Evaluating and Controlling Cultural Heritage Imaging: Reference objects, Methods and Practices

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R-CHIVE Conference, Rochester NY, 19 & 20 June 2017
(as presented, with references added on last page)

Basic ideas

- Establish relationship between images and objects being captured
- Evaluate performance, not technology used
- Methods based on including reference objects (targets)
  - Object-level
  - Device-level
- Analysis software paired with specific test target layout and reference values
- Evaluation can be independent of system set-up and calibration

Why measure imaging performance?

- Reduce variability (inter- and intra-image, etc.)
- Archiving and exchange of image and metadata
- Guidelines based on source material
- Acceptance testing, evaluation, benchmarking
- Quality control and vendor/industry compliance

Bennett, Boydston and Christens-Barry, 2014

Object-level target

This can be prevented?

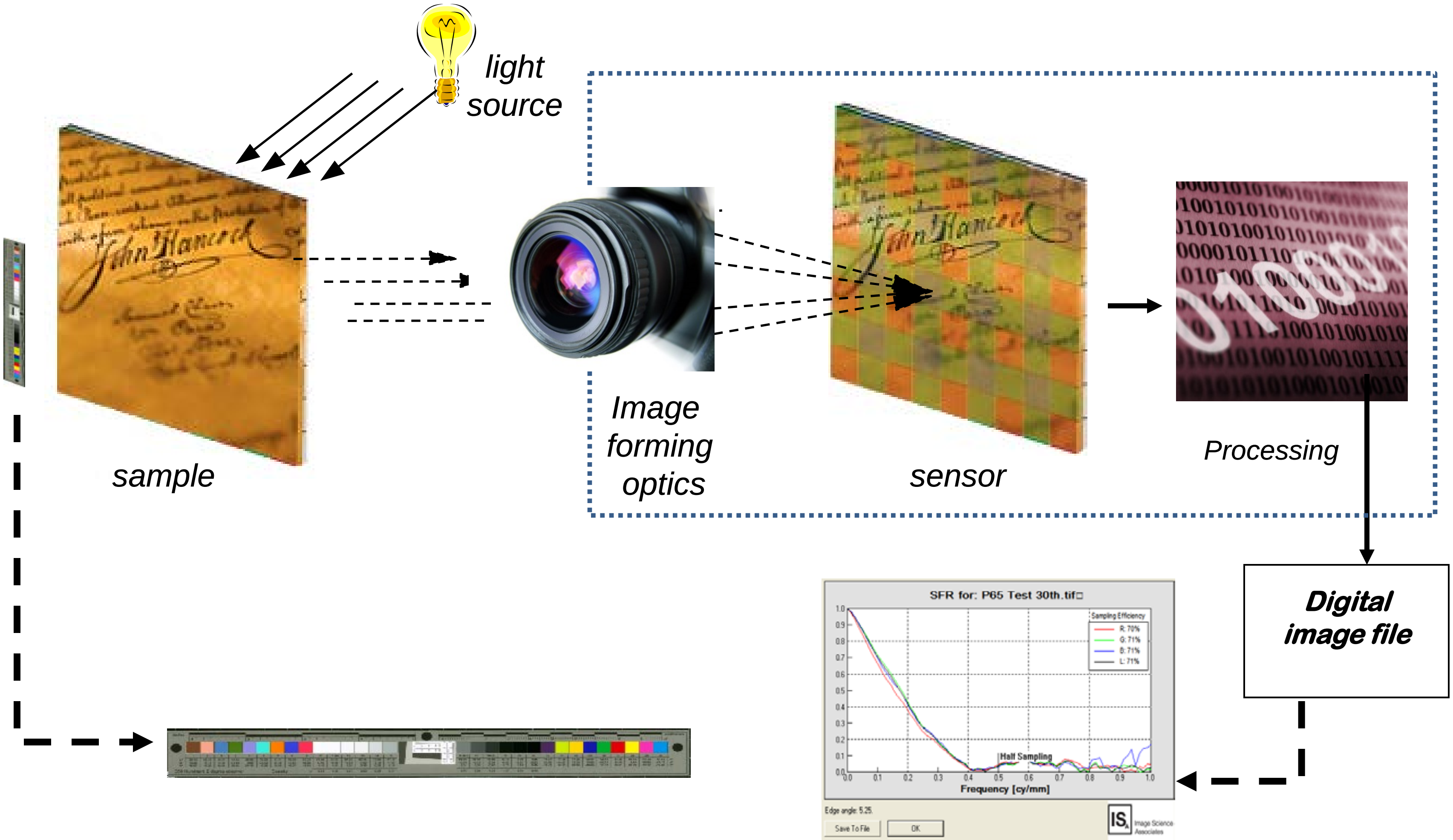
Is this system adequate?

