imaging.org
Society for Imaging Science and Technology

Peter Burns & Don Williams

IS&T's Archiving Conference

Soc. for Imaging Science and Tech. (IS&T) has run this conference series since 2004

- Digitization, Preservation, and Access
- Digital imaging
  - Imaging literacy within institutions
  - Good practice for photography
  - Guidelines for imaging performance
  - Large imaging projects

Introduction: Why and What?

Why are you imaging?

- Master file for repurposing
- Digital printing, catalog
- Web access
- OCR

What are you scanning?

- Photographic prints and negatives
- Printed or typed documents
- Halftone printed material
- Maps
- Handwritten documents

Content and use sets the imaging performance requirements

West Point Cadet Cavalry, 1896. Halftone print of movie frame enlargement
-US Library of Congress

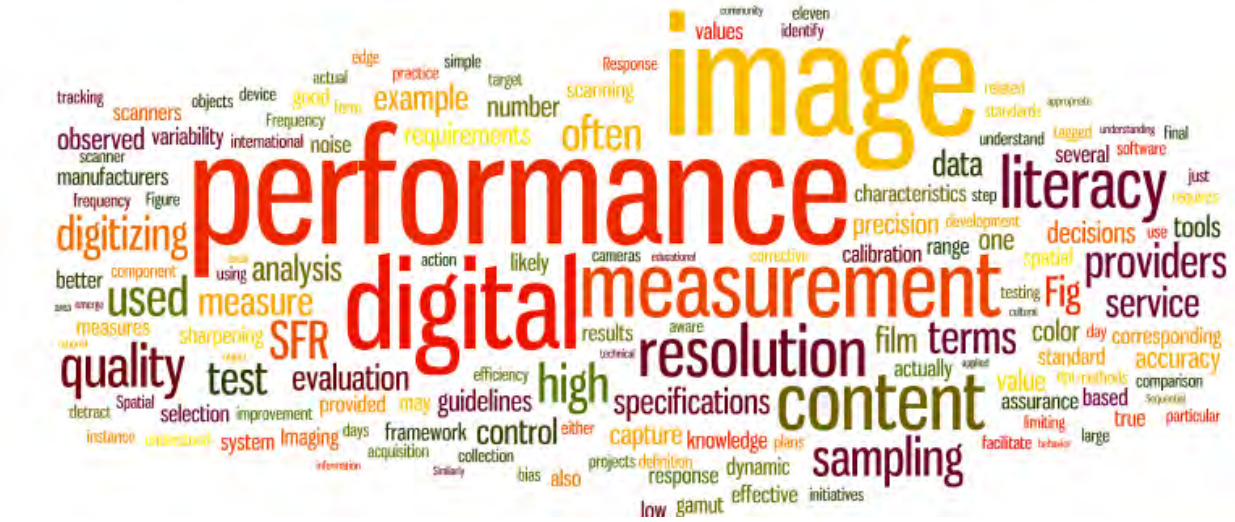
Digitizing for Cultural Heritage

Common concerns

- Image literacy
- technology and equipment selection
- vendor qualifications
- methods for controlling and improving imaging
- standards and guidelines for best practice

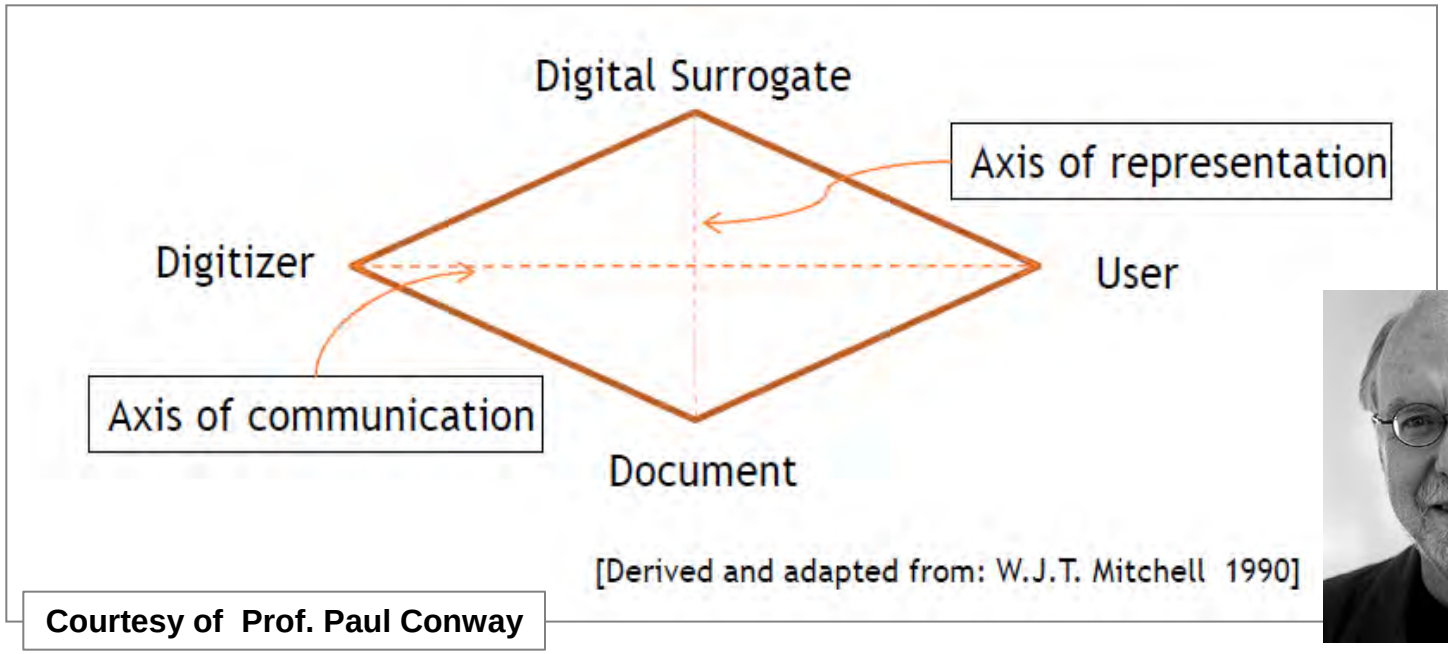
Image Literacy

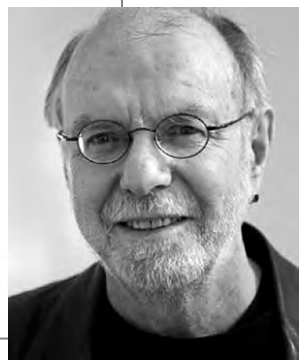
- Ability to read, interpret and use generally accepted *imaging results*
- to handle the corresponding *performance information*, to express ideas and opinions
- to make decisions and solve related problems



