– Image Digitization –
What is Quality and What is its Price?

Don Williams;
Image Science Associates

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What you will see

Background

- Image Quality vs. Performance
- FADGI -motivation and history
- Quality vs. Cost

Images & Image Capture

- Definitions
- ISO metrics and examples
- Examples of Visual Literacy
- Workflow Monitoring

Resources

- Online Webinars, Software,

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These Differences are Preventable

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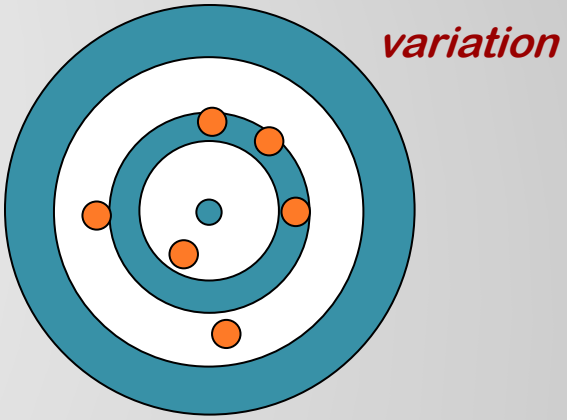
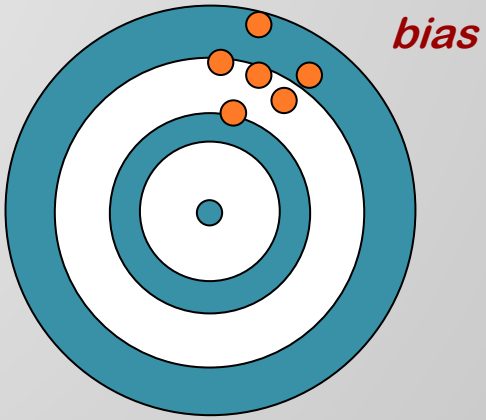
Consistent performance is often more important than accuracy.

- Accuracy - Image values from a target are compared with established ***aim*** values. These values are typically use-case dependent.



- Precision - ***Tolerances*** around these aims are also provided. Small tolerances imply greater precision and management ease, but also higher production costs.



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What makes Cultural Heritage Imaging different ?

- Future Re-purposing
  - Variety of use cases
  - Information durability
- Information critical
  - Images, not pictures
- Scientific and research component
- High volume, High speed
  - Think manufacturing
  - & error management
- Small Budgets
- Image Literacy

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Image Quality vs. Imaging Performance

qual·i·ty
/ˈkwäl(ə)dē/

noun a distinctive attribute or characteristic possessed by someone or something.
"he shows strong leadership qualities"
synonyms: feature, trait, attribute, characteristic, point, aspect, facet, side, property, value
"her good qualities"

Image quality tends to be a value judgement based on use case and desire. Image quality can vary for:

- Use case and utility
  - Reconnaissance, Medical, OCR, Cultural Heritage
  - Cultural Norms
- Long Term Durability
- Ease of Management

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Image Quality vs. Imaging Performance

per · for · mance*

pərˈfôrməns/

Noun The accomplishment of a given task **measured** against preset known *standards of accuracy, precision, completeness, cost, and speed.*

Imaging performance : Quantitative standards of accuracy and precision related to signal and noise.

Example performance measure that apply across disciplines:

- Resolution
- Sampling frequency
- Color encoding accuracy
- Noise
- Distortion

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* From: http://www.businessdictionary.com/definition/performance.html

Early Work

Proc. IS&T 2003 PICS Conference, pg. 77-81, Rochester, NY

Debunking of Specsmanship:

Progress on ISO/TC42 Standards for Digital Capture Imaging Performance

Don Williams

Proc. IS&T 2006 Archiving Conference, Ottawa, Canada

When Good Scanning Goes Bad: A Case for Enabling Statistical Process Control in Image Digitizing Workflows

Michael Stelmach, Library of Congress; Washington, DC
Don Williams, Technical Advisor, Rochester, NY

Preparing for the Image Literate Decade

Proc. IS&T Archiving Conf., pg. 124-127, IS&T, 2009

> **Image literacy (n)**: The 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.

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What is FADGI and Metamorfoze ?

- A suite of common and objective image quality digitization guidelines based on ISO standards for still image materials from cultural heritage institutions.
- More than a narrative - targets and software to measure, monitor, and interpret imaging performance accuracy and precision.
- Includes environmental, metadata, content and scanner/camera specificity
- Tiered levels of precision levels based on use case.

