BBM 444 – Week 14
Tone Style Enhancement,
What Makes a Great Picture?

© Robert Doisneau, 1955

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Last time

- High dynamic range (HDR) imaging and tone mapping
- Colorization
Today’s Agenda

• What makes a good picture?

• Tone Style Enhancement
Photography 101: The *where* & *when*

• Composition
  – Framing
  – Rule of Thirds
  – Leading Lines
  – Textures and Patterns

• Lighting
  – Color coordination / balance
Framing

“Photography is all about framing. We see a subject -- and we put a frame around it. Essentially, that is photography when all is said and done.”

-- from photo.blorge.com
Frame serves several purposes:

1. It gives the image depth
2. Use correctly, framing can draw the eye of the viewer of an interest to a particular part of the scene.
3. Framing can bring a sense of organization or containment to an image.
4. Framing can add context to a shot.

http://digital-photography-school.com/blog/frame-your-images/
Examples of nice framing

http://flickr.com/photos/paulosacramento/226545698/
http://flickr.com/photos/chrisbeach/13868545/
http://flickr.com/photos/74531485@N00/929270814/
http://flickr.com/photos/freakdog/223117229/
http://flickr.com/photos/cdm/253805482/
Rule of Thirds

http://www.photo96.com/blog/?p=371
Other examples
Leading Lines
More examples
Textures and Patterns
Color Coordination

Complementary colors
(of opposite hue on color wheel)
Front Lighting
Back Lighting
Anyone can take great pictures...
… if you can recognize the good ones.
Alyosha claims to be a bad photographer…
...but a pretty good photo critic!

http://flickr.com/photos/aaefros/

# of my Paris photos on Flickr: 32
Total # of Alyosha’s Paris photos: ~1250

~2%
The Postmodern Photographer

- The Old Days: a pre-process
  - Load film
  - Find subject
  - Position camera
  - Set all the settings “just right”
  - Take a deep breath…
  - …Press button!

- The New Digital Days: a post-process
  - Get a 16 GB memory cartridge
  - Take pictures like there is no tomorrow!!!
  - …
  - Back home, spend hours of agony trying to find 1-2 good ones
How to recognize the good photos?
Applications

• Image search for improved quality along with relevance.

• Automatically select the best photos from a set of vacation pictures to choose the best ones to show.

• See if computer can perform well on a traditionally human task.
Outline

• Photography 101

• Recognition (CVPR 2006)
  – What makes one photo better than another?
  – What features can we extract?
  – How can we measure our performance?
Not Critiquing Art

Not considering semantic measures of what makes a photo good (subject matter, humor, etc).

- Professional = those you would frame,
- snapshot = those that would stay in photo album.
What makes one photo better than another?

- Simplicity
- Realism
- Basic photographic techniques
Simplicity

Prof - Obvious what one should be looking at *i.e.* easy to separate subject from the background.
Snap – unstructured, busy, filled with clutter.

“Look Into” by Josh Brown @ Flickr
Simplicity

“alien flower” by Josef F. Stuefer @ Flickr
Simplicity

“Waiting in line!” by Imapix @ Flickr
Basic techniques

• **Blur**  
  Snaps – entire photo blurry indicates poor technique.  
  Prof – background out of focus by widening the lens aperture, but foreground in sharp focus.

• **Contrast and brightness**  
  - Make the subject pop out by choosing complementary colors for subject & background.  
  - Isolate the subject by increasing lighting contrast between subject & background.

Abstract concepts - “Good composition, color & lighting”
(Sur)Realism

Snaps look real, while prof photos look surreal.

“Golden Gate Bridge at Sunset” by Buzz Andersen @ Flickr

“Golden Gate 3” by Justin Burns @ Flickr
(Sur)Realism

“Somewhere Only We Know Prt2 (sic)” by Aki Jinn @ Flickr
Techniques (human)

• Lighting conditions
  - time of day (morning, dusk), colored filters to adjust color balance (make sky bluer, sunset more brilliant), careful color selection of scene

• Camera settings
  - adjust settings like focal length, aperture, shutter speeds to modify mood, perspective. E.g. might use long shutter speed to capture waterfall and give a misty look

• Subject matter
  - ordinary objects in unusual poses or settings (challenging since would need object recognition first)
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Features – Spatial Distribution of Edges

More edges near border due to background clutter

More edges near center of img

Trying to capture a photo’s “simplicity”
Spatial Distribution of Edges

Mean Laplacian of snapshots $\bar{M}_s$  
Mean Laplacian of professional $\bar{M}_p$

More uniformly distributed  
More concentrated

Low quality photos  
High quality photos

Expect high quality photos to have high spatial frequency edges nearer to center than snapshots
Edge width

- Calculate area that edges occupy – width of bounding box covering 96% of edge energy
- Cluttered regions should tend to produce a larger bounding box, and well defined subjects should produce a smaller one.
Color Distribution

- K-NN on color histogram

For query image find $k$ nearest neighbors in training set.
Quality = # of professional neighbors in top 5.

