Digital Imaging of Photographs

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What we'll cover

- Introduction
- Technical overview
- Best practices for capture
- Workflow considerations

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Digitization in context

- Can be one of the easier parts of digital projects but still requires careful planning
- If it's done poorly your whole project will suffer
- Can be done in-house or outsourced

Types of photographic materials

- Reflective
  - Prints
- Transparent (film)
  - Negative
  - Positive
- All come in various sizes

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Technical overview

- Analog to digital conversion
- Resolution
- Bit depth
- Color
- Compression

Analog to digital conversion

- Image is converted to a series of pixels laid out in a grid
- Each pixel has a specific color, represented by a sequence of 1s and 0s
- Pixel-based images are called “raster” images or “bitmaps”

Resolution (1)

- Often referred to as “dpi” or “ppi”
- RATIO of number of pixels captured per inch of original photo size
  - 8x10 print scanned at 300ppi = 2400 x 3000 pixels
  - 35mm slide (24x36mm!) scanned at 300ppi ≈ 212 x 318 pixels

Resolution (2)

- “Spatial resolution” refers to pixel dimensions of image, e.g., 3000 x 2400 pixels
- Flatbed and film scanners have a fixed focus, so they know how big the original is; digital cameras don’t

Resolution (3)

- Optical vs. interpolated
  - Optical is the number of sensors in the scanning array – what the scanner actually “sees”
  - Interpolated is a higher resolution - the number of pixels the software can make up based on what the scanner actually saw
  - Don’t set a scanner to use higher than its optical resolution

Bit depth (1)

- Refers to number of bits (binary digits, places for zeroes and ones) devoted to storing color information about each pixel

- 1 bit (1) = 2^1 = 2 shades (black & white)
- 2 bit (01) = 2^2 = 4 shades
- 4 bit (0010) = 2^4 = 16 shades
- 8 bit (11010001) = 2^8 = 256 shades

Bit depth (2)

1 bit (black & white)

2 bit (4 colors)

4 bit (16 colors)

8 bit (256 colors)

Color

- RGB
  - Scanners generally have sensors for Red, Green, and Blue
  - Each of these “channels” is stored separately in the digital file
  - 8 bits for each channel = 24 bit color
- CMYK (Cyan, Magenta, Yellow and Black) is used for high-end “pre-press” printing purposes

Compression

- Makes files smaller for storage
- Files must be decompressed for viewing – this takes time
- Lossless
- Lossy
  - “visually lossless”

Technical questions?

- Analog to digital conversion
- Resolution
- Bit depth
- Color

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Best practices for capture

- General considerations
- Resolution
- Color
- Image processing
- File formats

General considerations

- Determine purpose
- Capture once, use many times
  - Create “master” image when scanning
  - Create “derivatives” for specific uses later
- Scan from earliest generation practical
- Some imaging programs use color bars or rulers for future reference
- Train scanner operators in correct handling of materials

Determining resolution (1)

- Charts can be good starting points
  - Western States handout
  - Other standards/best practices listed on bibliography at end of presentation
- Current thinking is that master files for photographic materials should be 3000-5000 pixels on their longest side

Determining resolution (2)

- Higher is not always better
- Scan at highest resolution necessary to achieve your stated purpose, no higher