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Image Performance Categories

FADGI Guideline Still Imaging Performance Categories
Exposure / Tone Scale- *light, dark, contrast*
White Balance – *Hue*
Noise – *granular or patterned microstructure*
Resolution – *focus, size, stability*
Color Registration Error – *Chromatic aberrations*
Color Encoding Error – *color dictionary*

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FADGI Performance Ratings

FADGI Guideline aim and tolerance level ratings
★★★★ Best imaging practical today. Images created to this level represent the state of the art in image capture and are suitable for almost any use. High accuracy and precision
★★★ A very good professional image capable of serving almost all uses.
★★ These images will have informational value only, and may or may not be suitable for OCR.
★ Appropriate for applications where the intent is to provide a reference to locate the original, or the intent is for textual content only with no repurposing of the content.

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Imaging Performance Measurement
- Why should you care ? -

- Quality control - Consistent product
- Managing expectations – quantitative and objective acceptance testing
- Accurate Metadata population
- Diagnostics and corrective actions– problem solving and image processing identification.
- Effective communication & sharing
- Scan Once - Re-purposeable Master files
- Liability

You can't manage it, if you can't measure it.

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Guideline Summary

- FADGI & Metamorfoze aims are now included in many institutional contract requirements
- Guidelines are achievable and not onerous
- Proven very useful in detecting and diagnosing poor or variable performance
- A good target reference is the starting point

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Costs ?

Actual digitization is just a small portion of the total cost

Captain Capture to the rescue!

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Cost
….and a recent (unsolicited) e-mail

…..we can spend $250K on equipment without much problem but trying to spend 1% of that on something to help us get the most out of that equipment is a huge pain.

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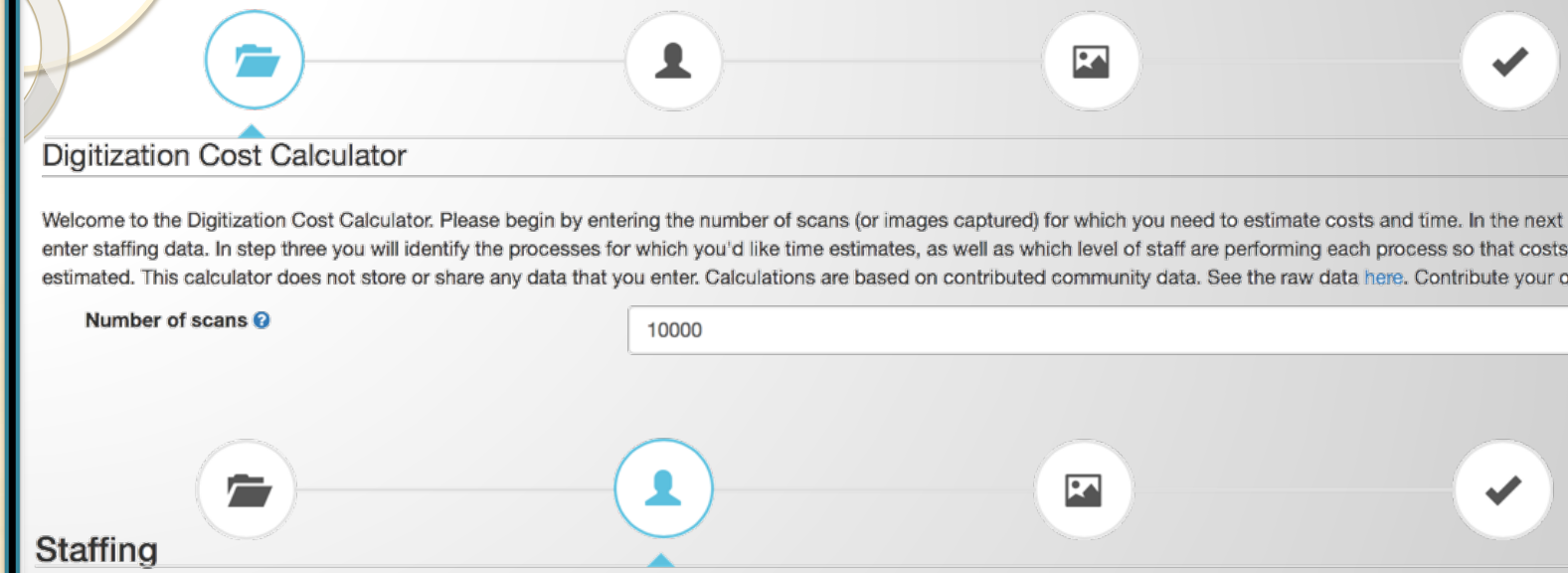
Cost Calculator



