Extremes

- high resolution
- high speed
- low speed
- small aperture
- large aperture
- narrow field of view
- wide field of view
- high dynamic range
- low dynamic range

Sinar view camera
10,000 × 8,000 pixels
Graham Flint’s gigapxl.org

- custom camera and lens
- 18” negative → drum scanner → printer
- 40,000 pixels × 25,000 pixels
Balboa Park, San Diego

(full-resolution print in Gates Hall, 3rd floor, entrance to graphics wing)
San Diego Skyline
San Diego Skyline
San Diego Skyline
xrez.com  (also gigapixel resolution)
xrez.com  (also gigapixel resolution)
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Harold Edgerton: “father” of high-speed photography

- no shutter
- electronic strobe
- microphone near gun

from Stopping Time, 1964
Ultra-high speed photography

- atomic explosion
- 1/100,000,000 second
- camera was 7 miles away
- telescopic lens
High-speed video with a still camera: the Casio EX-F1

- 640 x 480 pixels
- 300 frames per second
- border collie
- 320 x 480 pixels
- 600 frames per second
• 160 × 480 pixels
• 1200 frames per second
Extremes

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  - low speed
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Low-light photography

• composite of two 30-second exposures

Lee Frost, Santorini, Greece
Time exposures in astronomy

• 30-minute exposure
• telescopes can rotate to avoid smearing stars
• What is the unmoving star in the middle?

Lee Frost, star trails

(Palomar 200-inch)
Painting with light

- 30-second exposure
- multiple flashes
- Don’t stand between the flashed part of the scene and the camera!

Lee Frost, railroad yard
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Small aperture  (large depth of field)

Ansel Adams, Mission San Xavier del Bac, Tucson

• the f/64 club
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Large aperture (shallow depth of field)

Lewis Hine, Girl Worker in Cotton Mill, 1908
Synthetic aperture photography
Example using 45 cameras
[Vaish CVPR 2004]
(movie is available at http://graphics.stanford.edu/projects/array)
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• wide field of view
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• low dynamic range
Narrow field of view: telephoto lens

- 300mm lens

Bryan Peterson, Golden Gate Bridge
Extreme telephoto

- Nikon 1540mm Cassegrain reflector
Extremes

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✦ wide field of view
• high dynamic range
• low dynamic range
Wide field of view: stitched panoramas

• 4 photos, total = 90° field of view
• Canon point-and-shoot camera, handheld
• stitched using Photoshop CS3

Crater Lake, Oregon
Games with stitched panoramas

- 5 shots, with camera aimed slightly downwards and rolled clockwise around its optical axis between shots left to right, producing a curved world effect when stitched using Photoshop with cylindrical projection.
Nikon 6mm fisheye lens

- 220° field of view measured diagonally
- 11.4 pounds

(DigitalFreak.net)
360 x 360 panorama

- point a camera at a chrome ball

Paul Debevec, Uffizi Galleries, Florence
Image-based relighting
(Paul Debevec)

Light Stage

color and infrared LEDs

infrared

color

composite
Stanford CityBlock Project
(now Google StreetView)

- capture video while driving
- extract middle column from each frame
- stack them to create a panorama
Stanford CityBlock Project
Stanford CityBlock Project
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High dynamic range (HDR)

- one of photography’s key limitations
  - negative film = 250:1 (8 stops)
  - paper prints = 50:1
  - example below = 250,000:1 (18 stops)

(Paul Debevec)
DIY HDR

Early morning in Zurich

- 2 shots
- Photoshop CS4
DIY HDR

- 2 shots
- Photoshop CS4

Early morning in Zurich
DIY HDR

Early morning in Zurich

- 2 shots
- Photoshop CS4
Extremes

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Atmospheric perspective according to Leonardo

"the nearest objects will be bounded by evident and sharp boundaries, while those more distant will be... more blurred"

On Painting

Virgin and child with St. Anne
Sinar P3 view camera with 54H digital back

- 2¼ x 2¼ sensor, actively cooled, 14 real bits
Seeing through murky water

- scattering decreases contrast
- you can stretch the contrast, but...
- stretching is limited by imaging noise
Seeing through murky water

16 images

1 image
Coral reefs and shipwrecks
Slide credits
(in addition to individually credited images)

✦ [http://gigapixl.org](http://gigapixl.org)
✦ [http://xrez.com](http://xrez.com)