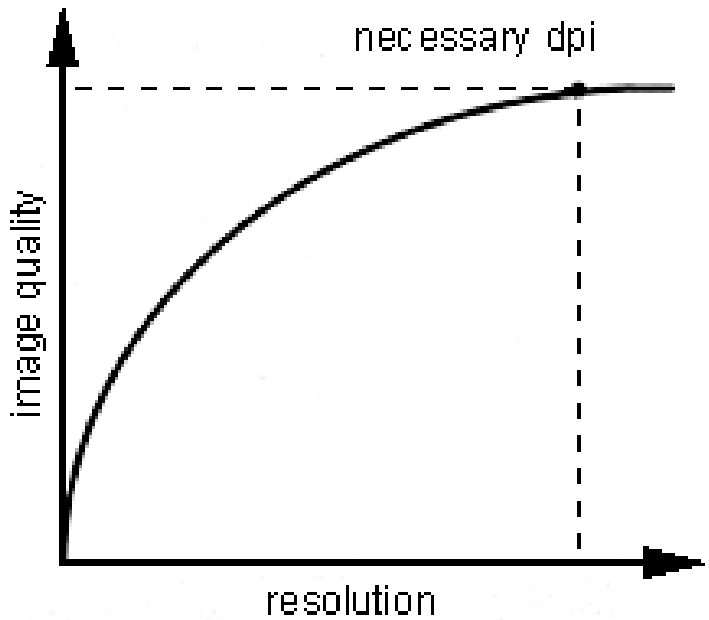


chart from Cornell's online digital imaging tutorial:
<http://www.library.cornell.edu/preservation/tutorial/conversion/conversion-03.html>