$q_{cd} = \# professional\_neighbors$
Hue Count

20 bin histogram defining possible unique hues

\[ q_h = 20 - (\# \text{ hues} > \text{threshold}) \]

# unique hues smaller for prof photos even though they tend to look more vibrant and colorful (S,V may vary more) – another measure related to “simplicity”
Blur

• Look at frequency distribution.
• Measure the amount of blur in the sharpest object, instead of the average blur.

Prof photos should have some part of photo in sharp focus
Low Level Features - Contrast

Prof photos usually have higher contrast

Contrast = width of middle 98% mass of hist
Contrast

\[ p(x) \]

Contrast (98% mass)
Low Level Features – Avg. Brightness

Professional photographers may adjust exposure to be correct on subject only so subject pops from background. Cameras tend to adjust brightness to average at 50% gray, but prof photos might deviate significantly. Use average brightness as feature.
Classifier

- Naives Bayes
- We assume independence of the features
- We achieve better results with added features even though they are not independent.
Outline

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  – What makes one photo better than another?
  – What features can we extract?
  – How can we measure our performance?

Use photos average rating as ground truth quality measure

Use only top 10%, bottom 10% as dataset.

Use half for training/half for testing.

### Dataset – DPChallenge.com

- **Photo contest website, user rated**
- **60K photos**
- **40K photographers**
- **10/90 percentile**

<table>
<thead>
<tr>
<th>Statistics</th>
<th>Voting Breakdown</th>
</tr>
</thead>
<tbody>
<tr>
<td>Place: 1 out of 829</td>
<td></td>
</tr>
<tr>
<td>Avg (all users): 7.987</td>
<td>1 = 0</td>
</tr>
<tr>
<td>Avg (commenters): 8.805</td>
<td>2 = 1</td>
</tr>
<tr>
<td>Avg (camera): 7.998</td>
<td>3 = 2</td>
</tr>
<tr>
<td>Avg (no camera): 6.333</td>
<td>4 = 5</td>
</tr>
<tr>
<td>Views since voting: 6597</td>
<td>5 = 24</td>
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<td>6 = 54</td>
</tr>
<tr>
<td>Votes: 478</td>
<td>7 = 89</td>
</tr>
<tr>
<td>Comments: 190</td>
<td>8 = 109</td>
</tr>
<tr>
<td>Favorites: 133 (View)</td>
<td>9 = 89</td>
</tr>
<tr>
<td></td>
<td>10 = 105</td>
</tr>
</tbody>
</table>
Difficulty of Dataset
Results

\[
\text{recall} = \frac{\# \text{ professional photos above threshold}}{\text{total } \# \text{ professional photos}}
\]

\[
\text{precision} = \frac{\# \text{ professional photos above threshold}}{\# \text{ photos above threshold}}
\]
Most Distinctive Feature: Blur

- A *badness* metric, rather than a *goodness* metric.
72% classification rate
Web Retrieval Results
Web Retrieval Results
Web Retrieval Results
Summary

• Yan Ke’s method and several closely related publications tend to answer the question “Is this photo well composed?” and not “Is this photo interesting?”.

• They focus on hand-formulated, mid-level cues and not high level considerations

• More recent works move towards higher-level reasoning.
Why is this photo awesome?
Test – Are these good or bad?
Flickr’s Most Interesting

- pot hill
  From *Cinnamon*

- Rock and Ether
  From vorich

- Where you'll find me, where you'll find:
  From Taylor-Tomorrow

-Untitled
  From .ultraviolet

- summer 's leaving
  From HansiH

- Olden fjord, Norway
  From Kenny Muir
Quality vs. Interest

- Quality and Interestingness are correlated, but they are different concepts.
Reading Assignments

Today’s Agenda

• What makes a good picture?

• Tone Style Enhancement
An Amateur Photographer
A Variety of Looks
Goals

Control over photographic look
Transfer “look” from a model photo

For example,

we want with the look of
Aspects of Photographic Look

Subject choice
Framing and composition
→ Specified by input photos

Tone distribution and contrast
→ Modified based on model photos
Tonal Aspects of Look

Ansel Adams

Kenro Izu
Tonal aspects of Look - Global Contrast

Ansel Adams

Kenro Izu

High Global Contrast

Low Global Contrast
Tonal aspects of Look - Local Contrast

Ansel Adams

Kenro Izu

Variable amount of texture  Texture everywhere
Recall - Example-based style transfer

Non-photorealistic styles

[Hertzmann 01; Efros 01; Drori 03; Rosales 03]

- mimics brush strokes or textures
- but does not target photorealistic style

[Her{mann 01; Efros 01; Drori 03; Rosales 03]

\[Hertzmann 01\]
Recall - Tone Mapping

Reduce global contrast

[Patnaik 98; Tumblin 99; Ashikhmin 02; Durand 02; Fattal 02; Reinhard 02; Li 05]

Seeks neutral reproduction

× Little control over look

In contrast,

we want to achieve particular looks
Learn professional tools...