Courtesy of
Prof. Paul Conway

Image literacy

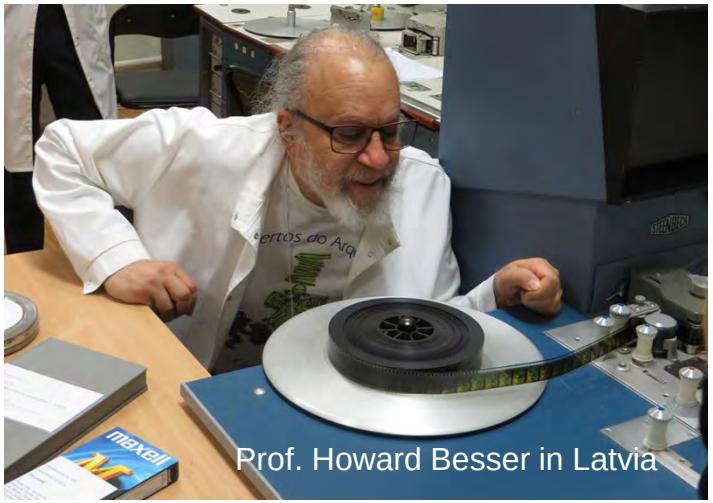




Courtesy of Prof. Paul Conway

- Representation, not reproduction
- Imaging requirements vs technologies
- Understand industry guidelines for best practice

Why is cultural heritage imaging different?