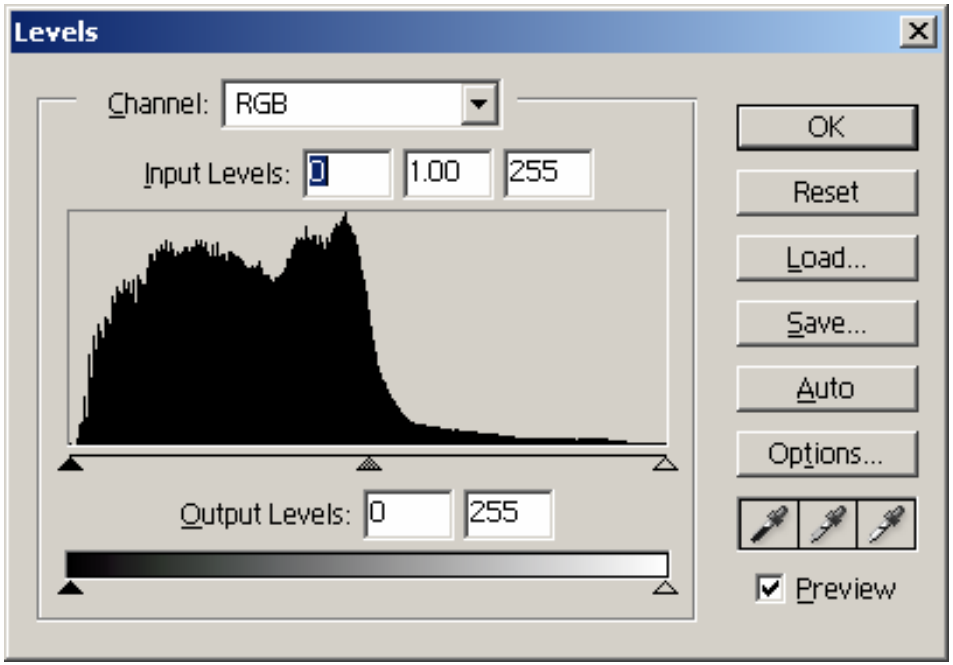
Resolution comparison

600dpi vs. 300dpi

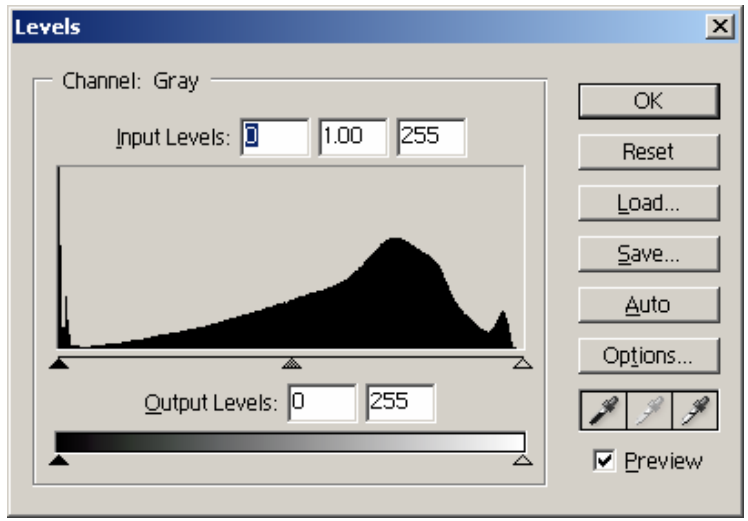
Color

- Match current photo or match original scene
- Final master images should be 8 bits per channel (8-bit grayscale, 24-bit RGB); some specialized projects using higher bit depths
- Any color adjustments should be done in scanning software before final scan is done
- Use almost the full tonal range; avoid “clipping”

Histograms



good (dark image)



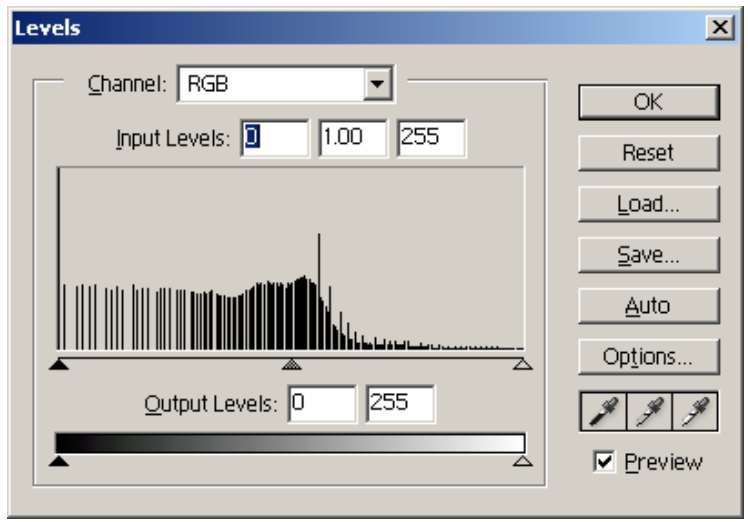


Image processing

- Color balance, cropping, etc., can be done when creating derivatives
- Generally avoided for master images
  - Descreening for halftoned images possible exception

halftoned

descreened

File formats

- Master
  - TIFF (uncompressed)
- Derivative
  - JPEG (web)
  - Zoomable formats (specialized uses)

JPEG compression

- Lossy-compressed every time they are saved
- No standard scale
  - Photoshop: 0 to 12 (low to maximum)
  - ImageMagick: 1 to 100, default 75

low compression, high quality

high compression, low quality

Best practice questions?

- General considerations
- Resolution
- Color
- Image processing
- File formats

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Digital imaging workflow

- Planning phase
- Production phase
- Post-production phase

Planning phase

- Define purpose of imaging project
- Define master image specifications
- Select scanning equipment
- Develop and test procedures for digitization
- Develop and test procedures for quality review
- Determine technical metadata to be recorded
- DOCUMENT

Choosing equipment

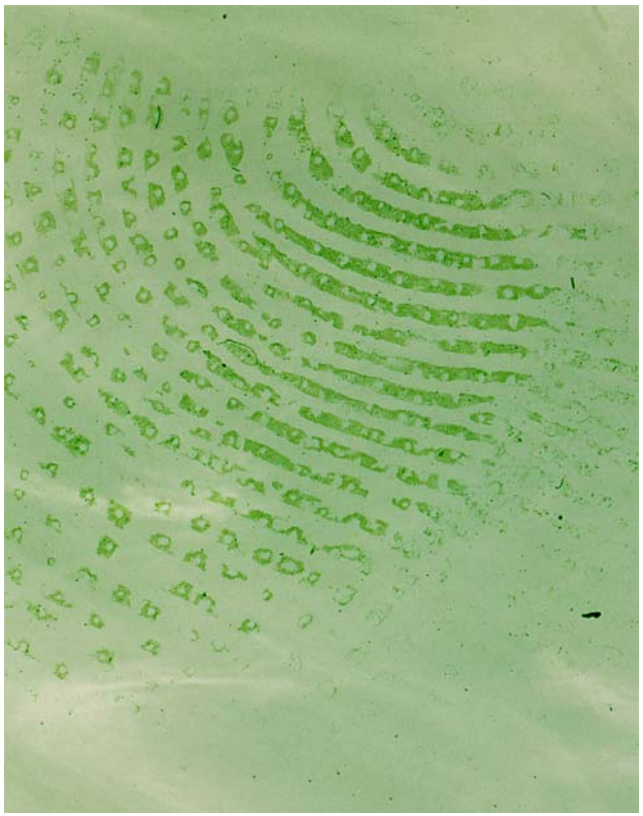
- Scanner
  - Resolution
  - Dynamic range
    - photographic prints: 1.4 – 2.0
    - negative films: 2.8
    - commercial grade colored slides: 2.8 – 3.0
    - high grade transparencies: 3.0 – 4.0
- Monitor: use CRT, not LCD

