the speed
      - Lower ISO when possible
      - High ISO results in more grainy photos
      - Common ISOs are 100, 200, 400 and 800
    - ISO setting recommendations
      - 100-200: outdoors, sunny conditions
      - 400-800: outdoors, cloudy conditions
      - 1600: night time, low light

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Camera Controls

- Iris (still and video cameras)
  - The iris controls the amount of light entering into the lens
  - The lower the light conditions, the wider the aperture (opening) should be
  - Iris is measured in f-stops
    - f/1.4, f/2, f/2.8
    - As f-stop numbers get larger, the aperture gets smaller (and vice-versa)

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Iris

The picture (right) shows an outdoor scene with an improper iris setting.

The picture (left) shows an outdoor scene with a proper iris setting.

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Camera Controls

- Shutter speed (still and video cameras)
  - Allows for shooting of fast moving objects without blurring
  - The faster the subject, the faster the speed
  - Measured in fractions of a second
    - 1/60 (of a second) – slow shutter
    - 1/2,000 - fast shutter
  - The faster the shutter speed, the less light the camera lens allows in

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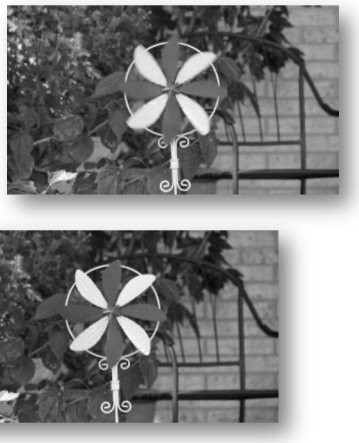
Shutter Speed

The difference between these two photographs is shutter speed. The bottom photo shows a faster shutter speed than the top. The pinwheel (which is moving) is clear and seems to be frozen in mid-air.



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Camera Controls

- Gain (video cameras)
  - Boosts the video signal in low light conditions.
  - Gain affects resolution.
    - Gain creates “video noise”
    - The higher the gain, the lower the resolution.
  - Gain is measured in decibels
    - +6 dB, +9 dB, +12 dB

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Gain

The picture below shows how boosting the gain gives the appearance of more light, but adds video noise, making it look “grainy”.

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Camera Controls

- ND Filter (Neutral Density Filter)
  - Filters out bright sunlight to avoid overexposure
  - May be a camera setting (video)
  - May be an actual filter placed on the front of the lens (photo)

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Camera Controls

- Focal Length
  - Distance from lens to imaging sensor
  - Determines the picture's angle of view (magnification)
    - As focal length increases
      - Angle of view becomes more narrow
      - Less elements are visible
- Zoom (increase in focal length)
  - May be controlled with the servo zoom control on the camera or by manipulating the lens (DSLR)
  - Zoom may be measured in millimeters (photography) or "power" (video)

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Camera Controls

- Optical zoom – focal length changes
  - No quality loss when going wide to narrow
- Digital zoom – focal length doesn't change, the camera enlarges the image
  - Pixels are enlarged
  - Loss of quality
- To determine optical zoom power, divide the zoom setting by the widest setting, ie 500mm/50mm = 10x
  - If a lens has a zoom range of 18mm – 270mm…
    - 18-35mm (1-2x) = wide angle
    - 36-70mm (3-4x) = normal angle
    - 135-270mm (7-15x) = telephoto

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Zoom

The photos below show the difference between optical zoom (left) and digital zoom (right). Notice the pixilation on the digital zoom.


Wide Angle (no zoom)


Optical Zoom (approx. 7x)


Digital Zoom

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Camera Controls

- Focus (both still and video)
  - Sharpness or clarity of an image
    - Manually adjusted with the focus ring located on lens
  - Selective focus
    - Creates variety, interest and emphasis in the shot
    - Must be zoomed in (the farther, the more dramatic)
    - Must have significant distance between foreground and background
  - Rack focus
    - Focus is shifted while recording video

In selective focus, we have a foreground subject in focus (rose) and a subject in the background (church) out of focus.