Prof. Howard Besser in Latvia

Future re-purposing

- Variety of uses
- Information durability

Information critical

- Images, not pictures

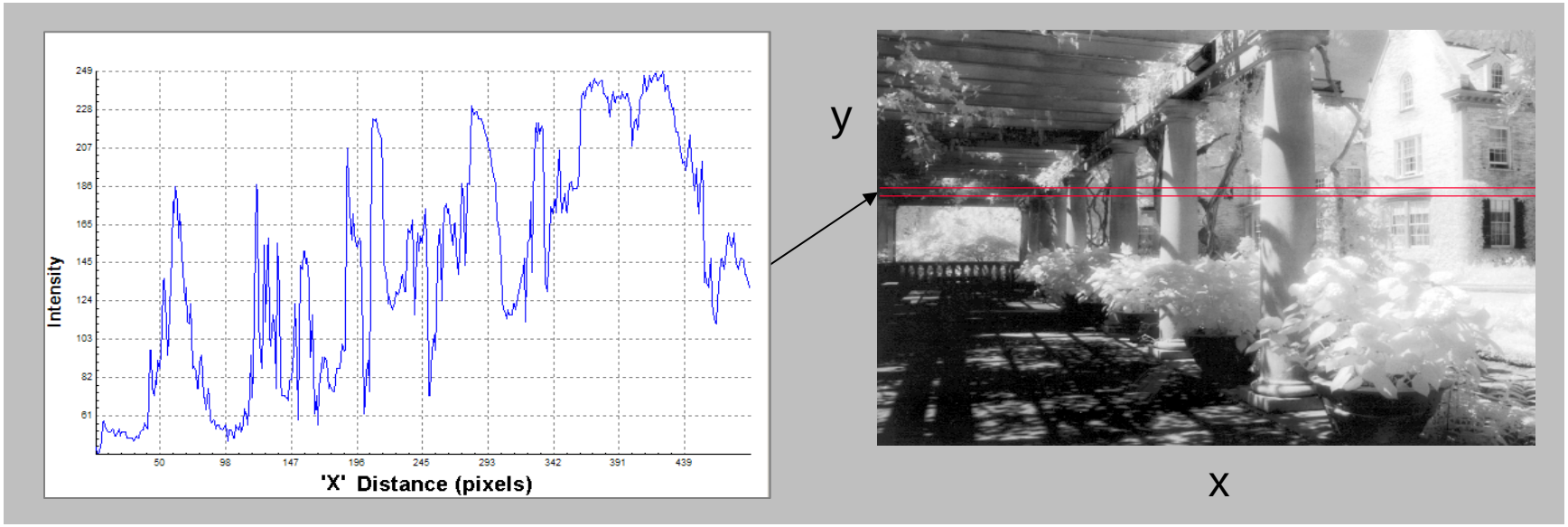
Science and research

High volume, High speed

- Think manufacturing
- Quality assurance

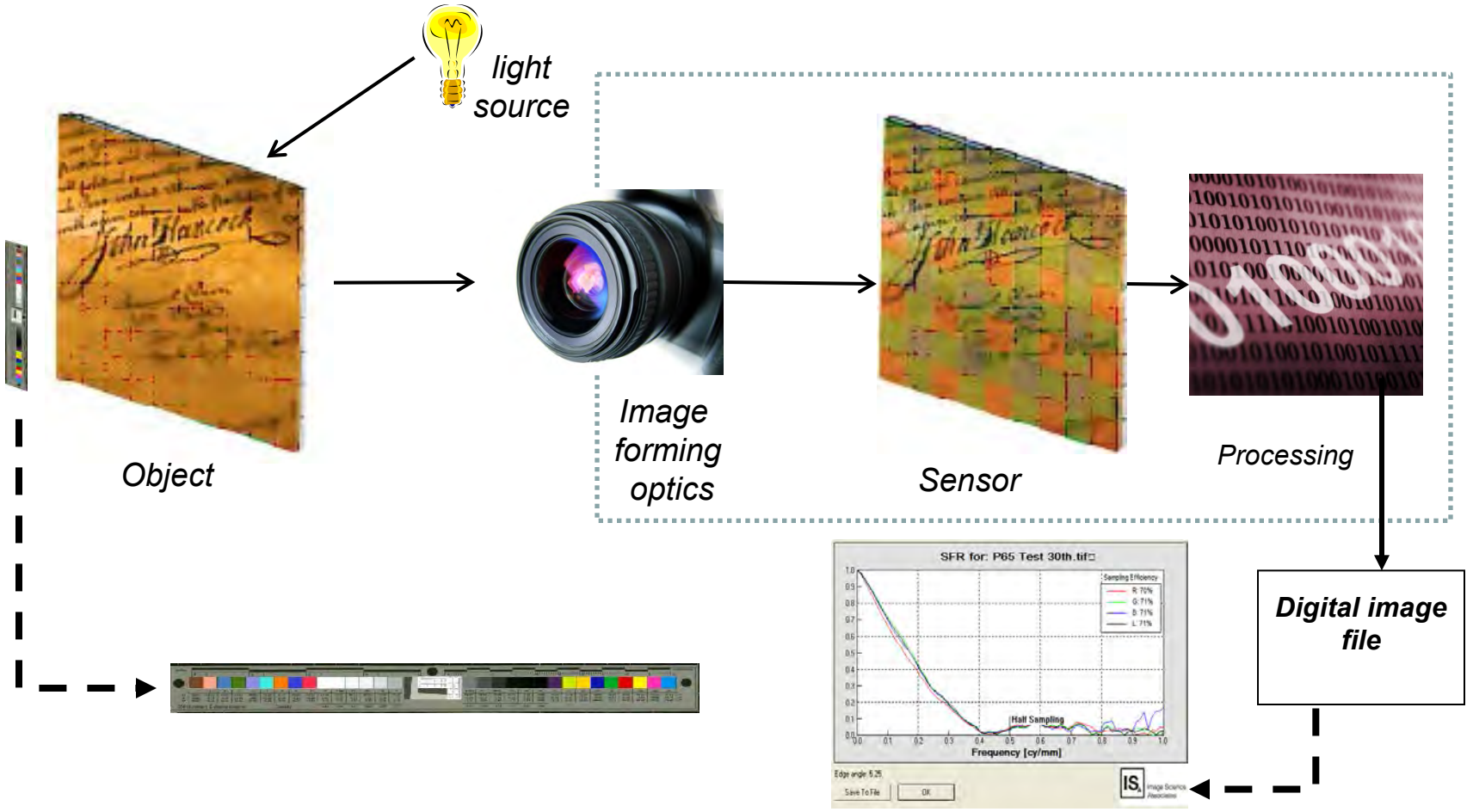
What is an image and how is one characterized?

- Two-dimensional map of varying light intensities or colors
- Variations can occur over short distances (high frequencies) or large distances (low frequencies)



- *Imaging Performance Metrics* indicate how an imaging system or component acts on optical characteristics of an input scene
- Once captured, the image ceases to exist as light intensities

Technology: from light to numbers



Reference provides an way to measure performance

Anything missing?

Why measure imaging performance?

- Acceptance testing, equipment evaluation or benchmarking
- Quantify and identify the influence of image processing, (e.g., sharpening, color profiles, etc.)
- Marketing leverage
- Quality control and Vendor/Industry compliance (FADGI or Metamorfoze guidelines)

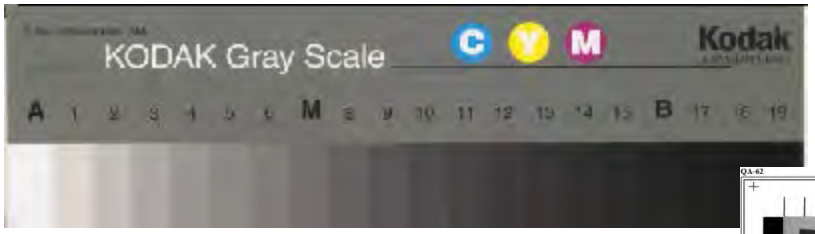
Measuring imaging performance

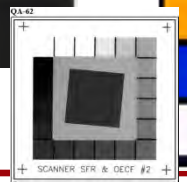
We use known test charts to evaluate *accuracy* and *variation*.

Smithsonian Institution

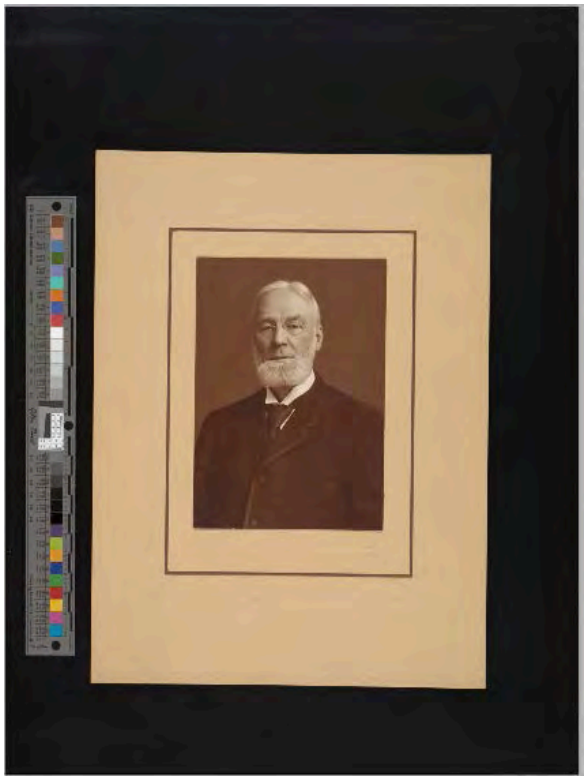
Targets: Object surrogates

- Intended for both calibration and performance testing
- Act as an archeological reference for light and resolution values. Required for change detection.
- Got software?
- Things to consider
  - ✓ How many of these colors are in your collection?
  - ✓ Are the gray patches spectrally neutral?
  - ✓ Are they self described?