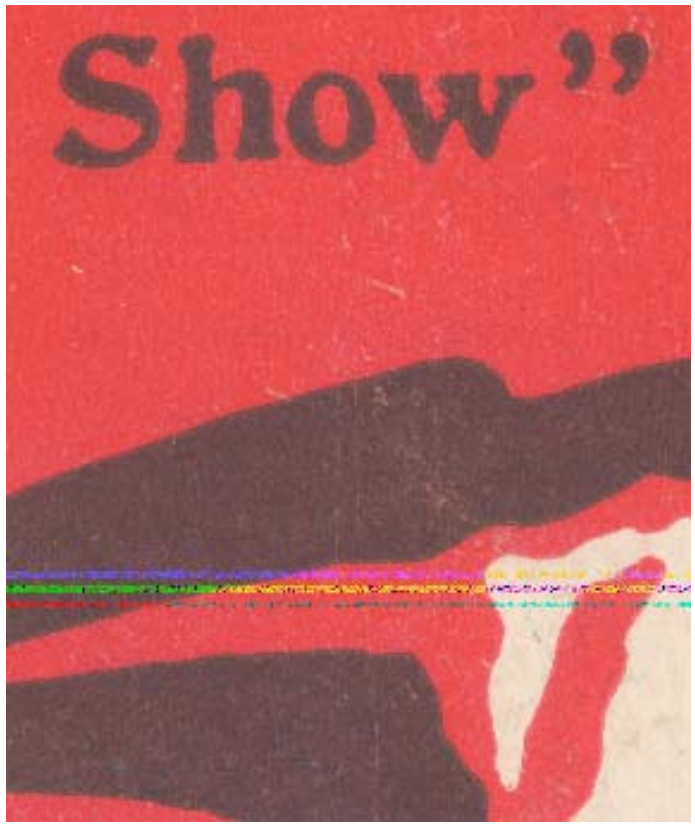
dynamic range chart from Kenney & Rieger, Moving Theory into Practice, p. 38

Quality review

- A consistent quality review process is *absolutely* essential
- Objective
  - pixel dimensions
  - resolution
  - bit depth
- Subjective
  - scanning artifacts
  - cropping
  - orientation

Subjective image review





TEST!

- Don’t blindly follow any specific recommendation – make sure it works for you
- Drawings, engravings, maps, printed text, handwritten text, musical notation, etc., all require different approaches

Metadata and documentation

- Essential!
- For fixing quality problems
- For long-term maintenance of files
- NISO draft standard: Technical Metadata for Digital Still Images