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Camera Controls

- Focus (cont.)
  - MOD – minimum object distance
    - This is the point at which a lens is too close to the subject to focus
    - MOD can be decreased (ie from six inches to three inches) with a macro, allowing the camera to focus at a closer distance
    - Macro may be a lens attachment or a setting on the camera

"macro" icon on many still cameras

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Camera Controls

This picture was taken with macro settings. Notice the contrast in focus between the foreground (close to the camera) and background.

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Basic Camera Care

- Handle the camera with care
- Do not point the lens at the sun, bright lights or bright reflections for an extended period of time
- Do not clean the camera or the lens with solvents, liquids, or chemicals
  - Use clean, dry cloth for camera; lens cloth for lenses
- Do not touch a camera lens
  - Keep covered when not in use
- Do not operate or store equipment in extreme temperatures or weather

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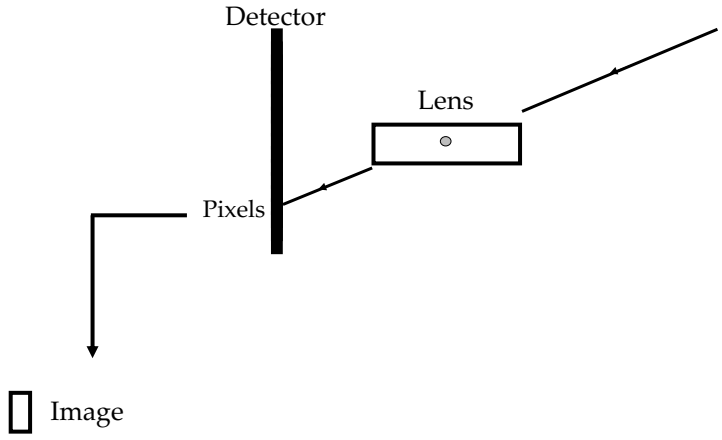
Traditional Photography



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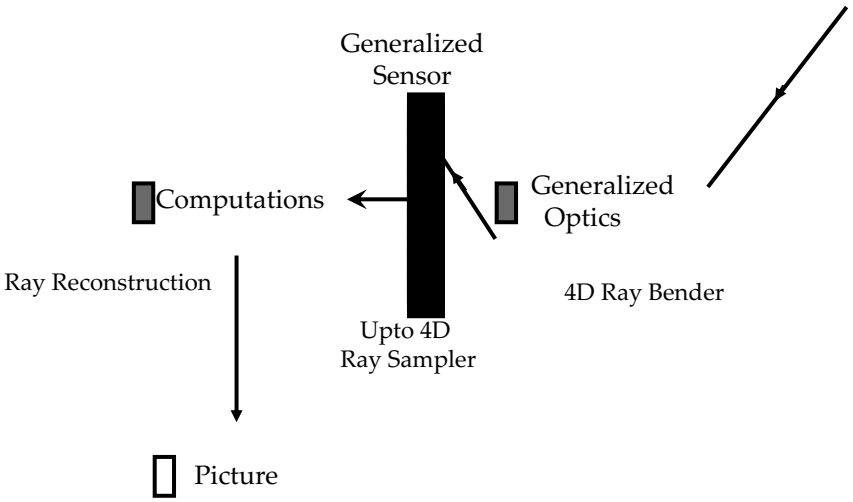
Computational Photography:
Optics, Sensors and Computations



