Better Photos

Today’s Agenda

• What makes a good picture?
  – The Design of High-Level Features for Photo Quality Assessment, Ke et al., 2006

• Tone Style Enhancement
  – Two-scale Tone Management for Photographic Look, Bae et al., SIGGRAPH 2006
  – Style Transfer for Headshot Portraits, Shih et al., SIGGRAPH 2014

Making better photos
Not a creativity session

- For those of us who are NOT talented photographers
- Heuristics, issues, that help get better photographs. Maybe not great photographs, but better
- If you are talented, good for you. Forget those “rules”, keep taking good photos.

Advice overview

- Simplify, avoid cluttered background
- Don’t center things
- Avoid harsh light
- White balance
- Portraits are all about the eyes
- Follow rules or really break them. No middle ground.
Move your feet! (1 meter away)

Distracting background

Shallower depth of field

Shallower depth of field
Crop

Isolate using blur (Photoshop, layering)

• But maybe don’t over-do it

Clone brush/Poisson cleaning

Desaturate, darken

From Digital Photographer’s Handbook
Fixing a cluttered background

- Change viewpoint
- Shallow depth of field
- Frame tighter
- Modify scene (move objects, add backdrop)
- Retouch (blur, desaturate, darken)

Get low

- Try to be at eye level

Composition

Eye level
Or really get high

- As usual, follow a rule or really break it.

Rule of the thirds

The rule of thirds is a guideline developed by artists centuries ago. When the subject—or its most important element—is placed near one of the intersecting points of an imaginary grid, the viewer's eye is led through the frame. The result is an aesthetically strong image.
Don’t center, especially for motion

... or do center
Try unusual angles

- Do or don’t:
  Either perfectly vertical or at least 30 degrees

Build on diagonal lines

Light

http://www.fotofinish.com/resources/centers/photo/takingpictures.htm
Bottom line

• Don’t get married on a sunny day!

Go in the shade

• Light is more diffuse

Overcast days are the best

• Just don’t put the sky in the frame

Best time of day: sunset & sunrise

• +/- 1 hour
• “Golden hours”
• Night photography: always near sunset/sunrise
  – because of nice diffuse light

The pictures
Other overcast-day pictures

Mid day: often not great
less than 1 hour after sunrise/before sunset
During sunset or sunrise
After sunset
Add fill flash

- For harsh lighting conditions
- Illuminate shadows with flash to reduce dynamic range
- But set the flash to -1.5 or -2 EV (3 to 4 times darker than existing lighting)

Without flash

- 10 minutes after sunset

With fill flash

How to recognize the good photos
[Ke 06]

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.
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”
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”

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Spatial Distribution of Edges

- Mean Laplacian of snapshots
  - More uniformly distributed
  - Low quality photos

- Mean Laplacian of professional
  - More concentrated
  - High quality photos

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

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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.

$q_{cd} = \# \text{professional_neighbors}$

Hue Count

20 bin histogram defining possible unique hues

$Hue Count$

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

Most unlikely colors...

From Lalonde and Efros, ICCV’ 2007

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

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.
Dataset – DPChallenge.com

Use photos average rating as ground truth quality measure
Use only top 10%, bottom 10% as dataset.
Use half for training/half for testing.

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

Difficulty of Dataset

Most Distinctive Feature: Blur

- A badness metric, rather than a goodness metric.
Results

72% classification rate

Web Retrieval Results
Related Concepts

- Image memorability [Isola 11; Khosla 12; Celikkale 13; Khosla 13]
- Image interestingness [Dhar 11; Gygli 13]
- Image popularity [Khosla 14]
- Image specificity [Jas 15]

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Ansel Adams

Ansel Adams, *Clearing Winter Storm*

An Amateur Photographer

Ansel Adams, *Clearing Winter Storm*
A Variety of Looks

Goals

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

For example,

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

Input

Model

Ansel Adams

Kenro Izu
Tonal aspects of Look
– Global Contrast

High Global Contrast
Low Global Contrast

Related Work
– 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

Related Work - Tone Mapping

• Reduce global contrast
  [Pattanaik 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
Related Work – 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