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http://dashboard.diglib.org/

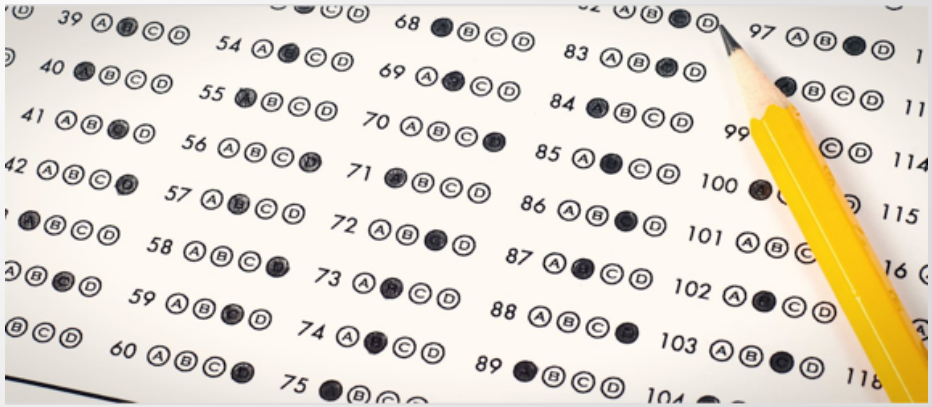
What price… cost ?

Rework, Embarrassment, Liability

EDUCATION

SAT Errors Raise New Qualms About Testing

By KAREN W. ARENSON and DIANA B. HENRIQUES MARCH 10, 2006



- Test takers challenged the scores
- Moisture caused answer sheets to expand
- Scanners missed lightly marked answers
- No Fail-safe in place to alert to mistakes
- Depending on test takers to identify problems is not good

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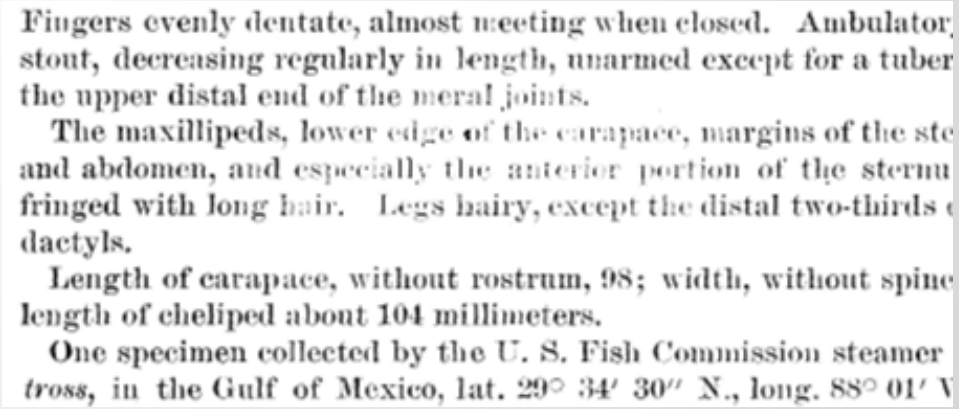
Why You Should Care

Robinson V McDonald

- The appellant (Robinson) disputed the contents of his scanned record.
- He claimed forms were missing from his military records



Fingers evenly dentate, almost meeting when closed. Ambulator
stout, decreasing regularly in length, unarmed except for a tuber
the upper distal end of the meral joints.

The maxillipeds, lower edge of the carapace, margins of the ste
and abdomen, and especially the anterior portion of the sternu
fringed with long hair. Legs hairy, except the distal two-thirds
dactyls.

Length of carapace, without rostrum, 98; width, without spine
length of cheliped about 104 millimeters.

One specimen collected by the U. S. Fish Commission steamer
tross, in the Gulf of Mexico, lat. 29° 34′ 30″ N., long. 88° 01′ W

Summary

- 5000 page claim at 99% accuracy = 50 pages would be missing or scanned incorrectly.
- No image quality criteria were cited by defendant
- No acceptable error rate was ever established for scanning

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How to Start ?