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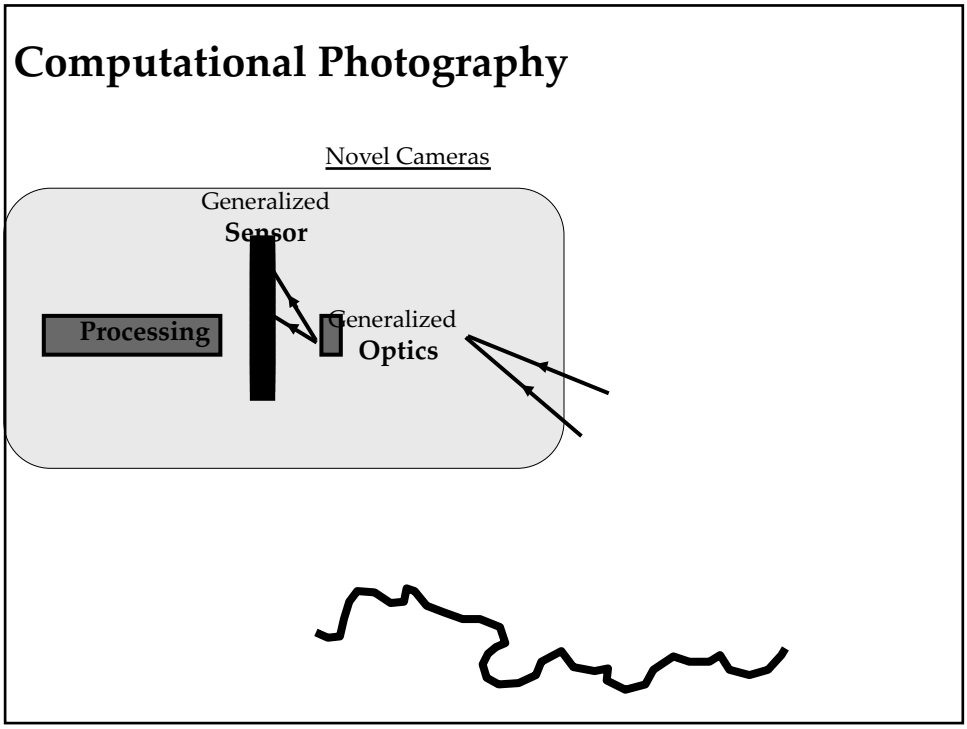
Computational Photography
Novel Cameras
Generalized
Sensor
Processing
Generalized
Optics

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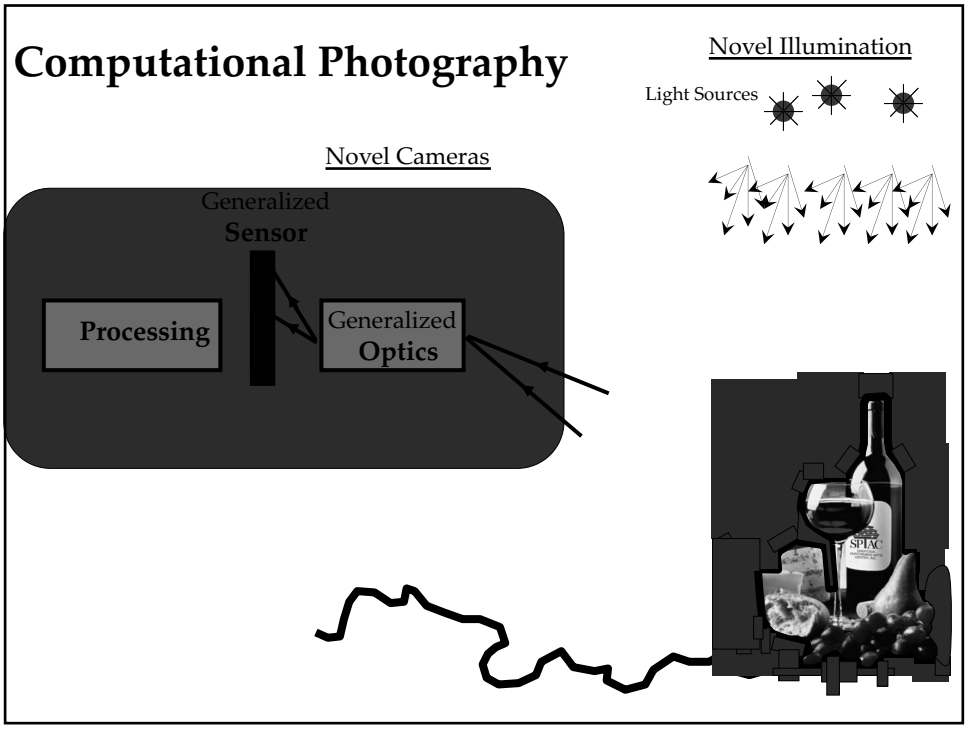
Computational Photography
Novel Illumination
Light Sources
Novel Cameras
Generalized
Sensor
Processing
Generalized
Optics