Image editing software
e.g. Adobe Photoshop

• need skills
• tedious

Photo management tools
e.g. Adobe Lightroom, Apple Aperture

• optimizes user efficiency (workflow)
• but has limited control
This work

Transfer look between photographs

- Tonal aspects
This work

Separate global and local contrast
Overview

Input Image

Global contrast

Careful combination

Local contrast

Split

Post-process

Result
Overview

Input Image

Global contrast

Split

Careful combination

Local contrast

Post-process

Result
Split Global vs. Local Contrast

- Naïve decomposition: low vs. high frequency
  - Problem: introduce blur & halos

Low frequency

Global contrast

High frequency

Local contrast
Bilateral Filter

Edge-preserving smoothing [Tomasi 98]
We build upon tone mapping [Durand 02]

After bilateral filtering
Global contrast

Residual after filtering
Local contrast
Bilateral Filter

Edge-preserving smoothing [Tomasi 98]
We build upon tone mapping [Durand 02]

After bilateral filtering
Global contrast

Residual after filtering
Local contrast
Global contrast

Bilateral Filter

Careful combination

Post-process

Local contrast

Input Image

Result
Global contrast

Input Image

Bilateral Filter

Local contrast

Careful combination

Post-process

Result
Global Contrast

Intensity remapping of base layer

Input base

Remapped intensity

Input intensity

After remapping
Global Contrast (Model Transfer)

Histogram matching
- Remapping function given input and model histogram
Global contrast

Input Image

Intensity matching

Bilateral Filter

Careful combination

Result

Post-process

Local contrast
**Local contrast**

**Global contrast**

Input Image → Bilateral Filter → Intensity matching → Careful combination → Result

Post-process
Local Contrast: Detail Layer

Uniform control:

- Multiply all values in the detail layer

Input

Base + 3 × Detail
The amount of local contrast is not uniform

Smooth region

Textured region
Local Contrast Variation

We define “textureness”: amount of local contrast

- at each pixel based on surrounding region

Smooth region $\Rightarrow$ Low textureness

Textured region $\Rightarrow$ High textureness
“Textureness”: 1D Example

Input signal  High frequency H  Amplitude |H|  Edge-preserving filter

Textured region  ⇒ Large high-frequency

Smooth region  ⇒ Small high-frequency

Textured region  ⇒ High textureness

⇒ Low textureness

Previous work: Low pass of |H|  [Li 05, Su 05]
Textureness

Input

Textureness
Textureness Transfer

Step 1:
Histogram transfer

- Input textureness
- Model textureness
- Desired textureness

- Hist. transfer

Step 2:
Scaling detail layer (per pixel) to match desired textureness

- Input detail
- Output detail

- x 0.5
- x 2.7
- x 4.3
Local contrast

Global contrast

Input Image

Bilateral Filter

Intensity matching

Careful combination

Post-process

Textureness matching

Result

Careful combination

100
Local contrast

Global contrast

Input Image

Bilateral Filter

Intensity matching

Result

Textureness matching

Careful combination

Post-process
A Non Perfect Result

Decoupled and large modifications (up to 6x)

→ Limited defects may appear

input (HDR)

result after global and local adjustments
Intensity Remapping

Some intensities may be outside displayable range.

- Compress histogram to fit visible range.

initial result  \rightarrow \text{remapped intensities}  \rightarrow \text{corrected result}
Preserving Details

1. **In the gradient domain:**
   - Compare gradient amplitudes of input and current
   - Prevent extreme reduction & extreme increase

2. **Solve the Poisson equation.**
Effect of Detail Preservation

uncorrected result

corrected result
Global contrast

- Intensity matching

Local contrast

- Texturedness matching

Input Image

- Bilateral Filter

Result

- Constrained Poisson

- Post-process
Global contrast

Input Image

Bilateral Filter

Intensity matching

Textureness matching

Local contrast

Constrained Poisson

Post-process

Result
Additional Effects

**Soft focus** (high frequency manipulation)
**Film grain** (texture synthesis [Heeger 95])
**Color toning** (chrominance $= f$ (luminance))

before effects

after effects
Global contrast

Input Image

Local contrast

Constrained Poisson

Bilateral Filter

Intensity matching

Textureness matching

Soft focus Toning Grain

Result
Recap

Intensity matching

Global contrast

Constrained Poisson

Soft focus Toning Grain

Result

Input Image

Bilateral Filter

Local contrast

Textureness matching

Input Image

Intensity matching
Result

Model
112
Comparison with Naïve Histogram Matching

Input

Naïve Histogram Matching

Model

Snapshot, Alfred Stieglitz

Our result

Local contrast, sharpness unfaithful
Comparison with Naïve Histogram Matching

Input

Model
Clearing Winter Storm, Ansel Adams

Histogram Matching

Our Result

Local contrast too low
Color Images

Lab color space: modify only luminance
Limitations

Noise and JPEG artifacts

- amplified defects

Can lead to unexpected results if the image content is too different from the model

- Portraits, in particular, can suffer
Summary

Transfer “look” from a model photo

Two-scale tone management
- Global and local contrast
- New edge-preserving textureness
- Constrained Poisson reconstruction
- Additional effects