Ground Truth

Targets - a requirement for disposable dog biscuit packaging

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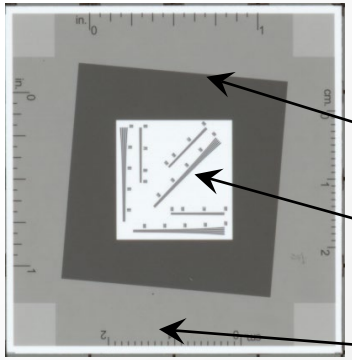
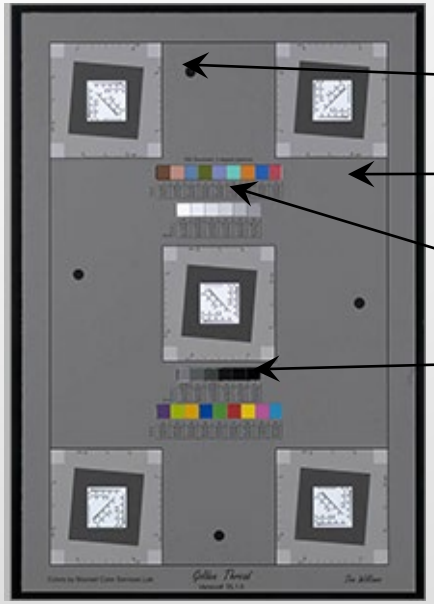
Scan, but Verify

Targets: Ground truth image quality rulers…..





GoldenThread DICE/Device target

1) ISO Optical resolution
2) Human interpretable resolution features
3) Correct scale
4) Automated feature detection
5) Neutral gray uniform background
6) Color annotations and color accuracy
7) Exposure gray patches

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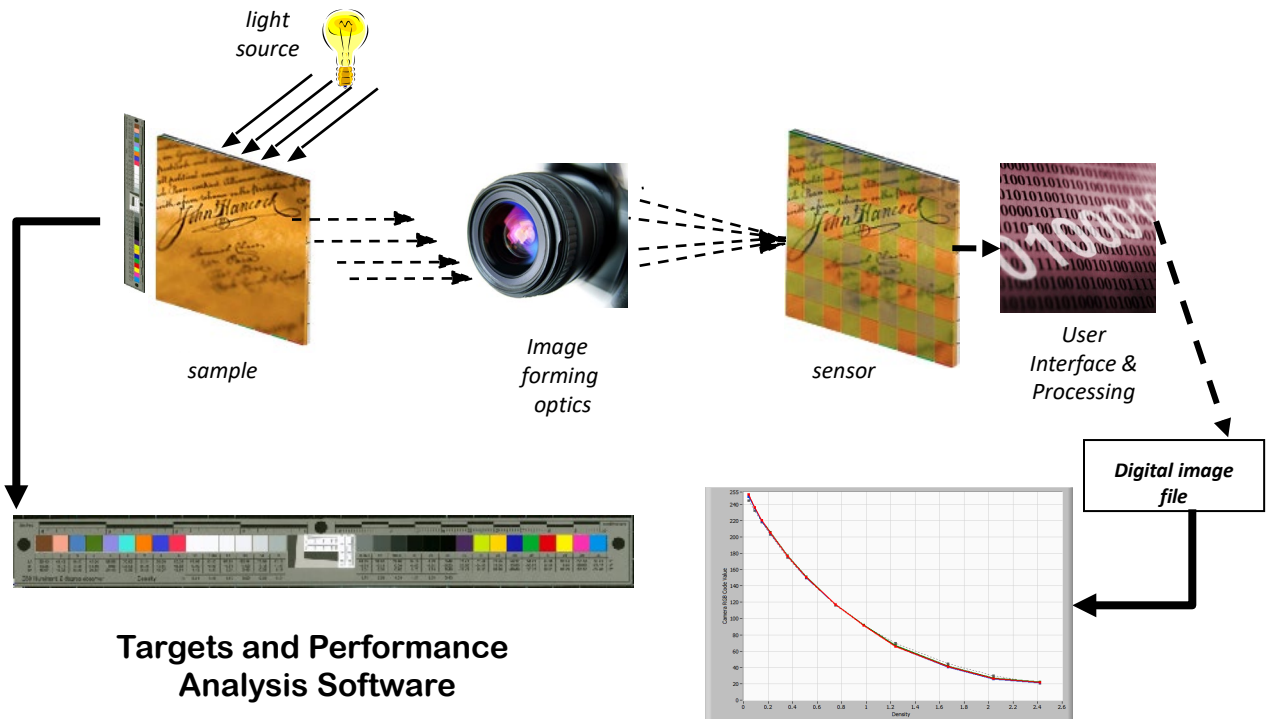
Target Use