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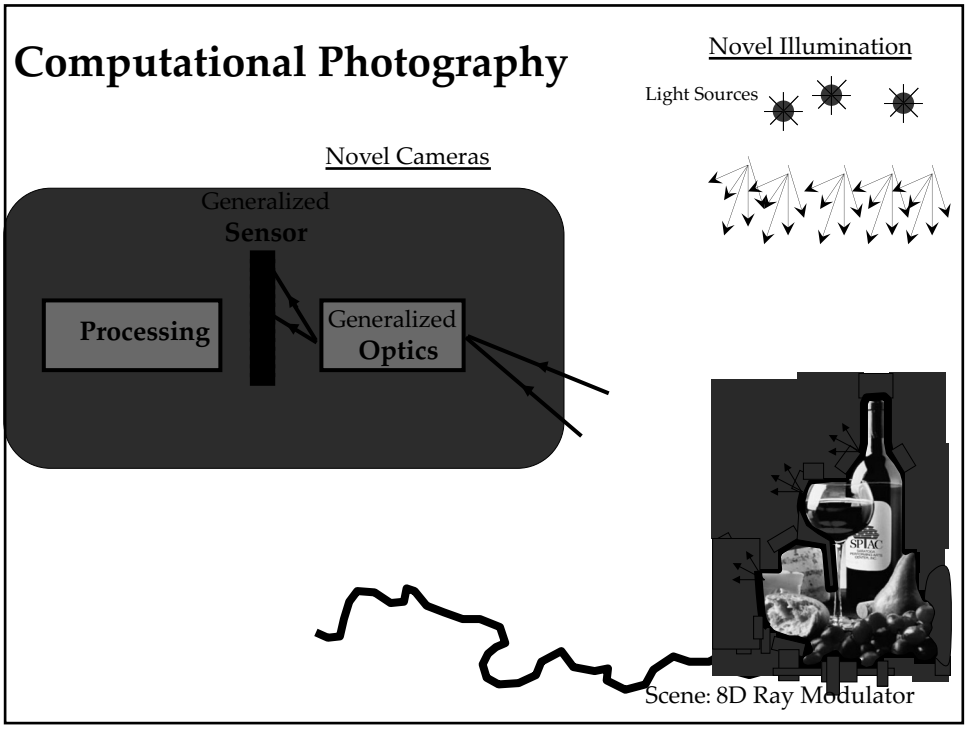
Computational Photography
Novel Illumination
Light Sources
Novel Cameras
Generalized
Sensor
Processing
Generalized
Optics
Scene: 8D Ray Modulator

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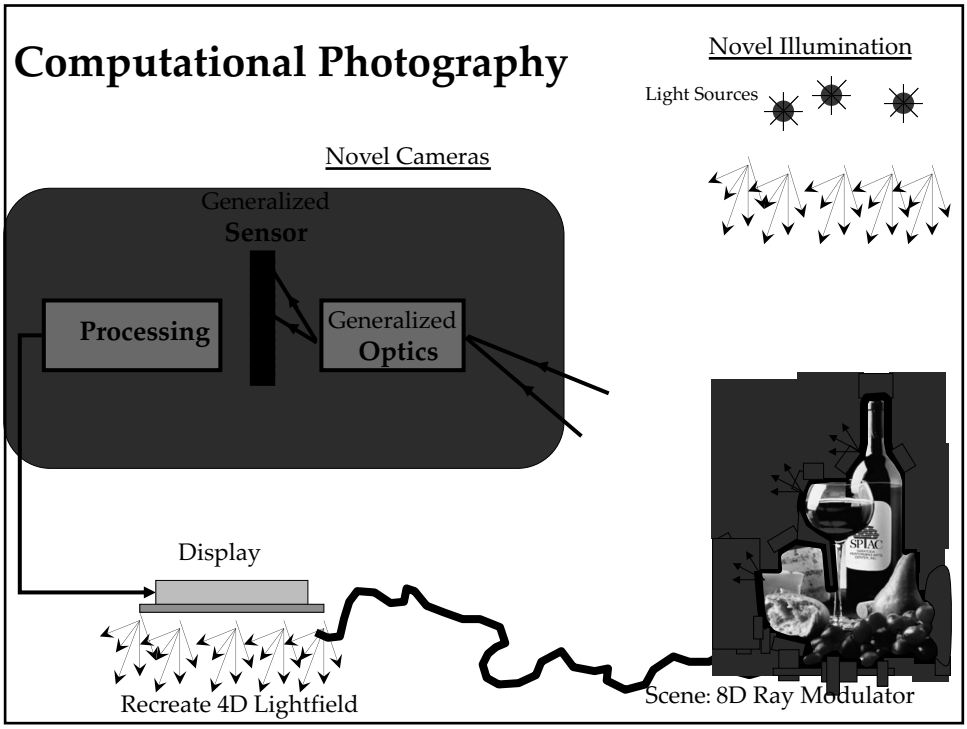
Computational Photography
Novel Illumination
Light Sources
Novel Cameras
Generalized
Sensor
Processing
Generalized
Optics
Display
Recreate 4D Lightfield
Scene: 8D Ray Modulator