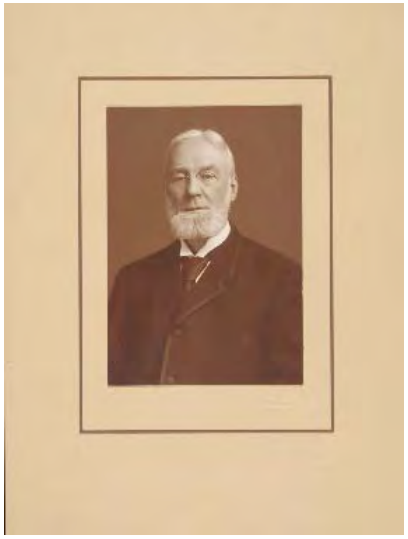




Proper capture setups enable reliable reformatting



Original Safety Master
Uncluttered contrasted background
Recognizable target features



Finished derivative image
Color & tone corrected
White balanced
Cropped target
De-skewed

Standards and Guidelines

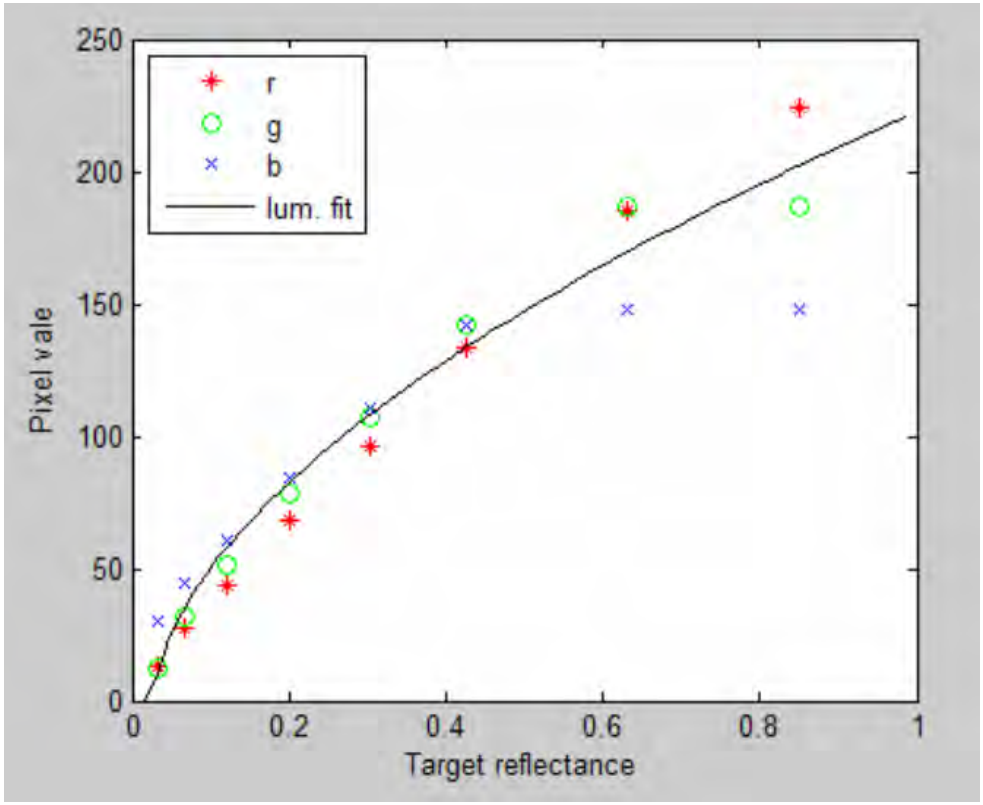
Standards

- Digital Camera, Internat. Standards Org. (ISO)