Going Mobile: Evaluating Smartphone Capture for Collections,
Burns & Williams, *Proc. IS&T Archiving Conf.*, 2016

Mobile phone camera used in small copy-stand arrangement

From light to numbers

Reference targets provide an objective way to characterize performance



Cultural heritage imaging performance

Metamorfoze† and FADGI* were born about a decade ago.

- **establish nominal levels of image-capture performance**
- **based on vetted international standards**

Standards

International (ISO, etc.) agreed upon methods on *how to measure* digital imaging performance metrics

Guidelines (Best Practices)

Imaging sector efforts on *what the performance levels* (aims and tolerances) should be for certain uses

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† Netherlands' national programme for the heritage preservation

* (US) Federal Agencies Digital Guidelines Initiative lead by the Library of Congress

Target-based methods

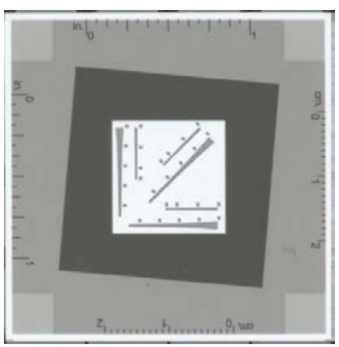
Target-based methods work well when

- we can define the imaging requirements
- target and collection images are captured under similar conditions

Measures

- uniform illumination, focus
- image detail, resolution
- distortion / misregistration
- image noise

Benchmarking and session target

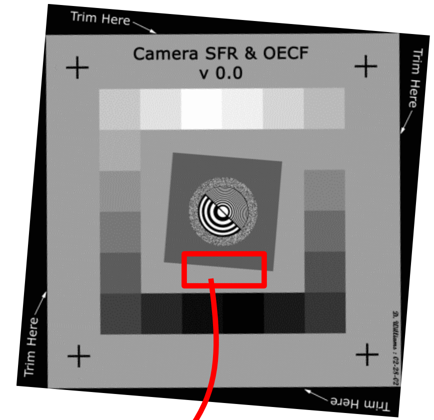


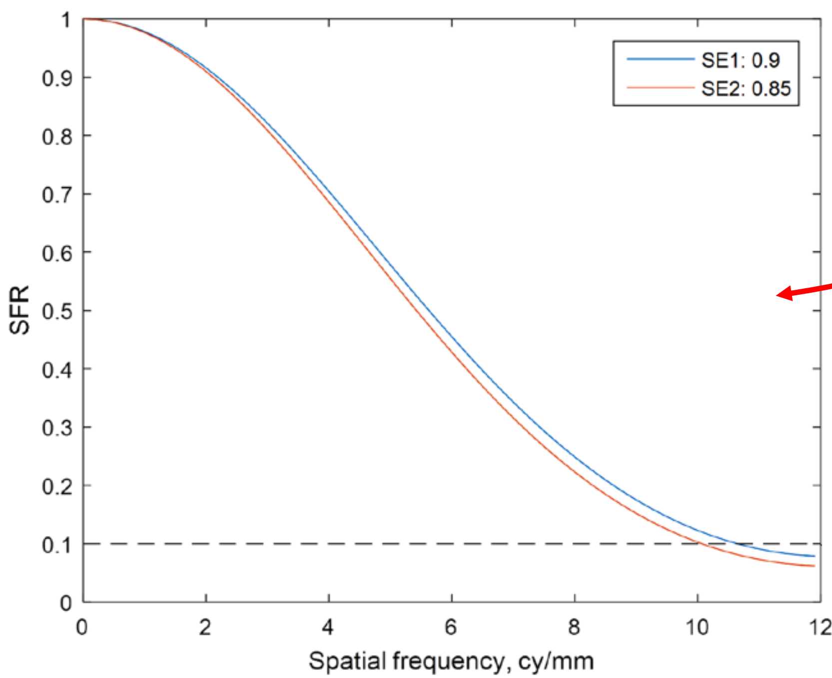
Device Target Elements

1. ISO Frequency Response (SFR) and resolution over the field of view
2. Automated feature detection
3. Neutral gray uniform background
4. Self-described colorimetric patch annotations
5. Ten spectrally neutral gray patches
6. Human interpretable resolution features
7. Dimensional scales

Example measure: image resolution

- Spatial Frequency Response (SFR) based on edges
- Measure object detail in the digital image
- Developed for optics and digital photography
- Used FAGDI Guidelines and ISO Standards