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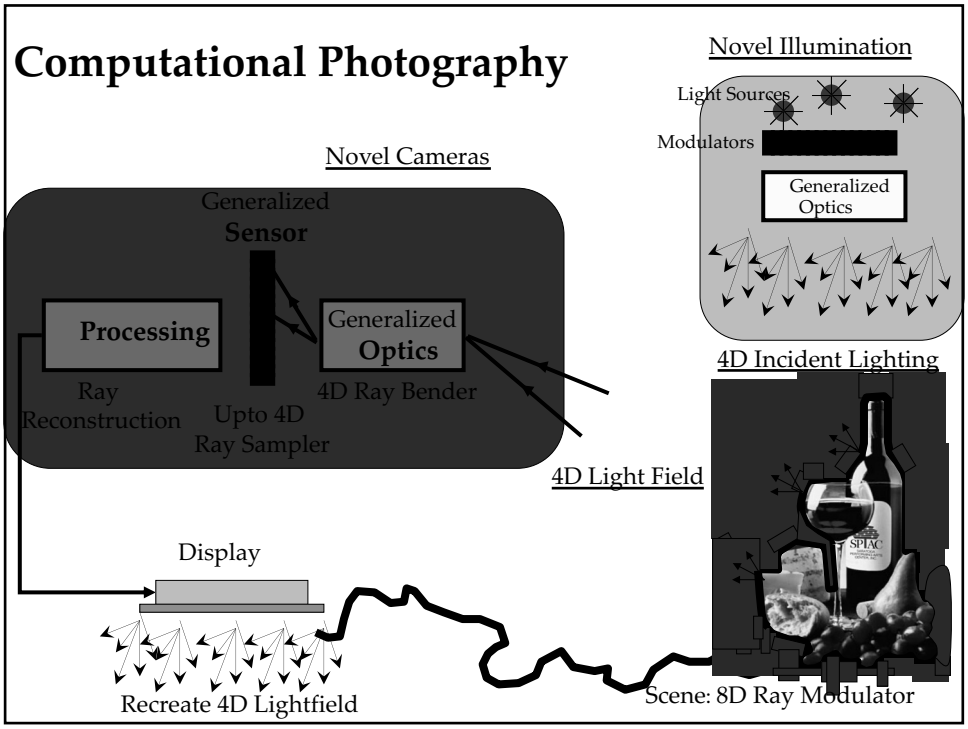
Computational Photography
Novel Illumination
Light Sources
Modulators
Generalized Optics
Novel Cameras
Generalized Sensor
Processing
Generalized Optics
Ray Reconstruction
Upto 4D Ray Sampler
4D Ray Bender
4D Incident Lighting
4D Light Field
Display
Recreate 4D Lightfield
Scene: 8D Ray Modulator