Production phase

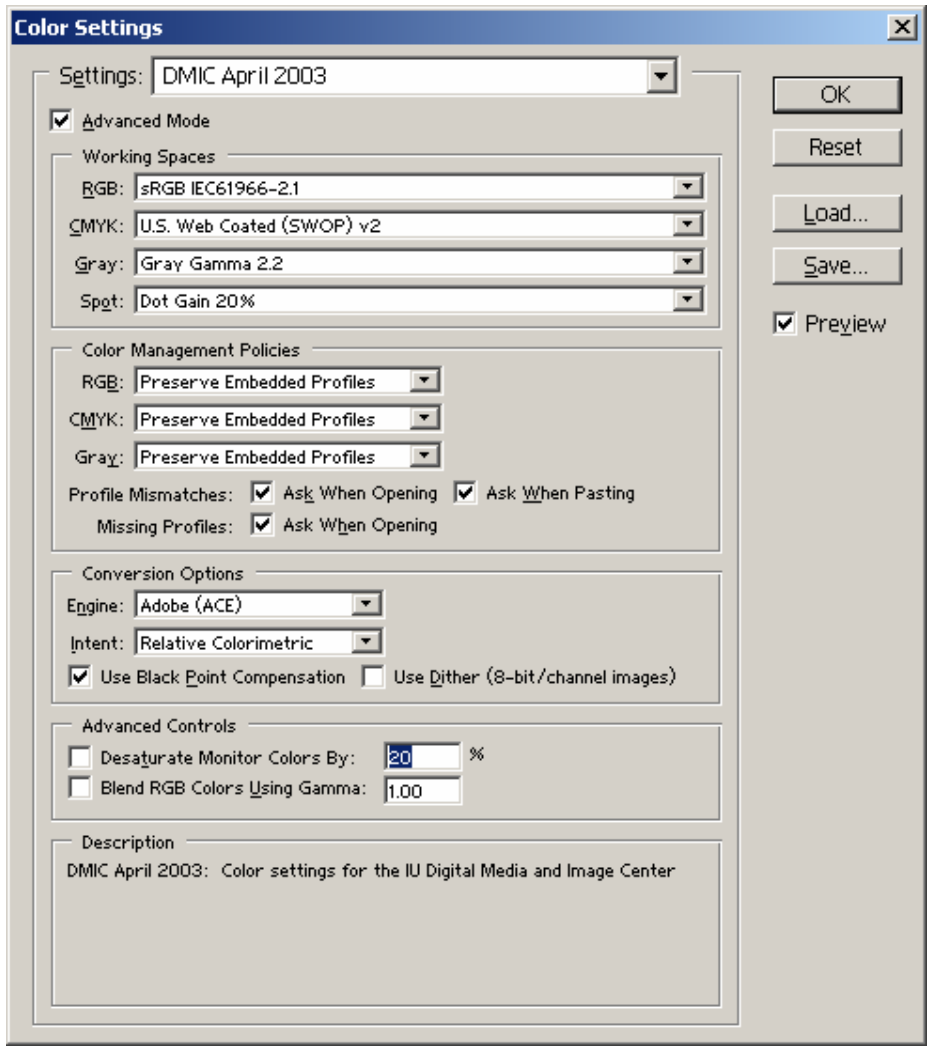
- Train employees in digitization and handling procedures
- Ongoing digitization
- Ongoing quality review
- Ongoing metadata creation
- Periodic equipment color characterization/calibration

Color management (1)

- ISO 3664 describes standard graphic viewing conditions
- All devices should be characterized with ICC profiles
  - monitors
  - scanners
  - printers
- Creating your own preferable to using “canned” profiles
- Profiling software from Monaco Systems; also included in high-end scanning software

Color management (2)

- Embed ICC profiles in master images
- Set up Photoshop to use that profile and to warn you when profiles are missing or different



Post-production phase

- Store master images safely
- Create derivatives
- Review process for areas of improvement

Workflow questions?

- Planning phase
- Production phase
- Post-production phase

Other questions?

- Technical overview
- Best practices for capture
- Workflow considerations
- Other?

More information

- These presentation slides: <http://www.dlib.indiana.edu/workshops/bbfall2003.htm>
- Digital imaging standards and best practices and how the IU DLP uses them: <http://www.dlib.indiana.edu/dmic/general/>
- Cornell digital imaging tutorial: <http://www.library.cornell.edu/preservation/tutorial/contents.html>
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