10% value used as limiting resolution

Multi-metric in-line targets

- Enables 100% quality control of imaging project
- Calibrated spatial and colorimetric connection to the original object
- Measures
  - SFR, Resolution, Noise, Color
  - Spectrally neutral grayscales
  - Dimensional scales
  - Automated feature detection
  - Self described colorimetry

Targets as standard practice for evaluation

....not just decorations

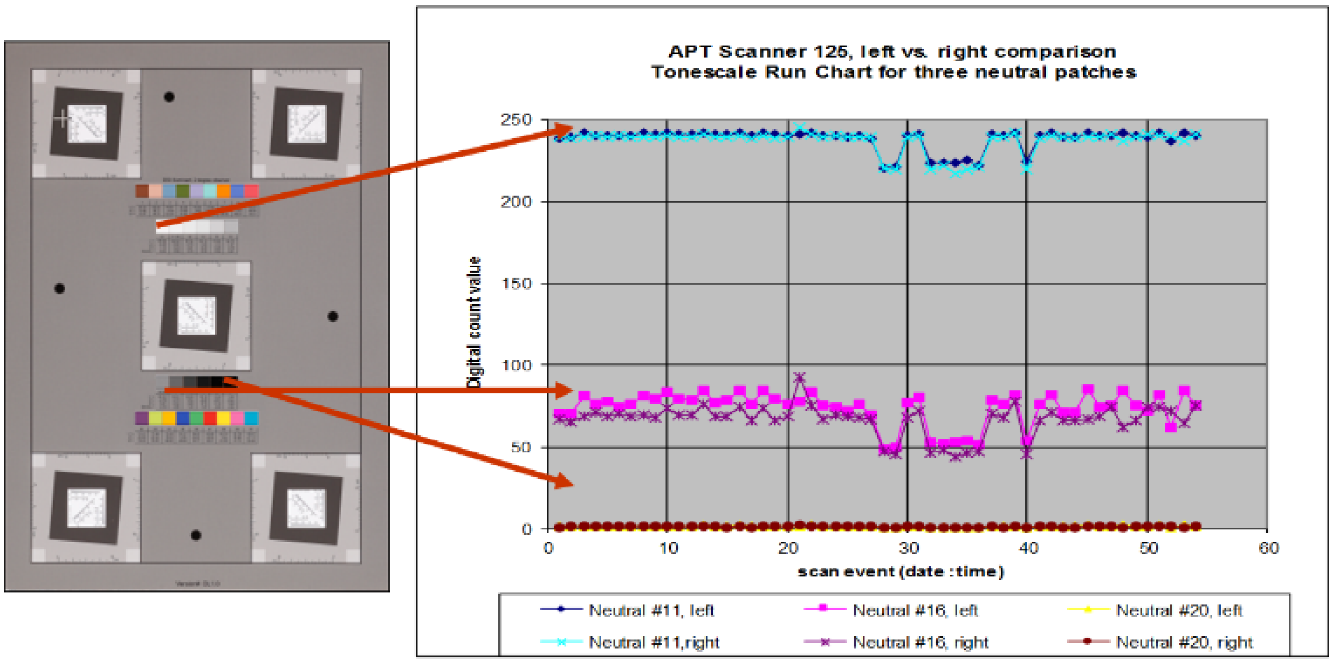
Enables easy post processing, remediation, and re-use
...if captured well initially

Multi-spectral Example

Golden Thread, Object-level targets in use

Spectral imaging of a Genesis scroll, Israel Antiquities Authority Official Channel