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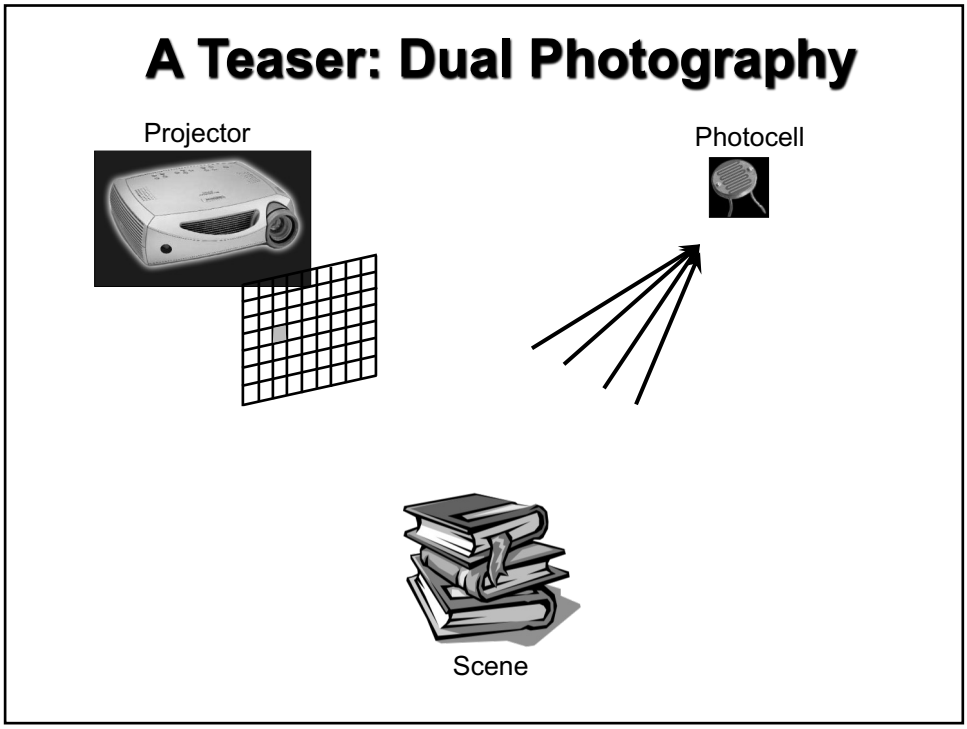
A Teaser: Dual Photography
Projector
Photocell
Scene

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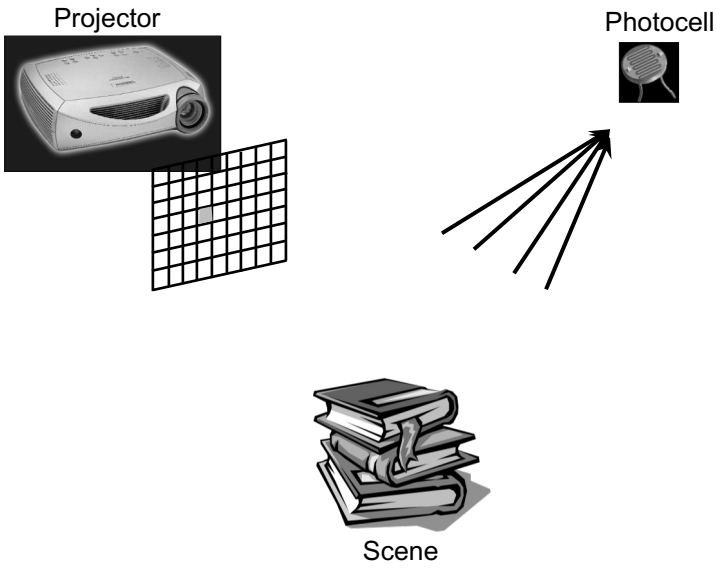
A Teaser: Dual Photography



