Extreme photography

CS 178, Spring 2010

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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
111-megapixel wafer-scale sensor

- 95mm × 95mm CCD sensor
- 10,580 × 10,560 pixels
- low yield, very expensive

5” (aperture) telescope at the U.S. naval observatory, Flagstaff, AZ
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)
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 \times 480 \text{ pixels}

• 1200 \text{ frames per second}
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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?
Jesse Levinson, Andromeda
Painting with light

In class I mentioned the "painting with light" photograph TA Art Tosborvorn submitted for one of his assignments in CS 178 last year. You can find this photograph at http://graphics.stanford.edu/courses/

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

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Small aperture  (large depth of field)

Ansel Adams, Mission San Xavier del Bac, Tucson

• the f/64 club
Extremes

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- low dynamic range
Large aperture  (shallow depth of field)

Lewis Hine, Girl Worker in Cotton Mill, 1908
Synthetic aperture photography
Example using 45 cameras
[Vaish CVPR 2004]
You can find the video I showed in class at http://graphics.stanford.edu/projects/array/, under "Slides, videos, and demos".
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Narrow field of view: telephoto lens

- 300mm lens

Bryan Peterson, Golden Gate Bridge
Extreme telephoto

- Nikon 1540mm Cassegrain reflector
Other extreme telephoto lenses

- Canon 1200mm
- Zeiss 1700mm
- Nikon 2000mm
Really extreme

Hale telescope on Mt. Palomar, CA

\[ A = 200'' \ (16') \]
\[ f = 650'' \ (50') \]
\[ N = f/3.3 \]
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♦ wide field of view
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• low dynamic range
Wide field of view: stitched panoramas
Wide field of view: stitched panoramas

Crater Lake, Oregon

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

- 2 shots
- Photoshop CS4

Early morning in Zurich
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  ✷ low dynamic range
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*
Sinar P3 view camera with 54H digital back

- 2¼ x 2¼ sensor, actively cooled, 14 real bits
Coral reefs and shipwrecks
Slide credits
(in addition to individually credited images)

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