Industry Guidelines

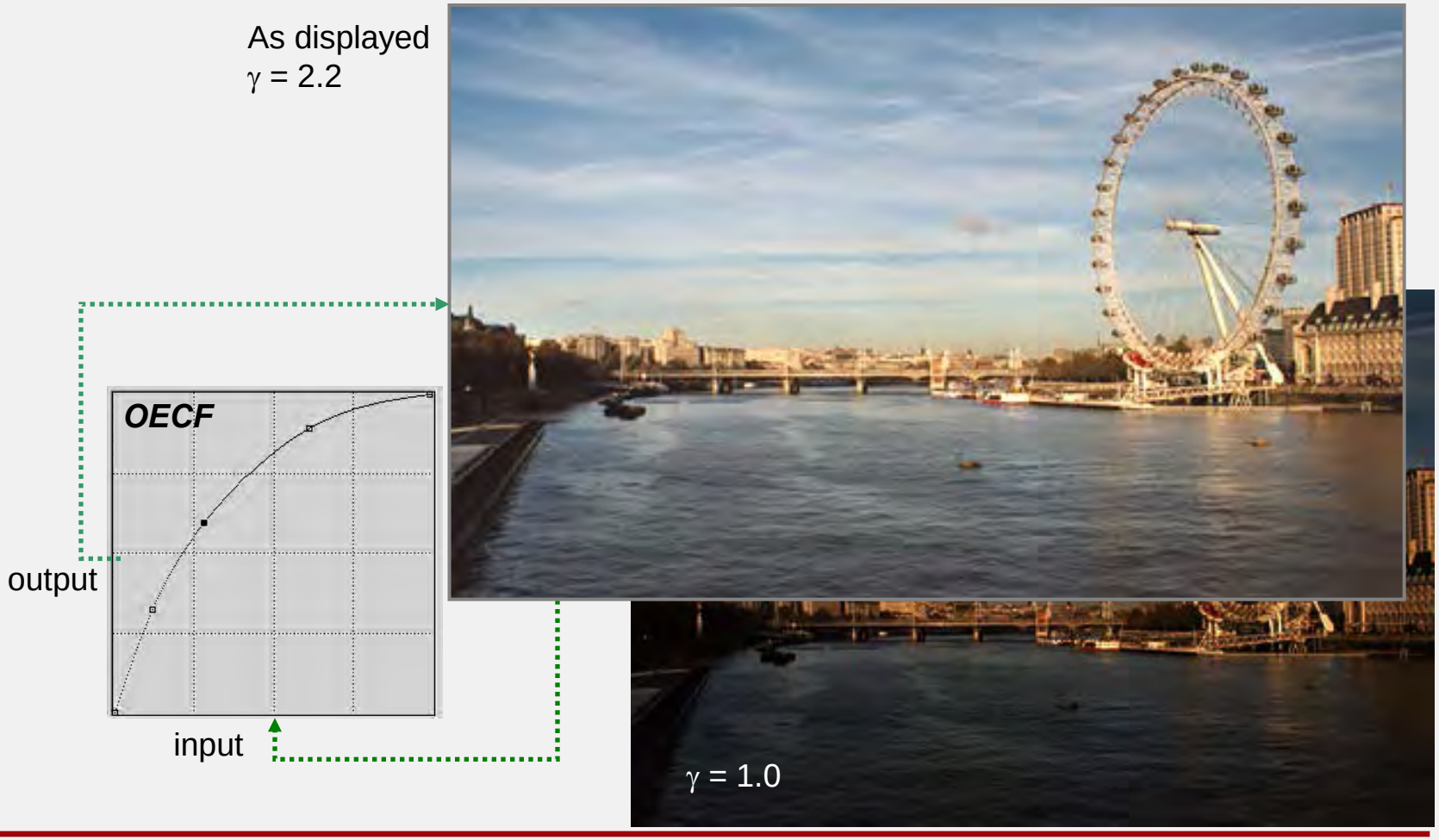
- Archiving Community
  - FADGI (US Government)
  - Metamorfoze (Netherlands)
  - These reference ISO Digital Camera standards

1. White balance from neutral test patches



- Keep the neutrals neutral. Maintain the neutrality of gray patches – white balance