The Approach

- Separate global and local contrast

Overview

Global contrast

Split

Careful combination

Post-process

Result

Input Image

Local contrast

Result

Input Image

Result
Overview

Split Local contrast

Global contrast

Input Image

Result

Careful combination

Post-process

Overview

Split Global vs. Local Contrast

• Naive decomposition: low vs. high frequency
  – Problem: introduce blur & halos

Global contrast

Local contrast

Bilateral Filter

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

After bilateral filtering

Residual after filtering

BASE layer

DETAIL layer

Bilateral Filter

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

- Intensity remapping of base layer

Global Contrast (Model Transfer)

- Histogram matching
  - Remapping function given input and model histogram
Local Contrast: Detail Layer

- Uniform control:
  - Multiply all values in the detail layer

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

![Image of smooth and textured regions]

Textureness

![Image of input and textureness]

Textureness Transfer

Step 1:
Histogram transfer

- Input textureness
- Model textureness
- Desired textureness

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

- Input detail
- Output detail

“Textureness”: 1D Example

- Textured region: Large high-frequency
- Smooth region: Small high-frequency
- Low textureness: Low pass of |H|

- Edges preserving filter
Global contrast

Input Image

Intensity matching

Bilateral Filter

Careful combination

Local contrast

Post-process

Result

Intensity Remapping

A Non Perfect Result

- Decoupled and large modifications (up to 6x)
  - Limited defects may appear

Intensity Remapping

- Some intensities may be outside displayable range.
  - Compress histogram to fit visible range.
Preserving Details

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

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**Preserving Details**

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**Effect of Detail Preservation**

![uncorrected result](slide by S. Bae, S. Paris and F. Durand)  
![corrected result](slide by S. Bae, S. Paris and F. Durand)

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**Global contrast**

- Intensity matching  
- Bilateral Filter  
- Texturenes matching  
- Constrained Poisson  
- Post-Process

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**Local contrast**

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**Additional Effects**

- **Soft focus** (high frequency manipulation)
- **Film grain** (texture synthesis [Heeger 95])
- **Color toning** (chrominance = \( f(\text{luminance}) \))

**Recap**

**Global contrast**
- Intensity matching
- Constrained Poisson
- Soft focus
- Toning
- Grain

**Local contrast**
- Textureness matching

**Results**

User provides input and model photographs.

- Our system **automatically** produces the result.

**Running times:**
- 6 seconds for 1 MPixel or less
- 23 seconds for 4 MPixels
- multi-grid Poisson solver and fast bilateral filter [Paris 06]
Comparison with Naïve Histogram Matching

Local contrast, sharpness unfaithful
Comparison with Naive Histogram Matching

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

Style Transfer for Headshot Portraits [Shih 14]

- Make look like

  • Transfer the style from the example photo
  • Automatic
Problem statement

- **Input**: a casual frontal portrait and an example
- **Output**: The input portrait rendered in the example style
  - Automatic
  - The style includes texture, tone, and color

Key idea #1: local transfer

- Local: eyes, nose, skin, etc. are treated differently

Key idea #2: multi-scale transfer

- Textures at different scales are treated differently

Overview of the algorithm

1. Dense matching between the input and example
2. Multiscale transfer of local statistics
3. Post processing on eyes and background
Step 1: dense matching

- Rigid warp + SIFT flow to align semantic features [Liu et al. 2008]

Step 2: multi-scale local transfer

1. Construct Laplacian stacks for the input and the example

2. Local match at each scale

3. Collapse the matched stacks to create the output of this step

Laplacian using a face mask

- Preserve the hair boundary using normalized convolution and a face mask

Step 3: post-processing

- Adding eye highlights
- Replacing the background
Results

Input

Example

Output

Comparison

Input

Example

Global transfer
[Bae et al. 2006]

Our result

Input

Style 1

Style 2

Style 3

Input

Style 1

Style 2

Style 3

Histogram transfer
[Reinhard et al. 2001]

[Pitié et al. 2007]

Photoshop Match
Color

Our method
[Sunkavalli et al. 2010]
Limitations

- Require the input and the example to have similar facial attributes, e.g., skin color
- Cannot handle hard shadows on the input