and where variability creeps in



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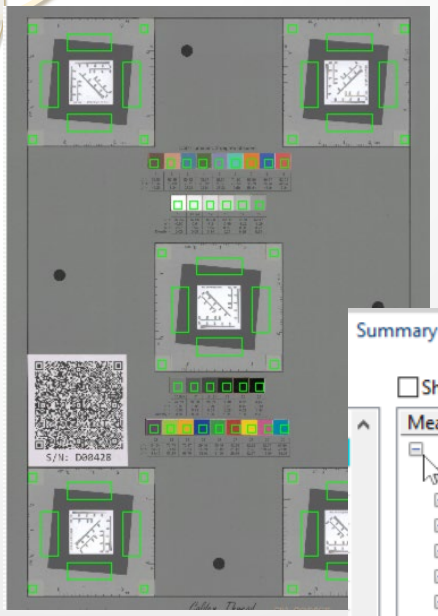
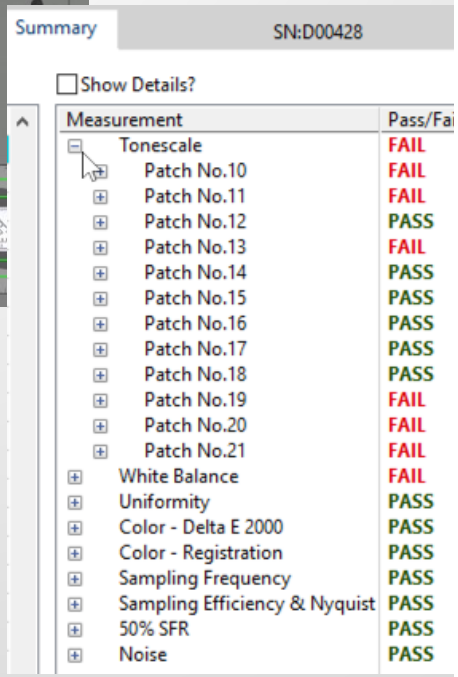
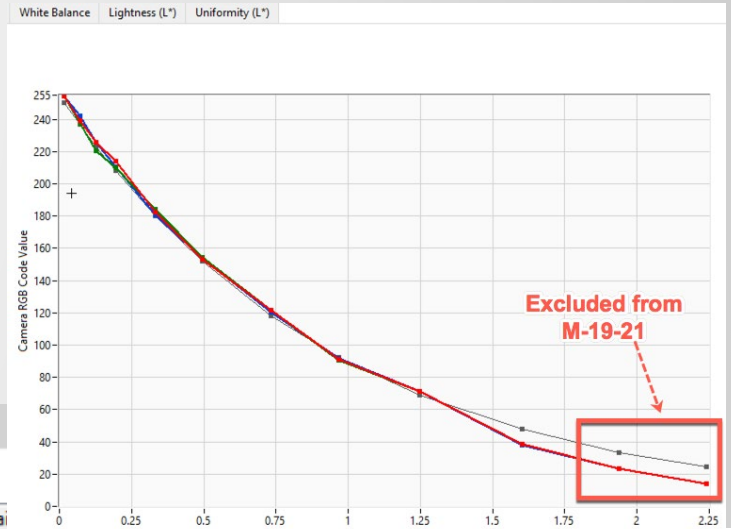
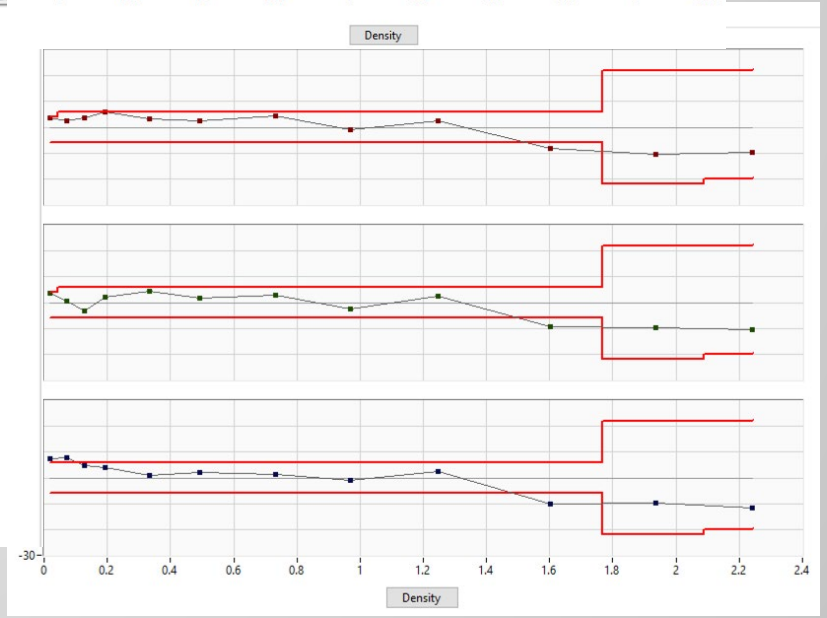
…for objective verification & reporting