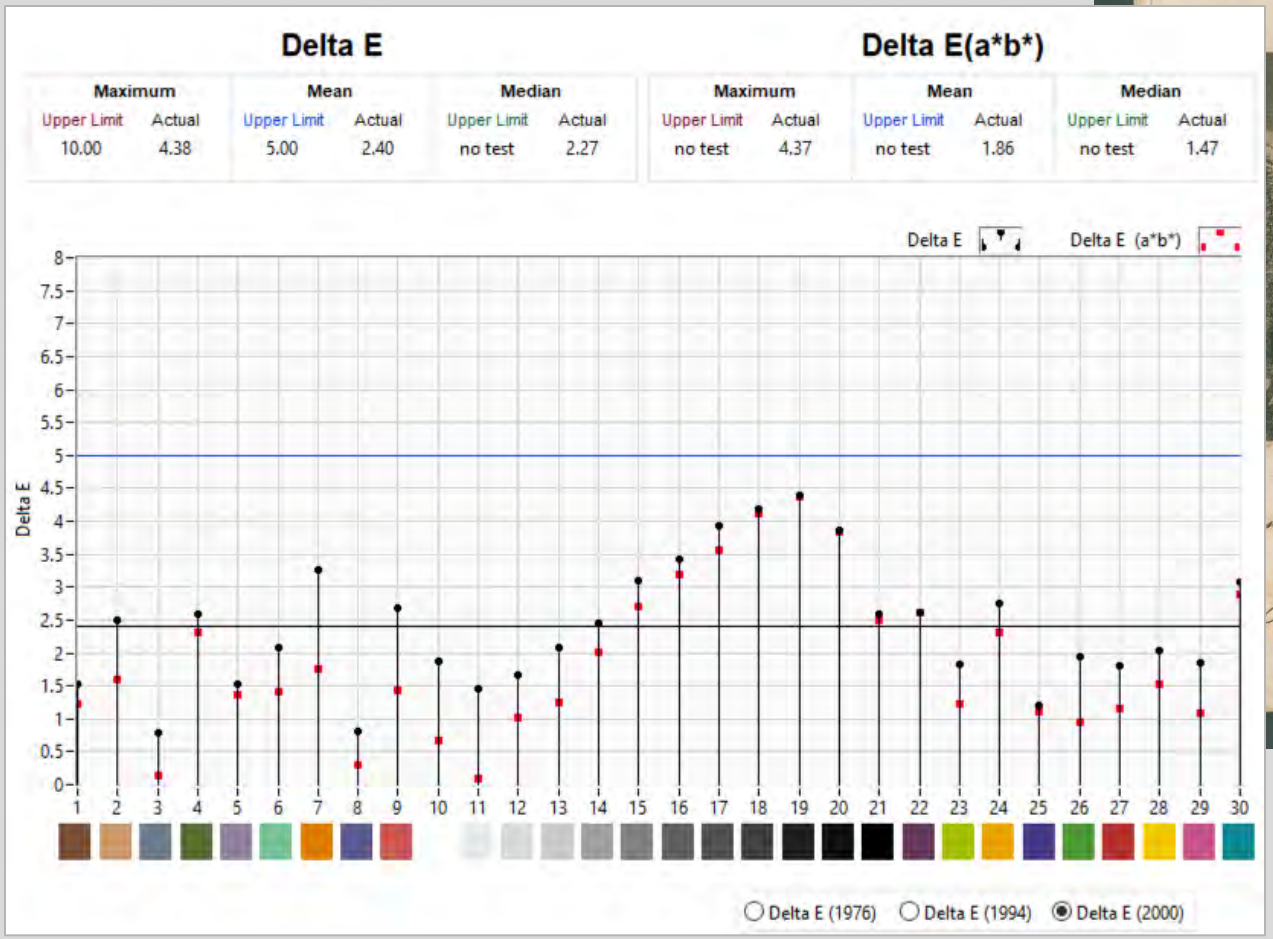
OECF example

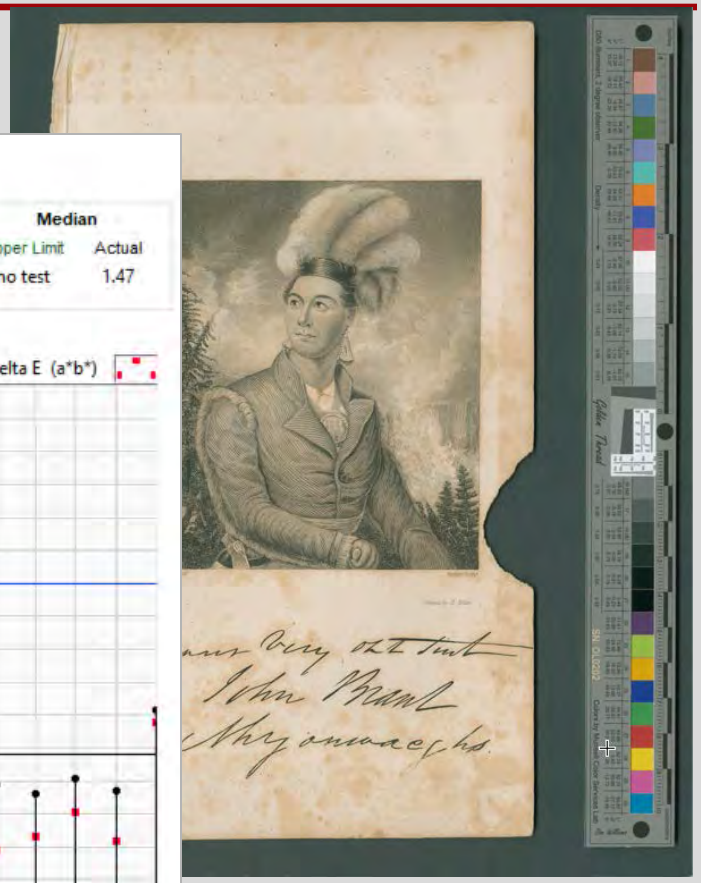


2. Evaluating Color Capture

FADGI (US) Federal Agency Digitization Guideline

- Metamorfoze Netherlands KB Initiative





Based on colorimetry

How automated color capture measurement is done

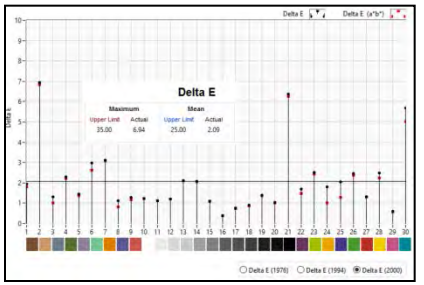
Known $L^*a^*b^*$ values of a measured color chart