Quality assurance



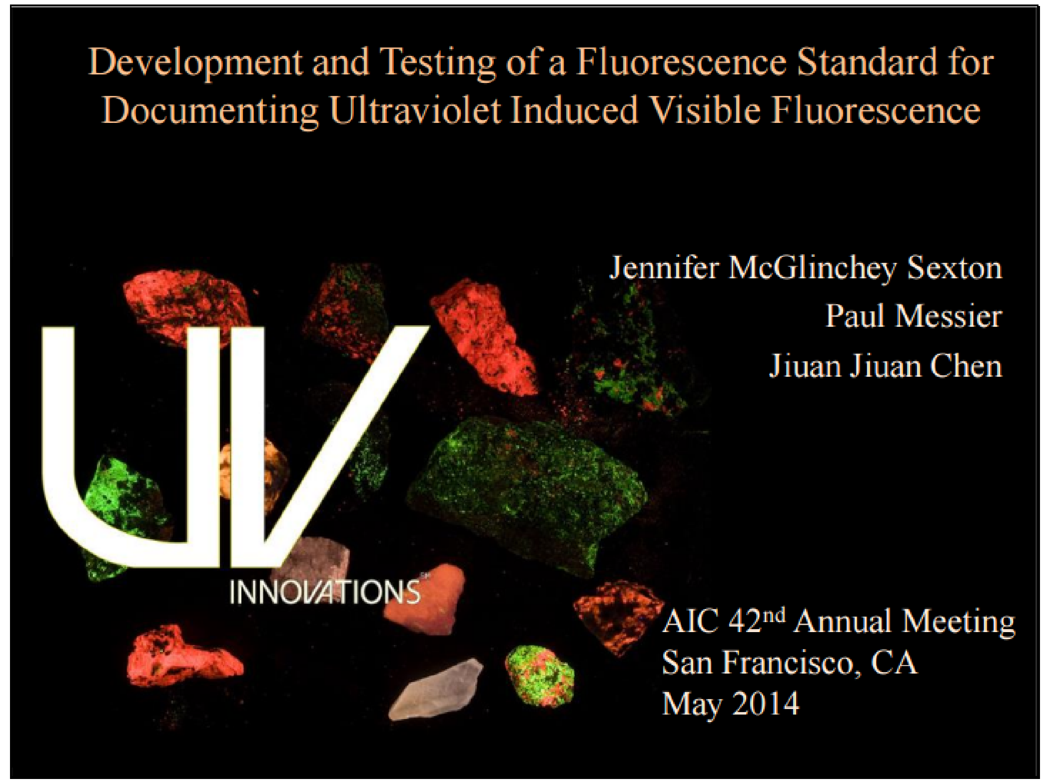
Bi-daily control chart for a robotic book scanner

Application to UV fluorescent materials

Developed for accurate and repeatable imaging of UVA induced visible fluorescence

- Art conservation
- Art authentication
- Forensic science
- Biology
- Mineralogy

Seen with normal light. Seen with UVA radiation.



Conclusions

Imaging performance evaluation guidelines are well established

- **focused mostly on visible wavelength range**
- **applied to digital collections: for access and as surrogates**
- **required by several institutions**

Though there are limitations, we can expect further development,

- **multi-spectral capture**
- **additional performance measures, such as distortion and chromatic displacement**
- **adaptation of guidelines for 3D imaging**

Discussion

Are there ways that imaging performance evaluation and monitoring could be useful for multispectral capture?

Batch versus supervised processing

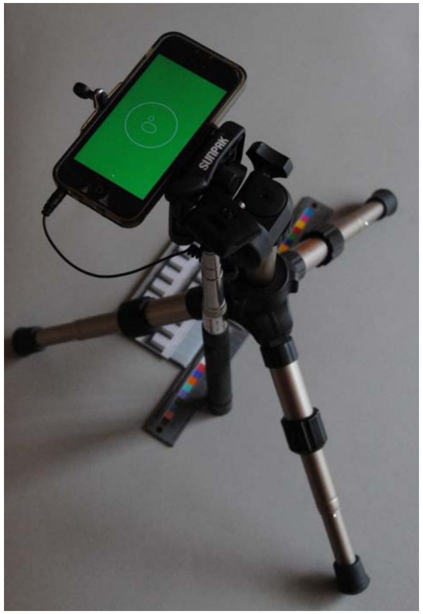
If so, how could current methods be adapted?

- **iccMAX?**
- **Reference objects?**
- **Analysis?**

Acknowledgements

Many thanks to:

- **Tom Rieger and staff at the US Library of Congress**
- **Hans van Dormolen and other staff members at the KB in The Hague**
- **Dietmar Wueller of Image Engineering**
- **Digitization staff at Smithsonian Institute**
- **Picturae (Netherlands)**
- **Digital Transitions (US)**



Green means level

References

Here are a few publications that discuss items from the talk,

1. Recent presentation on imaging guidelines Contains links to Metamorfose and FADGI imaging Guidelines,
   D. Williams and P. D. Burns, A Decade of Experience with Digital Imaging Performance Guidelines: The Good, the Bad, and the Missing, IS&T Arching Conf. 2017

2. Color-correction, validation and testing (color samples)
   D. Williams and P. D. Burns, Rethinking Image Color Correction, Validation and Testing, IS&T Archiving Conf., 2016

3. Mobile Phone example - evaluation against FADGI guidelines,
   P. D. Burns and D. Williams, Going Mobile: Evaluating Smartphone Capture for Collections, IS&T Archiving Conf., 2016

4. Projection imaging of 3D objects,
   P. D. Burns and D. Williams, Evaluation of 3D-Projection Image Capture, IS&T Archiving Conf., 2015