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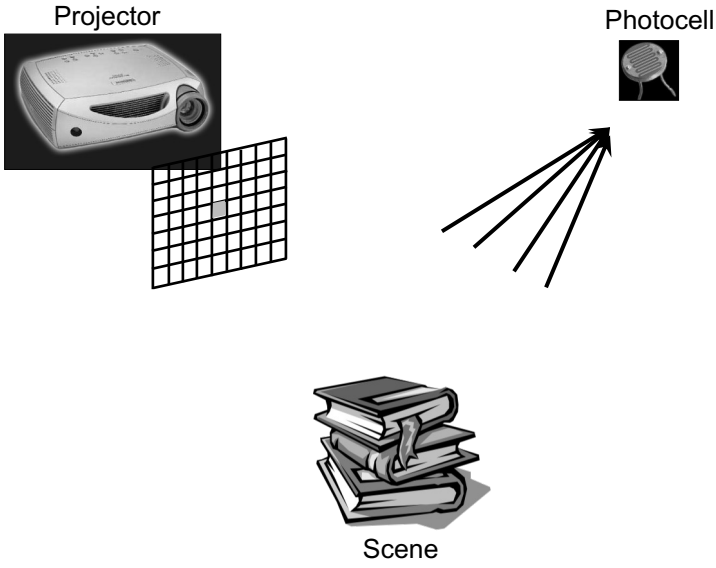
A Teaser: Dual Photography



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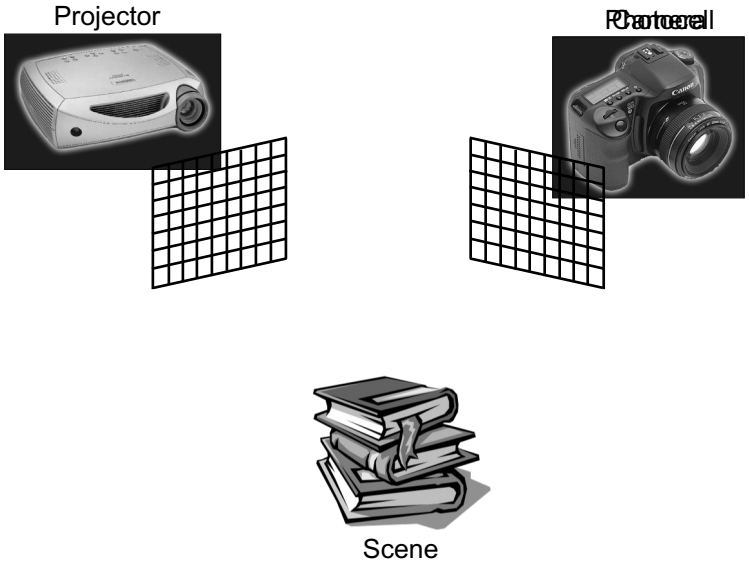
A Teaser: Dual Photography



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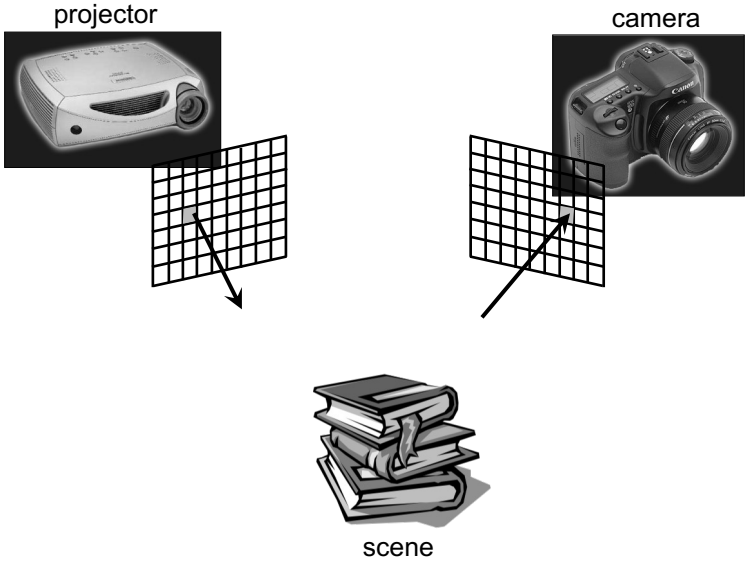
The 4D transport matrix:

Contribution of each projector pixel to each camera pixel



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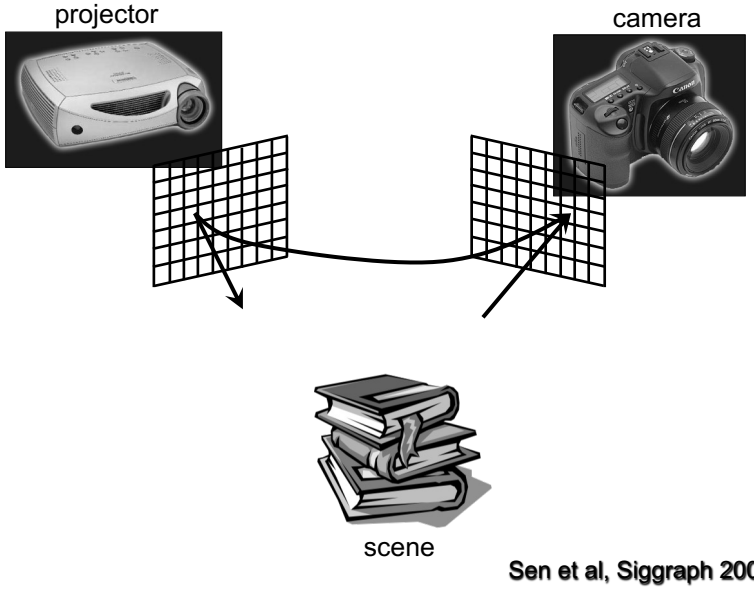
The 4D transport matrix:

Contribution of each projector pixel to each camera pixel



Sen et al, Siggraph 2005

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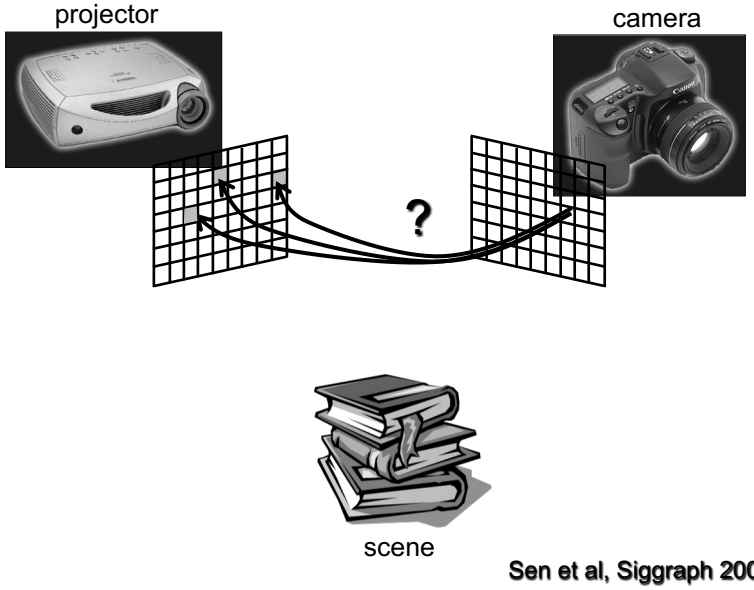
The 4D transport matrix:

Which projector pixel contribute to each camera pixel



Sen et al, Siggraph 2005

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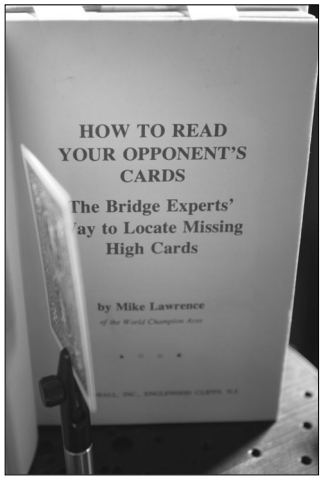
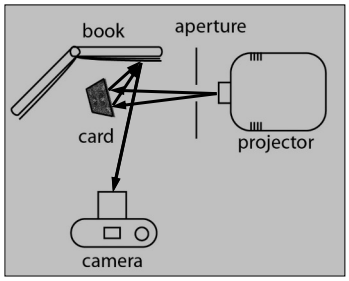
Dual photography from diffuse reflections



the camera's view



Sen et al, Siggraph 2005

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