$(L^*a^*b^*)$

Calculate ΔE_{2000} for each patch

Present ΔE_{2000} values for all patches

ΔE_{2000}



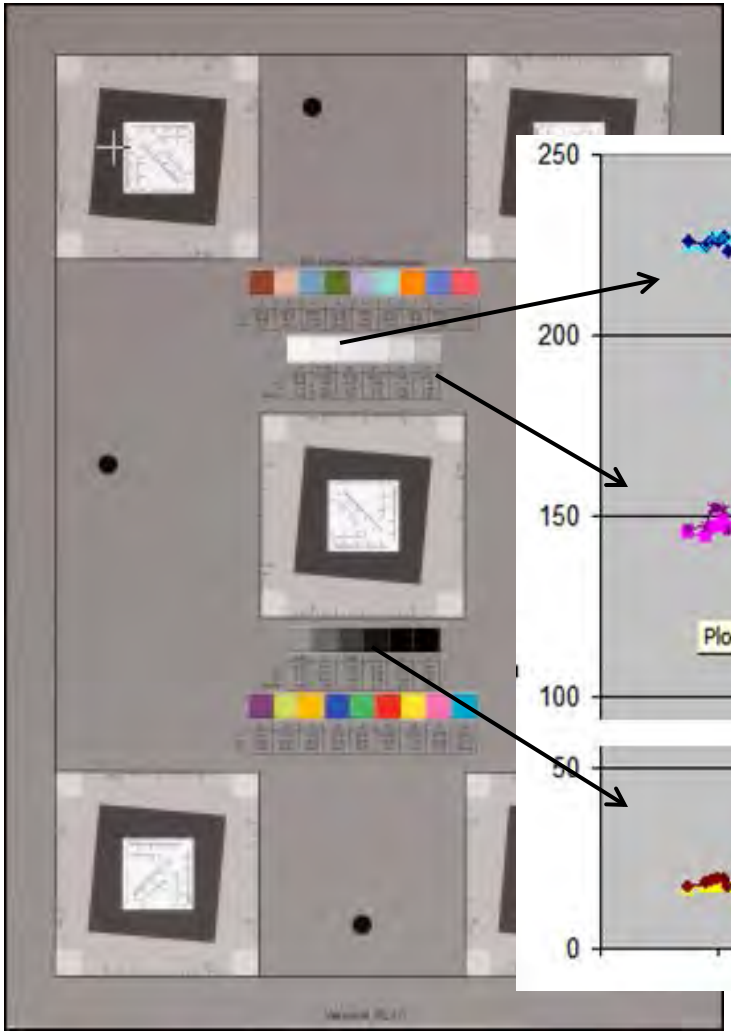
RGB image of color chart

average RGB value for each patch

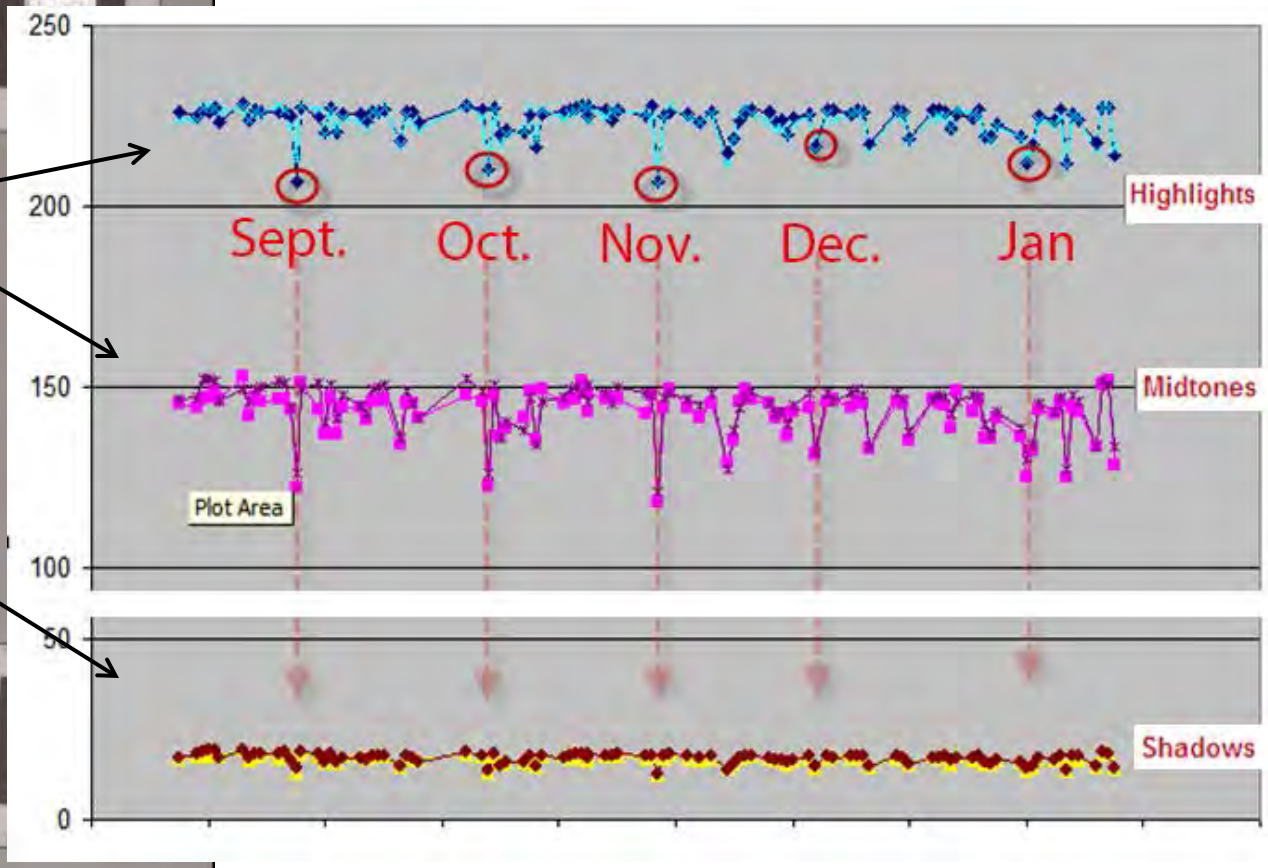
Convert RGB values into $L^*a^*b^*$ values via an ICC color profile

Color Difference/error Display

3. Performance Monitoring: Book Scanner



Three gray patches over time



4. Resolution* for Digital Capture Devices

In digital imaging two factors dictate the level of **spatial resolution or detail** that can ultimately be captured.

Quantity: *sampling frequency* (*i.e*. dots per inch, Mpixels)

- maximum resolution limit that can be achieved

Quality: *SFR – Spatial Frequency Response*

- level of image detail that optics, environmental factors, hardware, and image processing capture

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* resolution: measure of the ability of a camera system, or a component of a camera system, to depict picture detail *(ISO 12233:2014)*

Hubble Space Telescope Example

Before lens modification (*oops !*) – 1990
Spherical aberration due to lens/mirror

After lens modification (that's better) - 1993

Same # pixels, but different image resolution

MTF Measurement for Digital Cameras and Scanners

What is Modulation Transfer Function (MTF)?

- measures how image detail contrast (*modulation*) is maintained by imaging component or system

What good is it?

- Analyzing the influence of imaging components on the retention and reproduction of *image detail* - sharpness

How is it measured?

- Sine waves, noise fields, **edges**, square waves
- ISO standard refers to the *Spatial Frequency Response* (SFR), rather than an MTF
- Slanted-edge analysis