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- Simple Visual Examples -

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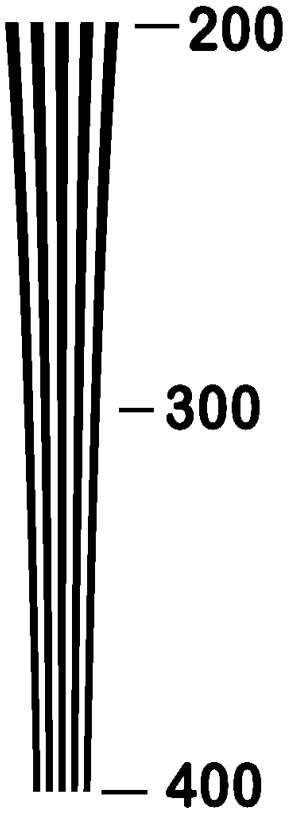
Resolution -> Quality of data (information)

Increasing lines/inch



(line width = 1/200 “)

(line width = 1/300 “)

(line width = 1/400 “)

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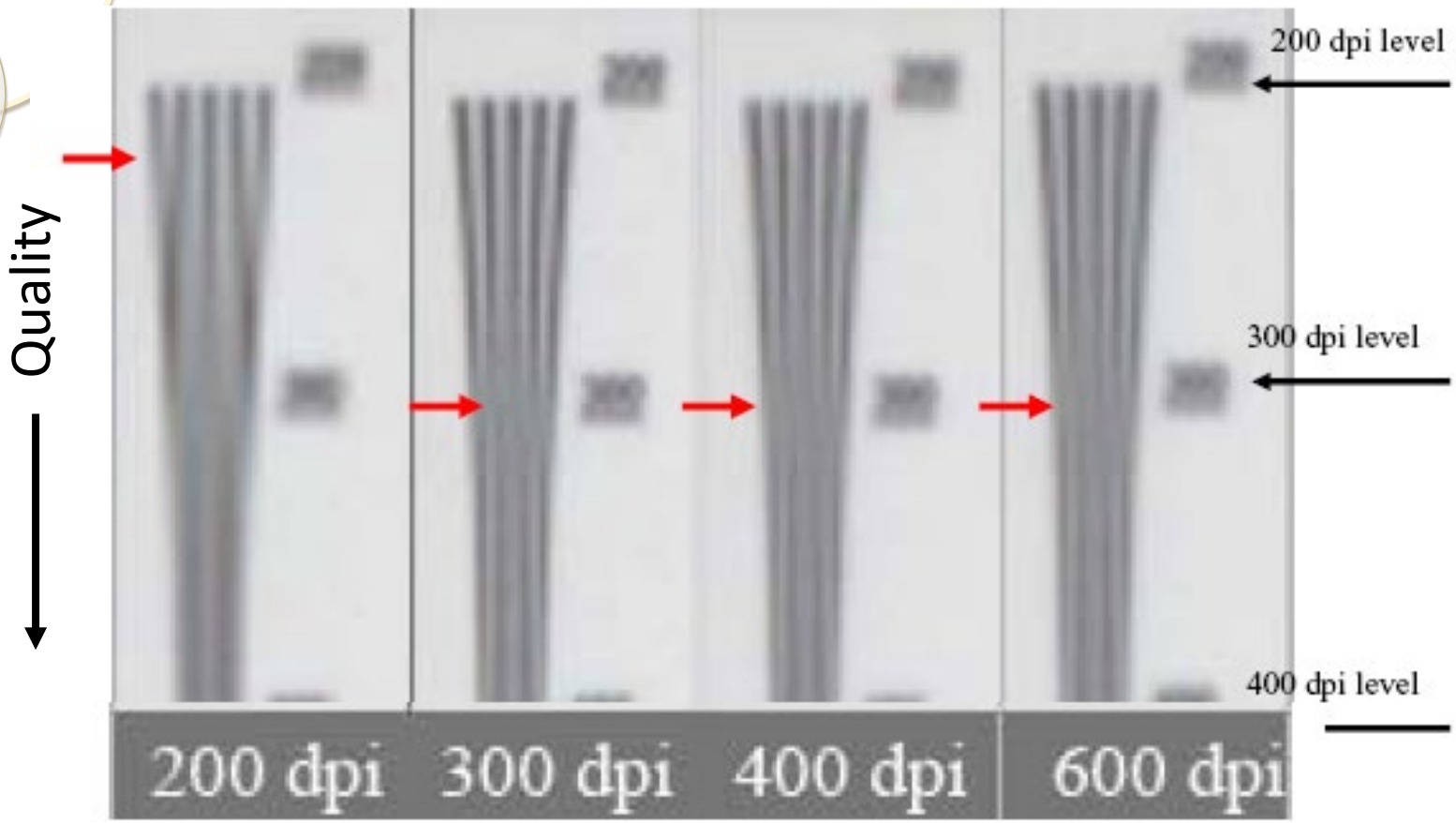
When are 5 lines clearly distinguishable ?



