The Art and Science of Depiction

Limitations of the Medium, compensation or accentuation: Contrast & Palette

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The Ambassadors

Limitations: contrast & palette

Makoto Nakamura

Limitations: contrast & palette

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Limitations: contrast & palette

Makoto Nakamura
<table>
<thead>
<tr>
<th>Limitations: contrast &amp; palette</th>
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<tbody>
<tr>
<td><strong>Assignments for Monday 16.</strong></td>
<td></td>
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<tr>
<td>• Solso Cognition and the Visual Arts</td>
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<tr>
<td>– Chapter 5 &amp; 6</td>
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<tr>
<td>• Essay</td>
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<tr>
<td>– Exploratory or Picture comment</td>
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<tr>
<td>– Choose subject</td>
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<tr>
<td>– Outline of the issues</td>
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<tbody>
<tr>
<td><strong>Personal Meeting II</strong></td>
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<tr>
<td>• Class</td>
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<td>• Essay</td>
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<td>• Project</td>
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<th>Limitations: contrast &amp; palette</th>
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<tr>
<td><strong>Plan</strong></td>
<td></td>
</tr>
<tr>
<td>• The picture is flat</td>
<td></td>
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<td>• The viewpoint is unique</td>
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<td>• The image is finite, it has a frame</td>
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<tr>
<td>• The picture is static</td>
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<tr>
<td>• The contrast is limited</td>
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<th>Limitations: contrast &amp; palette</th>
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<tbody>
<tr>
<td><strong>Context</strong></td>
<td></td>
</tr>
<tr>
<td>• Real world: $10^6$ to $10^6$ cd/m²</td>
<td></td>
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<tr>
<td>• Picture</td>
<td></td>
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<tr>
<td>– Max contrast 1:500</td>
<td></td>
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<tr>
<td>– Typically 1:50</td>
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<tr>
<td><strong>Two problems</strong></td>
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<tr>
<td>• The image intensity does not match the real conditions</td>
<td></td>
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<tr>
<td>$10^6$</td>
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<td>$10^6$</td>
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<tr>
<td>Watched in a dark room</td>
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<tr>
<td>• The image intensity does not match the real conditions</td>
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<tr>
<td>• The contrast is not sufficient</td>
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<tr>
<td>$10^6$</td>
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Three contexts

- Photo
- Computer Graphics
- Painting and drawing

Limitations: contrast & palette

The limit of illusion

- Pozzo’s ceiling: the Sky is not bright enough

Limitations: contrast & palette

Plan

- Problem 1: intensity does not match
  - Exposure
  - Viewing conditions
  - Night scenes
- Problem 2: insufficient contrast
  - Tone Reproduction
  - Lighting
  - Tone mapping in CG
  - Flares
  - Painting

Limitations: contrast & palette

Edge detection

- Similar to center-surround
- Measured using micro-electrodes

Limitations: contrast & palette

Land Retinex

- Local contrast

Limitations: contrast & palette
Photo exposure

Limitations: contrast & palette

Nikon 3D Color Matrix

• Database of 30,000 photos
• Multiple captors (segments)
• Exposure depends on
  – Brightness from each segments
  – Color
  – Contrast
  – Distance
  – Focus (where is the subject)

Limitations: contrast & palette

Hunt and Stevens effect

• Stevens effect
  – Contrast increases with luminance

Limitations: contrast & palette

Plan

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Limitations: contrast & palette

Metering

• Centered average
• Spot
• Incident
  – Measure incoming light

Limitations: contrast & palette

Hunt and Stevens effect

• Stevens effect
  – Contrast increases with luminance
• Bartleson-Breneman effect
  – Image contrast changes with surround
  – A dark surround decreases contrast
    (make the black of the image look less deep)
• Hunt effect
  – Colorfulness increases with luminance
• Hence the need for gamma correction

Limitations: contrast & palette
**Suprathreshold**

- Subjective brightness
- Power law
- Exponent
  - 0.33 to 0.5
- Gamma correction

**Perceptual tone mapping**

- [Ferwerda et al. 1996]
- Match the smallest perceptible intensity in the simulated scene and in the display condition
- Rod and cone vision