Highest resolution image of Mars

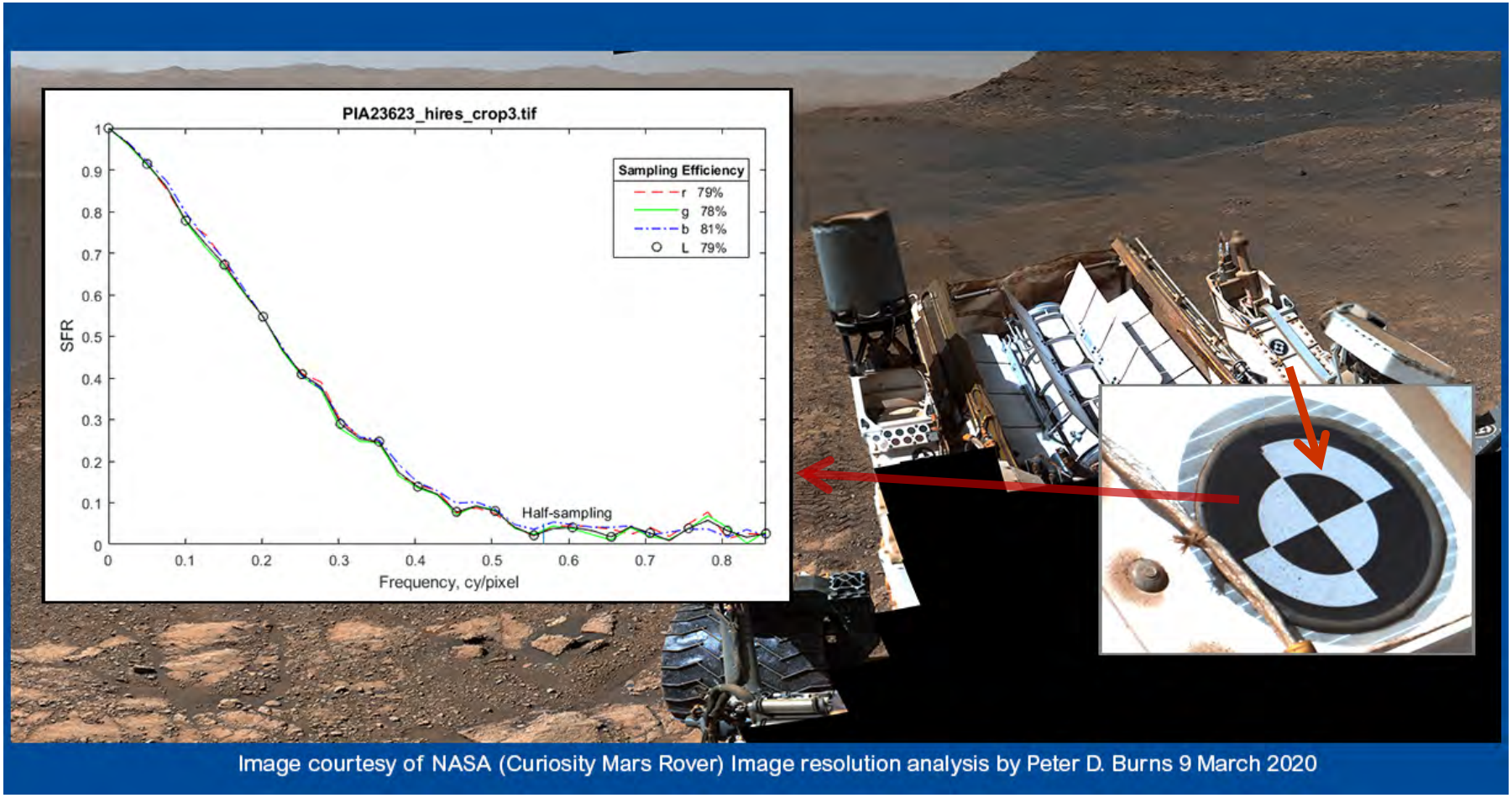

Image courtesy of NASA (Curiosity Mars Rover) Image resolution analysis by Peter D. Burns 9 March 2020

Summary: Digitizing for Cultural Heritage

1. It is helpful to develop an imaging literacy
   - Setting requirements
   - Evaluating technologies, systems and service providers
2. Imaging Guidelines and standards help with best-practice info.
3. All have their limitations, but help reduce variability
   - Monitor quality of digital content
   - Inter-image: frame-to-frame
   - lens aberrations (falloff, spatial distortion)
4. IS&T's *Archiving Conference* series covers these are other aspects

Resources

- Intro to FADGI for Still Image Digitization - http://lyrasis.adobeconnect.com/pdd6ko5j80ko/
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- FADGI Metrics, Part 1 - http://lyrasis.adobeconnect.com/plcrbcd5xt53/
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- FADGI Metrics, Part 2 - http://lyrasis.adobeconnect.com/p7ll26kmdi9m/
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- FADGI Metrics, Part 3 - http://lyrasis.adobeconnect.com/pfun8ftg4457/
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- What is next for FADGI and Still Image Digitization? - http://lyrasis.adobeconnect.com/po71bfqzdmmo/

ARCHIVING WEBINAR SERIES

Recorded and Available on Archiving Webpage

March 19

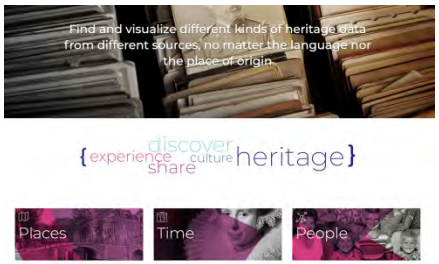
Digitization, Preservation, and Access: The Three Pillars of Cultural Heritage Archiving

Jeanine Nault, Smithsonian Institution Digitization Program Office

March 25

Designing Preservation, Responding to Collection, and User Community Needs

David Walls, US Government Publishing Office

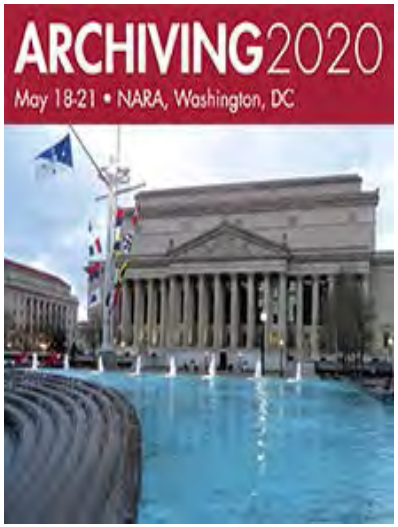


April 2

Access: Mind the Gap

Ariela Nitov, Heritage Leiden

LEARN MORE



Visit the Archiving webpage for the latest information on when the Archiving Conference will take place
www.imaging.org/archiving

IS&T WEBINAR SERIES

Complimentary webinars covering topics in imaging science and technology

For more in-depth information …

We present short courses on these topics at two IS&T conferences

- *Electronic Imaging Symposium*,
- *Archiving 2020* Conference Series