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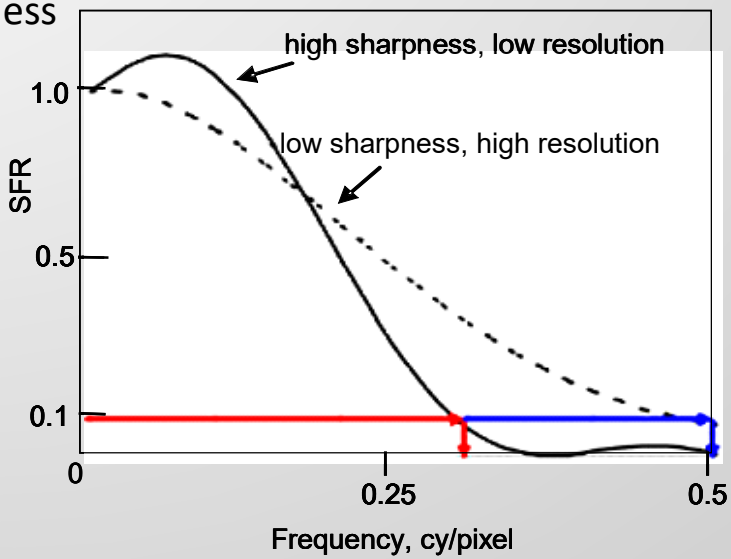
Resolution: Data vs. Information

Sharpness

Resolution



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Simple sizing errors

Metadata information

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- Execution -

How does this occur ?

- The Digital Imaging Conformance Evaluation program (DICE) provides the measurement and monitoring components of a compliant digitization program. It consists of three components:
  - Image targets
  - Analysis software
  - Monitoring and remediation
- The targets are designed to comply with various ISO specifications and validated at participating agencies and outside vendors.

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Triple Exposure

Read Once , Twice, more….?

Lyrasis.org: Theory to Practice

Intro to FADGI: http://lyrasis.adobeconnect.com/p224k5o9h2le/
FADGI metrics (Tone,White Balance, Lighting Uniformity) :
http://lyrasis.adobeconnect.com/pgqnda9v5cgb/
FADGI metrics (DeltaE, Color MisReg., Noise) :
http://lyrasis.adobeconnect.com/pml4gfd21jpm/
FADGI metrics (SFR, Scale Accuracy, Artifacts) :
http://lyrasis.adobeconnect.com/p5k20cv172oq/
FADGI: What's next: http://lyrasis.adobeconnect.com/pxbjmyy6ls5k/

Cambridge Colour

https://www.cambridgeincolour.com/color-management-printing.htm

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Summary

- FADGI requirements are now included in many federal & regional contract requirements
- Guidelines are achievable and not onerous
- Proven very useful in detecting and diagnosing poor or variable performance
- A good target reference is the starting point

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End

1907 autochrome

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