**Tone mapping**

- Real scene: large range of luminance
  - (from $10^{-6}$ to $10^6$ cd/m²)
- Limitation of the display
  - 1-100 cd/m²
- Goal:
  - Reproduce a faithful impression

**Threshold**

- Smallest perceptible stimulus
- Smallest perceptible stimulus difference

**Time-dependent tone mapping**

- Dazzling
- Slow dark adaptation
**Dark adaptation**
- Slow recovery after dramatic decrement

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**Representing night scenes**
- Pissaro, Montmartre
- James Abbott McNeil Whistler
  *Nocturne in Blue And Silver The Lagoon Venice* 1879-1880

**Time-dependent tone mapping**

**Representing night scenes**
- Rods, no color vision
- Blue shift
- Lower acuity
- Unable to adapt in shadows
Representing night scenes

• Whistler, Old Battersea Bridge

Limitations: contrast & palette

Representing night scenes

• Archibald J. Motley Jr, Gettin’ Religion 1948

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Night scenes in the movies

• Often Day for night
• Film during the day
• Few fill light (dark shadows)
• Add blue cast
• Avoid the sky

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Tone Reproduction

• Not linear

Limitations: contrast & palette

Tone Reproduction

• Not linear
• Gamma correction

Limitations: contrast & palette
Texture and contrast

Limitations: contrast & palette

The Zone System

Limitations: contrast & palette

Expansion and contraction

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Contraction

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Pre-exposure

- Expose with uniform white before taking the photo
- Raise the dark tones

Pre-exposure

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Two-solution development

- Different development of high and low value

The Print

- W. Eugene Smith photo of Albert Schweitzer
- 5 days to print!

Dodging and Burning

- Locally darken or lighten
- Use masks to expose some parts less
- Has to be done for each print!

Gradient Filter

- The sky is too bright
  - Gradient filter for the top of the photo
- The house is too dark
  - Gradient filter for the bottom of the photo
**Limitations: contrast & palette**

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**Curve tool in photo editing software**

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**The infamous 8 bits**

- Digital photography
- 8 bits means 1 to 255 contrast
- Enough for display
- Not enough for
  - Editing
  - Tone reproduction
  - Dodging & burning
  - Etc.

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**Three Point Lighting**

- Key light
  - Main and visible lighting
- Fill light
  - Fill-in shadows
- Back light
  - Emphasize silhouette
  - Make subject stand out
- Independent lighting

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**Lighting**

- Fill light

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**Portrait Lighting**

- Ansel Adams
**Fill-in**

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**Lighting**

• Painting with light

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**Local compensation**

• Use local average to compensate
• Haloing effects

**Local contrast**

• [Tumblin 1999]
• Organization into regions
**Local contrast**
- [Tumblin 1999]
- Organization into regions

**Histogram adjustment**
- [Larson et al. 1997]
- Disregard empty portions of the histogram

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**Flare, halo**
Flare, halo
• Van Gogh, *Le Semeur*, 1880

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Blue-yellow
• Karl Schulpig, 1925

Limitations: contrast & palette

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Flare in CG
• [Spencer et al 1995]
• Flare: scattering in the eye
• Size is constant

Limitations: contrast & palette

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Flare in CG
• [Spencer et al 1995]
• Flare: scattering in the eye
• Size is constant

Limitations: contrast & palette

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Limitations: contrast & palette
**Local lighting**
- Typically Florence Renaissance
- Mostly to reveal shape
- Raphael

**Tenebrism**
- Early 17\textsuperscript{th} century
- Caravaggio

**Radial balance**
- Georges de La Tour, Joseph the Carpenter, 1645

**Chinese painting**

**Rembrandt**

**White**
- Filippo Lippi
<table>
<thead>
<tr>
<th>Silhouette</th>
<th>Contrast</th>
<th>Pure drawing</th>
<th>Pure color</th>
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| Wolfrang Weber  
*The Lash Bird Dancer*  
On Madagascar  
Late 20s | Bert Stern  
*The Trouble With Being Beautiful* | Diego Riviera  
*Mother And Child*  

**Limitations:** contrast & palette

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